Description of document:	United States Air Force (USAF) reports/documents produced for Congress, 2006 - 2010
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Note:	Three reports supplied in response to this FOIA request could not be processed for inclusion here due to security settings remaining on the PDF files. These three reports are: CRR 109-286-037 Environmental Remediation McClellan – 21 Megabytes CRR 110-279-27 PCS Policy Review and Report – 135 KB CRR 111-230-190 Undefinitized Contract Actions, Letter Attachments – 2.7 MB

DEPARTMENT OF THE AIR FORCE
WASHINGTON, DC

25 July 2010

HAF/ICIO (FOIA)
1000 Air Force Pentagon
Washington DC 20330-1000

This is in response to your 8 December 2009, Freedom of Information Act request for "various documents produced for Congress by the USAF during the past 3 years, whether on public internet sites or not. (1). Periodic reports produced as a statutory obligation for a committee; (2) One-off reports produced in response to as specific request from a committee, or as a result of an inquire from a Congressman or Senator; (3) Unsolicited reports produced to help inform a Congressional office or a committee office".

Portions of records are exempt from mandatory disclosure and are being withheld because of internal agency personnel rules and practices, which would risk circumvention of legal requirement. The authority for this exemption may be found in United States Code, Title 5, Section 552 high (b)(2). The notation "b2" has been inserted for portions withheld using this exemption. Releasable portions are attached.

Portions of records are exempt from mandatory disclosure and are being withheld because they contain personal data, which if released to the public would result in a clearly unwarranted invasion of personal privacy. The authority for this exemption may be found in United States Code, Title 5, Section 552(b)(6). The notation "b6" has been inserted for portions withheld using this exemption. Releasable portions are attached.

The denial authority in this instance is Ms. Patricia J. Zarodkiewicz, Principal Deputy Assistant Secretary (Financial Management and Comptroller).

Should you decide that an appeal from this decision is necessary, you must write to the Secretary of the Air Force at the address below in sufficient time so that the appeal reaches us no later than 60 calendar days after the date of this letter. Include in the appeal your reasons for requesting reconsideration, and attach a copy of this letter. Address your letter as follows:

Secretary of the Air Force
Thru: HAF/IMIO (FOIA)
1000 Air Force Pentagon
Washington DC 20330-1000

Department of Defense Regulations 5400.7 indicated fees be assessed for processing this request; however, the fees are waived in this instance.

Sincerely,

MACIAS.DELLA.
V.1231414181
DELLA MACIAS
Freedom of Information Act Disclosure
Officer

Attachment:
Responsive Documents

USAF CONGRESSIONAL REPORTS INCLUDED

1. CRR 109-254-198 Report to the Defense Committees of the Congress of the United States on the Status of the Transformational Satellite Communications System (TSAT) Program, March 2007

2. CRR 109-286-10 Air Force Report to Congress Regarding FY07 Facility Repair Requirements, September 2006

3. CRR 109-292-53 Congressional Report: Air Force Personnel Reductions, March 2007

4. CRR 109-292-224 Air Force Clinical Health Psychology Postdoctoral Training, March 2007

5. CRR 109-452-226 Assessment of Wingtip Modifications to Increase the Fuel Efficiency of Air Force Aircraft, 2007

6. CRR 109-452-294 Congressional Report: Air Force Transformation, March 2007

7. CRR 109-452-312 Congressional Report: Academy Language Training, 2007

8. CRR 109-452-348 Air Force Health Study: Project Ranch Hand II, 2007 Report to Congress On The Transfer of Air Force Health Study Assets to the Medical Follow-Up Agency, 19 September 2007

9. CRR 109-504-165 Congressional Report: MQ-1 Predator and MQ-9 Reaper Roadmaps, 2007

10. CRR 109-676-43 Cost-Benefit Analysis of the 2006 Air Force Materiel Command Test and Evaluation Proposal, 2007

11. CRR 109-676-134 Congressional Report: Air Defense Mission, 144th Fighter Wing CANG, 2011(?)

12. CRR 109-702-133 Joint report to Congress on use of the Naval Postgraduate School and the Air Force Institute of Technology to meet requirements for enlisted graduate degrees, March 2007

13. CRR 109-702-404 Congressional Report: Report on Air Force Safety Requirements for Air Force Flight Training Operations at Pueblo Memorial Airport, Colorado, 2007(?)

14. CRR 109-702-561 Congressional Report: Multi-Spectral Imaging Capabilities on the Global Hawk Unmanned Aircraft System, 5 February 2007

15. CRR 110-77-131 FY2008 Congressional Report On C-5 Reliability Enhancement and Re-engining Program (RERP)

16. CRR 110-77-228 Department of Defense Progress Report for Operationally Responsive Space, A Report to Congressional Defense Committees, July 29, 2008

17. CRR 110-77-580 Congressional Report: Plan for Niagara Air Reserve Base, New York, March 2008

18. CRR 110-146-111a United States Air Force Report to Congressional Defense Committees: Master Plan for Warren Grove Gunnery Range, New Jersey, November 2008

19. CRR 110-146-315 Congressional Report: Report on Selecting an Initial Flight Screening (IFS) Program, September 2007

20. CRR 110-155-254 Congressional Report: Report on Counter-Man Portable Air Defense Systems (MANPADS) for the Civil Reserve Air Fleet (CRAF), 14 December 2007

21. CRR 110-155-280B Congressional Report: number of nurses assigned to the Graduate School of Nursing's Doctoral program at the Uniformed Services University of the Health Sciences, April 2008

22. CRR 110-279-363 Ballistic Missile Range Safety Technology (BMRST) Operations Acceptance Plan, 1 Feb 2008 (BMRT Attachment)

23. CRR 110-279-363 briefing on the Ballistic Missile Range Safety Technology (BMRST) operations acceptance plan established by the Air Force, March 2008 (BMRT Letters)

24. CRR 110-335-125 United States Air Force Report to Congressional Committees: Material Handling Equipment Study, May 2009

25. CRR 110-335-346 Aviation Career Incentive Pay (ACIP, March 2009

26. CRR 110-355-391 United States Air Force Report to Congress: Air Force Nuclear Security Report, August 2009

27. CRR 110-434-59 Congressional report on Air Force nurse recruiting and retention and proposed Troops to Nurse Teachers Program submitted by U.S. Air Force Medical Service, February 2008

28. CRR 110-434-72 Congressional Report: Review of Air Force End Strength, February 2008

29. CRR 110-434-385 Congressional Report on antibiotic resistant bacteria submitted by U.S. Air Force Medical Service, February 2008

30. CRR 110-477-76a Report on safety measures utilized at Warren Grove Gunnery Range, New Jersey, report to Congress, March 1, 2008

31. CRR 110-477-76b Congressional Report: Report on Search and Rescue Capabilities of the Air Force in the Northwestern United States, May 2008

32. CRR 110-477-77 Congressional Report: Report on Cheyenne Mountain Master Infrastructure Recapitalization Plan, March 2008

33. CRR 110-477-111 Congressional Report: Report on Utilization of Tuition Assistance by Members of the Armed Forces, 24 March 2008

34. CRR 110-477-197 Congressional Report: Report on Feasibility of Establishing an Association Between 120th Fighter Wing of the Montana National Guard and the Active Duty Stationed at Malmstrom AFB, 2008(?)

35. CRR 110-477-802 Congressional Report: Cost and Feasibility of Integrating a Space Based Infrared System Highly Elliptical Orbit Sensor onto a Geosynchronous Satellite, December 6, 2007

36. CRR 110-652-406 Congressional Report: Roles and responsibilities of Air Force Cyberspace Command, April 7, 2009

37. CRR 110-775 Air Force Family Housing Privatization Report: Status of Housing Privatization Projects at Hanscom, Patrick, Little Rock, and Moody Air Force Bases, August 1, 2008 (Housing Privatization Project CAS07-28-08)

38. CRR 110-775-13 Report to Congressional Appropriations Committees: Report on Child Care Waiting List, September 2008

39. CRR 110-775-25 United States Air Force Report to Congressional Appropriations Committees: Application of Inadequate Housing Definition, February 2009

40. CRR 111-37-45 Congressional Report: Air Force Medical Service funding, June 29, 2007

41. CRR 111-155-166 United States Air Force Report to Congressional Committees: Report in ICBM Industrial Base Capabilities to Maintain, Modernize, and Sustain Minuteman III Through 2030 and Provide a Replacement Land Based Strategic Deterrent System after 2030, October 2008

42. CRR 111-230-190 Undefinitized Contract Actions Letters, 25 Feb 2010

43. CRR 209-702-404 Congressional Report: Report On Air Force, Air Force Reserve, and Air National Guard Bases Affected by 2005 Round of Defense Base Closure and Realignment, 21 March 2007

44. CRR United States Air Force Report to Congressional Appropriations Committees: Grand Forks Air Force Base, North Dakota Infrastructure, December 2008

45. CRR HASC summary of the analytic approach used in the RAND Logistics Enterprise Analysis for the F-16 and KC-135 fleets, October 8, 2008

46. CRR HASC 10-66 United States Air Force Report to Congressional Defense Committees: Report on Reduction in Number of Firefighters in Air Force Bases, January 2009

47. CRR HASC 10-71 United States Air Force Report to Congressional Defense Committees: Report on Plan to Enhance Combat Skills of Air Force Personnel, January 2009

48. CRR HASC 10-189 United States Air Force Report to Office of the Secretary of Defense: Acquisition, Technology & Logistics Career Path and Other Requirements for Military Personnel in the Acquisition Field (Sec. 813/834), December 2008

49. CRR HASC 10-349 American Eagle Communities Analysis of Alternatives, 2008(?)

50. CRR HASC-10-74a Revision of Certain AF Regulations, March 27, 2009

51. CRR HASC-10-223 United States Air Force Report to Congressional Committees: Initial Report on Implementation of NDAA 2009, Business Transformation Initiatives for the Military Departments (Sec. 908), July 2009

52. CRR S3001-325-62 United States Air Force Report to Armed Services Committees: Report on Air Force Civilian Personnel Consolidation Plan, January 2009

53. CRR Stop Loss Impact Report, March 6, 2009

54. CRR Congressional Report: United States Air Force Academy Infrastructure Recapitalization Master Plan, March 2007

Report to the Defense Committees of the Congress of the United States

on the

Status of the Transformational Satellite Communications System (TSAT) Program

March 2007

Department of the Air Force
Washington D.C. 20301-1000

Report to the Congressional Defense Committees
on the
Transformational Satellite Communications System (TSAT) Program

The Conference Report accompanying the John Warner National Defense Authorization Act for Fiscal Year 2007 (House Report 109-702) contained the following language with respect to the TSAT Program:

> *"The conferees direct the Secretary of the Air Force to submit a report to the congressional defense committees by February 15, 2007, explaining what actions the Air Force has taken to address the remaining concerns raised by the TSAT Program Review Group and the Government Accountability Office, including: 1) the need to significantly refine requirements so that program content can be matched to budget constraints, and how the Department plans to control requirements to prevent problems associated with "requirements creep"; 2) the need to adequately staff the TSAT program office with experienced space acquisition professionals; 3) the status of refining key performance parameters so they provide specificity and validation metrics; and 4) the implications for other programs, such as Space Radar and Future Combat System, of a less capable initial block of TSAT satellites."*

The Department appreciates the opportunity to respond with this report to address these concerns.

Background

The Transformational Satellite Communications System (TSAT) will provide worldwide, secure, survivable satellite communications to U.S. strategic and tactical forces during all levels of conflict. It will sustain the Military Satellite Communications (MILSATCOM) architecture by providing connectivity across the spectrum of mission areas, to include land, air, and naval warfare; special operations; strategic nuclear operations; strategic defense; homeland security; theater operations; and airborne and space operations and intelligence.

The TSAT program acquisition strategy calls for separately awarding a Space Segment contract, a TSAT Mission Operations System (TMOS) Segment contract, and a System Engineering and Integration (SE&I) contract. The Space Segment will consist of a five-satellite constellation Transformational Satellite (TSAT) element, a TSAT Satellite Operations element (TSOE) for spacecraft command and control, and a CONUS Ground Gateway element (CGGE). The TMOS Segment will consist of centralized and distributed TSAT Network and Operational Management elements, a TSAT Network System Element (TNSE), a TSAT Gateway Border Element (TGBE), and a Distributed Planning Element (DPE). The TSAT system will serve a Terminal Segment of existing and new user terminals acquired and owned by the Military Services separately from this TSAT Acquisition. The SE&I contract performs the system integration among the interrelated Space, TMOS, and Terminal Segments.

Government Accountability Office (GAO)

The 24 May 2006 GAO report "Space Acquisitions: DoD Needs Additional Knowledge as it Embarks on a New Approach for TSAT" provided four key recommendations:

1) Reassess the value of TSAT in broader context of other DoD investments, using updated knowledge on likely cost, schedule, technology and initial capability;
2) Update requirements in coordination with the TSAT user community;
3) Demonstrate the maturity of all critical technologies;
4) Establish new cost, schedule and performance goals.

The DoD agreed to all four recommendations. Recommendation 1 was completed through the Quadrennial Defense Review (QDR) process resulting in the Block TSAT Approach. Recommendations 2-4 are being addressed in activities that will culminate in the establishment of the program baseline at Key Decision Point B (KDP-B) by the end of calendar year 2007.

The Air Force is in the process of updating requirements via the Chairman of the Joint Chiefs of Staff (CJCS) Joint Capabilities Integration and Development System (JCIDS) and should have approval of the Joint Requirements Oversight Council (JROC) by June 2007. In accordance with National Security Space Acquisition Policy 03-01, information is being captured and analyzed to conduct a Technology Readiness Assessment, as well as support an Independent Program Assessment chartered by the Under Secretary of the Air Force (USecAF) and an Independent Cost Estimate by the Office of the Secretary of Defense (OSD) Cost Analysis Improvement Group (CAIG). The initial Acquisition Program Baseline will be established at KDP-B by the milestone decision authority following the Defense Space Acquisition Board in October 2007.

GAO representatives have visited the program office and associated organizations in support of GAO Engagement Code 120575 to address requests made by the Senate Armed Services Committee (SASC) Subcommittee on Strategic Forces and the House Armed Services Committee (HASC) Strategic Forces Subcommittee with regards to employment of acquisition best practices, incorporation of critical knowledge gained by technology integration testing, and DoD trades regarding incremental capabilities and the needs of dependent systems and users. First, the program office provided insight into the employment of best practices including the Cost as an Independent Variable (CAIV)/Users Forum and the USecAF's back-to-basics motivated Block Approach to space acquisition. Second, the program highlighted the government "gold-standard" test program that is enabling assessment of technologies being matured by the risk reduction contractors. Third, the TSAT program office described how it comprehensively assessed the impact of reduced capabilities of the initial satellites on all aspects of the TMOS Segment and Terminal Segment of the TSAT program.

TSAT Program Review Group

In its 2005 review of the TSAT program, the TSAT Program Review Group, a subset of the joint task force that assessed the acquisition of National Security Space programs in 2003 and 2004, led by Mr. A. Thomas Young (the "Young Panel"), lauded the "comprehensive and impressive risk reduction program focused on critical technologies" and recognized TSAT's potential to serve as a model to "demonstrate the effectiveness of future space acquisition systems." [Ref: TSAT Program Review Group Report Briefing to Capitol Hill (19 Oct 05).] Cautions were noted that the program needed to be budgeted and scheduled to a most probable cost estimate of 80/20 confidence, that the program office staffing deficiencies needed to be corrected, and all involved organizations needed to commit to a common program solution and funding stability. In 2006, the Young Panel once again reviewed TSAT and identified two primary concerns: manpower for the TSAT system program office and the risks associated with a block approach. Key staffing deficiencies have since been addressed as seen below. Consultations with the USecAF have resulted in an achievable Block Approach with the flexibility to achieve desired outcomes.

Requirements

The TSAT program, together with the Air Force Space Command Directorate of Plans and Requirements (AFSPC/A5), continues to work hard to maintain an affordable set of requirements, while ensuring the warfighter gets needed capability. AFSPC knew the first approved TSAT requirements document (Capabilities Development Document (CDD), 21 Jan 2004) was unaffordable and promised to the Joint Requirements Oversight Council (JROC) they conduct a cost-as-an-independent-variable (CAIV) process with the user community in order to come back with a revised, affordable CDD. AFSPC and the MCSW developed the TSAT CAIV process, creating the TSAT Users Forum supported by the MILSATCOM Systems Wing (MCSW) CAIV & System Description Document Integrated Product Team (IPT). This process was presented by AFSPC at a MILSATCOM Senior Warfighters Forum (3-star level) in April 2004 to obtain buy-in. To date a total of 11 Users Forums have been convened to address both affordability and schedule issues and trades: the first Users Forum convened March 2004, and the most recent Users Forum met September 2006. The Users Forums also include a schedule-as-an-independent-variable (SAIV) process to ensure requirements permit a timely delivery of TSAT capability to the warfighter. This process was added to the User Forum as a result of the QDR deliberations and the adoption of the USAF back to basics, Block Approach to space acquisition outlined by the USecAF. The Block Approach allows for incorporation of new requirements into later blocks without disturbing on-going development of earlier blocks. This allows us to manage requirements in an approach similar to how pre-planned product improvements are handled, allowing us future flexibility in meeting emerging user needs. We will also be able to pursue evolutionary improvements to the system within the budget constraints at the time.

Action officer coordination is established via working groups, IPTs, and the Users Forum. The TSAT Users Forum meets approximately once per quarter and weekly telecons are convened to work issues in the interim. Program office coordination is ensured via a strong internal change control process including an Engineering Review Board and Configuration Control Boards for both the TSAT program and the enterprise-wide MILSATCOM Systems Wing. High-level (1, 2, 3, and 4 star) coordination is established via close interaction with AFSPC to update documentation for the JROC. This high visibility serves to ensure the implications of each proposed requirement change are fully defined and vetted. This process has received many accolades from the Young Panel and other sources, and iterations will continue throughout the development until the Build Approval decision in 2011. The successful application of the TSAT Block Approach resulted in AFPSC/A5 directing both the Global Positioning Satellite III and Space Radar programs to evaluate the TSAT CAIV/SAIV process for possible implementation.

Staffing

Some staffing challenges remain but significant steps have been taken to improve the situation. All key leadership posts on the TSAT team were filled in 2006 at grades commensurate with responsibilities to enable the program to be successful. The program director is a member of the Senior Executive Service and he is supported by three Air Force groups each led by senior program managers (O-6, GS-15). The program office is comprised of approximately 65 government personnel and over 100 personnel from Federally Funded Research and Development Centers (FFRDC) including the Aerospace Corporation, MITRE, and Carnegie Mellon Software Engineering Institute. FFRDC support level has been raised appreciably (about 35 percent) since 2006. This mix of personnel allows the program director to confidently exploit the technologies and mitigate risks on this highly promising and technically robust program.

Mr. Richard Pino is the Director of the Transformational Satellite Communications System program, MILSATCOM Systems Wing, at the Space and Missile Systems Center, Los Angeles AFB, California. His arrival in September 2006 marked the final building block of a highly experienced senior leadership team for the military satellite communications program--a team of four with nearly 90 years of combined acquisition and space experience. Mr. Pino came to the TSAT Program from the Navy Program Executive Office, Command and Control, Communications, Computer and Intelligence and Space, San Diego, California, where he was the Navy Future SATCOM Division Director from 2004 to 2006. Prior to that, he was the Assistant Program Manager for the Navy Multiband Terminal and earlier the Assistant Program Manager for Navy Extremely High Frequency SATCOM Programs in the Space and Naval Warfare Systems Command. From 1992 to 1997, he worked at Los Angeles AFB as the Army representative to the MILSATCOM Joint Program Office working Milstar and Advanced EHF. Prior to that, he worked for the Army as an engineer at Fort Monmouth, N.J. Mr. Pino has over 19 years of acquisition experience, 14 of them directly associated with MILSATCOM programs. Mr. Pino serves under Brigadier General Ellen Pawlikowski, MILSATCOM Systems Wing Commander, as the MILSATCOM Technical Director. Mr. Pino took the TSAT reins from Colonel Jay Moody who served as the acting Program Director for nine months.

Colonel Jay Moody is the TSAT Deputy Program Director and Commander of the TSAT Network Integration Group, responsible for the systems engineering and integration of all the segments and external interfaces of the program. Colonel Moody has been a leader in the program for over a year and brings over 21 years of acquisition program management, systems engineering and space expertise to his position.

Colonel Arnold Streland is the Commander of the TSAT Space Group responsible for TSAT spacecraft and payload development and production. He recently arrived on the program from the National Reconnaissance Office where he served as Deputy Director, Reconnaissance Systems Office. Colonel Streland brings over 18 years of space acquisition management experience to the team from Air Force programs such as Space Based Laser and the Space Test Program.

Mr. Joseph Vanderpoorten is the Director of the TSAT Mission Operations Group. He leads the ground-based network management and mission planning segment called the TSAT Mission Operations System. Mr. Vanderpoorten, who recently joined the program from industry, has 29 years of systems acquisition and space experience. He has held various program management and systems engineering responsibilities in MILSATCOM Terminals (Air Force Satellite Communications system, Defense Satellite Communications System, Milstar 1 and 2, and Advanced Extremely High Frequency), tactical communications, strategic communications, and ground segment program management and activation.

Within the TSAT program office, there are an additional nine "critical acquisition positions" identified. Two of those positions are vacant, but the program office is actively pursuing qualified fills for those positions. Within the company grade officer (lieutenant and captain) ranks, over two thirds of the officers have achieved the required level of acquisition professional development. The TSAT program office assessment is that within the next two years the government manning must grow to approximately 100 government personnel in order to provide sufficient program management coverage. However, in the current Air Force Force Shaping environment, obtaining military personnel plus-ups is a significant staffing challenge. The program office is also utilizing Intergovernmental Personnel Act (IPA) detailees and the Presidential Management Fellow (PMF) program to gain access to additional engineering and program management expertise.

The senior leadership and program office staff now in place collectively have the space acquisition expertise and experience to deliver on the TSAT vision.

Key Performance Parameters

The TSAT program leadership also appreciates the importance of refining key performance parameters (KPPs) so they provide specificity as well as metrics to validate attainment of the KPPs. In partnership with Air Force Space Command and the user community, KPPs are being updated for Joint Requirements Oversight Council (JROC) approval targeted for June 07. A High Performance Team (HPT) was convened in December 2006 to finalize the updates to be captured in the update of the Capability Development Document (CDD) to be approved by the JROC. Air Force Space Command had been working with the TSAT users community since March 2004, incorporating the requirements decisions of multiple TSAT Users Forum meetings into the CDD update. The result was the HPT being completed in half the normal time set aside for HPTs. The examples below demonstrate the types of activity underway to refine the KPPs and establish specificity and validation metrics.

As noted previously, the TSAT CDD approved by the JROC in 2004 was unaffordable. Specifically, Capacity was identified as the only KPP identified being unaffordable. While a great amount of work has been accomplished to ensure all attributes are technically feasible and affordable, by far the Capacity KPP is the single requirement that has received the most effort given its significance. While the CDD does not identify specific RF bands, the capacity numbers are based on interpreting the requirements in the CDD against the government's reference design.

Since EHF requirements are the most difficult to satisfy, several iterations of sophisticated modeling were used to achieve an affordable level of EHF support for users. Specifically, the Dynamic Communication Architecture Study Tool (DyCAST) was developed by The Aerospace Corporation to analyze capacity and performance of SATCOM and terrestrial architectures against static and dynamic, Joint Staff-developed operational scenarios derived from the SATCOM Data Base (SDB). The simulation models satellite communication payloads, terrestrial terminal laydowns for deployed forces, and end-to-end communication connectivity needed to support operational scenarios for each of thousands of individual connections. The results provide estimates of how many of those connections can be supported given the constraints on the satellite and terrestrial systems, link closure of the static and dynamic SATCOM links, and traffic performance over the supported networks for packet-based systems.

A summary of the changes in the Capacity KPP is provided in the table below [Gbps = Gigabits per second].

TSAT CDD	Capacity KPP	Explanation
TSAT CDD 21 Jan 2004	31 Gbps	• Unaffordable requirement established with throughput allocated to EHF, Ka, and Optical (multi- and single-access lasercom) in TSAT baseline
TSAT CDD Update (Summer 2007)	36.3 Gbps	• **EHF component reduced** due to improvements in modeling, additional information regarding system & terminal performance, changes in TSAT budget • **Ka component reduced** due to high concentration of AISR users in theaters per scenario -- more accesses/throughput available in baseline worldwide • **Optical component increased in throughput while significantly reducing number of accesses available for users.** High risk, multi-access lasercom *eliminated* from TSAT baseline. Per the 2006 Quadrennial Defense Review decisions, Airborne ISR users will be reliant primarily on the Ka component, instead of lasercom. This freed the remaining single accesses for Space ISR applications requiring additional throughput. After extensive study, it was determined that there is no cost, schedule, or performance impact to the existing TSAT baseline to accommodate additional throughput for space users

Similar in-depth analysis has been performed on numerous non-KPP attributes to ensure the CDD update going forward to the JROC is completely achievable and affordable. In some cases, no technical trades in capability were necessary since an operational clarification by the users sufficed. None of these non-KPP attribute trades/clarifications impacted the remaining KPPs for the system. However, some of the KPPs have been changed due to changes in the JCIDS instructions and JROC guidance issued by Joint Staff. It is important to note the CDD update does accommodate the Block Acquisition approach, identifying specific attributes for Block 1 when Block 1's performance is less capable than Block 2's. Importantly, all KPPs apply to the TSAT's full operational capability (FOC) when ***both*** Block 1 and Block 2 are on-orbit and operational, since neither block in and of themselves can achieve FOC of the system for users. The following is a list of the KPPs for the TSAT System being carried forward to the JROC, which is currently planned for June 2007.

KPP FOC=Block 1 + Block 2	**TSAT CDD** 21 Jan 2004	**TSAT CDD Update** Summer 2007
Capacity	The TSAT System must provide at least 31 Gbps of mission throughput to support the full range of DoD operations.	The TSAT System must provide at least 36.3 Gbps of mission throughput to support the full range of DoD operations.
Coverage	The TSAT System must be capable of providing continuous worldwide communications services to forces operating anywhere between 65 degrees North latitude and 65 degrees South latitude, 24 hours per day.	No change
Protection	The TSAT System must provide assured communications to survivable and enduring National, missile defense and nuclear forces exposed to the environment specified in CJCSI 6811.01A, for the following critical functions: situation monitoring, decision making, force direction, force management and planning.	No change

KPP FOC=Block 1 + Block 2	**TSAT CDD** 21 Jan 2004	**TSAT CDD Update** Summer 2007
Information Assurance	The TSAT System must provide the availability, integrity, authentication, confidentially and non-repudiation capabilities to avoid, prevent, negate, or mitigate the degradation, disruption, denial, unauthorized access or monitoring, and/or exploitation of sensitive and classified information that originates in, is conveyed by, or provided to TSAT systems.	No change
Operational Management	The TSAT Operational Management System must plan, configure, monitor, manage and control the TSAT platform, payload, network and terminal resources.	No change
Interoperability	The TSAT System must support interoperable networks between and among users from all operational elements (ground, air, SOF, maritime, intelligence, diplomatic, and support forces to include allies and coalition partners) with which they will form military or inter-agency mission task forces or otherwise be conducting operations.	No change
Net-Ready	The system must support Net-Centric military operations. The system must be able to enter and be managed in the network, and exchange data in a secure manner to enhance mission effectiveness. The system must continuously provide survivable, interoperable, secure, and operationally effective information exchanges to enable a Net-Centric military capability.	Replaced KPPs for Interoperability Information Exchange Requirements and Suitability as required by later publication of Joint Staff instruction.

The increase in throughput from 31 Gbps to 36.3 Gbps, for the capacity KPP does not constitute “requirements creep.” As explained above, the capacity KPP is comprised of three parts where some components of capacity are less costly and less difficult to achieve than others. The capacity increase resulted from substituting a higher throughput user's requirement (Space ISR) for a lower throughput user's requirement (Airborne ISR) on single access optical links. A side benefit is a significant reduction of the TSAT program's technology risk by eliminating several optical accesses for users and thus the elimination of multi-access lasercom from the TSAT baseline. Since the higher throughput requirement fell well within the capability limits of single-access lasercom already in the TSAT baseline, the Capacity KPP increase did *not* translate into increased cost and risk to the program. The TSAT program was able to accept the Capacity KPP increase while maintaining TSAT program affordability and schedule with acceptable risk.

Another update of key requirements capabilities documentation is also prescribed by National Security Space Acquisition Policy 03-01 to coincide with the end of the preliminary design phase (late 2008) and again prior to Build Approval (early 2011).

Regarding KPP specificity, the TSAT System KPPs either flow directly from the DoD SATCOM Mission Area Initial Capability Document, 22 Aug 04 or, in the case of the Net-Ready and Sustainment KPP, are mandated by the Department for all CDDs. By definition in CJCSM 3170.01B, KPPs are those attributes of a system that are critical and "so significant they must be verified by testing and evaluation or analysis." In describing the development of KPPs, CJCSM 3170.01B, Operation of the Joint Capabilities Integration and Development System, Encl B, Para 3 states, "A KPP will normally be a rollup of a number of supporting attributes that may be traded off to deliver the overall performance required." The flexibility that CJCSM 3170.01B provides allows the user to identify a critical system "capability" at the CDD level while leaving some trade space in determining the specific threshold attributes during the System Development Phase. While KPPs are required to be "testable," CJCSM 3170.01B allows that verification of a KPP is more often a function of analysis and not a single "test".

The test and evaluation community had expressed concern that the TSAT KPPs and attributes did not have "qualifiers" and could be interpreted as requiring a capability 100 percent of the time. The TSAT CDD does specify the required system availability and dependability as well as specific SATCOM link availability parameters by frequency band. To ensure that system test and evaluation would be based on these stated parameters the following guidance is being added to the Summer 2007 revision of the TSAT CDD: "The KPPs, Key System Attributes, and attributes in this document are considered to operate under the stated requirements for the system availability, system dependability and the link availabilities stated in Section D.6 (TSAT Threshold and Objective Attributes). For test and evaluation purposes, the requirements below are not to be interpreted as "100 percent" but should be evaluated based on the required system availability and dependability."

All KPPs and their supporting attributes are flowed to the Technical Requirements Document (TRD), the baseline against which TSAT development contractors prepare their designs. In all cases, a tracing is made between the KPPs and the supporting attributes. These requirements are in turn traced to still more detailed requirements in the TSAT TRD at the system (TSAT) and segment (Space, TMOS, and Terminal) levels.

Validation is done at both the segment and system levels through use of test, analysis, or simulation and traced back through the system requirements to validate the KPPs written in the CDD. Where necessary, more clarification guidance will be included in the TSAT Test and Evaluation Master Plan (TEMP) for use by the test community. Additionally, the TSAT program office uses a technical performance metrics (TPM) process that tracks and gauges the progress towards meeting and validating KPP requirements.

Block TSAT Implications for Other Programs

Acquiring TSAT in Blocks results in a higher confidence of on-time delivery of capabilities to the warfighter, by phasing risk incrementally across the Blocks. The incremental roll-out of capabilities to the warfighter through breaking the TSAT capabilities into “Blocks,” has been fully coordinated with the TSAT user community. Each Service and Combatant Command is a voting member of the TSAT Users Forum where all trades, including those required for the Block Approach, were studied in depth. The TSAT program office has carefully studied user requirements, working to determine how to structure the satellite system design features to meet the requirements at an acceptable cost and with low-risk to on-time delivery. Sometimes this results in identifying requirements needing to be initially relaxed to ensure a high-confidence of delivering the Block 1 configuration on-time.

The implementation of the Block Approach on the TSAT program still provides valuable operational utility for warfighters and their missions. The Future Combat System (FCS) will reap immediate operational benefits with the launch of the Block 1 satellites. Block 1 provides Space Radar a valuable transport mechanism to disseminate highly perishable intelligence information to deployed troops in combat zones; Block 2 completes worldwide coverage for dissemination of time-critical intelligence information from Space Radar, while combined with Block 1, providing enough optical accesses on orbit to support transporting data directly from Space Radar satellites back to the Continental United States (CONUS) and/or dissemination to theater. This will fulfill Space Radar's throughput and timeliness requirements for delivering critical ISR information.

The TSAT program office took the high-level Block Approach TSAT baseline, as approved by the 2006 QDR, and presented the Users Forum with lower-level trades in line with the Block Approach. The cooperation and synergism between all parties resulted in a set of approved trades, some of which originated from the users themselves. All trades, including those resulting from the Block Approach, that require one or more attributes to be modified were documented by Headquarters Air Force Space Command, the command lead for the TSAT Capability CDD. Once the update to the TSAT CDD has received JROC approval in Summer 2007, the set of capabilities Block TSAT must provide will be “set” until the Capability Production Document (CPD) is due at the end of the Preliminary Design Phase in late 2008. At an acquisition level, the TSAT program has defined on-ramps for both Block 1 and Block 2 configurations to enable early roll-out of capabilities to the warfighter should risk be appropriately mitigated. The on-ramps are being defined in the Space Segment Request for Proposal and will be considered for rolling onto TSAT as part of the KDP-C decision.

Future Combat System (FCS). As a part of the Joint Force, the Army will accomplish operational and tactical missions at higher operational tempos while being distributed across a much larger area. Current systems do not adequately provide continuous levels of situational awareness (SA), synchronization of fires, maneuver, and information dissemination, all of which will be required to support future conflicts and the Joint Warfighters’ dependence on a broad spectrum of information services (video/multimedia, graphics data, imagery, collaborative planning tools, and *one* Common Operating Picture).

All TSAT satellites, including Block 1, provide an Internet Protocol-layer transport that supplies network services to the soldier on-the-move (OTM), supporting modular forces including enabling Mobile Battle Command OTM (MBCOTM) and supporting the Warfighter Information Network-Tactical (WIN-T) system. TSAT support will give soldiers unprecedented access and full reachback capability as part of the Global Information Grid (GIG). High Capacity Communications Capability (HC3) tactical terminals will be installed on maneuver and tactical vehicles to provide high capacity on the move communications. Both TSAT Block 1 and 2 satellites will support the Army's and Marine Corps' need for high data rate (up to 1.544 Mbps) and anti-jam communications while moving at speeds up to 45 mph. TSAT is the only system being specifically designed to support the mobile ground forces, correcting a serious deficiency in the expeditionary environment resulting from limitations in communications bandwidth at corps level and below.

A single TSAT Block 1 satellite provides approximately the same amount of protected throughput as the entire AEHF constellation for ground, maritime, and airborne forces. A TSAT Block 2 satellite will provide identical anti-jam communications OTM (COTM) capabilities as Block 1, but twice the amount of resources. The increase in anti-jam COTM resources on Block 2 is necessary to meet the Capacity KPP for FOC. However with "less" COTM resources to integrate and test on a Block 1 satellite, it supports the Air Force's commitment to time-certain development to launch on schedule by lowering the integration complexity, and thus the risk. With space as a critical dimension of the battlespace, and warfighters' increasing reliance on space communication assets, TSAT is needed to meet the increasing demand for protected bandwidth.

The Users Forum has been a real success story where the TSAT program office supplies programmatic (cost, schedule, technical) and performance information on proposed trades to users so the overall program remains affordable, on schedule, and within acceptable risk limits. Also there are high-level versions of the Users Forum up to the General Officer level to ensure critical requirements issues for TSAT are vetted and decided at the appropriate level. The Army is a steadfast member of these forums ensuring TSAT will supply the necessary capabilities at the right times to support the Future Combat System. In addition to participation on the Users Forum since its inception in March 2004, the Army and other users from Services and Combatant Commands participated in the High Performance Team (HPT) that brought together all the stakeholders prior to the CDD entering official JCIDS coordination. The HPT provided a thorough review of the draft CDD including specific attributes drafted exclusively for Block 1. All HPT participants approved the contents of the draft CDD to be released into JCIDS coordination. In partnership with the users and acquisition community, Headquarters Air Force Space Command will continue to control cost, schedule, risk, and requirements even after KDP-B using established, proven processes like the Users Forum.

Space Radar. While the block approach has virtually no impact on ground mobile users who require anti-jam communications-on-the-move since both Blocks 1 and 2 provide this capability in differing amounts; similarly, Blocks 1 and 2 provide optical accesses for Space Radar also in differing amounts. How much support Space Radar initially receives from Block 1 alone will be dependent on the phasing of optical accesses since both Space Radar and TSAT are being launched in the same approximate timeframe. With the emphasis on time certain development, the fact that there will be fewer single-access lasercom antennas on Block 1 compared to Block 2 may *initially* impact Space Radar operations. Space Radar may be required to use an alternative path (e.g., a direct downlink) to offload their sensor data in the interim. This short-term impact begins to dissipate with the first launch of the Block 2 satellites and disappears completely with the full deployment of the TSAT constellation.

The TSAT Block Approach has no impact regarding disseminating intelligence products to theater users; however, it may initially impact TSAT's ability to accept raw sensor data from existing Space Radar satellites and delivering that data to CONUS. With fewer single-access lasercom antennas available on Block 1 satellites, fewer optical accesses will be available for Space Radar high data rate services. This is because the single-access lasercom antennas will be employed to support space-to-space crosslinks between TSAT Block 1 satellites to establish the backbone providing reach back for users and an exfiltration path to deliver sensor data from multiple AISR platforms being uplinked from the platforms via Ka-band capabilities on TSAT. Space Radar may need a short-term solution like a direct downlink to mitigate for fewer lasercom antennas on Block 1 satellites. However with both the TSAT and Space Radar constellations building up in basically the same timeframe, the smaller number of lasercom antennas on the TSAT Block 1 satellites will be offset by fewer deployed Space Radar satellites requiring user accesses from TSAT. Any deficiency dissipates as the Block 2 TSAT satellites are launched and disappears when TSAT reaches full operational capability. Nonetheless, Space Radar is required to carry two communications solutions forward to their KDP–B and will continue to assess their options to meet their communications needs.

The TSAT Block Approach supplies two single-access lasercom antennas, each capable of 10 Gbps on each Block 1 satellite. Lasercom capabilities are substantially increased on Block 2 satellites where each satellite has 4 single-access lasercom antennas, each capable of data rates up to 40 Gbps. All lasercom antennas are used interchangeably for supplying connectivity to High Data Rate users (i.e. user accesses) and for establishing a robust satellite-to-satellite transportation path (i.e. backbone) to provide timely delivery of vast amounts of collected ISR data from airborne and space collection platforms to the CONUS for processing, exploitation, and dissemination back to theater consumers of intelligence products. The smaller throughput of Block 1 lasercom antennas (i.e., 10 Gbps) has no impact on Space Radar since the buildup and final placement of satellites will ensure the backbone will support the throughput needs of accumulated airborne and space ISR data by strategically placing Block 2 satellites (each capable of 40 Gbps) in places where the throughput needs are the greatest.

Extensive studies have been performed by the National Security Space Office (NSSO) and the Air Force to ensure we fully understand the impacts of the Block TSAT approach on Space Radar and on *all* users of TSAT. The first study was led by the NSSO to understand if Block TSAT could still support Space Radar's communications requirements to off-load and deliver time-sensitive imagery, Surface Moving Target Information, and open ocean surveillance that is extremely perishable. Months of intensive modeling work and analysis was performed focusing on the final operational capabilities of both systems. The study concluded Block TSAT could indeed meet Space Radar's communications needs and still meet the communication needs of all its other ground, maritime, and airborne users.

Another study performed by the Air Force specifically looked at Block TSAT's ability to directly deliver unprocessed sensor data and intelligence products to the theater. Extensive analysis supported the overall conclusion that TSAT could be used to disseminate processed intelligence products to theater, but it wasn't practical to disseminate unprocessed (raw) sensor data except for limited circumstances.

All study results were briefed and fully coordinated with both the TSAT and Space Radar user communities.

Other TSAT Users. The TSAT program is currently acquiring both Block 1 (first two satellites) and Block 2 (last three satellites plus one spare) configurations of TSAT. The two blocks work together to meet FOC requirements in the TSAT CDD. Blocks 1 and 2 are being designed to be very capable and support net-centric Internet-Protocol (IP)-enabled protected SATCOM terminals such as the Army's High Capacity Communications Capability (HC3) terminal, the Navy's Multi-band Terminal (NMT), and Air Force's Family of Advanced Beyond Line-of-Sight Terminals (FAB-T), which will serve as gateways for tactical ad-hoc networks for Army FCS and other user networks. The Block 1 satellites provide IP-layer transport for FCS and other user networks, though direct interoperability requirements and interfaces are between TSAT and terminals such as HC3, NMT, and FAB-T.

The program office addresses potential impacts to the terminal community with their regular participation in the TSAT technical requirements forums. Potential impacts to the terminal community have also been discussed and coordinated in the TSAT User Forums. Additionally, the TSAT program has conducted extensive terminal fielding studies and shown how Block TSAT satisfies those terminal fielding plans in response to tasks requested by the Air Force and TSAT Users. These tasks have shown that TSAT provides the needed satellite placement, coverage and data throughput to support the terminals.

The TSAT program is developing a Memorandum of Agreement with the Defense Information Systems Agency (DISA) to create a "Joint Venture" between DISA and the TSAT program to ensure successful and seamless integration with the GIG and its various elements. This Joint Venture is an extension of the TSAT program's participation in the Net Centric Implementation Directive (NCID) development process which the DISA runs for the Assistant Secretary of Defense for Networks and Information Integration (ASD(NII)).

In a similar fashion to how the TSAT program has coordinated with the terminal communities to understand potential impacts of Block TSAT, the program has also coordinated impacts to connectivity with the Advanced Extremely High Frequency (AEHF) System and national/strategic operations with Headquarters Air Force Space Command, United States Strategic Command, and the rest of the strategic requirements and operational user community.

Summary

The TSAT program is on track towards mission success as a result of the significant progress made in FY06 to address issues raised by the GAO and Young Panel. In concert with the user community, the program office is solidifying requirements to support selection of the single contractor for satellite system development. We have a solid roadmap for FY07 and beyond that will result in mature, firm requirements, integration and use of mature, well understood technologies, and a clear understanding of the operational performance parameters of TSAT. Starting as early as March 2007, Key Performance Parameters and supporting attributes have been rigorously reviewed and modified in total partnership between the TSAT user community and the TSAT program office under Air Force Space Command leadership. Block development implications are being tracked to ensure an executable balance of cost, schedule and performance goals with a reasonable amount of manageable risk.

This work is occurring underneath the guidance of an experienced senior management team of civilians and military officers that will provide longevity and continuity on the program. This experienced team will ensure the proper planning and execution of the program to meet cost, schedule and performance expectations. Significant improvements in staffing have been implemented with assignment of key staff and increases in contractor and FFRDC staff. Program leadership is confident in the staff's ability to execute the program.

The Air Force is committed to delivering the net-centric capabilities that only TSAT can. The program is taking a measured approach to ensuring a disciplined, methodical and conservative back-to-basics approach with the TSAT Block Approach. The TSAT stakeholders have all been significantly engaged in the restructure. Users, including FCS, Space Radar, and other GIG elements understand and approve of how we will provide net-centric operations to enable their missions, and ultimately bring about the Services' Visions.

Thank you again for the opportunity to outline the steps the DoD community has taken to address the concerns raised by the GAO and the Young Panel. Significant work has gone into addressing these concerns and also incorporating lessons learned from prior space acquisition efforts. The Air Force is well positioned to execute the TSAT program provided that there is stable funding throughout the program life.

DEPARTMENT OF THE AIR FORCE
WASHINGTON DC

Office of the Assistant Secretary

SEP 2 9 2006

SAF/FMB
1130 Air Force Pentagon
Washington, DC 20330-1130

The Honorable Kay Bailey Hutchison
Chairman, Subcommittee on Military Construction and Veterans Affairs
Committee on Appropriations
United States Senate
Washington, DC 20510-6036

Dear Madam Chairman

The attached table responds to the requirement of Senate Appropriations Committee, Military Quality of Life Subcommittee Report 109-286 (pp. 10-11) that the Air Force "submit a report of its fiscal year 2007 facility repair projects...[to] include the account and sub-account from which the Air Force intends to fund each repair project."

The table lists repair projects exceeding $750,000 that the Air Force will consider funding in fiscal year 2007. The projects have not been prioritized. Some of the projects may be awarded during the final month of fiscal year 2006.

The table lists the "account" for each project as "Operation & Maintenance (O&M) 3400." This conforms to the past practice of including Facility Sustainment, Restoration and Modernization (FSRM) funds in O&M funds within the Defense Appropriation Act. In fiscal year 2007, we expect FSRM funds to be transferred to the Military Quality of Life and Veterans Affairs Appropriation Act. When enacted, this will require definition of a new account structure for Air Force FSRM funds.

Over the course of fiscal year 2007, field commanders will identify which projects to fund based on availability of resources and their assessments of each project's value in meeting Air Force missions. This flexibility allows consideration of changing mission assignments and such unanticipated events as storm damage and physical plant failures.

A similar letter has been sent to the Ranking Minority Member of your Subcommittee and to the Chairman and Ranking Minority Member of the House Appropriations Committee, Subcommittee on Military Quality of Life and Veterans Affairs.

Sincerely

FRANK R. FAYKES, Maj Gen, USAF
Deputy Assistant Secretary (Budget)

Attachment:
Project Report

DEPARTMENT OF THE AIR FORCE
WASHINGTON DC

Office of the Assistant Secretary

SEP 2 9 2006

SAF/FMB
1130 Air Force Pentagon
Washington, DC 20330-1130

The Honorable Dianne Feinstein
Ranking Minority Member, Subcommittee on Military Construction and Veterans Affairs
Committee on Appropriations
United States Senate
Washington, DC 20510-6036

Dear Senator Feinstein

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A similar letter has been sent to the Chairman of your Subcommittee and to the Chairman and Ranking Minority Member of the House Appropriations Committee, Subcommittee on Military Quality of Life and Veterans Affairs.

Sincerely

Frank R Faykes

FRANK R. FAYKES, Maj Gen, USAF
Deputy Assistant Secretary (Budget)

Attachment:
Project Report

DEPARTMENT OF THE AIR FORCE
WASHINGTON DC

Office of the Assistant Secretary

SEP 2 9 2006

SAF/FMB
1130 Air Force Pentagon
Washington, DC 20330-1130

The Honorable James T. Walsh
Chairman, Subcommittee on Military Quality of Life and Veterans Affairs
Committee on Appropriations
United States House of Representatives
Washington, DC 20515-6026

Dear Mr. Chairman

The attached table responds to the requirement of Senate Appropriations Committee, Military Quality of Life Subcommittee Report 109-286 (pp. 10-11) that the Air Force "submit a report of its fiscal year 2007 facility repair projects...[to] include the account and sub-account from which the Air Force intends to fund each repair project."

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Sincerely

FRANK R. FAYKES, Maj Gen, USAF
Deputy Assistant Secretary (Budget)

Attachment:
Project Report

DEPARTMENT OF THE AIR FORCE
WASHINGTON DC

Office of the Assistant Secretary

SEP 29 2006

SAF/FMB
1130 Air Force Pentagon
Washington, DC 20330-1130

The Honorable Chet Edwards
Ranking Minority Member, Subcommittee on Military Quality of Life and Veterans Affairs
Committee on Appropriations
United States House of Representatives
Washington, DC 20515-6026

Dear Mr. Edwards

The attached table responds to the requirement of Senate Appropriations Committee, Military Quality of Life Subcommittee Report 109-286 (pp. 10-11) that the Air Force "submit a report of its fiscal year 2007 facility repair projects…[to] include the account and sub-account from which the Air Force intends to fund each repair project."

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A similar letter has been sent to the Chairman of your Subcommittee and to the Chairman and Ranking Minority Member of the Senate Appropriations Committee, Subcommittee on Military Construction and Veterans Affairs.

Sincerely

FRANK R. FAYKES, Maj Gen, USAF
Deputy Assistant Secretary (Budget)

Attachment:
Project Report

Installation	Title	PA ($000)	Account (Appropriation) See Note*	Subaccount (Program Element)
AIR FORCE ACADEMY	Repl Condensor Water Piping-CETF	$1,000.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
AIR FORCE ACADEMY	Repl Fire Protection Pipes-CETF Ph1	$3,300.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
AIR FORCE ACADEMY	Improve Utilities-Mitchell Hall Infrastructure	$2,500.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
AIR FORCE ACADEMY	Repair Cadet Gym Ph 1/7	$7,050.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
AIR FORCE ACADEMY	Repair Cadet Gym Ph 2/7	$4,850.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
AIR FORCE ACADEMY	Repair Vandenberg Ph 1/7	$8,000.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
AIR FORCE ACADEMY	Repair Vandenberg Ph 2/7	$6,355.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
AIR FORCE ACADEMY	Repl Lead Sheath Cables-Ath Field	$1,200.0	Operation & Maintenance (3400)	Sustainment (***78)
AIR FORCE ACADEMY	Repair HTHW Phase 1/6	$1,500.0	Operation & Maintenance (3400)	Sustainment (***78)
AIR FORCE ACADEMY	Repair HTHW-Phase 2/6	$2,000.0	Operation & Maintenance (3400)	Sustainment (***78)
AIR FORCE ACADEMY	Repair HTHW-Phase 3/6	$3,200.0	Operation & Maintenance (3400)	Sustainment (***78)
AIR FORCE ACADEMY	Repair HTHW-Phase 4/6	$3,000.0	Operation & Maintenance (3400)	Sustainment (***78)
AIR FORCE ACADEMY	Repair HTHW-Phase 5/6	$3,000.0	Operation & Maintenance (3400)	Sustainment (***78)
AIR FORCE ACADEMY	Repair HTHW-Phase 6/6	$3,000.0	Operation & Maintenance (3400)	Sustainment (***78)
AIR FORCE ACADEMY	Repl West HTHW Line - Heat Plant to Pinion Dr.	$3,500.0	Operation & Maintenance (3400)	Sustainment (***78)
ALTUS AIR FORCE BASE	Repair Taxiway Mike	$1,265.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
ALTUS AIR FORCE BASE	REPAIR DORMITORY LODGING, Bldg 333	$1,950.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
ALTUS AIR FORCE BASE	Repair Failing Taxiway Asphalt Shoulder	$3,227.3	Operation & Maintenance (3400)	Sustainment (***78)
ANDERSEN AIR FORCE BASE	Repair Sewer Lift Stations	$900.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
ANDERSEN AIR FORCE BASE	Repair Approach Lighting Sys, 24R	$1,700.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
ANDERSEN AIR FORCE BASE	Install Fire Protection System, B-51104	$1,400.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
ANDERSEN AIR FORCE BASE	Repair Water Distribution System	$3,500.0	Operation & Maintenance (3400)	Sustainment (***78)
ANDERSEN AIR FORCE BASE	Repair Taxiway J between Taxiwy C and South Runway	$1,500.0	Operation & Maintenance (3400)	Sustainment (***78)
ANDERSEN AIR FORCE BASE	Repair Taxiway A, Phase 1	$1,200.0	Operation & Maintenance (3400)	Sustainment (***78)
ANDERSEN AIR FORCE BASE	Repair Taxiway A, Phase 2	$1,200.0	Operation & Maintenance (3400)	Sustainment (***78)
ANDREWS AIR FORCE BASE	Add To/Repair 113 FW Comm & 231 CCS Supply Facility	$3,000.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
ANDREWS AIR FORCE BASE	REPAIR WATER DISTRIBUTION SYS BACKFLOW PREVENTERS BASEWIDE	$1,655.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
ANDREWS AIR FORCE BASE	Add To And Alter Maintenance Hangar - Bldg 3119	$5,600.0	Operation & Maintenance (3840)	Sustainment (***78)
ANDREWS AIR FORCE BASE	REPLACE PRIMARY FEEDER ON WEST SIDE OF AAFB	$5,500.0	Operation & Maintenance (3400)	Sustainment (***78)
ANDREWS AIR FORCE BASE	Replace Roof - 201AS Squadron Operations Facility -Bldg 1234	$840.0	Operation & Maintenance (3840)	Sustainment (***78)
ANDREWS AIR FORCE BASE	REPAIR AIRFIELD LIGHTING SYSTEM	$6,000.0	Operation & Maintenance (3400)	Sustainment (***78)
ANDREWS AIR FORCE BASE	Replace Roof, Hangar 8, Building 1225	$1,150.0	Operation & Maintenance (3840)	Sustainment (***78)
ARNOLD AIR FORCE BASE	MAINTAIN WATER DISTRIBUTION SYSTEM, PH 1	$882.0	Operation & Maintenance (3400)	Sustainment (***78)
ATLANTIC CITY INTERNATIONAL AIRPORT	Repair Maintain Aircraft Apron/Shoulders	$790.0	Operation & Maintenance (3840)	Sustainment (***78)
AVIANO AIR BASE	REPAIR MOBILITY CONTROL CENTER	$2,800.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
BANGOR INTERNATIONAL AIRPORT (ANG)	Repair Aircraft Parking Aprons	$825.0	Operation & Maintenance (3840)	Sustainment (***78)
BARKSDALE AIR FORCE BASE	Repair CI Water Mains -Flightline	$875.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
BARKSDALE AIR FORCE BASE	Repair Runway Edge Light Conduit	$4,500.0	Operation & Maintenance (3400)	Sustainment (***78)
BARKSDALE AIR FORCE BASE	Repair Airfield Pavement Ph2	$1,000.0	Operation & Maintenance (3400)	Sustainment (***78)
BARKSDALE AIR FORCE BASE	Repair Airfield Pavement Ph3	$1,000.0	Operation & Maintenance (3400)	Sustainment (***78)
BARKSDALE AIR FORCE BASE	Repair HVAC System, 2 OG (B5341)	$1,700.0	Operation & Maintenance (3400)	Sustainment (***78)
BARNES MUNICIPAL AIRPORT ANG	Refurbish O&T Facility - Building 001	$2,250.0	Operation & Maintenance (3840)	Sustainment (***78)
BEALE AIR FORCE BASE	REPAIR OG, LG AREAS (B1086)	$2,500.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
BEALE AIR FORCE BASE	REPAIR / UPGRADE DOCK 1	$9,100.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
BEALE AIR FORCE BASE	REPAIR/UPGRADE DOCK 1 (PHASE 1)	$4,973.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
BEALE AIR FORCE BASE	REPAIR/UPGRADE DOCK 1 (PHASE 2)	$2,650.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
BEALE AIR FORCE BASE	REPAIR/UPGRADE DOCK 1 (PHASE 3)	$1,540.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
BEALE AIR FORCE BASE	REPAIR "B" STREET SUBSTATION	$2,600.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
BEALE AIR FORCE BASE	REPAIR POL REFUELER TRUCK PARKING LOT (B1073)	$1,500.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
BEALE AIR FORCE BASE	REPAIR VENTILATION SYS, INTEL FAC (B2145)	$815.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
BEALE AIR FORCE BASE	REPAIR A/C (B1086)	$800.0	Operation & Maintenance (3400)	Sustainment (***78)
BEALE AIR FORCE BASE	RPR FLIGHTLINE ELEVATED WATER STORAGE	$1,050.0	Operation & Maintenance (3400)	Sustainment (***78)
BOLES WELLS WATER SYSTEM ANNEX	RPR WATER MAIN (PRATHER)	$1,800.0	Operation & Maintenance (3400)	Sustainment (***78)
BUCKLEY AIR FORCE BASE	Repair Base Power Distribution	$1,700.0	Operation & Maintenance (3840)	Sustainment (***78)

*Effective with the passage of the FY07 Military QoL and VA Approp Act, AF FSRM requirements will no longer be funded from the Defense Approp Act and a new approp structure will be defined for FSRM.

Installation	Title	PA ($000)	Account (Appropriation) See Note*	Subaccount (Program Element)
BUCKLEY AIR FORCE BASE	Repair Taxyway "M"	$790.0	Operation & Maintenance (3400)	Sustainment (***78)
CANNON AIR FORCE BASE	REP/BURY PERIMETER ELEC CKT AMMO	$1,630.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
CANNON AIR FORCE BASE	REPAIR BILLETING & CLUB CIRCUIT	$900.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
CANNON AIR FORCE BASE	REPAIR 04 END AIRFIELD LIGHTING, PHASE 2	$2,700.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
CANNON AIR FORCE BASE	REPR WALLS AND WINDOWS, B680	$1,250.0	Operation & Maintenance (3400)	Sustainment (***78)
CAPE CANAVERAL AIR STATION	ROOF/SIDING REPAIRS, HURRICANE WILMA	$3,700.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
CAPE CANAVERAL AIR STATION	LO&SC HURRICANE WILMA REPAIR	$1,000.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
CARSWELL AIR RESERVE STATION	Upgrade Combat Comm Sq, B. 1404	$2,400.0	Operation & Maintenance (3840)	Restoration & Modernization (***76)
CARSWELL AIR RESERVE STATION	Upgrade Combat Comm Group, B. 1403	$2,600.0	Operation & Maintenance (3840)	Restoration & Modernization (***76)
CARSWELL AIR RESERVE STATION	Repair Vehicle Maintenance Facility - Building 1424	$990.0	Operation & Maintenance (3840)	Sustainment (***78)
CHARLESTON AIR FORCE BASE	REPAIR RUNWAY 03/21	$30,000.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
CHARLESTON AIR FORCE BASE	RPR ELECT DISTR SYS - AREA B	$2,800.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
CHARLESTON AIR FORCE BASE	REPAIR CAFB TAXIWAY - CHARLIE	$7,500.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
CHARLESTON AIR FORCE BASE	REPAIR CAFB TAXIWAY - DELTA	$8,400.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
CHARLESTON AIR FORCE BASE	REPAIR CAFB TAXIWAY - HOTEL	$6,800.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
CHARLESTON AIR FORCE BASE	REPAIR CAFB TAXIWAY - KILO	$5,200.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
CHARLESTON AIR FORCE BASE	REPAIR OVERHEAD UTILITY SYSTEMS - AREA D	$1,200.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
COLUMBUS AIR FORCE BASE	IDIQ-RPR T/W D, G, AND MAINT APRON	$4,200.0	Operation & Maintenance (3400)	Sustainment (***78)
COLUMBUS AIR FORCE BASE	IDIQ-REPAIR T/W E, F, H, & TRIM PAD	$3,800.0	Operation & Maintenance (3400)	Sustainment (***78)
COLUMBUS AIR FORCE BASE	REPAIR ROOF PM B230 & B1944	$1,500.0	Operation & Maintenance (3400)	Sustainment (***78)
CREECH AIR FORCE BASE	RPR ELECT DIST PREDATOR SUPPORT	$1,700.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
CREECH AIR FORCE BASE	RPR OVERLAY T/W A & D	$900.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
CREECH AIR FORCE BASE	RPR AIRCRAFT APRON	$3,400.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
CREECH AIR FORCE BASE	RPR AIRFIELD/INFIELD	$1,000.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
DAVIS-MONTHAN AIR FORCE BASE	Rpr Electrical Laterals 5th Street	$850.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
DAVIS-MONTHAN AIR FORCE BASE	Rpr (Relocate) PAPI Regulator	$875.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
DAVIS-MONTHAN AIR FORCE BASE	Rpr Corrosion Control	$1,200.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
DAVIS-MONTHAN AIR FORCE BASE	Rpr Electrical Laterals Ph 2	$800.0	Operation & Maintenance (3400)	Sustainment (***78)
DAVIS-MONTHAN AIR FORCE BASE	Rpr Exterior Electric	$2,000.0	Operation & Maintenance (3400)	Sustainment (***78)
DAVIS-MONTHAN AIR FORCE BASE	Repair Roof & Siding Hangar, Bldg 1750	$775.0	Operation & Maintenance (3740)	Sustainment (***78)
DAVIS-MONTHAN AIR FORCE BASE	Rpr (Sustain) Runway Lighting	$1,700.0	Operation & Maintenance (3400)	Sustainment (***78)
DAVIS-MONTHAN AIR FORCE BASE	Rpr (Sustain) Squadron Operations B-140	$800.0	Operation & Maintenance (3400)	Sustainment (***78)
DES MOINES INTERNATIONAL AIRPORT ANG	Repair Roof, Building 440	$840.0	Operation & Maintenance (3840)	Sustainment (***78)
DES MOINES INTERNATIONAL AIRPORT ANG	Replace Fuel Cell Hangar Doors	$860.0	Operation & Maintenance (3840)	Sustainment (***78)
DIEGO GARCIA	REPAIR HVAC SYSTEM, B631 (PH 2)	$800.0	Operation & Maintenance (3400)	Sustainment (***78)
DOBBINS ARB	REPAIR STORM WATER SYSTEM PHASE 2	$2,480.0	Operation & Maintenance (3740)	Restoration & Modernization (***76)
DOBBINS ARB	Airfield Lighting and Control System	$3,985.0	Operation & Maintenance (3740)	Restoration & Modernization (***76)
DOBBINS ARB	Repair Cracks & Spalls (Taxiway A, E, G, L & J)	$795.3	Operation & Maintenance (3740)	Sustainment (***78)
DOBBINS ARB	Repair Taxiway D & Shoulders	$1,270.0	Operation & Maintenance (3740)	Sustainment (***78)
DOBBINS ARB	Repair Cracks, Spall & Joint Seal Transient Ramp	$2,500.0	Operation & Maintenance (3740)	Sustainment (***78)
DOVER AIR FORCE BASE	Repair Facility 270	$1,760.0	Operation & Maintenance (3740)	Restoration & Modernization (***76)
DOVER AIR FORCE BASE	REPAIR RUNWAY 14/32 (R&M)	$46,000.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
DOVER AIR FORCE BASE	RPR HTHW MANHOLES (S/R)	$1,500.0	Operation & Maintenance (3400)	Sustainment (***78)
DOVER AIR FORCE BASE	Renovate Wing Hz Bldg	$3,200.0	Operation & Maintenance (3740)	Sustainment (***78)
DOVER AIR FORCE BASE	REPAIR RUNWAY 01/19 CENTERLINE LIGHTS (S/R)	$1,500.0	Operation & Maintenance (3400)	Sustainment (***78)
DUKE FIELD	RPR Fire Sys Fld 3 Hangar B/3020	$1,050.0	Operation & Maintenance (3740)	Restoration & Modernization (***76)
DYESS AIR FORCE BASE	REPAIR AIRCRAFT MAINTENANCE SHOP	$940.7	Operation & Maintenance (3400)	Restoration & Modernization (***76)
DYESS AIR FORCE BASE	REPAIR SMALL ARMS RANGE	$8,000.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
DYESS AIR FORCE BASE	REPLACE ELECTRICAL DIST AREA C	$1,676.5	Operation & Maintenance (3400)	Restoration & Modernization (***76)
DYESS AIR FORCE BASE	REPLACE ELECTRICAL DIST AREA D	$1,959.8	Operation & Maintenance (3400)	Restoration & Modernization (***76)
DYESS AIR FORCE BASE	REPAIR SOUTH TOUCHDOWN(RUNWAY)	$3,500.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
DYESS AIR FORCE BASE	REPLACE GAS MAINS P2	$1,168.1	Operation & Maintenance (3400)	Sustainment (***78)
DYESS AIR FORCE BASE	RPR AFLD PVMTS - MOBILITY STAGING	$1,000.0	Operation & Maintenance (3400)	Sustainment (***78)
DYESS AIR FORCE BASE	REPLACE WATER LINES(CAST IRON) PH 2	$3,000.0	Operation & Maintenance (3400)	Sustainment (***78)

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EARECKSON AIR STATION	CORRECT CATWALK OSHA DEFICIENCIES IN 6 RADAR SITES ph1	$1,000.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
EARECKSON AIR STATION	REPLACE HEAT BANKS ON RADAR SYSTEMS (LUR, TNC, EHM, CZF)	$800.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
EARECKSON AIR STATION	REPLACE WASTE HEAT LINES PH2	$2,350.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
EARECKSON AIR STATION	REPAIR GENERATOR PROTECTIVE RELAYS	$750.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
EARECKSON AIR STATION	OVERHAUL GENERATOR AND ALTENATOR #2	$1,500.0	Operation & Maintenance (3400)	Sustainment (***78)
EDWARDS AIR FORCE BASE	RPR SW GEAR SUB STN 19	$800.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
EDWARDS AIR FORCE BASE	RPR TAXIWAY CABLE/TRANSFORMER	$800.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
EDWARDS AIR FORCE BASE	RPR RAC3 RUNWAY 04 UNDERRUN	$1,000.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
EDWARDS AIR FORCE BASE	RPR SHOULDERS TAXIWAY F	$1,500.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
EDWARDS AIR FORCE BASE	RPR AIRFIELD LIGHTING NORTHBASE RUNWAY	$1,000.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
EDWARDS AIR FORCE BASE	RPR KEEL RUNWAY 24 NORTHBASE	$4,500.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
EDWARDS AIR FORCE BASE	RPR KEEL NORTHBASE RUNWAY 06	$4,500.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
EDWARDS AIR FORCE BASE	RPR UNG POWER CABLES WATER SYSTM, AFRL	$800.0	Operation & Maintenance (3400)	Sustainment (***78)
EGLIN AFB-FIELD 3	Renovate Reserve Forces O&T B3077	$1,600.0	Operation & Maintenance (3740)	Restoration & Modernization (***76)
EGLIN AIR FORCE BASE	REPR WEST RANGE SUBSTATION	$1,700.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
EGLIN AIR FORCE BASE	REPR EAST RANGE SUBSTATION	$2,160.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
EGLIN AIR FORCE BASE	CORRECT FPD FACS 130 129 132 444	$2,500.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
EIELSON AIR FORCE BASE	Repair Hangar Doors, Phase 2 (B1338)	$2,200.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
ELLINGTON FIELD	Rpr Elect Distr System	$2,900.0	Operation & Maintenance (3840)	Sustainment (***78)
ELLSWORTH AIR FORCE BASE	REPAIR ASBESTOS SIDING - PROP SHOP, B601	$1,600.0	Operation & Maintenance (3400)	Sustainment (***78)
ELLSWORTH AIR FORCE BASE	REPAIR STEAM BOILERS (B102)	$950.0	Operation & Maintenance (3400)	Sustainment (***78)
ELMENDORF AIR FORCE BASE	REPAIR 34.5kV TRANSMISSION LINE #1	$2,100.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
ELMENDORF AIR FORCE BASE	F-22 Repair AFR Training Facility 7348	$751.9	Operation & Maintenance (3740)	Restoration & Modernization (***76)
ELMENDORF AIR FORCE BASE	REPAIR TAXIWAY M & SHOULDERS, PH 2	$1,100.0	Operation & Maintenance (3400)	Sustainment (***78)
ELMENDORF AIR FORCE BASE	RPL ROOF 6260 3SUG	$1,300.0	Operation & Maintenance (3400)	Sustainment (***78)
ELMENDORF AIR FORCE BASE	REPAIR TAXIWAY D SOUTH PH 1	$1,450.0	Operation & Maintenance (3400)	Sustainment (***78)
ELMENDORF AIR FORCE BASE	REPAIR TAXIWAY D SOUTH PH 2	$1,450.0	Operation & Maintenance (3400)	Sustainment (***78)
FAIRCHILD AIR FORCE BASE	REPL PCC SLABS, T/W P FROM T/W D TO T/W C	$2,000.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
FAIRCHILD AIR FORCE BASE	Repair Squadron Operations Facility - Building 445	$2,700.0	Operation & Maintenance (3840)	Sustainment (***78)
FAIRCHILD AIR FORCE BASE	REPAIR ANNEX ROOFS AND PERIMETER TOWER ROOFS, BLDG 2050	$3,110.0	Operation & Maintenance (3400)	Sustainment (***78)
FAIRCHILD AIR FORCE BASE	REPAIR MAINTENANCE FACILITY ROOF, BLDG 2050	$12,252.0	Operation & Maintenance (3400)	Sustainment (***78)
FAIRCHILD AIR FORCE BASE	REPAIR VEHICLE MAINTENANCE ROOF, BLDG 2115	$1,500.0	Operation & Maintenance (3400)	Sustainment (***78)
FORBES FIELD ANG	Repair Vehicle Maintenance	$1,500.0	Operation & Maintenance (3840)	Sustainment (***78)
FORBES FIELD ANG	Repair Fire Station	$1,050.0	Operation & Maintenance (3840)	Sustainment (***78)
FRANCIS E WARREN AIR FORCE BASE	Maintain Natural Gas Distribution System	$900.0	Operation & Maintenance (3400)	Sustainment (***78)
FRANCIS E WARREN AIR FORCE BASE	Repair Electrical Distribution - "J" Circuit	$1,550.0	Operation & Maintenance (3400)	Sustainment (***78)
FRANCIS S GABRESKI AIRPORT (ANG)	Repair Fuel Cell Fire Suppression System	$1,100.0	Operation & Maintenance (3840)	Sustainment (***78)
FRANCIS S GABRESKI AIRPORT (ANG)	Repair Maintenance Hangar Fire Suppression System	$750.0	Operation & Maintenance (3840)	Sustainment (***78)
FRESNO YOSEMITE INTERNATIONAL	Repair Fuel Cell Hangar	$1,050.0	Operation & Maintenance (3840)	Sustainment (***78)
GOODFELLOW AIR FORCE BASE	ATFP INST KEYLESS LOCK SYS AT BILLETING ROOMS	$1,128.4	Operation & Maintenance (3400)	Restoration & Modernization (***76)
GOODFELLOW AIR FORCE BASE	Repair PL DORMITORY 250	$2,000.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
GOODFELLOW AIR FORCE BASE	Repair PL DORM/ADMIN 252/251	$3,742.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
GOODFELLOW AIR FORCE BASE	REPAIR PL DORMITORY 255	$2,000.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
GOODFELLOW AIR FORCE BASE	REPAIR PL DORM/ADMIN 257/256	$2,500.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
GRAND FORKS AIR FORCE BASE	REPAIR SOUTH TAXIWAYS (R/M)	$14,556.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
GRAND FORKS AIR FORCE BASE	REPAIR AIRFIELD LIGHTING SYSTEM (R/M)	$4,000.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
GRAND FORKS AIR FORCE BASE	INSTALL FIRE SUPPRESSION FUEL CELL (613) (R/M)	$2,000.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
GRAND FORKS AIR FORCE BASE	INSTALL AFFF HANGAR 600 (R/M)	$1,800.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
GRAND FORKS AIR FORCE BASE	INSTALL FIRE SUPPRESSION HANGAR 602 (R/M)	$1,800.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
GRAND FORKS AIR FORCE BASE	RPR ELECTRIC LINES-FLIGHT LINE NORTH (R/M)	$2,375.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
GRAND FORKS AIR FORCE BASE	RPR ELECTRIC LINES-EIELSON ST NORTH (R/M)	$1,600.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
GRISSOM ARB	Repair Bldg 600 For Life Support	$3,832.4	Operation & Maintenance (3740)	Restoration & Modernization (***76)
GRISSOM ARB	Repair Dock 2 for Fuel Systems Main Fac.	$4,717.4	Operation & Maintenance (3740)	Restoration & Modernization (***76)
GRISSOM ARB	Install Fire Suppression Sys, Dock 5	$1,076.4	Operation & Maintenance (3740)	Restoration & Modernization (***76)

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GRISSOM ARB	Rpr Taxiway A, D, E & F Edge Lights, Replace Threshold Light Fixtures	$2,156.1	Operation & Maintenance (3740)	Restoration & Modernization (***76)
GRISSOM ARB	Repair Nose Dock Access Apron	$1,398.2	Operation & Maintenance (3740)	Sustainment (***78)
GRISSOM ARB	Overlay & Joint Repair, Taxiway G	$1,397.1	Operation & Maintenance (3740)	Sustainment (***78)
GRISSOM ARB	Repair Mass Parking Apron, Ph 2	$4,242.4	Operation & Maintenance (3740)	Sustainment (***78)
HANSCOM AIR FORCE BASE	Repair Boiler Controls - Bldg 1201 Steam Plant	$1,300.0	Operation & Maintenance (3400)	Sustainment (***78)
HARRISBURG IAP	Repair Fuel Cell Hangar	$2,300.0	Operation & Maintenance (3840)	Sustainment (***78)
HICKAM AIR FORCE BASE	Repair Pavement, Row 1	$980.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
HICKAM AIR FORCE BASE	Repair Airfield Pavement, Taxilane	$1,500.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
HICKAM AIR FORCE BASE	Repair Aircraft Maintenance Facility, B1055 Phase II	$2,000.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
HICKAM AIR FORCE BASE	Repair Sewerline B2040 to SPS1/1A, Ind. (IDIQ)	$1,125.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
HICKAM AIR FORCE BASE	Upgrade Fire Protection Sys-Fuel Cell/Corr Cntrl- Bldg 3407	$770.0	Operation & Maintenance (3840)	Restoration & Modernization (***76)
HILL AIR FORCE BASE	RPR POWER LINES/UNDERGROUND	$800.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
HOLLOMAN AIR FORCE BASE	RPR TAXILANES AND APRON, WEST RAMP, FAC 11220	$1,014.1	Operation & Maintenance (3400)	Restoration & Modernization (***76)
HOLLOMAN AIR FORCE BASE	REPAIR TAXIWAY D	$4,205.2	Operation & Maintenance (3400)	Restoration & Modernization (***76)
HOLLOMAN AIR FORCE BASE	RPR HANGAR 500 APRON	$829.1	Operation & Maintenance (3400)	Sustainment (***78)
HOLLOMAN AIR FORCE BASE	RPR SAN ANDRES WTR MAIN	$1,200.0	Operation & Maintenance (3400)	Sustainment (***78)
HOLLOMAN AIR FORCE BASE	REPAIR PIPELINES WELLFIELDS	$1,000.0	Operation & Maintenance (3400)	Sustainment (***78)
HOLLOMAN AIR FORCE BASE	RPR TWY H	$4,500.0	Operation & Maintenance (3400)	Sustainment (***78)
HOLLOMAN AIR FORCE BASE	REPAIR GAF FUEL SYSTEM	$1,000.0	Operation & Maintenance (3400)	Sustainment (***78)
HOMESTEAD ARS	Repair Approach Lights	$1,161.0	Operation & Maintenance (3740)	Sustainment (***78)
HURLBURT FIELD	REPAIR EASON HANGAR, PH 3	$1,149.9	Operation & Maintenance (3400)	Restoration & Modernization (***76)
HURLBURT FIELD	MEI-REPAIR PAVEMENT, COMPASS ROSE	$1,708.5	Operation & Maintenance (3400)	Sustainment (***78)
HURLBURT FIELD	REPAIR COMBAT ARMS RANGE B/90518	$1,500.0	Operation & Maintenance (3400)	Sustainment (***78)
INCIRLIK AIR BASE ADANA	RPR GOLF LOOP TAXITRACK & ROAD STUBS	$1,000.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
INCIRLIK AIR BASE ADANA	RPR ELIMINATE PARALLEL WATER LINES	$800.0	Operation & Maintenance (3400)	Sustainment (***78)
INCIRLIK AIR BASE ADANA	RPR/REPLACE AIRFIELD SIGNS	$1,000.0	Operation & Maintenance (3400)	Sustainment (***78)
JACKSONVILLE IAP ANG	Repair Aircraft Hangar (Building 1001) Phase I	$3,500.0	Operation & Maintenance (3840)	Restoration & Modernization (***76)
JACKSONVILLE IAP ANG	Add/Repair Dining Facility	$1,600.0	Operation & Maintenance (3840)	Sustainment (***78)
KADENA AIR BASE	SECURITY LIGHTS, FLIGHT LINE, PH III	$1,812.3	Operation & Maintenance (3400)	Restoration & Modernization (***76)
KADENA AIR BASE	RPR CONCRETE PAVEMENT, FLOW THROUGH B805	$972.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
KADENA AIR BASE	GRIND/GROOVE NORTH RWY C ENDS	$2,000.0	Operation & Maintenance (3400)	Sustainment (***78)
KADENA AIR BASE	REPAIR 5L/23R RUNWAY PAVEMENT	$5,810.0	Operation & Maintenance (3400)	Sustainment (***78)
KAPAUN ADMINISTRATION ANX	REPAIR WATER LINES KAPAUN	$4,004.8	Operation & Maintenance (3400)	Sustainment (***78)
KEESLER AIR FORCE BASE	REPAIR AIRCRAFT PARKING APRONS PH 1	$2,268.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
KELLY FIELD ANNEX	FX-REPLACE MASTER AIRFIELD LIGHTING CONTROLS (1607)	$2,500.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
KELLY FIELD ANNEX	EXTERIOR WEATHER-TIGHT ENVELOPE FOR AIA (2000)	$4,600.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
KELLY FIELD ANNEX	ATFP-REPLACE AIRFIELD FENCING, PH 2	$1,700.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
KING SALMON AIRPORT	REPAIR/REPLACE GENERATORS, POWER PLANT	$750.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
KIRTLAND AIR FORCE BASE	Repair SUBSTATION 1	$1,900.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
KIRTLAND AIR FORCE BASE	REPAIR ELECTRICAL SYSTEM, MAINT BLDG	$3,000.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
KIRTLAND AIR FORCE BASE	REPAIR ARC-FLASH SAFETY COMPLIANCE	$2,000.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
KIRTLAND AIR FORCE BASE	REPLACE WATER WELL 1&2	$3,000.0	Operation & Maintenance (3400)	Sustainment (***78)
KLAMATH FALLS INTERNATIONAL AIRPORT ANG	Alter/Repair & Add Munitions Maintenance	$1,550.0	Operation & Maintenance (3840)	Restoration & Modernization (***76)
KLAMATH FALLS INTERNATIONAL AIRPORT ANG	Repair Fire Suppression System, B-219	$1,000.0	Operation & Maintenance (3840)	Sustainment (***78)
KUNSAN AIR BASE	REPAIR T-SPLICE CONNECTIONS ON HV UG CABLE, PH1B	$864.0	Operation & Maintenance (3400)	Sustainment (***78)
KWANG-JU AIR BASE	REPLACE LOW VOLTAGE FEEDERS A&B	$1,800.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
KWANG-JU AIR BASE	REPLACE LOW VOLTAGE FEEDERS A&B	$1,300.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
LACKLAND AIR FORCE BASE	Repair CES/ALCF General Training Support Facility B/874	$1,385.0	Operation & Maintenance (3740)	Restoration & Modernization (***76)
LACKLAND AIR FORCE BASE	Repair 68 Airlift Squadron Operations Facility B/828	$2,098.0	Operation & Maintenance (3740)	Restoration & Modernization (***76)
LACKLAND AIR FORCE BASE	FX-Repair Foundation B-9030	$850.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
LACKLAND AIR FORCE BASE	REVITALIZE PP DORMS (1201)	$2,000.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
LACKLAND AIR FORCE BASE	REVITALIZE Permanent Party DORM (1205)	$2,424.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
LACKLAND AIR FORCE BASE	REPAIR RECRUIT DORM (9310)	$14,000.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
LACKLAND AIR FORCE BASE	REPAIR STUDENT DORM (10251)	$2,700.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)

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LACKLAND AIR FORCE BASE	REPAIR STUDENT DORM (10255)	$2,700.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
LACKLAND AIR FORCE BASE	REPAIR STUDENT DORM (10261)	$2,700.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
LACKLAND AIR FORCE BASE	REPAIR STUDENT DORM (10265)	$2,700.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
LACKLAND TRAINING ANNEX	REPAIR MRSOC INTEL OPS FACILITY (B313)	$1,500.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
LACKLAND TRAINING ANNEX	REPLACE BACKUP PLANT GENERATORS, PH 2	$2,900.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
LAJES FIELD	Repair Runway, Phase I	$5,000.0	Operation & Maintenance (3400)	Sustainment (***78)
LAJES FIELD	Repair Runway, North Touchdown	$2,500.0	Operation & Maintenance (3400)	Sustainment (***78)
LAJES FIELD	Repair Runway, South Touchdown	$2,500.0	Operation & Maintenance (3400)	Sustainment (***78)
LAJES FIELD	Repair Sewer Lines, Multi	$1,500.0	Operation & Maintenance (3400)	Sustainment (***78)
LANGLEY AIR FORCE BASE	Repair Hammerhead, East EOR, Phase 2	$2,000.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
LANGLEY AIR FORCE BASE	Repair Taxiway Foxtrot Aprons, Phase 1	$950.0	Operation & Maintenance (3400)	Sustainment (***78)
LAUGHLIN AIR FORCE BASE	RPR PRIMARY ELEC DIST LINES PH-1	$1,645.5	Operation & Maintenance (3400)	Restoration & Modernization (***76)
LAUGHLIN AIR FORCE BASE	RPR PRIMARY ELEC DIST LINES PH-2	$856.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
LAUGHLIN AIR FORCE BASE	REPAIR TAXIWAY B	$1,500.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
LAUGHLIN AIR FORCE BASE	REPAIR TAXIWAY F	$1,250.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
LAUGHLIN AIR FORCE BASE	REPL FIRE PROT/NDI,FABR SHP	$800.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
LAUGHLIN AIR FORCE BASE	RPL SLABS-ROWS AA,BB,CC, Y, Z	$8,100.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
LAUGHLIN AIR FORCE BASE	UPGRADE AF ELEC DIST SYS	$1,700.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
LAUGHLIN AIR FORCE BASE	RPR/RPL ROOF B320, ANDERSON HALL	$1,200.0	Operation & Maintenance (3400)	Sustainment (***78)
LAUGHLIN AIR FORCE BASE	RRP SEWER SYSTEM PH-2	$2,500.0	Operation & Maintenance (3400)	Sustainment (***78)
LINCOLN MUNICIPAL AIRPORT (ANG)	Repair Airfield Pavements	$1,250.0	Operation & Maintenance (3840)	Sustainment (***78)
LITTLE ROCK AIR FORCE BASE	REPAIR/REMOVE AIRFIELD OBSTRUCTIONS	$2,900.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
LITTLE ROCK AIR FORCE BASE	REPAIR DORMITORY 748	$4,750.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
LITTLE ROCK AIR FORCE BASE	REPAIR DORM/VQ FIRE PROTECTION SYSTEMS	$1,221.3	Operation & Maintenance (3400)	Restoration & Modernization (***76)
LITTLE ROCK AIR FORCE BASE	REPAIR FACILTIY FIRE PROTECTION SYSTEMS	$996.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
LITTLE ROCK AIR FORCE BASE	REPAIR ALERT AIRFIELD PARKING RAMP	$950.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
LITTLE ROCK AIR FORCE BASE	REPAIR APRON JOINT SEAL/SLABS (ROWS S-Z2)	$800.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
LITTLE ROCK AIR FORCE BASE	REPAIR REPLACE SWITCHING STATION	$1,700.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
LITTLE ROCK AIR FORCE BASE	REPAIR DELUGE SYS HANGAR 250	$2,294.3	Operation & Maintenance (3400)	Restoration & Modernization (***76)
LITTLE ROCK AIR FORCE BASE	Repair C-130 Maintenance Hangar, B 207	$4,400.0	Operation & Maintenance (3840)	Sustainment (***78)
LUIS MUNOZ MARIN IAP	Repair/Maintain Dining Hall & Medical Training - Building 16	$890.0	Operation & Maintenance (3400)	Sustainment (***78)
LUKE AIR FORCE BASE	RPR WATER DISTRIBUTION SYSTEM	$2,500.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
LUKE AIR FORCE BASE	REPLACE AIRFIELD LIGHTING CABLE & DUCT SYSTEM	$2,500.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
LUKE AIR FORCE BASE	REPLACE ALL TAXIWAY LIGHTING XLP CABLE WITH EPR INSULATION	$2,500.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
LUKE AIR FORCE BASE	FOL-REPAIR FIRE PROTECTION, HANGAR 983	$800.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
LUKE AIR FORCE BASE	RPR HVAC HUMIDITY CONTROL, PMEL	$4,500.0	Operation & Maintenance (3400)	Sustainment (***78)
LUKE AIR FORCE BASE	Replace HVAC System in Maintenance	$900.0	Operation & Maintenance (3740)	Sustainment (***78)
LUKE AIR FORCE BASE	RPR PAVEMENT JOINT SEAL SE/SW 425 APRON	$1,757.1	Operation & Maintenance (3400)	Sustainment (***78)
MACDILL AIR FORCE BASE	RPR FIRE SUPPRESSION SYS, HANGAR 3	$1,700.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
MACDILL AIR FORCE BASE	RPR FIRE SUPPRESSION SYS, HANGAR 4	$1,700.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
MACDILL AIR FORCE BASE	RPR FIRE SUPPRESSION SYS, HANGAR 5	$1,200.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
MACDILL AIR FORCE BASE	REPAIR SOUTH BAYSHORE BLVD ELECTRICAL	$8,500.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
MACDILL AIR FORCE BASE	REPAIR ELECTRICAL DISTRIBUTION SYSTEM ADJACENT TO RUNWAY	$2,000.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
MACDILL AIR FORCE BASE	RPR FIRE SUPPRESSION SYS, HANGAR 1	$2,200.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
MACDILL AIR FORCE BASE	RPR FIRE SUPPRESSION SYS, HANGAR 2	$1,700.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
MACDILL AIR FORCE BASE	REPAIR SOUTH RAMP ASPHALT & CONCRETE	$7,000.0	Operation & Maintenance (3400)	Sustainment (***78)
MACDILL AIR FORCE BASE	REPAIR WATER LINE (FLIGHT LINE SIDE)	$1,650.0	Operation & Maintenance (3400)	Sustainment (***78)
MALMSTROM AIR FORCE BASE	RENOVATE DORMITORY 768	$1,700.0	Operation & Maintenance (3400)	Sustainment (***78)
MALMSTROM AIR FORCE BASE	Repair Hi Temp Hot Water System	$900.0	Operation & Maintenance (3400)	Sustainment (***78)
MARCH ARB	Renovate Fac 458	$789.0	Operation & Maintenance (3740)	Restoration & Modernization (***76)
MARCH ARB	Repair Fire Protection Hangar 2303	$1,864.0	Operation & Maintenance (3740)	Restoration & Modernization (***76)
MARCH ARB	Repair Fire Protection B373	$1,328.0	Operation & Maintenance (3740)	Restoration & Modernization (***76)
MARCH ARB	Repair Fire Protection Hangar 2306	$2,880.0	Operation & Maintenance (3740)	Restoration & Modernization (***76)
MARCH ARB	Repair Fire Protection B2302	$1,860.0	Operation & Maintenance (3740)	Restoration & Modernization (***76)

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MARCH ARB	Renovate 429/453 for KC-135 AMXS	$4,306.5	Operation & Maintenance (3740)	Restoration & Modernization (***76)
MARCH ARB	Renovate Tower No.3 for NDI Lab, B/2303	$1,312.0	Operation & Maintenance (3740)	Restoration & Modernization (***76)
MARCH ARB	Renovate 453 For KC-135 AMXS	$2,546.3	Operation & Maintenance (3740)	Restoration & Modernization (***76)
MARCH ARB	KC-135 Squad Ops Facility 2245	$2,318.1	Operation & Maintenance (3740)	Restoration & Modernization (***76)
MARCH ARB	Replace R/W 14/32 Keel Sect @ 32 R/Y End	$2,841.0	Operation & Maintenance (3740)	Sustainment (***78)
MARCH ARB	Renovate Bldg 1211	$3,919.9	Operation & Maintenance (3740)	Sustainment (***78)
MARTIN AIR NATIONAL GUARD STATION	Repair Aircraft Parking Apron	$1,100.0	Operation & Maintenance (3840)	Sustainment (***78)
MARTIN AIR NATIONAL GUARD STATION	Repair Fuel Cell, Building 135	$1,200.0	Operation & Maintenance (3840)	Sustainment (***78)
MAXWELL AIR FORCE BASE	REPR HANGAR DOORS, BLDG 843	$800.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
MAXWELL AIR FORCE BASE	RENOV CADRE (PH 1), BLDG 1400/1400A	$2,000.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
MAXWELL AIR FORCE BASE	RENOV CADRE (PH 2), BLDG 1400/1400A	$2,500.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
MAXWELL AIR FORCE BASE	RENOV AWC (PH 2), BLDG 1401	$2,800.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
MAXWELL AIR FORCE BASE	RENOV AWC (PH 3), BLDG 1401	$4,500.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
MAXWELL AIR FORCE BASE	RENOV ACSC (PH 2), BLDG 1402	$3,510.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
MAXWELL AIR FORCE BASE	RENOV ACSC (PH 3), BLDG 1402	$3,050.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
MAXWELL AIR FORCE BASE	UPGR TERTIARY CHILL WTR LOOP SYS	$1,500.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
MAXWELL AIR FORCE BASE	REPL AIRFIELD LIGHTING CONDUCTORS	$1,200.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
MAXWELL AIR FORCE BASE	UPGR CHILL WTR PUMPS & DRIVES, CENTRAL PLANT BLDG 1410	$1,650.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
MAXWELL AIR FORCE BASE	UPGR HVAC SYS, DORM BLDG 695	$770.0	Operation & Maintenance (3400)	Sustainment (***78)
MAXWELL AIR FORCE BASE GUNTER ANNEX	UPGR HVAC SYS, BLDG 1143 PH 1 SECTION	$950.0	Operation & Maintenance (3400)	Sustainment (***78)
MCCHORD AIR FORCE BASE	RPR STEAMLINES, PHASE III-2	$1,900.0	Operation & Maintenance (3400)	Sustainment (***78)
MCCONNELL AIR FORCE BASE	REPAIR AFFF MAINTENANCE HANGAR B/1106	$2,500.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
MCCONNELL AIR FORCE BASE	REPAIR ELECTRICAL DISTRIBUTION KANSAS ST PHASE 3	$4,800.0	Operation & Maintenance (3400)	Sustainment (***78)
MCCONNELL AIR FORCE BASE	REPAIR ELECTRICAL DISTRIBUTION KANSAS ST PHASE 4	$2,700.0	Operation & Maintenance (3400)	Sustainment (***78)
MCCONNELL AIR FORCE BASE	REPAIR WEST RUNWAY KEELWAYS	$10,519.0	Operation & Maintenance (3400)	Sustainment (***78)
MCCONNELL AIR FORCE BASE	Repair roof & renovate B. 36	$1,200.0	Operation & Maintenance (3840)	Sustainment (***78)
MCCONNELL AIR FORCE BASE	REPAIR TAXIWAY ALPHA	$4,309.5	Operation & Maintenance (3400)	Sustainment (***78)
MCCONNELL AIR FORCE BASE	REPAIR TAXIWAY BRAVO AND ECHO	$1,758.0	Operation & Maintenance (3400)	Sustainment (***78)
MCCONNELL AIR FORCE BASE	REPAIR AIRFIELD LIGHTING SYSTEM	$6,000.0	Operation & Maintenance (3400)	Sustainment (***78)
MCCONNELL AIR FORCE BASE	REPAIR MAINTENANCE HANGAR B/1107	$4,500.0	Operation & Maintenance (3400)	Sustainment (***78)
MCCONNELL AIR FORCE BASE	REPAIR TAXIWAY CHARLIE	$3,032.0	Operation & Maintenance (3400)	Sustainment (***78)
MCCONNELL AIR FORCE BASE	REPAIR TAXIWAY DELTA	$1,942.7	Operation & Maintenance (3400)	Sustainment (***78)
MCCONNELL AIR FORCE BASE	REPAIR TAXIWAY ECHO AND FOXTROT	$2,826.0	Operation & Maintenance (3400)	Sustainment (***78)
MCENTIRE AIR GUARD STN	Repair Base Water System	$3,000.0	Operation & Maintenance (3840)	Sustainment (***78)
MCGHEE TYSON AIRPORT	Repair Fire Station for Security Forces	$1,700.0	Operation & Maintenance (3840)	Restoration & Modernization (***76)
MCGUIRE AIR FORCE BASE	INSTALL FIRE ALARM TRANSCIEVERS VARIOUS DORMS R/M	$1,186.3	Operation & Maintenance (3400)	Restoration & Modernization (***76)
MCGUIRE AIR FORCE BASE	REPAIR PMEL,1809A R/M	$1,711.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
MCGUIRE AIR FORCE BASE	REPLACE APPROACH LIGHTING, RW 24 R/M	$1,900.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
MCGUIRE AIR FORCE BASE	(IDC) REPAIR CONCRETE ON VICTOR ROW R/M	$3,500.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
MCGUIRE AIR FORCE BASE	(IDC) REPAIR ALPHA/BRAVO PARKING RAMP	$3,400.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
MCGUIRE AIR FORCE BASE	(IDC) REPAIR CONCRETE X-RAY APRON R/M	$3,900.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
MCGUIRE AIR FORCE BASE	(IDC) REPAIR MAIN RAMP TAXIWAY R/M	$1,725.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
MCGUIRE AIR FORCE BASE	(IDC) REPAIR APRON, 3209, ROMEO, COMPASS R/M	$1,750.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
MCGUIRE AIR FORCE BASE	REPAIR HTHW LINES, MH#35A - MH#38, 2700 AREA S/R	$1,556.0	Operation & Maintenance (3400)	Sustainment (***78)
MCGUIRE AIR FORCE BASE	REPAIR HTHW LINES, MH #35 - MH #14, 2500 AREA S/R	$1,546.0	Operation & Maintenance (3400)	Sustainment (***78)
MCGUIRE AIR FORCE BASE	REPAIR HEAT SYSTEM HANGAR 3209 R/M	$2,873.5	Operation & Maintenance (3400)	Sustainment (***78)
MCGUIRE AIR FORCE BASE	REPAIR HTHW LINES, MH#29B - MH#55B, 2400 AREA S/R	$2,612.0	Operation & Maintenance (3400)	Sustainment (***78)
MINOT AIR FORCE BASE	RPR PARALLEL TXWY D/E (WEST)	$2,350.0	Operation & Maintenance (3400)	Sustainment (***78)
MINOT AIR FORCE BASE	Repair Tank 1963 & Install Fillstands	$980.0	Operation & Maintenance (3400)	Sustainment (***78)
MINOT AIR FORCE BASE	REPAIR APRON (SKID ROW)	$800.0	Operation & Maintenance (3400)	Sustainment (***78)
MINOT AIR FORCE BASE	REPAIR RUNWAY	$2,000.0	Operation & Maintenance (3400)	Sustainment (***78)
MISAWA AIR BASE	REPR ARM/DE-ARM PAD, TWY A5	$1,000.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
MISAWA AIR BASE	RPR AIRMEN DORM PH 3	$1,800.0	Operation & Maintenance (3400)	Sustainment (***78)
MISAWA AIR BASE	REPR AIRMEN DORM, PHASE 4	$1,800.0	Operation & Maintenance (3400)	Sustainment (***78)

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MISAWA AIR BASE	REPR Taxiway B West	$1,000.0	Operation & Maintenance (3400)	Sustainment (***78)
MISAWA AIR BASE	REPLACE CONTROL PANEL AT MAIN BASE PUMP HOUSE, B768	$1,700.0	Operation & Maintenance (3400)	Sustainment (***78)
MISAWA AIR BASE	Replace RUNWAY Touchdown, East End	$4,000.0	Operation & Maintenance (3400)	Sustainment (***78)
MOODY AIR FORCE BASE	REPAIR BAK-12 DECK SHEAVE SLOPE, B4141 (AORI)	$900.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
MOODY AIR FORCE BASE	REPAIR AIRFIELD PAVEMENTS IDIQ	$1,000.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
MORON AIR BASE	RPR PLACE O/H DIST U/G PH2	$1,226.1	Operation & Maintenance (3400)	Restoration & Modernization (***76)
MORON AIR BASE	RPR PLACE O/H DIST U/G PH3	$817.4	Operation & Maintenance (3400)	Restoration & Modernization (***76)
MORON AIR BASE	MAINTAIN TAXIWAY "A"	$2,779.1	Operation & Maintenance (3400)	Sustainment (***78)
MORON AIR BASE	MAINTAIN SOUTH TOUCHDOWN ZONE	$4,896.5	Operation & Maintenance (3400)	Sustainment (***78)
MORON AIR BASE	MAINTAIN EXTERIOR ELECTRICS	$1,122.7	Operation & Maintenance (3400)	Sustainment (***78)
MOUNTAIN HOME AIR FORCE BASE	RPR HXF, MAINT DOCK, FAC 201	$851.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
MOUNTAIN HOME AIR FORCE BASE	REPAIR AIRFIELD CABLING & ISOLATION TRANSFORMERS	$2,300.0	Operation & Maintenance (3400)	Sustainment (***78)
MOUNTAIN HOME AIR FORCE BASE	Repair D Circuit, Substation to Munitons	$1,850.0	Operation & Maintenance (3400)	Sustainment (***78)
MOUNTAIN HOME AIR FORCE BASE	Repair Airfield Stadium Lighting	$1,101.0	Operation & Maintenance (3400)	Sustainment (***78)
MOUNTAIN HOME AIR FORCE BASE	Repair Well #6	$2,999.0	Operation & Maintenance (3400)	Sustainment (***78)
MOUNTAIN HOME AIR FORCE BASE	Taxiway A Repair	$2,600.0	Operation & Maintenance (3400)	Sustainment (***78)
MOUNTAIN HOME AIR FORCE BASE	MAINTAIN SLABS, B RAMP (Phase 1 of 8)	$1,907.0	Operation & Maintenance (3400)	Sustainment (***78)
MOUNTAIN HOME AIR FORCE BASE	MAINTAIN SLABS, B RAMP (Phase 2 of 8)	$2,097.0	Operation & Maintenance (3400)	Sustainment (***78)
NELLIS AIR FORCE BASE	RPR TAXIWAY B LOLA	$1,500.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
NELLIS AIR FORCE BASE	RPR BASE FIRE REPORTING SYS	$800.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
NELLIS AIR FORCE BASE	RPR MAIN APRON ROWS 42-44	$3,000.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
NELLIS AIR FORCE BASE	INST HiX UNDERWING SYS B-270	$1,200.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
NELLIS AIR FORCE BASE	REPLACE WELL #2 NELLIS AFB	$800.0	Operation & Maintenance (3400)	Sustainment (***78)
NELLIS AIR FORCE BASE	RPR WATER TANKS	$1,500.0	Operation & Maintenance (3400)	Sustainment (***78)
NELLIS AIR FORCE BASE	RPR TAXIWAY F	$2,200.0	Operation & Maintenance (3400)	Sustainment (***78)
NEW ORLEANS NAS ANG	Rep Communications Electronic Training Facility	$1,400.0	Operation & Maintenance (3840)	Sustainment (***78)
OFFUTT AIR FORCE BASE	RPR FUEL SYSTMS,EMERG GEN,B518	$1,200.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
OFFUTT AIR FORCE BASE	FIRE PRTCTN EXT DIST, B301	$1,600.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
OFFUTT AIR FORCE BASE	RPR FIRE PRTCTN INT DIST MBB, B301	$1,159.8	Operation & Maintenance (3400)	Restoration & Modernization (***76)
OFFUTT AIR FORCE BASE	RPR GAS LINES & VALVES, BASEWIDE	$750.0	Operation & Maintenance (3400)	Sustainment (***78)
OFFUTT AIR FORCE BASE	RPR ROOF E-4 Hangar, B565	$850.0	Operation & Maintenance (3400)	Sustainment (***78)
OSAN AIR BASE	INSTALL FIRE PROTECTION SYSTEM - FUELS MAINT DOCK	$1,300.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
OSAN AIR BASE	AFFF AUTO FIRE SUPPRE IN HANGAR #4, B1732	$1,028.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
OSAN AIR BASE	INST FIRE PROT SYS IN AIRCRAFT SHELTER	$1,150.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
OSAN AIR BASE	M/R DIAMOND C & 5th RS APRON	$1,000.0	Operation & Maintenance (3400)	Sustainment (***78)
PATRICK AIR FORCE BASE	RPR DOCK 600, 601, 602, 604, 304, & CHEVRON PARK	$800.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
PATRICK AIR FORCE BASE	FILL/GRADE DRAINAGE, AIRFIELD	$1,000.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
PATRICK AIR FORCE BASE	MILL AND OVERLAY 02/20	$1,662.0	Operation & Maintenance (3400)	Sustainment (***78)
PEASE INTERNATIONAL TRADEPORT	Repair Fuel Cell - Fire System (Bldg 253)	$1,000.0	Operation & Maintenance (3840)	Sustainment (***78)
PEASE INTERNATIONAL TRADEPORT	Repair Hangar Fire Suppression System, Bldg 254	$2,300.0	Operation & Maintenance (3840)	Sustainment (***78)
PETERSON AIR FORCE BASE	REPAIR APRONS, PH2B	$1,200.0	Operation & Maintenance (3400)	Sustainment (***78)
PITTSBURGH IAP ARS	Repair Communications, Bldg 405	$866.0	Operation & Maintenance (3740)	Sustainment (***78)
POPE AIR FORCE BASE	RPR ELECT DIST, FORTRESS, SURVEYOR	$1,564.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
PORTLAND INTERNATIONAL AIRPORT	Rep Doors- Aircraft Maint Hngr	$950.0	Operation & Maintenance (3840)	Sustainment (***78)
PRAIA DA VICTORIA DOCK ANNEX	Repair Breakwater System, Phase 4	$21,600.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
QUONSET STATE AIRPORT ANG	Repair Fuel Cell Hangar, Bldg 8	$1,700.0	Operation & Maintenance (3840)	Restoration & Modernization (***76)
RAF CROUGHTON	REPLACE ROOF& REPAIR EXTERIOR, SATCOM	$800.0	Operation & Maintenance (3400)	Sustainment (***78)
RAF CROUGHTON	REPLACE ROOF MAIN COMMUNICATION BLDG	$1,500.0	Operation & Maintenance (3400)	Sustainment (***78)
RAF CROUGHTON	REPAIR INTERIOR OF DORMITORY	$900.0	Operation & Maintenance (3400)	Sustainment (***78)
RAF FAIRFORD	REPAIR HANGAR (1196)	$3,600.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
RAF FAIRFORD	REPAIR HANGAR	$10,900.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
RAF FAIRFORD	REPAIR AGE SHOP	$3,450.0	Operation & Maintenance (3400)	Sustainment (***78)
RAF FAIRFORD	REPAIR OFFICES VMS	$800.0	Operation & Maintenance (3400)	Sustainment (***78)
RAF FAIRFORD	REPAIR CONTROL TOWER	$750.0	Operation & Maintenance (3400)	Sustainment (***78)

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RAF FAIRFORD	REPAIR AIRCRAFT HARDSTANDS (SOUTH)	$890.0	Operation & Maintenance (3400)	Sustainment (***78)
RAF FAIRFORD	MAINTAIN/REPAIR APRONS 1-8	$1,400.0	Operation & Maintenance (3400)	Sustainment (***78)
RAF FAIRFORD	REP DORMITORIES	$1,400.0	Operation & Maintenance (3400)	Sustainment (***78)
RAF FELTWELL	REPAIR BOILER/HEATING MAINS BLDG 39	$800.0	Operation & Maintenance (3400)	Sustainment (***78)
RAF LAKENHEATH	REPAIR FIRE PROTECTION SYSTEM (BLDG 1005)	$1,340.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
RAF LAKENHEATH	REPAIR DORMITORY 941	$4,335.3	Operation & Maintenance (3400)	Restoration & Modernization (***76)
RAF LAKENHEATH	REPAIR / UPGRADE DORMITORY 943	$4,440.5	Operation & Maintenance (3400)	Restoration & Modernization (***76)
RAF LAKENHEATH	REPAIR FIRE SUPPRESSION SYSTEM, HANGAR 7	$3,710.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
RAF LAKENHEATH	REPAIR DORMITORY 946	$4,546.1	Operation & Maintenance (3400)	Restoration & Modernization (***76)
RAF LAKENHEATH	REPAIR IN-TRANS HARDSTANDS	$2,200.0	Operation & Maintenance (3400)	Sustainment (***78)
RAF LAKENHEATH	REPAIR BASE PIPELINE	$1,500.0	Operation & Maintenance (3400)	Sustainment (***78)
RAF LAKENHEATH	REPAIR SANITARY SEWER Ph 1	$1,500.0	Operation & Maintenance (3400)	Sustainment (***78)
RAF LAKENHEATH	REPAIR STORM WATER SYSTEM Ph 1	$1,500.0	Operation & Maintenance (3400)	Sustainment (***78)
RAF LAKENHEATH	REPAIR VICTOR TAXIWAY HARDSTANDS	$4,555.6	Operation & Maintenance (3400)	Sustainment (***78)
RAF LAKENHEATH	REPAIR RUNWAY	$4,500.0	Operation & Maintenance (3400)	Sustainment (***78)
RAF LAKENHEATH	REPAIR POROUS FRICTION COURSE 06 END	$3,500.0	Operation & Maintenance (3400)	Sustainment (***78)
RAF LAKENHEATH	REPAIR SANITARY SEWER Ph 2	$2,500.0	Operation & Maintenance (3400)	Sustainment (***78)
RAF LAKENHEATH	REPAIR SANITARY SEWER Ph 3	$1,000.0	Operation & Maintenance (3400)	Sustainment (***78)
RAF LAKENHEATH	REPAIR BOILER PLANT, BLDG 931	$800.0	Operation & Maintenance (3400)	Sustainment (***78)
RAF LAKENHEATH	REPAIR AIRFIELD PAVEMENT, PAS 40-42	$2,500.0	Operation & Maintenance (3400)	Sustainment (***78)
RAF MILDENHALL	RPR MAINTENANCE HANGAR B538	$3,500.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
RAF MILDENHALL	RPR BUILDING, B725	$3,250.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
RAF MILDENHALL	REPAIR TAXIWAY CHARLIE SOUTH	$1,600.0	Operation & Maintenance (3400)	Sustainment (***78)
RAF MOLESWORTH	REPAIR WATER MAINS	$900.0	Operation & Maintenance (3400)	Sustainment (***78)
RAF WELFORD AMMO STOR AREA	REPAIR WATER DISTRIBUTION SYSTEM	$895.0	Operation & Maintenance (3400)	Sustainment (***78)
RAF WELFORD AMMO STOR AREA	REPAIR WATER MAINS	$1,000.0	Operation & Maintenance (3400)	Sustainment (***78)
RAMSTEIN AIR BASE	REPAIR AIR OPERATIONS CENTER	$1,300.0	Operation & Maintenance (3400)	Sustainment (***78)
RANDOLPH AIR FORCE BASE	Additional Approach Light Towers and Strobes E Runway North	$1,400.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
RANDOLPH AIR FORCE BASE	RPR/RPL E/W SWITCHING STATIONS	$2,000.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
RANDOLPH AIR FORCE BASE	FIRE PROTECTION SYSTEM, H5	$3,100.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
RANDOLPH AIR FORCE BASE	RPR HVAC E DORM B861-863 (QOL)	$1,500.0	Operation & Maintenance (3400)	Sustainment (***78)
RENO TAHOE INTERNATIONAL AIRPORT	Repair Maintenance Hangar Bldg 9	$6,300.0	Operation & Maintenance (3840)	Sustainment (***78)
RICKENBACKER AIR NATIONAL GUARD BASE	Renovate Vehicle Maintenance Facility	$1,100.0	Operation & Maintenance (3840)	Restoration & Modernization (***76)
RICKENBACKER AIR NATIONAL GUARD BASE	Repair Fire Prot Pumphouse and Replace Water Storage	$1,300.0	Operation & Maintenance (3840)	Restoration & Modernization (***76)
ROBINS AIR FORCE BASE	RPR CONDENSATE LINE, 5th STREET	$1,500.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
ROBINS AIR FORCE BASE	RPR/RPL DIESEL FIRE PUMPS ,B/95	$750.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
ROBINS AIR FORCE BASE	RPR EXTG 25 METER FIRING RNG	$4,300.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
ROBINS AIR FORCE BASE	RPR/UPGRD PLNT ELECT SYS, IWTP, B/141	$750.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
SALT LAKE CITY INTERNATIONAL AIRPORT ANG	Repr South A/C Pkng Apron	$4,100.0	Operation & Maintenance (3840)	Sustainment (***78)
SAVANNAH INTERNATIONAL AIRPORT	Renovate CRTC Hangar, Building 199	$6,900.0	Operation & Maintenance (3840)	Sustainment (***78)
SCHRIEVER AIR FORCE BASE	Replace Electric Cables Basewide, 7 Phases	$7,745.1	Operation & Maintenance (3400)	Sustainment (***78)
SCHRIEVER AIR FORCE BASE	REPLACE 3 GENERATORS	$3,000.0	Operation & Maintenance (3400)	Sustainment (***78)
SCHRIEVER AIR FORCE BASE	REPLACE PRIMARY BASE BOILERS, B600	$1,300.0	Operation & Maintenance (3400)	Sustainment (***78)
SCOTT AIR FORCE BASE	RENOVATE ELECTRICAL, PHASE 3	$1,500.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
SCOTT AIR FORCE BASE	Repair Runway 14R-32L	$2,000.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
SCOTT AIR FORCE BASE	BASEWIDE ELECTRICAL RENOVATION, PHASE 2	$2,300.0	Operation & Maintenance (3400)	Sustainment (***78)
SCOTT AIR FORCE BASE	REPLACE BASE WATER LINE	$8,000.0	Operation & Maintenance (3400)	Sustainment (***78)
SELFRIDGE ANG BASE	Repair CE Roads & Grounds Facility - Building 118	$1,790.0	Operation & Maintenance (3840)	Sustainment (***78)
SEMBACH ADMIN ANNEX (WING HQ)	ADD KITCHENETTES	$967.0	Operation & Maintenance (3400)	Sustainment (***78)
SEMBACH ADMIN ANNEX (WING HQ)	REPLACE WATERLINE	$1,200.0	Operation & Maintenance (3400)	Sustainment (***78)
SEMBACH ADMIN ANNEX (WING HQ)	Renovate Dorm	$3,500.0	Operation & Maintenance (3400)	Sustainment (***78)
SEMBACH ADMIN ANNEX (WING HQ)	RELACE MAIN WATER LINES	$1,200.0	Operation & Maintenance (3400)	Sustainment (***78)
SEYMOUR JOHNSON AIR FORCE BASE	REPAIR TAXIWAY BRAVO HOLDING APRON	$1,600.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
SEYMOUR JOHNSON AIR FORCE BASE	REPAIR TWY ALPHA PAVEMENTS (WEST SIDE)	$3,981.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)

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Installation	Title	PA ($000)	Account (Appropriation) See Note*	Subaccount (Program Element)
SEYMOUR JOHNSON AIR FORCE BASE	REPAIR CES SHOPS, HVAC AND FUELS	$750.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
SEYMOUR JOHNSON AIR FORCE BASE	Repr Fire Suppression - B4909	$900.0	Operation & Maintenance (3740)	Restoration & Modernization (***76)
SEYMOUR JOHNSON AIR FORCE BASE	REPAIR FUEL CELL ACCESS APRON PAVEMENT	$1,867.3	Operation & Maintenance (3400)	Sustainment (***78)
SEYMOUR JOHNSON AIR FORCE BASE	REPAIR ALERT FACILITY PAVEMENTS AT BLDG 5015	$1,058.0	Operation & Maintenance (3400)	Sustainment (***78)
SEYMOUR JOHNSON AIR FORCE BASE	REPAIR WARM-UP APRON, TAXIWAY G	$900.0	Operation & Maintenance (3400)	Sustainment (***78)
SEYMOUR JOHNSON AIR FORCE BASE	REPAIR TAXIWAY ALPHA EAST END	$1,007.0	Operation & Maintenance (3400)	Sustainment (***78)
SEYMOUR JOHNSON AIR FORCE BASE	Repair Taxiway Alpha Pavement Phase III	$994.0	Operation & Maintenance (3400)	Sustainment (***78)
SEYMOUR JOHNSON AIR FORCE BASE	REPAIR ALERT TWY HOTEL PAVEMENTS	$1,427.3	Operation & Maintenance (3400)	Sustainment (***78)
SEYMOUR JOHNSON AIR FORCE BASE	REPAIR RUNWAY PAVEMENTS	$2,000.0	Operation & Maintenance (3400)	Sustainment (***78)
SEYMOUR JOHNSON AIR FORCE BASE	REPAIR RUNWAY SLABS, 26 END	$2,800.0	Operation & Maintenance (3400)	Sustainment (***78)
SEYMOUR JOHNSON AIR FORCE BASE	REPAIR RUNWAY PAVEMENTS	$4,180.0	Operation & Maintenance (3400)	Sustainment (***78)
SEYMOUR JOHNSON AIR FORCE BASE	REPAIR TAXIWAY A PAVEMENTS	$1,139.0	Operation & Maintenance (3400)	Sustainment (***78)
SEYMOUR JOHNSON AIR FORCE BASE	REPAIR RUNWAY PAVEMENTS	$4,120.0	Operation & Maintenance (3400)	Sustainment (***78)
SEYMOUR JOHNSON AIR FORCE BASE	REPAIR EAST WARM UP APRON	$1,000.0	Operation & Maintenance (3400)	Sustainment (***78)
SEYMOUR JOHNSON AIR FORCE BASE	REPAIR AFFF SYSTEM, BLDG 4522	$750.0	Operation & Maintenance (3400)	Sustainment (***78)
SHAW AIR FORCE BASE	Repair HVAC/Fire Sprinklers B1207	$1,400.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
SHAW AIR FORCE BASE	REPR PWR LINES MOTOR POOL	$1,115.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
SHAW AIR FORCE BASE	REPR BASE OPERATIONS B615	$950.0	Operation & Maintenance (3400)	Sustainment (***78)
SHEPPARD AIR FORCE BASE	FOL-Repair Civil Eng Training Bldg 1921 - 1 of 3	$1,000.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
SHEPPARD AIR FORCE BASE	Repair Civil Eng Training Bldg 1921 - 2 of 3	$1,000.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
SHEPPARD AIR FORCE BASE	Repair Civil Eng Training Bldg 1921 - 3 of 3	$1,000.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
SHEPPARD AIR FORCE BASE	Repair Exterior Hangar 1020	$975.4	Operation & Maintenance (3400)	Restoration & Modernization (***76)
SHEPPARD AIR FORCE BASE	Repair Exterior Training Hangar 1060	$760.3	Operation & Maintenance (3400)	Restoration & Modernization (***76)
SHEPPARD AIR FORCE BASE	(AOB) Repair Airfield Drainage Phase 2	$765.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
SHEPPARD AIR FORCE BASE	FOL-Inst Fire Suppression Sys Tech Trng Bld 1040, 1080, 1090	$1,026.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
SHEPPARD AIR FORCE BASE	Repair Tech Trng Hangar Doors Multiple Facilities	$865.0	Operation & Maintenance (3400)	Sustainment (***78)
SHEPPARD AIR FORCE BASE	FOL-IDIQ-Replace Roof Training Bldg 920	$1,100.0	Operation & Maintenance (3400)	Sustainment (***78)
SHEPPARD AIR FORCE BASE	SR-Repair Consolidated Dispatch/Emergency Ops Center B920	$806.0	Operation & Maintenance (3400)	Sustainment (***78)
SKY HARBOR INTERNATIONAL AIRPORT	Repair 107th Air Control Squadron Training Facility, 110	$3,850.0	Operation & Maintenance (3840)	Restoration & Modernization (***76)
SKY HARBOR INTERNATIONAL AIRPORT	Repair 107th ACS Radar Maintenance Facility, Bldg 112	$1,600.0	Operation & Maintenance (3840)	Sustainment (***78)
SPANGDAHLEM AIR BASE	REPAIR HANGAR 2	$3,500.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
SPANGDAHLEM AIR BASE	REPAIR PAVEMENT, TAXIWAY D	$1,000.0	Operation & Maintenance (3400)	Sustainment (***78)
SPANGDAHLEM AIR BASE	REPAIR HIGH VOLTAGE LINES	$1,750.0	Operation & Maintenance (3400)	Sustainment (***78)
STEWART INTERNATIONAL AIRPORT	Repair Maintenance Complex (B107)	$1,350.0	Operation & Maintenance (3840)	Sustainment (***78)
STEWART INTERNATIONAL AIRPORT	Repair Fuel Cell Hangar (B102)	$2,000.0	Operation & Maintenance (3840)	Sustainment (***78)
SUWON AIR BASE	REPAIR HVAC PIPE LINES	$750.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
TAEGU AIR BASE	REPAIR SUBSTATION TRANSFORMER	$1,000.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
THULE AIR BASE	REPAIR TAXIWAYS, PH3	$5,000.0	Operation & Maintenance (3400)	Sustainment (***78)
TINKER AIR FORCE BASE	REPAIR ALL FIRE ALARM SYSTEMS TO NARROW BAND	$1,700.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
TINKER AIR FORCE BASE	REPAIR PAVEMENT, MIDFIELD, RUNWAY 12/30	$3,500.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
TINKER AIR FORCE BASE	REPAIR PAVEMENT; TXWY B FROM RNWY 17/35 TO TXWY G	$4,300.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
TINKER AIR FORCE BASE	Repair / Renovate / Modernize, B/1067	$1,400.0	Operation & Maintenance (3740)	Restoration & Modernization (***76)
TINKER AIR FORCE BASE	REPAIR SUBSTATION #4 DUCT BANK FOR BASE 12.5 KV LOOP	$1,300.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
TINKER AIR FORCE BASE	REPAIR MAC RAMP	$2,100.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
TONOPAH AUXILIARY AIRFIELD ANNEX	Repair Electrical Power Grid	$1,800.0	Operation & Maintenance (3400)	Sustainment (***78)
TRAVIS AIR FORCE BASE	REPLACE ELECTRICAL DISTRIBUTION SYSTEM SUBSTATION-A	$20,000.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
TRAVIS AIR FORCE BASE	REPAIR 200 RAMP	$8,000.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
TRAVIS AIR FORCE BASE	RPR 500 RAMP SHOULDERS	$2,600.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
TRAVIS AIR FORCE BASE	REPLACE WATER PIPELINE FROM AREA F TO SUISUN DOCK	$6,100.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
TRAVIS AIR FORCE BASE	REPAIR RUNWAY 21R/03L KEEL SECTION	$4,700.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
TRAVIS AIR FORCE BASE	REPLACE WATER MAIN SDWA	$2,100.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
TRAVIS AIR FORCE BASE	REPAIR TXWY LIGHTS, D,G,H,M,N,R,T	$4,000.0	Operation & Maintenance (3400)	Sustainment (***78)
TRUAX FIELD	Alter 1212 for Security Forces	$920.0	Operation & Maintenance (3840)	Sustainment (***78)
TUCSON INTERNATIONAL AIRPORT	Repair Maint Hangar, B. 10	$3,400.0	Operation & Maintenance (3840)	Sustainment (***78)

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Installation	Title	PA ($000)	Account (Appropriation) See Note*	Subaccount (Program Element)
TYNDALL AIR FORCE BASE	RPR FIRE DELGE SYS,HNG 1,2,3,5	$3,250.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
TYNDALL AIR FORCE BASE	REPAIR TAXIWAYS, SHOULDERS, APRON, AND OVERRUNS	$4,000.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
TYNDALL AIR FORCE BASE	REPLACE PORTIONS OF TAXIWAY "P"	$4,400.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
TYNDALL AIR FORCE BASE	REPAIR HVAC IN AIRMEN'S DORMS , BLDG 1150-1156	$3,200.0	Operation & Maintenance (3400)	Sustainment (***78)
VANDENBERG AIR FORCE BASE	CORRECT FIRE & ELECTRICAL SAFETY DEFICIENCIES AT HYDRAZINE	$844.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
VOGELWEH FAMILY HOUSING ANNEX	RENOVATE DORMITORY	$1,500.0	Operation & Maintenance (3400)	Sustainment (***78)
VOGELWEH FAMILY HOUSING ANNEX	REPAIR WATER PLANT #1	$1,724.3	Operation & Maintenance (3400)	Sustainment (***78)
VOLK FIELD	Repair Warmup/Holding Pavement	$2,900.0	Operation & Maintenance (3840)	Sustainment (***78)
WESTOVER ARB	Conv Elec Cir 8, 4.8 To 13.8kv	$2,444.9	Operation & Maintenance (3740)	Restoration & Modernization (***76)
WESTOVER ARB	Conv Elec Cir 3, 4.8 To 13.8kv	$2,642.7	Operation & Maintenance (3740)	Restoration & Modernization (***76)
WESTOVER ARB	Conv Elec Cir 4, 4.8 To 13.8kv	$2,025.5	Operation & Maintenance (3740)	Restoration & Modernization (***76)
WESTOVER ARB	Conv Elec Cir 1, 4.8 To 13.8kv	$2,700.0	Operation & Maintenance (3740)	Restoration & Modernization (***76)
WESTOVER ARB	Conv Elec Cir 2, 4.8 To 13.8kv	$1,740.0	Operation & Maintenance (3740)	Restoration & Modernization (***76)
WESTOVER ARB	Conv Elec Cir 7, 4.8 To 13.8kv	$1,196.6	Operation & Maintenance (3740)	Restoration & Modernization (***76)
WESTOVER ARB	Regrade Airfield	$4,850.0	Operation & Maintenance (3740)	Restoration & Modernization (***76)
WESTOVER ARB	Reconstruct Taxiway "F"	$950.0	Operation & Maintenance (3740)	Restoration & Modernization (***76)
WESTOVER ARB	Secure Base Utility Manholes	$750.0	Operation & Maintenance (3740)	Restoration & Modernization (***76)
WESTOVER ARB	Install Fire Sprinkler System In Multi Facilities	$1,500.0	Operation & Maintenance (3740)	Restoration & Modernization (***76)
WESTOVER ARB	Repair C-5 Ramp Perimeter Drainage	$2,000.0	Operation & Maintenance (3740)	Restoration & Modernization (***76)
WESTOVER ARB	Emergency Repair Electric Circuits 2,3,4 & 7	$4,531.5	Operation & Maintenance (3740)	Restoration & Modernization (***76)
WESTOVER ARB	Repair Comm Ducts	$4,500.0	Operation & Maintenance (3740)	Restoration & Modernization (***76)
WESTOVER ARB	Repair Avionics Facility, Bldg. 2426	$1,842.0	Operation & Maintenance (3740)	Restoration & Modernization (***76)
WESTOVER ARB	Repair Snow Control Offices	$1,474.7	Operation & Maintenance (3740)	Restoration & Modernization (***76)
WESTOVER ARB	Pull-Thru Hangar Doors	$2,966.6	Operation & Maintenance (3740)	Sustainment (***78)
WESTOVER ARB	Repair Taxiway "L"	$1,517.6	Operation & Maintenance (3740)	Sustainment (***78)
WESTOVER ARB	Sustainment Base Hangar 7087, North Side P-2	$1,232.9	Operation & Maintenance (3740)	Sustainment (***78)
WESTOVER ARB	Sustainment Base Hangar South Side	$1,232.9	Operation & Maintenance (3740)	Sustainment (***78)
WESTOVER ARB	Replace Boilers, Multiple Facilities	$827.8	Operation & Maintenance (3740)	Sustainment (***78)
WESTOVER ARB	Replace Boilers, Multiple Facilities	$827.7	Operation & Maintenance (3740)	Sustainment (***78)
WESTOVER ARB	Repair Roof, Hangar 1 Bldg 7087	$2,784.8	Operation & Maintenance (3740)	Sustainment (***78)
WESTOVER ARB	Repair Roof, Hangar 9, Bldg 7071	$1,844.2	Operation & Maintenance (3740)	Sustainment (***78)
WESTOVER ARB	Repair Roofs Hangars 3,5, & 7	$2,855.0	Operation & Maintenance (3740)	Sustainment (***78)
WESTOVER ARB	Repair Roofs Various B1204, 1408, 1310, & 2426	$1,146.9	Operation & Maintenance (3740)	Sustainment (***78)
WESTOVER ARB	Maintain Stair Halls Hangars 1,3,5,7 & 9	$1,000.0	Operation & Maintenance (3740)	Sustainment (***78)
WESTOVER ARB	Mill And Overlay 05/23 Runway	$2,750.0	Operation & Maintenance (3740)	Sustainment (***78)
WESTOVER ARB	Repair Roof, DC Hangar, B 7000	$3,177.1	Operation & Maintenance (3740)	Sustainment (***78)
WESTOVER ARB	Repair Aircraft Maintance Shops H 7	$2,296.1	Operation & Maintenance (3740)	Sustainment (***78)
WESTOVER ARB	Repair A/C Parking Ramp	$1,308.1	Operation & Maintenance (3740)	Sustainment (***78)
WHITEMAN AIR FORCE BASE	REPAIR SOUTH WATER TOWER - FAC 1300	$785.0	Operation & Maintenance (3400)	Sustainment (***78)
WILLOW GROVE AIR RESERVE STATION	Repair Communications-Electronics Training, B354	$2,800.0	Operation & Maintenance (3840)	Sustainment (***78)
WRIGHT PATTERSON AIR FORCE BASE	RPL CIRCULATING PUMPS HTHW PLANT * (HP-2)	$1,132.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
WRIGHT PATTERSON AIR FORCE BASE	RPL WATER SYS BTW 10TH & 5TH ST * (W-1)	$2,500.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
WRIGHT PATTERSON AIR FORCE BASE	CONSOLIDATE DMATS	$1,000.0	Operation & Maintenance (3400)	Restoration & Modernization (***76)
WRIGHT PATTERSON AIR FORCE BASE	RPL TRANSFORMERS - SUBSTATION B (E-8)	$860.0	Operation & Maintenance (3400)	Sustainment (***78)
WRIGHT PATTERSON AIR FORCE BASE	RPL STEAM LINES PIT S-35 TO S-173 AND 10TH ST (SD-1)	$2,100.0	Operation & Maintenance (3400)	Sustainment (***78)
WRIGHT PATTERSON AIR FORCE BASE	RPL DIRECT BURIED STEAM LINES ALONG SKEEL AVE (SD-4)	$1,800.0	Operation & Maintenance (3400)	Sustainment (***78)
WRIGHT PATTERSON AIR FORCE BASE	RPL 24" SANITARY FORCE MAIN - AREA A/C (WW-2)	$2,500.0	Operation & Maintenance (3400)	Sustainment (***78)
WRIGHT PATTERSON AIR FORCE BASE	RPL FAILED SCADA SYSTEM (E-3)	$975.0	Operation & Maintenance (3400)	Sustainment (***78)
WRIGHT PATTERSON AIR FORCE BASE	RPL FAILING BOILER TUBES - HTHW PLANT (HP-1)	$750.0	Operation & Maintenance (3400)	Sustainment (***78)
WRIGHT PATTERSON AIR FORCE BASE	RPL WINDOW SYSTEM VEH MNT SHOP/STORAGE* 30013	$930.0	Operation & Maintenance (3400)	Sustainment (***78)
WRIGHT PATTERSON AIR FORCE BASE	RPL CROSS CONNECT STM LINES F20027 TO S-227 * (SD-2)	$1,400.0	Operation & Maintenance (3400)	Sustainment (***78)
WRIGHT PATTERSON AIR FORCE BASE	RPR/RPL HEATING MAINS PH I - AREA A (SD-3)	$2,500.0	Operation & Maintenance (3400)	Sustainment (***78)

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Congressional Report

Air Force Personnel Reductions

March 2007

U.S. AIR FORCE

Integrity — Service — Excellence

Index

Introduction

Senate Appropriations Committee Request

The Senate Appropriations Committee (SAC), in Senate Report 109-292 to accompany HR 5631, the "Department of Defense Appropriations Act, 2007," page 53, requested that the Air Force provide a report on planned personnel reductions. Specifically, the Committee stated:

> Air Force Personnel Reductions.
> *—The Committee is concerned about the impact of planned Air Force reductions to military personnel, civilian personnel, and contractor support. Thus, the Committee requests the Secretary of the Air Force to provide a report no later than January 31, 2007 that describes the planned reductions, their rationale, and their impact on Air Force major commands, agencies and activities.*

The SAC request, however, did not make it into the final version of the "Department of Defense Appropriations Act, 2007" as passed by both the Senate and House, or the Conference report for that Act. Nonetheless, the Air Force believes such a report would be beneficial to the relevant defense and appropriations committees, and is therefore submitting such a report

Roadmap

Manpower end strength and contractor support reductions programmed for the Air Force result from multiple causes. The single largest driver of programmed reductions is the December 2005 decision to reduce 40,000 Active Duty, Guard, Reserve and civilian Full-time Equivalents (FTEs) and contractor support by $6.2 Billion to help pay for recapitalization and modernization of the AF air, space, and cyberspace systems. The strategic and resource environment has continued to evolve since the 2005 decision. This report describes why the reductions were deemed necessary at the time, the programmed changes by category, the evolved reduction methodology, force shaping actions to effect the cuts, contractor support reductions, impacts on Regular and Reserve Components, and closes with a discussion regarding Air Force manpower requirements for the future.

Executive Summary

This report describes why the proposed reductions were deemed necessary during the Fiscal Year 2007 President's Budget (PB) submission, the programmed manpower changes by category, the evolved reduction methodology, force shaping actions to effect the cuts, contractor reductions, impacts on Regular and Reserve Component, and closes with a discussion on Air Force manpower requirements for the future.

Why Take the Cuts? Missions drive budgets, and our mission priorities are clear: winning the Global War on Terrorism...and preparing for the next war; developing and caring for our Airmen...to maintain our competitive advantage; and modernizing and recapitalizing our aircraft and equipment...to meet 21st century challenges. Budgetary pressures forced difficult choices to ensure that the AF would maintain the right balance across our personnel, infrastructure, readiness and investment portfolios – while fighting a long war on terrorism and focusing on recapitalizing aging, legacy "Cold War" hardware to be ready for an uncertain future. To fly, fight, and win in the air, space, and cyberspace domains and provide combatant commanders the spectrum of expeditionary, joint, warfighting capabilities they need, the Air Force needs more resources, and without those resources, is compelled to providing a portfolio that balances risk. For the past seven years, modernization and recapitalization has been the target of choice for mitigating reduced buying power, dramatically reducing our domination of the battlefield. Without a fundamental shift in strategy the ability of our infrastructure to meet future calls to action was problematic. The decision to reduce manpower sought to halt the intolerable risk of continued deferment of fielding modern battle systems, shifting more risk to the increasingly costly yet precious personnel accounts, and in turn, to our Total Force Airmen – the military and civilian heroes that comprise our Air Force and play as interdependent warriors on the joint team.

Changes by Category. In Fiscal Year (FY) 2005, prior to our latest round of reductions, we had 700,000 people in the total force; that breaks out to approximately 354,000 Active Duty, 182,000 Guard and Reserve, and 164,000 civilians. If planned reductions (plus all other program content) continue as they were presented in the FY 2008 President's Budget (PB) submission, by FY 2009 the Air Force would fall to 313,000 Active Duty, 174,000 Guard and Reserve, and 169,000 civilians (civilian growth occurs due to military-to-civilian conversions). Active Duty strength is heading towards levels very near the post-World War II drawdown low in 1947.

Reduction Methodology. Developing a reduction methodology required the Air Force to comprehend that this "is not our fathers' Air Force." Indeed, we are building a different Air Force, not "the same, but smaller." Reductions are intrinsically linked to a spectrum of transformational initiatives. The original Air Force plan had three key components: 1) reduction of legacy systems; 2) process efficiencies; and 3) organizational efficiencies. These three components had potential to generate significant manpower savings; however, the aggressive reduction plan conceived in November-December of 2005 became problematic to implement. Therefore, a follow-on "Value Metric Model" strategy was created to define the necessary reductions in detail during the FY 08 PB. The refined plan's centerpiece was development of a Value Metric Model and a process that involved interplay between the Air Force functional staffs and the commanders of major commands and activities within the field. Employing the model, plus retaining many features of the initial plan, allowed the Service to define the bulk of required reductions. The methodology factored in CONUS-to-Overseas rotation factors, DOPMA limits upon grades, expeditionary and contingency demands, and Air Force Specialty (AFS) sustainability. The Air Force sought to adjust Air Force Specialties to "balance stress" where practical. According to the framework, billets more near to directly fulfilling the combatant commanders' requirements to execute operations were least impacted; those furthest from that objective were generally more at risk.

Force Shaping. Force Shaping Programs are currently on target. Current/future programs Voluntary Separation Pay (VSP), Force Shaping Boards (FSB), Selective Early Retirement Boards (SERB), Reductions in Force (RIF), Date of Separation (DOS) Rollback, Limited Active Duty Service Commitment (LADSC) Waivers) will enable us to reach goals. Through proactive Total Force management, the personnel reductions associated with our transformation will induce the Air Force to further streamline organizational alignments and devise innovative process efficiencies. These initiatives will not only help pay for our recapitalization, but will improve the reaction times of our forces with reduced layering of decision processes, more specialized warfighting organizations, and more responsive command and control procedures. Changes of the magnitude we are facing come with a degree of uncertainty and difficulty for some of our people. We are making every effort to use voluntary measures to shape the force.

Contractor Reductions. In addition to the organic manpower reductions described throughout this report, the AF planned a reduction of approximately $7 Billion across the Future Years Defense Program (FYDP) in our contractor support to meet the vision of transforming the Air Force into a leaner, more efficient organization. These reductions were distributed to the various Air Force organizations based on their reported or derived contractor support usage. The Air Force programmed this contractor support reduction starting at 12 percent in FY07 increasing to about 25 percent in FY09 to provide the time necessary to reengineer processes and allow for a structured reduction. Headquarters AF is working with our major commands, agencies and activities to manage this reduction to minimize impact to our outputs due to process redesign or improvements.

Impacts. When the Air Force grew during cold war times, and when it was reduced over 40 percent in the post-cold war environment, the mission, weapons systems, and manpower changes were closely and systematically linked together using manpower management engineering techniques; for the most part, manpower changes were linked directly to program content, and so too the necessary personnel life cycle actions. Planned reductions are being executed within a defined framework to spread acceptable risk, not to "get well" in any area. Support and Logistics Air Force career specialties sustain the brunt of the reductions. Headquarters organizations sustain an average 18 percent reduction from their pre-decisional baseline and field units at Wing level and below lose approximately ten percent of their funded manpower. The changes are so dramatic as to drive a "burning platform" approach facilitating the Air Force's efforts to fundamentally review and redefine the way we do business. Individuals and organizations across the Air Force face increased or intense steady-state mission demands, and depending upon their specialty, may be required to deploy with more frequency. The Air Force has sought to preserve capability to sustain deployed and contingency missions, while managing risk to home station missions. The Air Force continues to implement functional reengineering, reachback, Component Headquarters, and continuous process improvement strategies that transform our Service to meet present and future missions. Many functional communities are using a combination of these techniques to fundamentally reshape the way in which they perform the mission.

Future AF Manpower Requirements. In the FY 07 Program Budget Decision (PBD) 720, the Air Force reduced 40,000 Active Duty, Guard, Reserve and civilian Full-time Equivalents (FTEs) to help pay for recapitalization and modernization of the Air Force air, space, and cyberspace systems. This reduction is the largest driver of end strength changes to the Air Force during the program years. The strategic and resource environment has continued to evolve since the 2005 decision. Remaining end strength is projected to only be sufficient for a 78 combat wing force structure, while the most current Air Force vision to support combatant commanders requires manpower associated with an 86 wing structure. Adding eight combat wing equivalents would require an increase in total force end strength of 19,000 Active Duty and 2,700 Air Force Reserve billets. As the Army and Marine Corps significantly increase end strength, a positive adjustment to Air Force funded manpower requirements is essential to ensure air power is available to combatant commanders within the interdependent, Joint battlespace of today and tomorrow. As presently projected within the FY 08 PB, the AF will decline from 349,000 Airmen on Active Duty down to 311,000 by Fiscal Year 2013 unless resources are reprogrammed and related force shaping programs halted.

Report

Background

The Senate Appropriations Committee (SAC), in Senate Report 109-292 to accompany HR 5631, the "Department of Defense Appropriations Act, 2007," page 53, requested that the Air Force provide a report on planned personnel reductions. Specifically, the Committee stated:

> Air Force Personnel Reductions.
> *—The Committee is concerned about the impact of planned Air Force reductions to military personnel, civilian personnel, and contractor support. Thus, the Committee requests the Secretary of the Air Force to provide a report no later than January 31, 2007 that describes the planned reductions, their rationale, and their impact on Air Force major commands, agencies and activities.*

The SAC request, however, did not make it into the final version of the "Department of Defense Appropriations Act, 2007" as passed by both the Senate and House, or the Conference report for that Act. Nonetheless, the Air Force believes such a report would be beneficial to the relevant defense and appropriations committees, and is therefore submitting such a report

FY 07 President's Budget

During Development of the Fiscal Year (FY) 2007 President's Budget (PB) exercise, Program Budget Decision (PBD) 720, Air Force Transformation Flight Plan, 28 Dec 2005, included proposals to realign resources to assist the Air Force in transforming to "a more lethal, more agile, streamlined force with an increased emphasis on the warfighter." The submission addressed organizational and process efficiencies, manpower reductions, contractor support reductions and weapon system enhancement. Military End Strength/Full-Time Equivalent (FTE) and contractor support reductions were reduced as a means of shifting resources to achieve recapitalization priorities congruent with assigned missions within a very constrained budget top line. These reductions, which constitute the largest single cause for ongoing Air Force manpower reductions today, were at that time non-specific in nature and were laid in from FY 06 through 11.

The plan as first conceived was to harvest dollars for recapitalization and modernization via savings from retirement of legacy systems, implementing organizational efficiencies, driving significant process improvements to achieve two-thirds of the goal and taking an arbitrary reduction in end strength to provide the rest. Proposals included legacy force structure changes such as reducing the B-52 bomber fleet, a portion of C-21 aircraft, U-2 aircraft, and acceleration of F-117A Nighthawk retirement – many of which were not executed as proposed for various reasons. Similarly, some of the significant organizational proposals inherent in the resource realignment were found unexecutable. The Air Force has aggressively pursued organizational and process transformation, but these actions cannot in themselves produce the required capital. Since the die was cast, the Air Force had to find other ways to continue with the reductions to stay within budget and meet transformation objectives.

FY 08 Program Objective Memorandum

During the Fiscal Year 2008 Program Objective Memorandum (POM) exercise, the Air Force developed and proceeded with a revised methodology which established billet-level detail (content) to the bulk of FY 07 programmed reductions. Additional near-term program shortfalls required the Service to accelerate the FY 10-11 manpower and contactor support reductions for the Active Air Force into FY 09.

At this point, the Air Force developed a "Value Metric Model" to define reductions to the Active force. This method included a comprehensive strategy involving senior Air Force functional and Major Command leadership participation to achieve the necessary savings. The Value Model process targeted reductions to specific Air Force specialties after protecting combatant commander top demands for deployment and sustaining the global war on terror (GWOT). The methodology however sought protection of the deployable structure while managing risk to home station missions. The plan also virtually halted all initiatives to grow end strength to meet emerging missions. The initial and revised methodologies for achieving the mandated reductions are further explained in the following sections.

Why Take Manpower Reductions?

In short, the Air Force undertook significant personnel reductions to generate billions of dollars to reprogram towards essential air, space, and cyber systems recapitalization and modernization congruent with three key mission priorities. Air Force budget proposals are driven by overarching priorities, constrained within a prescribed budget top line:

> *Our priorities are clear:*
> *-- Winning the Global War on Terrorism...and preparing for the next war*
> *-- Developing and caring for our Airmen...to maintain our competitive advantage*
> *-- Modernizing and recapitalizing our aircraft and equipment...to meet 21st century challenges*
>
> *- Air Force Posture Statement*

First we must win the GWOT. Operation Enduring Freedom (OEF) has already been going on for longer than US involvement in World War II. This fact provides some deep perspective – and it appears that we as a nation are engaged in a Global War on Terror for the long haul. The USAF has been in Southwest Asia non-stop for 16 years since Operation Desert Storm. The Service has operated from forward bases, patrolling designated "no-fly" zones, while providing global airlift, operating and provisioning contingency bases, supplying relief, delivering comprehensive Command and Control, Intelligence, Surveillance and Reconnaissance (C2ISR) coverage and otherwise providing a spectrum of key capabilities for joint operations. We, along with many Soldiers, Sailors and Marines, never left—and that commitment has had an impact on our equipment.

Airmen are warfighters. Air Force Active Duty, Guard, Reserve, and Civilian Airmen are the Service's most valuable assets in fighting the GWOT and ensuring we are the world's dominant air, space, and cyberspace force. People – our Airmen, civilians, and yes, contractor support, are the greatest asset in our inventory, but also an expensive one. We have been compelled to make some very difficult choices with respect to our people. Fewer platforms that require fewer operators and maintainers are part of the equation. We are also eliminating peacetime-only positions and streamlining our organizations. At the same time, we want to improve the training of our Airmen. The bottom line is that we are trying to become a leaner, more flexible, and more capable force.

Modernization and recapitalization actions have significantly languished within the past decade, consecutively forced into to the budget "out years" while the Nation dealt with more immediate challenges. All the Services are experiencing problems with old equipment. Not only is our equipment getting older, but we are consuming it at rates higher than we planned. Procurement of essential systems is an expensive undertaking, but a necessary one. Energy costs have soared. The dilemma: how do we fund procurement within a DoD budget that is already approximately $500B, while in a time of war, amidst evolving Quadrennial Defense Review (QDR) and Base Realignment and Closure (BRAC) decisions? This question has been a quandary for all the Services.

Funding our priorities and effecting sweeping transformation within a highly constrained resource environment has posed considerable challenges, opportunities, and risks. The Secretary of the Air

Force charted a course to "fund transformation through...organizational efficiencies, reduction of legacy systems and manpower while sustaining GWOT and ongoing operations in support of the Joint Fight." These decisions have proven extremely difficult, and with a constrained fiscal reality, require leaders at all levels to assume certain risks.

As part of our Air Force Transformation, the Service is doing quite a bit with our people. We are extending Basic Military Training to 8.5 weeks, to teach them skills to defend an Air Base and set them up in an expeditionary operation. We are teaching Airmen self aid and buddy care so they can take care of each other when their bases take mortar fire or the truck they are driving hits an Improvised Explosive Device (IED). We are teaching language training and enhancing regional studies in our Air Command and Staff College, Air War College, and NCO Academy. We are consolidating Air Force Specialty codes to provide broader skill sets and enabling flexibility in GWOT and support of COCOM missions.

Personnel costs have increased roughly 57 percent over the last ten years. Meanwhile, the costs to operate an aging fleet are up 87 percent, while the amount of money available to OSD as measured in terms of percent of US Gross Domestic Product expended for defense is near the post-World War II level of less than 4 percent. Even with fewer aircraft today, as our machines get older, they get more expensive to fly. Parts wear out and mean time between failures decreases, driving increased maintenance hours per flying hour.

> *"We are facing increasing budgetary pressures...we will make the difficult choices to ensure that we maintain the right balance across our personnel, infrastructure, readiness and investment portfolios – while fighting a long war on terrorism and focusing on recapitalizing an aging, legacy "Cold War" Air Force for an uncertain future."*
>
> *– T. Michael Moseley, General, USAF, Chief of Staff, 7 June 2006*

Given a budgeting shortfall of approximately $20 Billion per year throughout the program, the Air Force has been compelled to make difficult decisions to optimize remaining dollars and remain within budget. The past seven years' "recapitalization holiday" coupled with dramatic increases in day-to-day operating costs led to a "lesser of evils" alternative to reduce manpower end strength by 40,000 full-time equivalents over a three-year period and nearly 25 percent of our contractor support baseline to generate dollars protecting the Air Force from failure in other areas. Current reductions as programmed generate approximately $18 Billion in savings from FY07-11. These funds were reprogrammed, based on the results of QDR 05 and combatant command demands for emerging capabilities, to continue AF recapitalization and modernization. These recapitalization and modernization actions remain imperative towards meeting COCOM expeditionary, joint, warfighting capabilities we need to fly, fight and win in the air, space, and cyberspace domains.

Changes by Category (Active/Civilian/ARC)

In Fiscal Year (FY) 2005, prior to our latest round of reductions, we had 700,000 people in the total force; that breaks out to approximately 354,000 Active Duty, 182,000 Guard and Reserve, and 164,000 civilians. If planned reductions (plus all other program content) continue as they were presented in the FY 2008 Program Objective Memorandum, by FY 2009 the Air Force would fall to 313,000 Active Duty, 174,000 Guard and Reserve, and 169,000 civilians (civilian growth occurs due to military-to-civilian conversions). A graphical display shows Active Duty strength heading towards levels very near the post-World War II drawdown low in 1947.

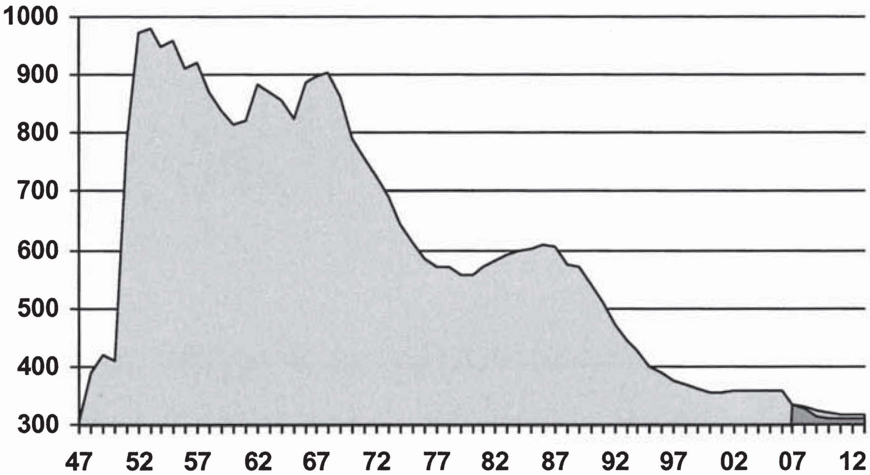

Figure 1: Actual AF Total Active Duty Military End Strength in Thousands, by Year

Throughout the program years, Air Force manpower force mix and levels are certainly not static, and there are many reasons for this. Changes to and between categories of Air Force manpower are driven by multiple factors, including the decision to reduce manpower, but also other concurrent activities. Those activities may include the decades old and often-useful process of competitively sourcing commercial functions; in those cases, savings are achieved by converting the work center to a most effective/efficient all-civilian workforce or contracting out the function, whichever is most cost-effective. For example, in fiscal year 2006, the AF announced 13 competitive sourcing (A-76) studies impacting 1640 manpower authorizations.

Manpower changes are also driven by the Service's continuous review of the military essentiality of various billets. In cases where the workload is determined to be inherently governmental in nature yet does not require a military fill or military as part of the total deployable pool, we may convert the billets from military to civilian. The Air Force has also realigned billets for numerous reasons, to include transferring billets from less-stressed career fields and converting them to bolster highly stressed career fields such as Security Forces, Transportation, Services, and Cryptologic Linguist. In some cases, such as new joint missions, we have to transfer manpower from one entity to another to satisfy the highest-priority commitments. In some cases, commands and functions have concurrent transformation initiatives already in progress that drive major bottom-line changes; case in point: the Personnel Systems Delivery (PSD) concept that significantly transforms military personnel activities—but at an expense of a several thousand billet reduction to field personnel structure.

Within this context of multiple end strength dynamics, one can appreciate the complexity of reductions levied by the AF decision. From the charts below, one can observe the changing impacts as first identified in the FY 07 PB (Table 1) and as further refined within the FY 08 PB submission (Table 2). These reductions are subject to refinement in any ongoing or future budget exercises.

Original Planned Reductions- FY 07 PB
57K Spaces = 40K FTEs

Active				
	Mil	33,290 spaces	=	33,290 FTEs
	Civ	2,000 spaces	=	2,000 FTEs
ANG				
	Full Time	384 spaces	=	384 FTEs
	Part Time	14,080 spaces	=	2,816 FTEs
AFRC				
	Full Time	64 spaces	=	64 FTEs
	Part time	7,680 spaces	=	1,536 FTEs
Total		57,498 spaces	=	40,090 FTEs

Part Time / 5 = FTEs 14,080/5 = 2,816 FTEs 7,680/5 = 1,536 FTEs

Table 1: The Original "40K FTE Reduction" Programmed in the FY 07PB

The initial plan to reduce manpower outlined a reduction of 57,498 Active, Guard and Reserve positions by FY 2011. "Forty-thousand" in many PBD discussions refers to the "full-time equivalent" (FTE) manpower reductions captured within the larger number. The Air Force applied a conversion factor of *one FTE for every five part-time position*s reduced, which accounts for the difference between "spaces" and full-time equivalent totals.

Revised PBD 720 in FY 08 POM
42K Spaces = 36K FTEs

Active*				
	Mil	32,538 spaces	=	32,538 FTEs
	Civ	2,000 spaces	=	2,000 FTEs
**ANG ** **				
	Full Time	0 spaces	=	0 FTEs
	Part Time	0 spaces	=	0 FTEs
AFRC**				
	Full Time	38 spaces	=	38 FTEs
	Part time	7,245 spaces	=	1,449 FTEs
	Civ	372 spaces	=	372 FTEs
Total		42,193 spaces	=	36,397 FTEs

Part Time / 5 = FTEs 7,245/5 = 1,449 FTEs
***U2 Restoration, 752 billets in 08 POM**
****ANG End Strength Restored in 08 POM/AFRC re-spread between categories**

Table 2: Revised Reductions Programmed in the FY 08 PB

Table 2 reflects Air Force corporate structure decisions tailoring the reduction plan during the FY 08 PB Exercise. During the FY 08 PB, the Air Force restored manpower billets associated with the originally-planned accelerated retirement of the U-2 program. The Active reductions were also accelerated from an FY 2011 completion up to FY 2009 to generate more immediate revenues to meet near-term shortfalls. In addition, the corporate structure accepted a proposal by the Air National Guard to take dollars from other sources rather than the targeted reduction of 384 full-time and 14,080 part-time positions. Planned reductions for the Air Force Reserve (AFR) remained a key towards generation of modernization offsets, but the Reserve came in with a proposal to re-spread their reductions: 5,064 Individual Mobilization Augmentees (IMAs), 2,181 Traditional Drilling Reservists (TRs), 38 Active Guard and Reserve (AGRs) and 372 Air Reserve Technicians (ARTs) tied to programmatic force reductions, for a total of 7,655 authorizations, by FY13.

Reduction Methodology

Developing a reduction methodology required the Air Force to comprehend that this "is not our fathers' Air Force." Indeed, we are building a different Air Force, not "the same, but smaller." Reductions are intrinsically linked to a spectrum of transformational initiatives. The Air Force's aggressive reduction plan conceived in November-December of 2005 became problematic to implement. Therefore, a follow-on "Value Metric Model" strategy was created to define the necessary reductions in detail during the FY 08 PB. The following paragraphs elaborate upon the initial and follow-on strategies.

The Initial Plan

The original Air Force plan had three key components: 1) reduction of legacy systems; 2) process efficiencies; and 3) organizational efficiencies. These three components had potential to generate significant manpower savings. In addition, the concept relied on an arbitrary reduction of 9,000 FTEs.

Reductions in Legacy Systems or accelerated retirement of certain systems can generate dollars and manpower end strength savings to be realigned towards recapitalization. Transformation to new systems may enable the Air Force to downsize its legacy forces without losing capability in today's fiscally constrained environment. Transformation to a leaner but more capable force can provide for modernization and recapitalization of selected weapon systems, allowing the Air Force to commit more resources to networked and integrated joint enablers, increased airlift and aerial refueling capability, more capable space constellations, persistent air-breathing ISR, improved close air support, and a far more capable fighter force. As a result of migrating from legacy to modern systems, the future Air Force can provide the capabilities required by the joint force. To the extent that legacy force structure proposals were unachievable to date (retiring a portion of the B-52 bomber force, retire U-2's which have largely been replaced with other ISR platforms, F-117A Nighthawk retirement and other such initiatives) the Air Force was unable to achieve commensurate savings, having to make up the difference elsewhere.

Process Efficiencies have created and will continue to generate savings. The Air Force has a rich history of taking a hard look at our processes, streamlining them, and eliminating non-value added workloads. Big savings can come when we do that deliberately, systematically, and Air Force enterprise-wide. Our Air Force Smart Operations 21 (AFSO 21) initiative harnesses cutting-edge lean and six sigma techniques into an Air Force standard methodology for achieving continuous process improvement. To identify process efficiencies, processes must be addressed "end-to-end" to create process improvements that apply to the whole enterprise and produce substantial savings. Functional communities and Major Command, Activity, and Agency leaders have sought and embraced a portfolio of dramatic transformational concepts and improvement efforts. AFSO 21 projects are continuing to provide dramatic opportunities for change.

The third component of our initial strategy involved **restructuring and consolidating organizations**, actions by nature that are closely related to driving process efficiencies already discussed. Structural efficiencies are still very much a "work in progress," but here are some of the rules of engagement the Air Force has used to guide changes:

- Organize Around Component Headquarters – win today's warfight and prevent and prepare for tomorrow's.
- "Reach back" for base operating support, policy, and advice wherever possible
- Eliminate manning overages and resist temptation to "peanut butter spread" the reductions
- Fix existing manning and billet shortages; if necessary, grow in some areas
- Enhance combat capability through risk-based resource allocation realigning billets to directly support warfighting capability

Eliminating redundancies and streamlining organizations can make it possible to field a more capable force of military, civilian and contractor members and provide some resources for recapitalization. If our operations tempo remains high and manpower has to be reduced to pay for modernization and ongoing activities, we are compelled to drive towards a smaller, more efficient management structure.

Part of gaining organizational efficiencies involves reducing management headquarters. We have sought to challenge old assumptions and foster different ways of doing business. We have been reviewing where work is performed: at management headquarters, at Major Commands (MAJCOMs), and in the field. We have systematically sought to eliminate redundancies in both our structure and our processes. And we have sought to develop a major paradigm shift for commanders: more "reach back" for support. As "form follows function," as we streamline our processes and functions we should in turn seek streamlining of our management headquarters. In the Manpower and Personnel community, for example, MAJCOM/A1 staffs that were in the neighborhood of 150-175 positions in the past have been halved as processes are streamlined and centralized.

Revising the Plan: the Value Metric Model

As explained above, reductions as originally conceived were composed of a combination of dramatic organizational streamlining and force structure change proposals, along with a large arbitrary reduction, which in practice became partially infeasible. In addition, Air Force proposals to transform through BRAC were to a great extent not realized; in fact, the Air Force took on the challenge of other Service mission support at a significant number of locations. Therefore, during the interim between December 2005 and the Spring of CY 2006, the Air Force forged a new game plan to achieve the necessary savings. The refined plan's centerpiece was development of a Value Metric Model and a process that involved interplay between the Air Force functional staffs and the commanders of major commands and activities within the field. Employing the model, plus retaining many features of the initial plan, allowed the Service to define the bulk of required reductions.

Throughout the reductions, leadership has reminded all stakeholders to maintain an Air Force-wide sense of maintaining focus on support to the warfighter. The modeling and methods employed to shape the reductions prioritized combatant command as paramount, sought to meet Unit Type Code (UTC) deploying commitments without increased mobilization, and to uphold the Air Force's ability to present Air Expeditionary Forces with an acceptable dwell, that is, rotation factor between home station and forward deployment. However, the down side involved costs elsewhere: significant risk to sustain "in garrison" support and missions and various functions having to make dramatic changes to perform satisfactorily in a post-reduction environment.

The Value Metric Model methodology sought to preserve Air Expeditionary Force and Operational Plan capabilities within the Air Force, but it also halted growth. Although expeditionary combat support took the brunt of the reductions, the modeling and functional expert review was performed to ensure no particular function should exceed given "red lines" in capability to provide deployable forces. During the time of designing the reductions, many vetted, logical increases to Air Force manpower were competing for potential funding; nearly all of these prudent growth proposals were eliminated. To the maximum extent, areas which the model protected (such as front-line aircrews) were shielded, but not removed from the equation, to include aircraft crew ratios. The new methodology made some accommodations for protecting experience levels, dealing with absorption capability, and sought to bring as much objectivity as possible to a reduction of this scale—that is, sought to avoid a simple pro-rata or "fair share" method of spreading the reductions. The process was not easy—but the Service determined that the impact was still a better alternative than flying 70-year old aircraft.

The Air Force Manpower and Personnel (A1) and Studies and Analysis (A9) experts worked with the staff to create the Value Metric model to examine all Air Force Specialties/positions at organization level to provide the most objective tool possible to assess where reductions could be levied. The methodology factored in CONUS-to-Overseas rotation factors, DOPMA limits upon grades, expeditionary and contingency demands, and Air Force Specialty (AFS) sustainability. The Air Force sought to adjust Air Force Specialties to "balance stress" where practical. According to the framework, billets more near to directly fulfilling the combatant commanders' requirements to execute operations were least impacted; those furthest from that objective were generally more at risk (see Figure 2).

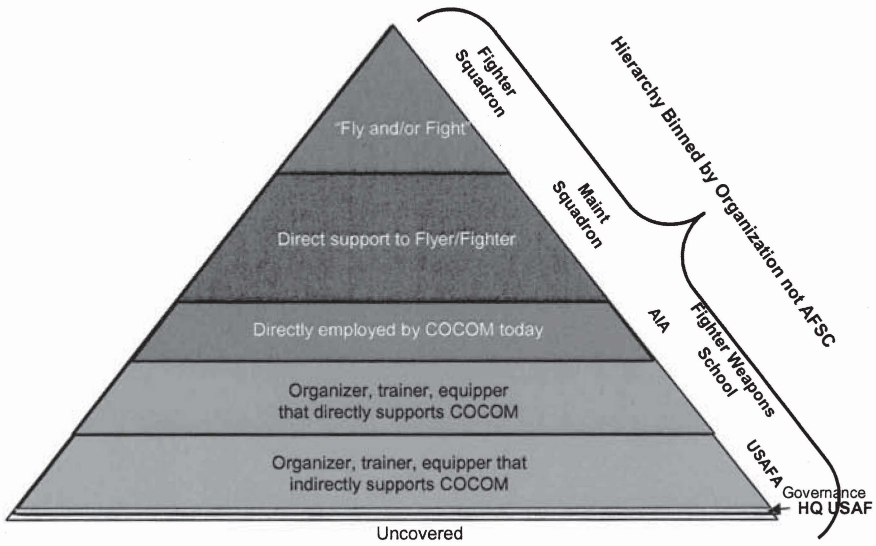

Figure 2: Value Metric Model Hierarchy

The Value Metric modeling considered such questions as *does the billet*:

- Fly and fight?
- Directly support the flyer and fighter?
- Directly support (employed by) the COCOM?
- Indirectly support (employed by) the COCOM?
- Provide required governance?
- Have a history of extended vacancy?
- Provide a redundant capability?

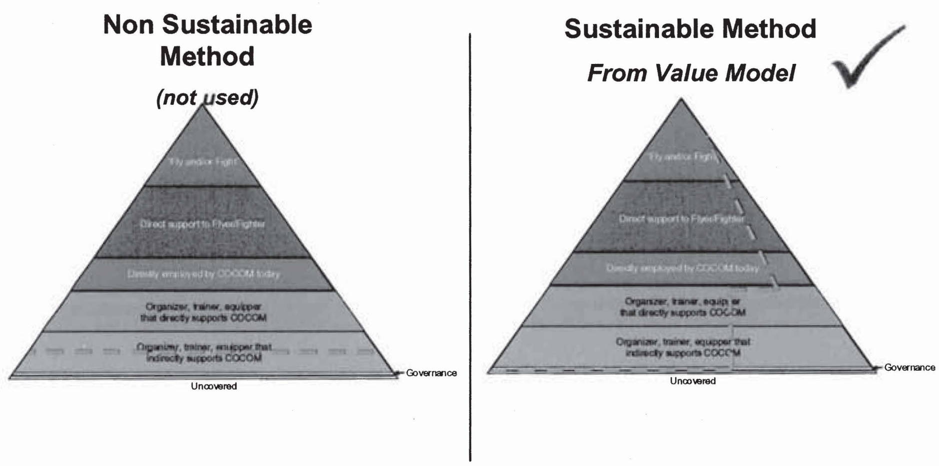

Figure 3: Value Metric Model: Ensuring Sustainability

Reviewing the pyramid in Figure 3, it would have seemed easy to only cut from the organizations that contribute less directly to the war-fighting combatant commanders, but cutting straight "off the bottom" from our training, acquisition, and support muscle would guarantee a broken force in the future. Thus, the model levied reductions from higher value organizations (but to a much smaller degree) while also targeting a higher share of reductions to organizations "further from the spear" in order to reduce overall risk.

> *"We will take this reduction by slicing down the side of the pyramid."*
> *- Michael W. Wynne, SECAF*
>
> *"I will not wait to be told to reduce the G.O. Corps ... I'll start there."*
> *- Gen T. Michael Moseley, CSAF*

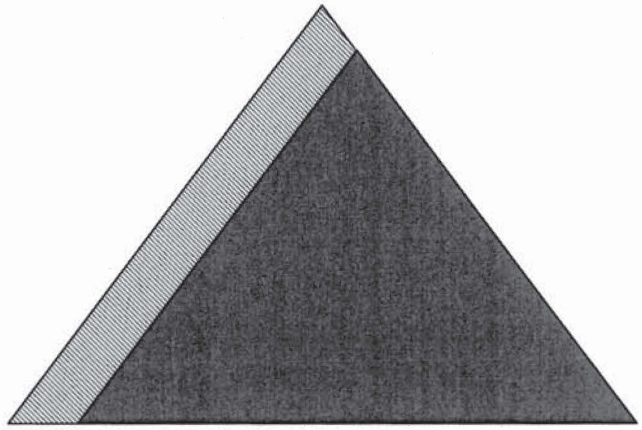

Figure 4: Slicing Down the Side of the Military Grades Pyramid

The employed methodology also included careful consideration of ***grade structure***. Normally, the Air Force conducts periodic, in-depth "Grades Exercises" to maintain the shape of the force, but such significant reductions required an out-of-cycle plan, linked closely to the Value Metric strategy. To stay within DOPMA limitations and preserve career field growth and development "pyramids", the revised methodology targeted a "vertical slice" of the Air Force, that is, grade rollbacks or reductions from General Officer down through Airmen Basic. The reductions would not be targeted to the lowest airmen and junior grade officers. Taking scaled reductions from each grade category sets conditions for viability of Air Force specialties in the future; taking reductions from only the bottom grades would not be prudent. The planned reductions drove the Service to identify a small amount of General Officer grades for roll-down. However, the growing demand for senior military leadership in both the Air Force and Joint organizations will result in those reductions being harder to achieve than planned. The Colonel grade adjustments have been identified through an extremely thorough AF/CVA-led formal board, with representatives from the Joint Staff, Air Force commands, and functional communities. The board process took the prioritized Colonel position descriptions prepared by Air Force and joint senior commanders and their staffs and systematically made the tough decisions on how to baseline colonel grades to take necessary reductions by year. A similar Chief Master Sergeant billet review process was executed. Although at a macro level, grade reductions were levied across the Service in a tiered manner; the Air Force is continuing the process with a formal grades exercise to complete review of funded officer and enlisted billet grades.

The Value Metric methodology employed a ***functional community approach*** seeking to mitigate against every major command deciding upon "county options" that would erode standardization and global interoperability. Senior functional leadership at the Air Staff appointed experts to a "Task Force 21" team to review model outputs (quotas by Air Force Specialty) and make specific recommendations as to where reductions could be made in the headquarters, agencies, major commands, and field activities. The functional leaders were also careful to seek solutions that would preserve deployment capability, even at risk to home station demands. Initial quota development excluded only Major Force Program 11 (Special Operations), National Intelligence Program, and

Defense Health Program areas. Some areas previously identified as "highly stressed career fields" were earlier provided additional funding at the expense of less stressed specialties, and the reductions were usually less.

Functional proposals were delivered to Major Command and Field Activity leadership with instructions to accept or offer counter-proposals for each reduction candidate. During a 3-star level Video Teleconference on 16 June 2006, MAJCOM commanders confirmed their refinements and ability to complete the model-driven and functional plans, leaving a shortfall of 2,944 billets to be further refined at billet detail for reduction prior to FY 09. In the month after this VTC, leadership determined that a portion of the model-driven reductions to the US Air Force Academy, Air University, Judge Advocates, Chaplain Corps, and Joint/Defense Agencies posed an unacceptable risk due to academic certification, training capability, functional viability, joint manning, and governance issues. These post-CORONA adjustments drove a further gap of 1,935 shortfalls to the planned unit manning document adjustments. Shortfalls were allocated to the MAJCOMs as decrements to FYDP end strength, but deferred to the 09 APOM exercise for resolution.

Command staffs were directed to create billet-level manpower programming detail for all reductions (less the 4,690 shortfall) by fall calendar year 2006. Functions and command leadership have continued to define and refine simultaneous transformational streamlining, reengineering, and "reachback" proposals, discussed later in this report.

Force Shaping

Force Shaping is how we better describe the actions and initiatives associated with the "faces" side of the equation. The intent of the planned reductions was to take a "vertical slice" down the side of our force; that is, the Air Force cannot afford and has no intention of taking the reductions solely upon the backs of our junior officers and enlisted members. Thus, reductions had to be taken at a proportional amount from the highest grades down through the lowest to stay within DOPMA-mandated ceilings and continue to provide sustainable career paths for our people.

Force Shaping Programs are currently on target. Current/future programs (Voluntary Separation Pay, Force Shaping Boards, Selective Early Retirement Boards, Reductions In Force, Date of Separation Rollbacks, Limited Active Duty Service Commitment Waivers) will enable us to reach goals. Through proactive Total Force management, the personnel reductions associated with our transformation will induce the Air Force to further streamline organizational alignments and devise innovative process efficiencies. These initiatives will not only help pay for our recapitalization, but will improve the reaction times of our forces with reduced layering of decision processes, more specialized warfighting organizations, and more responsive command and control procedures. Changes of the magnitude we are facing come with a degree of uncertainty and difficulty for some of our people. We are making every effort to use voluntary measures to shape the force.

In 2005, SECAF authorized implementation of annual Force Shaping Boards (FSBs). The purpose of the FY 06 FSB was to reduce officer overages by identifying officers with less than 6 years of service for separation while, at the same time, balancing career fields and officer commissioned year groups. Prior to the board, eligible officers were offered voluntary options to transition to other forms of service in and out of the Air Force. For example, officers could move from active duty to vacancies in the Reserve and Air National Guard under the PALACE CHASE program and to the Army under the Blue to Green program. The Air Force also waived most Active Duty Service Commitments to allow personnel to separate early.

In addition to the FSBs, the Air Force provided incentives to encourage separations and early retirements for those eligible. The time in grade required for colonels and lieutenant colonels to retire in grade was reduced from three years to two years and a liberal separation policy was instituted to encourage officers serving in overage skills to leave if they so decided. This was accomplished by announcing the intent to waive active duty service commitments incurred for education, recent assignments, and other administrative actions. Officers (colonel and below) were also allowed to request retirement more than 12-months from their originally requested date and the FY06 NDAA provided legislation allowing officers with an least 20 years of Active Service to retire as an officer with only 8 years of commissioned service instead of the 10 years normally required. Together these programs provided flexible options for Airmen wanting to pursue early retirement or separation.

Initially, Enlisted Force Shaping options were primarily limited to the Career Job Reservation (CJR) System and the Non-Commissioned Officer Retraining Program (NCORP). The CJR system limits reenlistments into the career force by constraining AFSCs for first-term airmen in specified AFSCs and the NCORP identified over- and under-manned AFSCs and allowed personnel to cross-train from career fields with excess personnel into the career fields with greater needs. In addition to those programs, two other enlisted programs are being employed. Airmen with 6 years to less than 11 years of active service are being offered Limited Active Duty Service Commitment (ADSC) Waivers and voluntary separation. A date of separation (DOS) rollback was implemented to speed up separations for personnel with limitations on their enlistment eligibility or assignment availability and TSgts/MSgts are eligible to apply for Active Duty Service Commitment (ADSC) Waivers and voluntarily retire.

The Air Force hopes to reduce over 4,000 officers and 10,000 enlisted by the end of FY 07. Making these reductions will be difficult, but they are necessary to ensure the Air Force maintains the right size and mix of forces to meet the global challenges of today and tomorrow.

Just as BRAC and QDR have assisted in moving us toward appropriate infrastructure and investments, force shaping is essential to ensuring we have the right sized and shaped force to support core and emerging missions for the new century. When active duty Airmen have to leave, we're giving them opportunities to transfer to our Guard and Reserve forces; we're using our Blue-to-Green program to move our most spirited departing Airmen in critical Army skills; and we're making every effort possible to retain skills by hiring separatees back in the government civilian force. Some personnel will retrain into critical or stressed career fields. Reductions are always difficult, but we believe we can proactively manage them and minimize the turbulence. We are managing the reduction and building our future enlisted force through normal attrition, fewer accessions appropriate for building a smaller force, and force shaping tools. Reductions in our officer corps are more challenging and required additional legislative authorities which the Congress granted us last year. We are grateful to the support you showed us by authorizing Voluntary Separation Pay and reauthorizing reduction in force statutes so we can resize the force and reshape the skill sets appropriate for our future force. Our civilian force is experiencing an overall growth, though less than previously planned. We still may confront some turbulence as we must also shape our civilian workforce for the challenges of the future. The effects will be regionally and locally confined, but there will be simultaneous processes of voluntary reductions in force, early retirement, and hiring incentives and freezes. Accurate communication is our strong suit and will continue to be the key to success in shaping our civilian force.

Overall, we are on a glide slope to meet our end strength in FY 07 of 334,000 and 329,000 in FY 08. Meeting the priority to develop and care for Airmen, the Air Force is committed to securing the best equipment, training, and education. The Air Force will shape the force to meet our mission with the right number of people with the right skills for the joint warfighter. The Air Force will continue to use voluntary reductions as much as possible, but will conduct non-voluntary reductions when necessary and we will help those who leave the Service.

Civilians are offered a full range of protections in places where number of reductions goes beyond normal attrition and "Reduction in Force" (RIF) rules come into play.

A Discussion of Contractor Support Reductions

In addition to the organic manpower reductions described throughout this report, the AF originally planned a reduction of approximately $7 Billion across the FYDP in our contractor support to meet the vision of transforming the Air Force into a leaner, more efficient organization.

These reductions were distributed to the various Air Force organizations based on their reported or derived contractor support usage. The Air Force programmed this contractor support reduction starting at 12 percent in FY 07 increasing to about 25 percent in FY 09 to provide the time necessary to reengineer their processes and allow for a structured reduction.

Headquarters AF is working with our major commands, agencies and activities to manage this reduction to ensure there will be limited impact to our outputs due to process redesign / improvements.

When Congress receives the FY 08 President's Budget Request, it will contain reductions in the areas identified by the MAJCOMs through the budget process where efficiencies can be realized. It will also contain funding restored to three areas the AF identified where efficiencies could not be fully realized: (1) AFMC's Major Range and Test Facility Bases; (2) AFSPC's Space Operations Support; and (3) COCOM's critical mission support areas. The Air Force will continue to review these reductions during each budget cycle with the MAJCOMs to ensure the efficiencies are realized as expected.

Impacts on Regular Component

Since the inception of the Service, the Air Force has employed state-of-the-art scientific/industrial engineering tools and techniques to connect required manpower and assignment of personnel to the assigned Air Force missions. For example, when a new aircraft is introduced into the inventory, Aircrew Ratio models define the flyers required, the Logistics Composite Model tools compute the required logistics and maintenance, Training algorithms define student and instructor demands, and various accepted manpower studies and approved Air Force manpower standards link the combat support required under approved Air Force organizational structures. When the Air Force grew during cold war times, and when it was reduced over 40 percent in the post-cold war environment, the mission, weapons systems, and manpower changes were closely and systematically linked together using manpower management engineering techniques; for the most part, manpower changes were linked directly to program content, and so too the necessary personnel life cycle actions.

In the case of these planned reductions, significant manpower reductions have been levied, but in most cases, missions and weapon systems have not been eliminated; in fact, the Air Force is required to perform more missions with less manpower than ever before. Joint and combatant command demands for highly experienced personnel grow while overall Air Force manpower resources remain limited. Although organizations and functions are systematically executing large-scale transformational plans, the programmed manpower cuts have in many cases preceded those plans. The reductions are being executed within a defined framework to spread acceptable risk, not "get well" in any area. The changes are so dramatic as to drive a "burning platform" approach facilitating the Air Force's efforts to fundamentally review and redefine the way we do business. Individuals and organizations across the Air Force face increased or intense steady-state mission demands, and depending upon their specialty, may be required to deploy with more frequency. The Air Force has sought to preserve capability to sustain deployed and contingency missions, while managing risk to home station missions. The combination of our manpower reductions, demanding GWOT OPSTEMPO, and additional non-core In-Lieu-of (ILO) taskings certainly stress our Airmen. Commanders in the field will of necessity adapt to these changes, using every method available to mitigate the risk, as personnel and manpower billets are removed from their units in the time ahead.

Air Force Specialty (AFS) Family	Percent Reduction from Baseline	Percent Total Active Reductions Programmed
1XX Operations	-3%	4%
2XX Logistics & Maintenance	-10%	39%
3XX Support	-14%	46%
4XX Medical	-2%	2%
5XX Professional (Chaplain, Judge Advocate)	-13%	1%
6XX Acquisition & Science	-5%	4%
8XX Special Duty Identifiers	-11%	3%
		100%

Table 3: Air Force Specialty Family Reductions through FY 2011 All Causes

Impacts by Air Force Specialty. Analysis of planned, coded reductions for the Active force reflects the protection of "tip of the spear" operations career fields driven by the model. Operations Air Force specialties, which include Air Force pilots, navigators, space, missile, command and control, weather, international affairs and intelligence career fields, sustained a very small percentage (approximately three percent of operations AFS total inventory) absorbing four percent of total AF reductions. Logistics and Maintenance career fields sustained just over ten percent reductions, many of which were associated with ongoing maintenance process transformations. The Logistics and Maintenance Career families absorb a very substantive 39 percent of all programmed total Active reductions, surpassed only by the Support Career Fields, taking a 14 percent loss from their baseline and contributing towards *nearly half* of all Active reductions. Support and Professional career fields sustained significant reductions, over 13 percent overall, to include Communications, Civil Engineers, Historian, Services, Public Affairs, Mission Support, Visual Information, Legal, and Chaplain Services. Security Forces, although a key Support function, were protected from the same level of cuts. Air Force Medical manpower was for the most part sheltered from manpower reductions as Defense Healthcare Program resources were not subject to reprogramming to recapitalize the force, although other initiatives, such as OSD-directed military to civilian conversions, are impacting the Medical Corps. Air Force Acquisition career families such as scientific research and development, developmental engineers, acquisition, contracting and finance lost five percent of their baseline, contributing about four percent to the total number of active AF reductions. Special Duty assignments, to include instructors, training commanders, recruiters, inspector general, and other unique assignments also sustained a less than eleven percent reduction.

ORGANIZATION LEVEL	Percent of AF Mil at this Org Level in FY 07 Baseline	Percent of the Overall AF Mil Reductions through FY 11 Sustained at this Org Level	Percent Mil Reduction to Org Level
HAF/AF FOA/DRU	4%	7%	-18%
MAJCOM FOA/DRU	4%	6%	-19%
NAF/CENTER	2%	2%	-10%
WING & BELOW	87%	84%	-10%
OUTSIDE AF	3%	1%	-4%

Table 4: Active Duty Military Reductions for All Causes through Fiscal Year 2011

Impacts by Organization Level. Organizational level analysis provides some insight. Reductions were targeted across all levels of organization, and organizations above wing level sustained deeper reductions as a percentage of their starting baseline. Headquarters and their Field Operating Agencies (FOAs) and Direct Reporting Units (DRUs) are contributing to the planned reductions. An average organization above wing level has been targeted for an approximately 18 percent reduction to its total funded military authorizations, although since headquarters are a significantly smaller part of the Air Force, all headquarters and their FOAs/DRUs have absorbed only seven percent of the total reduction target. Units at Wing level and below are enduring an average 10 percent reduction to their funded baseline, but because they comprise the bulk of Air Force Active end strength, have absorbed most of the total reduction. The wing Active military numbers also decrease due to factors such as military to civilian conversions and OMB Circular A-76 cost comparisons. As funded manpower and the personnel filling them depart the wings with no backfill, commanders in the field will experience the impact of an approximate ten percent decrease in manpower resources while still responding to a demanding mission challenge.

Mitigation Strategies

The Air Force continues to implement **functional reengineering, reachback, Component Headquarters, and continuous process improvement strategies** that transform our Service to meet present and future missions. A separately requested Air Force Report to Congress during this cycle outlines the Air Force transformational vision. Many functional communities are using a combination of these techniques to fundamentally reshape the way in which they perform the mission in today's resource-constrained environment.

Simultaneous with planned reduction efforts, Air Force senior leaders launched transformational organizational to reduce MAJCOM Headquarters (HQs) functional footprints and centralize management support for activities previously spread across the Service. Common overarching guidance assumptions to bound the initiatives included: number of MAJCOMs are not reduced, just smaller; Component Numbered Air Forces (NAFs) should reflect the reductions; future AF BOS management in MAJCOMs may be increasingly supported by reachback in FOAs; MAJCOMs remain responsible for operational readiness of all assigned units; explore significant change to processes and the way MAJCOMs receive support; and there is no higher mandate to reduce Management HQs activities, but failure to reduce such structure is not defensible.

The Reachback Timeline.

- April 19, AF announced a major two-part realignment plan to create new, focused Air Force component headquarters (AFCHQs) and consolidate duplicative management functions.
- April 21, A1 chartered Integrated Product Team under the TF 720 umbrella to look at how management support and BOS functions are performed.
- 5 May VTC, Future Management Support Briefs to MAJCOM Vice Commanders (CVs).
- 16 Jun VTC with MAJCOM CVs, Manpower Reduction Impacts.
- Jul 06, A1 CORONA brief, Task Force 720 16 Jun VTC Follow-up.
- Jul 17, A1 HAF functionals directed to take lead for their functional area and work hand-in-hand with MAJCOM counterparts to build a CONOPs and PAD for functional areas with the detail necessary to implement reachback IAW the timeline dictated to achieve the target manpower end strength levels.
- Functionals to create Program Action Directive details by Dec 2006 through Spring 2007

Every functional community in the Air Force has embarked upon deliberate, transformational organizational and process changes. Overarching and emerging themes of these enterprise-wide strategic transformations include: pursuing a consolidation of transactional workload approach; de-layering management headquarters; and redefining service delivery at every level of the organizational structure.

Here are just a few examples of **Air Force Enterprise Transformation**:

- **Manpower and Personnel.** MAJCOM and Squadron PADs are in official coordination. The A1 proposal provides details for centralization of Manpower, Personnel, and Services processes from MAJCOMs to FOAs and at Squadron level, provides details for test phase of the Services/Mission Support integration; at AFS level, career path merger initiatives are included.

- **Logistics, Installations and Mission Support**. This community has conducted a series of dramatic Lean events and built a portfolio of significant changes, to include: creation of Global Logistics Support Center (GLSC); centralizing management of Air Force Fuels, Vehicles, Equipment Support Agency (AFFVESA); Centralizing Munitions Control Points; redefining structure of AFCEE, AFSFC to take on functions from MAJCOM staffs, and more.

- As an already small **Chaplain** community deals with the reductions, the Chaplain Services Plans and Programs, Readiness, and Personnel functions will consolidate within a year.

- The **Judge Advocate** is well into execution of the ***JAG Corps 21*** plan, with multiple proposals to preserve, enhance, and centralize key capabilities. One example: consolidation of legal claims processing has reduced required manpower and dramatically improved average processing times.

- The **Surgeon General** has actively engaged in Lean events leading to reduced MAJCOM/SG footprint and reachback.

- Both the **Comptroller** and **Public Affairs**, with significant reductions, have aggressively laid in plans to centralize, consolidate, and realign critical Air Force functions.

- **Warfighting Integration.** The War Fighting Integration team is organizing innovation and move the entire AF toward operations in the cyber domain. This community is transforming the delivery of network services; developing modern, globally linked Air Operations Centers to provide robust warfighting capability; and implementing IT initiatives such as standard software configurations, commodity buying, and service-oriented architectures to free up funds for recapitalization. One of the most dramatic PADs in development will transform the former C2ISRC, AFCA, and 38 EIG to form Global Cyberspace Integration Center (GCIC). The new center will provide system development, support, and sustainment to NAF-C / MAJCOMS.

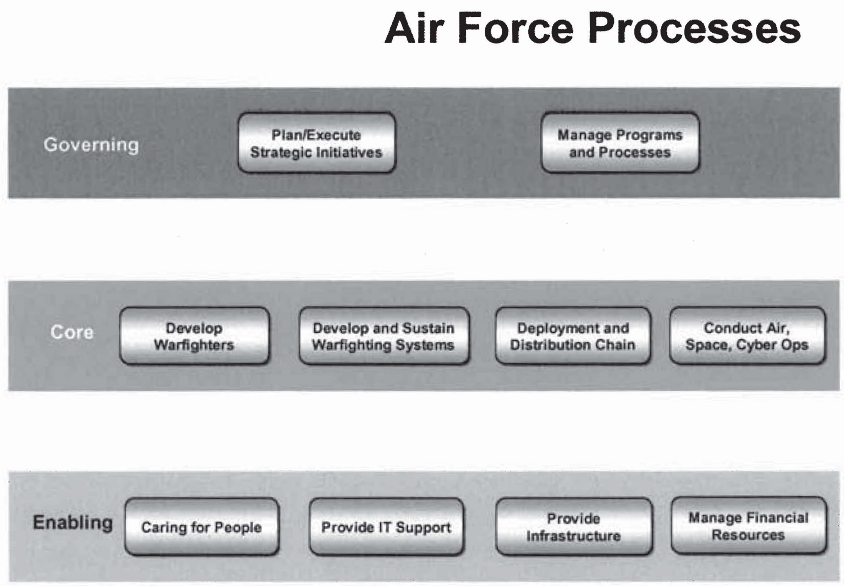

Figure 5: Governing, Core, and Enabling Air Force Processes

The Air Force is systematically implementing Air Force Smart Operations 21 (AFSO21) across the Service. AFSO21 employs **Continuous Process Improvement** techniques and encourages a new way of thinking. The Air Force has embarked upon a review of the governing, core, and enabling processes identified in Figure 5 above. This strategy is already producing process efficiencies, enhanced productivity, and measurably improved support to the warfighter. Efficiencies realized through AFSO21 efforts allow commanders to reallocate resources and address needs in the most important mission areas. For more details and examples of AFSO21 initiatives, please refer to the following website: http://www.af.mil/library/smartops.asp.

Impacts on Reserve Component

Impacts upon the Reserve Component organizations and people can best be reviewed by an understanding of major transformational initiatives and their related end strength impacts.

Total Force Integration (formerly called "Future Total Force") is transforming how the Air Force integrates the Air National Guard, Air Force Reserve, and civilian force to: (1) produce greater combat capability more efficiently; (2) change the Guard and Reserve from strategic reserves into operational reserves; and (3) optimize Guard and Reserve for new missions such as unmanned aircraft, space, information operations, intelligence, and homeland defense. Total Force Integration will make the reduced force structure more efficient by: (1) redistributing manpower; (2) enabling higher crew to platform ratios; (3) combining the best of capabilities of each Component through associate wings; (4) increase the availability of the Active Component for higher demand missions, and (5) minimizing the need for longer mobilizations.

The Air Force Reserve (AFR) will still be able to meet operational requirements after the reductions. The AFR focused on maintaining combat capability when making reductions and focused the majority of its actions on the IMA force. IMA reductions minimized the operational risk to the Air Force by retaining needed experience by re-rolling IMAs to the participating Individual Ready Reserve where the AF still has access to their capabilities. The AFR also significantly reduced medical manpower by restructuring the delivery of medical services in accordance with AF Surgeon General transformation efforts. The AFR is transforming in concert with the Regular Component, i.e., other than medical restructuring, the Regular Component did not relieve reserve units of wartime requirements.

Because the reduction was effective FY08 for the Air Force Reserve, the AFR was able to redefine the FY07 reductions after a more thorough analysis with a focus on retaining critical war-fighting, skilled airmen currently serving within the AFR. The AFR used recent UTC mobilizations, deployable capability, recruiting and retention data, and value-added to the war-fighter as benchmarks to determine where to take the reductions. In addition, lower cost IMAs were reduced earlier while higher cost full-time were taken later to stay within the fiscal constraints.

Medical Restructuring. The Air Force Reserve has taken 2,429 military reductions from medical career fields. The medical personnel reductions were a result of a mission change directed by the Air Force Surgeon General (AF/SG). The mission change refocused the Air Force Reserve to the core specialty of Aeromedical Evacuation / en-route casualty support force structure versus expeditionary medical support. The restructure shifted expeditionary medical support wartime requirements to the Regular Component.

This mission change affected both the traditional reserve and IMA programs. The decision to reduce manpower was not the primary factor requiring a medical force reduction, however, it was used to satisfy a portion of the overall planned reduction.

As a result of the mission change, the AFR lost 895 officer and 1534 enlisted authorizations. Of the officer decrease, 33 were in the traditional reserve (unit) program and 862 in the IMA program. The specific medical specialties impacted within the IMA program have not been fully identified and AFR developmental teams are continuing to identify the specific requirements. Of the 862 IMA officer reductions, 437 will be from within the Nurse Corps. The remaining 425 will be divested among the Medical, Dental, Medical Service and Biomedical Science Corps. The officer specialties within the traditional reserve program will be reduced as follows: Internal Medicine Physician (3), Emergency Medicine Physician (1), Anesthesiologist (1), Clinical Nurse (27), and Dentist (6). These reductions, when offset by a slight increase in other critical medical specialties, result in a net loss of 33 medical authorizations.

There are multiple recruiting initiatives underway to attract any displaced medical personnel to other services. The Air Force has no ability nor is it funded to maintain manpower against another service's requirement. While the Air Force is filling significant "in lieu of" missions for other services, we must do so from within the resources of the Air Force. If it is decided that excess Air Force manpower should be retained to support other service vacancies, the authorizations and funding must be surrendered to the Air Force.

Communications Restructuring. The Air Force Reserve has taken 275 military and civilians from the communications functional area. The reduction removes funding from lower priority, out-year requirements; the positions are effective FY10 so there are no personnel impacted. Communications equipment will be maintained with current resources; there is no wartime mission impact (no UTC reduction).

Willow Grove Air Reserve Station. The AFR reduced 1,308 military and civilians at Willow Grove ARS PA as a secondary impact of BRAC. BRAC closed the airfield and distributed Navy and Air National Guard aircraft to other locations. The AFRs 913th Airlift Wing sent its aircraft to the Regular Component as backfill for C-130E's with center wing box problems.

Strategic to Operational Reserve. The Air Force Reserve reduced 3,643 IMAs. These IMAs will have the opportunity to continue to participate and will still be available in the Individual Ready Reserve (IRR). Their availability will be dependent on the individuals' desire to participate for retirement points only (no pay) and/or the availability of the Regular Component to fund participation with mandays. The AFR has shifted its strategy from investing in IMAs as a strategic reserve to a strategy of devoting resources to enable the use of reservists as an operational force, with a focus on traditional reserve units. The AFR will continue to shift the strategic reserve from the Selected Reserve (SelRes) to the IRR while strengthening connections with members of the IRR to encourage and facilitate volunteerism.

Way Ahead: Does the Air Force Need More Manpower?

In Program Budget Decision 720, the Air Force cut 40,000 Active Duty, Guard, Reserve and civilian Full-time Equivalents (FTEs) and nearly 25 percent of contractor support to help pay for recapitalization and modernization of the AF aircraft/missile and space fleet. Remaining end strength is only sufficient for a 78 combat wing force structure, while the Air Force requires manpower associated with an 86 combat wing structure. Additionally, as the Army and Marine Corps increase end strength, a commensurate Air Force positive adjustment is required to ensure air power is available to combatant commanders in the interdependent, Joint battlespace.

Given a budget shortfall of approximately $20 Billion per year throughout the program, the Air Force was compelled to make difficult decisions to optimize remaining dollars and remain within budget. The past seven years' "recapitalization holiday" coupled with dramatic increases in day-to-day operating costs led to a "lesser of evils" alternative to reduce manpower end strength by 40K full-time equivalents over a 3-year period to generate dollars protecting the Air Force from failure in other areas. Personnel reductions as programmed generate approximately $11 Billion in savings from FY07-11. These funds were reprogrammed, based on the results of QDR 05, to continue AF recapitalization and modernization. These recapitalization and modernization actions remain imperative towards meeting COCOM expeditionary, joint, warfighting capabilities we need to fly, fight and win in the air, space, and cyberspace domains.

The Air Force has begun to articulate and execute a vision to evolve from a 78 combat wing equivalent force to an 86 combat wing structure. Knowing what we know today, the Air Force clearly needs to halt manpower reductions and reinvest end strength to ensure the manpower is available to resource the much-needed future bomber, ISR, combat airmen, and other emerging joint war fighting capabilities. These eight combat wing equivalents, as presently planned, could require an increase in total force end strength of 19,000 Active Duty and 2,700 Air Force Reserve manpower authorizations of the appropriate Air Force Specialties. As these emerging structures are being defined, the planned reductions add risk to this plan to achieve the above wing structure. As presently projected, the Air Force will decline from 359,000 Airmen on Active Duty at the end of FY 06 down to 311,000 by Fiscal Year 2013 unless resources are reprogrammed and related force shaping halted.

Additionally, as the US Army and Marines are targeted for significant increases to bolster combat capability, there will be a commensurate requirement for an increase in Air Force manpower to ensure the effectiveness of the interdependent, joint team. We have trimmed our Air Force using a methodology that preserved our strong expeditionary capability for a 78 combat wing force, but at considerable risk to in place or home station requirements and overall long-term readiness; supporting additional ground forces was not considered in the reduction plan. Any significant growth planned for active ground units inherently drives commensurate need to increase Air Force strength as part of the interdependent joint fight. Our Air Mobility units are intrinsically tied to supporting our Army and Marine team with logistical reach to go and be supplied anywhere in the world. Our weather teams, tactical air control, and other forces are imbedded with or closely tied with the ground forces. AF provides the full range of air assets as part of the interdependent joint fight, including increased Special Forces and intelligence requirements. Failure to recognize and fund the increase in capabilities provided by the Air Force would significantly reduce the joint commanders' combat effectiveness.

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON DC

16 March 2007

HQ USAF/SG
1780 Air Force Pentagon
Washington, DC 20330-1780

The Honorable Robert Byrd
Chairman, Committee on Appropriations
United States Senate
Washington DC 20510

Dear Mr. Chairman

I am pleased to provide this letter on Air Force Clinical Health Psychology Postdoctoral Training as directed in Senate Report 109-292, Department of Defense Appropriations Bill, 2007. The Air Force has sponsored a postdoctoral training program in Clinical Health Psychology at Wilford Hall Medical Center since 1981. This program was the second health psychology fellowship accredited by the American Psychological Association and is the only Department of Defense accredited program. All Air Force Clinical Health Psychology Postdoctoral Training is consolidated at Wilford Hall Medical Center.

In 2006, the program added an additional training year, creating a 2 year training program, to incorporate advances in this specialty area. Applicants are recruited through recruitment booths at professional conferences, listing in the Association of Psychology Postdoctoral and Internship Centers website, formal messages to Air Force psychologists, and contacting qualified individuals who have expressed interest in the training. A growing challenge is the ability to recruit qualified active duty psychologists to compete for the available training positions. The ideal time to apply for active duty specialty training in psychology is at the end of the first service commitment. Many psychologists are choosing to leave the Air Force at this juncture, due in part to the changing missions of our Service.

Air Force health psychologists have had a significant and comprehensive impact on research, practice, and policy in the Air Force Medical Service. The Wilford Hall Clinical Health Psychology Program has been the site of over $13.5M in research grants, including two National Institutes of Health grants totaling $3.8M targeting tobacco cessation—a critical concern for the health of our force. Over the past decade our Behavioral Health Optimization Program in Primary Care, pioneered by Air Force clinical health psychologists, created greater beneficiary access to behavioral health services through the integration of behavioral health providers in primary care. The Air Force is recognized as a national leader in the integration of behavioral health services in primary care.

Finally, health psychologists have been involved in policy related to the assessment of personnel returning from deployments, substance abuse, suicide prevention, and population health. Air Force health psychologists have made significant contributions to behavioral health, and I will continue to provide my strongest support for our outstanding training program.

Thank you for your interest in the Air Force's tradition in training clinical health psychologists. If you have any questions about clinical health psychology in the Air Force, please contact [redacted] A similar letter has been sent to the Ranking Minority Member of your committee and to the Chairman and Ranking Minority Members of the other Congressional Defense Committees. (b)(6)

Sincerely

JAMES G. ROUDEBUSH
Lieutenant General, USAF, MC, CFS
Surgeon General

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON DC

16 March 2007

HQ USAF/SG
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Washington, DC 20330-1780

The Honorable Ted Stevens
Ranking Minority Member, Subcommittee on Defense
Committee on Appropriations
United States Senate
Washington DC 20510

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Sincerely

JAMES G. ROUDEBUSH
Lieutenant General, USAF, MC, CFS
Surgeon General

DEPARTMENT OF THE AIR FORCE
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16 March 2007

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The Honorable Ike Skelton
Chairman, Committee on Armed Services
United States House of Representatives
Washington DC 20515

Dear Mr. Chairman

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Sincerely

JAMES G. ROUDEBUSH
Lieutenant General, USAF, MC, CFS
Surgeon General

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON DC

16 March 2007

HQ USAF/SG
1780 Air Force Pentagon
Washington, DC 20330-1780

The Honorable David Obey
Chairman, Committee on Appropriations
United States House of Representatives
Washington DC 20510

Dear Mr. Chairman

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Surgeon General

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON DC

16 March 2007

HQ USAF/SG
1780 Air Force Pentagon
Washington, DC 20330-1780

The Honorable John P. Murtha
Chairman, Subcommittee on Defense
Committee on Appropriations
United States House of Representatives
Washington DC 20510

Dear Mr. Chairman

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DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON DC

16 March 2007

HQ USAF/SG
1780 Air Force Pentagon
Washington, DC 20330-1780

The Honorable John McCain
Ranking Minority Member, Committee on Armed Services
United States Senate
Washington DC 20510

Dear Senator McCain

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JAMES G. ROUDEBUSH
Lieutenant General, USAF, MC, CFS
Surgeon General

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON DC

16 March 2007

HQ USAF/SG
1780 Air Force Pentagon
Washington, DC 20330-1780

The Honorable Jerry Lewis
Ranking Minority Member, Committee on Appropriations
United States House of Representatives
Washington DC 20510

Dear Mr. Lewis

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Lieutenant General, USAF, MC, CFS
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DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON DC

16 March 2007

HQ USAF/SG
1780 Air Force Pentagon
Washington, DC 20330-1780

The Honorable Carl Levin
Chairman, Committee on Armed Services
United States Senate
Washington DC 20510

Dear Mr. Chairman

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Surgeon General

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON DC

16 March 2007

HQ USAF/SG
1780 Air Force Pentagon
Washington, DC 20330-1780

The Honorable Daniel K. Inouye
Chairman, Subcommittee on Defense
Committee on Appropriations
United States Senate
Washington DC 20510

Dear Mr. Chairman

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Surgeon General

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON DC

16 March 2007

HQ USAF/SG
1780 Air Force Pentagon
Washington, DC 20330-1780

The Honorable Duncan Hunter
Ranking Minority Member, Committee on Armed Services
United States House of Representatives
Washington DC 20515

Dear Mr. Hunter

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Lieutenant General, USAF, MC, CFS
Surgeon General

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON DC

16 March 2007

HQ USAF/SG
1780 Air Force Pentagon
Washington, DC 20330-1780

The Honorable Thad Cochran
Ranking Minority Member, Committee on Appropriations
United States Senate
Washington DC 20510

Dear Senator Cochran

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Lieutenant General, USAF, MC, CFS
Surgeon General

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON DC

16 March 2007

HQ USAF/SG
1780 Air Force Pentagon
Washington, DC 20330-1780

The Honorable C.W. Bill Young
Ranking Minority Member, Subcommittee on Defense
Committee on Appropriations
United States House of Representatives
Washington DC 20515

Dear Mr. Young

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Lieutenant General, USAF, MC, CFS
Surgeon General

PREPUBLICATION COPY
SUBJECT TO EDITORIAL CHANGE

Assessment of Wingtip Modifications to Increase the Fuel Efficiency of Air Force Aircraft

Committee on Assessment of Aircraft Winglets for Large Aircraft Fuel Efficiency

Division on Engineering and Physical Sciences

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This is a report of work supported by Grant F49620-01-1-0269 between the U.S. Air Force and the National Academy of Sciences. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the views of the organizations or agencies that provided support for the project.

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[1] Member, National Academy of Engineering

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ENITA A. WILLIAMS, Research Associate

Preface

At the request of the U.S. Air Force, and in light of greatly increased government emphasis on the need for greater fuel efficiency in the fleet of military aircraft, the National Research Council (NRC) was asked to study whether business cases could be made for modifying engines or re-engining large Air Force aircraft. The Committee on Analysis of Air Force Engine Efficiency Improvement Options For Large Nonfighter Aircraft was formed and their report[1] was provided to the Air Force on January 31, 2007.

While that study was under way, congressional interest in fuel efficiency increased, resulting in the inclusion of the following language in Report 109-452 of the House Armed Services Committee on H.R. 5122 (National Defense Authorization Act for FY07):

> The committee commends the Air Force in its efforts to increase aircraft fuel efficiency and decrease fuel consumption. The committee notes that initiatives such as re-engining aircraft, modifying in-flight profiles, and revising aircraft ground operations contribute to decreased fuel consumption and increased life-cycle savings.
>
> The committee is aware that winglet technology exists for aircraft to increase fuel efficiency, improve take-off performance, increase cruise altitudes, and increase payload and range capability. The committee notes that winglets are currently used on commercial aircraft and result in a five to seven percent increase in fuel efficiency. On September 16, 1981, the National Aeronautics and Space Administration released the KC–135 Winglet Program Review on the incorporation of winglets for KC–135 aerial refueling aircraft. However, the Air Force concluded that the cost of adding winglets to the KC–135 did not provide sufficient payback in fuel savings or increased range to justify modification. Although the Air Force did conclude that modifying aircraft with winglets could increase fuel efficiency, the Air Force determined that re-engining the KC–135 aircraft produced a greater return on investment. The committee believes that incorporating winglets on military aircraft could increase fuel efficiency on certain platforms and that the Air Force should reexamine incorporating this technology onto its platforms.
>
> Therefore, the committee directs the Secretary of the Air Force to provide a report to the congressional defense committees by March 1, 2007, examining the feasibility of modifying Air Force aircraft with winglets. The report shall include a cost comparison analysis of the cost of winglet modification compared to the return on investment realized over time for each airlift, aerial refueling, and intelligence, surveillance, and reconnaissance aircraft in the Air Force inventory; the market price of aviation fuel at which incorporating winglets would be beneficial for each Air Force platform; all positive and negative impacts to aircraft maintenance and flight operations; and investment strategies the Air Force could implement with commercial partners to minimize Air Force capital investment and maximize investment return.

In response to a subsequent request from the Air Force, the NRC appointed the Committee on Assessment of Aircraft Winglets For Large Aircraft Fuel Efficiency to examine the feasibility of modifying Air Force aircraft with winglets. Since this study is a follow-on effort to a study

[1] NRC, 2007, *Improving the Efficiency of Engines for Large Nonfighter Aircraft*, Washington, D.C., The National Academies Press, prepublication.

examining methods to improve fuel efficiency in large Air Force aircraft, appropriate members of the original study committee, including the chair and vice chair, agreed to participate in this study. They were joined by new members with the expertise to address the necessary technical areas. This report responds to the request of Congress as outline above.

The chair thanks the members of the committee for generously taking time from their demanding schedules and working hard to complete this report in the short time allotted. The entire committee, in turn, thanks the many organizations and the guest speakers who provided excellent briefings and background information, and it thanks the National Research Council staff members who supported the study. Primary among them were Marta Vornbrock, Gregory Eyring, Jim Garcia, Michael Clarke, LaShawn Sidbury, and Detra Brodrick-Shorter.

Kenneth E. Eickmann, *Chair*
Committee on Assessment of Aircraft
Winglets for Large Aircraft Fuel Efficiency

Acknowledgments

This report has been reviewed in draft form by individuals chosen for their diverse perspectives and technical expertise, in accordance with procedures approved by the National Research Council's Report Review Committee. The purpose of this independent review is to provide candid and critical comments that will assist the institution in making its published report as sound as possible and to ensure that the report meets institutional standards for objectivity, evidence, and responsiveness to the study charge. The review comments and draft manuscript remain confidential to protect the integrity of the deliberative process. We wish to thank the following individuals for their review of this report:

William G. Agnew, NAE, General Motors Corporation (ret.),
Kenneth C. Hall, Duke University,
Wesley L. Harris, NAE, Massachusetts Institute of Technology,
Frank T. Lynch, Independent Consultant, Yorba Linda, Cal.,
Gregory S. Martin, GS Martin Consulting,
John P. Sullivan, Purdue University,
Charles F. Tiffany, NAE, The Boeing Company (ret.), and
Henry T. Y. Yang, NAE, University of California, Santa Barbara.

Although the reviewers listed above have provided many constructive comments and suggestions, they were not asked to endorse the conclusions or recommendations nor did they see the final draft of the report before its release. The review of this report was overseen by Alexander H. Flax, NAE. Appointed by the National Research Council, he was responsible for making certain that an independent examination of this report was carried out in accordance with institutional procedures and that all review comments were carefully considered. Responsibility for the final content of this report rests entirely with the authoring committee and the institution.

The committee also acknowledges and appreciates the contribution of the members of the Air Force Studies Board of the National Academies for their support of this study.

The Air Force Studies Board (AFSB) was established in 1996 by the National Research Council at the request of the Air Force. The AFSB brings to bear broad military, industrial, and academic scientific, engineering, and management expertise on Air Force technical challenges and other issues of importance to senior Air Force leaders. The board discusses potential studies of interest, develops and frames study tasks, ensures proper project planning, suggests potential committee members and reviewers for reports produced by fully independent ad hoc study committees, and convenes meetings to examine strategic issues. The board members listed on page v were not asked to endorse the committee's conclusions or recommendations, nor did they review the final draft of this report before its release. Board members with appropriate expertise may be nominated to serve as formal members of study committees or to review reports.

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Acronyms

AA	American Airlines
ACEE	aircraft energy efficiency
APB	Aviation Partners Boeing
API	Aviation Partners Incorporated
APU	auxiliary power unit
AWACS	Airborne Warning and Command System
BBJ	Boeing business jets
CFD	computational fluid dynamics
CG	center of gravity
DESC	Defense Energy Support Center
DOD	Department of Defense
DOE	Department of Energy
EGT	exhaust gas temperature
EPR	engine pressure ratio
ESPC	Energy-Savings Performance Contract
FAA	Federal Aviation Administration
ISR	intelligence, surveillance, and reconnaissance
JSTARS	Joint Surveillance Target Attack Radar System
L/D	lift-to-drag ratio
MOG	maximum on ground
MRO	maintenance, repair, and overhaul
MZFW	maximum zero fuel weight
NASA	National Aeronautics and Space Administration
NG	next generation
NPV	net present value
NRC	National Research Council
OEM	original equipment manufacturer
RVSM	reduced vertical separation minimums

SOT	statement of task
SiS	share-in-savings
SWA	Southwest Airlines
TACAMO	take charge and move out
TOGW	takeoff gross weight
USAF	United States Air Force

Summary

Since the 1970s, when the price of aviation fuel began to spiral upward, airlines and aircraft manufacturers have explored many ways to reduce fuel consumption by improving the operating efficiency of their aircraft. Fuel economy concerns have been particularly keen for operators of commercial aircraft, which typically fly many hours per day in competitive markets, but they have been growing for military aircraft as well. The fuel consumed by the U.S. Air Force is in excess of 3 billion gallons per year, which is over 8 million gallons per day. The aircraft used by the Air Force for airlift, aerial refueling, and intelligence, surveillance, and reconnaissance—which are the aircraft covered in this study—account for over half of that total.[1]

One very visible action taken by commercial airframe manufacturers and operators to reduce fuel consumption is the modification of an aircraft's wingtip by installing, for example, near-vertical "winglets" to reduce aerodynamic drag. Experience shows that these tip devices reduce block fuel consumption (total fuel burn from engine start at the beginning of a flight to engine shutdown at the end of that flight) of the modified aircraft by 3-5 percent, depending on the trip length.[2] These wingtip modifications are offered as options to the original design of many newer commercial jetliners but are also available for retrofit to selected older aircraft. To date, however, only one military-unique aircraft (the C-17 transport) features winglets, though some studies have been conducted on the feasibility of retrofitting tip modification devices on other military aircraft.

In light of its growing concerns about rising fuel costs, the Air Force asked the National Research Council (NRC) to evaluate its aircraft inventory and to identify those aircraft that may be good candidates for winglet modifications. Specifically, the Air Force asked the NRC to perform the following four tasks:

1. Examine the feasibility of modifying Air Force airlift; aerial refueling; and intelligence, surveillance, and reconnaissance aircraft with winglets, to include a cost-effectiveness analysis of the feasible winglet modifications in net present value (NPV) terms.
2. Determine the market price of aviation fuel at which incorporating winglets would be beneficial for each platform.
3. Consider impacts to aircraft maintenance and flight operations (including ground operations).
4. Offer investment strategies the Air Force could implement with commercial partners to minimize Air Force capital investment and maximize investment return.

Although the statement of task above refers specifically to "winglets," the Committee on Assessment of Aircraft Winglets for Large Aircraft Fuel Efficiency chose to broaden the scope of its deliberations slightly by including a variety of possible modifications to the wingtip (e.g.,

[1] Fuel Usage by MDS for FY05. Defense Energy Support Center (DESC), 2006. Ft. Belvoir, Va.

[2] This range of 3-5 percent block fuel savings, derived from commercial experience, is lower than the 5-7 percent cited by the U.S. House of Representatives Armed Services Committee in Report 109-452, which may reflect fuel savings under cruise conditions.

wingtip span extensions). Thus, in this report, the term "winglet" denotes the traditional, nearly vertical wingtip design, while "wingtip modifications" is used to refer to the more general set of wingtip designs, including winglets and wingtip extensions, aimed at reducing aerodynamic drag.

These tasks call for a quantitative assessment of the costs and benefits of winglet modifications on a variety of platforms. In a comprehensive analysis, one would need to include the nonrecurring engineering costs of wing analysis and wingtip design, the costs of materials, manpower, and out-of-service time to accomplish the modification, financial implications, training costs, potential impacts on maintenance docks and hangar space, costs associated with software and technical manual revisions, and any impacts on maintenance, operations, or mission accomplishment. Benefits to be considered would include not only improved fuel economy, but also improved payload-range capability and improved takeoff performance, and less takeoff noise. In most cases, quantitative data on these costs and benefits were not known or not available. However, the committee did use preliminary net present value (NPV) calculations to calculate approximate payback periods for wingtip modification investments on various platforms by treating fuel costs, savings, and wing modification costs parametrically. These calculations supplemented the committee's expert judgment on which platforms appear to be the best candidates for wingtip modification.

Besides wingtip devices, there are other methods to reduce aircraft fuel consumption, but since they were not mentioned in the statement of task, the committee did not examine them in detail or the extent to which the Air Force may already be using some of these other methods. Likewise, it did not make any formal recommendations concerning them. However, the committee suggests this is an area that should be considered as potentially providing benefits (significant fuel savings) to the Air Force.

FINDINGS AND RECOMMENDATION

In this section, the committee presents two findings and a recommendation in response to the four tasks it was asked to perform.

Feasibility and Cost Effectiveness of Modifying Air Force Aircraft

Finding: The committee's analysis, for a broad range of fuel prices and with the data available to it on potential improvements in block fuel savings, modification cost estimates, operational parameters for the aircraft, and so forth, indicates that wingtip modifications offer significant potential for improved fuel economy in certain Air Force aircraft, particularly the KC-135R/T and the KC-10.

To assess the feasibility and cost-effectiveness of wingtip modifications, the committee began by investigating those aircraft in the Air Force inventory that burn the most fuel. In decreasing order of annual fuel burn (by fleet), they are the C-17, KC-135R/T, C-5, KC-10, and C-130H/J. Based on factors such as estimated fuel savings, cost of modification, operational flexibility, mission profiles, and remaining service life, the committee ranked these aircraft in order of their likely suitability for wingtip modifications, as shown in Table S-1.

TABLE S-1 Potential for Wingtip Modifications to Benefit Air Force Aircraft

Aircraft	Priority/Potential Benefit
KC-10	High
KC-135R/T	High
C-5	Medium
C-17	Medium/Low
C-130H/J	Low

KC-10

The KC-10 airframe is based on the commercial DC-10 airframe, and early commercial DC-10 flight tests validated a 2-3 percent improvement in fuel efficiency at cruise conditions with winglets as compared with the original wing design.[3] Not only was the DC-10 modified and tested with winglets, but its successor, the MD-11, was designed and certified with winglets. With the computational fluid dynamics (CFD) tools of today, moreover, a winglet or other wingtip modification designed for the KC-10 aircraft might well achieve greater fuel savings than were demonstrated on the DC-10 fitted with winglets some 25 years ago. In addition, recent winglet design experience using high Reynolds number (RN) wind tunnels could have applicability for winglet designs that may be more effective on the KC-10 and other government transport aircraft. As a result of all of this past work, the KC-10 fleet would require much less development time and effort to determine the effectiveness and suitability of various aerodynamic improvements.

KC-135R/T

The KC-135 airframe is closely related to the commercial Boeing 707. In the late 1970s and early 1980s, a joint National Aeronautics and Space Administration (NASA)/Air Force program was conducted to evaluate the benefits that could be achieved from retrofitting winglets on the KC-135 aircraft. The wind tunnel test indicated that winglets would reduce KC-135 aircraft drag by 6-8 percent[4], and flight tests with a KC-135 modified with winglets indicated substantial benefits. The study also indicated that the structural modifications required to install winglets on the KC-135s are a reasonable-size work package. Additional study would now be required to establish that the wings of these aging aircraft still meet the requirements of winglet installation.

C-5

Given that the C-5 is one of the largest contributors to Air Force's fuel consumption and that its missions are long range, a study to quantify the potential gains and the effects of integrating winglets is warranted. Unfortunately, unlike the KC-10 and the KC-135, on whose derivative commercial aircraft there has been a comprehensive winglet development effort, a C-5 fleet retrofit program would add a measurable nonrecurring cost and require expanding the time to recover the investment.

C-17

A number of design considerations led to the final winglet configuration on the C-17. One such consideration was that the wingspan was limited to that of the C-141 in order to maintain compatibility with facility infrastructure. The C-17 winglet was shown in wind tunnel testing to

[3] A.B. Taylor. 1983. "DC-10 Winglet Flight Evaluation Summary Report," NASA-CR-3748. December.

[4] NASA,1982, "KC-135 winglet program review," NASA Conference Publication 2111, January.

provide approximately 2.5 percent reduction in drag under cruise conditions. Also, flight testing showed no additional buffeting for takeoff or landing. However, while these benefits are considered to be substantial, the C-17 winglet was developed in a low RN wind tunnel. The low RN environment can give misleading results with regard to drag, buffet, pitching moment, and loads because the much higher RN of the full-scale flight vehicle exhibits different flow phenomena. Also, the C-17 configuration was developed in the 1980s, before the the full-scale wind tunnel at the National Transonic Facility became available and before modern Navier-Stokes CFD tools had been developed. With these new capabilities, a more accurate assessment of the current C-17 winglet design could be obtained. In addition, with these new tools and lessons learned from other winglet designs, it may be possible to improve the C-17 winglet design to provide another 1 percent or more cruise drag improvement.[5]

C-130

Compared with the gains realized for commercial airline applications, the performance benefits provided by wingtip modifications on the C-130 would be less. For one thing, the C-130's wing is already very efficient because its aspect ratio of 10 is relatively high. Another reason for the lower gain in expected winglet efficiency is the C-130's unswept wing with its lower tip loading. Since winglets are more effective for longer ranges and with higher wingtip loading (realized at higher altitudes), the potential benefit of winglets for the C-130 is limited.

Intelligence, Surveillance, and Reconnaissance Aircraft

While these aircraft are mentioned in the study's statement of task, the committee notes that they are not major fuel consumers, and their wings are already optimized for aerodynamic efficiency such that they would be expected to derive little benefit from wingtip modifications.

Other Air Force Aircraft

Finding: Most of the aircraft that are in the Air Force inventory that derive from commercial aircraft now operating with winglets already have winglets themselves, or the decision has been made to install winglets. The remaining Air Force aircraft that are derivatives of commercial aircraft do not appear to be good candidates for wingtip modifications.

The easiest decisions on whether to install winglets obviously pertain to commercial derivative aircraft in the Air Force inventory that derive from commercial aircraft now operating with winglets. In each case, the aircraft structure has already been studied and determined to be appropriate, the engineering design has been done, the modifications have been prototyped, tested, and certified, modification kits developed, flight manuals revised as required, and so on. However, the committee's review of all such Air Force aircraft revealed that most of them already have winglets or the decision has been made to incorporate winglets, as shown in Table S-2.

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[5] Robb Gregg. Senior Manager for Aircraft Programs. Boeing-Phantom Works. "Drag Improvement: A Study of the DC-10/MD-11/C-17 Winglet Programs." Presentation to the Committee on December 13, 2006.

TABLE S-2 Winglet Status of Air Force Aircraft Derived from Commercial Airframes

USAF Aircraft	Commercial Equivalent	Inventory	Winglets
C-9	Douglas DC-9-30	3	No
C-20B	Gulfstream GIII	5	Yes
C-20H	Gulfstream GIV, GIVSP	2	Yes
C-37	Gulfstream GV	9	Yes
C-21	Learjet 35A	59	No
C-40B	Boeing 737-700	4	Yes
C-40C	Boeing 737-700	3	Yes
VC-25	Boeing 747-200 (-300 wings)	2	No
E-4	Boeing 747-200	4	No
C-32	Boeing 757-200	4	Yes

SOURCE: Data provided by USAF.

All of these aircraft have winglets except for the C-9s, the C-21s, the VC-25s, and the E-4s. The three C-9s, derivatives of the DC-9, are scheduled to retire in FY11 and should not be considered for wingtip modifications. Also, past work on winglets for the DC-9, as discussed in Chapter 3, did not prove to be favorable. The C-21s, derivatives of the Learjet 35A, are small aircraft and the entire fleet uses less than 8 million gallons of fuel per year and would not be a priority for modifications. Furthermore, they have tip tanks, and wingtip modifications would require the removal of these tanks, severely limiting the range of these aircraft even with a more efficient wing. Lastly, the VC-25s and the E-4s are derivatives of the Boeing 747-200, with the VC-25s having 747-300 wings. The 747-200 has not been produced since the late 1980s, so the commercial fleet is aging and retiring from service. As a result, the entire cost of winglets designed for 747-200/300 wings would have to be borne by the government. All of the Boeing 747s in the commercial world that have winglets are 747-400s, which have a structurally modified wing. The structural modification to allow installing the 747-400 wingtip on the VC-25s or the E-4s would be very expensive and impractical.

Preliminary Net Present Value Analysis

The committee followed up the qualitative analysis described above with a preliminary NPV analysis based on a simple spreadsheet model that considered a range of assumed modification costs and fuel savings for the most promising aircraft identified above. These preliminary NPV calculations confirm that wingtip modifications should be seriously considered for the KC-135R/T and KC-10 (see "Fuel Price Analysis," below). However, a detailed engineering and economic analysis would be required for each aircraft type before a final decision could be made to proceed with the installation of winglets or other aerodynamic modifications.

Recommendation: The Air Force should initiate an engineering analysis with the original equipment manufacturers (OEMs) to determine (1) the extent and cost of modifications needed for the KC-135R/T and the KC-10 to enable installation of wingtip devices and (2) the fuel savings that could be achieved by this modification for each aircraft type. It should then perform an NPV analysis with these data to calculate the net savings. The Air Force should also analyze the C-5 and C-17 for potential wingtip modifications.

The original equipment manufacturers (OEMs) have the detailed knowledge of wing designs and previous modifications that is necessary for carrying out these analysis. The results should be shared with the other Services operating similar aircraft.

Fuel Price Analysis

To illustrate the types of costs and benefits that might be realized through wingtip modifications (e.g., winglets) that would produce a reduction in fuel burn, the committee performed its own preliminary NPV analysis for the KC-135R/T and the KC-10. The analysis was used to determine whether wingtip modifications for selected aircraft would pay for themselves well before the aircraft are due to retire. Since it is not possible to know the modification costs and fuel savings without performing a detailed engineering analysis, these were treated as parameters in the model. The range for modification costs was chosen from list prices and committee estimations. For fuel savings, the calculations were done for block fuel savings of 3 percent and 5 percent, consistent with commercial airline experience and the findings of this report. Results were calculated for the worst case (highest modification cost and lowest fuel savings) and the best case (lowest modification cost and highest fuel savings) payback periods at a fuel cost of $2.50 per gallon. The committee assumed an annual fuel cost escalation rate of 3 percent and a discount rate of 3 percent.

In the KC-135R/T best case, net savings become positive 9 years after starting the modification program. All 417 aircraft in the inventory are modified. Total net savings to the Air Force are approximately $400 million (FY07 $). In the KC-135R/T worst case, net savings become positive 24 years after starting the modification program. Only 217 of the 417 aircraft in the inventory are modified (the others are not modified because they are expected to be retired from the inventory before reaching the ends of their payback periods). Total net savings to the Air Force are approximately $36 million (FY07 $).

In the KC-10 best case, net savings become positive 8 years after starting the modification program. All 59 aircraft in the inventory are modified. Total net savings to the Air Force are approximately $221 million (FY07 $). In the KC-10 worst case, net savings become positive 23 years after starting the modification program. Only 53 of the 59 aircraft in the inventory are modified (the others are not modified because they are expected to be retired from the inventory before reaching the ends of their payback periods). Total net savings to the Air Force are approximately $12 million (FY 07 $).

The price per gallon of fuel was also parameterized at $2.50, $5.00, $10.00, and $20.00 to account for the fully burdened cost of fuel. In constant dollars, when the cost of fuel is doubled, the payback period is cut in half. Total net savings to the Air Force rise significantly.

These numbers are illustrative only, and more accurate estimates of breakeven fuel prices would require engineering analysis to determine actual modification costs and the fuel savings potential for each aircraft.

Impacts on Aircraft Maintenance and Flight Operations

Commercial experience with aircraft that have installed winglets has shown that there have been no significant impacts on aircraft maintenance, flight operations, or ground operations (gate space, taxiways, hangars, etc.). Similarly the Air Force has not experienced any significant impacts on aircraft maintenance or flight operations for aircraft it currently operates with winglets, and the committee does not expect any major problems with modifications to other aircraft under consideration.

Investment Strategies

Implementing the Modifications

Should the decision be to proceed with wingtip modification on the KC-10, the committee recommends the work be done while the aircraft are in normal scheduled overhaul. Since the KC-10 is maintained on contract with industry engineers who have intimate knowledge of commercial DC-10s, it is possible that wingtip modification could be added to the work specification with little or no added downtime or loss of operational availability.

Much of the same applies to the KC-135R/T aircraft fleet, except that unlike the KC-10, many of these aircraft are maintained by Air Force personnel in-house. The committee therefore believes that the wingtips could be retrofitted while the aircraft are undergoing their 5-year cycle of programmed depot maintenance. Rather than divert Air Force mechanics from other tasks, however, it might be wiser to partner with industry and have an experienced contract field team work with the Air Force mechanics to accomplish the modification. For the KC-135 R/T undergoing programmed depot maintenance at contractor facilities, the Air Force should consider adding any proposed wingtip modifications to the existing overhaul contract. This would minimize training and allow returning the aircraft to the Air Force in the shortest possible time.

Financing Options

Wingtip modification programs and other fuel economy investments are examples of long-term investments that may require a significant initial investment that provides returns over time. Securing financing for such long-term investments is always a challenge given the current military acquisition practices and congressional appropriation processes. In a previous report on engine fuel economy in military aircraft,[6] the NRC discussed innovative financing mechanisms that might be pursued. The statement of task for that study included a request to "develop implementation strategies to include conventional, as well as innovative, acquisition, financing, and support concepts."[7] The committee believes that three of the mechanisms discussed in that report—specifically, creating a line item in the defense budget, implementing an "Energy Savings Performance Contract" strategy, and competing airframe maintenance contracts—could be applicable in implementing wingtip modifications. Those mechanisms are discussed in some detail in the earlier report.

CONCLUDING REMARKS

It is clear that aerodynamic improvements, including winglets, can make significant contributions to the efficiency of aircraft and should be considered for the military fleets discussed in this report. In each case, however, the appropriateness of such structural modifications must be determined on a fleet by fleet basis. These decisions are very complex and will depend on many factors, including the design of the aircraft structures, design margin within those structures, the condition of the structures, mission profiles, utilization rates, fuel consumption rates, fuel prices, and the remaining life of the aircraft. The Air Force should support the analysis required and make the appropriate modifications as quickly as possible. There are also other methods to reduce fuel consumption, many of which have already been adopted by the commercial airlines. The committee believes it is important for these other

[6]NRC, 2007, *Improving the Efficiency of Engines for Large Nonfighter Aircraft*, Washington, D.C., The National Academies Press, prepublication.

[7] Ibid.

strategies to be considered, and while they were not the focus of this study and the extent to which the Air Force may already be using some of these strategies was not examined, examples are provided in Appendix B for the reader's benefit.

1

Background and Overview

INTRODUCTION

Since the 1970s, when the price of aviation fuel began to spiral upward, airlines and aircraft manufacturers have explored many ways to reduce fuel consumption by improving the operating efficiency of their aircraft. Fuel economy concerns have been particularly keen for operators of commercial aircraft, which typically fly many hours per day in competitive markets, but they have been growing for military aircraft as well. The fuel consumed by the U.S. Air Force is in excess of 3 billion gallons per year, which is over 8 million gallons per day.[1] The stated Air Force policy is now to "make energy a consideration in all Air Force actions" and to "promote a culture in which airmen conserve energy."[2] More generally, reduced energy consumption and reduced dependence on foreign oil have become strategic goals of the U.S. Department of Defense (DOD).[3]

Broadly speaking, the fuel economy of an aircraft can be thought of as having three components: the efficiency of the engines, the aerodynamic performance, and the weight efficiency. In a recent report, the National Research Council (NRC) examined the potential for improving engine performance in military aircraft, and briefly discussed various aerodynamic improvements.[4] This report examines potential aerodynamic improvements in large military tanker and transport aircraft in greater detail, in particular the potential for the modification of the wingtips to reduce aerodynamic drag. An example of such a wingtip modification is the "winglet" now seen on many commercial jet aircraft and some military aircraft, shown in Figure 1-1; however, many other aerodynamic improvements are possible.

The concept of winglets was originally developed in the late 1800s by British aerodynamicist F.W. Lancaster, who patented the idea that a vertical surface at the wingtip would reduce drag.[5] The idea was refined by Richard Whitcomb at the National Aeronautics and Space Administration (NASA) Langley Research Center in the late 1970s, who designed a winglet using advanced airfoil concepts integrated into a swept, tapered platform that would interact with the wingtip airflow and circulation to reduce drag. Dr. Whitcomb proved the efficacy of winglets in wind tunnel and computer studies.[6]

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[1]Fuel Usage by MDS for FY05. Defense Energy Support Center (DESC), 2006. Ft. Belvoir, Va.

[2]Ron Sega, Under Secretary of the Air Force, "Air Force Energy Strategy," Presentation to the committee on April 19, 2006.

[3]Terry Pudas, Acting Director, Office of Force Transformation, U.S. Department of Defense, "Transformation Trends," Presentation to the committee on June 12, 2006.

[4]National Research Council, *Improving the Efficiency of Engines for Large Nonfighter Aircraft*, Washington, D.C., The National Academies Press, 2007, prepublication version.

[5]Joseph R. Chambers, 2003Concept to Reality: Contributions of the Langley Research Center to U.S. Civil Aircraft of the 1990s. NASA SP-2003-4529. 2003. Available on at http://oea.larc.nasa.gov/PAIS/ Concept2Reality. Last accessed on February 26, 2007.

[6]Ibid.

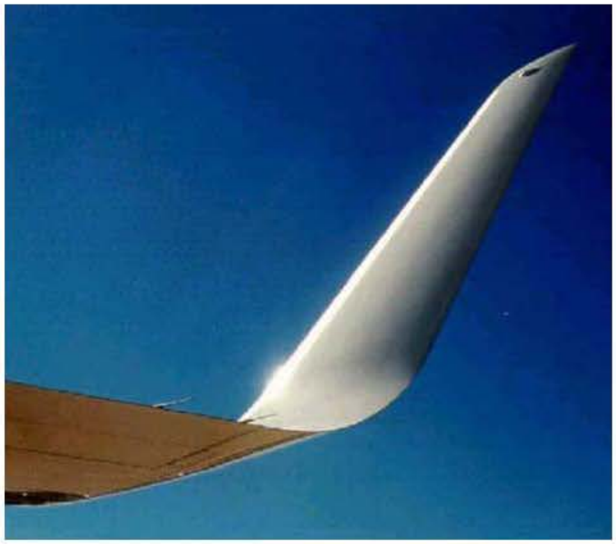

FIGURE 1-1 A common wingtip modification is the "winglet." SOURCE: Courtesy of Aviation Partners Boeing.

The first commercial aircraft to use winglets were corporate-size Learjets in 1977, and the first big jetliner to feature winglets was the B747-400, followed by the MD-11.[7] Winglets and wingtip modifications are now standard equipment on many business jets and jetliners (e.g., A320/330/340/380, B747-400). In addition, winglet options are now offered on Boeing 737 aircraft. Winglets are also original equipment on the C-17 military transport. Winglet retrofit kits and services are available for the modification of older aircraft.[8]

In addition to improved fuel economy—which tests suggest may be as high as 5 percent (this may be traded off to obtain increased range)—aircraft manufacturers and winglet retrofit companies have reported that winglets offer higher operating altitudes, improved aircraft roll rates, shorter time-to-climb rates, lower takeoff speeds, and less takeoff noise. In the commercial world, winglets have not only reduced fuel costs but have also increased operational flexibility, by, for example, bringing new international destinations within range and increasing payload capability at airports at high altitudes or with shorter runways.

The payback time for wingtip modification investments in large military tankers and transport aircraft is likely to be longer than the time for the corresponding commercial aircraft, since on average these military aircraft fly many fewer hours per year than do commercial jetliners. However, in combination with fuel savings, the ancillary operational flexibility offered by winglets may make a winglet retrofit a good idea for certain types of military aircraft. This is the issue examined in this report.

STATEMENT OF TASK

As noted in the preface, this report follows up on an earlier NRC study requested by the U.S. Air Force dealing with the re-engining of military aircraft. The following four tasks are addressed in this report:

[7]Ibid.

[8]Aviation Partners Boeing.

1. Examine the feasibility of modifying Air Force airlift; aerial refueling; and intelligence, surveillance, and reconnaissance aircraft with winglets, to include a cost-effectiveness analysis of the feasible winglet modifications in net present value (NPV) terms.
2. Determine the market price of aviation fuel at which incorporating winglets would be beneficial for each platform.
3. Consider impacts to aircraft maintenance and flight operations (including ground operations).
4. Offer investment strategies the Air Force could implement with commercial partners to minimize Air Force capital investment and maximize investment return.

SCOPE AND COMMITTEE APPROACH

Although the statement of task SOT specifically uses the term "winglet," which typically refers to a nearly vertical surface located at the wingtip, the committee chose to broaden the scope of its deliberations slightly to include a variety of possible modifications to the wingtip (e.g., wingtip extensions) that can have a similar impact on fuel economy and aerodynamic performance. Thus, in this report, winglet denotes the traditional, nearly vertical wingtip design, while the phrase 'wingtip modifications' will be used to refer to the more general set of wingtip designs, including winglets and wingtip extensions, aimed at reducing aerodynamic drag. In addition, given the SOT's emphasis on fuel economy, the committee also considered a variety of possible aerodynamic modifications and operational changes to the aircraft (e.g., improved pressure seals, improved control systems) that would be expected to be relatively simple and inexpensive to implement and that, taken together, might provide fuel economy benefits comparable to those provided by wingtip modifications. Since they were outside its charter, the committee did not examine these other methods in detail, or the extent to which the Air Force may already be using some of these methods. Likewise, it did not make any formal recommendations concerning them. However, the committee suggests this is an area that should be considered as potentially providing significant fuel savings to the Air Force.

The committee also recognized that some of the other reported benefits of wingtip modifications, such as increased range/endurance, ability to utilize shorter runways, increased payload, and decreased time-to-climb, might be particularly valuable for certain Air Force missions, and that wingtip modifications might therefore be justified for reasons other than fuel cost savings.[9] While it was not possible to quantify these benefits exactly, the committee sought to consider them qualitatively in its assessment.

In tackling Task 1, the committee first generated a list of all Air Force aircraft that would be candidates for retrofit wingtip modifications. The committee assessed the missions and typical flight profiles of those that do not currently have wingtip modifications to identify the most promising subset of aircraft to subject to a more detailed analysis. Based on the testimony of representatives of aircraft manufacturers and on information provided by the Air Force, the committee sought to determine qualitatively the cost—including the cost of engineering analysis, structural modification to the wing, and so forth—of retrofitting each system compared to the fuel savings predicted to accrue. For aircraft that already have wingtip modifications, the committee assessed whether further aerodynamic improvements for even more fuel efficiency were warranted.

Task 2 seeks to determine a price for aviation fuel at which the cost of wingtip modification retrofits is justified by fuel cost savings alone. For the most promising subset of aircraft identified in Task 1, the committee estimated the cost of wingtip modification retrofit based on the estimated cost of retrofitting comparable commercial aircraft. By also estimating the potential fuel savings together with the number of these aircraft, the committee performed preliminary

[9] Some of these benefits, such as increased payload and range, must be traded off for fuel savings.

NPV calculations to calculate whether wingtip modifications for selected military aircraft would pay for itself well before the aircraft is due to be retired. Recognizing that the cost of fuel delivered to the location where it is used may be many times higher for military aircraft than for commercial aircraft,[10] the committee treated fuel cost as a parameter that could be varied over a large range.

As required by Task 3, the committee considered the impact of wingtip modifications on maintenance (depot and field) and flight operations (including hangars, runways, taxiways, and mission requirements), basing its analysis on experience with comparable commercial aircraft.

For those Air Force aircraft that the committee judged were the most promising candidates for wingtip modifications, the committee suggests investment strategies, as called for by Task 4.

STRUCTURE OF THIS REPORT

Chapter 2 discusses how wingtip modifications work including how they affect aerodynamic performance. It identifies the various benefits and potential negative impacts of wingtip modifications. Chapter 3 summarizes the commercial and military experience with wingtip modifications, as well as lessons drawn from past studies and experience. In Chapter 4, the committee identifies the Air Force aircraft it found to be the best candidates for wingtip modifications based on the suitability factors discussed in Chapter 2. This is followed by a qualitative analysis of the relative costs and benefits of retrofitting wingtip modifications on these aircraft, as well as a discussion of appropriate strategies the Air Force should use to maximize its fuel economy investments. Additional methods that might be considered by the Air Force to improve fuel economy, such as other aerodynamic changes, improving maintenance and operations, and reducing unnecessary weight, are discussed in Appendix B.

[10]AFSAB (Air Force Scientific Advisory Board), 2006, Technology Options for Improved Air Vehicle Fuel Efficiency: Executive Summary and Annotated Brief. SAB-TR-06-04, May.

2

Wingtip Modifications

HISTORY OF WINGTIP DEVICES

Within a few years of the first heavier than-air-flight, the idea of beneficial wingtip devices was introduced. Lanchester patented the concept of a wing end plate in 1897 and suggested that it would reduce wing drag at low speeds. Theoretical studies of end plates by Munk in 1921[1] were followed by von Karman and Burgers[2] and Mangler[3] in the 1930's, and well-known papers on nonplanar wings were published by Cone in 1962[4] and Lundry and Lissaman in 1968.[5] This work was paralleled by many experimental studies (see, for example, NACA work from 1928[6] to 1950[7]), most of which did not attain the potential savings suggested by the theory. This was partly due to simplistic design, which often included low-aspect-ratio, untwisted, flat-plate airfoils. Recognition of the importance of winglet location, twist and aspect ratio was clear in the patent of Vogt in 1951[8] and in a variety of other nonplanar wingtip geometries, studied and patented by Cone.[9] In the early 1970s, Whitcomb[10] of the National Aeronautics and Space Administration (NASA) defined and tested high-aspect-ratio, carefully designed nonplanar wingtips, termed "winglets," which were soon to appear on numerous aircraft, including Rutan's VariEze in 1975 and the Learjet 28/29 in 1977. The winglet of the Boeing 747-400 has a much lower dihedral angle than the Whitcomb winglet, and since that time, numerous vertical, canted, and horizontal wingtip extensions have been put into commercial and military service, as shown in Figure 2-1.

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[1] M.M. Munk, 1921, "The minimum induced drag of aerofoils," NACA Report 121.

[2] T. von Karman and J.M. Burgers, "General aerodynamic theory—perfect fluids," In *Aerodynamic Theory,* W.F. Durand ed., Julius Springer-Verlag, Berlin/Vienna, 1934-1936, and Dover Publications, New York, 1963), Div. E, Vol. II, pp. 216-221.

[3] W. Mangler, 1938, "The lift distribution of wings with end plates," NACA TM 856; transl. by J. Vanier from "Die Auftriebsverteilung am Tragflugel mit Endscheiben," *Luftfahrtforschung* 14: 564-569.

[4] C.D. Cone, Minimum Induced Drag Airfoil Body, U.S. Patent 3,270,988, September 1966.

[5] J.L. Lundry and P.B.S. Llssaman, 1968, "A numerical solution for the minimum induced drag of nonplanar wings," *Journal of Aircraft* 5 (1).

[6] Paul E. Hemke, 1928, "Drag of wings with end plates," NACA TR-267.

[7] John M. Riebe and James M. Watson, 1950, "The effect of end plates on swept wings at low speed," NACA TN-2229.

[8] Vogt, Richard, Twisted Wing Tip Fin for Airplanes, U.S. Patent 2,576,981, December 1951.

[9] C.D. Cone, Minimum Induced Drag Airfoil Body, U.S. Patent 3,270,988, September 1966.

[10] Richard T. Whitcomb, 1976, "A design approach and selected wind-tunnel results at high subsonic speeds for wing-tip mounted winglets," NASA TN D-8260.

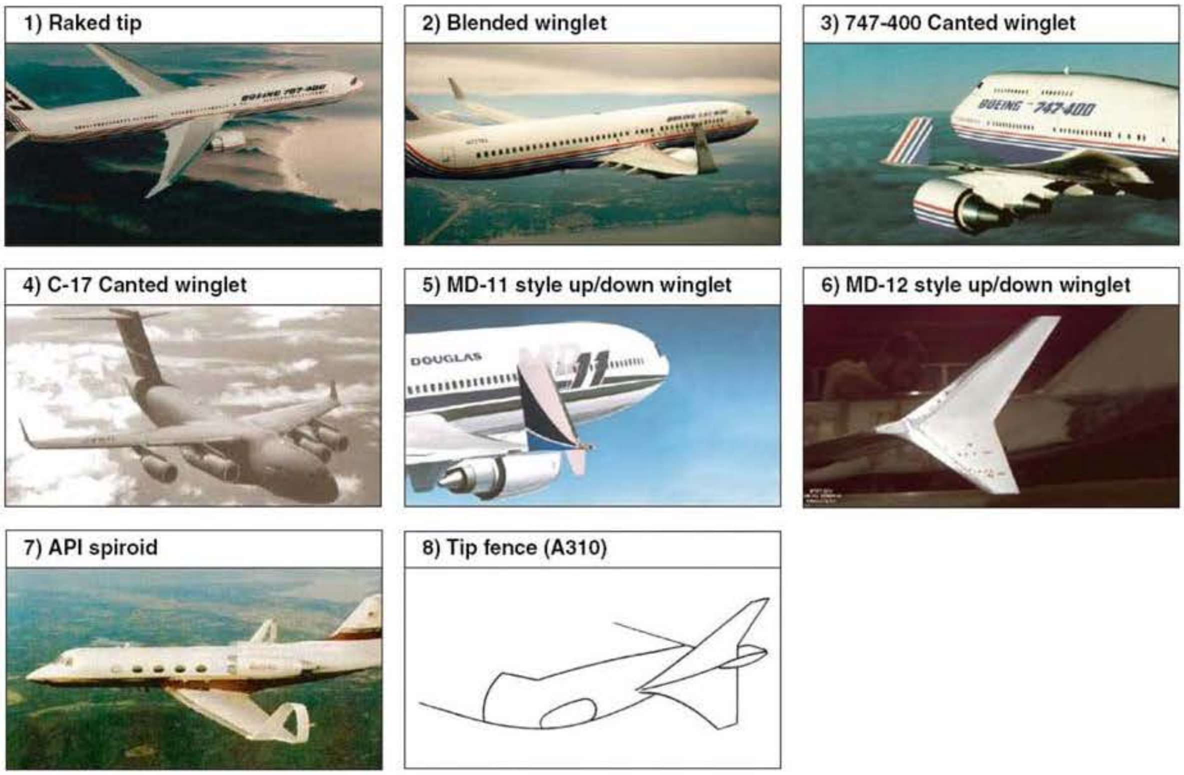

FIGURE 2-1 Wingtip modifications with a variety of geometries have been tested and deployed on both commercial and military aircraft. SOURCE: Courtesy of Doug McLean, "Wingtip devices: What they do and how they do it," presentation at Boeing Performance and Flight Operations Engineering Conference, September 2005.

INTRODUCTION TO WINGTIP AERODYNAMICS

Much of the drag of an aircraft is related to the lift generated by its wing. To create this lift, the wing pushes downward on the air it encounters and leaves behind a wake with a complex field of velocities. This air behind the wing moves downward then outward, while the air outboard of the wing tips moves upward, then inward, forming two large vortices, as shown in Figure 2-2.

The energy required to create this wake is reflected in the airplane "induced," or "vortex" drag. For most aircraft, induced drag constitutes a large fraction, typically 40 percent, of cruise drag. During takeoff, induced drag is even more significant, typically accounting for 80-90 percent of the aircraft's climb drag. And while takeoff constitutes only a short portion of the flight, changes in aircraft performance at these conditions influence the overall design, and so have an indirect, but powerful, effect on the aircraft's cruise performance. Consequently, concepts that reduce induced drag can have significant effects on fuel consumption.[11]

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[11] Ilan Kroo, 2005, "Nonplanar wing concepts for increased aircraft efficiency," VKI Lecture Series on Innovative Configurations and Advanced Concepts for Future Civil Aircraft, June 6-10.

FIGURE 2-2 The vortex wake behind lifting wings descending through a thin cloud layer. SOURCE: Airliners.net. Photo courtesy of S.C. Morris; copyright by Steve Morris.

Note that the wake flow pattern illustrated in Figure 2-2 is a gross feature of the wing lift generation—it is not a localized phenomena associated with wing tip geometry—so that reduction of the induced drag requires more than a small device at the tip. The basic method by which the vortex drag may be reduced is to increase the horizontal or vertical extent of the wing: By increasing the wing dimensions, a larger mass of air can be affected by a smaller amount to produce a given lift, and this leads to less energy in the wake and lower induced drag. So, perhaps the simplest means to reduce induced drag is to increase wingspan through horizontal wingtip extensions. However, in some cases this modification may not be appropriate because of explicit geometric constraints such as hangar width; in others it may not be desirable because of the increased structural weight of the wing, which must be designed to carry greater bending loads. On the other hand, adding vertical wing extensions creates many of the same effects as increasing the wing span (although one must add a bit more than twice the length of wing vertically to achieve the same savings as a horizontal extension). Vertical wing extensions (e.g., winglets) increase the effective span of the wing, lowering induced drag but increasing wing bending moments. They impose different and sometimes more acceptable challenges than horizontal wingtip extensions.

DESIGN OF WINGTIP DEVICES

Winglets are a visible sign of an improvement that is often perceived as high technology, and this apparently appeals to a segment of the commercial customer community. But from an aerodynamicist's point of view, the motivation behind most wingtip devices is to reduce induced drag. Beyond that, as Whitcomb showed, the designer's job is to configure the device so as to minimize the offsetting penalties, resulting in a net performance improvement. There are also aerodynamic and structural aspects that must be considered in the design of the wingtip device. The performance improvement for any particular wingtip device can be measured relative to the performance of the same airplane with no tip device.

Aerodynamic factors potentially offsetting these the induced drag savings include an increase in the profile drag due to increased wetted area and junction flows, high sectional loadings, and so on and an increase in the trim drag resulting from increased outboard loading. The amount of trim drag increase is dependent on the specific aircraft and the ability to control the cruise center-of-gravity (CG) location (e.g., via fuel management). Increased outboard loading also increases the deflection of the wing at cruise, reducing the drag benefit relative to using a tip device on a theoretical rigid wing. Thus, the benefit associated with the tip device will depend on the specific aircraft and the structural margins of the wing. Finally, the wingtip device adds weight that comes not only from the device itself and its attachment fitting, but also from any structural modifications to the existing wing to allow it to handle the additional static loads and to meet flutter and fatigue requirements.

Optimal Wing Span

As stated earlier, induced drag can usually be reduced by simply increasing wingspan, with a resulting reduction in total fuel consumption. Why, then, do aircraft have the limited spans they do if larger spans almost always reduce drag? There are two principal reasons for this:

- Aircraft are often span-constrained due to infrastructure and operational considerations such as hangar, gate, or taxiway dimensions. For instance, the A380 was limited to a 262.5 ft span to be compatible with large airport infrastructures. Naval aircraft are often span-constrained by aircraft carrier elevator dimensions and deck limitations.
- Larger spans generally entail larger structural loads on the wings and therefore increased material and manufacturing cost. Eventually, the increased structural weight offsets the drag advantage of larger spans, but simple scaling laws suggest that this does not occur until the wings weigh about one-third as much as the total airplane. Nonetheless, the increased weight and cost of larger span wings leads to diminishing returns as span is increased. This, combined with the geometric issues noted above, leads to the choice of optimal span.

Many aircraft in the Air Force inventory were designed at a time when fuel costs were far lower than they are today — especially when the fully burdened cost of delivered fuel is considered. However, as fuel costs increase, the optimal span increases, since the ratio of fuel cost to manufacturing costs becomes larger. This means that if these same aircraft were being designed today, their spans would likely be larger than those of the aircraft in the current fleet.

To improve fuel economy, several options are possible. One could buy new aircraft designed for current and future fuel costs; redesign the wings of the most widely used aircraft and re-wing the existing airframes; or modify just a portion of the existing wings (by installing a retrofit device) to achieve a portion of the potential fuel savings. Retrofitting existing wings may be the lowest cost option in the near term. This option is especially attractive for aircraft having substantial structural margins.

Wing Retrofits

Several approaches to wing retrofits, which increase the effective aerodynamic span, are possible. The addition of winglets is perhaps the most obvious approach — obvious because of the recent success of winglet retrofits for the Boeing 737s and 757s, and because the effective span may be increased without changes to the geometric span. Simple wingtip span extensions are also viable alternatives for reducing fuel consumption. Rather than adding winglets with a height of 10 ft, one could add 5-ft horizontal span extensions to each wingtip and achieve similar drag savings. Span extensions have been added to many commercial aircraft such as the DC-9, DC-10 and Boeing 767. They are less obvious than winglets, but can also reduce fuel consumption–and, depending on the details of the original design, may be more effective. Some aircraft growth versions have included both tip extensions and root plugs (DC-9 Series 50 to MD-80).[12] This approach involves more substantial modification of the wing but can produce greater fuel savings than simple tip modifications, adding wing area and permitting higher root bending loads than would be possible with tip changes alone.

Whether a specific existing wing is best modified by adding winglets or wingtip span extensions depends on many factors. If an aircraft is span constrained, a well-designed winglet can provide a significant reduction in drag. However, if an aircraft is not span constrained, whether to use winglets or tip extensions is less clear. Both winglets and tip extensions add bending loads, subsequently increasing the wing weight. In one study allowing for identical increases in root bending moments, winglets produced better results than tip extensions.[13] However, in another study in which integrated bending moments were constrained, winglets and tip extension produced the same results.[14] Both of these studies employed highly simplified models of the wing structure. In practice, the existing structure and load distribution must be considered. If, for example, substantial structural margins are available on the outer portion of a wing (e.g., due to minimum gauge constraints), but little at the root, a winglet might be more easily added than a span extension.

The geometry of the best wing extension or winglet retrofit also depends on other critical structural constraints. If flutter is critical, the reduced torsional frequencies created by winglets may lead to the choice of a smaller horizontal extension. Similarly, if large sideslips at high dynamic pressure are required for military operation, winglet loads could exceed loads of conventional span extensions. These various constraints make it difficult to generalize about winglets versus tip extensions. Also, stability and control changes can often be accommodated with either modification, but as with structural considerations, they must be treated in detail on a case-by-case basis.

BENEFITS OF WINGTIP MODIFICATIONS

A net aerodynamic performance improvement made possible by wingtip modifications is satisfying to an engineer, but for an airplane manufacturer or operator the objective is to realize the kind of bottom-line benefits that translate into real savings as measured by cost, noise, engine exhaust emissions, operational flexibility, etc. The potential bottom-line benefits of wingtip devices are reduced fuel burn, increased capability, and improved performance, described below in order of importance.

Reduced Fuel Burn

By reducing drag, wingtip devices help the aircraft operate more efficiently and, in turn, reduce fuel burn. The fuel savings benefits of wingtip modifications depend on the mission flight profile, particularly the range and time spent at cruise speed. Commercial experience with winglet retrofits on the Boeing 737-300/700/800 indicate a 1.5 percent block fuel savings for trips of 250

[12] The terms "root plug" and "root insert" refer to a modification to a wing in which span is added at the inboard end of the wing, adjacent to the fuselage. This is similar to a tip extension, which is added at the wingtip. For example, the MD-80 uses both a root insert and a tip extension.

[13] H.H. Heyson, G.D. Riebe, C.L. Fulton, 1977, "Theoretical parametric study of the relative advantages of winglets and wing-tip extensions." NASA Technical Paper-1020.

[14] R.T. Jones, and T.A. Lasinski, 1980, "Effects of winglets on the induced drag of ideal wing shapes," NASA Technical Memorandum-81230.

nautical miles (nmi), increasing to 4 percent for trips of 2,000 nmi.[15] For the Boeing 757-200 and 767-300, block fuel savings were 2 percent for 500 nmi trips and 6 percent for 6,000 nmi. On an annual basis, winglets were projected to result in savings to commercial operators of up to 130,000 gallons of fuel per aircraft on the B737-800 and up to 300,000 gallons per aircraft on the B757-200.[16] Reduced fuel consumption translates directly into a reduction in operating cost.

Increased Payload-Range Capability

If less fuel is required to accomplish a particular mission at a specific takeoff weight, then that credit can be realized in more than one way. For example, the aircraft can carry more weight (more payload) the same distance or it can carry the same payload further (greater range). Figure 2-3 show the increase in payload-range capability made possible by winglets on one commercial aircraft, the Boeing 737-800. The benefits begin to become apparent for ranges beyond 2,000 nmi. Between 2,000 and 3,000 nmi range, winglets enable 80 nmi more range or 910 lb more payload. Beyond 3,000 nmi range, winglets allow for 130 nmi more range or 5,800 lb more payload.[17] In the commercial world, this capability translates into operational flexibility — for example it allows, substitution of aircraft used along certain routes or the opening up of new routes and destinations that were not previously within range.

The increased payload-range capability is valued in military aircraft applications just as it is in commercial aircraft applications. Carrying more payload to the same distance could mean in fewer sorties to accomplish a specific goal, or it could allow servicing more customers with the same number of operational aircraft.

Improved Takeoff Performance

The reduced drag associated with wingtip modifications reduces the thrust levels required for takeoff, (reducing community noise at the same time) and enables faster second-segment climb. This increased climb rate allows the use of airports having shorter runways and allows for operations from airports located at higher altitudes and in hotter climates, or they may be traded for carrying higher payloads or a combination of both.

Critical performance constraints for military aircraft can be dictated by either airfield constraints or a combat situation. For example, at an airfield in hostile territory, a steep climb out may be desired to reduce the time an aircraft is vulnerable to surface-to-air threat systems around the airfield. Another example would be takeoff and landing constraints at a commercial airport where military tankers, airlift, or ISR platforms may also have to operate.

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[15] Jay Inman, Vice President of Programs, Aviation Partners Boeing, "Blended winglets." Presentation to the Committee on Analysis of Air Force Engine Efficiency Improvement Options for Large Non-Fighter Aircraft on June 14, 2006.

[16] Ibid.

[17] Ibid.

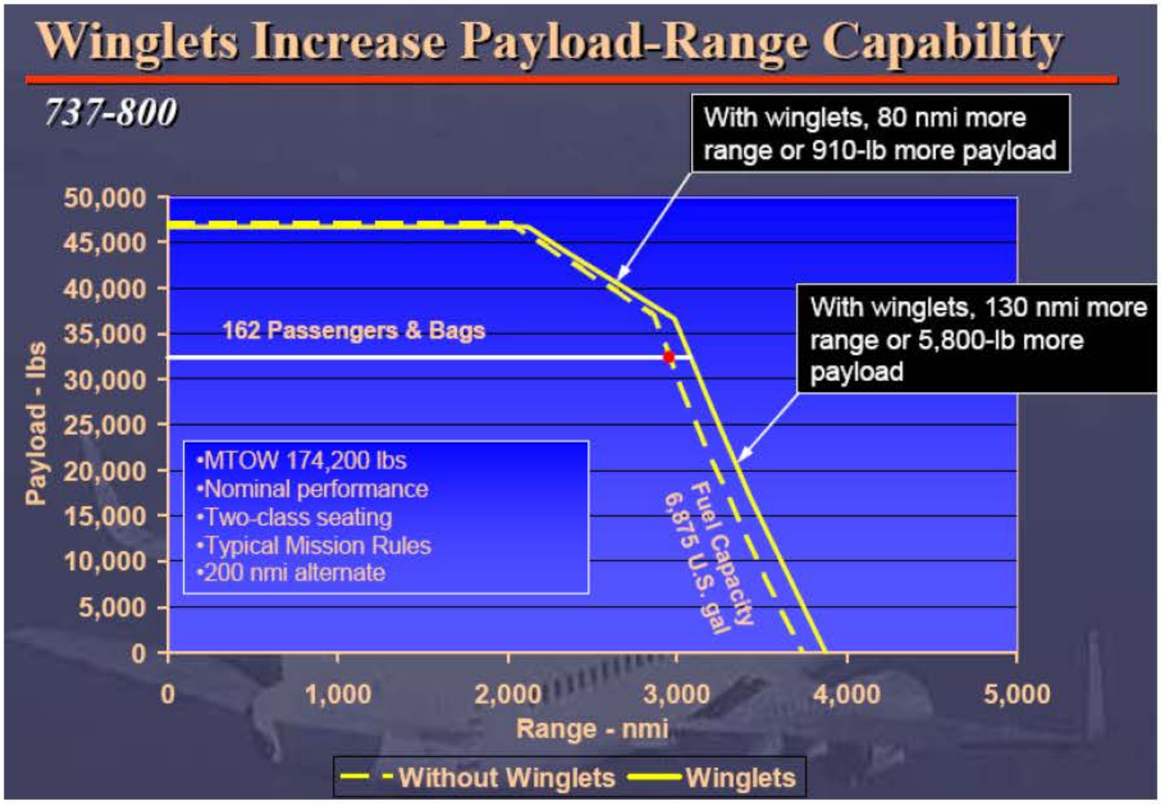

FIGURE 2-3 Winglets increase payload-range capability for the Boeing 737-800, SOURCE: Courtesy of Aviation Partners Boeing, presentation to the Committee on Analysis of Air Force Engine Efficiency Improvement Options for Large, Non-Fighter Aircraft, June 14, 2006.

CHALLENGES ASSOCIATED WITH WINGTIP MODIFICATIONS

The potential benefits of wingtip modifications do not come without a price. Offsetting factors include the cost of the modification, added weight, added span and height, and potential interference with other wing equipment. These offsetting considerations are discussed below.

Cost

The costs of a wingtip modification retrofit include the costs for the nonrecurring engineering, for the modification of the wing itself, tip device design, manufacturing, and installation. To determine if a wingtip modification is cost-effective, the extent and cost of the nonrecurring engineering and of modifying the existing wing must be calculated. The wing modification costs depend on specific wing characteristics, including structural margins and loadings, as well the strength remaining in light of structural fatigue and corrosion. The wing modifications required to accommodate a tip device could be extensive.

Currently, a winglet retrofit kit for a suitable narrow body commercial jetliner like the Boeing 737 ranges in cost from $500,000 to $1 million per aircraft. For a wide-body like the Boeing 767, the costs are between $1 million and $1.5 million. For a jumbo-sized aircraft like the Boeing 747, the costs would probably be higher.[18]

[18] Costs based on list prices and committee estimates.

Military aircraft having a close commercial analog that has been evaluated or fitted with tip devices could have substantially lower nonrecurring engineering costs because of this existing knowledge. For example, the C-32 is based on the Boeing 757-200, which has already been modified with winglets; therefore, that experience can inform the decisions regarding the C-32.[19] Similarly, in the 1980s the suitability of winglets on the KC-135 was studied.[20] This previous work could help to inform a winglet retrofit decision today. However, the KC-135s are now more than 20 years older, and the current condition of their wings would need to be evaluated.

Winglets may have a smaller nonrecurring statement of work than other means of achieving similar improvements. For example, a re-engine program can also improve fuel burn, operational flexibility, and takeoff performance. If the magnitude of the needed improvements is similar, the winglet solution would almost certainly be less costly.

Added Weight

There are two components of added weight: (1) any modifications to the wing that might add weight (e.g., stiffening of the wing to satisfy static and dynamic requirements) and (2) the weight of the winglets themselves. As examples, commercial designs have yielded total modification weights (winglet plus wing modification) of 340 lb for the 737-700 and 1,328 lb for the 757-200.[21]

Added Span and Height

The height of a winglet varies but can be as great as 10-20 ft. A winglet can also increase the wingspan by several feet. These dimensions impact airfield operations such as parking, taxiing, and maneuvering the aircraft on the ground. If space is critical, a few additional feet of span per aircraft could limit the number that can be on an airfield at any given time, also known as "maximum on ground" (MOG). This could constrain throughput for cargo and tanker aircraft, in particular. Winglet height could be an issue if there are obstacles that the winglet would hit when parking or taxiing, damaging both the winglet and obstacle.

However, winglets may be more compatible with existing infrastructure than, say, wingtip extensions. For the same aerodynamic improvement, winglets typically add less span to the airplane than a wingtip extension and might enable the continued use of existing ramp space, gates, hangars, etc.

Interference with Other Wing Equipment

Wingtip modifications might also impact other wing requirements. For example, a winglet might interfere with antennas or sensor equipment on military airplanes. Wingtip modifications might also impact airplane lighting solutions, anti-icing system requirements, and lightning strike dissipation solutions. Winglets can be efficient ice collectors and raise ice protection issues. Such problems should be thoroughly assessed before committing to any wingtip modification solution. Also, wingtip modifications may alter the effectiveness of high lift or control devices by changing their aerodynamic loading either favorably or adversely. Wings with outboard lateral control devices (ailerons, spoilers, and the like) may be particularly susceptible to changes resulting from the addition of a wingtip device such as a winglet or a wingtip extension.

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[19] The C-32 was recommended for winglet modification in the Department of Defense Appropriations Bill for 2007 and signed into law on September 29, 2006.

[20] NASA, 1982, "KC-135 winglet program review," NASA Conference Publication 2111, January.

[21] Jay Inman, Vice President of Programs, Aviation Partners Boeing, "Blended winglets." Presentation to the Committee on Analysis of Air Force Engine Efficiency Improvement Options for Large Non-Fighter Aircraft on June 14, 2006.

GENERAL OBSERVATIONS

In summary, there are many questions that have to be answered and trade-offs that have to be evaluated in determining whether or not to invest in wingtip modifications. Do wingtip devices require that the wing be strengthened in order, for example, to deal with added moments that might be introduced by wingtip modifications? What is the work package that needs to be developed to assess the extent of the modification, the cost of the modification, and the time an aircraft is out of service? What is the remaining life of the aircraft over which the costs will be amortized? All of these factors will determine the overall costs, which can then be compared with the overall benefits in order to decide whether to go forward. One cannot simply say: "Wingtip modifications save fuel on commercial aircraft; therefore, the Air Force should embark on putting wingtip modifications on its mobility aircraft." Investigating the viability/efficacy of such modifications is of value, and a lot can be learned from the extensive work that has already been done on commercial aircraft. But one should not assume a priori that such an investigation will result in a decision to proceed. Both engineering and operational analyses must be done to inform an investment decision.

3

Previous Analyses and Experience with Wingtip Modifications on Existing Aircraft

This chapter reviews the results of previous studies and deployment of wingtip devices on existing commercial and military aircraft. On the commercial side, the experience and decision processes of aircraft manufacturers as well as two operators (airlines) are described. On the military side, one transport aircraft (the C-17) already has winglets as original equipment, and others (e.g., the KC-135 tanker) have been evaluated for this modification. In some cases, military airplanes are closely related to commercial analogues (e.g., the C-32 is based on the Boeing 757-200) and can benefit from wingtip modification studies that have been conducted for the commercial aircraft. In other cases, the aircraft are military-unique (e.g., the C-5), and the evaluation of their suitability for wingtip modifications would have to start from the beginning. Military-unique aircraft for which no previous wingtip modification studies are available are discussed in the next chapter. This chapter concludes with a summary of the lessons that can be learned from past experience with wingtip devices that could help with deciding on military wingtip device retrofits.

EARLY RESEARCH PROGRAMS

NASA-Led Research: ACEE

The Aircraft Energy Efficiency (ACEE) program was initiated by the Department of Energy (DOE) and the National Aeronautics and Space Administration (NASA) in 1975 as a 10-year effort to advance aircraft performance and increase fuel economy by 40 to 50 percent per unit of commercial passenger travel. The technological opportunities for doing this included more fuel-efficient engines, lighter weight structures, and better aerodynamic designs.[1]

The winglet concept was evaluated and tested extensively by NASA in its 8-Foot Transonic Pressure Tunnel from 1974 to 1976. In July 1976, NASA published a general design approach that summarized the aerodynamic technology involved in winglet design. At that time, the tunnel tests indicated that, for typical subsonic transport aircraft configurations, induced drag could be reduced by about 20 percent and the aircraft lift-drag ratio could be increased by about 9 percent. The improvement in lift-drag ratio was more than twice as great as that achieved by a wingtip extension producing the same wing-root bending moment.[2] In coordination with the NASA ACEE program, Boeing, McDonnell Douglas, and Lockheed studied the impact of winglets on

[1] National Research Council, 1980, Evaluation of NASA's Program for Improving Aircraft Fuel Efficiency, OSTI ID 6589834. Washington, D.C. January 1.

[2] Joseph R. Chambers, 2003. Concept to Reality: Contributions of the Langley Research Center to U.S. Civil Aircraft of the 1990s. NASA SP-2003-4529. 2003. Available on at http://oea.larc.nasa.gov/PAIS/ Concept2Reality. Last accessed on February 26, 2007.

near-term derivative aircraft. The results of these efforts and additional efforts by the airframe manufacturers are described below.

COMMERCIAL EXPERIENCE

There are a number of very successful applications of winglets and wingtip extensions in the world's commercial airplane fleet. These programs have been successful for a number of reasons, most notably because they have enhanced the economic value of the subject commercial airplanes. These wingtip device strategies have been employed both on new design aircraft and as postproduction retrofits on existing aircraft. The following is a summary of the strategies employed by the main commercial airframe manufacturers and two commercial airlines.

Airframe Manufacturers

Boeing

Boeing 7-Series aircraft have been manufactured by the "heritage" Boeing Commercial Airplanes Company in the Seattle area. The first in-production winglet produced by Boeing was for the 747-400, an improved Boeing 747 introduced in the late 1980s. The wingtip modification introduced on the 747-400 included a 6-ft per side wingtip extension and a canted 6-ft per side highly swept winglet (see Figure 3-1). The purpose of the wingtip modification was to improve the cruise aerodynamic efficiency of the airplane and, to a certain extent, differentiate of the -400 model of the 747 family from the earlier -100/200/300 models. The tip modification increased the cruise lift-to-drag ratio (L/D) of approximately 4 percent (less than half of the upper limit of 9 percent suggested by wind tunnel tests in the NASA ACEE program, see above), with much of the improvement coming from the span extension. The L/D increase gives an equivalent increase in fuel efficiency.

FIGURE 3-1 Boeing 747-400 with swept, canted winglets. SOURCE: Reproduced by permission of Boeing.

Boeing introduced the 737 Next-Generation (NG) aircraft in the late 1990s without a tip device. Several years after entry into service, the Boeing Business Jets (BBJ) Company accepted a proposal to test a set of blended winglets on the 737-BBJ from Aviation Partners Incorporated

(API), a small Seattle-based aircraft modification company. The API design was a relatively large winglet, 8 feet in length, installed on a relatively small commercial airliner. API required the intimate product knowledge of the original equipment manufacturer (OEM), Boeing, to be able to successfully integrate this winglet with the airplane structure and systems. In a joint flight development program with Boeing, the API winglet demonstrated a 4-5 percent block fuel reduction on the 737-NG series of aircraft (Figure 3-2).

FIGURE 3-2 Boeing 737-NG with blended winglets. SOURCE: Reproduced by permission of Boeing.

The original design of the 737-NG wing allowed the winglet to be installed with only minor modifications to the wing structure, Owing to its non-strength design features such as minimum gages required for hail and lightning protection, stiffness requirements for flutter, and design conservatism, the outer wing of the 737-NG had sufficient structural margins to accommodate the winglet readily. This made retrofiting the API winglets to the 737-NG technically and economically feasible. The BBJ market was a good trial for the winglets in that owner/operators of these airplanes were looking as much for a high-tech look for their airplanes as for efficiency benefits. Once the development work for the BBJ application had been completed, extending blended winglets to the commercial fleet of the 737-NG became a business decision that was accelerated by the rapid rise in fuel prices and the economies of scale of large-volume production of winglets. Following the successful certification of the BBJ and commercial retrofit winglet design, Boeing then modified the in-production 737-NG design to accommodate the winglets, and that has become the almost de facto standard configuration for the 737-NG. Several thousand sets of 737-NG winglets had been ordered through the end of 2006 by the overwhelming majority of 737-NG operators.

Based on the success of the 737-NG winglet design, Aviation Partners Boeing (APB) was formed after Boeing purchased a minority interest in API. APB then developed a retrofit-only winglet installation for the Boeing 757 airplane (Figure 3-3). While the 757 is no longer in production, there are approximately 1,000 airplanes in service with the potential for another 20 years of life. APB was ultimately able to develop a retrofit package that uses the same winglet as the 737-NG on the 757. This was accomplished by developing a 17.5 in. tip extension that provides a transition from the 757 wingtip to the 737-NG wingtip, thus enabling a common interface to the existing winglet contour. Because of this tip extension and because the 757 wing did not provide as much excess structural margin as the 737-NG wing, the weight penalty of the 757 installation is considerably larger than that of the 737-NG. The total 757 installation weighs 1,328 lbs versus approximately 340 lbs for the 737-NG. However, the 757 tip extension also increases the efficiency gains for the installation, resulting in a block fuel savings potential of up to 5 percent, depending on mission range. A number of large domestic 757 operators, including American Airlines, Continental Airlines, and Northwest Airlines, have now opted for the APB winglet retrofit.

FIGURE 3-3 Boeing 757 with retrofit blended winglets. SOURCE: Courtesy of Adrian Pingstone.

APB is also pursuing winglet retrofits for several other Boeing 7-Series aircraft. Recently, a retrofit winglet was certified for earlier models of the 737 family (737-300/400/500). This fleet went out of production in 1998, but there are still approximately 2,000 aircraft in service with decades of remaining life. APB is also investigating the feasibility of a winglet retrofit for the 767 family and the earlier models of the 777 family. An earlier program to develop an improved winglet installation for the 747-400 was not successful. The lesson from this experience is that not every airplane is a good candidate for a winglet retrofit. Success depends on aerodynamic compatibility and structural features such as strength margins and flutter margins.

Boeing took a different approach to improve the performance of its latest models of the 767 and 777 families. Both the 767-400ER and the 777-200LR/300ER incorporate a raked wingtip span extension design (Figure 3-4). Similar in effect to winglets, the raked tips provide a reduction in cruise fuel burn and improved takeoff performance at the expense of longer wingspan. Boeing chose these designs because market studies indicated that the airplanes would still be able to use the same infrastructure as the older airplanes they would replace. The 767-400ER would be replacing DC-10 and L-1011 aircraft and competing with Airbus A330 aircraft, and the 777-200LR/300ER would be replacing or competing with Boeing 747-200/300/400 and Airbus A340 aircraft. In addition, the raked tip offers a takeoff performance advantage over winglets because it improves not only drag but also lift, both of which are important for takeoff. Finally, the raked tip proved to be more efficient structurally because its design provides more aeroelastic relief than winglets for critical structural design conditions. The engineering trade-off for winglets versus raked tip extensions is a close call, and for these two aircraft families —767 and 777 — the design space was more favorable for the raked tips than the winglets.

Boeing is currently designing a new family of long-range, wide-body transports, the 787 family (Figure 3-5). The 787 is intended to replace the 767 family and the Airbus A300/A330/A340 families. For reasons similar to the design solutions discussed for the 767-400ER and 777-200LR/300ER, Boeing selected a raked tip for the base 787-8 airplane. For growth versions of the 787, an even larger raked tip is envisioned, because the airplane will easily fit in the infrastructure that exists for the airplanes that it will replace. However, for the shorter range 787-3 model, which will be used for regional transport to smaller airports, the market asked for a smaller span that would be more compatible with DC-10/L-1011/A300/767 operations. To satisfy that market, Boeing has shortened the span of the 787-3 wing and recovered some of the lost efficiency by developing a large vertical winglet. That design was still evolving at the end of

2006, and at this writing the precise outcome is still to be decided. The 787 strategy does provide an excellent example of the design trades that need to be made in order to decide on which wingtip solution is appropriate for a given aircraft.

FIGURE 3-4 Boeing 767-400ER with raked wingtips. SOURCE: Reproduced by permission of Boeing.

FIGURE 3-5 The Boeing 787 family, featuring various wingtip modifications. SOURCE: Reproduced by permission of Boeing.

McDonnell Douglas Heritage Commercial Aircraft

Aircraft produced by the McDonnell Douglas Corporation, now part of Boeing, continue to be a large segment of the installed fleet of commercial airplanes. The two main families include the small twinjet DC-9/MD-80/MD-90/B-717 models and the large trijet DC-10/MD-10/MD-11 models.

The trijet family has had numerous winglet studies conducted, including work done in cooperation with NASA in the 1970s and 1980s, and a production winglet design was incorporated into the MD-11, a derivative of the original DC-10 family (the military KC-10 is also a derivative of the DC-10). The earlier DC-10 work culminated in a flight test demonstration program that validated a 2-3 percent cruise efficiency improvement over the original DC-10 design, depending on the height of the winglet utilized. The winglet configuration included a large upward canted winglet and a small downward canted winglet, as shown Figure 3-6. The selection of the dual winglet configuration was driven by the additional cruise drag benefit of the added span offered by the lower winglet and the favorable aerodynamic interactions between the upper and lower winglets at low-speed, high-angle-of-attack conditions. This configuration was developed in the early days of computational fluid dynamics (CFD) codes, when the original 747-400 winglet was being developed. Today's CFD capabilities are much improved; the Navier-Stokes codes are considered capable of generating more accurate results and have been used in the latest aircraft designs to reach a successful design more quickly and with less wind tunnel testing.[3] In both cases the selected design philosophies might have been different had the current CFD capabilities and design lessons learned been available. Nevertheless, both the 747-400 and DC-10/MD-11 winglet designs have provided substantial airplane performance benefits to their products. The dual winglet design developed for the DC-10 has only been incorporated into the production MD-11 aircraft. Although the winglet was not flight tested separately from other aerodynamic modifications, it has been credited with a performance benefit of 2.5 percent. To date, there has not been a retrofit program for the DC-10 aircraft.

FIGURE 3-6 McDonnell Douglas MD-11 with dual winglets. SOURCE: Reproduced by permission of Boeing.

[3] Forrester T. Johnson, Edward N. Tinoco and N. Jong Yu. 2003. "Thirty Years of Development and Application of CFD at Boeing Commercial Airplanes, Seattle." AIAA-2003-3439. 16th AIAA Computational Fluid Dynamics Conference, Orlando, Florida, June 23-26.

The Douglas twinjet family has also been the subject of wingtip redesign studies. In the early 1980s, the DC-9 was redesigned as the MD-80, including a wing root insert and a wingtip extension. These changes provided more wing area, more wing span, and increased fuel volume, allowing increases in payload and range for this aircraft family. Also included in the MD-80 transformation were new, higher thrust/higher efficiency engines and an elongated fuselage. The wingtip extension for the MD-80 was notable in that it was a constant chord design, allowing the existing tip fairing and navigation light design to be retained. However, the wingtip extension and span loading were not optimized for efficient long-range cruise, as some other designs have been. The result of that is that the MD-80 wingtip devices do not show significant fuel economy benefits.

APB has investigated a retrofit design for the DC-9 family. Those design studies have not been successful in creating a viable business case. Projected block fuel burn reductions of less than 2 percent are offset by substantial modification costs. The limited potential for the DC-9 is a result of the existing wing structure, which hinders installation of a large winglet, as was possible on the Boeing 737 family. Since the DC-9 has been out of production since the early 1980s, the fleet size has shrunk and the fleet has aged, making the business case for a retrofit winglet or wingtip not as attractive as that for the Boeing 737 and 757 families.

Just as Boeing and McDonnell Douglas were merging in 1997, a new derivative of the DC-9 family emerged as the renamed Boeing 717. That aircraft essentially combined the airframe of the original DC-9 with new engines and new systems. Since nearly 200 Boeing 717 aircraft were delivered before production terminated in 2006, there may still be a retrofit potential for this very new fleet. However, since the airframe is essentially a DC-9, it is not likely that an outcome better than the projected reduction of 2 percent or less is possible without a significant structural modification of the aircraft. As of late 2006, no retrofit solutions for the twinjet family were being pursued.

Airbus Industries

There are two distinctly different winglet design strategies apparent on the commercial aircraft produced by Airbus Industries. The first is a "tip fence" concept, employed on the A310/A320/A380 families. The tip fence is a small dual winglet configuration with highly swept, nearly vertical upper and lower partial-chord winglets (Figure 3-7). For both the A310 and A320, the size of these winglets indicates that they were installed to take advantage of structural margin in the wings, since both aircraft were initially certified with plain wingtips.

A similar configuration was included in the initial rollout configuration of the A380, which was certified in December 2006. The design that preceded the A380, the design for the A330 and A340, had large, single-canted and highly swept winglets similar to the 747-400 configuration (Figure 3-8).

In 2006, Airbus flight tested several winglet designs on the A320 that appear to be similar to the 737-NG blended winglets. According to media reports, Airbus has decided not to offer these winglets for production or retrofit because the aerodynamic efficiency benefits determined from flight testing were not sufficient benefit to overcome the very large weight increase needed for the installation. Airbus also expressed concern over potential long-term effects on the structural integrity of the wing due to stress imparted by winglet forces.[4] An implication to be drawn is that the wing may require significant structural modifications in order to accommodate the additional loads and/or flutter requirements of the large winglets. The Airbus experience provides a valuable lesson on the difficulties that may be encountered in the design of winglets for retrofit to an

[4] M. Kingsley-Jones, "Airbus rethinks plan to put winglets on A320." *Flight International*, October 10, 2006.

existing aircraft — namely, engineering analysis is necessary prior to initiating an expensive flight test program.

FIGURE 3-7 Airbus A320 with tip fence. SOURCE: Reproduced by permission of EADS North America.

FIGURE 3-8 Airbus A340 with swept, canted winglets. SOURCE: Reproduced by permission of EADS North America.

Airline Experience

A number of airlines throughout the world have ordered or retrofitted some of their aircraft with winglets. The following summarizes the rationale and results for two commercial airlines that have chosen to modify their in-service aircraft with winglet devices.

Southwest Airlines

In 2000, when the price of oil reached $27 per barrel, Southwest Airlines conducted a study to retrofit a portion of its existing Boeing 737 fleet of aircraft with winglets as a means of reducing fuel burn. Although the proposed modifications held the potential for market expansion and increased revenue due to improved range and takeoff gross weight performance and other performance considerations, as well as in residual value of the modified aircraft, the original study payback period was based solely on the financial justification provided by reduced fuel burn.[5] The intent was to demonstrate the required performance benefits with no degradation in operational capability.[6]

The study indicated a block fuel burn improvement (total fuel burn from engine start at the beginning of a flight to engine shutdown and the end of that flight) of 2.4 percent for flight segments of 500 nmi to a maximum of 4.0 percent for flight segments of 2,000 nmi. This improvement translated into a potential annual fuel savings of up to 110,000 gallons[7] per aircraft for the modified fleet.

With a projected payback period of 2 years for the first batch of modified 737 aircraft, the fuel burn savings satisfied financial and operational considerations for SWA and the first order for winglets was placed in 2003. The modification process was coordinated through a Boeing Service Engineering team that operated as the single point of contact between Southwest and APB in order to improve communications and program management. Southwest planned for a 7-day out of service time for each aircraft winglet modification, but its experience demonstrated that the modification could be accomplished in 3 or 4 days.[8]

In addition to the planned fuel savings, the modification demonstrated some increase in take-off gross weight (TOGW) capability. As a result, the airline has benefited from an increase in stage lengths by adding take-off fuel at facilities where the aircraft were previously limited by TOGW.[9]

The potential issues of ground damage, lightning strike, and hangar clearance that constituted the airline's internal justification for the modification program have proven to be of no consequence. Southwest reports that there have been no appreciable costs or operational limitations tied to crew training, technical data, or the like.

The success of the 737-700 modification program has motivated Southwest to initiate a new proposal for older aircraft 737-300 aircraft that lack suitable wing structure. The extra weight for this modification is estimated to be 783 to 801 lb. This proposal is based on a projected block fuel burn improvement of 2.6 percent for a 500 nmi stage and 4.4 percent for a 2,000 nautical mile stage and could save up to 100,000 gallons of fuel per aircraft per year.[10] Because the wing structure must be modified the out-of-service time to complete the winglet modification for the 737-300 aircraft is estimated to be 14 days.[11] The results of the Southwest 737 winglet modification program are summarized in Table 3-1.

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[5]Jim Sokul, Vice President of Maintenance and Engineering, Southwest Airlines, Conversation with the Committee on Assessment of Aircraft Winglets for Large Aircraft Fuel Efficiency on December 14, 2006.

[6]Jay Inman, Vice President of Programs, Aviation Partners Boeing, "Blended winglets," Presentation to the Committee on Analysis of Air Force Engine Efficiency Improvement Options for Large Non-Fighter Aircraft on June 14, 2006.

[7]Ibid.

[8]Jim Sokul, Vice President of Maintenance and Engineering, Southwest Airlines, Conversation with the Committee on Assessment of Aircraft Winglets for Large Aircraft Fuel Efficiency on December 14, 2006.

[9]Ibid.

[10]Jay Inman, Vice President of Programs, Aviation Partners Boeing, "Blended winglets," Presentation to the Committee on Analysis of Air Force Engine Efficiency Improvement Options for Large Non-Fighter Aircraft on June 14, 2006.

[11]Jim Sokul, Vice President of Maintenance and Engineering, Southwest Airlines, Conversation with the Committee on Assessment of Aircraft Winglets for Large Aircraft Fuel Efficiency on December 14, 2006.

TABLE 3-1 Southwest Airlines 737 Winglet Modification Summary

Aircraft Type	Retrofit Weight Increase (lb) [a]	Production Weight Increase (lb) [b]	Increase in Wing Dimensions Attributable to Winglets	Block Fuel Savings (%)
737-700 (non-provisioned wing)	340	N/A [c]	8 ft 2 in. (height) 6 ft 4 in. (span)	2.4 to 4.0
737-700 (provisioned wing)	241	220	8 ft 2 in. (height) 6 ft 4 in. (span)	2.4 to 4.0
737-300	783-801	N/A [c]	7 ft 6 in. (height) 8 ft 10 in. (span)	2.6 to 4.4

[a] Difference between the weight of the aircraft manufactured without winglets and the weight of the aircraft after retrofitting with winglets.

[b] Difference between the weight of the aircraft manufactured without winglets and the weight of the aircraft with winglets.

[c] Aircraft are not manufactured with winglets as original equipment.

SOURCE: Data from APB.

American Airlines

Following an extensive study, American Airlines decided in 2004 to add winglets to its long-range international fleet of 20 757-200ER aircraft.[12] The decision was made subsequent to a detailed business planning effort. American considered the following costs and benefits in its winglets business case:[13]

> The business case for installing winglets considers the following costs:
>
> - Materials (hardware, software, consumables),
> - Labor,
> - Tooling,
> - Spares for inventory,
> - Expected Maintenance (repairs, inspection, replacements),
> - Out of Service (lost contribution),
> - Ferry costs,
> - Fuel (use forward-fuel-curve-based futures market),
> - Airport gating loss, modifications, or flexibility costs, and
> - Maintenance hangar modifications at bases and airports,
>
> The business case for installing winglets considers the following benefits:
>
> - Improved fuel burn,
> - Engine derate,
> - Possible new markets due to increased range,
> - Additional payload, and
> - Change in residual value of the aircraft.
>
> Other factors for consideration:

[12] John Novelli. Director, Operations Engineering and Optimization, American Airlines. "American Airline Winglets." Presentation to the committee on December 14, 2006.

[13] Ibid.

- Lease agreements,
- Coordinating modifications with other base maintenance visits, and
- Economic life of aircraft.

American found that the winglet was supported on the basis of fuel conservation alone, a high NPV discount rate was used,[14] and it contracted with APB to manufacture the winglets. The negotiation yielded a single extra kit to install on one of American's 737-800s as a test case for the benefits on that fleet of aircraft. Prior to the modification program, American's 737-800 fleet was operating at an average +2.2 percent fuel burn over the specification, or book level (worse than design level).[15] The modification program held the potential to return fuel burn to book level or better. The first winglets were installed on the 737-800, and the modified aircraft became operational in October 2005.

Whether the winglets are original equipment or retrofitted, the weight penalty for the aircraft is 380 lb. As with Southwest's installation on its 737-700s, the vertical portion of the winglet adds 8 ft 2 in. to the height of the wing, while the horizontal portion of the winglet modification adds 4 ft 7 in to the wingspan.

The modified 757-200ER aircraft was released to service in December 2005. The weight added by the winglet modification was approximately 1,400 lb. To mitigate the added weight, American obtained an increase in the certified maximum zero fuel weight (MZFW). The effect on wing geometry for the winglet modification is an increase in wing height of 8 ft 2 in. and an increase in wingspan of 9 ft 9 in.

American used two separate methods (actual flight burn data and aircraft performance monitoring software) to calculate the fuel savings realized by the winglet modification of its 737 and its 757 aircraft. Those calculations demonstrate a fuel savings for the 737-800 aircraft of 3.2 percent when compared to its 737-800 nonwinglet fleet. This equated to 32 gallons of fuel saved per flight hour.[16]

The modified 757-200ER fleet demonstrated a fuel savings of 3.3 percent in comparison with its unmodified 757-200ER fleet, a fuel savings of 40 gal per flight hour.[17] Both findings are in line with reports of savings from other operators of similar aircraft.[18]

The results of American's 737-800 and 757-200ER winglet modification programs are summarized in Table 3-2.

American concluded that there were no changes in flying qualities and the Federal Aviation Administration (FAA) required no changes to the flight simulators of either fleet as a result of the winglet modifications. The FAA deemed that the flight crew training requirements could be satisfied with appropriate technical manuals.

The added winglets improved the takeoff performance of American's aircraft and gave them greater takeoff gross weight capability. These resulting improvements expanded the airline's market potential by giving it access to previously climb-limited airports (generally high-altitude, high-temperature, or short-field airports). American has taken advantage of these new capabilities and thereby increased its revenue.[19]

[14]Ibid.
[15]Ibid.
[16]Ibid.
[17]Ibid.
[18]Ibid.
[19]Ibid.

TABLE 3-2 American Airlines 737-800 and 757-200ER Winglet Modification Summary

Aircraft Type	Retrofit Weight Increase (lb)[a]	Production Weight Increase (lb)[b]	Increase in Wing Dimensions Attributable to Winglets	Block Fuel Savings (%)
737-800 (non-provisioned wing	520	N/A[c]	8 ft 2 in height 4 ft 7 in span	3.2
737-800 (provisioned wing)	380	380	8 ft 2 in height 4 ft 7 in span	3.2
757-200ER	1358	N/A[c]	8 ft 2 in height 9 ft 9 in span	3.3

[a] Difference between the weight of the aircraft manufactured without winglets and the weight of the aircraft after retrofitting with winglets.

[b] Difference between the weight of the aircraft manufactured without winglets and the weight of the aircraft with winglets.

[c] Aircraft are not manufactured with winglets as original equipment.

SOURCE: Data provided by APB and American Airlines.

MILITARY EXPERIENCE

C-17

The C-17 was designed by the McDonnell Douglas Corporation, now a part of the Integrated Defense Systems component of the Boeing Company (Figure 3-9). Winglets were incorporated into the design for reasons relating to taxi clearance, turning radius, maneuverability, and parking. In particular, the Air Force wanted to limit the wingspan to that of the C-141 to make the C-17 compatible with facility infrastructure. Clearly, it was preferable to achieve the desired airplane cruise performance by adding winglets rather than increasing the wingspan.

FIGURE 3-9 The Air Force's C-17 with winglets.

A number of these design considerations led to the final winglet configuration on the C-17. Early C-17 designs included upper and lower winglets. However, the lower winglet was eliminated after it was determined that the cruise performance goals could be met with a single upper winglet configuration; that ground clearance requirements would be problematic with the lower winglet; and that the lower winglet would result in higher manufacturing and maintenance costs. The planform and placement of the C-17 winglet were also driven by exterior lighting requirements.

The winglet was shown in wind tunnel testing to reduce cruise drag approximately 2.5 percent. Also, no additional buffeting was observed for takeoff or landing configurations during flight testing. However, while these benefits are considered to be substantial, the C-17 winglet was developed in a low Reynolds number (RN) wind tunnel. The low RN environment can produce misleading results with regard to drag, buffet, pitching moment, and loads because the flow phenomena are different from those at the much higher RN of the full-scale flight vehicle. Also, the C-17 configuration was developed in the 1980s before the full-scale National Transonic Facility Wind Tunnel and before modern Navier-Stokes CFD tools. With these new capabilities, the current C-17 winglet design could be more accurately assessed. These new tools, together with lessons learned from other winglet designs, might make it possible to improve the C-17 winglet design, and thereby cruise drag another 1 percent or more.[20]

C-32

The C-32 is a military derivative of the Boeing 757-200 commercial aircraft and is used for government executive transport. APB offers a retrofit package for this aircraft, and a contract was awarded in October 2006 for installation of this package on the four C-32 aircraft in the Air Force inventory.

KC-135

A number of studies have been conducted over the years to determine the suitability of adding winglets to the KC-135 aircraft, which is closely related to the Boeing 707. Some of the pioneering work on winglets was conducted at NASA in the mid-1970s on the KC-135. That work was followed by several Air Force contracts with Boeing to investigate the design space for winglets on the KC-135 and included extensive wind tunnel testing. That work, in turn determined that winglets could greatly improve cruise efficiency. An improvement in the L/D of nearly 8.5 percent was reported, along with an estimated empty weight increase of approximately 600 lb, for a net performance improvement of nearly 7.5 percent.[21] The winglet selected for this work was nearly 9 ft in length, slightly larger than the production winglets on the 737-NG.

The improvement predicted for this winglet on the KC-135 is considerably larger than that for any winglet that has actually been incorporated into an airplane. In the 1970s, it was speculated that the KC-135 would be an excellent candidate for winglets because the wing was overloaded relative to the ideal elliptical span load, which would presumably allow the winglet to load more optimally. While that explanation may have had some merit, it would not be surprising if the current methods used to design and analyze winglets were to arrive at a less optimistic prediction. Certainly it is now known that the aeroelastic impact of the winglet on the wing's twist must be considered, and that should decrease the benefit somewhat. Nevertheless, the work conducted in the 1970s suggests that a significant benefit could accrue from using winglets on the KC-135 and that the structural requirements for installation appear to be manageable..

Later the Air Force conducted a flight test of winglets on a KC-135. The published report on that flight test indicated good agreement with the analytical and wind tunnel testing when known differences between the tests were accounted for.[22]

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[20] Robb Gregg. Senior Manager for Aircraft Programs. Boeing-Phantom Works. "Drag Improvement: A Study of the DC-10/MD-11/C-17 Winglet Programs." Presentation to the Committee on December 13, 2006.

[21] K.K. Ishimitsu. 1976. Design and Analysis of Winglets for Military Aircraft. AFFDL-TR-76-8 Wright-Patterson Air Force Base, OH: Air Force Dynamics Laboratory.

[22] NASA,1982, "KC-135 winglet program review," NASA Conference Publication 2111, January.

SUMMARY OF COMMERCIAL AND MILITARY EXPERIENCE

The commercial airframe manufacturers began testing winglet installations for several aircraft more than 20 years ago. At the time many of these ideas were first proposed, fuel prices were not sufficiently high to justify retrofit costs. However, the retrofit idea took off once fuel prices started rising, and airlines saw the need to use more economical aircraft for longer-range missions. Cost-benefit analyses conducted by the airlines (American Airlines and Southwest Airlines) indicated that winglet retrofit programs on appropriate aircraft would pay for themselves within about 2 years based on the fuel savings alone.

The Boeing 737-NG became the flagship for the retrofitting commercial fleets with winglets. It was an aircraft that was well suited since it needed very little structural upgrade, was easily modifiable, and proved to have 3-5 percent fuel burn improvements depending on mission length and other factors. The installation takes only 4 or 5 days, and the aircraft have had no negative operational issues nor have they needed any change to flight operational procedures or training of crew.

The winglet-modified Boeing757 shows similar fuel burn improvements, and this makes the it ideally suited for secondary European markets from the U.S. East Coast. It actually has allowed using a smaller aircraft that originally was intended for domestic use, turning it into an efficient international aircraft.

The commercial experience is that wingtip modifications make sense if one can achieve a 3-5 percent fuel burn improvement, if careful engineering analysis shows that the aircraft have sufficient structural integrity to easily accept wingtip extensions or winglets, and if the modifications are relatively easy to install. The airlines have been able to overcome with little difficulty the initial concerns relating to the added wing height and wingspan in hangars, at gates, and on taxiways.

Only one military-unique aircraft, the C-17, features winglets. Designers had a choice of either increasing the wingspan or using winglets to achieve the desired performance, and winglets were chosen because they minimize problems relating to taxi clearance, turning radius, maneuverability, and parking. However, the C-17 design was done before modern analysis and optimization tools were fully developed, and application of these tools could further improve the C-17's aerodynamic performance.

As discussed earlier, the retrofit potential of some other military aircraft, such as the KC-10 (based on the DC-10 airframe) and KC-135 (which is closely related to the Boeing 707 airframe), have been studied and found promising. Other military-unique aircraft, such as the C-5, and would require extensive engineering analysis before a judgment could be made. In Chapter 4, the committee reviews all the candidate aircraft in the Air Force inventory and recommends those that merit careful consideration for tip device retrofits.

4

Assessment of Wingtip Modifications for Various Air Force Aircraft and Potential Investment Strategies

This chapter provides the committee's evaluation of steps the Air Force could take to improve the fuel economy of aircraft in its inventory, in particular by modifying the wingtips. It begins with a checklist of factors that must be considered to determine if these modifications make sense. This is followed by a discussion of specific aircraft in the Air Force inventory, including those that are responsible for the greatest fuel consumption as well as those that are derived from commercial aircraft. The committee then identifies those aircraft that appear most promising for wingtip modification. For these selected aircraft, a simple spreadsheet model is used to estimate payback periods for modification investments, treating modification costs and fuel prices as parameters. These calculations are combined with the committee's expert judgment to prioritize various aircraft for their suitability for wingtip modifications. Finally, the chapter concludes with a discussion of strategies by which the Air Force can maximize its investment in fuel economy programs.

CHECKLIST FOR MAKING WINGTIP MODIFICATION DECISIONS

The investment in winglets for a particular aircraft type depends on a number of factors, including the potential fuel burn efficiency improvements provided, the size of the statement of work required for the installation, the utilization rate of the aircraft fleet, and the expected lifespan of that particular fleet. An extensive engineering and economic analysis would be required for each aircraft type in order to determine the appropriateness of installing winglets. The following elements are necessary in order to make a balanced decision for each aircraft fleet.

Technical Issues

Cruise Fuel Burn Efficiency Improvement

The primary reason for installing winglets (or other tip devices) is to improve the efficiency of the fuel burn at cruise conditions of the aircraft. The two most important components of fuel burn efficiency affected by winglets are the aerodynamic efficiency of the configuration, measured in terms of lift-to-drag ratio (L/D) and the empty weight of the aircraft, which will increase when the winglets are installed. The viability of a winglet installation is different for each aircraft configuration., and sophisticated design studies are required to achieve the proper balance between aerodynamic efficiency and weight efficiency. There are numerous design parameters involved in selecting the optimum winglet configuration, including winglet span, area, sweep, taper, cant angle (inclination), twist, thickness, sweep, juncture flow, etc. The selection of materials for winglet construction will affect the empty weight. In addition, the additional loads and moments imparted to the wing due to the winglet installation may require that the wing be strengthened, adding more weight. A sophisticated dynamic aeroelastic analysis of the wing/winglet structure is required for this assessment.

Collateral Impact of the Winglet Installation on Airplane Design

In addition to the aerodynamic and structural effects of the installed winglet, ancillary issues related to the winglets must also be considered. Including the need to revise flight control systems, brought about by the changed stability and control characteristics. These include changed longitudinal, lateral, and directional stability characteristics and altered control system effectiveness, particularly with regard to the effectiveness of outboard ailerons and spoilers. Winglets also can affect the configuration of tip lighting systems and the lightning strike protection systems for the wing.

Collateral Impact of the Winglet Installation on the Infrastructure

The interaction of the airplane with its infrastructure must also be factored into a winglet decision. Typically the physical span of the aircraft increases with the installation of winglets, but not as much as with a conventional tip extension. Nevertheless, consideration must be given to issues related to ground handling, parking, maintenance (depot and field), and associated facilities such as gates, ramps, hangars, runways, taxiways, etc. This is particularly important when analyzing the economic life-cycle of winglets.

Design Information Availability

Developing a winglet design for an existing aircraft requires a deep understanding of the characteristics of the original aircraft design. Generally that detailed design knowledge resides primarily with the original equipment manufacturer (OEM). However there have been successful retrofit designs of winglets that were originated by third-party companies. For older aircraft, the existing design data may be scarce and not compatible with current design tools. In addition, there may be few, if any, engineering personnel with a working knowledge of that particular aircraft design. These factors must be considered in developing a financial estimate for the cost and risk of developing a winglet retrofit design.

Economic Issues

In addition to the formidable technical challenges of developing a winglet retrofit configuration, there are significant economic factors that come into play when making a life cycle business case. Among the factors that must be considered are the following:

- *Cost of installation.* A contractor will need to charge a reasonable price to establish a positive business case for proceeding. The fixed cost to the contractor will consist of engineering and tooling costs required to design, test, and validate the winglet configuration. That cost is nearly independent of the size of the fleet of airplanes, so the larger the subject fleet, the more units that the fixed design costs can be amortized over. So the business case for winglets is likely to be more favorable for a large fleet of aircraft.
- *Life span of the fleet.* A retrofit design solution will have a potentially longer payback period for a younger fleet of airplanes with a longer economic life than for an aging fleet that is soon to be retired. This economic factor can also be influenced by the rate at

which the retrofit is conducted. A slow retrofit program eats into the payback on the initial investment, while a rapid fleet retrofit accelerates the payback period.

- *Utilization rate of the fleet.* Winglets reduce the fuel burn per flying hour of an aircraft. The more the aircraft is used, the faster the investment will be paid back. This favors installing winglets on heavily used fleets.
- *Cost of fuel.* Since the means of payback of the initial investment is a reduction in the amount of fuel consumed, costlier fuel means that the payback is quicker and more likely. Less costly fuel requires a longer payback period.
- *Cost of capital.*: As with any up-front investment, there is a cost for the capital that is expended before payback can occur. Assuming that the capital investment is made with borrowed money, the economic environment in terms of interest rates and inflation must be considered to understand the business case. High interest rates and low inflation will adversely affect the business case, while low interest rates and high inflation will make the cost of borrowing less.

Putting It All Together

A business case model can be created to establish the viability of a winglet retrofit program for a fleet of airplanes. Independent variables in the assessment include the following:

- Winglet unit price ($/airplane),
- Fuel burn reduction (%),
- Cost of fuel ($/gallon or lb)
- Interest rate (%),
- Inflation rate (%),
- Fleet size (number of airplanes),
- Fleet utilization (hours/year),
- Retrofit rate (airplanes/year), and
- Life span remaining (years).

These variables can be used in a business case model to determine the cash flow profile. The profile will be negative during the development and early retrofit years and should become positive during the lifetime of the program. If there is not a positive outcome, winglets should not be installed. If the outcome is positive but requires a long period to break even, the decision is not clear cut. If the outcome is positive over a short period, winglets should clearly installed.

CANDIDATE AIRCRAFT IN THE AIR FORCE INVENTORY

Given the emphasis on fuel economy in the study's statement of task, the committee began by considering those aircraft that consume the greatest amount of fuel, as shown in Figure 4-1. The five that stand out most clearly are, in order of annual fuel usage by fleet, the C-17, KC-135 R/T, C-5, KC-10, and C-130H/J. As noted in Chapter 3, the C-17 already has winglets, and the KC-135 and KC-10, which are closely related to the Boeing 707 and DC-10 commercial airframes, respectively, have been studied previously for wingtip modifications. The aircraft are discussed further below.

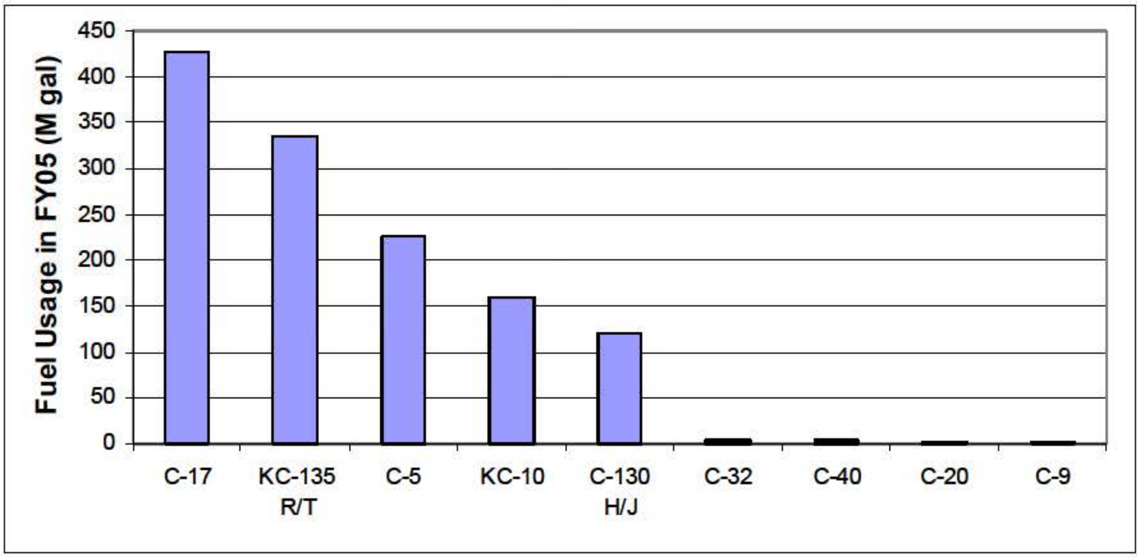

FIGURE 4-1 Fuel usage of selected Air Force aircraft (by fleet) in FY05. SOURCE: DESC.

C-17

The C-17 is the most current freighter aircraft and one that has some of the latest structural and aerodynamic improvements installed. As described in Chapter 3, the C-17 aircraft is already equipped with a winglet that was incorporated into the original design. While a newly designed winglet for the C-17 might result in somewhat improved cruise fuel efficiency, the magnitude of that improvement is likely to be in the 1 to 1.5 percent range,[1] and it would only make sense if combined with other efficiency improvement modifications. The considerable data already developed for the C-17 which could also be considered for further wing upgrades beyond winglets. These should be reviewed and considered for possible installations since much of the research has already been accomplished.

C-5

The Lockheed Martin C-5 is a global strategic airlift system capable of carrying outsized cargo. A total of 111 C-5's are in service with the Air Force. A portion of the fleet is being modified with modern commercial turbofan engines, improving range by up to 11 percent. Aerodynamic range improvement efforts have focused on airframe housekeeping such as orphan weight removal and airframe cleanup. Given that the C-5 is one of the major contributors to fuel consumption by the Air Force and its missions are long range, a study to quantify the potential performance gains and integration effects of winglets is warranted. Unlike efforts devoted to winglets for the commercial transport, there has been no detailed C-5 winglet development effort, adding a sizable measurable nonrecurring cost to a fleet retrofit program and extending the time required to recover the investment.

Specific data for C-5 aerodynamic improvements have not been approved for release by the System Program Office. The committee believes that the C-5 has the potential for drag reduction with wingtip modifications because of its current large fuel consumption, its missions, wing design, etc. Aerodynamic improvements combined with orphan weight and obsolete component removal, would contribute to operating efficiency increases for the aircraft.

[1] Estimate provided by Mark Goldhammer, committee member, based on unpublished Boeing work.

KC-135R/T

As noted in Chapter 3, there has been some testing with winglets and other improvements on the KC-135/707 wings. These studies should be reviewed for applicability. The issue with these airframes is primarily their age and the limited remaining useful life. The current fleet of approximately 417 KC-135R/T aircraft would be good candidates for winglet installation. Some of these aircraft are expected to be in service until approximately 2040. The fleet of TF-33/JT-3D equipped KC-135s (D/Es) is potentially subject to retirement, so they may not have sufficient payback life remaining. The RC-135 V/W/S/TC fleet may be candidates for winglets as well. However, the installation of the over wing high-frequency antenna and wingtip pitot-static probes would probably create another problem for the addition of winglets. Therefore, the committee believes the focus within the KC-135 fleet should be on the R/T models.

Three related military fleets derived from the Boeing 707 commercial aircraft are the E-3 AWACS, the E-6 TACAMO, and the E-8 JSTARS. While the wings of these aircraft are closely related to those of the KC-135 fleet, any such winglet would have to be further investigated to conform for aerodynamic and structural compatibility. In addition, there would need to be consideration of winglet interference with the AWACS antenna function. The TACAMO has an extended wingtip that houses antenna pods, so it is very unlikely that those aircraft could be modified for winglets. Moreover, less is known about the structural suitability of these 707-based platforms than is currently known about the KC-135 fleet.

The KC-135/Boeing 707 aircraft are similar in gross weight to the Boeing 757 commercial aircraft, with a maximum takeoff weight (MTOW) of approximately 250,000 lb. The Boeing 737-NG winglet solution has been installed on the Boeing 757 using a 17.5- in. transition wing tip that accommodates the tip airfoil differences between the 737-NG and the 757. This experience may provide a solution for the KC-135/Boeing 707 military fleet as well.

C-130

The Lockheed Martin C-130 is a tactical airlifter designed to operate from short, austere airfields. A total of 655 aircraft in 16 variations carry out a broad spectrum of missions, from intertheater airlift to electronic and psychological warfare.

In evaluating the suitability of C-130 for the application of winglets to increase cruise efficiency, several factors suggest that performance might improve less than seen on commercial aircraft. The C-130's wing is already very efficient because its aspect ratio of 10 is relatively high, reducing the overall benefit expected from winglets. The wing design was driven by the need for short- field performance–a requirement not imposed on jet airliners–as well as cruise performance, resulting in the high-aspect-ratio geometry and associated high aerodynamic efficiency. A further reduction in winglet effectiveness is attributed to the C-130's unswept wing with its lower tip loading.

Operational considerations also reduce the effectiveness of a winglet modification program. The C-130 missions tend to be short range and flown at lower altitudes. Since winglets are more effective for longer ranges and with higher wingtip loading (realized at higher altitudes), the potential benefit of winglets for the C-130 is limited.

A development effort would be needed to optimize winglet geometry, determine integration effects, and evaluate system-level benefits. Other drag reduction approaches, such as aft body strakes and revised wing fillets, have been identified in other studies and should be considered in any fuel consumption reduction study.

KC-10

The KC-10 is a military derivative of the McDonnell Douglas DC-10 commercial aircraft. As mentioned in Chapter 3, while there has not been a winglet retrofit program for the DC-10, winglets were successfully flight tested on the aircraft and were later successfully incorporated into the derivative MD-11 aircraft. There are currently 59 KC-10 aircraft in the Air Force inventory, and they are flown extensively. The KC-10 fleet is quite young, with the oldest aircraft having approximately 22,000 flight hours and 14,000 flight cycles. For comparison, the older DC-10 still in service had over 131,000 flight hours and 45,000 flight cycles as of September of 2006. There are also approximately 150 of the DC-10 family of aircraft still in commercial service, both passenger and cargo, so the combined potential market for retrofits may be large enough to motivate a retrofit program.

The MD-11 experience indicates that a successful winglet can be incorporated into the DC-10-based wing design. The DC-10 flight test program that was conducted identified approximately 3 percent cruise efficiency improvement, which was later replicated on the MD-11 design.[2] In addition, recent winglet design experience using modern CFD methods and high Reynolds number (RN) wind tunnels may provide lessons that could have applicability for winglet designs that may be more effective on the KC-10 and other government transport aircraft. With new multi-disciplinary design and optimization methods available, it is likely that an even more efficient and simpler design could be feasible for this aircraft family.

Intelligence, Surveillance, and Reconnaissance (ISR) Aircraft

The committee was asked explicitly to consider the suitability of ISR aircraft for wingtip modifications. While the U-2 and Global Hawk fall into the ISR category, their mission requirements (extremely high altitude and long endurance) result in wing designs that are already extremely efficient and would be expected to show little if any benefit from winglets. In fact, there might be performance penalties for integrating winglets on these platforms because performance at high altitudes is extremely sensitive to weight. Thus, these aircraft are not good candidates for wingtip modification.

Other Air Force Aircraft

The easiest decisions on whether to install winglets obviously pertain to aircraft in the Air Force inventory that derive from commercial aircraft now operating with winglets. In each case, the aircraft structure has already been conducted studied to be appropriate, the engineering design has been done, the modifications have been prototyped, tested, and certified, modification kits developed, flight manuals revised as required and so on. However, the committee's review of all such Air Force aircraft revealed that most of them already have winglets or the decision has been made to incorporate winglets, as shown below in Table 4-1.

All of these aircraft have winglets except for the C-9s, the C-21s, the VC-25s, and the E-4s. The three C-9s, derivatives of the DC-9, are scheduled to retire in FY11 and should not be considered for wingtip modifications. Also, past work on winglets for the DC-9, as discussed in Chapter 3, did not prove to be favorable. The C-21s, derivatives of the Learjet 35A, are small aircraft and the entire fleet uses less than 8 million gallons of fuel per year and would not be a priority to modify. Furthermore, they have tip tanks, and wingtip modifications would require the removal of these tanks, severely limiting the range of these aircraft even with a more efficient wing. Lastly, the VC-25s and the E-4s are derivatives of the Boeing 747-200, with the VC-25s

[2] C.A. Shollenberger, et al. Results of winglet development studies for DC-10 derivatives. NASA-CR-3677. March 1983.

having 747-300 wings. The 747-200 has not been produced since the late 1980s, so the commercial fleet is aging and retiring from service. As a result, the entire cost of winglets designed for 747-200/300 wings would have to be borne by the government. All of the 747s in the commercial world that have winglets are 747-400s, which have a structurally modified wing. The structural modification to allow installing the 747-400 wingtip on the VC-25s or the E-4s would be very expensive and impractical.

TABLE 4-1 Winglet Status of Air Force Aircraft Derived from Commercial Airframes

USAF Aircraft	Commercial Equivalent	Inventory	Winglets
C-9	Douglas DC-9-30	3	No
C-20B	Gulfstream GIII	5	Yes
C-20H	Gulfstream GIV, GIVSP	2	Yes
C-37	Gulfstream GV	9	Yes
C-21	Learjet 35A	59	No
C-40B	Boeing 737-700	4	Yes
C-40C	Boeing 737-700	3	Yes
VC-25	Boeing 747-200 (-300 wings)	2	No
E-4	Boeing 747-200	4	No
C-32	Boeing 757-200	4	Yes

SOURCE: Courtesy of U.S. Air Force.

This discussion leads to the following finding:

Finding: Most of the aircraft in the Air Force inventory that derive from commercial aircraft now operating with winglets already have winglets themselves, or the decision has been made to install winglets. The remaining Air Force aircraft that are derivatives of commercial aircraft do not appear to be good candidates for wingtip modifications.

PRIORITY AIRCRAFT TO BE CONSIDERED FOR WINGTIP MODIFICATION

Based on the committee's judgment of a variety of factors, some of which are detailed in the following pages, five aircraft were ranked in the order of their suitability for wing modifications, as shown in Table 4-2.

TABLE 4-2 Potential for Wingtip Modifications to Benefit Air Force Aircraft

Aircraft	Priority/Potential benefit
KC-10	High
KC-135R/T	High
C-5	Medium
C-17	Medium/low
C-130H/J	Low

However, these judgments are based on minimal basic data, and a detailed engineering and economic analysis would be required for each aircraft type before a final decision could be made to proceed with the installation of winglets or other aerodynamic modifications.

PRELIMINARY NET PRESENT VALUE ANALYSIS

To illustrate the types of benefits and costs that might be realized through wingtip modifications (e.g., winglets) that would produce a reduction in fuel burn, the committee shows here, as examples, the results of its preliminary net present value (NPV) analysis for the KC-135R/T and the KC-10. Appendix A shows the sets of data values the committee used for both aircraft, including number of aircraft, fuel burn, flying hours, and projected retirement dates to calculate the NPV of savings. The mission profiles are inherent in the data used for each aircraft. In particular, the fuel consumption rates (pounds or gallons per hour) are the average over the various mission profiles actually flown.

Since it is not possible to know the fuel savings and modification cost for a specific aircraft without performing a detailed engineering analysis, as described earlier in this chapter, the committee parameterized fuel savings and modification cost for each aircraft.

The calculations were done for block fuel savings ranging of 3 percent and 5 percent, consistent with commercial airline experience and the findings of this report. The price per gallon of fuel was parameterized at $2.50, $5.00, $10.00 and $20.00 to represent the fully burdened cost of fuel. (All monetary values are in dollars of 2007 purchasing power.)

The committee estimated modification cost range for the KC-135R/T and one for the KC-10 as shown in Table 4-3.

TABLE 4-3 Estimated Aircraft Modification Costs

Aircraft	Estimated Modification Cost (million $)[a]
KC-135R/T	0.5 and 1.0
KC-10	1.5 and 3.0

[a] Includes non-recurring development costs.

For the NPV calculations, the committee assumed an annual fuel cost escalation rate of 3 percent and a discount rate of 3 percent.

Using the above costs and fuel saving and the data in Appendix A, the committee first calculated the time required for fuel savings to pay back the cost of modifying an individual aircraft.

The results shown in Tables 4-4 and 4-5 suggest that [3] modifying the KC-135R/T and KC-10 aircraft in its inventory might financially benefit the Air Force. Even in the worst case (highest modification cost, lowest fuel usage reduction, and fuel cost of $2.50 per gallon) for each, the payback periods are within the expected remaining service lives of the aircraft. The results also how the payback period is affect by the cost of fuel. In constant dollars, if the cost of fuel were to double, the payback period would be cut in half.

The NPV results are shown in Figure 4-2 for the KC-135R/T and in Figure 4-3 for the KC-10. The figures show the estimated cumulative fleet net savings over time from the start of aircraft modification to when the last aircraft is retired from service. Results are shown for the worst case (highest modification cost and lowest fuel usage reduction) and best case (lowest modification cost and highest fuel usage reduction) payback periods at a fuel cost of $2.50 per gallon. These calculations also take into account the modification cost, aircraft specific information such as number of aircraft, projected lifetime, flight hours per year, fuel burn, etc. For these illustrative calculations, it was assumed that the non-recurring engineering would be done by FY08 and the modifications would begin in 2009. The modifications would be done while an aircraft is undergoing regular depot maintenance, so it would not be out of service for any additional time. The committee also assumed for these calculations all of the aircraft in the fleet would undergo programmed depot maintenance at a uniform rate between FY09 and FY13 inclusively.

[3] The committee's parametric analysis suggests—but does not prove—that financial benefits would accrue from modifying these aircraft. As stated earlier in the report, deeper, aircraft-specific engineering analysis is required to support more precise and higher confidence estimates of the costs and benefits of making the modifications.

TABLE 4-4 Payback Period for a KC-135R/T Using 649,000 gal/yr

Estimated cost of modification (FY07 $M)	Fuel usage reduction from modification (%)	Fuel saved (K gal/yr)	Fuel cost saved (FY07 $K)	Payback period (years)
Fuel at $2.50/gal				
0.5	5	32	81	6.2
0.5	3	19	49	10.3
1.0	5	32	81	12.3
1.0	3	19	49	20.6
Fuel at $5.00/gal				
0.5	5	32	162	3.1
0.5	3	19	97	5.1
1.0	5	32	162	6.2
1.0	3	19	97	10.3
Fuel at $10.00/gal				
0.5	5	32	324	1.5
0.5	3	19	195	2.6
1.0	5	32	324	3.1
1.0	3	19	195	5.1
Fuel at $20.00/gal				
0.5	5	32	649	.8
0.5	3	19	389	1.3
1.0	5	32	649	1.5
1.0	3	19	389	2.6

TABLE 4-5 Payback Period for a KC-10 Using 2.057 million gal/yr

Estimated cost of mod (FY07 $M)	Fuel usage reduction from modification (%)	Fuel saved (K gal/yr)	Fuel cost saved (FY07 $K)	Payback period (years)
Fuel at $2.50/gal				
1.5	5	103	257	5.8
1.5	3	62	154	9.7
3.0	5	103	257	11.7
3.0	3	62	154	19.4
Fuel at $5.00/gal				
1.5	5	103	514	2.9
1.5	3	62	309	4.9
3.0	5	103	514	5.8
3.0	3	62	309	9.7
Fuel at $10.00/gal				
1.5	5	103	1,028	1.5
1.5	3	62	617	2.4
3.0	5	103	1,028	2.9
3.0	3	62	617	4.9
Fuel at $20.00/gal				
1.5	5	103	2,057	0.7
1.5	3	62	1,234	1.2
3.0	5	103	2,057	1.5
3.0	3	62	1,234	2.4

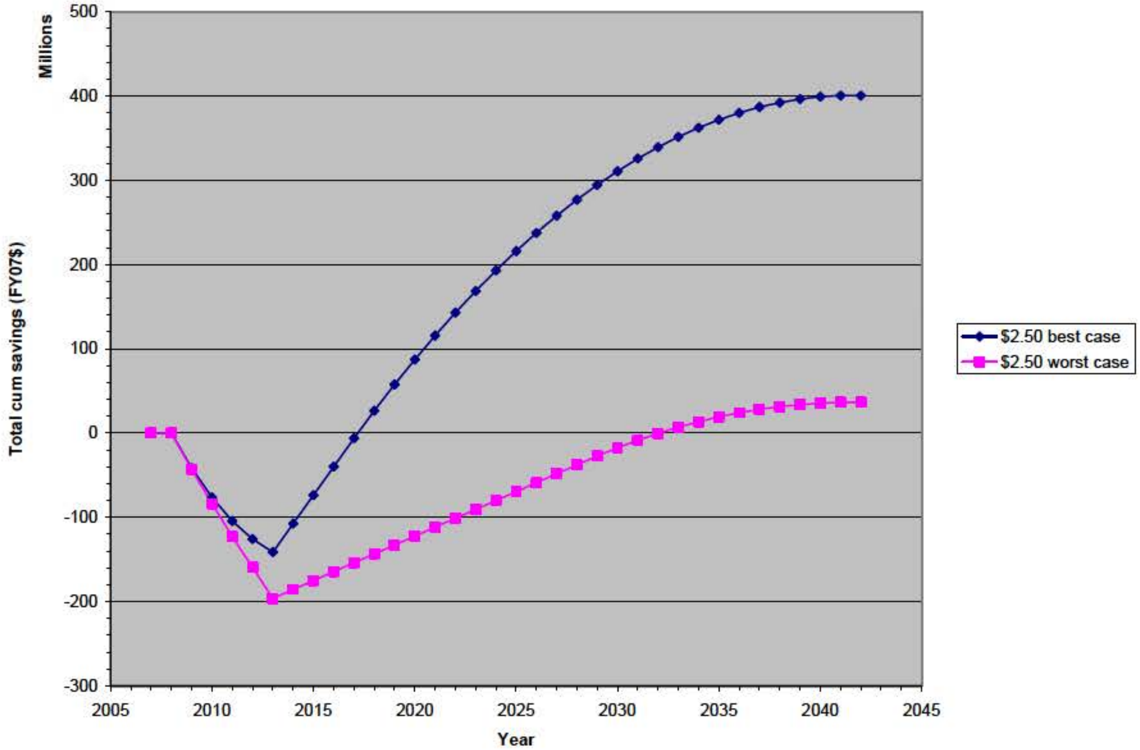

FIGURE 4-2 KC-135R/T estimated cumulative inventory-level net savings.

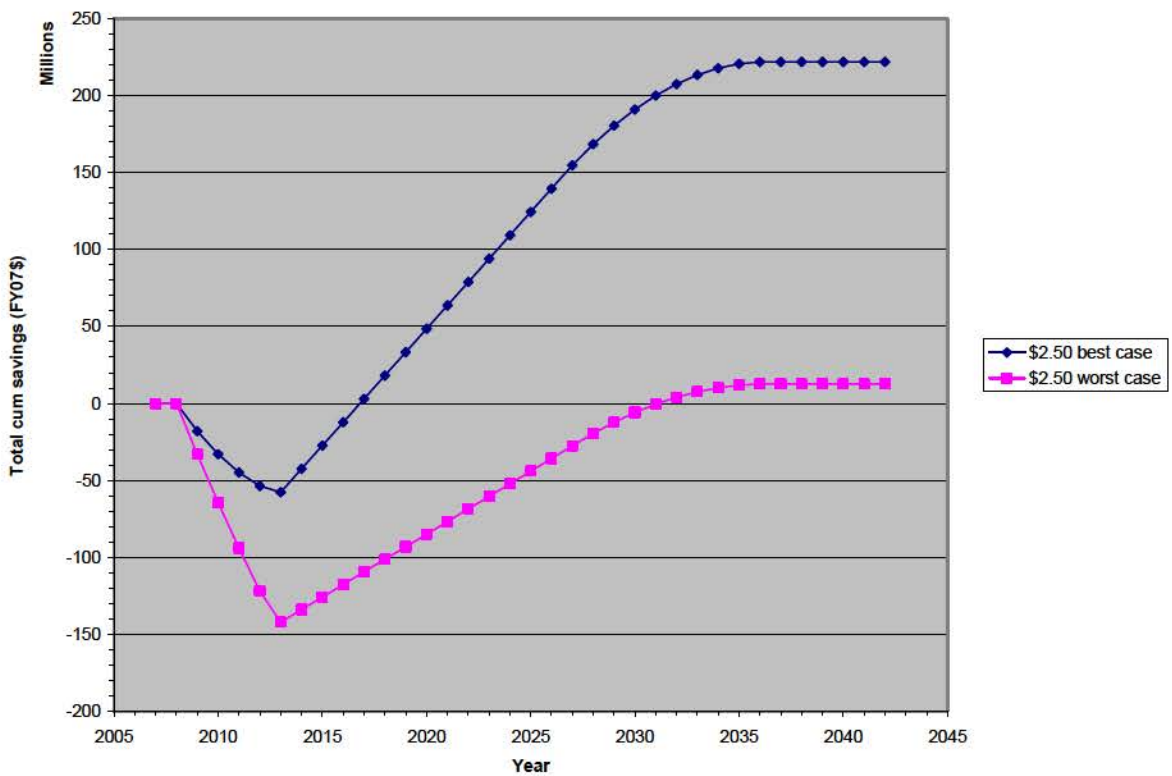

FIGURE 4-3 KC-10 estimated cumulative inventory-level net savings.

In the KC-135R/T best case, net savings become positive 9 years after starting the modification program. All 417 aircraft in the inventory are modified. Total net savings to the Air Force are approximately $400 million (FY07$). In the KC-135R/T worst case, net savings become positive 24 years after starting the modification program. Only 217 of the 417 aircraft in the inventory are modified—the others are not modified because they are expected to be retired from the inventory before reaching the ends of their payback periods. Total net savings to the Air Force are approximately $36 million (FY07$).

In the KC-10 best case, net savings become positive 8 years after starting the modification program. All 59 aircraft in the inventory are modified. Total net savings to the Air Force are approximately $221 million (FY07$). In the KC-10 worst case, net savings become positive 23 years after starting the modification program. Only 53 of the 59 aircraft in the inventory are modified—the others are not modified because they are expected to be retired from the inventory before reaching the ends of their payback periods. Total net savings to the Air Force are approximately $12 million (FY07$).

Figure 4-4 illustrates how the cost of fuel affects net savings. The KC-135R/T worst case payback periods are shown at fuel costs of $2.50, $5, $10, and $20 per gallon.

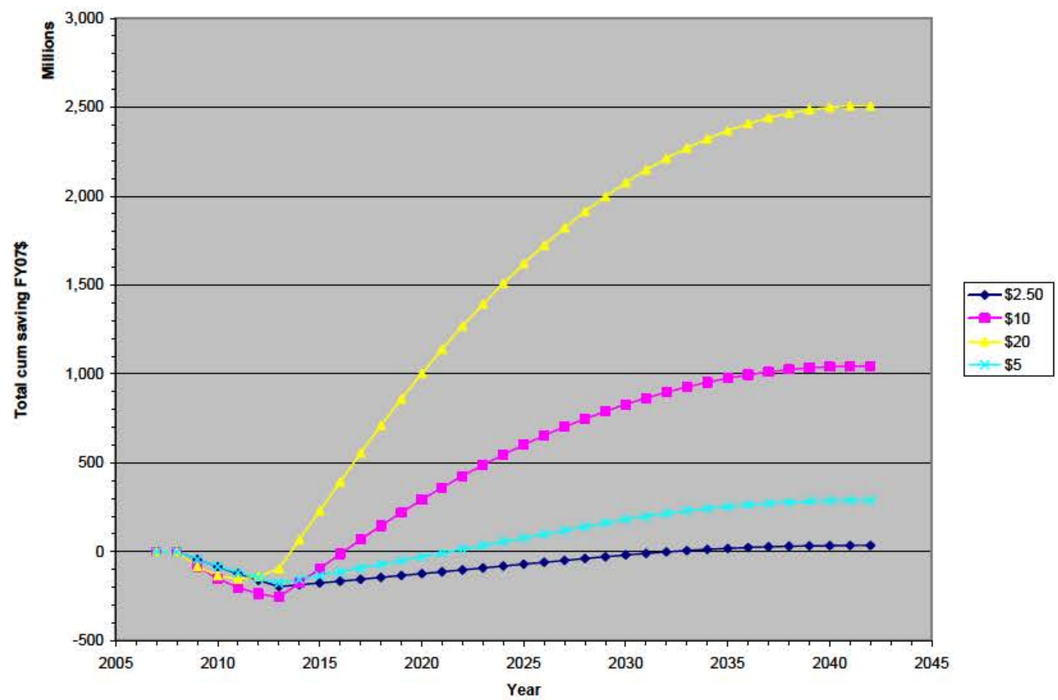

FIGURE 4-4 KC-135R/T effect of cost of fuel on payback period.

In constant dollars, when the cost of fuel is doubled, the payback period is cut in half. Total net savings to the Air Force rise significantly. The committee's analyses give only rough estimates of the costs and benefits of the modifications but, for reasonable projected values of the various factors these rough estimates suggests that further analysis is warranted.

Finding: The committee's analysis, for a broad range of fuel prices and with the data available to it on potential improvements in block fuel savings, modification cost estimates, operational parameters for the aircraft, and so forth, indicates that wingtip modifications

offer significant potential for improved fuel economy in certain Air Force aircraft, particularly the KC-135R/T and KC-10.

Recommendation: The Air Force should initiate an engineering analysis with the original equipment manufacturers (OEMs) to determine (1) the extent and cost of modifications needed for the KC-135R/T and the KC-10 to enable installation of wingtip devices and (2) the fuel savings that could be achieved by this modification for each aircraft type. It should then perform an NPV analysis with these data to calculate the net savings. The Air Force should also analyze the C-5 and C-17 for potential wingtip modifications.

Once these analyses have been performed, more accurate and specific values for the modification costs and fuel savings will be known. The NPV calculations will give an idea of how long it takes to recover the investment. Note that an important parameter in the NPV calculation is the price of fuel, which cannot be known in advance but instead must be hazarded. In any event, based on this preliminary analysis and the current price of fuel, these modifications are worthy of very serious consideration and analysis.

INVESTMENT STRATEGIES

The statement of task for this study asks for "investment strategies that the Air Force could implement with commercial partners to minimize Air Force capital investment and maximize investment return." Based on the analysis presented in this and earlier chapters, the committee proposes that the Air Force (1) follow through on its recommendation to initiate detailed engineering analysis in collaboration with the OEMs, (2) implement the modifications, if deemed cost effective, while the aircraft are in depot and in collaboration with industry, and (3) use innovative financing mechanisms as needed. The committee also suggests that the Air Force evaluate the fuel economy practices of commercial aircraft operators, some of which are described in Appendix B, and implement those that are applicable and not currently used by the Air Force. The strategies for investing in wingtip modifications are described in further detail below.

Performing Retrofit Studies and Implementing Modifications

Fuel economy has been a primary focus of commercial aircraft operators for a number of years. They have done an excellent job of working with the airframe manufacturers to perfect the aerodynamic design of aircraft to include wingtip modifications that will reduce drag, of implementing maintenance and operations procedures that save fuel, and making fuel conservation a part of everyone's job and a factor in every decision. As a result, it is not surprising that this committee believes the aircraft with highest priority for further analysis are the KC-10 and the KC-135, two derivatives of commercial aircraft. The fact that these aircraft are commercial derivatives means that there is extensive commercial knowledge and experience to complement the military knowledge and experience. It also means that aerodynamic modifications have been examined more carefully and that more experienced engineers and maintenance personnel exist in the commercial industry than would be the case for military-unique aircraft such as the C-5. Thus, making the engineering analysis somewhat easier and increasing the availability of information. In any case, the feasibility and cost effectiveness of wingtip modifications on all of the aircraft should be worked out in partnership with the OEMs, whose knowledge of the aircraft structures and load distributions will be critical. In each case, the feasibility studies should be initiated as soon as possible. Then, a high priority should be given to funding the installation of wingtip modifications where they have been determined to be justified from a cost/benefit perspective. The sooner the modifications are incorporated, the sooner they will begin to pay back the initial investment and the less dependent the United States will be on foreign sources of fuel.

In addition, the KC-10 and the KC-135 constitute the aerial refueling capability of the Air Force and as such are force multipliers. As the fuel efficiency of these aircraft improves, they can either extend their range, carry more payload (i.e., offload more fuel to other aircraft), or do a combination of both things.

KC-10

In the case of the KC-10, winglet design work and testing have already been done on its commercial counterpart, the DC-10, as noted in Chapter 3. Although winglets were never incorporated on commercial DC-10 fleets, the knowledge gained from the engineering analysis, design work, and flight tests led to the installation of winglets on the MD-11. There is also the potential that commercial DC-10 operators such as FedEx could follow the Air Force lead and thus create a larger market for wingtip device modifications to the KC-10/DC-10s.

Should the decision be to proceed with such a modification, the committee suggests that the work be done while the aircraft are in normal scheduled overhaul. Since the KC-10 is maintained on contract with industry engineers who have intimate knowledge of commercial DC-10s, it is possible that wingtip modification could be added to the work specification with little or no added downtime or loss of operational availability.

KC-135R/T

Much of the same applies to the KC-135R/T aircraft fleet, except that unlike the KC-10, these aircraft are predominately maintained by Air Force personnel in-house. Also, as noted in Chapter 3, aerodynamic studies of wingtip modifications were done in the 1970s, and a test aircraft was modified with winglets and flight tested. Since the analysis and tests were done so many years ago and there are some uncertainties surrounding the condition of the KC-135 wings and their ability to handle the load increases from wingtip modifications, a sample of the fleet would have to be inspected. The best opportunity to do such an inspection or condition analysis is while the aircraft is in depot maintenance. Most depot overhauls of the KC-135s are performed by the Air Force at the Oklahoma City Air Logistics Center. During maintenance, paint is removed, engines are removed, and the aircraft are opened up for inspection of structural integrity, providing an excellent opportunity to take a careful look at the wings with minimal impact on depot flow. Like the KC-10s, these aircraft are critical to the operational commands, and every effort should be made not to increase scheduled downtime in the maintenance shops.

Should the modifications be justified, the committee believes the wingtips could be retrofitted while the aircraft are undergoing their 5-yearly depot maintenance. Rather than divert Air Force mechanics from other tasks, however, it might be wiser to partner with industry and have an experienced contract field team augment the Air Force workforce to accomplish the modification. This would minimize the training required and allow returning the aircraft to the operational forces in the shortest time. For the KC-135 R/T undergoing programmed depot maintenance at contractor facilities, the Air Force should consider adding wingtip modifications to the existing overhaul contract.

Other Aircraft

The next priority aircraft for consideration of wingtip modifications are the C-5 and the C-17. The same factors discussed in the investment strategies for the KC-10 and the KC-135R/T should be part of the planning process for these fleets as well.

Financing Mechanisms

Wingtip modification programs and other fuel economy investments are examples of long-term investments that may require a significant initial investment that provides returns over time. Securing financing for such long-term investments is always a challenge given the current military acquisition practices and congressional appropriation processes. In a previous report on engine fuel economy in military aircraft,[4] the NRC discussed innovative financing mechanisms that might be pursued. The statement of task for that study included a request to "develop implementation strategies to include conventional, as well as innovative, acquisition, financing, and support concepts." The committee believes that three of the mechanisms discussed in that report—specifically, creating a line item in the defense budget, implementing an "Energy Savings Performance Contract" strategy, and competing airframe maintenance contracts—could be applicable in implementing wingtip modifications. Those mechanisms are discussed in some detail in the earlier report.

[4]NRC, 2007, *Improving the Efficiency of Engines for Large Nonfighter Aircraft*, Washington, D.C., The National Academies Press, prepublication.

Appendixes

Appendix A

Data Used in Net Present Value Analyses

The data values used in the net present value analyses discussed in Chapter 4 are shown in Tables A-1 and A-2.

TABLE A-1 KC-135R/T Data

Average individual aircraft flight hours per year (hr/yr)	425
Average fuel consumption of an individual aircraft (lb/hr)	10,224.2
Weight of fuel (lb/gal)	6.7
Number of aircraft in inventory in 2007	417
Number of aircraft retired from inventory at start of year	
2018	16
2019	17
2020	17
2021	16
2022	17
2023	17
2024	16
2025	17
2026	17
2027	16
2028	17
2029	17
2030	16
2031	17
2032	17
2033	16
2034	17
2035	17
2036	16
2037	17
2038	17
2039	16
2040	17
2041	17
2042	17

TABLE A-2 KC-10 Data

Average individual aircraft flight hours per year		783
Average fuel consumption of an individual aircraft (lb/hr)		17,600
Weight of fuel (lb/gal)		6.7
Number of aircraft in inventory in 2007		59
Number of aircraft retired from inventory at start of year		
2028	6	
2029	6	
2030	6	
2031	6	
2032	6	
2033	6	
2034	6	
2035	6	
2036	6	
2037	5	

Appendix B

Additional Methods for Improving Fuel Consumption

The statement of task for this study focuses on the fuel economy of military aircraft and the potential of wingtip devices to reduce fuel consumption. However, wingtip devices are just one method for reducing fuel consumption. Other methods include making other aerodynamic modifications to the aircraft, improving engine efficiency, changing maintenance and operation practices, and improving weight management. Many of these strategies have already been adopted by the commercial airlines, which operate in an intensely competitive environment[1], and others have been touched upon by several recent studies.[2] The committee believes it is important for these strategies to be considered, and while they were not the focus of this study and the extent to which the Air Force may already be using some of these strategies was not examined, some examples are discussed below for the reader's benefit.

Based on commercial experience, these other methods are expected to be relatively inexpensive, easy to implement, and could yield fuel consumption benefits comparable to wingtip devices. This appendix first explains some of the challenges experienced by commercial aircraft and then discusses other strategies for improved fuel efficiency. Since the preceding NRC report dealt with improving engine efficiency, an important determinant of fuel consumption this strategy is not covered here.[3]

CHALLENGES

The aging and service use of commercial aircraft and jet engines take a toll, reducing aerodynamic and propulsion efficiency, as evidenced by increased fuel burn. As aircraft age and material wears, or suffers minor damage, fuel efficiency tends to decline because of external repairs, increased air leakage from the fuselage, weight gain from the entry of moisture and from years of modification programs, and engine deterioration. It is common for new commercial aircraft types to experience fuel burn increases over the specification (or "book" level) of 2-4 percent within 4 years of entry into service. The regulatory agencies and internal technical organizations that certify continued airworthiness set the allowable in-service expansion of the original by tight manufacturing tolerances to accommodate the effects of normal wear and tear on commercial machinery.

Then, too, owners and operators of aircraft often push the performance limits of their equipment to achieve greater payload, range, endurance, or takeoff performance. Regardless of

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[1]Joseph C. Anselmo. 2004. "Airline fuel crisis." *Aviation Week & Space Technology*. December 6. pp. 54-56.

[2]Past studies on fuel conservation measures in the Air Force and at DoD have included Defense Science Board (DSB), 2001, *More Capable Warfighting Through Reduced Fuel Burden*, AFSB, 2006, *Report on Technology Options for Improved Air Vehicle Fuel Efficiency,* and NRC, 2007, *Improving the Efficiency of Engines for Large Nonfighter Aircraft, Prepublication.* Each of these studies included at least some discussion on current commercial practices.

[3]National Research Council, 2007, *Improving the Efficiency of Engines for Large Nonfighter Aircraft*, Washington, D.C., The National Academies Press.

the specifications that prevailed when the aircraft were procured, political, regulatory, economic, or demographic influences open up prospects for new missions or markets that lie tauntingly just beyond the existing capabilities of existing in-service aircraft. Aircraft operators must then either seek new equipment with the required performance, or attempt to improve the performance of existing equipment, through modification, to accommodate those new missions and markets. Specific strategies to take on these challenges are discussed below.

AERODYNAMICS

Lessons learned from the commercial airplane industry suggest that aerodynamic improvements wingtip modification are worth consideration for the Air Force's fleet of aircraft. Many of the its transport aircraft were designed in the early days of swept-wing transport design and do not take advantage of some more recent technological advancements, such as supercritical aft-loaded wings; low-interference, pod-mounted engine installations; reduced static stability; and digital designs with low excrescence drag.

Wing Modifications

A number of common performance improvements have been incorporated into the commercial fleet, both by the original equipment manufacturers (OEMs) and by third-party aircraft modification firms. Obviously, winglets are the most visible sign of this activity. Another common modification of earlier generation of aircraft is re-rigging of the high-lift devices for cruise flight, creating a pseudo-aft-cambered wing. This has been done for the Boeing 727, for example. Another modification is the addition of a small, trailing-edge wedge on the lower surface of the wing. This creates some aft-camber and can also be used to change the span loading of the wing. That strategy was implemented on the MD-11 derivative of the DC-10 wing and is being studied for use on other aircraft. These trailing-edge modifications can be worth a reduction in fuel burn of up to 2.5 percent, depending on factors such as wing flexibility, trim drag characteristics, the original wing airfoil design, etc.[4]

Engine Installation

Pod-mounted engine installations of early generation aircraft were crude by the standards of today when high-powered computational fluid dynamics (CFD) methods have allowed very close coupling of engines with little or no interference drag. If a re-engine program is considered for a transport category airplane, it is likely that a new engine installation can take advantage of this technology, resulting in a shorter pylon with less weight and wetted area and perhaps less interference drag as well. It is not likely that re-design of an existing engine installation to reduce drag or weight would pay off on its own, but if combined with a re-engine program, there could be a synergistic payoff of 1-2 percent.

Aerodynamic Clean-up

Aerodynamic cleanup programs are common, both for in-production and in-service airplanes. This would include redesign of excrescences, such as door seals, high-lift system seals, rigging, antenna installations, protruding fasteners, air inlets and exhausts for external air exchange systems, and so on. It also might include redesign of aerodynamic fairings, including

[4]R.D. Gregg, R.W. Hoch, P.A. Henne. "Application of Divergent Trailing-Edge Airfoil Technology to the Design of the a Derivative Wing." SAE Technical Paper 892288. September 1989; P.A. Henne and R.D. Gregg. "New Airfoil Concept." AIAA Journal of Aircraft. Vol. 28, No. 5. May 1991. p. 300-311.

flap support fairings, wing-to-body fairings, and the like. Up to 4 percent of airplane drag has been saved on commercial aircraft, some having clean-up programs and other not. As an example, the MD-11 had a Cruise Performance Improvement Program that resulted in approximately a 4 percent improvement to the fuel burn efficiency of the modified aircraft.[5] Further investigation would be required to determine if any of these redesigned items, which were above and beyond the basic improvements made to the original MD-11 design by incorporation of the winglets and trailing-edge wedges, are applicable to the KC-10/DC-10 family.

MAINTENANCE AND OPERATIONS

The mechanical condition of an aircraft and the means by which it is operated are critical for to maintaining original performance design characteristics and objectives. As stated earlier, airline aircraft typically exhibit fuel burn 2-4 percent above the book value within 4 or so years of entering service. Airline experience demonstrates that it is difficult to determine the relative contribution of the airframe and the engine to this fuel burn deterioration. Over the years, the airlines and commercial aircraft and engine manufacturers have developed comprehensive maintenance and operational procedures to return aircraft to their certified fuel-burn performance. Collectively, these efforts can improve fuel burn by 1-3 percent. These procedures are effective and relatively easy to implement. Where these procedures make operational sense and are not currently used by the Air Force, military managers should consider implementing the practices that have merit.

Maintenance

Initial efforts to improve performance improvement generally rest with an attempt to regain the original tolerances and material conditions for in-service aircraft. These efforts are generally accomplished according to priorities that are jointly developed with the OEM. Based on individual airline operating experience, these maintenance activities or fine-tuning exercises to return the aircraft as close as practical to its original material condition and configuration will frequently reduce fuel burn by 1-3 percent (or possibly more).

Effective maintenance programs require a comprehensive knowledge of the mechanical condition of the aircraft and its systems and the conditions that cause mechanical malfunctions. They require, as well, a detailed accounting of the maintenance actions conducted and the resulting effect on the malfunction. Most important, for any such program to succeed requires the development of measures and standards for efficient operation of the equipment.

Maintenance programs must be developed to take into account some of the systems and elements which, if not operating properly, can have a major negative impact on fuel burn:[6]

- *Air data*. Air data generally refers to the aircraft pitot-static system that provides crew and system reference for airspeed, altitude, and vertical velocity information. Air data refers as well to some engine instrumentation such as engine pressure ratio (EPR) that provides crew and systems reference for proper engine power information. Proper maintenance of these systems is essential to assure that the aircraft is operating at the airspeed/Mach number, altitude, and power that give the most efficient fuel burn. In addition, improper power setting can result in asymmetric thrust, which must be compensated for by trimming the control surfaces, increasing drag. The commercial

[5]Robb Gregg, Senior Manager for Aircraft Programs, Boeing-Phantom Works, "Drag improvement: A study of the DC-10/MD-11/C-17 winglet programs." Presentation to the committee on December 13, 2006.

[6]These are also discussed in *Improving the Efficiency of Engines for Large Nonfighter Aircraft.* That earlier report also discusses improvements to the maintenance programs for engines when they are in depot (rather than on-wing). That discussion is omitted here.

industry recently went through an accuracy improvement in air data systems to support the worldwide Reduced Vertical Separation Minima (RVSM) program. This revealed system deficiencies that have resulted in system improvements to assure optimum operational and fuel burn performance. This exercise technology is now available that would allow collecting more accurate airspeed data.

- *Pneumatics*. Pneumatic leakage through door cutouts, improper sealing, airframe damage, and fuselage attach fitting adversely affect fuel burn in two ways: (1) extra fuel is consumed because the air-cycle machines must work harder to compensate for the leakage and (2) the leakage of air from the fuselage disrupts the airflow around the aircraft, resulting in increased drag. Close monitoring of the airframe and engine pneumatic systems is encouraged to maintain optimum fuel burn.
- *Seals*. It is essential to assure that the aerodynamic seals between the lower and upper wing are in good condition, especially on the leading edges.
- *Flight controls*. Flight controls must be properly rigged. Floating spoilers, flaps that are not properly seated, and ailerons not properly rigged can all have a very large impact on fuel burn. Large surfaces such as rudders are especially critical and adversely impact fuel burn if out of rig or trimmed to offset asymmetric thrust conditions.
- *Fuel indicators*. To assure the best flight profiles for fuel efficiency, it is essential to have accurate references for fuel quantity and fuel flow. In order to achieve this objective it is essential that fuel quantity probes and indicating systems as well as flowmeters be calibrated periodically.
- *Engine performance*. Over time, the wear on engine blades adversely affects the gas path of turbine engines. The earliest sign of these effects is commonly the loss of exhaust gas temperature (EGT) margins. This loss is typically between 5 and 7 C° EGT per 1,000 hours of flight time and ultimately impacts takeoff performance, especially at hot and/or high-altitude airports with relatively short runways. This deterioration can be mitigated by a rigorous on-wing engine wash program that initially returns between 5 and 10 C ° EGT. As the engine continues to deteriorate over time, this effect decreases over time as well.
- *Housekeeping*. Simple housekeeping actions can have benefits, such as maintaining leading edges so that they are clean and free of excessive dents, making sure the pitot-static lines are free of obstructions, and assuring the proper calibration and functioning of systems to measure air mass temperature. The removal of fittings and materials remaining from of past modifications or temporary accoutrements that add unnecessary weight to the airframe is also important. The importance of reducing unnecessary weight is discussed elsewhere in the appendix.

Operations

A number of operational procedures and practices have been developed by the air transport industry to reduce fuel consumption. Their effectiveness is dependent on (1) the commitment of management and flight crews to their use and (2) standardization in their application throughout all functions of the organization.

The following elements are fundamental to controlling excessive fuel burn. They are well known by all aircraft operators. To the extent that they are effectively managed to affect fuel burn depends on how ingrained they are into the thought processes of individual flight, maintenance, planning, and configuration control personnel — in other words, how well they are accepted into the culture of the organization.

Fuel Burn Tracking

Most airlines have strict fuel burn reduction plans that track individual aircraft and flight crews to isolate equipment or operational factors that contribute to excessive fuel burn. The plans, which are frequently developed in conjunction with the aircraft manufacturer, include the following:

- Develop flight-phase operational configurations and profiles — that is take off and climb to cruise, cruise, descent/land profiles) to provide the optimum airspeed and power setting for targeted fuel burn and flight performance at the given gross weight and altitude of the aircraft.
- Report periodically while in flight on fuel burn, power settings, airspeed, and altitude.
- Determine block fuel use for specific aircraft and flight crews.

Continuous monitoring of cruise performance can give aircraft operators the information they need to decide how and where to save fuel. Such monitoring allows the operators to do the following:

- Adjust the baseline performance levels they use for flight planning so that the correct amount of fuel is loaded on each and every flight.
- Increase flight crew confidence in flight plans and possibly decrease the amount of discretionary fuel requested.
- Identify airplanes the burn a lot of fuel for possible corrective actions.
- Match the airplanes and engines that perform best with respect to fuel burn to fly the longest range/endurance missions.

If a specific aircraft is flagged as having excessive fuel burn, maintenance action is initiated to determine, and correct, the cause of that burn (the preceding section on maintenance gives details). Airframe and engine manufacturers may be called on to assist if the corrective actions are not readily identifiable.

If a particular flight crew, or flight crew member, consistently exceeds average block fuel usage for specific flight segments, the situation may be addressed with appropriate training. Wherever possible, the flight crew should assure that their fuel burn practices comply with the following guidelines:

- Use the manufacturer-recommended fuel burn procedures for wing tanks as appropriate to maintain wing structural integrity and stiffness.
- Maintain lateral balance during fuel burn.
- Maintain aft center of gravity (CG) with fuel burn.

Trim

One of the most frequent reasons for excessive fuel burn for specific aircraft and/or flight crew members is improper trim, which can come from a suboptimal If the performance indicating system, fuel quantity system, or flight control rig or from flight crew members failing to trim the aircraft properly. Airline experience has demonstrated that even pilots with thousands of flying hours and years of experience in the cockpit can fail to trim aircraft properly.

A number of priorities must be observed to properly trim an aircraft. When the mission requires predominate use of the autopilot, the flight crew should assure that the aircraft is trimmed properly prior to connecting the autopilot and should then disconnect the autopilot periodically to retrim as necessary. Proper aircraft trim is achieved by the following means:

- Maintain lateral balance with fuel burn.
- Manually fly the aircraft to maintain straight and level flight.
- Balance the thrust using all of the engine performance indicators.
- Trim elevator to eliminate elevator control force and maintain level flight.
- Trim rudder to eliminate rudder control force and sideslip/turning flight.
- Trim aileron to eliminate control force.
- Verify control displacements (spoilers, ailerons, and rudder within manufacturer/service limits) for potential maintenance action (rigging).

As mentioned in the maintenance section, it is important to verify control displacements (spoilers, ailerons, and rudder should be monitored within the manufacture's service limits) for potential maintenance action (rigging). Also, it is obvious that failure to calibrate flight and performance instrumentation will prevent the flight crew from trimming the aircraft properly.

Ground Operations

Standard procedures exist for ground operations as well to minimize unnecessary use of engine power and the auxiliary power unit (APU). The following exemplify such procedures:

1. Single-engine taxi is used for two-engine aircraft, and one- or two-engine shut-down taxi for three-engine and four-engine aircraft, whenever the airport and operational conditions and configurations allow.
2. Engines are not started until the appropriate time in the departure sequence.
3. The APU is not used until required for engine start or postflight operations unless external conditions require it (high temperatures, absence of ground power, etc.).

WEIGHT MANAGEMENT

The main goal of aircraft manufacturers is to design their aircraft to carry out the intended mission with the best possible performance. A common objective relative to that goal is to eliminate as much unnecessary weight and material as possible. This is true because every added pound of weight eats into aircraft performance margins by feeding the twin detriments of unnecessary fuel burn and reduced payload. Two facts are certain to apply to almost every commercial or military aircraft: (1) The basic aircraft empty weight will increase over the life of the aircraft (to the detriment of payload capability and fuel burn performance) and (2) mission demands will grow to push the operational limits of the aircraft.

To address these realities, aircraft operators must work diligently and continuously to determine and control the actual weight and balance of their aircraft. This is accomplished by programs that allow the following:

- Periodic and accurate determination of individual aircraft weight and balance (CG).
- Controlling aircraft modification programs to minimize weight increases and maintaining CG toward aft allowable limits to reduce drag.
- Maintaining the external condition of the aircraft to maintain aerodynamic efficiency and minimize drag — for example assure that dirt and other external contaminants such as grease build due to cleaning lubricants and the like do not add weight or affect the aerodynamics).
- Calibrating flight and performance instrumentation to assure proper criteria for weight, flight conditions, and performance.

The following are examples of additional and relatively simple actions that can be taken to reduce fuel consumption:

- Establish a baseline of equipment and material routinely carried on the aircraft (pallets, tools, etc.). Obtain fleet aircraft weight samples to determine the spread in actual weights, including weighing some operational aircraft ready to go out on a mission and some empty aircraft. Weigh all the equipment that is put on aircraft, such as repair kits. Use actual rather than estimated weights for cargo. Load all materials so as to maintain the maximum allowable (or practical) aft CG.
- Revise operational practices to reduce unnecessary weight. For training and operational flights, eliminate any equipment that is not essential to the mission. Do not carry excess fuel since its weight increases fuel consumption. Review the need to carry remote station tools and equipment and accurately account for the weight of necessary tools and equipment. Weigh all cargo to verify that registered weights are accurate.
- Revise maintenance practices to reduce unnecessary weight. Ensure aircraft are clean and not carrying water, trash, or dirt in cavity and swamp areas. Check insulation blankets for condensation which can increase the weight of the blankets significantly — by, for example, more than 1,000 lb in the case of 707 blankets. Consider lighter weight replacement materials for nonstructural items such as floor panels, (floors in KC-135s, for example, are plywood). Create a weight maintenance czar to keep aircraft weight as stable as possible over time.

The commercial airline industry has also employed changes when designing new aircraft to improve center-of-gravity management. Newer designs, such as the Boeing 777 and 787 and the MD-11, have used stability augmentation to allow smaller tail surfaces and to shift the CG aft, reducing trim drag. For an existing aircraft, it is probably not practical to change the design to improve stability or allow smaller tail surfaces. But, as mentioned above, by paying careful attention to payload loading position, an aircraft can be routinely flown near its aft CG limit, often saving a percent or more in trim drag. Commercial airlines have automated their loading processes to make aft loading more routine.

Appendix C

Presentations to the Committee

MEETING 1

DECEMBER 13-14, 2006

WASHINGTON, D.C.

Wingtip Devices: What They Do and How They Do It
Doug McLean, Boeing Technical Fellow
Boeing Commercial Airplanes

Overview of Winglets on Boeing Commercial Airplanes
Mark Goldhammer, Committee Member
Committee on Assessment of Aircraft Winglets for Large Aircraft Fuel Efficiency

American Airlines Winglets
John Novelli, Director, Operations Engineering and Optimization
American Airlines

Drag Improvement: A Study of the DC-10/MD-11/C-17 Winglet Programs
Robb Gregg III, Senior Manager
Boeing Phantom Works

C-5 and C-130 Discussion
Lane Ito, Advanced Development Programs
Lockheed Martin Aeronautics Company

Past Winglet Studies: AFSAB Fuel Efficiency Study
Ilan Kroo, Committee Member
Committee on Assessment of Aircraft Winglets for Large Aircraft Fuel Efficiency

Winglets Experience at Southwest (teleconference)
Jim Sokul, Vice President of Maintenance and Engineering
Southwest Airlines

Appendix D

Biographical Sketches of Committee Members

Kenneth E. Eickmann, *Chair*, retired from the Air Force after a 31-year career in which his last assignment was commander of the Aeronautical Systems Center within the Air Force Materiel Command at Wright-Patterson Air Force Base, Ohio. In that capacity he led the Air Force's center of excellence for research, development, and acquisition of aircraft aeronautical equipment and munitions. His leadership accomplishments also include having led the federal rescue and recovery efforts following the 1995 bombing of Oklahoma City's Alfred P. Murrah Building. More recently, he served as the director of the Construction Industry Institute (CII) at the University of Texas (UT) at Austin. CII, a nonprofit research institute, is the principal national forum for the multitrillion-dollar-a-year construction industry. Gen. Eickmann earned a B.S. in mechanical engineering from UT Austin in 1967 and M.S. in systems engineering from the Air Force Institute of Technology in 1968. He is also a graduate of the University of Michigan Executive Business Program and the John F. Kennedy School of Government at Harvard University. Gen. Eickmann is currently a member of NRC's Air Force Studies Board and was chair of the NRC's Committee on Analysis of Air Force Engine Efficiency Improvement Options for Large Non-Fighter Aircraft.

Natalie W. Crawford *(NAE), Vice Chair,* is senior fellow and former vice president and director of Project Air Force (PAF) at the RAND Corporation. Since joining RAND in 1964 as a member of the Engineering Sciences and Aeronautical and Astronautics departments, she has held a wide variety of research and administrative posts. She has led PAF research on aircraft survivability, conventional standoff weapons, tactical aircraft, electronic combat, and integrated avionics for the advanced tactical fighter. As director of PAF's Theater Force Employment Program, Mrs. Crawford formed a team of analysts to compile and edit Desert Storm air campaign data, leading to the first usable databases for analysis of that campaign. While associate director of PAF (1995-1997), she was in charge of a comprehensive, multidisciplinary analysis of the roles and capabilities of the Air Force in the 21st century. Then, as director of PAF, Mrs. Crawford oversaw all research conducted at RAND for the U.S. Air Force. In FY00, at the request of the Air Force chief of staff, she led a major review of requirements, acquisition, operations, and sustainment of Air Force electronic warfare programs and systems, culminating in a four-star summit chaired by the chief of staff. She has been a member of the Air Force Scientific Advisory Board since 1988, serving as its vice chairman in 1990 and 1991 and co-chairman from 1996 to 1999. To develop insight and understanding in her research, she has flown missions in several Air Force aircraft. In 2003, she was awarded the Vance R. Wanner Memorial Award from the Military Operations Research Society. She received a B.A. in mathematics from the University of California at Los Angeles, where she also pursued graduate studies in engineering. Mrs. Crawford was also vice chair of the NRC's Committee on Analysis of Air Force Engine Efficiency Improvement Options for Large Non-Fighter Aircraft.

Mark I. Goldhammer is the chief engineer for the Product Development Airplane Performance organization at Boeing Commercial Airplanes. In this position, he has functional oversight of the airplane performance disciplines assigned to the 787 and product development, including responsibilities for the 747-8, derivative and new airplane product development, advanced concepts, and competitive analysis. Mr. Goldhammer joined Boeing Commercial Airplanes in early 1977 and has worked on a variety of product development studies in high-lift aerodynamic design methods, transonic wing design, wind tunnel testing, and other aerodynamic design issues. He held positions as engineer, lead engineer, and manager of aerodynamics engineering on the 777 and was responsible for the aerodynamic configuration design from preliminary design through flight testing and certification. Mr. Goldhammer has also held managerial responsibilities for the aerodynamic configuration development of a re-winged/stretched derivative of the 747 and the certification of the 737-700C and the 737-900. He also represented the 737-NG on Boeing safety review boards and was instrumental in implementing lean principles to the delivery certification process for the 737-NG program. Prior to Boeing, Mr. Goldhammer began his career at the Douglas Aircraft Company. He received a B.S. in aeronautical engineering from Rensselaer Polytechnic Institute and an M.S. in aeronautical engineering from the University of Southern California. He is also a licensed private pilot.

Stephen Justice is concept exploration and development manager within Lockheed Martin's advanced development programs, also known as the Skunk Works, with responsibility for generating and developing new project ideas. Mr. Justice joined Lockheed in 1984 and held roles of increasing responsibility on programs that included the F-117 Nighthawk Stealth Fighter, YF-22 Stealth Air Superiority Fighter, and numerous classified programs. His aeronautical engineering experience ranges from conceptual design to preliminary design, detail design, fabrication liaison, flight test, design leadership, and program management. He has a B.S. in aerospace engineering from the Georgia Institute of Technology and has two awarded patents and five classified patent disclosures. Prior to Lockheed, Mr. Justice began his career in defense aerospace as a structural designer in Texas with General Dynamics' Fort Worth Division. In 2005, he received the LM Aeronautics Company AeroStar award and corporate NOVA award for leadership. Mr. Justice also is an instructor for Lockheed Martin Technical Institute in aircraft configuration development, structural design, systems design, and low observables (stealth) technology integration and is a licensed pilot.

Clyde Kizer retired in 2004 from Airbus Industries of North America as president of customer service. In that capacity, he had total customer services responsibilities for all Airbus aircraft operating in North America and spares and training responsibilities for all Airbus operators in the Western Hemisphere. Mr. Kizer's 12-year tenure with Airbus saw explosive growth for that company in North America, going from 98 Airbus aircraft of all types in North America to 980. Prior to Airbus, Mr. Kizer served as senior vice president of operations for Midway Airlines; vice president of engineering and maintenance at the Air Transport Association; and vice president of engineering at United. Mr. Kizer also served for 23 years as a Navy operational and experimental test pilot and flew 14 years as an engineering test pilot for United. He earned a degree in biochemistry from Eastern Michigan University in 1960. Mr. Kizer was also a member of NRC's Committee on Analysis of Air Force Engine Efficiency Improvement Options for Large Non-Fighter Aircraft.

Ilan Kroo *(NAE)* is a professor in the Department of Aeronautics and Astronautics at Stanford University, where he also received a Ph.D. Prior to joining the faculty at Stanford in 1985, he worked in the Advanced Aerodynamics Concepts Branch at NASA's Ames Research Center for 4 years. His research in aerodynamics and multidisciplinary design optimization includes the study of innovative airplane concepts. He participated in the design of unmaned aerial vehicles (UAVs) flying pterosaur replicas, America's Cup sailboats, and high-speed research aircraft. In addition to his research and teaching interest, he is director of a small software company and is an advanced cross-country hang glider pilot. He is a fellow of the American Institute of Aeronautics and Astronautics. Dr. Kroo was elected to the National Academy of Engineering for new concepts in aircraft design methodology and for the design and development of the SWIFT sailplane.

Eli Reshotko *(NAE)* is Kent H. Smith Professor Emeritus of Engineering at Case Western Reserve University and currently resides in Denver. Dr. Reshotko joined the faculty at Case Western in 1964 and prior to that worked at NASA-Lewis Flight Propulsion Laboratory (now NASA-Glenn Research Center). Dr. Reshotko graduated from the California Institute of Technology with a Ph.D. in aeronautics and physics, and his expertise includes viscous effects in external and internal aerodynamics. He is a fellow of the following societies: American Institute of Aeronautics and Astronautics, the American Society of Mechanical Engineers, the American Physical Society, and the American Academy of Mechanics, of which he has served as president. He is coauthor of over 100 publications and is affiliated with many task forces, committees, and governing boards, many of which he served as chair. Dr. Reshotko was also a member of the NRC's Committee on Analysis of Air Force Engine Efficiency Improvement Options for Large Non-Fighter Aircraft.

Raymond Valeika retired from Delta as senior vice president for technical operations (TechOps), where he directed a worldwide maintenance and engineering staff of more than 10,000 professionals, for a fleet of nearly 600 aircraft. Currently, he is an independent consultant advising major companies in aviation matters and an internationally recognized senior airline operations executive with over 40 years of experience managing large airline maintenance operations. Through his leadership and focus on continuous improvement of the human processes in aviation maintenance, Delta TechOps consistently rated at the top of the industry for performance benchmarks in the areas of safety, quality, productivity, and reliability. Prior to Delta, he held senior executive positions with Pan Am and Continental Airlines. In 1996, Mr. Valeika was honored with the Air Transport Association's Nuts & Bolts award, which recognized his leadership in the aviation industry. In October 1999, Mr. Valeika received the Marvin Whitlock Award from the Society of Automotive Engineers for his accomplishments and long-term leadership within the aeronautical engineering and commercial aviation industries. Most recently, the Aviation Week Group honored him with a lifetime achievement award. He is also a member of NRC's Aeronautics and Space Engineering Board. He graduated from St. Louis University with a degree in aeronautical engineering in 1964. Mr. Valeika was also a member of NRC's Committee on Analysis of Air Force Engine Efficiency Improvement Options for Large Non-Fighter Aircraft.

Congressional Report

Air Force Transformation

House Report 109-452, page 294

U.S. AIR FORCE

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Introduction

This report is provided to the Senate Committee on Armed Services and the House Committee on Armed Services as directed in House Report 109-452, page 294.

Background

The Fiscal Year 2007 (FY07) President's Budget (PB07) on Air Force Operations & Maintenance (O&M) included an Air Force "transformation plan" focused on "streamlining the organizational structure, incorporating process efficiencies, and continuing force structure reductions" to enable critical modernization and recapitalization. House Report 109-452 expresses concern that these efforts will continue what it perceives as "declining trends in readiness" and that the $945 million in O&M savings the Air Force claims in PB07 for FY07 from these initiatives are "not clearly justified."

Therefore, House Report 109-452 requested the Secretary of the Air Force submit a report to the Senate and House Committees on Armed Services by April 1, 2007 "describing transformational initiatives, evaluating the impact of these changes on unit-level readiness, detailing force structure realignments and reductions, and accounting actual cost savings accrued through the transformational initiatives."

Executive Summary

Describe Transformational Initiatives:

The U.S. military is in the process of transforming to:

- Change from a force designed to fight traditional threats prevalent during the Cold War to one also able to address emerging irregular, catastrophic, and disruptive threats
- Exploit rapid advances in information technology to dramatically improve its agility and speed of action
- Cope with the rising pressure on defense spending

The Air Force is pursuing the following transformation strategy:

- Enhance joint and coalition warfighting
- Restructure organizations to improve support to the Combatant Commanders and reduce manpower
- Shift from threat-based to capabilities-based planning and programming
- Develop "transformational" capabilities that the Air Force cannot achieve today or must be significantly improved to address evolving challenges
- Vastly improve efficiency
- Divest older – and thus expensive to operate and maintain - equipment that is declining in their ability to address current and emerging threats

Full details of Air Force transformation can be found in the *US Air Force Transformation Flight Plan*.

The Air Force's "transformation plan" highlighted in PB07 focuses on those parts of its transformation strategy described above that will generate O&M savings. As described in PB07, these include "streamlining the organizational structure, incorporating process efficiencies, and continuing force structure reductions." More specifically, "streamlining the organizational structure" is comprised of the **Air Force Component Headquarters** (formerly known as Warfighting Headquarters) initiative and the related restructuring of the Headquarters Air Force and Major Commands. "Process efficiencies" include the **Air Force Smart Operations for the 21st Century (AFSO21)** initiative and **reducing contractor support**, which accounts for more than half of the projected $945 million savings figure.

<u>Detail Force Structure Realignments And Reductions</u>:

As for the "continuing force structure reductions" portion, the Air Force transformation plan in question includes expected O&M savings for planned retirements of Active component aircraft in FY07. These consist of 3 U-2 surveillance aircraft and 38 C-21s (used to ferry Pentagon executives and cargo and execute medical missions). However, to date, Congressional limitations have prevented any U-2 retirements in FY07 and the Air Force has since decided to retire only 20 C-21s in order to provide some Guard units an interim aircraft until the Joint Cargo Aircraft becomes available. Additional force structure reductions planned and executed by the Air Force in FY2007 impacted Guard and Reserve aircraft, whose O&M is funded by other accounts.

<u>Account Actual Cost Savings</u>:

Official O&M savings figures for any fiscal year (FY07 in this case) are not available until the end of that fiscal year. At this point, however, the Air Force expects that its planned contractor reductions, AFSO21 efforts, and Air Force Component Headquarters initiatives will continue to remain on track and produce the expected savings for FY07. However, given the minor adjustments to the force structure reductions summarized in the previous section above, the Air Force expects actual O&M savings for the AF transformation plan will be slightly smaller than the original $945 million estimate.

<u>Evaluate Impact Of These Changes On Unit-Level Readiness</u>:

Given that the "Air Force transformation plan" in question: (1) only includes a very small number of ongoing force structure reductions (see Section IV); (2) will reduce unnecessary and redundant processes; (3) will shift manpower intensive tasks from forward deployed locations to centralized reachback; and (4) will shift manpower from obsolete fields to highest demand fields; its impact on Air Force readiness is expected to be acceptable in the near-term, but enhance future readiness, especially of key Expeditionary Combat Support communities.

Report

I – INTRODUCTION

Exhibit PBA-19 Appropriation Highlights of the Air Force O&M budget in PB07 stated the following:

> *In the current environment of diminishing resources while challenged with the oldest aircraft fleet in Air Force history, our leadership has faced the FY 2007 President's Budget head-on with the Transformation Flight Plan[1] to ensure continued air and space dominance for tomorrow. As the O&M appropriation has been the cornerstone to Air Force readiness, it has now become the cornerstone for transformation and Air Force readiness for years to come. The O&M appropriation in this President's Budget will reflect the movement towards becoming a more lethal, agile, and balanced total force. In order to produce the targeted investment capital necessary for modernization and capitalization, the FY 2007 President's Budget outlines proposed savings in readiness and personnel accounts achieved in a three-pronged approach: streamlining the organizational structure, incorporating process efficiencies, and continuing force structure reductions. As we apply creative solutions, smart business practices and lean processes across the board (i.e., Air Force Smart Operations 21), the O&M appropriation will lead the way in transforming our Total Force. Though we may have to accept reasonable near-term risk, the urgent need to reinvigorate our legacy systems and infrastructure is an undeniable reality toward our Service's future viability to fly, fight, and win!*

In PB07, the Air Force included a program decrease for FY07 of $944.974 million in O&M funding for "Air Force Transformation," which, as described in the PB07 text above, comprises of "streamlining the organizational structure, incorporating process efficiencies, and continuing force structure reductions." "Streamlining the organizational structure" consists of consolidating Air Force command and control functions into Component Headquarters and the related restructuring of the Major Commands and Headquarters Air Force. "Incorporating process efficiencies" consists of incorporating Lean processes throughout the Air Force and streamlining information technology into a central enterprise (both via AFSO21) and reducing contractor support.

In response, House Report 109-452 included the following text requesting this report on page 294:

> *Air Force Transformation:*
>
> *The committee is aware that the Air Force has initiated a transformation plan in an effort to modernize and recapitalize the force structure by focusing on three areas: streamlining the organizational structure, incorporating process efficiencies, and continuing force structure reductions to become a more lethal, agile, and balanced total force. Although not clearly justified, the fiscal year 2007 operation and maintenance budget request reflects a $945 million reduction due to efficiencies that the Air Force anticipates reaping through transformation. The committee is aware of declining trends in readiness, and is concerned that these trends will continue to decline as a result of this swift move to organizational change.*

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[1] Note: this is not the same as the *US Air Force Transformation Flight Plan* document submitted to the Office of the Secretary of Defense.

> *Therefore, the committee directs the Secretary of the Air Force to submit a report to the Senate Committee on Armed Services and the House Committee on Armed Services by April 1, 2007, describing transformational initiatives, evaluating the impact of these changes on unit-level readiness, detailing force structure realignments and reductions, and accounting actual cost savings accrued through the transformational initiatives.*

To address this requirement, this report first briefly summarizes the ongoing transformation of the U.S. military and the Air Force transformation strategy to support those efforts to provide context before addressing each of the four tasked questions above in separate sections.

II - OVERVIEW OF AIR FORCE TRANSFORMATION

Providing Strategic Context: What Is Transformation? Why Transform?

According to the Office of the Secretary of Defense's (OSD) Transformation Planning Guidance, *"transformation is a process that shapes the changing nature of military competition and cooperation through new combinations of concepts, capabilities, people, and organizations that exploit our nation's advantages and protect against our asymmetric vulnerabilities to sustain our strategic position, which helps underpin peace and stability in the world."*[2]

There are three primary reasons the US military is transforming.

The first reason is to change from a Cold War to a post–Cold War force. The military advantages America currently enjoys are in danger of being eroded in the face of challenges emerging in the post–Cold War security environment. The United States must win the Global War on Terrorism. It must negate rapidly emerging threats to its space assets and networks, low observable cruise and ballistic missile attacks on its forces and territory, and attacks by chemical, biological, radiological, or nuclear (CBRN)–armed adversaries. It must also be able to achieve air supremacy, which is a critical enabler for joint operations, against significantly improved and rapidly proliferating advanced air defense systems (the primary threat to current joint air dominance) and "fifth generation" fighter aircraft. It must effectively adjust to the unique demands generated by homeland security, peace and stability operations, urban operations, and low-intensity conflicts such as insurgencies; the unpredictability of many conflict locations; the rapidly advancing disruptive technologies available to adversaries (such as directed energy); and advanced dispersal and deception techniques. To deal with this new security environment, where traditional concepts of deterrence may no longer apply, the US military must be able to conduct operations effectively across the entire spectrum of conflict against a broad range of adversary capabilities rather than focus on fighting traditional adversaries in conventional major combat operations, as envisaged during the Cold War. Indeed, the 2006 Quadrennial Defense Review (QDR) reaffirmed the need for fifth generation fighters, modern space assets, a larger and more capable intelligence, surveillance, and reconnaissance (ISR) fleet, accelerated development of a new long-range strike capability, expanded support to Army transformation, and increased special operations capabilities.

The second reason is to exploit rapidly evolving information technology to dramatically improve capabilities and evolve from an industrial-age force to an "information-age" force. Vast leaps in information technology in the areas of ISR, command and control, and precision kinetic and non-kinetic effects, are dramatically reshaping warfare. In due course, Joint Force Commanders will be able to quickly and accurately select the precise targets necessary to achieve desired effects and focus on the quality, rather than the quantity, of targets attacked. They will be able to identify an adversary's key centers of gravity and relay that information to combat forces in near real-time in order to attack and destroy those centers of gravity in the particular sequence

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[2] Office of the Secretary of Defense, "Transformation Planning Guidance," April 2003, 3.

most devastating to the adversary. These technological enhancements will allow the Joint Commander to defeat an adversary by disabling its ability to operate rather than destroying it through mass attrition— producing the effects of mass without having to mass forces (air, ground, or naval). In turn, this may require the deployment of fewer forces (which would also enhance rapid global mobility), reduce the length of the conflict, and limit collateral damage and casualties. Some refer to these developments as the ongoing "revolution in military affairs." In the context of air, space, and cyber operations, the keys to applying the right force to the right place at the right time are the closely related concepts of parallel warfare and effects-based operations.

In addition, these new revolutionary information technologies will allow US forces to: (1) see all forces on both sides in a battlespace in near-real time while preventing the adversary to do the same; (2) strike adversaries before they can mount an effective defense, (3) deny sanctuary to adversaries such as terrorists anywhere on the globe; and (4) neutralize mobile targets.

The third reason is to cope with rapidly rising pressure on defense spending. Along with the majority of the Western world, the United States faces the issue of an aging population. After 2010, the ratio of elderly population to the economically active population between the ages of 15-64 rises dramatically. As an increasing number of people retire from the economically active population, the growth rate of the gross domestic product may decline. Preparing for these demographic changes is already shaping federal budget policy decisions and will apply immense pressure to all discretionary federal spending, of which defense is a significant part. Indeed, defense spending levels overall are currently leveling off after years of increases and many expect them to even drop in the future.

Costs are also sharply increasing:

- The cost to operate and maintain air platforms has increased 87 percent over the past decade due to the increasing cost of maintaining aging equipment at the required levels of readiness
- Personnel costs have risen 57 percent over the past decade
- Fuel prices have increased dramatically. Each $10 increase per barrel of oil adds $600 million to the Air Force annual energy bill. In FY07 alone, fuel price increases cost the Air Force $1.4 billion in additional and unforeseen spending.

These demands on the federal budget come at a time when military operational tempo, including the Air Force, is very high and significant recapitalization is required, as previously discussed. Therefore, given this difficult fiscal environment, a significant goal of Air Force transformation is to become significantly more efficient, whether it is in its business practices, how it is organized, or employing "more bang for the buck" capabilities.

The Air Force's Transformation Strategy

To play its part in these transformations in support of the Nation and the Joint Commander, the Air Force is pursuing the following strategy:

- Enhance joint and coalition warfighting
- Restructure organizations to improve support to the Combatant Commanders and reduce manpower
- Shift from threat-based to capabilities-based planning and programming
- Develop "transformational" capabilities that the Air Force cannot achieve today or must be significantly improved to address evolving challenges
- Vastly improve efficiency
- Divest older and expensive to operate and maintain equipment that is declining in its ability to address current and emerging threats

More specifically, in addition to developing transformational capabilities, the Air Force is working with the Joint Staff, OSD, Allies, and the other Services and Agencies to improve joint warfighting and develop new joint concepts. It already has robust strategic planning, innovation, and long-term science and technology processes in place to support the development of transformational capabilities. It is creating flexible, agile organizations that will facilitate transformation, institutionalize cultural change, and enable the Air Force to remain a potent and relevant force in the post-Cold War security environment. One aspect of this work is the integration of Air National Guard, Air Force Reserve, and civilian force with the Active Duty force. The Air Force is also transforming the way it educates, trains, and offers experience to its Airmen to increase their understanding of the evolving security environment and encourage all to think "outside the box." It is continuing to transform into a capabilities-based force through the Air Force Concepts of Operations and the Integrated Capabilities Review and Risk Assessment, which together lay out the future capabilities required to conduct future operations and identify disconnects between those capabilities and existing programs. The Air Force is also working to ensure that its business processes and operations become more efficient, flexible, and agile to support the rapidly changing needs of the warfighter in the future. Finally, the Air Force is aggressively divesting outdated and expensive to maintain legacy systems and restructuring its manpower.

The details of the Air Force's transformation strategy can be found in the *US Air Force Transformation Flight Plan* report (http://www.af.mil/shared/media/document/AFD-060328-005.pdf) that the Service submits to OSD. Each aspect of this strategy is strongly dependent upon each other and should be viewed as an integrated package.

In sum, Air Force transformation is essential to ensure that the US military can maintain air, space, and information superiority to enable global vigilance, reach, and power against rapidly evolving threats and challenges. These capabilities, when combined with the efforts of the other Services and the rest of the Department of Defense, are absolutely critical to enable the Joint Commander to execute the US National Security Strategy, National Defense Strategy, and National Military Strategy into the foreseeable future.

III – DESCRIPTIONS OF SPECIFIC TRANSFORMATION INITIATIVES OF INTEREST

This section addresses the Congressional requirement to provide a report "describing transformational initiatives" associated with the "AF transformation plan" described in PB07. As previously mentioned in Section I, those initiatives primarily consist of the Air Force Component Headquarters, along with associated Headquarters Air Force and Major Command restructure, and AFSO21.

The **Air Force Component Headquarters** are a key part of the Air Force's effort to restructure organizations as part of its transformation strategy. They will provide continuous operational-level command and control of Air Force assets for the Combatant Commands. The Component Headquarters will also enable the immediate transition from day-to-day to major combat operations and provide each Combatant Commander with an in-place Commander of Air Force Forces. The Air Force Component Headquarters are also configured to take on the roles of the Combined/Joint Force Air Component Commander's Headquarters or Joint Task Force Headquarters, if required. While the introduction of Air Force Component Headquarters will likely not result in significant O&M savings, the associated restructuring of the Headquarters Air Force and Major Commands may generate some cost savings over the Future Years Defense Plan.

AFSO21 is the key part of the Air Force's effort to significantly increase efficiency as part of its transformation strategy. It intends to create a culture of Airmen who ask "why do we do it this way, how can we improve it, and how do we institutionalize this improvement?" AFSO21 is based on a variety of process improvement tools, including Lean and Six Sigma and builds upon the Continuous Process Improvement successes achieved in isolated sectors of the Air Force and more broadly in the private sector. By eliminating, or minimizing, tasks that add no value from the perspective of the customer, the Air Force intends to save money, enhance productivity, increase agility, improve quality, and provide a safer workplace.

The AFSO21 effort has its initial focus set on five key areas that promise the greatest initial impact, particularly against the Presidential Budget Decision 720 manpower reductions:

- Increase Airmen productivity
- Significantly increase critical equipment availability rates
- Improve response time and agility
- Sustain safe and reliable operations
- Improve energy efficiency

Like the Air Force Component Headquarters, AFSO21 is a work in progress. From 2002-05, it consisted of a few local experiments focused on improving processes at the Air Logistics Centers. This initial block of experiments was extremely successful. At Robins Air Force Base, C-5 AFSC-5 overhaul flowdays were reduced from 339 to 171, mechanic travel time reduced by 60 percent, and one dock was freed up for additional workload. At McChord Air Force Base, manpower at a wheel and tire shop was reduced from 14 to 5, the overhaul process was reduced from 7 to 4 steps, and cycle time was reduced by 67 percent. At a higher level, Air Force Civil Engineers streamlined the Air Force design-build process by reducing flow days from 1046 to 599. The savings realized through these initiatives were reallocated to fund other tasks. The real return is better measured in terms of efficiency, effectiveness, reduced flow times, and increased quality, morale, and safety.

These successful experiments led the Air Force to institutionalize AFSO21 across the Service. This has been the initiative's focus during 2005 and 2006. In order to achieve the cultural transformation needed to implement and sustain this effort, the Air Force has established a multi-tiered training program, which is already producing organic facilitators and Continuous Process Improvement experts and mentors. Targeted training programs extend from General Officer and Senior Executive Service members downwards through officer and enlisted Professional Military Education and training programs. In addition, the Air Force has established an AFSO21 governance structure that provides direct senior leader involvement in Air Force core processes and facilitates the targeting and alignment of Service-wide improvement efforts. Together with aggressive outreach efforts, these initiatives encourage and enhance cultural transformation by communicating program goals and accomplishments and focusing process improvement efforts on the areas of greatest benefit.

The Air Force intends to fully implement AFSO21 across the Air Force over the next few years by establishing sustained programs with the goal of making it part of normal operations by 2009. For more details and examples of AFSO21, please refer to the following website: http://www.af.mil/library/smartops.asp.

IV – FORCE STRUCTURE REALIGNMENTS AND REDUCTIONS

This section addresses the Congressional requirement for a report "detailing force structure realignments and reductions" associated with the "AF transformation plan" described in PB07. Transformation is enabling the Air Force to downsize its legacy forces without losing capability in today's fiscally constrained environment. To achieve this, the Air Force will modernize and recapitalize selected capabilities: networked and integrated joint enablers, increased airlift and aerial refueling capability, space constellations, persistent air-breathing ISR, close air support, and the fighter force. For details of the Air Force's planned future force structure, please refer to the *Air Force Roadmap 2006-25* (http://www.af.mil/shared/media/document/AFD-060713-002.pdf).

To help fund this critical modernization, the Air Force is in the process of divesting legacy and outdated force structure. In PB07, the Air Force planned to make the following force structure reductions in FY07:

- **36 F-15 A/Bs:** retires oldest, least capable aircraft
- **65 F-16s:** retires oldest, least capable aircraft
- **84 T-37Bs:** retires oldest, least capable aircraft
- **10 F-117s:** the F-22 and B-2, when combined with modern stand-off precision weapons such as the Joint Air to Surface Stand Off Missile provide the required survivability and lethality against the next generation of air defense systems
- **18 B-52Hs:** allows essential modernization of the remaining fleet, whose size meets any single Combatant Commander requirement
- **3 U-2s:** its ISR capability is being replaced by the RQ-4 Global Hawk
- **78 KC-135Es:** the service life of the aircraft engine struts expires by FY10
- **51 C-130E/Hs:** facing serious airframe aging issues as fleet average age is now over 40 years old
- **38 C-21s:** Air Force analysis found only 50 percent of its capacity was being applied against the requirement to fly 3-Star Generals and above

Most of these reductions are from Reserve and Guard units, which are funded by other accounts than the Air Force Active component O&M funding in question in this report. Therefore, the $945 million savings figure for the "Air Force transformation plan" only includes expected O&M savings for planned retirements of Active component aircraft in FY07 (i.e., the U-2s and C-21s). However, to date, Congressional limitations have prevented any U-2 retirements in FY07 and the Air Force has since decided to only retire 20 C-21s in order to provide some Guard units an interim aircraft until the Joint Cargo Aircraft is available. In addition, of the planned Guard and Reserve aircraft reductions described above, Congress reduced the planned retirement of KC-135Es in FY07 to 29.

In PB07, the Air Force also reduced contractor support in areas such as advisory and assistance services, "A-76-like" privatized functions, and miscellaneous contract services. The intent is to restrict requirements growth and force efficiencies into contract support areas through targeted funding reductions. In response, Air Force Major Commands (MAJCOMs) enhanced their efforts to find efficiencies and mitigate operational risk with constrained contract support in the following areas: information technology, range support, base communications, and other base support functions (dining halls, custodial, fitness centers, and grounds maintenance). These contractor cuts comprise more than half of the Air Force transformation plan's $945 million savings estimate in PB07.

V - ACCOUNTING FOR ACTUAL COST SAVINGS ACCRUED

This section addresses the Congressional requirement for a report "accounting actual cost savings accrued through the transformational initiatives." Official O&M savings figures for any fiscal year (FY07 in this case) are not available until the end of that fiscal year. At this point, however, the Air Force expects that its planned contractor reductions, AFSO21 efforts, and Air Force Component Headquarters initiatives will continue to remain on track and produce the expected savings for FY07. However, given the minor adjustments to the force structure reductions summarized in Section IV, the Air Force expects actual O&M savings for the AF transformation plan will be slightly smaller than the original $945 million estimate.

VI - EVALUATING THE IMPACT ON AIR FORCE UNIT-LEVEL READINESS

This section addresses the Congressional requirement for a report "evaluating the impact of these changes on unit-level readiness." The Air Force is in the process of conducting an analysis of the impact of all planned force structure and manpower reductions (i.e., not only the Active unit reductions that are part of the Air Force transformation plan in question – see Section IV) and the organizational changes that are part of the PB07 O&M "Air Force transformation plan" based on best available information. This section provides an unclassified summary of the preliminary analysis completed to date relevant to the Air Force transformation plan.

For this assessment, the Air Force is employing the Predictive Readiness Assessment System (PRAS), which is designed to assess the impact of operations tempo, funding, and numerous other input variables on readiness for each combat community. It was developed in response to a Congressional tasking directing the Services to develop a predictive readiness capability. This system, however, is still under development and therefore cannot yet provide full, detailed, or automated quick turn analyses. PRAS employs advanced, statistically-based predictive algorithms that examine the expected tempo generated in meeting an expected force demand. The system considers forecasted force structure over the assessment period as well as forecasted O&M funding levels given the current and outyear funding levels in key O&M accounts. Readiness predictions are reported in terms of the four Status of Resources and Training System (SORTS) readiness categories: Equipment Readiness (R-rating), Training Readiness (T-rating), Supply Readiness (S-rating), and Personnel Readiness (P-rating). R- and S-ratings are most sensitive to O&M funding levels while T- and P-ratings are most sensitive to tempo. PRAS evaluates tempo for the force by aggregated capabilities (fighter, bomber, mobility, command and control, ISR, etc.). For this report, it also evaluated PB07 O&M funds for FY07 and beyond in terms of the expected impact on readiness using September 2006 SORTS ratings as base values.

Combat and Combat Support force structure cuts and personnel realignments were considered during the first step in the predictive readiness process. Relevant to the PB07 Air Force transformation plan are the planned accelerated retirement of the U-2 and realignments in the Expeditionary Combat Support communities. Force tables for FY07 and the outyears were modified to reflect future Air Force plans.

The accelerated retirement of the U-2 was assessed given the impact of efforts to modernize the ISR force. The long-term changes in the ISR force and continuing adjustment of deployed footprints mean that the mission currently filled by the U-2 can be fully divested into components of the layered ISR force. Therefore, <u>accelerated retirement of the U-2 will have minimal impact on the ISR community tempo</u>.

Given that Air Force analysis found only 50 percent of its capacity was being applied against the requirement to fly 3-Star Generals and above, <u>the Air Force believes the C-21 reductions will not negatively impact readiness</u>.

In addition to capitalizing on transformational concepts, the Air Force continues to optimize the utilization of all personnel within the expeditionary force and to gain full utility out of those functions that support combat operations. In FY01, the 200 career fields having the highest tempo were made up of approximately 40,000 members. By FY06, the distribution had shifted to increase that pool nearly two-fold to 75,000. At the same time, the total number of days deployed by the 200 most stressed career fields increased by nearly three-fold. Continued realignment of personnel from the least stressed to the most stressed communities is essential if these trends are to be mitigated. Moreover, reductions in overall manpower will be focused on career fields whose utility is diminished or made obsolete by technological advancements, reorganization, and AFSO21 efficiencies. <u>Personnel realignment and reductions will be carefully managed to ensure optimal use of resources, mitigate tempo trends, preserve unit-level readiness, and ensure a potent and relevant future force</u>. The Air Force will also continue to conduct MAJCOM quarterly reviews to assess corporate O&M risk of ongoing contractor cuts and each MAJCOM's actions to operate effectively within their program. When needed, refinements will be made to minimize operational risk in the year of execution.

While they will not directly or significantly impact readiness levels in FY07, reorganizing certain staff functions through the Air Force Component Headquarters initiative and eliminating unnecessary or redundant processes through AFSO21 will leverage technology and shift manpower intensive tasks from forward deployed locations to centralized reachback. In short, <u>the readiness of key Expeditionary Combat Support communities will be enhanced once these initiatives are implemented</u>.

In sum, given that the "Air Force transformation plan" in question: (1) only includes a very small number of ongoing force structure reductions (see Section IV); (2) will reduce unnecessary and redundant processes; (3) is shifting manpower intensive tasks from forward deployed locations to centralized reachback; and (4) is shifting manpower from obsolete fields to highest demand fields, its impact on Air Force readiness is expected to be minimal in the near-term while enhancing future readiness, especially of key Expeditionary Combat Support communities.

VI- CONCLUSION

As described in Section I, this report addresses a Congressional task to: (1) provide more detail regarding the "Air Force transformation plan" that the Air Force contended in PB07 would save near $945 million in O&M funding in FY07; (2) account for actual cost savings accrued by the plan; and (3) evaluate the impacts of this plan on unit-level readiness.

As emphasized in PB07, the Air Force is facing a huge dilemma. It must modernize to ensure that US forces can maintain air, space, and information superiority against rapidly evolving threats and challenges at the same time it has been:

- Operating at a high operational tempo for the past 15 years and continue to do so into the foreseeable future prosecuting the Global War on Terrorism
- Using the oldest aircraft fleet in its history, which requires spending 20 percent of procurement dollars (historic high) to modify and upgrade and a nearly 100 percent increase in O&M funding over the past decade to maintain
- Operating in a long-term budget environment of diminishing resources

To achieve this, the Air Force has been forced to make some major and often extremely difficult decisions:

- Execute the "AF transformation plan" described in PB07's O&M budget, which includes organizational restructure, implementing process efficiencies, and divesting expensive to maintain, outdated legacy systems
- Reduce manpower and contractor support
- Accept increased, but acceptable, risk in readiness in short-term to enable long-term readiness to face future challenges

For reasons described in Section V, actual savings from PB07's "Air Force transformation plan" will likely be slightly less than the $944.974 million estimate for FY07. However, actual official savings figures will not be available until the end of the fiscal year.

Congressional Report

Academy Language Training

House Report 109-452, page 312

U.S. AIR FORCE

Introduction

This report is being provided to the Senate Committee on Armed Services and the House Committee on Armed Services, as directed in House Report 109-452, page 352, dated 17 October 2006, detailing U.S. Air Force plans for the expansion of language programs at the US Air Force Academy and the resource requirements to accomplish the plan. Congress has noted that the Department of Defense has placed great emphasis on improving the strategic language posture of the United States. The military academies of the United States are implementing new plans to strengthen their current programs. Accordingly, the committee directed the secretaries of the Army, Navy, and Air Force to report on the current state of language programs and the plans for implementing a strategic language development program at the United States Military Academy, the United States Naval Academy, and the United States Air Force Academy. In consultation with the superintendents of each U.S. Air Force Academy, this report provides data on the number of students participating in language training, the languages in which they are participating, levels of proficiency, and language classes offered. In addition, this report provides an update on its current implementation of the language initiatives included in the fiscal year 2007 budget request, and describes the costs required for the programs.

Executive Summary

The U.S. Air Force Academy has implemented a plan to provide for the development of a strategic language capability based on Quadrennial Defense Review findings that the services need to provide for foundational language capability. The US Air Force Academy has developed a robust program that ensures all cadets receive language training prior to graduation as well as a system developed to target cadets with an increased aptitude for learning languages. Language immersion opportunities have increased by 580% and cultural immersions by 850%. Semester Exchanges have also been expanded 33% along with a 400% increase in the number of U.S. Air Force Academy cadet visits to foreign academies directly affecting the Air Force's ability to influence future operations and build alliances. The increased emphasis on strategic language posture has provided a positive impact that will pay dividends well into the future for the Air Force.

Background

The end of the Cold War brought about a change in focus in the Department of Defense. No longer are all efforts concentrated on just a few countries, but rather the US military is engaged in operations globally. Engaging in effective operations globally and being able to influence operations as well as build alliances requires Airmen who are culturally aware with enhanced language capability.

In February 2005, the Assistant Secretary of Defense approved the Defense Language Transformation Roadmap. This provided for a way ahead to significantly improve organic capability in emerging languages and dialects, a greater competence and regional area skill in those languages and dialects and a surge capability to rapidly expand language capabilities on short notice. The Defense Language Transformation Roadmap contained a recommendation to ensure service accession programs, like those offered by the U.S. Air Force Academy, were developing Airmen who are language capable warfighters. This aligns with the understanding that learning a language is time intensive and the services may be better served by Airmen who enter active duty with a capability that can be immediately put to use.

As part of the effort of the Department of Defense to institutionalize language learning programs at the service academies, the Department of Defense worked to provide the Academies increased funding beginning in FY 2007.

Report

The United States Air Force Academy has embraced the intention of the Defense Language Transformation Roadmap by expanding language education opportunities. Programming decisions within the U.S. Air Force, endorsed by the Department of Defense and enacted by Congress have enabled the U.S. Air Force Academy to expand language learning opportunities to all cadets. They have added two language minor programs, significantly expanded opportunities offered to cadets for foreign language and culture immersion, and increased the number of semester exchanges and study abroad programs offered. The end result will be a US Air Force Officer who is culturally aware, with linguistic capabilities and ability to contribute immediately to the US mission abroad, influencing operations and building alliances.

The US Air Force Academy began implementing its strategic language development program at the beginning of the 2007 academic year. The key to developing strategic language capability in future Air Force Officers has been the expansion of language courses in Arabic and Chinese, as well as significantly expanding opportunities for language and cultural immersion. By the 2009 academic year, the US Air Force Academy projects about 314 cadets a year will participate in a language immersion opportunity compared to just 54 during 2006, while 240 cadets a year will participate in a cultural immersion opportunity compared to just 28 during 2006. This is a significant step to ensure cadets are exposed to foreign cultures, gain an appreciation for cultural differences and are prepared for the challenges they will face when conducting operations abroad.

Currently, the U.S. Air Force Academy is on-target with the implementation of its strategic plan to expand language courses to all cadets. The U.S. Air Force funded an additional 17 instructor positions at a cost of $4.15M in fiscal year 2007. As a result of the additional instructors, the U.S. Air Force academy added Chinese and Arabic minors and implemented a requirement for all cadets to take at least two semesters of language training prior to graduation. Cadets graduating with a technical degree are required to take two semesters of language courses. Cadets graduating with a non-technical degree are required to take four semesters of language courses. Language minors will have completed four advanced level language courses prior to graduation. In order to accommodate the additional student load, the U.S. Air Force funded an additional $0.5M provided to update the language learning center. Data on the total number of student participating in language training for the 2007 academic year as well as forecasts through 2011, by language, is listed in Table 1 below, as compared to the 2006 academic year. In the graduating class of 2006, 11% (99 out of 888) scored at a 1+/1+ level in listening and speaking on the Defense Language Proficiency Test (DLPT).

US Air Force Academy Cadet Enrollment, by Language and Academic Year

Language	2006	2007	2008	2009	2010	2011
Arabic	169	246	264	284	284	284
Chinese	163	197	211	227	227	227
French	316	364	391	420	420	420
German	177	232	250	268	268	268
Japanese	161	194	209	224	224	224
Portuguese	0	268	288	309	309	309
Russian	117	335	360	387	387	387
Spanish	381	398	427	459	459	459

Table 1

The US Air Force Academy's plan also includes assessing all new cadets' language aptitude to meet Air Force needs. All cadets in the recently arrived Class of 2010 took the Defense Language Aptitude Battery test. Test results show that 40% of the cadets performed well enough to qualify to study the difficult strategic languages of Chinese, Arabic, Japanese and Russian. Other cadets qualified for the key languages of our allies, Spanish, French, German and Portuguese.

A cornerstone of Air Force requirement for language professionals is the need to have senior officers who are able to influence operations and build alliances. The Academy's plan meshes with this concept by increasing semester exchanges from 18 cadets to 24 cadets. By allowing 175 cadets a year to participate in the foreign academy visit program, the U.S. Air Force Academy increased participation by 400% in the program. Table 2, below, shows academic year 2006 actual participation in immersion and exchange programs as well as forecasted participation through 2011 based on funding. These programs, at an annual cost of $2.63M in fiscal year 2007, serve to expose our future senior leaders to their foreign counterparts, building bonds that will last a lifetime.

US Air Force Academy
Participation in Immersions and Exchanges

Program	2006	2007	2008	2009	2010	2011
Language immersion:	64	227	236	314	314	314
Cultural immersion:	34	195	205	240	240	240
Semester exchange:	18	20	22	24	24	24
Study abroad:	0	0	12	24	24	24
Foreign academy visit programs:	20	150	175	175	175	175

Overall, the Air Force is confident the US Air Force Academy plan for developing strategic language capability in the force is adequate and meets mission requirements. A summation of funding allocation for the current fiscal year, 2007 through 2011 is provided in Table 3 below.

US Air Force Academy Language and Cultural Funding Plan

Cost Category	2007	2008	2009	2010	2011
Faculty	$4,315,000	$ 4,715,000	$ 5,315,000	$ 5,315,000	$5,315,000
Immersion Programs	$2,022,640	$ 2,319,525	$ 2,885,541	$ 2,885,541	$2,885,541
Exchanges/Study Abroad	$605,000	$ 615,000	$ 745,000	$ 745,000	$ 745,000
Language Lab Upgrade	$304,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000

Table 3

The Air Force has dutifully programmed for continued implementation of the US Air Force Academy's language and culture plan through the Future Year Defense Plan. The infusion of funding has provided for a robust language education program and will ensure that all graduating cadets will be ready to step-in, culturally aware and linguistically astute. The current status of the plan does not call for any expansion of programs but permits re-examination to allow for a changing operations environment and the need to ensure the cadets are attending immersion programs in the countries the Department of Defense most believes future operations are imminent.

Air Force Health Study
Project Ranch Hand II

2007 Report to Congress
On
The Transfer of Air Force Health Study Assets to the Medical Follow-Up Agency

19 September 2007

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EXECUTIVE SUMMARY

Purpose

This Air Force Health Study (AFHS) transfer report addresses the requirement to submit, to the Committees on Armed Services of the Senate and House of Representatives, an account of the transfer of AFHS assets as outlined in Public Law 109-364, Section 714, Transfer of Custody of the Air Force Health Study Assets to Medical Follow-Up Agency.

Air Force Health Study Overview

An overview of the AFHS is provided at attachment 1.

Transition and Transfer Activities

On 17 October 2006, the DOD FY07 Authorization Bill was signed by the President as Public Law 109-364. Section 714, directed the transfer of custody of the AFHS assets to the MFUA on or before 30 September 2007.

Key Organizations

There are three organization involved in accomplishing the transfer and disposition of the AFHS asset; the Air Force, the Medical Follow-Up Agency, and the National Archives and Records Administration. The Air Force conducted the AFHS and holds the AFHS assets; MFUA was selected as the new AFHS custodian by Congress; and the NARA is responsible for archiving the original hard copy AFHS materials as well as associated electronic data.

MFUA is an agency under the Institute of Medicine's Board of Military and Veterans Health. MFUA was founded shortly after WWII to conduct military veteran clinical follow-up studies; it now conducts epidemiological studies and collaborates with numerous researchers.

NARA is responsible for safeguarding and preserving records created by the federal government.

Two Air Force activities within the Air Force Research Laboratory (AFRL), the Air Force Health Study and the Division of Biosciences and Protection (HEP) are vital to this transfer process. The AFHS activity prepared materials and specimens for transfer and HEP was selected by MFUA as the site for storage of the AFHS biospecimens.

The Air Force followed the disposition guidance provided by NARA and the following outlines the general types of records to be archived by NARA:

1. Participants' medical records and associated documentation (hard copy)
2. Participants' spouse/partner and offspring medical documentation (hard copy)
3. Participants' x-ray films
4. Participants' dental videos
5. Administrative and research files (hard copy)
6. All AFHS-related electronic databases and datasets
7. Data tapes/reels containing AFHS data files
8. Biological specimen inventory
9. Miscellaneous data and documents: (AFHS monitor documentation, group pictures taken at the examinations, etc.).

One of the NARA requirements for the archiving of electronic data is that it must be submitted in ASCII format. The hard copy records were shipped via government carrier and electronic data will be delivered on external hard drives.

Air Force Health Study Population Available for Transfer

The AFHS had 2,758 participants who were fully compliant to at least one or more physical examinations. Of these, 2,310 were thought to be still living in October 2006. The remaining 248 participants were deceased. Assets belonging to deceased participants could be transferred without consent.

Consent Process

A transfer consent form and a letter of explanation were drafted. MFUA reviewed both documents and the AFRL Institutional Review Board (IRB) reviewed and approved them for use. The consent form required the signature and date by the participants and an adult witness. If any one of these elements were missing the consent form was returned to the participant for correction. All mail outs to participants included a self-addressed and stamped return envelope. If a participant had any questions about the consent form or process, they were given the toll-free AFHS number to call. Additionally, MFUA was willing to talk with any participant about their role as the future custodian.

Three major mail outs were accomplished. In October 2006, the first mail out of 2,310 consent forms occurred. The second mail out was accomplished as undelivered letters were returned with change of addresses noted. The third mail out occurred after the AFHS population was screened against the Internal Revenue Services database to further identify additional address changes as well as newly deceased participants. Furthermore, internet white page searches were accomplished in attempt to locate participants without a current address.

In addition to the mail outs, over 1,200 phone calls were made to participants who had not returned consent forms or had returned incomplete consent forms.

Over 90% (2,488) of the AFHS participants' consented to the transfer of their data and biological specimens to MFUA. The remaining 9.8% will not have their assets transferred because of the reasons outlined in the table below.

Reason for Non-Transfer	Participants
Returned a "No" on consent form	148 (44 were Ranch Hands)
Letter returned undelivered/no forwarding address located	8
Letter resent but not returned by participant	86
No contact or response from participant	28
Total	270

Preparation of Electronic Physical Examination Data

AFHS staff meticulously identified, located, reviewed, documented, conducted quality assurance checks, and prepared for transfer 125,452 AFHS files, documents, and datasets covering six physical examinations and 20+ years of research activities. The general types of data included:

1. The raw physical examination data for all six physical examinations
2. The raw questionnaire data for all six physical examinations
3. Analysis files for all six physical examinations
4. Analysis programs for all six physical examinations
5. Participant questionnaires from all six physical examinations
6. Biological specimen listings
7. Specialty files
8. Data dictionaries
9. Laboratory data collected at each examination
10. Dioxin files
11. Spouse questionnaires (for NARA only)
12. Conception file (for NARA only)
13. Laboratory test master file
14. Miscellaneous files.

Part of the preparation requirements was to convert all non-flat files such as SAS™ analysis files in to ASCII format per NARA requirements. This requirement, which was not identified to the AFHS until January 2007, doubled the preparation timeline. Ninety percent of the files required conversion. An additional step to this effort was the creation of a record lay out for each SAS™ file.

Once the conversion effort was completed, the datasets/databases were separated in to two files; one containing only consenting participants for MFUA and one containing non-consenting participants to be held by HEP for one year post-transfer.

Preparation of Medical Records, X-Rays and Other Documents

All participant, spouse/partner, and offspring medical records and associated documentation were scanned into PDF format. Prior to scanning, each record was reviewed page-by-page to ensure they were in the correct chronological order. Over 8 million image files were created and quality checked. These files also required further splitting in accordance with whether the participant files were to be transferred to MFUA or not.

More than 15,000 X-ray scanned images were separated into consenting and non-consenting files. Furthermore, all historical documents such as news clippings and study initiating documentation were scanned, organized by year and transferred to NARA.

Participants' Spouse/Partner and Children Documentation

The participants' spouse(s)/partner(s) and offspring medical documentation could not be transferred to MFUA without first obtaining consent from each spouse/partner and child. It would have required the locating and consenting of more than 3,600 spouses/partners and more than 6,000 offspring known to be living in 1982. This task was determined to be unachievable. Besides additional staffing requirements; it is estimated this task would have required at a minimum, an additional 18 to 24 months to complete.

The hard copy records and the datasets created from these records were transferred to the National Archives.

Preparation of Biological Specimens

There were over 90,000 biological specimens in the AFHS inventory collected at the physical examinations. These specimens include blood, fat tissue, semen, and urine. Originally, these specimens were archived by physical examination and housed in 23 medical freezers. Because of the requirement to only transfer consenting participants study materials the specimens were re-organized by participant. A new electronic specimen database was created which identified the freezer location; type of specimen, quantity and vial size (1ml….20ml); and at which physical examination the specimen was collected.

Over the years specimens were sent to external researchers or organizations such as CDC. These organizations, potentially holding AFHS specimens, were contacted via certified letter (included was a return postcard to indicate whether they did or did not have specimens in their possession) with instructions to return any specimens still in their possession. With the exception of CDC, all remaining organizations/researchers did not have any AFHS specimens in their inventory. CDC returned the AFHS specimens they held in September 2007.

An added step to re-organizing the specimens was consolidating all specimens considered to be potentially infectious. This was essential to ensure that all Department of Transportation interstate transport of biological specimen requirements will be met when the specimens are shipped to HEP for storage.

External Collaborators

The AFHS scientists collaborated with more than 40 scientists from universities, private and governmental agencies. These collaborations resulted in numerous publications in peer-reviewed journals as well as technical reports.

Each collaborator was contacted via certified mail and asked to return or destroy all AFHS datasets in their possession. As with the specimens, a postcard was included for the collaborator to return to the AFHS for verification purposes. All collaborators provided a response that either they did not have any AFHS datasets or the datasets had been destroyed. This was accomplished to ensure only data from consenting participants would be used in the future through the MFUA.

Listing of Materials for transfer to the Medical Follow-Up Agency

The following table lists all the AFHS assets that will be transferred to MFUA. All electronic data will be placed on a hard drive for transfer to the MFUA. Again, these are assets of consenting participants only.

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AFHS Asset to be sent to the Medical Follow-Up Agency	**Notes**	**Cycle 1 1982**	**Cycle 2 1985**	**Cycle 3 1987**	**Cycle 3 Dioxin 1987**	**Cycle 4 1992**	**Cycle 5 1997**	**Cycle 6 2002**
Physical examination (PE) data (raw) in ASCII format (includes psychological test files)		**X**	**X**	**X**	**X**	**X**	**X**	**X**
PE analysis data files in ASCII format		**X**	**X**	**X**	**X**	**X**	**X**	**X**
PE questionnaire data files (raw) in ASCII format		**X**	**X**	**X**	**X**	**X**	**X**	**X**
PE SAS analysis programs in ASCII format		**X**	**X**	**X**	**X**	**X**	**X**	**X**
PE laboratory results data files (raw)		**X**	**X**	**X**	**X**	**X**	**X**	**X**
PDF file of ICD codes used for the PE analyses		**X**	**X**	**X**	**X**	**X**	**X**	**X**
Data dictionaries for PE and specialty files		**X**	**X**	**X**	**X**	**X**	**X**	**X**
PDF PE forms at each AFHS exam (coded and uncoded)		**X**	**X**	**X**	**X**	**X**	**X**	**X**
PDF of variable codes used for the PEs and questionnaires		**X**	**X**	**X**	**X**	**X**	**X**	**X**
Dioxin files (raw, analysis file, and 2002 dioxin congeners)	CDC was not able to complete all of the congener analysis (PCB/pesticides not accomplished) for 2002 specimens prior to closure of the AFHS				X	X	X	X
PDF participant PE medical records		**X**	**X**	**X**	**X**	**X**	**X**	**X**
PDF external medical records		**X**	**X**	**X**	**X**	**X**	**X**	**X**

AFHS Asset to be sent to the Medical Follow-Up Agency	Notes	Cycle 1 1982	Cycle 2 1985	Cycle 3 1987	Cycle 3 Dioxin 1987	Cycle 4 1992	Cycle 5 1997	Cycle 6 2002
PDF participant questionnaire (baseline and interval)		X	X	X	X	X	X	X
Biospecimens		X	X	X	X	X	X	X
Rational Information Warehouse program, database, and technical guide	Contains a number of specialty files as well		X	X	X	X	X	X
Participant military microfiche								
Air Force Health Study website								
Specimen inventory data file		X	X	X	X	X	X	X
PE biomedical test plans	Not created for Cycle 1		X	X	X	X	X	X
Specialty files: a. BPH b. Cancer c. Cardiac d. Diabetes e. Hematology f. Hepatic/Gastro g. Neurology h. Polycythemia i. Prostate j. Psychiatric k. Pulmonary l. Renal m. Thyroid n. Vascular o. Geo-coding p. Master q. Address file r. Mortality s. Others	These files contain a participant's history from cradle to grave. Details for each file provided in the data dictionary							

AFHS Asset to be sent to the Medical Follow-Up Agency	**Notes**	**Cycle 1 1982**	**Cycle 2 1985**	**Cycle 3 1987**	**Cycle 3 Dioxin 1987**	**Cycle 4 1992**	**Cycle 5 1997**	**Cycle 6 2002**
Scanned x-ray images	Includes x-rays participants brought to exams	**X**	**X**	**X**	**X**	**X**	**X**	**X**
PDF of technical reports								
Listing of AFHS publications								

Disposition of Non-Consenting Participants AFHS Assets

Because the Public Law 109-364 requires the assets of the non-consenting participants be maintained for one year past the date of transfer to MFUA by the Air Force, AFRL/HEP assumed this responsibility. At the end of the 12 months of retention these non-transferred specimens and electronic data will be destroyed.

Other Transition Activities

Frequent teleconferences were held with representatives from MFUA as well as HEP. The purpose of the meetings was to ensure a smooth transition of assets from the responsibility of the Air Force to MFUA.

AFHS staff provided HEP, the MFUA-designated AFHS specimen repository, with information on the specimens, freezers, and monitoring activities.

Per Air Force IRB requirements, AFHS staff pulled all original consent forms (40K+) signed by the AFHS participants from their medical records and forward them to the IRB office at Wright-Patterson AFB, OH. The more than 2,600 transfer consent forms were also forwarded to the IRB office.

Transfer Issue

During the last week of June 2007, MFUA reported their General Counsel advised them to not accept custody of the biological specimens until Congress provided funding for FY08 and beyond.

It was a concern of the Air Force whether or not just the electronic data could be transferred to MFUA when this Agency was instructed to not accept custody for the biospecimens. AFHS staff sought advice from the Air Force attorneys at Brooks City-Base who advised that the Air Force must comply with the law, and provide MFUA with the electronic data. On 18 September the Air Force was notified that MFUA received the go ahead to accept custody of the electronic data. At this time it is planned for a MFUA staff member to hand carry the hard drive with the data to MFUA on Friday, 21 September.

Furthermore, a letter to the consenting participants will be mailed the week of 24 September informing them that the MFUA will not be receiving custody of their biological specimens but had been given a copy of their electronic record. Until MFUA can accept custody, the specimens will be physically transferred to the custody and control of HEP (Wright-Patterson AFB) along with a copy of the electronic records.

Conclusion

The disposition of all AFHS documentation and electronic files has been accomplished as directed by the Public Law 109-364 and the National Archives. All hard copy documentation was retired to the care of the National Archives. This documentation included such items as original participant, spouse/partner, and offspring records; research files; miscellaneous administrative records, participant photos from the examinations; copies of returned transfer consent forms and a set of publications. A complete set of the AFHS electronic data was also retired to the National Archives. Besides the analysis files and physical examination data, all hard copy records of the participants, their spouses/partners and offspring were scanned and are a part of the electronic dataset. Furthermore, two hard drives containing this electronic data were sent to two separate National Archive locations – College Park MD and Ft. Worth TX.

The original transfer consent forms, returned by participants, were sent to the AFRL IRB as required by regulation.

MFUA will receive all electronic data of the consenting participants as well as associated documentation.

As mentioned, HEP was selected by MFUA as the storage site for the biospecimens. As of 28 September 2007, HEP assumes responsibility for the safekeeping of the specimens. The specimens will remain at Brooks City-Base TX until transported to Wright-Patterson AFB OH. While the specimens are at Brooks City-Base, they will be cared for by an experienced individual who is familiar with the specimens' storage requirements as well as the freezer maintenance needs. This individual will serve as the on-site observer of the packing and shipping of the specimens to HEP. A new specimen storage facility is under construction at HEP and so, the shipment of the specimens to Ohio is scheduled for November 2007. Finally, until such time as MFUA is funded and can assume custodianship of the specimens HEP will continue to maintain the specimens.

In addition to the specimens, HEP will retain a complete AFHS electronic database as well as the data of the non-consenting participants. This will be retained per Public Law 109-364 for one year post-transfer to MFUA. At the end of the year the electronic data will be destroyed as well as the specimens of the non-consenting participants.

Attachment:
1. AFHS Overview

Attachment 1

Air Force Health Study Overview

To address concerns of veterans and the public regarding the consequences of exposure to Agent Orange and its contaminant 2,3,7,8-tetrachlorodibenzo-p-dioxin (dioxin), the Air Force began planning the AFHS in 1978 to evaluate the health, survival, and reproductive experience of veterans of Operation Ranch Hand, the unit responsible for the aerial spraying of herbicides in Vietnam from 1962 to 1971. The study sought to determine whether exposure to herbicides or dioxin in Ranch Hand veterans was associated with adverse health outcomes. Ranch Hand veterans were exposed to herbicides during loading, flight operations, and maintenance of the aircraft and spray equipment. A comparison group of other Air Force veterans involved in C-130 aircraft missions in Southeast Asia during the same period that the Ranch Hand unit was active was included in the study. Comparison veterans were not involved with spraying herbicides. The study protocol was written and reviewed during the period June 1979 through January 1982. The study included periodic analyses of post-service mortality, physical examinations, in-person interviews, medical record retrievals, and psychological testing.

In 1982, 1985, 1987, 1992, 1997, and 2002 physical examinations were accomplished. External medical records for each veteran, and if provided, for his spouse and children were obtained and used to verify and code self-reported medical conditions. The following table identifies the number of participants eligible to attend, number who attended and total number of attendees for each examination.

Group/Examination	1982	1985	1987	1992	1997	2002
Ranch Hand veterans eligible to participate	1,209	1,199	1,188	1,149	1,102	1,043
Ranch Hand participants	1,046	1,017	996	953	870	777
Percentage of Ranch Hands who participated relative to those eligible to participate	86.5%	84.8%	83.8%	82.9%	78.9%	74.5%
Comparison participants	1,223	1,292	1,298	1,280	1,251	1,174
Total	2,269	2,309	2,294	2,233	2,121	1,951

In 1986, the Centers for Disease Control and Prevention (CDC) developed an assay for dioxin in serum and demonstrated its suitability as a substitute for the assay of dioxin in adipose tissue obtained by biopsy. Each participant had at least one dioxin level collected at the earliest opportunity at the 1987, 1992, 1997, or 2002 physical examination.

In 1987, and thereafter, the serum dioxin measurement was used as an exposure index in this study. The median current dioxin level in 872 Ranch Hands in 1987 was 12.7 parts per trillion (ppt), range: 0 to 617 ppt. The median level in 1,060 Comparisons was 4.2 ppt, range: 0 to 54.8 ppt. Ninety-nine percent of the Ranch Hand dioxin levels are less than 200 ppt, and 99 percent of the Comparison levels are less than 13 ppt.

The study benefited from technical oversight by the Ranch Hand Advisory Committee, an independent panel appointed by the Food and Drug Administration, and from periodic reviews by the National Academy of Sciences. AFHS researchers briefed staff of the House and Senate Veterans Affairs Committee periodically as well.

In accordance with the AFHS protocol, the Study was scheduled to end September 2006 but because of the Congressional decision to transfer the AFHS assets to the Institute of Medicine's Medical Follow-Up Agency (MFUA) the protocol was extended for an additional year.

Strengths and Limitations

The strengths of the study included medical record verification of health outcomes, 100% quality control, high participant compliance, measurement of serum dioxin levels, and multiple levels of peer review. Limitations of the study were recognized. The results cannot be generalized to other groups (such as all Vietnam veterans or Vietnamese civilians) who had been exposed in different ways and to different levels of herbicide. The AFHS was only able to look at the effect of dioxin at levels found in the participants. Groups with higher exposures may well have effects not seen in our study. The size of the study made it difficult to detect increases in the prevalence of rare diseases. Hence, small increases in the risk of rare diseases may have been missed by the study. For example, because liver cancer is rare, even a tenfold increase in risk may not be detected.

Congressional Report

MQ-1 Predator and MQ-9 Reaper Roadmaps

House Report 109-504, page 165

Office of Congressional Budget and Appropriations Liaison
Pentagon (Room 5D-749A)

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Introduction

This report is being provided to the HASC, SASC, HAC-D, SAC-D and SAC as directed in House Report 109-504, page 165, dated 16 Jun 2006. The report will also be forwarded to the SSCI and HPSCI.

Executive Summary

This report outlines the Air Force's MQ-1 Predator and MQ-9 Reaper allocation and beddown strategy to meet Combatant Commander (COCOM) needs and honor commitments to build a total force of active and reserve component capabilities to meet peacetime and wartime demands. The report will outline key funding requirements, unit destinations and planned aircraft inventory, approximate delivery schedules and associated personnel and training to produce combat capability in terms of MQ-1 and MQ-9 combat air patrols (CAP).

The term CAP has replaced the term "orbit" to describe MQ-1 and MQ-9 missions. The FY 2008 President's Budget separated the MQ-1 Predator and MQ-9 Reaper programs due to the distinctive mission focus of each system. The MQ-1 operates in a primarily intelligence, surveillance and reconnaissance (ISR) role and is part of the Military Intelligence Program (MIP). The MQ-9 operates in a primarily strike role and is not included in the MIP.

Background

The report was directed by the Defense Appropriations Subcommittee via House Report 109-504, page 165 accompanying the Fiscal Year 2007 Defense Appropriations bill. The committee has expressed an interest in the development of unmanned aircraft systems and their beddown strategy. Specifically, the language reads:

> *The Committee directs the Secretary of the Air Force to submit a report to the congressional defense committees on the allocation and beddown strategy for MQ–1 and MQ–9 aircraft within the active and reserve components for the period of fiscal year 2006 through fiscal year 2011. The report shall include funding requirements, unit destinations and planned aircraft inventory, approximate delivery schedule, associated personnel and training, and the number of orbits capable. The report shall be submitted by March 15, 2007.*

Report

MQ-1 Predator

The MQ-1 Predator is a multi-role, single engine, long-endurance, remotely piloted aircraft designed to operate over-the-horizon at medium altitude. Its primary mission is Intelligence Surveillance and Reconnaissance (ISR) and target acquisition with a secondary strike mission in direct support of the COCOMs.

A Predator system includes four aircraft, one Ground Control Station (GCS), one Predator Primary Satellite Link (PPSL) [a satellite communications suite], associated ground support equipment, spares, and personnel required to operate, maintain, and sustain the Predator system. The system is designed to be modular and open-ended: mission specific equipment is employed in a mission kit concept allowing specific aircraft and control station configurations to be tailored to fit mission needs.

Funding Requirements

- Both the United States Central Command (USCENTCOM) and the United States Special Operations Command (USSOCOM) require the capability of persistent ISR in order to provide 24/7 supporting over-watch and to find, fix and finish time-sensitive, high-value targets (HVT).

- Often HVTs can only be developed with patient collection of information [the "unblinking eye"], and require rapid, decisive action during the short periods in which they present themselves. For USSOCOM to perform this mission most effectively, assets tasked must fall under operational control (OPCON) of special operations forces (SOF), and must have a close, habitual relationship with the SOF units they support. Therefore, USSOCOM has identified a requirement for a SOF-organic Medium Altitude Long Endurance Tactical (MALET) Unmanned aircraft system (UAS) capability. Filling this requirement with additional Predator force structure, within AFSOC, the Air Force component for USSOCOM, represents the most expedient, cost-effective and sustainable means of providing the needed capability.

- Sustaining MQ-1 Predator operations which support multiple COCOMs, further enhancing the capabilities of the MQ-1, and developing a follow-on capability continue to be one of the Air Force's highest priority requirements.

Unit Destinations

- The Air Force's allocation and beddown strategy for the MQ-1 Predator is consistent with our wartime and peacetime readiness requirements and commitments to our Total Force Initiative (TFI). The Air Force will strive to meet the demands of the national security and national military strategies through effective and efficient presentation of these forces to our COCOMs. At the same time, the Air Force must meet the demands placed on the department by the Base Realignment and Closure Committee (BRAC). The department will accomplish this through an integrative approach which honors our TFI initiative and employs UASs by way of remote-split operations from continental United States-based mission command elements, directly supporting multiple COCOMs. UAS make innovative use of net-centric and distributed operations principles to reduce forward footprint, yet grow capacity to meet continually increasing demands.

- Air Combat Command (ACC) MQ-1 units include squadrons currently subordinate to the 57th Wing based at Nellis AFB, NV: 11th Reconnaissance Squadron (RS), 15th RS, and 17th RS. The 11th RS and 17th RS operate from Creech AFB, NV and the 15 RS operates from Nellis AFB, NV. 17th RS is currently operating both MQ-1 Predator and MQ-9 Reaper aircraft.

- National Guard Bureau (NGB) ACC-gained MQ-1 units include or will include: 163rd Reconnaissance Wing of the California Air National Guard based at March ARB, CA; Detachment 1 of the Arizona Air National Guard based at Davis Monthan AFB and Ft. Huachuca, AZ; 119th Fighter Wing of the North Dakota Air National Guard based at Hector Field and Grand Forks AFB, ND; 147th Fighter Wing of the Texas Air National Guard based at Ellington Field, TX.

    - The California ANG has already achieved its initial operating capability (IOC) and is currently supporting USCENTCOM with one CAP. The state will stand-up its Flying Training Unit (FTU) and Field Training Detachment (FTD) [for maintenance training] capability at the end of FY 2008 and achieve a full operational capability (FOC) in FY 2011.

    - The Arizona ANG will stand-up its first COCOM CAP this FY, 2007. The state will receive additional equipment in order to achieve FOC sometime after FY 2011.

- The North Dakota ANG will stand-up its first COCOM CAP and achieve IOC this FY, 2007. The state will receive additional equipment to provide COCOMs an additional surge CAP capability in FY 2009 and to achieve FOC sometime after FY 2011.

- The Texas ANG will stand-up its first COCOM CAP and achieve IOC in FY 2008. The state will receive additional equipment to provide COCOMs with one surge CAP in FY 2009, another surge CAP in FY 2010 and achieve FOC sometime after FY 2011.

- The Air Force Special Operations Command (AFSOC) MQ-1 unit is the 3rd Special Operations Squadron (SOS) currently operating from Nellis AFB, NV. The 3rd SOS will move to Cannon AFB, NM at a time to be determined.

Planned Aircraft Inventory

- The Air Force currently plans to build to and maintain an objective force structure of 170 MQ-1 aircraft.

Fiscal Year (FY)	2006	2007	2008	2009	2010	2011
Anticipated Total Aircraft Inventory MQ-1 (Accounts for Attrition Loss)	82	97	103	109	117	141

Approximate Delivery Schedule

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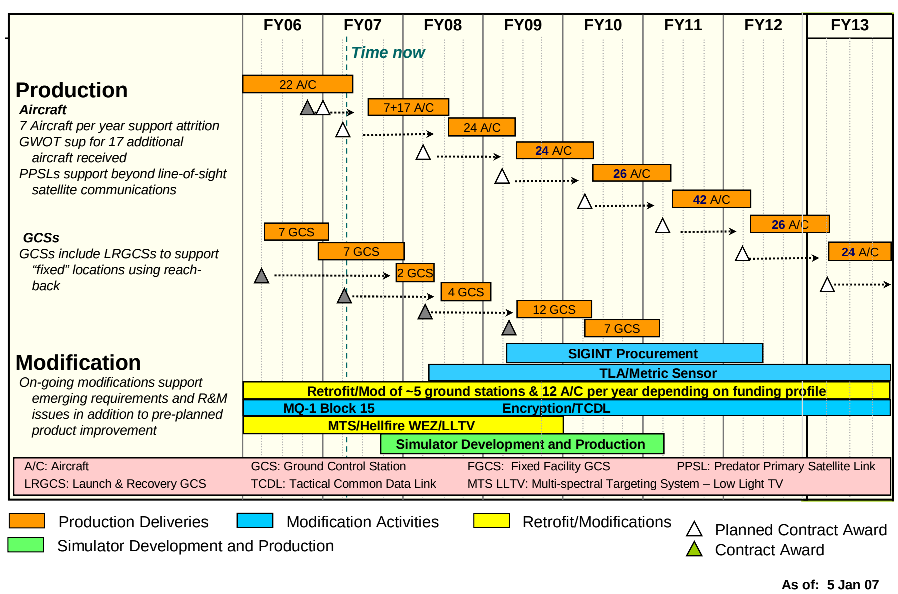
MQ-1 Predator Schedule



Associated Personnel and Training

- The MQ-1 Predator FTU at Creech AFB will train 120 pilots and sensor operators in FY 2007. As the Air Force increases to the 21 MQ-1 CAPs as directed by the DoD, the demand for training will continue to increase. The requirement for training in FY 2008 will increase to support ACC, AFSOC, AFMC and reserve component units. ACC is taking measures to increase training capacity to meet the demand. The CA ANG is building a Predator FTU at

March ARB, CA which will incrementally build to a maximum production capacity of 40 aircrews by FY 2009.

Number of Combat Air Patrols Capable

- The FY 07 PB, the DoD's FY 08 PB submission and the DoD's Global War on Terrorism (GWOT) supplemental requests will posture the Air Force to meet the current DoD demand for 21 full-time CAPs to employ persistent ISR by FY 2010. The following table estimates the capacities by year from FY 2006 through FY 2011.

Fiscal Year (FY)	2006	2007	2008	2009	2010	2011
MQ-1 CAPs at End of FY	10	12	17	20	21	21

MQ-9 Reaper

The MQ-9 Reaper is a multi-role, single-engine, long endurance turbo prop remotely piloted aircraft designed to operate over-the-horizon at medium-to-high altitude. Its primary mission is strike – to prosecute critical emerging time-sensitive targets as a radar-based attack asset with on-board hard-kill capability (hunter-killer). Its secondary mission is ISR and target acquisition. In the hunter-killer role, the aircraft will employ fused multi-spectral sensors to automatically find, fix and track ground targets and assess post-strike results. Its performance characteristics allow it to fly at twice the altitude and twice the airspeed of the MQ-1. It also has a significantly larger payload capacity with over 12 times the external payload of the MQ-1.

A Reaper system includes four aircraft, one ground control station, one PPSL [satellite communication suite similar to MQ-1], associated ground support equipment, spares, and personnel required to operate, maintain and sustain the system. The system is designed to be modular and open-ended; mission specific equipment is employed in a "plug-and-play" mission kit concept allowing specific aircraft and control station configurations to be tailored to meet mission needs.

Funding Requirements

- Sustaining current MQ-9 Reaper operations, developing and enhancing the Reaper's capability, while meeting IOT&E goals; and building COCOM CAP capacity to support the long war with persistent, unmanned strike capability is a top Air Force priority.

Unit Destinations

- Air Combat Command (ACC) MQ-9 units include squadrons currently subordinate to the 57th Wing based at Nellis AFB, NV: 17th RS and 42nd Attack Squadron (ATKS) operating MQ-9 Reaper aircraft from Creech AFB, NV.

- NGB ACC-gained MQ-9 units will include the 174th Fighter Wing of the New York Air National Guard based at Hancock Field and Ft. Drum, NY.

    - The New York ANG will stand-up its first MQ-9 COCOM CAP and achieve IOC in FY 2010. The unit is programmed to receive all equipment by FY 2012 to achieve FOC in FY 2013.

Planned Aircraft Inventory

- The Air Force currently plans to build to and maintain an objective force structure of 60 MQ-9 aircraft.

Fiscal Year (FY)	2006	2007	2008	2009	2010	2011
Anticipated Total Aircraft Inventory MQ-9 (Accounts for Attrition Loss)	5	18	24	28	37	42

Approximate Delivery Schedule

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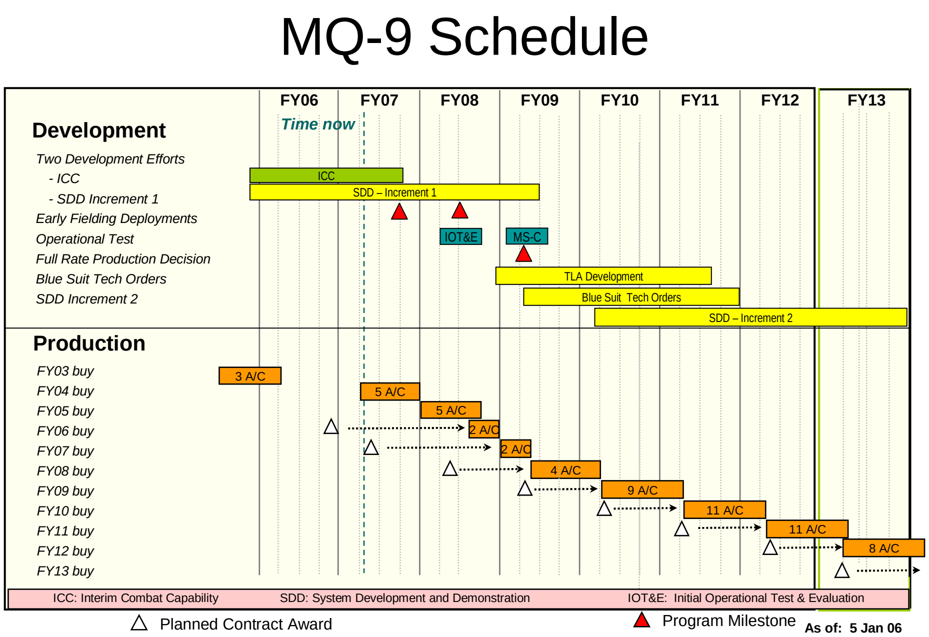

Associated Personnel and Training

- The initial cadre for the MQ-9 Reaper is currently in the academics portion of their training at the 42nd ATKS. While the training capacity will continue to be evaluated depending on the rate of increasing demands on the system, the 42 ATKS will concurrently train aircrews and stand-up additional CAP capacity.

Number of Combat Air Patrols Capable

- The FY 07 PB, the DoD's FY 08 PB submission and the DoD's Global War on Terrorism (GWOT) supplemental requests will posture the Air Force to meet the current DoD demands for 8 full-time CAPs of unmanned strike capability. The following table estimates the capacities by year from FY 2006 through FY 2011.

Fiscal Year (FY)	2006	2007	2008	2009	2010	2011
MQ-9 CAPs at End of FY	1	2	3	4	6	7

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Cost-Benefit Analysis of the 2006 Air Force Materiel Command Test and Evaluation Proposal

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Abstract

This monograph provides the results of a cost-benefit analysis of an Air Force proposal to consolidate and divest itself of a portion of its test and evaluation facilities and capabilities within the Air Force Materiel Command. Congress directed the Air Force, in the 2007 Defense Appropriations Act, to study the effects of this proposal, and the Air Force asked RAND Project AIR FORCE to carry out the analysis. The analysis indicates that there are financial merits to some of the proposal: The Air Force could save on its costs over the Future Years Defense Program from 2007 through 2011 if the consolidation of the 46th and 412th Test Wings were to occur in conjunction with the transfer of open-air range flight testing from Eglin Air Force Base (AFB) to Edwards AFB and the Naval Air Warfare Centers at Point Mugu and China Lake. Other parts of the Air Force proposal were considered not to be cost effective; these included the closure of Eglin ground-range test facilities, as well as other test facilities at Eglin AFB, at Holloman AFB, and at Moffett Field, California. The report highlights areas of risk that the Air Force should consider prior to implementation.

Preface

This report provides the results of a cost-benefit analysis (CBA) of an Air Force proposal to consolidate and divest itself of a portion of its test and evaluation (T&E) facilities and capabilities. Congress directed the Air Force, in the 2007 Defense Appropriations Act, to study the effects of this proposal, and the Air Force asked RAND Project AIR FORCE to carry out the analysis. This monograph should interest those associated with military T&E facilities and capabilities.

RAND Project AIR FORCE

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CHAPTER FIVE

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Summary

As with other military services, the Air Force must recapitalize its equipment, which is an expensive undertaking. In 2006, to make additional funds available for recapitalization, the Office of the Secretary of Defense issued Program Budget Decision 720 (PBD-720), which directed a $6.2 billion reduction in support contractors over fiscal years (FY) 2007 through 2011. Air Force Materiel Command's (AFMC's) share of this reduction totaled $839 million, of which $371 million was T&E's share. To meet the $371 million budget objective, AFMC considered several options. One of these options, referred to as the "Organizational Streamline Approach," focused on the consolidation and potential divestiture of U.S. Air Force T&E facilities and capabilities. This option was included in the FY 2008 budget process. The option proposed three things:

- consolidation of the 46th Test Wing at Eglin Air Force Base (AFB), Florida, with test organizations at Edwards AFB, California, primarily the 412th Test Wing[1]
- full or partial divestiture of seven Air Force test facilities
- reduction in the T&E range capacity at Eglin AFB.[2]

Congress, in the 2007 Defense Appropriations Act, directed the Air Force to study the potential costs and benefits of this option. The Air Force asked RAND Project AIR FORCE to help conduct the CBA.

Project Scope and Approach

The boundaries of this work were purposefully limited to the AFMC proposal articulated above. We did not propose ideas that we deemed to be more efficient or more effective than the

[1] Test personnel supporting command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR); the Air Force Special Operations Command (AFSOC); and the Air Force Seek Eagle Office (AFSEO) were expected to remain in place at Eglin AFB.

[2] Air Force organizations that were asked to implement this proposal inferred that this also meant preserving some ability to support deployed flight testing, if necessary. This assumption was the foundation on which Eglin AFB provided data to RAND for this analysis.

alternatives presented to us for analysis. This was consistent with the direction that we received throughout the project from congressional staff and in discussions with personnel from the Air Force and the Test Resource Management Center. Specifically, we were asked to assess, in terms of the spirit and intent of the language in the appropriations act, the specific set of proposals and the alternatives that AFMC had articulated. The only addition to the AFMC proposal that RAND considered was whether Edwards AFB and the Navy installations at Point Mugu and China Lake could accommodate the flight- and ground-test workload from Eglin AFB. Although the AFMC proposal did not specify explicitly, it did imply that, if the PBD-720 cuts significantly affected the Eglin range, the Air Force would need to conduct these activities elsewhere (e.g., Edwards AFB and the Navy range and facilities).

We drew our data from three primary sources. First, we visited the installations and other organizations the proposal would affect. In all, we interviewed over 200 people. Next, at each site, we collected data about facilities and range function and use, maintenance activities, flying hours, and so forth. Our third source of information was a review of the literature.

After collecting relevant data for the study, we constructed financial analyses that captured the economic benefits and costs of the proposal. Data were provided by the organizations that the AFMC proposal would affect, including test facilities, the test center staff, and customers. One key assumption of our work was that the demand for test-program content would remain constant. This meant that customers of Air Force T&E that were affected by the AFMC proposal would still have a requirement to test and would therefore require the capability to do so. This assumption ensured that we captured relevant alternative effects. Although we attempted to quantify T&E issues as much as possible, we were not able to do so in several cases. In these cases, we qualitatively assessed the potential for benefit or cost. The results of the economic analysis were compared with the qualitative findings to draw conclusions.

Results

Consolidation of 46th Test Wing (Eglin) with the 412th Test Wing (Edwards)

We analyzed the cost-benefit effects of a consolidation of the 46th and 412th Test Wings in three areas: their flying hour programs, maintenance functions, and support structures. With respect to the maintenance and staff support consolidations, we also analyzed how the movement of the 46th Test Wing would affect the 53rd Wing at Eglin, which has a combined maintenance function and combined test force (CTF) with the 46th Test Wing. The Future Years Defense Program (FYDP) savings from this consolidation are projected to be $43.2 million in current-year dollars. This savings includes the types and amounts of costs that the 53rd Wing would need to recapitalize its maintenance capability. Table S.1 summarizes our results.

Range Closings

We also drew conclusions about ground and open-air range (OAR) flight-test activities. With respect to ground ranges, we analyzed eight facilities that were dedicated primarily to ground

Table S.1
Summary Chart—Unified Set of Cost Accounts ($M)

	Annual Savings	Annual Costs	Total Annual Savings	Nonrecurring Costs	Cost Savings Over FY 2007–2011 FYDP
Total for all 46th Test Wing consolidation[a]	71.7	30.4	41.3	58.3	43.2
53rd Wing total[a]	0.0	30.4	(30.4)	0.0	(91.2)
53rd operations support[b]	0.0	3.5	(3.5)	0.0	(10.5)
53rd maintenance					
53rd flightline[b]	0.0	15.6	(15.6)	0.0	(46.5)
53rd backshop[b]	0.0	11.3	(11.3)	0.0	(33.9)
Combined 46th and 412th flightline maintenance[c]	27.5	0.0	27.5	8.6	53.4
Combined 46th and 412th maintenance, backshop[d]	3.8	0.0	3.8	40.1	(28.6)
Flying hour program[e]	3.1	0.0	3.1	0.0	7.3
Support staff[f]	37.3	0.0	37.3	9.6	102.3

[a] These totals include flightline scenario 2 and backshop scenario 1, as discussed in the maintenance section of Chapter Two.

[b] See Table B.12 for supporting information. Not included in AFMC plan.

[c] See Table B.11 for supporting information. AFMC's planned reductions are not used in the RAND analysis and are explained further in Chapter Two. Two scenarios for cost reductions are provided in the text. The first maintains the current ratio of maintainers to aircraft using AFMC's direction to excess three F-16 aircraft as a result of consolidation.

[d] See Table B.8 for supporting information. AFMC's planned reductions are not used in the RAND analysis and are explained further in Chapter Two. The current ratio of maintainers to aircraft is retained as workload is consolidated, using AFMC's direction to excess three F-16 aircraft. Nonrecurring costs include civilian recruitment, reduction to contractor workforce, support equipment moving costs, and military construction.

[e] See Table 2.2 for supporting information. The RAND analysis partially rejects the AFMC plan, as explained further in Chapter Two. The savings generated are less than AFMC and driven by the AFMC plan to reduce three F-16 aircraft.

[f] See Table B.5 for supporting information. The RAND analysis partially rejects the AFMC plan, as explained further in Chapter Two. AFMC's savings appear to be overstated. RAND calculations are based on a 30-percent reduction of support staff as a combined operation, as opposed to AFMC's 40-percent reduction.

tests on the range. In its original proposal, AFMC had not intended to close any facilities beyond those it had explicitly identified in the original options. AFMC was therefore unaware that reducing the range capacity would force the closure of ground-range capabilities—RAND uncovered these potential consequences during the early stages of the CBA.

Table S.2 summarizes the results. Because of the many uncertainties involved, we do not attempt to produce a total cost or savings for the entire set of facility closures. In general, there is no compelling reason to treat all these facilities as an indivisible whole; different cost-effective outcomes can be found for each.

Table S.2
Costs and Savings Calculations for Proposed Facility Closures (FY 2007 $M)

	Nonrecurring Costs	Annual Costs	Nonrecurring Savings	Annual Savings	Total Savings Over FY 2007–2011 FYDP
Base Installation Security Systems (BISS)	3.91	0	0	4.37	9.2
Gunnery and Ballistics Test Facilities (GBTF)	19.45	0.36	0	1.55	(15.9)
HELLFIRE Test Facility (HTF)	0.69	0	0	0.91	2.0
Kinetic Energy Munitions Test Facility (KEMTF)	1.36	0.85	0	0.82	(1.4)
Operational/Functional Ground Test (OGT/FGT)	0.6	0	0	0.45	0.77
Portable Seeker/Sensor/Signature Evaluation Facility (PSSSEF)	1.84	0	0	3.24	7.9
Simulated Test Environment for Munitions (STEM)	0.76	0.12	0	0.27	(0.3)
Static Munitions Test Arenas (SMTA)	0.36	0.16	0	0.82	1.6

The Air Armament Center (AAC) provided specific additional program costs for only two of these facilities: the BISS, at $50 million nonrecurring, and the HTF, at $5.12 million over the FYDP. However, these estimates are simply for recreating the facilities and so are not particularly informative for estimating additional costs to users. Although we do not have specific program costs for the other facilities, we do have a total for programs that use ground-test facilities. This can be compared to the total cost or savings of closing these facilities, as shown in Table S.2. The AAC estimate for three years of costs (2009, 2010, and 2011) following closure is $85.44 million. If we subtract the already considered BISS and HTF facilities, the additional costs total $30.32 million.[3] From Table S.2, the total for the remaining six facilities is a cost, not a savings, of $7.37 million. With the additional program costs of $30.32 million, the cost of closing all six facilities would then total $37.69 million. This option is clearly not cost-effective. Note, however, that this does not preclude the cost-effectiveness of selected facility closures. Individual savings may be large enough and additional program costs small enough to make closure cost-effective despite this aggregate result.

In summary, closing BISS could produce good returns, but the results are misleading because of the lack of data on the costs of equipping alternatives and on possible additional costs to testers. More analysis is necessary. Transfering all costs to the limited number of test program users, as is already under way, is the most likely solution for reducing AFMC costs, but the overall cost to DoD would remain unchanged. Even if DoD did obtain a cost benefit,

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[3] Two large programs, Large Aircraft Infrared Countermeasures and Other Infrared Countermeasures, account for $18.29 million of the total.

AFMC is simply shifting costs to other parties. When this occurs, it shifts a portion of the burden created by PBD-720.

Closing PSSSEF and SMTA would likely produce a cost benefit for both AFMC and DoD. Closing GBTF, KEMTF, HTF, OGT/FGT, or STEM would offer little or no cost benefit, even with current cost and savings estimates. The HTF may be another good candidate for single-user status with its U.S. Army users, although this would simply transfer costs and not result in savings for DoD as a whole.

With respect to OAR flight-test activities, a savings of $149 million over the FYDP is possible.[4] To inform this assessment, several stakeholders from Eglin AFB, Edwards AFB, Naval Air Warfare Center (NAWC) China Lake, and NAWC Point Mugu met to understand what types of flight operations could be conducted if OAR activities moved from Eglin to the western test ranges (WTR). This exercise specifically addressed capability (not range capacity) and was predicated on 17 weeks of actual flight testing at Eglin. The stakeholders' results showed that Edwards AFB and its range could not support the entire Eglin workload of this 17-week period. However, the combined capabilities of the WTR—specifically, Edwards, the Point Mugu sea range, and China Lake—could support almost all the Eglin workload, except possibly the telemetry. In the exercise, all the sorties were launched from Edwards. Sixty percent of the missions could be completed with Edwards capabilities alone. Twenty percent required additional support from the Point Mugu sea range, and another 19 percent also required additional support from China Lake and the R-2508 complex. About 1 percent required support from other ranges, such as White Sands Missile Range. Moving the Eglin open-air developmental testing would provide an opportunity for the Air Force to save substantial resources. These savings come from (a) test wing staff consolidation and (b) increased OAR efficiency.

The range activities cannot be shifted to the WTR in isolation or without risk. Movement of the OAR flight testing to the WTR must be linked with the consolidation of the 46th and 412th Test Wings, and in this light, the costs and benefits of range consolidation and wing consolidation can only be considered together. Wing consolidation can succeed only if the Navy supports expanded Air Force activity at the western Navy ranges. This consolidation of both wing and OAR flight-test activities would require significant planning and transition to minimize the effects on the customers. See Table S.3 for an OAR test summary.

Facility Closings

Our analysis of the seven facilities outlined in the AFMC proposal leads us to conclude that the Air Force should not divest itself of these facilities,[5] with two exceptions: the National Full-

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[4] See Tables S.3 and C.12 for details. Two areas of uncertainty are whether the Navy can really support additional activity at the WTR with the staffing they it estimates and whether the Air Force would really decide to reduce the Eglin range by 689 positions. In Table C.11, we present a case in which the Navy's staffing requirement is three times higher than in the base case and the Eglin range retains 748 staff, rather than the 509 staff retained in our base case. In that scenario, FYDP savings decrease to $78 million.

[5] These facilities should not be confused with the ground range facilities articulated in the previous paragraph. The facilities referred to in this case are those that AFMC explicitly specified in its proposal.

Table S.3
Cost Estimate Summary for Range Consolidation

	Eglin	Edwards	China Lake	Point Mugu	Total
Number of employees	(698)	64	10	5	(619)
Cost per person ($000)	91	100	91	100	
Personnel transition costs ($000)	12,676	3,200	454	250	
Other transition costs ($000)		1,000	250	100	
Recurring costs ($000)				70	
Total transition costs ($000)	12,676	4,200	704	350	17,930
Total recurring costs ($000)	(63,378)	6,400	978	500	(55,500)

NOTE: All costs are in 2007 dollars.
Summary over FY 2007–2011 FYDP: (148,572).

Scale Aerodynamic Complex (NFAC) and the Joint Preflight Integration of Munitions and Electronic Systems (J-PRIMES). NFAC, a wind tunnel, is a specialized facility that few Air Force customers use and that has little direct benefit for the Air Force. J-PRIMES allows testing of aircraft with radio frequency sensors and emitters in a simulated threat environment to exercise new and updated software. This facility is relatively inexpensive and is valuable for Army testing and flight-test programs at Eglin. However, if most flight testing is moved to the WTR, it would make sense for the Air Force to transfer the activities it does carry out at J-PRIMES to its Benefield Anechoic Facility or to the Navy's testing facilities at Patuxent River Naval Air Station (NAS), Maryland, and to transfer J-PRIMES to the Army. For the other five facilities considered, we concluded that either (1) that the facilities' capabilities were too unique to allow their closure and that there was no adequate substitute or (2) customer costs would likely outweigh any savings if the facilities were closed. Table S.4 summarizes the results.

Risk

Throughout this document, we highlight potential risks for the Air Force and the DoD of implementing the AFMC proposal. In the aggregate, these risks are not trivial and indicate that the Air Force needs to study the details further and needs to develop an understanding of how the plan would affect customers, test organizations, and the DoD. When possible, we include relevant and validated customer effects, in terms of the costs programs may incur. Admittedly, these costs do not include those for classified programs—more analysis and a change in the classification of this document would have been required to consider them.

We also discuss the risks associated with the consolidation of the 46th and 412th Test Wings and the transfer of OAR flight-test activities to the WTR. In both cases, significant

Table S.4
Summary of Facilities Closure

Facility	AFMC-Proposed Action	RAND Findings	Comments
Central Inertial Guidance and Test Facility	Close or divest	Retain	No practical alternatives Broad customer base
Guided Weapons Evaluation Facility	Close or divest	Retain	Insufficient alternative capacity
Joint Preflight Integration of Munitions Systems Facility	Close or divest	Consider divesting to Army if flight testing moves	Low cost Should be collocated with range
McKinley Climatic Laboratory	Mothball	Retain	Unique capability High usage Low cost
Seeker-Signature T&E Facility	Close or divest	Retain	Low cost
Benefield Anechoic Facility	Reduce	Restore if J-PRIMES divested and/or to retain network-centric test capability	Sole Air Force full-size anechoic chamber if J-PRIMES divested
National Full-Scale Aerodynamic Complex	Close or divest	Consider divesting to Army	Not related to core Air Force mission (Policy decision)

coordination would be required to prevent testing from being hampered. The Air Force would need to work out details on how to merge the wings effectively. At the time we conducted this study, the details were not fully refined. Similarly, this effort would require a thorough examination of the types of personnel required, as well as the selection of best practices for testing programs and maintaining and flying aircraft. With respect to the OAR, the Air Force would need to work closely with the Navy to ensure an equitable allocation of time on the range schedules at NAWC Point Mugu and NAWC China Lake. Although Air Force personnel at Edwards AFB routinely work with Navy colleagues to coordinate airspace and range activities in the WTR, the amount of OAR flight-test activities that the AFMC proposal would transfer would require a purposeful approach to ensure that the test activities can be accomplished.

As the Air Force looks to the future, there is a broader concern about the risk the service may incur by divesting itself of T&E infrastructure. If facilities or ranges are divested, the Air Force would be eliminating its capability to conduct future developmental testing at various locations. This in turn could lead to one of two possible outcomes:

1. greater reliance on contractors in the longer term for developmental testing, which could possibly offset savings from divestiture or consolidation
2. fewer tests, which could increase a program's risks over its life cycle.

One of T&E's current priorities is to find ways to do better and more-realistic developmental testing earlier to avoid problems later. It is possible that consolidation or divestiture could move the Air Force in the opposite direction, with more reliance on contractors and less-insightful developmental testing overall.

Limitations of This Analysis

As a significant caveat to our work, the results presented in this monograph are driven primarily by cost considerations. We do not attempt to quantify the value of benefits that would be lost in the future if the Air Force required the use of the affected ranges or facilities. For example, the Air Force might require more testing in the future at a specific facility or range. If that capacity were already in maximum use or no longer existed, the effects on programs and their ability to test would be negative.

We could not objectively quantify the potential for future operational surges or other associated benefits, such as increased capacity, that are available to the Air Force today. RAND's findings about cost are driven primarily by data and estimates from the Air Force and from other government sources that we contacted and interviewed for this work. In many cases, we were not able to assess the quality of the cost and savings estimates provided to us. As previously stated, we used a series of repetitive inquiries to stakeholders and compared data sources and interviews to develop a more-complete picture for the analysis.

Because of the general uncertainty of the details in parts of the AFMC proposal, it was not uncommon for the test organizations to provide updated inputs to us as further consideration matured their thinking about possible consequences. We expect that, with more time and further study of this subject, the test enterprise will be able to continue to refine data collection and analysis.

All the data that was collected and presented in this analysis are unclassified. The AFMC proposal, as stated, addressed programs that were considered to be unclassified. We did not include consequences for classified programs or for facilities that address classified T&E activities. Consideration of how these programs would be affected would likely indicate that the Air Force will face higher costs and risks if the AFMC proposal were implemented.

Finally, we emphasize that not all the cost savings identified in the analysis should be interpreted as being available to meet the $371 million budget decrement that PBD-720 imposes on AFMC T&E over the FYDP. In some cases, the savings are in fact available to be taken without imposing burdens elsewhere in the DoD budget. In other cases, however, the AFMC proposal may allow the AFMC T&E to meet its savings goal by shifting the burden elsewhere in the Air Force or the DoD.

Conclusions

In sum, analysis shows that the FYDP savings support consolidation of the 46th and 412th Test Wings discussed earlier. The wing consolidation would involve a substantial amount of effort, and more-detailed planning would be needed to ensure that all parties involved understood the plan and the sequence of events. The effects on the Eglin range are mixed. The demand for use of the ground-test ranges and the consequences for customers if the ranges are closed indicates that the ranges should remain open or be transferred to other services. The analysis of OAR flight testing shows potential savings over the FYDP, but transferring the flight-test activities would require considerable coordination between the Air Force and the Navy and could affect a myriad of other users. It is important to note that the consolidation of the 46th Test Wing and the OAR must be linked—that is, one cannot be done without the other. Analysis of the facilities shows a continuing need for them but not in all cases a need for the Air Force to control them.

The financial savings associated with both the consolidation and the transfer of the open-air flight testing from Eglin to the WTR must be tempered according to the type and amount of risk that the Air Force is willing to accept from the AFMC proposal. These risks are not trivial and include potential schedule delays for program testing, increased customer costs, and decreased T&E capacity. When possible, we have examined how the plan would affect customers but were limited by time and an inability to verify all potential consequences for customers. Many of these risks require further study and could not be definitively captured within the constraints of this analysis.

Acknowledgments

We thank the U.S. Air Force for the opportunity to contribute to this important topic as it considers the effectiveness and efficiency of managing T&E across the institution. This monograph could not have been completed without the assistance of many people within the Air Force and across the DoD. Their tireless commitment to answering our requests for data, interviews, and site visits was paramount to the successful completion of this CBA. Without their support, we could not have compiled or analyzed the significant amounts of data provided within the time frame set forth by Congress. We are indebted to the people of the Air Force, Navy, Army, and the Office of the Secretary of Defense T&E enterprise—their professionalism and commitment to T&E were apparent throughout our conversations and research. We are also thankful for the time and interest of the congressional staff members who were engaged throughout this process and helped us ensure that the scope of the project was appropriate. The authors also thank the sponsors and reviewers for their thoughtful comments on the various drafts and the briefing material that has been presented to date. Any errors or omissions are the sole responsibility of the authors.

Abbreviations

AAC	Air Armament Center
ABSTIRRS	Airborne Staring Infrared Radiometric System
ACC	Air Combat Command
ACETEF	Air Combat Environment Test and Evaluation Center
ACM	Advanced Cruise Missile
AEDC	Arnold Engineering Development Center
AFB	Air Force base
AFSEO	Air Force Seek Eagle Office
AFEWES	Air Force Electronic Warfare Evaluation Simulator
AFFTC	Air Force Flight Test Center
AFI	Air Force Instruction
AFMC	Air Force Materiel Command
AFOTEC	Air Force Operational Test and Evaluation Center
AFSEO	Air Force Seek Eagle Office
AFSOC	Air Force Special Operations Command
AGE	aerospace ground equipment
AGRI	Air-to-Ground Radar Imaging
AIM	air intercept missile
ALCM	Air-Launched Cruise Missile
AMIRS	Advanced Millimeter Wave Imaging Radar System

AMRAAM	Advanced Medium-Range Air-to-Air Missile
ARAT	Army Reprogramming Analysis Team
ARTM	Advanced Range Telemetry
ASIMS	Airborne Spectral Infrared Measurement System
ATEF	Aeroballistics Test and Evaluation Facility
BAE	BAE Systems Inc.
BAF	Benefield Anechoic Facility
BISS	Base Installation Security Systems
BOS	base operating support
BRAC	Base Realignment and Closure
BRU-57	Bomb Rack Unit 57
C4ISR	command, control, communications, computers, intelligence, surveillance, and reconnaissance
CBA	cost-benefit analysis
CIGARS	Calibrated Infrared Ground and Airborne Radiometric System
CIGTF	Central Inertial and Global Positioning System Test Facility
CME	contractor manpower equivalent
CPM	civilian personnel manual
CSAR-X	combat search and rescue
CTF	combined test force
D&D	denial and deception
DARPA	Defense Advanced Research Projects Agency
DBA	direct budget authority
DEWSIM	Directed Energy Weapon Simulator
DHS	Department of Homeland Security
DIA	Defense Intelligence Agency
DIRCM	Directional Infrared Countermeasures
DJC2	Deployable Joint Command and Control

DoD	Department of Defense
DU	depleted uranium
EEE	electromagnetic environmental effects
EGI	embedded Global Positioning System and inertial systems
ELSS/FP	Electronic Systems Squadron/Force Protection
EMMLS	Eglin Mobile Missile Launcher System
EMPIRS	Eglin Multi-Platform Imaging Radiometric Systems
EO	electro-optical
ESC	Electronic Systems Command
EW	electronic warfare
EWG	electronic warfare group
FAA	Federal Aviation Administration
FGT	functional ground test
FHP	flying hour program
FM	frequency modulation
FQPSK	Feuer QPSK
FY	fiscal year
FYDP	Future Years Defense Program
GBTF	Gunnery and Ballistics Test Facilities
GPS	Global Positioning System
GWEF	Guided Weapons Evaluation Facility
HEI	high explosive incendiary
HITL	hardware-in-the-loop
HPO	high performance organization
HTF	HELLFIRE Test Facility
I&M	improvement and modernization
IBAR	Integrated Battlespace Arena

IR	infrared
JASSM	Joint Air-to-Surface Standoff Missile
JDAM	Joint Direct Attack Munition
J-PRIMES	Joint Preflight Integration of Munitions and Electronic Systems
JSOW	Joint Standoff Weapon
KEMTF	Kinetic Energy Munitions Test Facility
LASI	Large Aircraft Survivability Initiative
LRTA	Large Rotor Test Apparatus
MALD	Miniature Air-Launched Decoy
MANPADS	man-portable air defense system
MCL	McKinley Climatic Laboratory
MERAJS	Millimeter Wave Emitters, Radars, and Jamming System
MMS	Millimeter Wave Materials Measurement System
MMW	millimeter wave
MOS	military occupational specialty
MROCS-2	Millimeter Wave Obscurant Characterization System
MRTFB	Major Range and Test Facility Base
MSCF	Master Surveillance and Control Facility
MSIC	Missile and Space Intelligence Center
MSTTE	Multi-Spectral Test and Training Environment
MXG	maintenance group
MXS	maintenance squadron
NAS	naval air station
NASA	National Aeronautics and Space Administration
NASIC	National Air and Space Intelligence Center
NAVAIR	Naval Air Systems Command
NAWC	naval air warfare center

NAWCWD	Naval Air Warfare Center Weapons Division
NDAA	National Defense Authorization Act
NFAC	National Full-Scale Aerodynamic Complex
NGIC	National Ground Intelligence Center
NPV	net present value
OAR	open-air range
OFP	operational flight program
OG	operations group
OGT	operational ground test
OMB	Office of Management and Budget
OPM	Office of Personnel Management
OSD	Office of the Secretary of Defense
OSS	operations support squadron
OUSD/AT&L	Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics
PAA	primary aircraft authorization
PAI	primary aircraft inventory
PAF	Project AIR FORCE
PCM	pulse code modulation
PCS	permanent change of station
PDAI	primary development and test aircraft inventory
PBD-720	Program Budget Decision 720
PMO	program management office
PSSSEF	Portable Seeker-Sensor-Signature Evaluation Facility
QPSK	quadrature phase shift keying
RBA	reimbursable budget authority
RIF	reduction in force
REU	resource earning unit

RF	radio frequency
RTTC	Redstone Technical Test Center
SAF/AQ	Office of the Assistant Secretary of the Air Force for Acquisition
SAR	synthetic aperture radar
SARIS	Spatial and Spectral Airborne Radiometric Infrared System
SDB	Small Diameter Bomb
SDBII	Small Diameter Bomb Increment II
SFW	sensor fuzed weapon
SFW-IR	sensor fuzed weapon, infrared
SMTA	Static Munitions Test Arenas
SOCOM SAM	special operations command surface-to-air missile
SPO	system program office
SRC	Sea Range Complex
SRILR	Santa Rosa Island Littoral Range
STEF	Seeker/Signature Test and Evaluation Facility
STEM	Simulated Test Environment for Munitions
STIRRS	Staring IR Radiometric System
T&E	test and evaluation
THAAD	theater high-altitude area defense
TM	telemetry
TPS	Test Pilot School
TRMC	Test Resource Management Center
TSA	Transportation Security Administration
TW/OG	test wing operations group
USAFWC	U.S. Air Force Warfare Center
WCMD	Wind-Corrected Munitions Dispenser
WCMD-ER	Wind-Corrected Munitions Dispenser–Extended Range

CHAPTER ONE

Introduction

Background

The Air Force fleet is aging, with many aircraft older than the pilots who fly them. However, recapitalizing the fleet is expensive, and, given the many operational demands on the Air Force, additions to the budget for this purpose are unlikely. Thus, the Air Force has looked inside its own budget for savings that it could apply to recapitalizing the fleet. In 2006, the Office of the Secretary of Defense issued Program Budget Decision 720 (PBD-720), which, among other things, directed a $6.2 billion reduction over fiscal years (FYs) 2007 through 2011. A significant portion of this amount was to be gained by reducing contractor support. Air Force Materiel Command's (AFMC's) share of this reduction totaled $839 million, of which $371 million was test and evaluation's (T&E's) share. To meet the $371 million budget objective, AFMC examined several options with varying effects on the T&E infrastructure. One of these options, referred to as the "Organizational Streamline Approach" focused on the consolidation and potential divestiture of U.S. Air Force T&E facilities and capabilities. This option was originally submitted to Office of the Secretary of Defense (OSD) as part of the Budget Estimate Solution for FY 2008.

Generally, the option proposed a combination of consolidation, divestiture, and reductions in T&E facilities. More specifically, it proposed the following:

- consolidation of the 46th Test Wing at Eglin Air Force Base (AFB), Florida, with test organizations at Edwards AFB, California, primarily the 412th Test Wing[1]
- full or partial divestiture of seven Air Force test facilities:
  - McKinley Climatic Laboratory (MCL, Eglin AFB)
  - Guided Weapons Evaluation Facility (GWEF, Eglin AFB)
  - Seeker Test and Evaluation Facility (STEF, Eglin AFB)
  - Joint Preflight Integration of Munitions and Electronic Systems (J-PRIMES, Eglin AFB)

[1] Test personnel supporting command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR); the Air Force Special Operations Command (AFSOC); and the Air Force Seek Eagle Office (AFSEO) were expected to remain in place at Eglin AFB.

    – Central Inertial Guidance Test Facility (CIGTF, Holloman AFB, New Mexico)
    – National Full-Scale Aerodynamics Complex (NFAC, Moffett Field, California)
    – Benefield Anechoic Facility (BAF, Edwards AFB) (partial)[2]
- a reduction in T&E Range capacity at Eglin AFB.[3]

In the 2007 Defense Appropriations Act, Congress responded to the AFMC proposal by directing the Air Force to study the potential effects of this option.[4] Section 8110(a) of the 2007 Defense Appropriations Act directed:

> the Secretary of the Air Force shall, not later than March 31, 2007, submit to the congressional defense committees a cost-benefit analysis of significant proposed realignments or closures of research and development or test and evaluation installations, activities, facilities, laboratories, units, functions, or capabilities of the Air Force. The analysis shall include an evaluation of missions served and alternatives considered and of the benefits, costs, risks, and other considerations associated with each such proposed realignment or closure.

In November 2006, the Air Force contacted RAND Project AIR FORCE to conduct the CBA. Discussions in late November 2006 and early December 2006 focused on understanding the intent of the appropriations requirement, concluding that it meant an analysis of the "Organizational Streamline Approach" option that was presented in the AFMC PBD-720 proposal.

Project Scope

Given that we had approximately three months to complete this work, it was important to ensure that we were addressing the correct policy question(s) that were underlying the appropriations act. The boundaries of this work were purposefully limited to the AFMC proposal articulated above. We did not propose ideas that we deemed to be more efficient or more effec-

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2 An anechoic chamber is a room in which there are no echoes. This description was originally used in the context of acoustic (sound) echoes caused by reflections from the internal surfaces of a room, but the same description has more recently been adopted for the radio frequency (RF) anechoic chamber.

3 Air Force organizations that were asked to implement this proposal inferred that this also meant preserving some ability to support deployed flight testing, if necessary. This assumption was the foundation on which Eglin AFB provided data to RAND for this analysis.

4 The 2007 Defense Authorization Act language also included this subject, but the Air Force is addressing that language through other means. The FY 2007 authorization language (Items of Special Interest, p. 633) also requires several reports, one from the Secretary of the Air Force and the other jointly from the Office of the Under Secretary of Defense, Acquisition, Technology and Logistics (OUSD/AT&L) and the Director of the Test Resources Management Center (TRMC) "analyzing the proposed actions." No specific deliverable date is associated with these reports. Although the RAND Corporation's cost-benefit analysis (CBA) specifically addresses the appropriations language, Air Force T&E, AFMC, and RAND have agreed that information from the CBA document will also be helpful to the Air Force in answering the authorization language.

tive than the alternatives presented to us for analysis. This was consistent with the direction that we received throughout the project from congressional staff and in discussions with personnel from the Air Force and TRMC. Specifically stated, we were asked to assess, in terms of the spirit and intent of the language in the appropriations act, the specific set of proposals and the alternatives that AFMC had articulated. As we dug deeper into understanding the AFMC proposal, we realized that it was driven by budget cuts to meet PBD-720 objectives and that the Air Force had completed limited transition planning by the time that we were engaged in November 2006.

The latter point was especially important for defining the analytical scope of the CBA. Within days of starting this work, it was clear to us that the Air Force did not have finalized, detailed plans for how the divestiture and consolidation of T&E infrastructure would occur. In some cases, there were limited plans; for example, the original AFMC proposal listed alternatives to simply closing the seven facilities listed earlier. In other cases, such as the consolidation of the 46th and 412th Test Wings or transfer of range activities, there was limited documentation that specified all the cost effects and activities that would need to occur to ensure a proper transfer of people, assets, and activities.

Because of the limited documentation and our commitment to directly addressing the purpose for the appropriations act language, we were careful not to create new alternatives to the AFMC proposal that had not already been stated; rather, we attempted to analyze the plans that were in place as of November 2006, when we began this work. The only addition to the AFMC proposal that RAND considered was whether Edwards AFB and the Navy installations at Naval Air Warfare Center (NAWC) Point Mugu and NAWC China Lake could accommodate the flight- and ground-test workload from Eglin AFB. Although the AFMC proposal did not specify explicitly, it did imply that, if the PBD-720 cuts significantly affected the Eglin range, the Air Force would need to conduct these activities elsewhere (e.g., Edwards AFB and the Navy range and facilities). To arrive at a better understanding of what open-air range (OAR) flight-test activities could be conducted on the western test ranges (WTR), personnel from Eglin AFB, Edwards AFB, NAWC China Lake, and NAWC Point Mugu met to discuss the capabilities of the organizations. This group completed documentation of this exercise in February 2007, which became an important assessment resource for our CBA.

Research Approach

In conducting this research, RAND used several methods to collect and analyze data.

Data Sources

During the course of the three months over which we conducted this work, we interviewed more than 200 people from across the Department of Defense (DoD) T&E infrastructure, collected data on the part of that infrastructure directly related to the AFMC proposal, and conducted literature searches to gather insight from previous studies. The bulk of personnel interviewed for this work were located at the bases and facilities that were directly affected by the AFMC proposal: Eglin AFB, Florida; Edwards AFB, California; Moffett Field, California; Holloman AFB, New Mexico; and Arnold AFB, Tennessee. We also interviewed people outside the Air Force, including some from the Army and the Navy. In the latter case, RAND facilitated the dialogue between the Air Force and the Navy to develop an understanding of the technical and cost consequences for flight- and ground-test operations at NAWC Point Mugu and NAWC China Lake.

Throughout the project, RAND actively engaged stakeholders across DoD to ensure that the data collected for the project represented the most accurate information available. Hundreds of contacts were made, via telephone calls, emails, site visits, and video teleconferences, to ensure that we had the very best data to consider for this work. We not only coordinated our data collection in real time with the many stakeholders involved but also shared data with colleagues within OSD who were working a similar research effort in parallel, as required by the National Defense Authorization Act (NDAA) for FY 2007.[5] In many cases, test organizations provided updated inputs up to the final stages of preparing this document.

A key objective of this research process was to ensure that all the stakeholders were aware of the data that we were collecting—the data were openly shared with personnel from the Air Force, Navy, Army, and OSD to ensure that all were using the same data for their analyses and as the basis of their conclusions. Finally, we met with congressional staffs several times to keep them abreast of our research approach and methodology and to ensure that they were in agreement with the scope of our work. All the data collected and presented in this analysis is unclassified.[6]

Effects on Customers

We also considered what the effects on customers of the T&E facilities and ranges that were analyzed in the AFMC proposal would be. The Air Armament Center (AAC), in conjunction with SAF/AQ, collected data from customers of the 46th Test Wing facilities and range at Eglin AFB, Florida, and at Holloman AFB, New Mexico. The data included customers from the Air Force, DoD, and U.S. government–sponsored programs.

It is our understanding that customers were asked for assessments of the additional costs they might incur during the FY 2008–2013 time frame because of the AFMC proposal. The types and amounts of cost and schedule effects were left open to the interpretation of the customers that responded to the survey. This information was aggregated and provided to RAND in late December 2006 in the form of a slide presentation. Our immediate review of the presentation indicated that back-up detail on how the costs were generated was very limited.

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5 The NDAA requires two additional reports that are similar in intent to this one: (1) a report by the Test Research Management Council and (2) a report jointly authored by the Air Force and the Office of the Secretary of Defense.

6 This important consideration should not be overlooked. The AFMC proposal, as stated, addressed programs that were considered to be unclassified. We did not include the consequences for classified programs or to facilities that addressed classified T&E activities.

At face value, the AAC presentation showed considerable consequences for customers—on the order of $673.7 million over the FY 2008–2013 time frame, which is two years beyond the Future Years Defense Program (FYDP) of FY 2007–2011 that AFMC proposed. Of this figure, $359.1 million was allocated to customers that tested in facilities; the remaining $314.6 million was allocated to customers that tested on the range or with the aircraft of the 46th Test Wing.

To understand how these costs were developed, we worked with staff at AAC and Eglin AFB to review the customer inputs. AAC staff provided us with emails and other inputs from customers that listed cost figures. In many cases, the data provided to AAC were not substantiated by rigorous cost-estimating methods or detailed background information that we could decipher and readily adjudicate. In our assessment, this limited our ability to include the entirety of the data in the CBA.

Although we were able to use some of the customer cost data in our CBA—our calculations in Chapters Two through Four include these data when we could verify their integrity—we also found cases in which the quality of the data was suspect. In some instances, the data in the AAC presentation could not be substantiated by the same organizations that had provided information during the original survey. In other cases, there was significant uncertainty about the validity of data: (1) Some customers appear to have assumed worst-case cost scenarios that required an entire rebuild of capital infrastructure (when other, more cost-effective solutions may have been available), and/or (2) customers projected large costs in the FY 2012–2013 time frame, beyond the FYDP of the AFMC proposal. In the latter instance, we question the inability of a customer to readjust its scheduling to another facility or range if it were given five to six years (starting in 2007) to do so. In other cases, we had already included data in our analysis (effects on the 53rd Wing at Eglin) that the AAC analysis captured as a "customer cost." In the remainder of this monograph, we refer to the AAC data when we were or were not able to verify usage. Given the schedule constraints of this project, our ability to validate every program schedule and cost that the AFMC proposal affected was limited. We openly state this as a limitation in the analysis.

How We Analyzed the Data

After collecting relevant data for the study, we constructed financial analyses that captured the economic benefits and costs of the proposal. One key assumption of our work was that the demand for test-program content would remain constant. This meant that customers of Air Force T&E who were affected by the AFMC proposal would still have a requirement to test—and to do so, they would have to gain some capability to achieve their objectives. This assumption ensured that we addressed relevant collateral effects. When possible, we attempted to quantify the effect on the customers by analyzing what it would cost the programs to do the testing themselves and how schedule concerns would affect their T&E approach. As we collected and analyzed this information, we discovered that some effects were quantifiable and verifiable and that others were not. In both cases, we determined that implementing the AFMC proposal also held risks for the customers and for the organizations involved. In this monograph, we address the customer-related issues and discuss how we did or did not use the information we received. Comparing and contrasting the results of the economic analysis with the qualitative findings helped us draw conclusions.

Although we attempted to quantify T&E issues as much as possible, we were unable to do so in several cases. In these, we qualitatively assessed the potential for benefit or cost. This required us to compare all data sources and to fact-check information continuously through inquiries and discussions with subject-matter experts within the organizations. Because of the general uncertainty of the details of parts of the AFMC proposal, it was not uncommon for the test organizations to iterate on their inputs to us as they further considered and matured their thinking on possible consequences. We expect that, with more time and further study of this subject, the test enterprise will continue to refine data collection and analysis.

Financial Methods and Considerations

In conducting our financial calculations, we considered financial effects over FYs 2007 through 2011, to be consistent with the FYDP time frame that AFMC proposed. As discussed later in the monograph, we examined the effects on facilities, ranges, and organizations over this time frame, while also including potential recurring impacts in FY 2012 and beyond. We also performed net present value (NPV) analysis on the AFMC proposal to ensure that we were accounting for longer-term effects that went beyond the FYDP.[7] This information is presented in Appendixes B, C, and D.

As a significant caveat to our work, the results presented here are driven primarily by cost considerations and do not attempt to quantify the value of benefits that would be lost in the future if the Air Force required the use of the affected ranges or facilities. For example, it is possible that the Air Force could require more testing in the future at a specific facility or range. If that capacity was already in maximum use or no longer existed, the effects on programs and their ability to test would be negative. We did not consider the potential for future operational surge or other associated benefits, such as increased capacity, that are available to the Air Force today. RAND's findings about cost are driven primarily by data and estimates from the Air Force and other government sources that we contacted and interviewed for this work. In many cases, we were not able to assess the quality of inputs into the cost estimates and savings estimates provided to us. A series of repetitive inquiries to stakeholders helped us make comparisons among data sources, and interviews helped us develop a more-complete picture of the analysis.

Finally, we emphasize that the cost savings identified in the analysis should not be interpreted as being available to meet the $371 million budget decrement that PBD-720 imposes on AFMC T&E over the FYDP. In some cases, the savings are in fact available to be taken

[7] NPV analysis is a standard approach used in DoD and non-DoD financial analyses used to examine capital budgeting decisions. By definition, it accounts for the time value of money by discounting future cash flows to the present time frame to compare net effect of aggregating the cash flows.

without imposing burdens elsewhere in the DoD budget. In other cases, however, the AFMC proposal may allow the AFMC T&E to meet its savings goal by shifting the burden of the wedge elsewhere in the Air Force or the DoD.

Organization of This Monograph

In Chapter Two, we discuss the effects of consolidating the 46th Test Wing from Eglin AFB and the 412th Test Wing at Edwards AFB. This analysis addresses not only how the transition would affect the 46th Test Wing's test aircraft but also how the transition would affect the 46th Test Wing's supportability, Edwards AFB and its ability to absorb 46th Test Wing aircraft and personnel, and the 53rd Wing's supportability at Eglin AFB. Chapter Three addresses the effects on the Eglin test range—both flying, open-air activities and ground-range activities that would be affected by the amount of support contractor cuts that would be necessary under the AFMC proposal. Chapter Four covers the effects on the seven facilities that were proposed for divestiture or partial closure.[8] In conducting this analysis, RAND visited all the proposed facilities, interviewed key staff members, and analyzed facility and customer cost and schedule data. Chapter Five presents a summary of key findings and recommendations.

There are also five appendixes: Appendix A summarizes the Flight Test Consolidation Scheduling Exercise that was conducted in February 2007. Appendixes B through D detail the financial calculations for our analyses in Chapters Two through Four, respectively.

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8 The Benefield Anechoic Chamber is the sole candidate for partial closure.

CHAPTER TWO

Test Wing Consolidation

This chapter describes the effects of the proposed consolidation of the 46th Test Wing, currently at Eglin AFB, with the 412th Test Wing at Edwards AFB. It begins with a brief description of the two test wings, then moves to a brief discussion of some of the personnel issues that would attend the proposed transfer. It next discusses the assets that would move to Edwards AFB and describes the effect of these moves. That discussion is followed by one about support staff reductions, and, finally, how the movement of the 46th Test Wing would affect the 53rd Wing, which would remain at Eglin and which currently shares resources with the 46th Test Wing.

The Test Wings

Overview: The Air Armament Center and the 46th Test Wing

The AAC at Eglin AFB comprises the 46th Test Wing, 96th Air Base Wing, 328th Armament Systems Wing, 308th Armament Systems Wing, and 329th Armament Systems Group.

The 46th Test Wing, as part of the AAC, is the test organization responsible for AAC weapon and range system acquisition programs; Electronic Systems Center command, control, communications, computers, and intelligence (C4I) system acquisition programs; and Air Force Special Operations Command systems acquisition programs. The wing also serves as the steward of the Major Range and Test Facility Base (MRTFB) located at Eglin AFB, Florida, which provides a national capability for T&E of defense weapons. The Eglin MRTFB military complex comprises more than 134,000 mi^2 of airspace and 724 mi^2 of land ranges. The wing offers a scientific test process that supports the development and enhancement of munitions systems that support triservice smart-weapon development. It also has the correct technology for testing such weapon systems as the Advanced Medium-Range Air-to-Air Missile (AMRAAM), Joint Direct Attack Munitions (JDAM), Small Diameter Bomb (SDB), Combat Search and Rescue X (CSAR-X), Advanced Short-Range Air-to-Air Missile, Joint Tactical Information Distribution System, Joint Surveillance Target Radar System, and Combat Talon. The 46th Test Wing controls test aircraft, test facilities, and land and water test ranges at Eglin and additional test facilities at Holloman AFB, New Mexico; Nellis AFB, Nevada; Kelly AFB, Texas; and Wright Patterson AFB, Ohio.

Edwards AFB Overview

Edwards AFB, California, covers 301,000 acres (roughly 470 mi^2) and is the second largest Air Force base. It boasts the country's longest runway, measured in miles rather than feet. Edwards is located in the Mojave Desert, adjacent to the largest dry lakebed in North America—Rogers Dry Lake, whose clay surface measures roughly 12 by 5 mi.

The base has 19 runways—three are paved, and the other 16 are located on the lakebed. The longest paved runway is 15,000 ft long, 300 ft wide, and 3 ft thick. The longest of the lakebed runways is 7.5 mi long. Because of the forgiving length and width, this vast array of landing surfaces can be a huge benefit for the safe recovery of test aircraft or for aircraft landing with in-flight emergencies.

The Air Force Flight Test Center (AFFTC) at Edwards AFB provides DoD-wide support for weapon-system development and operational T&E for aircraft, aircraft subsystems and weapon systems, aerospace research vehicles, unmanned miniature vehicles, cruise missiles, parachute delivery and recovery systems, cargo-handling systems, communications, information operations, and electronic warfare (EW) systems.

The EW test process provides a scientific methodology for the effective and efficient test of EW and avionics systems. Testing is conducted on EW systems that can be used in any military action involving the use of electromagnetic and directed energy to control the electromagnetic spectrum or to attack the enemy. Related operations are conducted using the Air Force Electronic Warfare Evaluation Simulator (AFEWES) at Air Force Plant 4 in Ft. Worth, Texas. The Edwards AFB mission includes the U.S. Air Force Test Pilot School (TPS).[1]

Human Capital Issues

The majority of the savings from the AFMC consolidation plan would accrue either from closing facilities entirely or from transferring a function from one location (Eglin AFB) to another (Edwards AFB) and operating more efficiently there. These actions primarily redistribute the workforce, reducing the number of contractor support personnel at Eglin, recharacterizing positions in the new location, and filling positions at Edwards with either civilian or military personnel.

Civilian and military personnel would be redistributed within the existing workforce to cover the reduction of the contractor workforce specified in PBD-720. The military workforce is mobile. The military workforce undertakes assignment changes and permanent changes of station (PCSs) regularly. However, convincing a civilian worker to move from Ft. Walton Beach, Florida, to the high desert of Palmdale, California, would be a formidable challenge. For the purposes of this analysis, we used a Base Realignment and Closure (BRAC)–accepted PCS rate for civilians of 20 percent.

It may take more than several years to reconstitute the Eglin civilian workforce at Edwards AFB. Doing so successfully, by achieving manning levels consistent with the intended outcome of this plan, would require aggressive recruitment, nationwide searches for new hires, and the

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1 Headquarters, U.S. Air Force, 2007.

associated expenses. Hiring this new workforce is likely to lead to such additional costs as instituting incentive bonus programs, long-term training programs, college tuition incentives, and other programs necessary to attract a new civilian workforce to Edwards. For the purposes of this CBA, we not only have assumed a 20-percent PCS rate but also take 50 percent of the annual civilian pay rate for expenses associated with incentives, recruitment, and training for each new civilian that would be hired for the new combined test wing.

Summary of Findings

This rest of this chapter discusses specific effects of the test wing consolidation. Table 2.1 summarizes our findings, and each area listed is discussed in greater detail within this chapter.

What Functions Would Move from the 46th Test Wing to Edwards AFB?

AFMC's plan proposes to combine the 46th Test Wing flying hour program (FHP), maintenance functions, and support staff with the 412th Test Wing at Edwards AFB. Our analysis explores each activity, describes the baseline funding and manpower levels of the AFMC plan, projects alternative plans as appropriate, and discusses the associated manpower and funding effects of moving each.

46th Flying Hour Program

The AFMC plan combines the two test fleets of the 46th and 412th Test Wings at Edwards AFB.[2] This involves moving not only the 46th Test Wing FHP but also all the associated maintenance functions, as we will discuss later. Maintenance is discussed later in this chapter. The 46th Test Wing FHP includes the following primary aircraft authorization (PAA)[3]:

- Seven F-15s. Three F-15 A-Ds are fully instrumented for all development of F-15 testing, including operational flight program (OFP) and software suites. These aircraft support all combat air force and foreign military air-to-air missile development, internal countermeasure system software and hardware upgrade testing and development, and improvement programs for APG-63, APG-63(V)1, and APG-70 radar systems and operational flight programs. The remaining 4 F-15Es are considered highly modified, one-of-a-kind test articles. These aircraft support development of all conventional U.S. Air Force and some foreign weapons, air-to-air and air-to-ground, including Joint Air-to-Surface Standoff Missile (JASSM), Joint Standoff Weapon (JSOW), JDAM, SDB, Wind-Corrected Munitions Dispenser (WCMD), Wind-Corrected Munitions Dispenser–Extended Range (WCMD-ER), AMRAAM, and Air Intercept Missile

[2] The FHP discussed here does not include the 46th Test Group located at Holloman AFB. Although the operational control of the 46th Test Group will transfer to Edwards AFB under this plan, no aircraft will be moved from Holloman to Edwards.

[3] PAA is the number of aircraft authorized to a unit to carry out its mission.

Table 2.1
Summary Chart—Unified Set of Cost Accounts ($M)

	Annual Savings	Annual Costs	Total Annual Savings	Nonrecurring Costs	Cost Savings Over FY 2007–2011 FYDP
Total for all 46th Test Wing consolidation[a]	71.7	30.4	41.3	58.3	43.2
53rd Wing total[a]	0.0	30.4	(30.4)	0.0	(91.2)
53rd operations support[b]	0.0	3.5	(3.5)	0.0	(10.5)
53rd maintenance					
53rd flightline[b]	0.0	15.6	(15.6)	0.0	(46.5)
53rd backshop[b]	0.0	11.3	(11.3)	0.0	(33.9)
Combined 46th and 412th flightline maintenance[c]	27.5	0.0	27.5	8.6	53.4
Combined 46th and 412th backshop maintenance[d]	3.8	0.0	3.8	40.1	(28.6)
Flying hour program[e]	3.1	0.0	3.1	0.0	7.3
Support staff[f]	37.3	0.0	37.3	9.6	102.3

[a] These totals include flightline scenario 2 and backshop scenario 1, as discussed in the maintenance section.

[b] See Table B.12 for supporting information. Not included in AFMC plan.

[c] See Table B.11 for supporting information. AFMC's planned reductions are not used in the RAND analysis and are explained further elsewhere in this chapter. Two scenarios for cost reductions are provided in the text. The first maintains the current ratio of maintainers to aircraft using AFMC's direction to excess three F-16 aircraft as a result of consolidation.

[d] See Table B.8 for supporting information. AFMC's planned reductions are not used in the RAND analysis and are explained further elsewhere in this chapter. The current ratio of maintainers to aircraft is retained as workload is consolidated, using AFMC's direction to excess three F-16 aircraft. Nonrecurring costs include civilian recruitment, reduction to contractor workforce, support equipment moving costs, and military construction.

[e] See Table 2.2 for supporting information. The RAND analysis partially rejects the AFMC plan, as explained further elsewhere in this chapter. The savings generated are less than AFMC and driven by the AFMC plan to reduce three F-16 aircraft.

[f] See Table B.5 for supporting information. The RAND analysis partially rejects the AFMC plan, as explained further elsewhere in this chapter. AFMC's savings appear to be overstated. RAND calculations are based on a 30-percent reduction of support staff as a combined operation, as opposed to AFMC's 40-percent reduction.

9-X (AIM-9X), and countermeasures, including chaff, flare, and towed decoys, and support the development and testing of APG-70 radar and Pratt-Whitney F-100-229 and F-100-220 engines. They also provide high speed and supersonic chase to capture photographic evidence of safe separation of weapons.
- Ten F-16s. Seven of these F-16s are highly modified, one-of-a-kind test aircraft, while the other three provide supersonic chase support for photographic documentation of weapon separation events. The F-16s support testing for Seek Eagle, JASSM, JDAM, Sensor-Fuzed Weapon (SFW), WCMD, WCMD-ER, JSOW, BRU-57, AMRAAM, AIM-9X,

Operational Flight Program integration and verification, foreign military sales, and commercial programs.
- Two A-10C aircraft. Only two of these are in the AFMC inventory; they are equipped with over $4 million of specialized modifications for supporting numerous avionics and munitions testing and development programs. The prototype C aircraft accomplish validation and verification for the entire Air Force fleet upgrade (to "C"). These aircraft specifically support testing related to weapon and avionics integration and reliability and maintainability upgrades, as well as major upgrades, such as Suite 3 Precision Engagement. The aircraft also support gunfire evaluations and anomaly resolution with the GAU-8 30-mm internal gun, as well as conventional-weapon development programs.

The following aircraft are currently assigned to the 46th Test Wing but will remain at Eglin AFB even if the wing relocates:

- Two UN-1N helicopters. These two aircraft provide flight-test program and AAC range-resource support. These aircraft specifically support JASSM, Rotor Swash Plate verification, aircraft performance validation and verification, onboard oxygen-generating system and night-vision goggle performance testing, flight testing of unique attack profiles for precision attack seeker development, and airdrop testing of unique sensors. They also retrieve targets and cruise missiles terminated in the Gulf.
- One C-130. The primary mission of this uniquely equipped, dedicated AFMC test-bed aircraft is Airborne Seeker Evaluations and Test System testing. The aircraft also supports Advanced Tactical Advanced Concept Technology Demonstration and other airborne directed-energy testing.

Effect of Moving FHP to Edwards AFB. The primary issue with consolidating the two aircraft fleets is whether all the 46th Test Wing's aircraft will be necessary when collocated with the 412th Test Wing. AFMC's annual T&E Fleet Board Minutes, dated June 6, 2006, specifically state:

> F-16 Fleet Reduction (Approved)—The AFMC Plan for implementing PBD-720 contract reduction achieves efficiencies though fleet consolidation. These efficiencies require a reduction to the F-16 fleet by 1 aircraft in FY09 and 2 additional aircrafts in FY10. The fleet board approved these reductions. The reductions approved above cannot be achieved without consolidation which is planned to occur in FY09.[4]

As a result of this decision, the AFMC plan reduces the combined aircraft fleet by three aircraft. Because no changes were planned for the F-15 or the A-10, the remainder of this subsection will deal only with the F-16 fleet.[5]

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4 Headquarters, AFMC, 2006, p. 2.

5 Tables B.1 through B.4 provide more information on recent activity in the FHPs at both Eglin AF and Edwards AFB.

Findings. Our approach was to determine the savings that would result from the AFMC plan to excess three aircraft. The following assumptions are part of this analysis:

1. Crew ratios (number of pilots per aircraft) would remain constant.
2. The current number of test hours would remain constant.
3. Pilot levels would include attached and assigned pilots. We assume the same ratio of proficiency to test and test support for assigned and attached pilots.[6]
4. Since the AFMC plan implements this change across two years (one excess F-16 in FY 2009, two in FY 2010), we will, for simplicity, calculate annual savings for the entire three aircraft reduction and include one-third of this total savings in FY 2009 and the entire savings beginning in FY 2010.
5. Note that we take credit below for the total flight hours of the two excess pilots, not just their proficiency hours. This is because we assume that the tests flown by these pilots will be taken up by the remaining pilots, which in turn would reduce their proficiency hours by an equal amount. Thus, the fleetwide savings is the total hours of the excess pilots.

In summary, The Air Force would achieve a savings from merging the FHPs because it is excessing the F-16 aircraft. Table 2.2 provides a detailed analysis of these savings.

46th Test Wing Maintenance

The 46th Test Wing's Maintenance Group (MXG) provides personnel, equipment, tools, materiel, vehicles, supervision, logistics, training, technical support, and other items and services necessary for managing and performing all maintenance and support tasks and functions. The test wings at both Eglin and Edwards divide maintenance work into two functional areas: maintenance other than backshop or flightline maintenance and backshop maintenance. All maintenance activities currently at the 46th Test Wing support a combined maintenance support for the 53rd Wing. Although Air Combat Command (ACC) has not analyzed the effects of the 46th Test Wing's departure in detail, the 46th Maintenance Operations Squadron Programs and Resources and 53rd Wing Manpower Office have looked into maintenance requirements for the 53rd Wing independent of the 46th Test Wing.

Flightline Maintenance (Maintenance Other Than Backshop). At the 46th Test Wing, the personnel manning this area are primarily enlisted, while at the 412th Test Wing, they are primarily civilians. Table 2.3 shows the current manning levels and distribution of the two workforces. This table reflects the entire list of AFMC Unit Manning Document positions, including the AFMC personnel that support the 53rd Wing fleet. The AFMC plan combines two maintenance activities, shifting all funding and manpower in FY 2009, then decrementing both funding and manpower in FYs 2010 and 2011, to result in the overall savings listed in Table 2.4.

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6 This assumption was based on direction received from 46th Test Wing Operations Group (TW/OG).

Table 2.2
Flying Hour Program Savings from AFMC Plan to Excess Three F-16s Under Combined Operations

FY 2006 Description	Data	Cost Basis
Eglin F-16 flying hour rate ($)[a]	11,369	Cost per flight hour
F-16 pilots (no.)	13	Eight attached, five assigned
Current fleet size (no.)	10	
Excess aircraft (no.)	3	
Crew ratio	0.77	Pilots (13) : Aircraft (10)
Excess pilots (no.)	2	Current crew ratio (0.77) × excessed aircraft (3) = 2.31
Total F-16 FHP	1,645	Hours per year
Flying hours per F-16 pilot	126.5	Total F-16 FHP (1,645) ÷ F-16 Pilots (13)
Excess F-16 hours	253	Excess pilots (2) × flying hours per pilot (126.5)
Flying hour savings ($)	2,876,357	Excess hours (253) × Eglin F-16 Flying Hour Rate ($11,369)
Salary savings ($)	241,040	Excess F-16 pilots (2) × officer rate (122,052)
Total annual savings ($)	3,120,461	
FYDP savings ($)	7,281,076	Annual savings above FYs 2010 and 2011 and one-third of annual savings for FY 2009.

[a] Personal communications, 46th Test Wing.

Table 2.3
Flightline Maintenance: Current AFMC Labor Totals

	Civilian	Officer	Enlisted	CME	Total
46th Test Wing	87	16	553	26	682
412th Test Wing	840	11	355	19	1,225
Test wing total	927	27	908	45	1,907
53rd Wing	(3)	(4)	(209)		(216)

NOTE: In this table, the numbers for the 46th Test Wing include the maintainers who support the 53rd Wing. The last row breaks out how many of the individuals actually support that wing.

The 412th Test Wing maintenance other than backshop workforce consists primarily of civilians who are part of what is referred to as a *high performance organization* (HPO). DoD created this designation in response to an FY 2004 NDAA (Public Law 108-136) requirement for federal agencies to submit candidates for HPOs. The conversion of military enlisted positions to civilian positions was a key requirement for the HPO designation. DoD approved the

Table 2.4
Flightline Maintenance: AFMC Plan

	Civilian	Officer	Enlisted	CME	Total
46th Test Wing	69	9	292	0	370
412th Test Wing	840	11	355	19	1,225
Total manning (proposed)	909	20	647	19	1,595
Total manning (current)	924	23	699	45	1,691
Change (%)	(2)	(13)	(7)	(58)	(6)

412th MXG as an Air Force HPO pilot project, and the group has been operating as such for a year.

The immediate change was to convert 918 military positions to 453 civilian civil-service slots, resulting in an immediate manpower savings—nearly a two for one savings on the conversion to a civilian organization. To remain an HPO program, the savings must continue to be demonstrated over the five years of this program.

Effect of Moving to Edwards AFB. The AFMC plan did not specifically address the effects on the 53rd Wing. The AFMC plan combines the two maintenance activities, shifting all funding and manpower in FY 2009, then decrements both funding and manpower in FYs 2010 and 2011, with the results in Table 2.4. Overall, the AFMC plan reduces 96 positions, from the original 1,691 positions to the planned 1,595. This is a net change (reduction) of 6 percent, based primarily on the idea that combining organizations will result in efficiencies.

Findings. Our analysis rejects the AFMC claim that a 6-percent efficiency could be achieved. We believe the savings for AFMC are greater. Our first challenge was to identify how many of these maintainers were associated with the specific workload that is scheduled to move to Edwards. This workload, as discussed previously, includes maintaining a total of 16 aircraft.[7] Included in the total number of maintainers listed in Table 2.3 for the 46th Test Wing is the workload associated with the AFMC support of the 11 ACC aircraft for the 53rd Wing. In addition, the 46th Test Wing FHP will leave behind several aircraft (two UH-1s and one C-130) that will require a small cadre of maintainers (31 flightline maintainers and 27 backshop maintainers will be required).[8] We examined two possible scenarios for calculating the savings that could result from the consolidation.

The first scenario assumes a simplified approach to developing a ratio of current aircraft maintained to current number of maintainers required. This approach was used to determine only the number of people that would move to the 412th from the 46th Test Wing to support the 16 aircraft also proposed to move. Leaving behind the 31 maintainers required for the support of the UH-1 and C-130 aircraft to remain at Eglin provides a ratio of 24 maintainers

7 Seven F-15s, seven F-16s (the current total is 10 F-16s, but AFMC will excess three of these), and two A-10s.

8 Information received from 46th Test Wing personnel, April 3, 2007.

to each aircraft.[9] If 24 maintainers per aircraft are required and 16 aircraft will move to the 412th Test Wing, a total of 386 maintainers will be required to move with the workload. We also need to calculate nonrecurring costs that would be required as part of the consolidation. First, 20 percent of the civilian workforce (17) would PCS, at a cost of $35,496 per person. The remaining 66 civilians would have to be hired at Edwards. Throughout this monograph, the assumption is that civilian hiring costs 50 percent of one year's salary for each hiring action to cover the cost of recruitment activities.

Cost Savings Summary for Scenario 1. To summarize the costs and savings for flightline maintenance scenario 1:

- annual recurring savings: $16.7 million
- nonrecurring (transition) costs: –$3.9 million[10]
- FYDP savings (FY 2009–2011): $46.3 million
- payback period: less than one year (beginning in FY 2009).[11]

The second scenario results in a greater savings and is based directly on information received from the 412th Test Wing Maintenance HPO. The 412th provided us with an estimate from its HPO manpower model, a tool that tracks manpower requirements for flightline maintenance and can be used to predict the required manpower for the gaining workload. This information from the 412th indicates that the flightline maintenance can be accomplished with 177 people, but this estimate includes the following assumptions:

- The 412th specifically states that a definitive number cannot be determined until a full HPO analysis is performed. This could result in either a lower or higher number.
- With the exception of the 216 maintainers associated with 53rd Wing fleet maintenance and the 31 maintainers for the remaining AFMC aircraft (UH-1s and the C-130), all remaining personnel move in the first year. In FYs 2010 and FY 2011, reductions and military-to-civilian conversions would occur at a rate of 50 percent each year to achieve an end state of 177 total new positions at the 412th Test Wing.

Nonrecurring costs with this scenario assume the same PCS costs as for scenario 1. In addition, we assume that 160 civilians will be hired as part of the military-to-civilian conversions over the two-year period (FYs 2010 and 2011), resulting in a total recruitment cost of $8.1 million.

Cost Savings Summary for Scenario 2. The savings from flightline maintenance scenario 2 reduce the current workforce from 466 to 208 (177 at the 412th Test Wing and the remain-

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9 Starting from 682 current maintainers less the 31 to remain at Eglin yields 651 maintainers times the 27 total aircraft (11 in the 53rd Wing fleet plus 16 in the AFMC fleet moving from Eglin) times 16 AFMC aircraft.

10 This includes PCS costs of $0.6 million and civilian recruitment costs of $3.3 million.

11 See Table B.10 for supporting information.

ing 31 at the 46th Test Wing). As a result, the costs savings from this second scenario are as follows:

- annual recurring savings: $27.5 million
- nonrecurring (transition) costs: –$8.6 million[12]
- FYDP savings (FY 2009–2011): $53.4 million
- payback period: less than 1 year (beginning in FY 2009).[13]

These savings in flightline maintenance for the 46th Test Wing and AFMC will be offset by the additional personnel required by the 53rd Wing in ACC. It would reportedly require 216 personnel for the MXG staff, Maintenance Squadron (MXS), MOS, and aircraft MXS functions.[14] These personnel are currently assigned to the 46th Test Wing, so the 53rd Wing will need to add these 216 manpower slots to its organization, at an additional cost of $13.5 million per year. In addition, to support the aerospace ground equipment (AGE), an additional 23 personnel are required at a cost of $2.1 million per year.

Backshop Maintenance. Both the 46th and 412th Test Wings operate aircraft backshop repair functions, providing propulsion, avionics, accessory, and armament system maintenance, fabrication, maintenance control, nondestructive inspection, structural repair, and metal technology.

The 46th Test Wing conducts backshop repair primarily with a contractor workforce. The wing's backshop repair group completed an A-76 study competition several years ago, a process in which the workload is competed between organic (civilian and/or military) and contractors. The backshop repair activity at the 46th Test Wing was subsequently awarded to a contractor workforce. Of the current 164 personnel assigned to backshop maintenance, 155 are contractors. The current intermediate aircraft maintenance contract at the 46th Test Wing provides labor, equipment, tools, materiel, vehicles, supervision, logistics, training, technical support, and other items and services necessary for managing and performing backshop maintenance and support tasks.

At the 412th MXS, the workforce is primarily civilian. Of the 564 positions authorized, 496 are filled by civilian personnel. These personnel perform on- and off-equipment maintenance and logistics T&E support.

Effect of Moving to Edwards AFB. The AFMC plan would move the maintenance function from Eglin AFB to Edwards AFB. Overall, the plan would shift all funding and manpower in FY 2009, then decrement both funding and manpower in FYs 2010 and 2011, to result in the overall savings listed in Table 2.5. The table represents the current manning levels at both locations and clearly shows the workforce structure and the balance between contract

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[12] This includes PCS costs of $$0.6 million and civilian recruitment costs of $8.1 million.

[13] We elected to use flightline maintenance scenario 2 for our in-depth cost estimates. See Table B.11 for supporting information.

[14] Personal conversation with 46 MOS and 53 MO.

and civilian personnel. As these workforces merge, the AFMC plan would replace the contractor workforce at the 46th Test Wing with civilians, as shown in Table 2.6. This plan would increase the civilian workforce form 7 to 106 and remove the 155 contractor personnel for the 46th Test Wing workload. The AFMC plan would result in an 8-percent efficiency as a cost savings, as reflected in Table 2.6.

Findings. Instead of using the AFMC plan, which appears to have taken a straight percentage manpower reduction, we used two different scenarios to develop cost savings, both approaches derived from a simple ratio model of manpower required to support the current fleet level. Scenario 1 begins by developing this ratio of maintainers to aircraft. Our first challenge was to identify how many of these maintainers are associated with the specific workload that is scheduled to move to Edwards AFB. This workload, as discussed previously, includes a total of 16 aircraft. From a total of 164 people assigned to the backshop, 27 will stay in place at the 46th Test Wing to support the aircraft remaining at Eglin AFB (two UH-1s and one C-130). The ratio of maintainers to each aircraft nets to five.[15] If five maintainers per aircraft are required and 16 aircraft will move to the 412th Test Wing, then a total of 82 maintainers will be required to move with the workload.

This analysis also includes several nonrecurring costs. Discussions with the 412th Test Wing, along with subsequent OSD-required funding exhibits,[16] indicate that moving the 46th

Table 2.5
Backshop Maintenance: Current Labor Totals

	Civilian	Officer	Enlisted	CME	Total
46th Test Wing	7	0	2	155	164
412th Test Wing	496	0	67	1	564
Total	503	0	69	156	728

Table 2.6
Backshop Maintenance: AFMC Plan (operation after combination)

	Civilian	Officer	Enlisted	CME	Total
46th Test Wing (proposed)	106	0	2	0	108
412th Test Wing (proposed)	496	0	67	1	564
Total manning (proposed)	602	0	69	1	672
Total manning (current)	503	0	69	156	728
Change (%)					(8)

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15 Starting from the 164 current backshop maintainers less the 27 maintainers to remain at Eglin yields 137 maintainers divided by 27 total aircraft (11 in the 53rd Wing fleet plus 16 in the AFMC fleet moving to Edwards).

16 Major Range Test Facility Base Exhibits, September 2006.

Test Wing backshop maintenance activities would require a new military construction project to house the munitions moved from Eglin to Edwards.[17] The total cost for this project was estimated at $31 million, with construction to begin in FY 2009.[18] This project divided into a near-term phase and beyond-FYDP phase. For the purposes of this CBA, we have included the entire military construction effort as a cost in FY 2009. Discussions with the 412th Test Wing indicate that, if the military construction project is not funded early enough for the military construction to be complete before the consolidation, additional costs will be accrued for just-in-time storage and transportation of munitions off site.

We also included transportation costs for the support equipment for maintenance activities. The AFMC Directorate of Strategic Plans and Programs' list of potential support equipment that would be moved with the maintenance function runs to more than 1,400 line items. The subject-matter expert at the AFMC Directorate of Logistics, Logistics Readiness Division estimates that the cost for this move would be 5 million. This does not involve a per-pound estimate using BRAC's COBRA standards because much of the relocation cost would be a function of the size and weight of the equipment being moved. Many of these items will likely have to be disassembled to be moved. The logistics directorate is working with the Surface Deployment and Distribution Command for a complete estimate. The amount of support equipment that would actually need to move is likely to be minimal. If the 53rd Wing remains at Eglin AFB, the most efficient plan would be to transfer this equipment to the activities remaining for the 53rd Wing. The majority of the necessary support equipment for the combined organization is already in place at Edwards AFB. We have taken into account the transition costs for hiring and firing members of the workforce. Finally, we have taken into account the transition costs for civilian recruitment and firing for the contractor workforce at Eglin.

Backshop maintenance cost savings (in FY 2007 dollars), primarily the results of manpower savings, are projected as follows:

- annual recurring savings: $3.8 million
- nonrecurring costs: –$40.1 million
- FYDP savings (FYs 2009–2011): –$28.6 million
- payback period (years): 10.4 years (starting in FY 2009).[19]

Scenario 2 is exactly the same as scenario 1 except that it uses a lower backshop manning level (155 maintainers). Our assumption is the difference between the current level of 164 personnel includes overhead and administrative civilians and enlisted personnel—essentially, this overhead would not be required for the combined operations at 412th Test Wing because that sup-

[17] The plan calls for constructing seven large and four small earth-covered igloos, four multibay reinforced concrete munitions maintenance facilities, five storage shelters, and one drive-through igloo; adding to and alter existing facilities; and constructing a live munitions facility.

[18] AFFTC/FMC, "Economic Analysis, Munitions Storage Phase 1," August 2006.

[19] We elected to use backshop maintenance scenario 1 for our in-depth cost estimates. See Table B.8 for supporting information.

port is already in place at the 412th Test Wing. These nine overhead positions would remain in place for 53rd Wing operations. The same calculation would result in a current combined (46th Test Wing and 53rd Wing) workforce of 128 maintainers (155—27 remaining for the C-130 and the UH-1s). The 128 maintainers for 27 aircraft (11 aircraft for the 53rd Wing and 16 for AFMC) equates to 4.7 maintainers per aircraft. The net 76 maintainers will move with the 46th Test Wing aircraft. The resulting savings is the difference between the current manning level (155) and the proposed new level (103).[20] The same nonrecurring costs also apply, with slight differences for recruitment and termination costs. Our calculations yield the following savings results:

- Annual recurring savings: $4.4 million
- Nonrecurring (transition) costs: –$41.1 million
- FYDP savings (FYs 2009–2011): –$27.8 million
- Payback period: 9.3 years (beginning in FY 2009).[21]

As with flightline maintenance, a portion of the 46th Test Wing savings for AFMC will be offset by additional expenses for ACC's 53rd Wing. Several years ago, the 46th Test Wing employed 319 personnel in the maintenance backshop, 92 of them funded by the 53rd Wing.[22] That facility underwent an A-76 conversion to contractor personnel, which resulted in a reduction to 164 personnel and the 53rd giving up the 92 manpower positions. As a result, the 53rd Wing does not currently pay for any of its backshop maintenance, although its overall maintenance budget is also lower than would normally be expected.

According to the 46 MOS/MXOP analysis, a maintenance backshop for the 53rd alone would require 124 personnel, a reduction of 40 from the current level. Hence, when the 46th Test Wing leaves, it would transfer 124 of 164 backshop personnel to the 53rd Wing (presumably firing or transferring the additional 40 to other duties). These 124 additional personnel, to be funded by the 53rd and ACC, cost $11.3 million per year.[23]

Note that the proposed backshop manning for the 53rd Wing, 124 personnel, gives a ratio of 11.3 maintainers per aircraft. This is much higher than the current level of 5.1 per aircraft in the current combined 46th Test Wing–53rd Wing operation. Although we would expect this ratio to increase somewhat because of the need for maintenance overhead personnel, an increase of more than two times seems excessive. As a parametric excursion we will call scenario 2 to correspond with the accompanying case in the 46th analysis, we computed a 53rd backshop size using current personnel ratios and assuming a current level of maintenance overhead manning. Today, the backshop has 128 contractors and nine civilian and military, for a total of 137 (after the personnel needed for the two UH-1s and on C-130 are removed). If

[20] So, 76 will move to Edwards, and 27 will stay at Eglin to maintain the remaining aircraft.

[21] See Table B.9 breaks out the specific manpower calculations used in this analysis and lists the nonrecurring costs.

[22] 46 MXG, 2007.

[23] Table B.12 provides supporting information.

we assume the nine individuals are the maintenance overhead, the true maintainer-to-aircraft ratio is 4.7 (128 divided by 27). For the 53rd Wing's 11 aircraft, this results in a requirement of 53 maintainers. Adding back the nine overhead personnel then produces a total backshop size of 62, or exactly one-half the size proposed by the 46 MOS/MXOP. This backshop would be an additional cost to the 53rd Wing and ACC of $5.6 million per year and $16.9 million over the FYDP.

The final maintenance-related cost element would come from any support equipment the 53rd Wing required but that the 46th Test Wing had taken to Edwards AFB. Correctly accounting for this cost requires the 46th Test Wing to decide specifically what equipment it must take and what it can leave at Eglin. Obviously this will require close coordination with the 412th Test Wing at the AFFTC, which has not occurred. According to ACC, the maximum needed support-equipment procurement would be as follows, in FY 2007 dollars:

- $33 million (for the F-15 only)
- $18 million (for the F-16 only)
- $39 million (common to both aircraft).[24]

Again, this is reportedly a complete list of support equipment, the procurement of which may not be necessary depending on what the 46th Test Wing leaves behind. It appears logical that the 46th Test Wing could leave most of its support equipment behind because it would be merging with the 412th Test Wing, and the 53rd Wing requires only one-third of the current total at Eglin AFB. We therefore assume that there is no additional support equipment cost to the 53rd Wing.

Support Staff Reductions

Overview. The AFMC plan reduces staff in several areas, and savings accrue primarily from manpower reductions. We describe these reductions in two main areas:

1. staff activities performed at both locations that are similar and presumably redundant; these functions do not move to Edwards in the AFMC plan
2. miscellaneous AFFTC center and wing staff reductions.

Activities Not Moving to Edwards. AFMC's plan does not move certain staff activities to Edwards. It is understood that some of the support staff, such as the 46th Test Wing commander and staff, the directorate and division heads, portions of the flight support, and portions of the miscellaneous 46th Test Wing responsibilities would become redundant with the consolidation. Ultimately, these redundant positions would not be moved. The personnel not moved under the AFMC plan include the following:

[24] ACC, 2007.

1. The 46th Test Wing staff, which consists of the wing or group commander, vice commander, command chief, and miscellaneous front-office support staff. Various other wing support functions are also part of these activities, including plans and programs, information technology, resources, strategic initiatives, security, contracting, financial management, and personnel services. A small staff would remain at Eglin.
2. The 46th Test Wing test staff, which consists of such test-support personnel as specialized engineers, programmers, and contractors. These personnel plan, execute, and report on various types of developmental testing and are trained and certified in specific functions.
3. Flight operations support personnel, who plan, execute, and report on various types of testing.
4. Miscellaneous 46th Test Wing personnel, including plans and programs, vehicle operations, additional information technology management, and safety offices personnel.

The total manpower and projected AFMC savings are presented in Table 2.7.

Staff Reductions at the 412th Test Wing. The AFMC plan also significantly reduces the center and wing staff at Edwards AFB, from 809 positions to 587 positions. From a combined support-staff perspective, the support staff reductions at AFMC represent an overall reduction of 42 percent (Table 2.8).

Support Manpower Conclusions. AFMC's 2006 proposal projected that merging staff personnel from the 46th and 412th Test Wings would yield an efficiency savings of 41 percent. To understand whether or not this number was reasonable, we did three things:

1. interviewed USAF personnel to understand details associated with the potential merge
2. conducted a literature search on the mergers and associated personnel savings
3. spoke with subject-matter experts experienced in merger activities.

Table 2.7
Total 46th Test Wing Manpower Savings from Activities That Do Not Move

	Manpower Savings		
Activity	Budget	Proposed	Savings
46th Test Wing test staff	17	0	17
Flight support	47	0	47
46th Test Wing staff[a]	145	29	116
Miscellaneous 46th Test Wing	224	121	103
Total	433	150	283

[a] These numbers do not include the staff located at Holloman AFB

Table 2.8
Manpower Savings from Support Staff Functions at Both Locations (46th and 412th Test Wings)

	Manpower Savings		
Activity	Budget	Proposed	Savings
46th Test Wing test staff	17	0	17
Flight support	47	0	47
46th Test Wing staff	145	29	116
Miscellaneous 46th Test Wing	224	121	103
AFFTC and wing staff	809	587	222
Total	1,242	737	505
Reduction (%)			41

We discovered from the literature review and discussions with subject-matter experts that no "norms" or "standard ranges" of savings are typical for mergers like the one proposed in AFMC's consolidation case. On the contrary, savings associated with mergers are very difficult to assess and, as one source indicated, "idiosyncratic"—very specific to the case being studied. Given that the workload requirements would remain relatively the same and even though the two support staffs could produce some degree of efficiency through economies of scale, we considered the AFMC plan for a 41-percent efficiency not to be executable.

As we assessed this specific merger, we discussed the potential savings with Air Force personnel and considered

- the purpose of the merger
- its objectives
- the Air Force's desire to keep a viable staff that could supervise existing activities.

For purposes of this CBA, we assume an efficiency of 30 percent after the 46th Test Wing merges with Edwards center and wing staff. The AFMC plan moves none of the 46th Test Wing support staff to Edwards. We maintain that some of this staff should be shifted with the 46th Test Wing workload. Thus, our assumptions for this CBA reduce the overall workforce levels by 30 percent instead of 41 percent and assume these savings are all taken by reducing the contractor workforce.

We calculated nonrecurring transition costs for contractor layoffs at Eglin and Edwards. We also applied both PCS costs for the civilian workforce that would move to Edwards as well as new recruitment and hiring costs for civilians that would have to be hired at Edwards.[25]

[25] We assumed that 20 percent of the 46th Test Wing workforce would move to Edwards—the remaining personnel would have to be new civilian hires.

We received several comments from both the 412th and the 46th Test Wings that indicate that the manpower cuts for both the 46th Test Wing staff and the AFFTC center and wing staff may require further analysis to determine the actual levels of manpower necessary to sustain current operations. The reductions to these staffs may not only include reductions to the contractor workforce but may also affect specific contracts that do not require labor. The 46th Test Wing staff provided information that may require more positions to remain at Eglin than the original AFMC plan assumed. Although the RAND analysis recommends a much lower overall reduction to the support personnel than AFMC's recommended level, we further suggest considering a full, bottom-up manpower study before implementing the recommended staff support reductions. The final results are a projected savings for staff support, as follows, in FY 2007 dollars:

- annual recurring savings: $37.3 million
- nonrecurring costs: –$9.6 million
- FYDP savings (FYs 2009–2011): $102.3 million.
- payback period: less than one year.[26]

Miscellaneous AFMC Test Wing Reductions not Included in This CBA

This CBA does not address several areas of the original AFMC plan. As we have already mentioned, the AFMC proposal was driven by budget cuts to meet PBD-720 objectives. Several areas within the AFMC proposal appear to be driven primarily to meet budget-cut objectives instead of being related to the issues of consolidating the test wings. In addition, limited information and studies are available to support specific factual analysis for the majority of the manpower reductions that follow. For clarity and for tracking with the AFMC plan, we mention these areas below; however, RAND did not specifically address any of these because of a determination that either (1) the manpower reductions are cost neutral or (2) the reductions are not relevant to the test wing consolidation.

46th Test Wing Resource Earning Units That Move

The AFMC plan includes moving 487 people from the 46th Test Wing in a category of study titled "REUs that move." The plan moves nearly the entire workforce, with a minor change in total manpower to 478 positions by FY 2011. The primary effect of the AFMC plan would be to change the mix of personnel. Specifically, contractor personnel would ramp down from 277 in FY 2007 to 185 in FY 2011. Conversely, civilian positions would increase from 153 in FY 2007 to 212 by FY 2011.

[26] Table B.5 breaks out the funding and manpower data that fed into our calculations.

With the exception of a one-time, nonrecurring cost to move 20 percent of the civilian workforce ($1.5 million[27]), we determined that the results would be cost neutral and so did not include this in our CBA. We do note that these positions are part of the total personnel that would be required to move with the 46th Test Wing and include the required engineers, program managers and support staff. The positions represent specific skills for weapon testing and support and for the F-15 OFP. Specifically, the required positions include the following:

- Personnel from the 780th Test Squadron include those who plan, execute, and report on the testing of air-to-air missiles, launchers, and scoring systems and on ground and flight testing for weapon testing development, avionics system integration, navigation systems, and guided weapons, as well as munitions tests involving terminal effects, lethality, target vulnerability, warhead characterization, fuzes, guns, ammunition, and modeling and simulation.
- Technical support personnel includes all those providing engineering, science, financial, and acquisition support. Engineering and scientific support includes ground and flight test planning, execution, data analysis and reduction, and technical report writing.
- Personnel from the 40th Flight Test Squadron are aircrew, such as test pilots,[28] weapon systems officers, and flight test engineers.
- For F-15 OFP testing, the OFP combined test force (CTF) is responsible for managing F-15A/E flight-test programs. It develops test concepts; prepares test plans; manages test execution; analyzes data; and produces test briefings, reports, and fielding recommendations.

According to the 412th Test Wing, it should be noted that transferring these positions is critical. Not doing so would put the uninterrupted operation of these test capabilities at risk.[29]

412th Test Wing REU

The AFMC plan also cuts funding from the 412th Test Wing resource earning unit (REU). These reductions appear to have been driven by budget cuts in the AFMC plan and are not specifically related to the test wing consolidation; therefore, we did not address these savings in this monograph. For informational purposes, this "REU" is a "bundle" of five REUs, all CTF facilities: The Airborne Laser, Global Power Bomber, Global Reach, Global Vigilance, and Global Power Fighter. Each of these CTFs is made up of representatives from the Air Force Flight Test Center, participating test organizations, Air Force Operational Test and Evaluation Center, and using and support commands and contractors. The CTF is responsible for all aspects of planning, coordinating, managing, flight operations, safety, testing and reporting

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[27] This is the cost of moving 20 percent of the 212 civilians at a cost of $35,496 each.

[28] This CBA does include test pilots, in the FHP analysis.

[29] Personal correspondence with the 412th Test Wing.

of T&E, and supporting initial operational T&E and follow-on T&E programs. According to both AFMC and AFFTC personnel, these reductions, coupled with the consolidation, present a significant challenge for producing an executable organization.

C4ISR

AFMC's budget-driven manpower cuts reduce the contractor workforce and increase the civilian workforce. The positions and C4ISR workload remain at Eglin and are not part of the test wing consolidation activities. This monograph does not address this area.

Arnold Engineering Development Center Contractor Staff and Information Technology

According to further clarification from AFMC/A3 personnel, the cuts levied on the Arnold Engineering Development Center (AEDC) reduce information-technology contractor support. This support provides management of resources and equipment as they relate to personal computers, network services, servers, Web access, telephones, and other information technology functions. The contractor reductions in this area are also not related to the test wing consolidation. This monograph does not address this area.

Effect of Changes at Eglin AFB on the 53rd Wing

Although not explicitly addressed by the AFMC plan, the changes to take place at Eglin AFB will have a significant effect on the 53rd Wing. We examine each of the major effects in turn, beginning with facility closures, moving to range capacity reductions, and finally to the loss of 46th Test Wing support. We conclude this section with a short discussion of possible alternative courses of action for the 53rd Wing at Eglin other than the baseline case of remaining in place.

Wing Activities at Eglin

The 53rd Wing is a major tenant of Eglin, with approximately 850 personnel and 11 aircraft.[30] The wing has a major role in operational testing and tactics development for ACC and has 29 aircraft based at Nellis, 11 at Eglin, one at Holloman AFB; two at Barksdale AFB, Louisiana; and six at Creech AFB, Nevada. The wing includes four major groups: the 53rd Electronic Warfare Group (EWG), the 53rd Weapons Evaluation Group, the 53rd Test and Evaluation Group, and the 53rd Test Management Group.

Although the 53rd Wing reports to the Air Warfare Center at Nellis AFB and has the largest number of aircraft based there, the wing headquarters and many flight-test activities are at Eglin. The EWG and Test Management Group account for approximately 700 of the 850 staff members, with the remainder in wing headquarters (70) and in the weapon evaluation and T&E groups (40 each). As mentioned, 11 of the wing's aircraft are at Eglin in the form of

[30] ACC, 2007.

block 40/50 F-16s, F-15Cs, and a single F-15E.[31] These aircraft form the 85th Test and Evaluation Squadron.

As can be seen in the personnel mix, EW test and reprogramming activities account for a large portion of the 53rd Wing's activities at Eglin, where the EWG can develop changes and quickly ground-test them at the Joint Preflight Integration of Munitions and Electronic Systems (J-PRIMES) facility or flight test them on the range using the Multi-Spectral Test and Training Environment (MSTTE) capability. The wing's activities at Eglin also include Operational Flight Program testing in conjunction with the 46th Test Wing and chemical-biological defense testing with the 28th Test and Evaluation Squadron at the Eglin range and facilities.[32]

Effect of Facility Closures

The 53rd Wing primarily uses two facilities at Eglin AFB: J-PRIMES and MSTTE. Both facilities are used in concert for ground and open-air testing for electronic-warfare tape development, reprogramming and validation. Closure of either or both of these facilities would obviously have a major effect on many of the 53rd Wing's activities. J-PRIMES, which accounts for approximately 70 percent of mission data-tape testing, allows testing a full-up aircraft with RF sensors and emitters against a simulated threat environment to exercise new and updated software.[33] The MSTTE threat simulators are used in conjunction with the open-air testing facility for similar instrumented EW evaluation.

Although J-PRIMES and MSTTE are both important to the 53rd Wing's mission, the wing's activities themselves do not come close to fully using these facilities. In the J-PRIMES FY 2007 schedule, the 36th Electronic Warfare Squadron, part of the 53rd Wing's EWG, is scheduled for almost a month's work in the main chamber and a similar amount of U-2 testing outside the anechoic chambers. There is also continuing work on "SUMMER Dev," which is scheduled for continuous use throughout the fiscal year outside the chambers.[34] From these data, it appears that 53rd Wing activities account for less than 10 percent of J-PRIMES use.

Measuring the use of the MSTTE is difficult because many of its capabilities could be used simultaneously by different users. However, 53rd Wing's utilization rate for test sites A-30 and A-31, where threat emitters are located, is 30 percent.[35] For comparison, these test areas are utilized at 48 percent by the 46th Test Wing and 65 percent for training, making the 53rd Wing the least frequent user.

From these results, it appears that the AFMC plan to close J-PRIMES and reduce the capacity of the MSTTE will greatly affect the 53rd Wing's EW testing activities. At the same

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[31] USAFWC, 2006.

[32] USAFWC, 2006.

[33] USAFWC, 2006.

[34] Reimer, 2006.

[35] Dyess, 2007d. This utilization is defined as a percentage of possible duty days that were scheduled at least once a day by the organization. So in this case, with 224 possible duty days per year, the 53rd Wing tested at least once on 67 of them.

time, however, these activities are not significant enough by themselves to support the facilities. There are, however, possible alternatives to these capabilities that the 53rd could use. For J-PRIMES, the three most commonly identified alternatives are a U.S. Army takeover of the facility, use of the Benefield Anechoic Facility at Edwards AFB, or testing at the Navy's Air Combat Environment Test and Evaluation Facility (ACETEF) at Patuxent River, Maryland. The 53rd Wing has estimated that its additional cost would be a nonrecurring charge of $160,000. No details were provided on the makeup of that charge. The Benefield Anechoic Facility is also slated for significant reduction in the AFMC plan, so it may not be a reasonable alternative. The Navy has studied the use of the ACETEF as a J-PRIMES alternative and concluded that it could take on 32 percent of the J-PRIMES workload at a cost of $3 million per year. However, taking on all the testing would require an additional chamber, at a one-time cost of $24 million.[36] Presumably, additional staff would be necessary as well. Although the ACETEF could reportedly take on the 53rd Wing's J-PRIMES testing activities at relatively low cost, it is doubtful that there would be sufficient capacity for all of it. This would imply shifting the 53rd Wing's share from 10 percent at J-PRIMES to 30 percent at the ACETEF. Such a priority shift would be unlikely. Furthermore, if the 53rd Wing remains at Eglin AFB, as the AFMC plan assumes, all the tests would require personnel and aircraft deployments and travel delays, at significant extra cost. Additional analysis with detailed access to the 53rd Wing's test schedule and cost structure would be necessary to calculate the size of these costs.

The best alternative for the MSTTE appears to be the China Lake Electronic Combat Range (Echo Range). According to the Naval Air Systems Command's (NAVAIR's) analysis, this facility appears to be able to take on the entire MSTTE workload, of which the 53rd Wing's portion should be around 30 percent, if future schedules remain similar to today's.[37] The primary unknown issue is whether the Echo Range has the appropriate number and type of threat systems. Addressing this issue would likely require analysis at a classified level. As with J-PRIMES alternatives, additional costs to the 53rd Wing and ACC would arise because of the need to deploy personnel and aircraft from Eglin to China Lake, if the 53rd Wing remains in Florida. Also, aircraft test instrumentation, particularly telemetry, may need modification to be compatible with China Lake's range. As with the J-PRIMES, these costs would require further analysis using the 53rd Wing's test schedule and costs for the calculations. However, the 53rd Wing did provide an analysis of its costs should both the J-PRIMES and MSTTE facilities completely close. The additional annual cost was calculated to be $800,000 per year.[38]

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[36] NAVAIR, 2007a. These additional costs are being tabulated in section of this document on the facilities and so will not included here.

[37] NAVAIR, 2007b. In its analysis, NAVAIR originally used low values for the MSTTE workload (one additional operation every two weeks instead of two operations per week). Follow-up with NAVAIR indicated that this higher workload could still be easily accommodated because the typical workload is currently 13 to 14 operations per week.

[38] This cost would be incurred only if the JPRIMES and MSTTE were to close and is based upon inputs from the 53rd Wing. Per the analysis conducted in this monograph, we do not find that JPRIMES or the MSSTE should close.

Although no details were provided, this amount is presumably to cover additional temporary duty and deployments to alternative facilities.

Effect of Overall Range Capacity Reduction

A major portion of the cost savings the AFMC plan would realize would result from personnel cuts across the Eglin range. The reduced range was planned by AFMC to handle only deployed tests and AFSOC and C4ISR developmental testing, resulting in staffing levels being cut by approximately 75 percent.[39] Table 2.9 illustrates the test missions scheduled in FY 2006, with the current personnel levels. Note that the table shows only testing missions, not training. As expected, missions flown by 53rd Wing aircraft account for around 10 percent of the total range utilization, and these missions are split between 53rd Wing–specific activities and the Operational Flight Program testing as part of the Combined Test Force. Note that the 53rd Wing's 11 aircraft flew 204 test missions on the Eglin range during the year—approximately one test mission per aircraft every 13 days.

Table 2.9
Scheduled Eglin Range Test Missions in FY 2006

	Aircraft			
Test Organization	46th Test Wing	53rd Wing	Other	Total Missions
40th Flight Test Squadron	500		13	513
46th Test Squadron	109		510	619
780th Test Squadron	192		25	217
53rd Wing		85	260	345
Operational Flight Program Combined Test Program	117	119		236
413th Test Squadron	11		88	99
46th Test Wing Range Management Squadron	65		405	470
Air Force Operational Test and Evaluation Center (AFOTEC)			5	5
Air Force Special Operations Command (AFSOC)			1	1
Total	994	204	1,307	2,505
Percentage	40	8	52	

SOURCE: Dyess, 2007d.

[39] Dyess, 2007d.

As with the other facilities, the 53rd Wing has a relatively small effect on the Eglin open-air range. On the other hand, if the range capacity is reduced by 75 percent, it would likely be difficult to accommodate all the 53rd Wing's testing without a large shift in priorities in favor of the 53rd Wing. There are several possible alternative locations for open-air flight testing. Analysis by the 46th and 412th Test Wings in conjunction with NAVAIR has indicated that most of Eglin's test activities could be accommodated on a combination of the Edwards, China Lake, and Point Mugu ranges.[40] The range section of this document addresses many of the capability and capacity issues, such as spectrum availability, but the additional cost entailed by the 53rd Wing for personnel and aircraft deployment requirements will require further analysis with detailed access to the appropriate data.[41] Estimates of additional costs to the 53rd Wing cannot be considered complete until such an analysis is completed.

Effect of the 46th Test Wing Relocation

The 46th Test Wing provides many supporting services for the 53rd Wing, some directly paid for, some subsidized. In general, these supporting activities can be characterized as operational support and aircraft maintenance. For the most part, neither the 53rd Wing nor ACC has performed detailed analysis on the effects of the AFMC plan, so most of what is reported here comes from individuals in the 53rd Wing and the 46th Test Wing and should not be considered official positions.

Generally speaking, if the 46th Test Wing leaves Eglin, the 53rd Wing is not manned to take over the functions of a traditional operations support squadron (OSS). The 53rd Wing provided a rough accounting of the necessary manpower, shown in Table 2.10.

Although the personnel needed total 203, this likely significantly overstates the real difference should the 46th Test Wing leave, since the AFMC plan specifies that several relevant organizations will remain at Eglin. These are noted in the top half of Table 2.10 and account for the vast majority of personnel. The functions new to the 53rd Wing add up to a manpower requirement of 35. This figure agrees fairly well with ACC's estimate of 40 new personnel.[42] We use the slightly higher number for our cost calculation. The personnel mix of military enlisted, officers, civilians, and contractors for this 40-person addition remains unclear. For the sake of simplicity, we use the same mix as the 46th OSS currently operates: 23 percent enlisted, 15 percent officer, 32 percent civilian, and 30 percent contractor.[43] This may be somewhat in error because of the mix of functions that remain and that need creating but should not have a major effect on the cost calculations.

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[40] Dyess, 2007c.

[41] Personal communication with telemetry specialists at Edwards indicated a cost of around $35,000 per aircraft to upgrade to more modern, less-bandwidth-intensive telemetry equipment. Total nonrecurring cost for the 53rd Wing's 11 aircraft would then total $385,000.

[42] USAFWC, 2006.

[43] 46 TW/XPR, 2007.

As with the other elements of this analysis, we use the FY 2007 Total Annual Average Standard Composite Rates from Air Force Instruction (AFI) 65-503 for military enlisted and officers and a standard fully burdened rate of $100,000 per year for civilians and contractors. With the 46th Test Wing expected to complete its move to Edwards AFB by FY 2009, we would add the extra personnel to the budget in that year. In FY 2007 dollars, the annual cost for the 40 extra operations-related personnel would be approximately $3.5 million.

Table 2.10
Operational Support Manning Needed for 53rd Wing

Position	Staffing
46th Test Wing leaves behind	
Airfield operations	14[a]
Airfield management	22[a]
Radar control	66[a]
Control tower operations	29[a]
Life support	6[b]
Operations system management	4[b]
Weather squadron	23[c]
Operations plans	4
Subtotal	168
53rd Wing to recreate	
Commander	2
Squadron section commander	3
Weapons and tactics	5
Current operations management	11
Scheduling and current operations	2[b]
Operations training	2[b]
Simulator management	0
Intelligence	10[d]
Subtotal	35
Total	203

SOURCE: 53rd Wing MO, 2007.
[a] Current 46th Test Wing.
[b] Air Force Manpower Standard.
[c] Range requirement.
[d] PAI-driven.

Cost Summary

To summarize the additional costs to be incurred by the 53rd Wing, we simply sum the expenses discussed here over the FYDP.[44] In addition, some elements of the additional costs have not been tallied, particularly extra test costs to the wing as a result of having to perform some of its operational testing at locations away from Eglin. It would be necessary to analyze the 53rd Wing's planned test schedule and cost accounts in some detail to make a reasonable assumption about these costs. The available costs total as follows, in FY 2007 dollars:

- J-PRIMES and MSTTE closure: $800,000 per year
- operations personnel: $3.55 million per year
- backshop personnel: $11.26 million per year
- flightline personnel: $15.64 per year
- support equipment: $0 to 90 million.

If we assume no additional support equipment is required, the costs over the FY 2007 through 2011 FYDP total to $93.75 million. This is calculated as follows:

$$3 \text{ years (2009 through 2011)} \times (0.8 + 3.55 + 11.26 + 15.64) = \$93.75 \text{ million.}$$

Again, the actual effect may be somewhat larger than this if the remaining open-air range capability is insufficient because the wing will incur additional test costs as it is forced to test at remote locations, such as Edwards AFB or China Lake

Other Alternatives for the 53rd Wing

As expected, if the AFMC plan is executed, the 53rd Wing will incur a significant negative cost effect. The baseline case assumes that the 53rd Wing remains in place at Eglin with no noteworthy changes. This may not be the most cost-effective approach if the plan is executed. Although the 53rd Wing and ACC have not performed any detailed analysis on other plans, four have been identified as at least worthy of further consideration.[45]

The first course of action is our baseline, which is to retain the current 11 53rd Wing primary development and test aircraft inventory at Eglin with ACC-owned maintenance. AFMC would continue to provide airfield management and air traffic control. This is the option priced above.

The second option would move Eglin aircraft to Edwards and Nellis, specifically the F-15C/D/Es to Nellis and the F-16s to Edwards. The remainder of the 53rd Wing, primarily the EWG, would stay at Eglin. This approach has the advantage of consolidating various aircraft types at the two other bases, thus avoiding additional maintenance manpower requirements at Eglin. There would be costs to relocate the aircraft, of course, as well as travel costs to

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44 NPV calculations over a 30-year period are also included in Appendix B (see Table B.6).

45 USAFWC, 2006.

return to Eglin for any testing required there. This option would also increase test activities at Nellis, which may affect training there. Additional study would be needed.

The third option moves the 53rd Wing headquarters and the majority of the 53rd Test Management Group to Nellis while leaving the EWG at Eglin. The Eglin aircraft would move to Edwards, thus keeping the close relationship between the 46th Test Wing and 53rd Wing intact. As with the previous option, there would be costs to relocate the aircraft, as well as travel costs to return to Eglin for testing there.

The final course of action mentioned is to move the 53rd Wing headquarters, the majority of 53rd Test Management Group, and the 85th Test and Evaluation Squadron to Nellis, while keeping the EWG at Eglin. This option would consolidate the 53rd Wing's aircraft at Nellis for operational test, creating economies of scale there. However, this option would also increase test activities at Nellis, which may affect training there. Additional study would be needed. As with the previous options, there would be costs to relocate the aircraft, as well as travel costs to return to Eglin for testing there.

It is outside the scope of this effort to attempt an evaluation of these three additional options, either in terms of cost or effectiveness. Given the high cost of keeping the 53rd Wing in place after the 46th Test Wing moves, if the AFMC plan appears to be moving forward, it is probably worth revisiting the subject with the 53rd Wing and going into more detail with wing staff members about their requirements and potential future needs.

CHAPTER THREE

Ranges

Although a flight-test range is typically thought of as land area, airspace, and the associated test equipment, the Eglin "range" also includes important ground-test facilities. This chapter discusses the ranges involved in the AFMC proposal. It begins with the ground-based activities at Eglin, describing their functions and the potential cost and savings associated with their closure. It then turns to the potential cost effects of consolidating most open-air testing at Edwards and other nearby facilities.

The word *range* is used in a variety of ways in the Air Force, sometimes causing confusion. We use very specific definitions here. In this report, *open-air range* (OAR) refers to activities conducted to support open-air testing involving aircraft. It includes providing telemetry ground stations to receive data from aircraft and all other associated ground equipment, such as infrared and optical cameras, ground targets both intelligence, surveillance, and reconnaissance, testing weapon testing, control rooms to run tests, safety equipment and management, and air traffic control. The term does not include aircraft crewing, maintenance, or other activities necessary to support sortie generation of either test aircraft or chase planes; these are the responsibilities of the test wing, not the OAR. The term also does not include the base operations necessary to support the range. Most important, it does not include activities that take place on the land that the range physically controls when these activities are not directly related to aircraft open-air testing. This monograph refers to these as *ground-based activities*.

This is a significant issue. Testing weapons and aircraft is inherently dangerous. Safety requirements dictate that, when necessary, testers have exclusive use of large areas of land and large volumes of airspace. Eglin and Edwards are, by land area, the two largest U.S. Air Force bases, at 724 and 470 mi^2, respectively. Access to such large areas is a key requirement for range operation, but, at any given time, the space is likely not to be in use. That makes these large facilities attractive locations for other relatively dangerous activities, such as ground testing of munitions. At Eglin, many of these activities are administered by the organization known as the 46th Test Wing Range Group and are staffed through the same contracting vehicle used to staff the OAR. The distinction this report makes between the OAR and ground-based activities is therefore purely functional. It does not reflect the way activities are organized or identify individual contractor employees.

Ground-Based Activities

The AFMC proposal does not explicitly list what is to be closed; however, Eglin's analysis indicates that the majority of these facilities will have to be closed to accomplish AFMC's proposed savings. Note that these facilities are distinct from those that are explicitly called out in the AFMC plan, such as the McKinley Climatic Laboratory. This section of the chapter discusses the functions of these miscellaneous facilities and the potential savings and costs that could result from closing them.

Description

As described to RAND by the 46th Test Wing, if facilities required to support flight-test operations at Eglin directly are excluded, the Eglin "range" includes the eight ground-test installations described in the following paragraphs.[1]

Base Installation Security Systems (BISS). Located at Eglin Test Site C-3, the BISS provides a dedicated test area for evaluation of security equipment and systems. The site covers 757 acres of cleared area on the Eglin range and simulates a section of a base perimeter and a secure area within a base or installation. The facility contains over 17,000 ft of security fencing, two 40-ft master surveillance and control facility (MSCF) towers, a security system facility building, and an entry control building with several types of entrance security systems designed for testing modifications and upgrades.

Gunnery and Ballistics Test Facilities (GBTF). The GBTF consists of four fully instrumented test areas or sites. These ranges are the Aeroballistics Test and Evaluation Facility (ATEF), located on Eglin Main Base; Test Area A-22, also located on Eglin Main; Test Area C-74L; and Test Area C-64. The gun ranges provide a capability to conduct gun and ammunition tests using high-explosive incendiary, armor-piercing incendiary, and target-practice ammunition. Typical calibers range from small arms up to 155-mm howitzers.

ATEF. The ATEF contains fixed, installed instrumentation systems used to measure and calculate the aeroballistic coefficients of supersonic shapes in flight. Fifty pairs of orthogonal film cameras and illumination sources are used to photograph the shapes during flight down the 230 meter facility.

A-22. This facility contains six gun bays and associated bullet traps to perform automatic and single shot gun and ammunition tests using target-practice ammunition.

C-74L. This facility has two firing bays with associated target areas for testing high explosive incendiary rounds using single-fire and automatic gun systems.

C-64. This facility contains fixed firing positions, instrumentation, gun, calibration systems, and a vulnerability and lethality test area. The lethality test area consists of gun firing placements and associated target areas, warhead firing areas, and an 800-ft-long sled track. A radiation control area is included to accommodate firing of depleted uranium (DU) rounds.

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1 The following text is largely paraphrased from Dyess, 2007b.

HELLFIRE Test Facility (HTF). The HELLFIRE Test Facility is a unique network of remotely controlled instrumentation, data acquisition, and control systems used to support missile and other electro-optical (EO), infrared (IR), and laser-guided weapon testing. The HELLFIRE Test Facility consists of Test Area C-72, Test Site C-7, and Test Site C-7A.

Kinetic Energy Munitions Test Facility (KEMTF). KEMTF is located in Test Area C-74 and provides the capability to gather data on warhead effectiveness (up to 2,000 pounds net explosive weight), fuse function, and weapon target interaction by accelerating a fully functional weapon to an operational delivery velocity along a 2,000-ft dual-rail track.

Operational and Functional Ground Test (OGT/FGT). This facility offers test customers a nondestructive, open-loop, operational test capability that simulates critical portions of a guided weapon's employment environment. The facility provides a ground test in which the guided weapon is "launched," its engine is started and running, and it is "flying" toward its target. During the free-flight and terminal portions of the flight, hardware-in-the-loop (HITL) simulations expose the item to EO/IR, visible, laser, and Global Positioning System (GPS) signals.

Portable Seeker-Sensor-Signature Evaluation Facility (PSSSEF). This facility provides the capability to collect high-fidelity target signatures that are critical for seeker and sensor development, guided weapon evaluation via simulated engagements, and live-fire target validation. The facility provides one-of-a-kind and state-of-the art instrumentation that includes the following:

- Staring IR Radiometric System (STIRRS)
- Airborne Staring IR Radiometric System (ABSTIRRS)
- Eglin Multi-Platform Imaging Radiometric Systems (EMPIRS)
- Calibrated IR Ground and Airborne Radiometric System (CIGARS)
- Airborne Spectral IR Measurement System (ASIMS)
- Spatial/Spectral Airborne Radiometric IR System (SARIS)
- Advanced Millimeter Wave Imaging Radar System (AMIRS): 10, 35, and 95 GHz
- Millimeter Wave Obscurant Characterization System (MROCS-2), operating at 10, 35, and 95 GHz
- Lynx: Ku-band synthetic aperture radar (SAR) on B-18
- Millimeter Wave Emitters, Radars, and Jamming System (MERAJS)
- Millimeter Wave Materials Measurement System (MMS)
- Directed Energy Weapon Simulator (DEWSIM), consisting of various high-power microwave devices.

Simulated Test Environment for Munitions (STEM). The STEM provides a wide range of performance testing under simulated, induced, and natural environments to test and determine that small munitions, mechanical and electronic assemblies and components, and related items are safe and that they will function as intended. Full rounds and component or subsystem items with an net explosive weight up to 10 lbs can be tested. The following chambers and systems support test methods contained in Military Standard 810: temperature-humidity-altitude chambers; temperature-vibration chambers; a thermal drying oven, a thermal shock chamber; an immersion chamber; a salt fog corrosion chamber; an explosion-proof testing chamber; a sand and dust chamber; a static ejection system; drop towers; a centrifugal accelerator; and jolt, jumble, and impact test machines.

Static Munitions Test Arenas (SMTA). The SMTA at the Test Area C-80 complex is used to test the lethality of conventional munitions, submunitions, gun ammunition, missile warheads, fuel air explosives, and insensitive explosives. Test Area C-80A has a total recovery fragmentation system for small munitions (under 8 lbs net explosive weight), and is the site for the OGT facility used to test full-up guided weapons up to 2,000 lbs net explosive weight. Test Area C-80B has a test area and control bunker for testing conventional munitions up to 500 lbs net explosive weight. Also at Test Area C-80B is the Gauntlet facility, which includes a 220-ft tower for launching submunitions for effectiveness testing. Test Area C-80C is the main test arena and includes a test area and control bunker for conventional munitions up to 3,000 lbs net explosive weight.

Current Personnel and Funding

Although some of these ground-based test facilities are quite large, they do not enjoy the same budgetary and functional visibility as more prominent facilities, such as the McKinley Climatic Laboratory. To give a sense of their scale in personnel and dollars, Table 3.1 summarizes the budgetary categories used by the 2008 Program Objectives Memorandum and AFMC, employee numbers, and reimbursable budget authority (RBA) and direct budget authority (DBA) as budgeted for FY 2007.[2]

Several items in this summary table merit comment. First, all eight of these facilities are assigned to the Miscellaneous 46th Test Wing super–resource earning unit (super-REU) defined by AFMC.[3] This categorization will be important in the next section as we examine the AFMC-planned cuts. Second, the number of personnel assigned to each is difficult to define. Given the nature of these facilities, this is not hard to understand. Typically, these facilities are fully manned as necessary to support specific tests and are simply maintained during off periods. The numbers given in the table above are simply the numbers necessary to operate the facilities fully. Some tests may require fewer personnel, who may only be needed for portions of a day. Finally, note that, overall, 54 percent of the total funding is direct (institutional) and 46 percent is reimbursable customer (program) dollars.

These issues are also highlighted when we examine the test utilization rates of the facilities. In fact, because these facilities are part of the Eglin range, their utilization data are not gathered directly but are instead gathered for the test areas in which they reside. In some cases, when there is a one-for-one correspondence between the two (such as the HELLFIRE Test Facility), this utilization may be fairly indicative of the use of the facility itself. However, it is

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2 The RBA and DBA figures given here are FY 2006 actuals and do not include base operating costs (BOS). They do include facility sustainment and modernization costs when available.

3 We are assuming here that the OGT/FGT facility is part of the "Miscellaneous 46th Test Wing" super-REU.

Table 3.1
Funding Summary of Miscellaneous Test Facilities

Facility	2008 Program Objective Memorandum (REU)	Personnel Assigned[a]	RBA Budgeted FY 2007 ($M)	DBA Budgeted FY 2007 ($M)
Base Installation Security Systems (BISS)	TE 3.10	48	3.9	1.7
Gunnery and Ballistics Test Facilities (GBTF)	TE 3.11	17	0.6	1.5
HELLFIRE Test Facility (HTF)	TE 3.12	10	0.3	0.8
Kinetic Energy Munitions Test Facility (KEMTF)	TE 3.8.2	9	0.5[b]	0.3[b]
Operational Ground Test and Functional Ground Test (OGT/FGT)	Not provided	5	0.3[c]	0.1[c]
Portable Seeker-Sensor Signature Evaluation Facility (PSSSEF)	TE 3.9.2	34	0.3	2.3
Simulated Test Environment for Munitions (STEM)	TE 3.5	3	0.3	0.4
Static Munitions Test Arenas (SMTA)	TE 3.13	9	0.9	1.4
Total		135	7.1	8.5

SOURCE: 46 TW/XPR, 2007c and Dyess, 2007g.

[a] These personnel numbers do not include government operational personnel (test engineers and program engineers), environmental personnel, safety personnel, logistics personnel or support personnel. The number of contractors is given as contract manpower equivalents (CME).

[b] FY 2007 budgeted numbers not provided, so FY 2008 used here.

[c] FY 2007 budgeted numbers not provided, so FY 2006 actuals used here.

still possible for the test area to be used for some type of test that does not actually make use of the "facility," i.e., the buildings and equipment listed in the previous section. With these caveats, Table 3.2 gives the average daily utilization of test areas and associated facilities for the period October 1, 2004, through June 1, 2006. The numbers given are the percentages of normal duty days scheduled by at least one activity. If more than one test by single organization (46th Test Wing, 53rd Wing, etc.) occurred on a single day, only one was counted. If, however, different organizations scheduled activities, the activities of all were counted. This is the primary cause of percentages higher than 100 and may cause a general overstating of utilization.

As can be seen, most of these facilities appear to be quite heavily scheduled, given the various caveats just discussed. As a result, closing them would be expected to have a large effect on current testing activities. However, the aforementioned caveats raise concern that utilization may be overstated. Since more-useful metrics, such as hours in use per day coupled with personnel levels, simply do not appear to be available, it is difficult to determine whether these facilities are truly seeing the level of utilization the data indicate.

Table 3.2
Estimated Utilization Rates of Miscellaneous Test Facilities

		Test Utilization (percent)		
Name	**Test Area**	**46th Test Wing**	**53rd Wing**	**Other**
Base Installation Security Systems (BISS)	C-3	100.0	1.4	1.0
Gunnery and Ballistics Test Facilities (GBTF)	A-22, C-64, and C-74L	143.5	1.4	1.9
HELLFIRE Test Facility (HTF)	C-72	88.2	1.9	1.0
	C-7, C-7A	41.1	1.9	0.0
Kinetic Energy Munitions Test Facility (KEMTF)	C-74	71.6	1.4	1.0
Operational/Functional Ground Test (OGT/FGT)	C-80A	See SMTA	See SMTA	See SMTA
Portable Seeker/Sensor/Signature Evaluation Facility (PSSSEF)	Not applicable	Not provided	Not provided	Not provided
Simulated Test Environment for Munitions (STEM)	Not provided	Not provided	Not provided	Not provided
Static Munitions Test Arenas (SMTA)	C-80A/B, C-80C, and C-80W	136.8	1.4	1.0

SOURCE: Dyess, 2007b.

Effects of the AFMC Plan

Figure 3.1 gives the FY 2006 through 2011 DBA funding levels for the Miscellaneous 46th Test Wing super-REU, as specified in the AFMC plan. Note that much of the funding for these REUs comes from customer RBA sources, so the numbers given here do not reflect the actual dollars the super-REU requires to conduct testing.

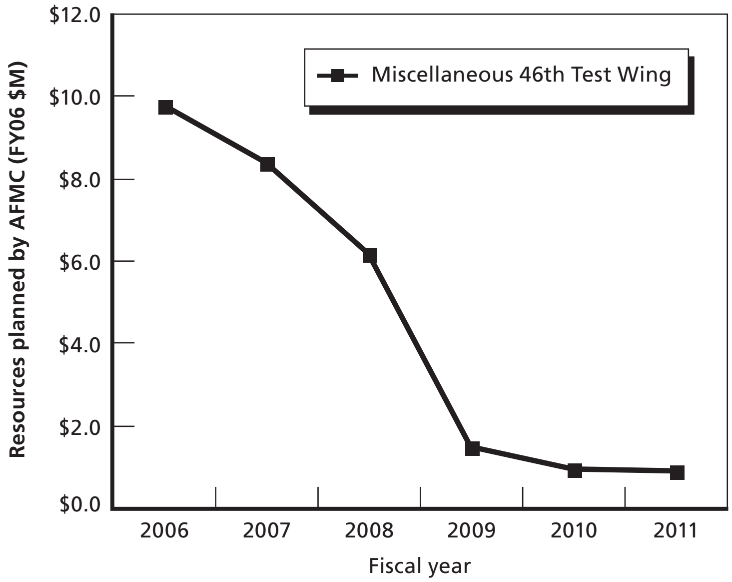
Although these data do not provide the detail we need about our eight facilities, they do help scope the problem, in that the Miscellaneous 46th Test Wing super-REU is planned to have significantly lower resource levels. Recall that our eight remaining facilities belong to this REU. This super-REU was planned to move from $9.6 million in FY 2006 to $0.8 million in FY 2011.[4]

This planned cut in DBA (which is budgeted to be about 46 percent of the operating cost of the facilities in FY 2007) results in planned personnel cuts, focused on contractors.[5] Figure 3.2 shows the planned personnel levels for this Miscellaneous 46th Test Wing super-REU. As can be seen, there are cuts in all four categories, but the majority of cuts come in contractors—

[4] Note that the actual FY 2006 DBA total was $15.9 million. The figures used for the original AFMC plan appear to have underestimated the cost of this super-REU by a fairly large amount.

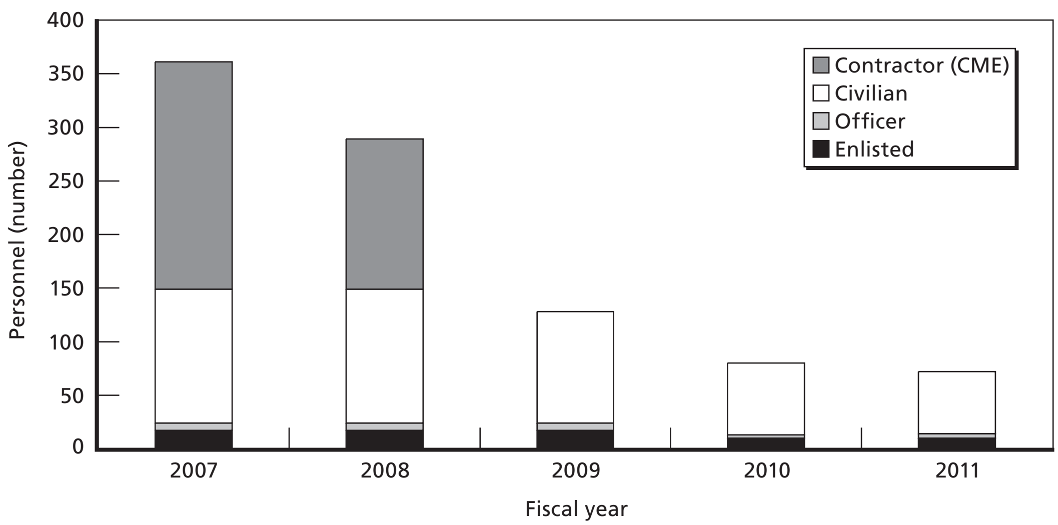
[5] Focusing on contractor cuts was part of the original PBD-720 mandate.

Figure 3.1
AFMC Planned DBA Resources for Three "Super-REUs"



SOURCE: AFMC, 2007a.
NOTE: Excludes military pay and government civilians. Amounts are in FY 2006 dollars.
RAND *MG619-3.1*

Figure 3.2
AFMC Planned Personnel Levels for Miscellaneous 46th Test Wing Super-REU



SOURCE: Dyess, 2007b.
RAND *MG619-3.2*

down to zero, as a matter of fact. The totals drop from 405 to 72.[6] Also, of this 405 total, only 135 are specifically assigned to our eight facilities (see Table 3.1). Hence, only about 40 percent of the planned 333 personnel cuts can be realized by closing the eight facilities in this super-REU. This also implies that cutting these facilities will generate only about 40 percent of the total super-REU savings.

The AFMC plan did not attempt to turn these dollar and personnel cuts into specific facility cuts for the Miscellaneous 46th Test Wing super-REU. However, the 46th Test Wing staff did do so and concluded that all eight facilities (BISS, GBTF, HTF, KEMTF, OGT/FGT, PSSSEF, STEM, and SMTA) would have to be closed. The other categories within the Miscellaneous 46th Test Wing super-REU are range support functions, such as vehicle operations, Link 16, OSS other than operations support, information technology management, core test-support elements, and safety. The personnel savings for these functions are discussed in Chapter Two as part of the 46th Test Wing staff reduction.

Cost Savings from Facility Closures

Since the AFMC plan did not break out savings between ground-test facilities and the other functions just discussed, it is difficult to use its cost numbers to estimate savings from closures. Furthermore, the plan used outdated budget numbers, which have since been revised. As a result, we make our own savings estimates using the FY 2007 budgeted personnel and other expenditures for each facility, as provided by the 46th Range Group.

It is important to clarify several assumptions about potential cost savings. First, we calculate the recurring and nonrecurring costs and savings over the FY 2007–2011 FYDP. The text in this chapter focuses on these costs and savings, which are the most important for current DoD programming decisions. As shown in Table C.1, we also calculate a 30-year NPV for both savings and any additional costs, using a 3-percent discount rate.[7] This is the appropriate method of determining the overall utility of a particular course of action, particularly one with both recurring and nonrecurring effects that will stretch out far into the future.

There can be confusion about the correct approach to calculating savings from personnel cuts due to facility closures, primarily because of the split in funding between RBA and DBA dollars. One criticism of the AFMC approach was that the command calculated personnel losses that result from cuts to DBA funding only. Since personnel are funded by both DBA and RBA, this approach underestimates either the savings realized from dismissing personnel or the necessary number of discharged personnel to realize the desired savings, depending on one's perspective. Furthermore, this approach does not capture savings in RBA that might also be realized (typically by the testing programs) through efficiency gains. However, a focus only

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6 Note that the actual FY 2006 total was 425. The figures used for the original AFMC plan appear to have slightly underestimated the personnel levels of this super-REU.

7 We are following the procedures laid out in Office of Management and Budget Circular A-94, which guides U.S. government cost-benefit and cost-effectiveness analyses.

on DBA is appropriate if the goal is to determine what AFMC can do, by itself, to service the desired PBD-720 cuts.

Our solution to this issue is straightforward. We will simply track changes in the overall governmental payroll and, for the most part, ignore the details of the DBA-RBA split.[8] RAND's analysis takes this perspective because the primary consideration for cost-effectiveness should be whether it generates savings for the DoD as a whole, rather than solely for AFMC. Simply moving costs from AFMC to ACC, to acquisition programs or to the Navy will not offer any real benefit to the government or taxpayers. Thus, the results reported here are not relevant to what AFMC can do to service its share of the PBD-720 wedge and should not be interpreted in such a light. They take a DoD-wide perspective, not an AFMC- or Air Force–only perspective.

With this in mind, cost savings from facility closures or reductions can come from three sources. First and most important, because of the size of the possible savings, are the savings that result from reducing military personnel, government civilian, or contractor staffs. The 46th Test Wing provided RAND a budgeted FY 2007 workforce count for each facility, which we used to calculate reductions and hence the cost savings.[9] For transparency and simplicity, we assumed that each facility would close in FY 2009 (to correspond with the date of the 46th Test Wing move and other range reductions), used the FY 2007 Total Annual Average Standard Composite Rates from AFI 65-503 for military enlisted and officers, and used $100,000 per year as the total cost to the government for civilians and contractors.[10] Although some facilities may use a mix of more- or less-expensive personnel, these rates should, in the aggregate, reasonably reflect costs and allow us to avoid determining the exact skill level and pay scale of every employee.[11]

The second possible source of cost savings would be avoiding planned sustainment and modernization costs for a shuttered facility. The 46th Test Wing provided budgeted sustainment and modernization costs for each facility, although, for the most part, no costs were present in these categories.

The final source of savings could be reducing BOS costs. We would expect that the 46th Test Wing pays the host base at a rate proportional to the size of its presence and, hence, that this cost would decline as its personnel levels drop. However, unlike other MRTFBs, such as the AFFTC or AEDC, we have not been able to locate any data about BOS costs for the Air Armament Center and so are unable to capture these possible savings.

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8 In fact, if DBA and RBA dollars are fully tracked and accounted for from the initial cut to their eventual destination, the costs and savings calculated would produce results identical to those shown here.

9 Dyess, 2007g.

10 This rate is corrected to $90,800 for civilians and contractors at Eglin AFB and China Lake as per Office of Personnel Management (OPM) locality pay adjustments. This agrees fairly well with average civilian pay rate of $96,852 provided by 46 TW/XPR.

11 For contractors in particular, this may be difficult or impossible to determine.

Potential Additional Costs

Of course, closing these facilities will not only produce savings but also incur costs. These additional costs include, at a minimum, the following:

- closure costs, such as environmental cleanup and disposal
- the additional costs and risks for each testing program that must change test schedules; locations; and, possibly, type of testing
- the cost to upgrade the capacity and capability of alternative facilities, if necessary.

We also include one-time penalties of 20 percent of salary for each employee terminated at a closed facility (to account for various costs, such as contract-termination fees) and 50 percent of salary for each new employee hired at an alternative location (for recruitment costs, for instance).

If the Air Force ceases funding the eight facilities the 46th Test Wing specified in response to the AFMC cuts, changes will be necessary in the testing plans of the affected programs. There are five obvious ways for programs to accommodate these closures, arranged here roughly in order of increasing short-term cost:

1. Do not perform the testing.
2. Perform the tests at another existing facility or facilities that can support the testing without modification or upgrade.
3. Modify or upgrade an existing facility or facilities so that they can perform the tests.
4. Allow a different entity (the program itself, another service, or a private venture) to take over operation of the current facility.
5. Rebuild or otherwise recreate the closed facility in a new location.

Determining the least expensive of these five options is not easy. For instance, option 1, avoiding testing, may reduce costs for a program in the short term but increase them later, when undiscovered technical problems emerge. Because evaluating this option would require detailed knowledge of each program's requirements, we generally avoid this approach and simply assume that the amount of testing will remain constant. Options 2 and 3 will be the most common approaches, although option 4, which could appear expensive from the program's viewpoint, may actually be cost-neutral from an Air Force or DoD-wide perspective. It is difficult to imagine option 5 being preferred in any circumstance unless the new, rebuilt facility has much lower operating costs than, yet similar capabilities and capacity to, the previous one. In general, the "optimum" solution will vary by facility and could vary by program using each facility. Conceivably, the cost effects for each program using each facility could be tallied then summed for every option, although this would be an enormous undertaking and is beyond the scope of the present study.[12]

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[12] The Air Armament Center actually did attempt a similar effort at the request of SAF/AQ. We will refer to some of their results in this section. For the full report, see AAC, 2006.

Facility Closure Net Costs or Savings

To show how we calculate the DoD-wide effects of the AFMC plan, we first discuss the effects of a facility closure or reduction and a recommended strategy programs can use to manage their testing needs cost-effectively. We lay out, in a simple fashion, all the savings and costs we have identified and highlight missing data. In these cases, we either examine a parametric range of values or make the most conservative estimate possible (favoring the status quo). We conclude with a summary of the quantitative findings and a discussion of their implications.

In the following analysis, all the current facility staffing levels, sustainment and modernization costs, and closing costs were provided by the 46th Test Wing and were used without independent confirmation. No RAND-generated cost estimates are used. As discussed above, staffing levels were converted to costs using standardized government pay rates. For computing savings, facilities were assumed to close in FY 2009 and thus save annual personnel and sustainment costs from that point on, minus the nonrecurring closing cost. When available, the costs of upgrading and operating an alternative facility were provided by NAVAIR. These costs were also used without independent verification, although qualitative comments on their validity were provided by the 46th Test Wing and are noted below. For these facilities, few data were available on the extra costs programs might entail by testing at a new location instead of the closed Eglin facility. When available, such data were provided by an Air Armament Center analysis and are noted as such.

Base Installation Security Systems. This facility covers over 750 acres and includes several large buildings and towers; two 8,000-ft runways; and a large number of security sensors and supporting infrastructure. Obviously, such a large facility cannot be relocated easily. One analysis put the cost of recreating the BISS at a new location as between $30 million and 50 million.[13] The 46th Test Wing estimates of mothball costs are $2.4 million initially and $4.8 million to restart. Total shutdown would reportedly cost approximately $3 million, but result in the cost savings for 48 contractors.[14] The Air Armament Command collected data from user programs on their additional expenditures if this were facility to close, which totaled $50 million in nonrecurring costs. This figure turned out to be the cost of entirely recreating the BISS at a new location.[15]

If the BISS were simply closed, as per the AFMC plan, we calculated the following costs and savings, in FY 2007 dollars:

- personnel decreases
  - enlisted: 0
  - officers: 0
  - government civilians: 0
  - contractors: 48

[13] 46 OG/CA, 2007.

[14] Dyess, 2007b.

[15] 46 OG/CA, 2007.

- total personnel cost savings: \$4.36 million per year minus \$871,680 in termination fees
- BOS savings: not provided
- closure and cleanup costs: \$3.04 million
- additional costs to programs: \$50 million, nonrecurring
- upgrade costs to alternative sites: unknown
- modernization costs avoided: \$0
- sustainment costs avoided: \$14,009 per year.

Using these figures, if the BISS were simply closed in 2009, \$9.2 million would be saved for the FY 2007–2011 FYDP.[16] This result is obtained via the following calculation:

$$3 \text{ years} \times (4.36 + 0.0144) - (3.04 + 0.87) = \$9.2 \text{ million.}$$

Recall that the AAC-provided additional program cost was \$50 million, wiping out any savings over the FYDP. However, closing a facility only to recreate it in a new location is obviously never going to be a cost-effectiveness option. Presumably, the recreated facility will have operating costs similar to those of the original; hence, the nonrecurring cost will never be recouped.

Rather than simply closing the facility, however, or closing it and recreating the capability elsewhere, the most logical choice, if it must be removed from AFMC funding, is simply for the users to take over funding of the facility. Unlike many other test facilities, comparatively few programs (the Air Force Security Forces Center, AFOTEC, and 642nd Electronic Systems Squadron/Force Protection) use the BISS; hence, funding could be transferred efficiently, with little disruption to other users. Such an effort is already reportedly under way for the BISS with Electronic Systems Command (ESC). Although this option would reduce AFMC costs by \$1.7 million (FY 2007 budgeted DBA), there would be no overall Air Force or DoD savings because the costs are simply shifting to the programs.[17] This may not satisfy the intention of the PBD-720 cuts.

There are, of course, possible downsides to this approach. Deconfliction with other range users could be an issue and would require close coordination among the facility users and the range organizations. Although simply having the users take over the facility appears to be a viable option, the programs may find the cost burden too great, and cost transfers from AFMC may be programmatically impossible. If this is the case, the remaining solution is to move testing to alternative locations. Most BISS capabilities are not particularly unique and could be implemented at other existing locations, although most likely not at a single site. For instance, several of the national laboratories have programs that test security measures for nuclear facilities. As just mentioned, however, no cost analysis has been performed for this option, and

16 Our calculations over the FY 2007–2011 FYDP do not include a discount rate and are in constant FY 2007 dollars. They are presented here merely for convenience in comparison with other analyses. In general, the net present value calculations are a much more accurate measure of the long-term cost or savings of a particular action.

17 46 TW/XPR, 2007c.

additional research is needed to quantify exactly what work would be necessary to upgrade other facilities. Further, additional program costs, such as travel expenses, would need to be determined.

We can examine this somewhat parametrically by determining the maximum annual cost all programs together would be willing to pay over the FYDP and still have a net savings for closure. For the BISS, if we calculate what additional annual cost would produce zero savings over the FYDP this comes to \$3.1 million per year. This figure is calculated with the following formula:

$$\$9.2 \text{ million savings} \div 3 \text{ years} = \$3.1 \text{ million per year.}$$

Compared to the \$3.9 million the programs are already paying (FY 2007 budgeted RBA), this indicates that alternative facility and additional program costs could be quite large (almost twice the current costs) yet still make it cost-effective to close the BISS.

Gunnery and Ballistics Test Facilities (GBTF). This facility includes several instrumented aircraft firing ramps, gun ranges, and stands and permits the use of DU rounds. Test tracks, drop towers, temperature-conditioning equipment, and mobile test facilities are also available. ATEF provides the capability to image flying projectiles in a 230-m underground facility. Several dozen programs use GBTF, primarily for investigating malfunctions and conducting ammunition acceptance and sustainment tests.

Such options as simply stopping this type of testing or having the programs themselves take over the facility appear to be problematic. Gun and ammunition systems can require regular testing for acceptance and sustainment, and operational failures put lives at risk and are difficult to resolve. Because so many different programs use these facilities, coordination and cost-sharing would be quite complicated.

If testing is to continue, several possible alternatives to this facility have been identified, including Hill AFB, Utah, and the Utah Test and Training Range; the Yuma Proving Ground, Arizona; Picatinny Arsenal, New Jersey; and NAWC China Lake, California. Of these, however, only the Yuma Proving Ground has the ability to test DU rounds, and most of the others are limited in the sizes of rounds they can test. The most detailed analysis was carried out by NAVAIR to examine non-DU testing at China Lake. Its conclusion was that the GBTF testing could be accommodated by adding magazine storage space (approximately a \$350,000 investment) and hiring four people (\$363,000 per year). However, this analysis reportedly ignored some GBTF capabilities (such as shaped-charge jet characterization, explosively forged penetrator characterization, and gun-launched simulants) and neglected to include the costs of transporting some equipment from Eglin to China Lake.[18] If this is correct, the missing capabilities could likely be generated at the other facilities with additional investment, although no cost analysis has been performed. A closer look should also include an examination of whether all testing conditions (such as tropical weather) can be met at the other locations. Another

[18] Dyess, 2007c.

factor is a BRAC 2005 recommendation that China Lake move all ammunition testing to the U.S. Army Picatinny Arsenal, thus making them unavailable to take on GBTF workload. AAC did not provide additional program costs specifically for this facility.

We calculated the following GBTF-related costs and savings, in FY 2007 dollars, if the GBTF were closed and the testing moved to China Lake:

- personnel decreases
  - enlisted: 0
  - officers: 0
  - government civilians: 0
  - contractors: 17
- total personnel savings: $1.54 million per year minus $308,720 in termination fees
- BOS savings: not provided
- closure and cleanup costs: $18.62 million
- additional costs to programs: unknown
- upgrade costs to alternative sites: $341,802 investment plus $363,200 per year plus $181,600 in hiring fees
- modernization costs avoided: $0
- sustainment costs avoided: $4,009 per year.

Given these inputs, simply closing the facility and moving the testing to China Lake results in an overall cost of $15.9 million (although Appendix B shows a savings over a longer time period). This is calculated as follows:

$$3 \times (1.54 + 0.004) - 3 \times 0.363 - \\ (0.308 + 18.62 + 0.342 + 0.182) = -\$15.9 \text{ million.}$$

This is because the large $18.62 million closure cost (primarily for DU cleanup) outweighs the annual savings of around $1 million per year.[19] Also, no analysis has been performed to determine additional costs that individual programs might incur by testing at China Lake (such as travel) or by delays waiting for the additional capacity to come on line. These additional costs will only increase the negative outcome.

A large unknown here is the location and extent of DU testing. The Yuma Proving Ground appears to be only other DoD facility with a permit to test DU rounds. Since gaining permission for DU testing is likely to be a long, involved process, one mechanism to facilitate the closure of this facility is to move the non-DU testing to other facilities and simply cease Air Force testing (and hence use) of DU ammunition. The only current user is the 30-mm cannon on the A-10 aircraft, for which the DU rounds provide excellent capability for penetrating armored vehicles. However, wartime use of this type of ammunition has become less frequent

[19] Dyess, 2007b.

because of the criticism the United States has received over possible health risks. This issue is obviously outside the scope of this study but will require additional analysis to examine the cost and effectiveness trade-offs for this type of testing.

HELLFIRE Test Facility (HTF). The HTF focuses on Army and Air Force guided-missile testing and includes significant instrumentation and target facilities, as well as such infrastructure as a hanger and missile launchers.

As with the BISS, the HTF is a substantial facility that would be expensive to relocate but supports only a few users, primarily the Army HELLFIRE, Apache Longbow, and Joint Common Missile programs with developmental work for Advanced Precision Kill Weapon System and Compact Kinetic-Energy Missile. AAC provided additional program costs for four Army programs using the HTF: HELLFIRE II, Laser HELLFIRE, Longbow HELLFIRE, and Joint Common Missile. For the three years following closure (2009–2011), these programs projected additional costs of $5.12 million, although $5 million of those costs were simply to rebuild the HTF in a new location.

We calculated the following HTF-related costs and savings if the HTF were closed, in FY 2007 dollars:

- personnel decreases
  - enlisted: 0
  - officers: 0
  - government civilians: 0
  - contractors: 10
- total personnel savings: $908,000 per year minus $181,600 in termination fees
- BOS savings: not provided
- closure and cleanup costs: $506,052
- additional costs to programs: $5.12 million over the FYDP
- upgrade costs to alternative sites: unknown
- modernization costs avoided: $0
- sustainment costs avoided: $1,877 per year.

Without including the additional program costs, the savings for simply closing the facility totals $2.0 million over the FYDP. If we include the cost to programs of $5.12 million, there is a net cost of $2.9 million over the FYDP. If these additional program costs are realistic, it would not appear cost effective to close the HTF. However, closing a facility only to recreate it in a new location is obviously never going to be cost-effective. Presumably, the recreated facility will have operating costs similar to those of the original; hence, the nonrecurring cost will never be recouped.

As a result, and as with the BISS, a sensible option for this facility, if it must be removed from AFMC funding, is for the users to take over funding from Eglin AFB and AFMC. As with the BISS, however, transferring ownership of the facility would save AFMC costs but only by transferring them to another DoD entity—in this case, the Army. It is not clear that this would satisfy the intention of the PBD-720 cuts. Although this approach has potential disadvantages, such as the need for deconfliction with other range users and the requirement for the programs to take over $804,000 in costs (FY 2007 budgeted DBA), these issues should dwarf the expense and disruption of moving all testing to a new location or closing and recreating the entire facility. The programs would need to estimate and budget for periodic repair and upgrade costs, as well as the cost of support staff, such as environmental, safety, and logistics personnel. Additional research would be necessary to quantify these costs and evaluate whether current programmatic resources would be sufficient. In terms of cost accounting, however, the effect should be small because our projected savings also do not include their effects.

Kinetic Energy Munitions Test Facility (KEMTF). The KEMTF is oriented around a 2,000-ft sled track with associated support facilities, such as targets, pre- and post-test instrumentation, cranes, and warhead temperature-conditioning equipment. A large number of munitions programs use the facility because it commonly uses the sled track to test live rounds. This is reportedly because sled-track repairs cost less here than at other sled facilities and because live munitions can be destructively and nondestructively inspected here after a test. Facilities such as the 4-mi-long Supersonic Naval Ordnance Research Track (G-4 track) at China Lake do test live rounds as well, however.

The KEMTF is not a prime candidate for simple transfer to program or other service management because so many testers utilize the facility. The primary option of interest here would be to use other, similar facilities. Alternative sled tracks are available, including the G-4 track at China Lake and the 10-mi-long High Speed Test Track at Holloman AFB. However, both tracks provide speeds well beyond those necessary for typical KEMTF tests and reportedly would be quite expensive to repair after live-fire tests.[20] NAVAIR analyzed the sled-track facilities at China Lake and concluded that it would be necessary to invest approximately $800,000 (and 12 to 15 months for construction) in improvements, add eight staff members (at annual cost of around $800,000), and budget an additional $120,000 per year for maintenance to accommodate the Eglin KEMTF tests.[21] More research would be necessary to confirm these costs and ensure that all needed equipment was available. AAC did not provide additional program costs specifically for this facility.

We calculated the following KEMTF-related costs and savings if the KEMTF were closed and testing moved to China Lake, in FY 2007 dollars:

- personnel decreases
  - enlisted: 0
  - officers: 0
  - government civilians: 0
  - contractors: 9
- total personnel savings: $817,000 per year minus $163,440 in termination fees

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[20] Dyess, 2007b.

[21] Dyess, 2007c.

- BOS savings: not provided
- closure and cleanup costs: not provided
- additional costs to programs: unknown
- upgrade costs to alternative sites: $828,609 investment plus $846,400 per year plus $363,000 in recruiting fees
- modernization costs avoided: $0
- sustainment costs avoided: $2,970 per year.

Using these inputs results in a small loss of $1.4 million over the FYDP. Recall, however, that we have not been provided KEMTF closure costs or additional program costs, so the actual cost would be higher. This facility would not appear cost-effective to close.

Operational/Functional Ground Test (OGT/FGT). This facility is used to simulate an entire aircraft sortie to exercise the weapon's temperature, rain, icing, and vibration resistance and its seeker performance during the free-flight and terminal phases. Only five personnel staff this facility, and the calculated closure cost is approximately $500,000.[22] AAC did not provide additional program costs specifically for this facility.

We calculated the following OGT/FGT closure costs and savings, in FY 2007 dollars:

- personnel decreases
  - enlisted: 0
  - officers: 0
  - government civilians: 0
  - contractors: 5
- total personnel savings: $454,000 per year minus $90,800 in termination fees
- BOS savings: not provided
- closure and cleanup costs: $506,052
- additional costs to programs: unknown
- upgrade costs to alternative sites: unknown
- modernization costs avoided: $0
- sustainment costs avoided: $0.

As with many of the other facilities, no analyses of substitute locations or additional program costs were provided to RAND for this facility. We therefore calculate a savings of $770,000 over the FYDP. The NAVAIR analysis concluded that the Navy had no capability to replace the OGT/FGT facility. If we again compute the maximum annual program cost increase that produces zero savings, the result is the result is $256,667 per year ($770,000 divided by 3 years). Given that there are no obvious alternatives and that additional costs of this magnitude may not be difficult to realize, closing this facility is unlikely to be cost-effective.

Portable Seeker-Sensor-Signature Evaluation Facility (PSSSEF). The PSSSEF is an unusual "facility" in that it is actually a set of fairly disparate capabilities. First, there is a large

[22] Dyess, 2007b.

variety of EO, IR and RF signature-measurement systems, both airborne and ground-based. Second, there is the Eglin Mobile Missile Launcher System (EMMLS), which provides live launch capabilities for man-portable air-defense systems (MANPADS) against real or simulated aircraft.

The unique feature of the PSSSEF is that it concentrates signature measurement capabilities in one location and can operate in similar environments against the same targets. Other locations, such as Point Mugu and Patuxent River, have some elements of this signature-measurement capability, but not at all wavelengths and not against all target types. On the other hand, the name of the facility itself indicates that much of it could be relocated to other test locations. The primary issue could be the availability of a diverse set of target types and environmental and background environments. Eglin estimates that complete shutdown of this facility would cost approximately $1.2 million, although the cost breakdown has not been provided.[23] AAC did not provide additional program costs specifically for this facility, and NAVAIR did not analyze possible alternatives.

We calculated the following costs and savings if the PSSSEF were closed, in FY 2007 dollars:

- personnel decreases
  - enlisted: 0
  - officers: 0
  - government civilians: 34
  - contractors: 0
- total personnel savings: $3.09 million per year minus $617,440 in termination fees
- BOS savings: not provided
- closure and cleanup costs: $1.22 million
- additional costs to programs: unknown
- upgrade costs to alternative sites: unknown
- modernization costs avoided: approximately $36,676 per year
- sustainment costs avoided: approximately $119,497 per year.

With these savings and costs, simply closing the PSSSEF gives $7.9 million in savings over the FYDP. However, the lack of data on alternative upgrades or additional program costs will affect this result. The calculated maximum total program cost per year that would offset these savings is $2.6 million per year compared to the current RBA of $318,000 (FY 2007 budget). More analysis is needed to address these issues, but given that most of the PSSSEF capabilities exist in other facilities and if the capacity exists to accommodate Eglin testing, it may very well be cost-effective to close the PSSSEF.

Simulated Test Environment for Munitions (STEM). STEM is a set of testing facilities for subjecting munitions to realistic environmental conditions, such as temperature and vibration.

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[23] Dyess, 2007b.

It also includes noninvasive test instrumentation, such as X-ray and fluoroscope, for examining test articles.

As with some of the other facilities, STEM serves a wide variety of customers and so would not be easy for a single user to take over. However, its capabilities are not particularly unusual and could be undertaken at several alternative locations, most likely with some moderate upgrades required. NAVAIR conducted an analysis of STEM activities and concluded that all the STEM work could be accommodated at existing facilities at China Lake with the addition of one technician and $30,000 per year additional maintenance.[24] Eglin estimates that complete shutdown of the STEM would cost $650,000.[25] AAC did not provide additional program costs specifically for this facility.

We calculated the following STEM-related costs and savings, in FY 2007 dollars, if the STEM were to be closed and testing performed at China Lake:

- personnel decreases
  - enlisted: 0
  - officers: 0
  - government civilians: 0
  - contractors: 3
- total personnel savings: $272,400 per year minus $54,480 in termination fees
- BOS savings: not provided
- closure and cleanup costs: $657,868
- additional costs to programs: unknown
- upgrade costs to alternative sites: $120,800 per year plus $45,400 in recruitment fees
- modernization costs avoided: $0
- sustainment costs avoided: $1,270.

The calculation with these inputs gives a small cost of $300,000 over the FYDP (although Table C.1 shows a savings over a longer period). No additional program costs have been included in this calculation, so the actual loss would likely be greater.

Static Munitions Test Arenas (SMTA). The SMTA primarily consists of several cleared range areas equipped for explosive munitions testing up to 3,000 lbs net explosive weight. Each area has instrumentation for evaluating blast and fragmentation effects, as well as such assorted capabilities as drop towers, bunkers, control rooms, and temperature conditioning chambers. Little is unique here, although the facilities are quite large and could not be moved easily. Eglin has estimated the cost for closing this facility to be around $100,000.[26] NAVAIR conducted an analysis of SMTA activities and concluded that the facilities at China Lake could accommodate 100 percent of the tests and that the staff could support 80 percent of them. Since no

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[24] Knight and Taylor, 2007.

[25] Dyess, 2007b.

[26] Dyess, 2007b.

cost estimate was provided for this last 20 percent of capacity, we have simply added 20 percent of Eglin's current personnel cost to the alternative facility as first order estimate of additional annual cost. No estimates for additional program costs were available.

We calculated the following for SMTA closure with testing moved to China Lake, in FY 2007 dollars:

- personnel decreases
  - enlisted: 0
  - officers: 0
  - government civilians: 0
  - contractors: 9
- total personnel savings: $817,200 per year minus $163,440 in termination fees
- BOS savings: not provided
- closure and cleanup costs: $111,332
- additional costs to programs: unknown
- upgrade costs to alternative sites: $163,440 per year plus $81,720 in recruitment fees
- modernization costs avoided: $0
- sustainment costs avoided: $12,505.

As would be expected with relatively large savings and small additional costs, we obtain a savings of $1.6 million over the FYDP. Although there were no data on additional program costs, the maximum additional cost to offset the savings is $533,000, compared to the current RBA of $900,000 (FY 2007 budgeted). More-detailed research would be necessary to determine how likely programs would be to accrue this additional cost, but because of this relatively high allowable additional cost, there is a reasonable likelihood that it would be cost-effective to close this facility.

Summary of Results

Table 3.3 summarizes the results of the previous discussion. Because of the many uncertainties involved, we do not attempt to produce a total cost or savings for the entire set of facility closures. In general, there is no compelling reason to treat all these facilities as an indivisible whole; different cost-effective outcomes can be found for each.

Of the above facilities, AAC provided specific additional program costs for only two: the BISS, at $50 million nonrecurring, and the HTF, at $5.12 million over the FYDP. Although these estimates are simply for recreating the facilities and so are not particularly informative as an estimate of additional costs to users. Although we do not have specific program costs for the other facilities, we do have a total for programs that use ground test facilities. This can be compared to the total cost or savings if these facilities were closed, as shown in Table 3.3. The AAC estimate of three years of costs (2009, 2010, and 2011) following closure is $85.44 million. If we subtract the already considered BISS and HTF facilities, the additional costs total $30.32 million ($18.29 million of the total is for two programs: Large

Table 3.3
Costs and Savings Calculations for Proposed Facility Closures (FY 2007 $M)

	Nonrecurring Costs	Annual Costs	Nonrecurring Savings	Annual Savings	Total Savings Over FY 2007–2011 FYDP
Base Installation Security Systems (BISS)	3.91	0.00	0	4.37	9.2
Gunnery and Ballistics Test Facilities (GBTF)	19.45	0.36	0	1.55	(15.9)
HELLFIRE Test Facility (HTF)	0.69	0.00	0	0.91	2.0
Kinetic Energy Munitions Test Facility (KEMTF)	1.36	0.85	0	0.82	(1.4)
Operational/Functional Ground Test (OGT/FGT)	0.60	0.00	0	0.45	0.77
Portable Seeker / Sensor / Signature Evaluation Facility (PSSSEF)	1.84	0.00	0	3.24	7.9
Simulated Test Environment for Munitions (STEM)	0.76	0.12	0	0.27	(0.3)
Static Munitions Test Arenas (SMTA)	0.36	0.16	0	0.82	1.6

Aircraft Infrared Countermeasures and Other Infrared Countermeasures). From Table 3.3, the total for the remaining six facilities is a cost, not a savings, of $7.37 million. With the additional program costs of $30.32 million, the total cost of closing all six facilities would then total $37.69 million. This is clearly not a cost-effective option. Note, however, that this does not preclude the cost-effectiveness of selected facility closures. Individual savings may be large enough and additional program costs small enough to result in a cost-effective closure despite this aggregate result.

In summary, closing BISS could produce good returns, but the results are misleading because of the lack of data on the costs of equipping alternatives and on possible additional costs to testers. More analysis is necessary. Transferring all costs to the limited number of test program users, as is already under way, is the most likely solution for reducing AFMC costs, but the overall cost to DoD would remain unchanged. Even if DoD did obtain a cost benefit, AFMC is simply shifting costs to other parties. When this occurs, it shifts a portion of the burden of its share of the wedge created by PBD-720.

Closing PSSSEF and SMTA would likely produce a cost benefit to both AFMC and DoD.

Closing GBTF, KEMTF, HTF, OGT/FGT, or STEM would offer little or no cost benefit, even with current cost and savings estimates. The HTF may be another good candidate for single-user status with its U.S. Army users, although this would simply transfer costs and not result in savings to DoD as a whole.

Consolidation of Open-Air Test Ranges

Aircraft-related open-air testing consists of a wide range of activities. It includes relatively undemanding tests, such as those performed with aircraft stationary on the ramp. It also includes demanding testing with serious safety concerns, such as live-fire tests of low-range munitions. Many types of open-air testing take place daily at Air Force installations around the world. However, many types of tests are best performed on a dedicated range equipped with appropriate instrumentation and with control of large amounts of land and airspace. The U.S. Air Force currently operates two major facilities of this type, at Eglin AFB and Edwards AFB.

This section examines the potential cost effects of consolidating most open-air testing at Edwards and other nearby facilities, collectively known as the WTR. Such a consolidation would greatly reduce the level of open-air test activity at Eglin. We are concerned here with costs associated with what we call the "range."

Definitions

The terms *capability* and *capacity* are frequently used in discussing the ability of an OAR to conduct operations. While we will use these terms as the OAR community commonly uses them, it is important to be explicit about what they mean.

In this context, *capability* refers to the physical capability of a facility, what it can do with the land, equipment, etc., available. For example, Edwards itself does not have the capability to conduct sea-level testing. Eglin does not have the capability to conduct attacks on targets buried in mountainsides. Restrictions on capability are relatively difficult to mitigate.

Capacity refers to the volume of work that a range can perform at a given level of staffing (and therefore of funding). Ranges generally operate at full capacity because they are well managed. They are not overstaffed, so if the workload were to increase substantially, new people would have to be hired or existing staff would have to work longer hours. Historically, capacities at both Eglin and Edwards have varied with national requirements. Note that this is different from the definition of capacity used in the BRAC process. The BRAC analysis defined capacity by looking at historic activity levels. For example, because Edwards activity had been higher in the recent past, the BRAC process concluded that Edwards had excess capacity.

Research Approach

We have not independently assessed Air Force requirements for open-air testing. Instead, we have assumed that the current level of activity at Edwards and Eglin AFBs is effectively the Air Force's requirement. We have assumed that any reduction in capacity at Eglin must therefore be offset with an equal enhancement in capacity at the WTR or elsewhere.

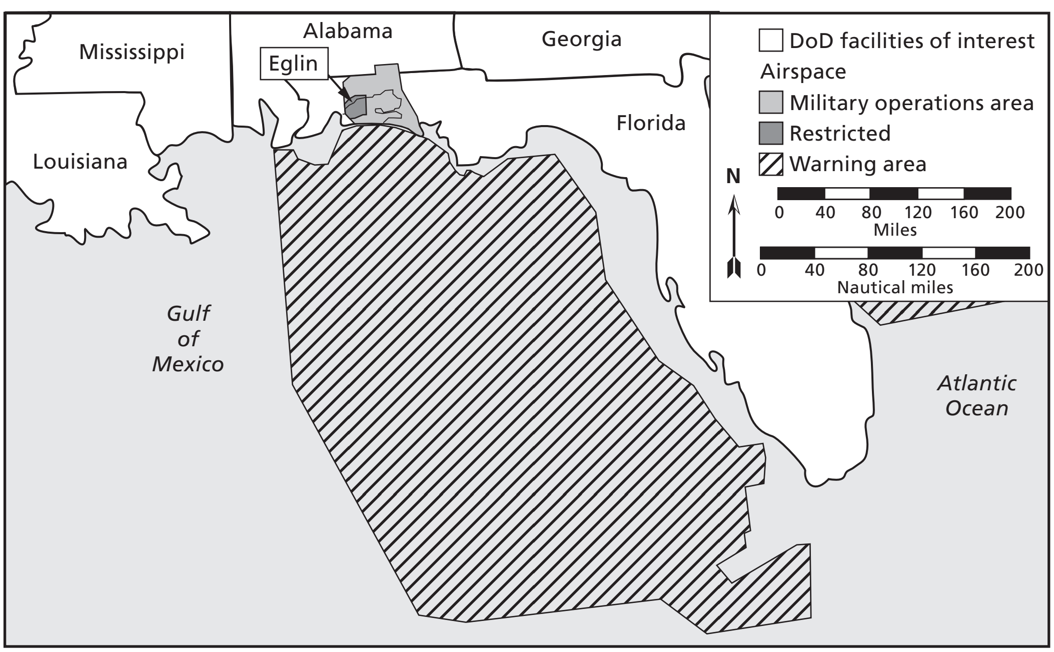
The core of this effort is to provide an independent high-level view of the probable cost effect of transferring the 46th Test Wing's open-air munitions testing workload to the WTR and other facilities. This cost effect includes the direct costs that units in the WTR would incur, as well as indirect costs affected programs would incur. As elsewhere, the term *cost* refers to the total cost to the U.S. taxpayer, not the cost in any particular budget category. That is, we have not treated program costs and institutional costs separately. There may be legitimate differences of opinion about how these costs would be ultimately apportioned. Our study does not address that issue.

We consulted with many organizations involved in range operations, especially the range group at Eglin AFB, the range squadron at Edwards AFB, and the Navy's range organizations at Point Mugu and China Lake, both part of Naval Air Warfare Center Weapons Division (NAWCWD). All these organizations were extremely helpful, providing us with extensive documentation and access to their facilities and personnel.

Range Background

Eglin Range Complex (Eglin AFB). The Eglin range is located in the panhandle of Florida and in the adjacent Gulf of Mexico (Figure 3.3). Eglin's over-water range (called the Eglin Gulf Test and Training Range) provides 98,500 mi^2 of over-water airspace that is jointly used for a variety of T&E activities and training exercises. The over-water range contains several test areas that are used for long-range, all-altitude, air-to-air activities, including drone target engagements, electronic combat, and long-range (or antiship) air-to-surface and surface-to-surface evaluations.[27] The over-water airspace is complemented by the over-land airspace, providing interaction between water and land test ranges.

Figure 3.3
Eglin AFB and Associated Airspace



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[27] Global Security, 2006.

Land and airborne radar systems, as well as EO time-space-position-information systems, are used to monitor operations in the range area. The test wing at Eglin AFB is developing an over-the-water scoring system for bombs, air-to-surface missiles, and aircraft guns.[28] Eglin maintains several warning areas in the over-water range, as well as restricted areas at the over-land range. Short- and medium-range missile testing occurs in one of the warning areas, including operational T&E of these missile systems against drones launched from Tyndall AFB, Florida. Other T&E activities occurring over water include aircraft and munitions systems compatibility tests.

Within Eglin airspace, the Navy's Aegis cruisers perform missile exercises, and Tomahawk missiles utilize both the land and water range areas. The Tomahawks are launched over water to a land impact area at Eglin.

Restricted Area 2508 (R-2508) Complex. R-2508 is located in east-central California and extends into a portion of Nevada (Figure 3.4). It is the largest single area of over-land special-use airspace within the United States. The complex airspace is over all three primary users: the AFFTC Edwards, the Naval Air Warfare Center Weapons Division (NAWCWD) China Lake, and the National Training Center, Ft. Irwin, California. The complex consists of the overlying R-2508, five underlying restricted areas, and 10 memorandums of agreement. Typical operations within R-2508 include

- aircraft research and development in all stages of flight
- operational weapon T&E flights
- student pilot training
- air combat maneuvering and proficiency flights
- civilian test aircraft in direct support of DoD and/or defense testing.[29]

Scheduling of airspace use is coordinated among each of the three primary users. AFFTC (Edwards AFB) utilizes R-2508 to support testing of manned and unmanned aircraft and related avionics, flight-control, and weapon systems. Edwards AFB also operates the Air Force TPS. To support testing, the AFFTC operates the Edwards Flight Test Range, which comprises 20,000 mi^2 of airspace. The main runway at Edwards AFB is 15,000 ft long, with a 9,000-ft lakebed overrun.

NAWCWD China Lake utilizes R-2508 in support of primary research and development, T&E work for air warfare, and missile weapon systems. The Navy and Marine Corps have developed or tested nearly every significant airborne weapon system in the past five decades at NAWCWD. Operations at NAWCWD involve programs that range from the Tomahawk Cruise Missile to the new JSOW and from the JDAM to the new F/A-18E/F Super Hornet.

Sea Range Complex (SRC). SRC is located along the California coast, just north of SCORE (Figure 3.4). The mission of SRC is to support the Navy's research, development, test evalua-

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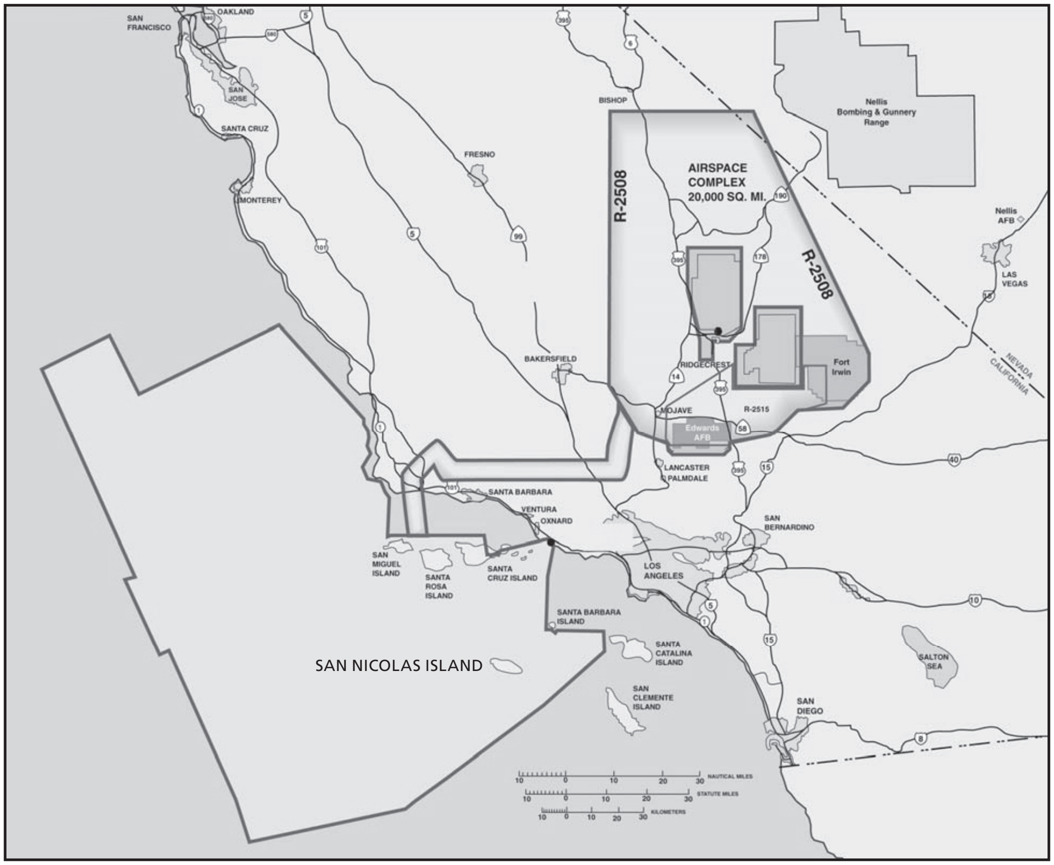
[28] Global Security, 2006.

[29] According to R-2508 staff, 2006.

Figure 3.4
Airspace in the Western Test Ranges



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tion, and in-service engineering center for weapon systems associated with air warfare, missiles and missile subsystems, aircraft weapon integration, and assigned airborne EW systems.

The SRC includes Naval Base Ventura County (formerly NAS Point Mugu), California, which also encompasses Point Mugu, the Laguna Peak complex, San Nicolas Island, and Santa Cruz Island. SRC contains 36,000 nmi^2 of controlled air space. In addition, SRC can connect to Naval Air Weapons Station China Lake via a Federal Aviation Administration (FAA)–approved flight path.

Naval Base Ventura County maintains three runways, including 11,000-ft and 5,500-ft runways at Point Mugu and a 10,000 ft runway on San Nicolas Island. The surface launching and ordnance facilities at Point Mugu support operations at SRC.

The Laguna Peak complex provides optical coverage, telemetry, airborne and surface target control, radio communication and data transmission, surveillance radar, and the Command Transmitter System.

San Nicolas Island has an area of approximately 24 mi^2; the west end provides a secure area for missile targets. Its capabilities include launching subscale and unmanned full-scale targets and launch sites for surface-launched weapons. The airfield on San Nicolas Island can support aircraft up to and including the C-5. In addition, the island has a beach landing area for bulk barge cargo transportation.

AFFTC routinely conducts operations within the Sea Range Complex, especially operations requiring flight at near sea level, large footprint weapons, and directed energy systems.

In summary, the ranges have the following areas, in square miles:

- Eglin land: 724
- Eglin sea: 98,000
- Edwards land: 470
- JSRAC R-2508: 26,000
- China Lake land: 1,718
- Point Mugu sea: 46,000.

Scheduling Exercise

From January 30 to February 3, 2007, schedulers from the 46th and 412th Test Wings sat down together to input 17 weeks of Eglin range activity into the Edwards range-scheduling system.[30]

This exercise focused on range capability, not range capacity. In particular, the methodology assumed unlimited staff availability to support the transfer of activities being studied. This would highlight potential deficiencies in capability. The analysis showed that Edwards AFB and its range could not support the entire Eglin workload over the 17-week period. However, the combined capabilities of the WTR—specifically, Edwards, the Point Mugu sea range, and China Lake—could support almost all the Eglin the workload, except possibly the telemetry. In the exercise, all the sorties were launched from Edwards. Sixty percent of the missions could be completed with Edwards capabilities alone. Twenty percent required support from the Point Mugu sea range, and another 19 percent required support from China Lake, Edwards, and the R-2508 complex. About 1 percent required support from other ranges, such as the White Sands Missile Range.

This exercise generated specific lists of tasks that Edwards, China Lake, and Point Mugu would need to perform. In no case does the WTR, as it now exists, have the capacity to support the additional operations required. However, the WTR does appear to have adequate capability to support the additional operations, except for a possible shortfall of telemetry bandwidth.

[30] Appendix A reproduces a report on this exercise that we received from the Eglin Range Group. This report is included to provide background for and visibility into our analytic process. It is not a RAND document. Its conclusions are not the final conclusions of our analysis. Our complete analysis is partly based on important information not available to the authors of Appendix A at the time it was written.

Telemetry

The scheduling exercise identified a potentially serious shortfall in the capability of WTR telemetry to support the combined Eglin and WTR workload. In particular, there appeared to be a shortage of bandwidth at S-band to support consolidated operations. On this issue, Eglin and Edwards did not reach consensus. Edwards schedulers believed that the inherent flexibility of the short-term scheduling methods would enable the WTR to provide adequate telemetry support to the Eglin mission load. Eglin schedulers did not concur.

For the purposes of this study, we did not attempt to resolve this disagreement independently. We proceeded on the conservative assumption that Eglin's view was correct and that the telemetry systems of the ranges would have to be improved to deal with this possible capability constraint.

We note that, in the Navy's response to the Eglin-Edwards scheduling exercise, China Lake reported that it would not be able to support Air Force operations at the proposed level unless the Air Force aircraft involved were upgraded to support Advanced Range Telemetry (ARTM) Tier I. The core of our analysis was determining the cost to the Air Force of upgrading all test aircraft to at least the ARTM Tier 1 standard.[31]

Basic Technical Issue

The basic technique of pulse code modulation (PCM)—sending digital data on RF—was first developed in 1926. Over the decades it has been continuously improved to carry more data in a fixed bandwidth with the lowest possible error rate.

Modern quadrature phase shift keying (QPSK) encoding systems are roughly three times as efficient in use of bandwidth than older PCM and frequency modulation (FM) systems. This is not a function of the basic radio technology of transmitters, receivers, or antennas but of the algorithm used to generate an analog signal from digital data. Even a tiny improvement in the amount of digital data that can be transmitted in a fixed bandwidth is valuable to bandwidth-constrained industries, such as cellular telephone providers. Because of the magnitude of revenues involved, the commercial world has invested heavily in recent decades on schemes to use bandwidth more efficiently. Unlike these companies, the military has not explicitly had to buy bandwidth on the open market and has, perhaps for that reason, lagged behind commercial users in adopting the most efficient techniques.

Nevertheless, WTR has invested in equipment using modern encoding, in particular, Feuer QPSK, [FQPSK], a shaped offset QPSK derivative. This system is compliant with the RCC Telemetry Standard IRIC 106 and is often referred to as *ARTM Tier 1*.[32]

However, despite the fact that the telemetry ground equipment is set up to handle FQPSK, this encoding technique cannot be used unless the aircraft transmitting the telemetry is also

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31 With increasing emphasis on jointness, the Air Force will likely have to do this anyway, as it has in other locations that use joint facilities or ranges.

32 ARTM is an OSD-funded program to upgrade telemetry systems. Tier 0 is PCM/FM; Tier 1 is shaped offset QPSK; and Tier 2 is CPM. Tier 1 capability has already been installed on the network of telemtry ground stations at Edwards.

using it. Air Force range-owned aircraft are generally equipped to transmit using PCM/FM (ARTM Tier 0). The test wings have plans to upgrade their aircraft, but these plans have not yet been implemented.

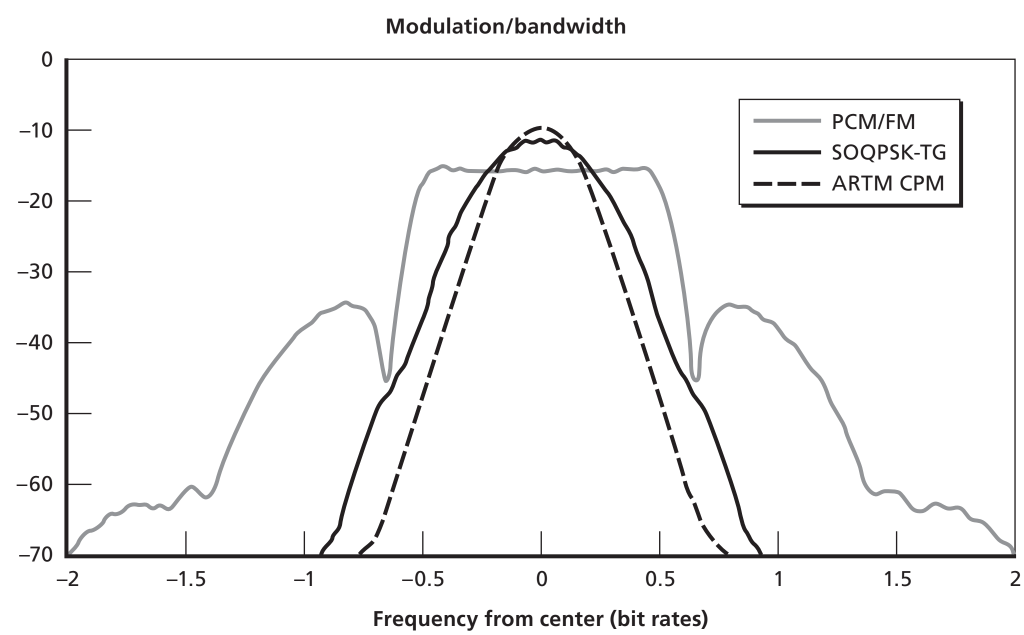
Figure 3.5 illustrates the key technical issue, the bandwidth needed to support digital encoding methods. The relatively broad shoulders of the older PCM/FM encoding systems make it difficult for other users to operate in nearby frequencies. The more-modern FQPSK system has a narrower frequency footprint, allowing more-efficient use of available bandwidth.

Cost to Upgrade

New radios will replace existing PCM/FM systems. There is no reason to believe that the replacement systems will have space, power, or cooling requirements greater than those of the systems they replace. The required radios are readily available from commercial suppliers. For our cost estimates, we assumed that the cost per radio upgrade is $5,000 and that the cost to install, test, and document the new radio is another $5,000. In addition, we assumed that the overall upgrade program would have an administrative cost of $500,000.

Except for the cost of the radios, which are commercial products, these cost estimates are arbitrary. Nevertheless, it is striking that these costs are very low compared to other costs examined in this monograph. It may appear unusual that such inexpensive, well-understood upgrades have not already been implemented. A key point here is that the Air Force has been

Figure 3.5
Modulation and Bandwidth



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able to perform its mission with the older radios. That is, even though the cost of the upgrade is very low, there has been, until now, no particular reason to make the upgrade a priority for allocation of limited funds.

Note that these costs are for upgrading aircraft radios to support consolidation of current wing capabilities. Of course, the ranges will continue to support older encoding techniques. There will likely be situations in which it is necessary or advantageous to upgrade the radios on individual weapons. We have not included that cost here.

While the formal analysis here has looked at current levels of activity, note that the Air Force will in future years migrate to more net-centric forms of warfare and that this migration will substantially increase Air Force requirements for radio communications throughput. Regardless of whether wing consolidation occurs, all Air Force ranges will have to invest in new communications capabilities. In particular, the Air Force will have to migrate to more modern methods of spectrum management, including Internet-protocol radios and spread-spectrum operations. Communications will require use of higher frequencies and more use of directional antennas.

Spectrum access will continue to be an issue. Future spectrum access will not be managed just within the T&E community but on the DoD-wide and nationals. Future tests will benefit from their distance from civilian populations and other DoD activities that raise the noise floor. However, we have not included this in the analysis reported here.

Western Test Range Effects

Edwards' analysis of the requirements generated by the scheduling exercise indicated that, based on experience, the Edwards range would have to go to a full two-shift operation. This would require an increase of 64 personnel. Edwards did not explicitly calculate hardware costs, but these are clearly small. We estimate that necessary upgrades to the telemetry capability of test wing aircraft would require a one-time charge of about $1 million.[33]

China Lake and Point Mugu would be affected considerably less than Edwards would. China Lake has estimated that, to support its share of the Eglin workload, it would need an additional ten personnel. In addition, China Lake would sustain increased recurring costs of $70,000 per year and a one-time cost of $250,000. Point Mugu estimated that it would require an additional five personnel and a one-time cost of $100,000.

Cost Assumptions

Our analysis focused on the relative costs of conducting operations at various facilities. We were not concerned with the details of how work is apportioned between, for example, civilian government employees and contractor employees or the details of each contract. We have therefore made the simplifying assumption that contractor costs per employee will be the same at all facilities except for variations caused by differences in overall wage levels in different geo-

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[33] Eglin has independently estimated a cost of $500,000. We do not dispute that number but have opted for a more-conservative assumption in this analysis.

graphic areas. For the wage-level difference, we used the differentials OPM has calculated to determine locality pay adjustments for federal employees. According to OPM, both Edwards AFB and NAWC Point Mugu are in the Los Angeles area. Both NAWC China Lake and Eglin AFB are in the "rest of the United States" category. According to OPM, federal workers should be paid 10.1 percent more if they work at Edwards or Point Mugu than if they work at China Lake or Eglin. To comply with that direction, we assumed that contractor employees will cost $100,000 per year at Point Mugu and Edwards and $90,800 per year at China Lake and Eglin. These sums do not reflect the actual labor costs of contracts at either facility but are rough estimates of the total cost to the federal government of employing people.

We assumed that Eglin would pay transition costs equal to 20 percent of other annual costs for each employee no longer required and that the facilities gaining employees would pay 50 percent of their annual cost as a transition expense. For the actual reduction in employment, we have assumed, using information from Eglin, that the range contract would be reduced by the equivalent of 698 positions. Of these, 647 are people attached to open-air testing, and 51 are in range administration.

We note that the additional employees at Edwards, Point Mugu, and China Lake would be a small group compared to the existing large workforces with the relevant skill set. Both Edwards and Point Mugu are located in areas with large labor pools. This has not always been true of Edwards in the past, but the population of the Antelope Valley, in which Edwards is located, has recently undergone rapid growth as a bedroom community, housing workers who commute to Los Angeles. These workers would find it much easier to commute to Edwards than to Los Angles. China Lake is different; it does dominate the labor market in the nearby town of Ridgecrest. However, we expect China Lake to add only ten employees, a small number compared to the 7,000 currently employed there. So, we have not assumed that heroic efforts will be needed to attract workers to any of these facilities.

Throughout, we have assumed that transition costs are incurred in FY 2009 and that recurring costs and savings begin at that time. All costs are in thousands of 2007 dollars. Table 3.4 summarizes our cost estimates for range consolidation. Total FY 2007–2011 FYDP savings equal $149 million.[34]

Observations

Economy of Scale in Range Operations. The potential cost savings from range consolidation are quite large. They also manifest themselves very quickly, showing a positive return even over the FYDP. These are attributable to the facts that range operation is very labor intensive and that range operations exhibit large economies of scale.

We were surprised by the extent of the economies of scale. However, after detailed investigation, we are convinced that they are real and are inherent in range activities. Range work includes many different activities that take place at many different physical locations. Often, the success of a test depends on coordinating many of these activities. Yet testing is often, by

[34] See Table C.12.

Table 3.4
Cost Estimate Summary for Range Consolidation

	Eglin	Edwards	China Lake	Point Mugu	Total
Number of employees	(698)	64	10	5	(619)
Cost per person ($000)	91	100	91	100	
Personnel transition costs ($000)	12,676	3,200	454	250	
Other transition costs ($000)		1,000	250	100	
Recurring costs ($000)				70	
Total transition costs ($000)	12,676	4,200	704	350	17,930
Total recurring costs ($000)	(63,378)	6,400	978	500	(55,500)

NOTE: All costs are in 2007 dollars.OTE: All costs are in 2007 dollars.
Summary over FY 2007–2011: (148,572).

nature, unpredictable. The upshot of this is that workers on the range often spend time waiting for something to happen. This may seem wasteful, but it is obviously better to have a worker in a pickup truck waiting for a B-2 to show up than the other way around.

So, in general, because there is more activity on the range, there is more opportunity for efficient scheduling, creating economies of scale. One Eglin leader commented that it takes about 500 people just to have a basic range capability. That fits with our observations. However, once one pays for that basic capability, the range can support quite a lot of activity at only modest additional cost.

From the Air Force's point of view, the question is why, given this high fixed cost of keeping a range in existence, it should have more ranges than necessary. The analyses that the ranges and RAND conducted in connection with this project indicate that the WTR is capable of supporting the entire Air Force requirement for open-air, fixed-wing, developmental testing. It is therefore not surprising that large cost savings can be achieved by consolidating operations at one range.

In principle, one might ask about the consequences of moving activity from the WTR to Eglin. We were not asked to study this issue.

Dependence on Other Activities. Consolidation of range activities cannot be achieved in isolation. Obviously it requires moving most of the 46th Test Wing's flying-hour operation to Edwards AFB. The costs and benefits of range consolidation and wing consolidation can only be considered together.

However, consolidation of open-air testing does not require moving other testing activities from Eglin AFB to the WTR. For example, the BISS is administratively connected with the Eglin open-air testing range, but there is no operational reason that it needs to be physically close to open-air testing. The analysis in this section should not be considered to comment on activities other than open-air testing.

Cooperation with the Navy. The consolidation of Eglin open-air testing and the WTR can only succeed with the cooperation of the Navy. Edwards cooperates with the Navy in many ways every day. R-2508 airspace is managed jointly. Military radio frequencies are managed jointly through the Integrated Frequency Deconfliction System. Edwards aircraft frequently deliver munitions to test sites at China Lake. However, the extent of joint cooperation would increase substantially if Air Force open-air developmental testing were consolidated in the WTR. This report has focused on the physical capabilities of the WTR and the cost implications of operations there. But there are management and policy issues in joint cooperation that deserve serious consideration and joint discussion before the Air Force commits to a path that makes it more dependent on the Navy.

User Versus Institutional Funding of Test Activity. This chapter examined the total reduction of costs to the U.S. government. We have estimated a total recurrent savings of $55 million per year to the Air Force from OAR consolidation. How much of that savings will be credited to institutional funding of the will depend on how activities are billed at the WTR. Assuming that WTR operations are 50-percent RBA and 50-percent DBA, the T&E enterprise would could realize estimated savings of $28.5 million per year, and the customer programs would save the other $28.5 million.

Cost Sensitivity to Assumptions. Two areas of uncertainty are whether the Navy can really support additional activity at the WTR with the staffing it estimates and whether the Air Force would really decide to reduce the Eglin range by 689 positions. In Table C.11, we present a case in which the Navy's staffing requirement is three times higher than in the base case and the Eglin range retains 748 staff, rather than the 509 staff retained in our base case. In that scenario, FYDP savings decrease to $78 million.

Summary

Consolidation of open-air developmental testing provides an opportunity for the Air Force to save substantial resources. These savings come from consolidation of test wing staff and increased OAR efficiency. Wing consolidation can succeed only if the Navy supports expanded Air Force activity at western Navy ranges.

CHAPTER FOUR

Facilities

Overview

As part of the PBD-720 funding cuts, AFMC identified five T&E facilities for closure or divestiture, one for mothballing, and one for reductions. The facilities are listed in Table 4.1.

Table 4.1
Facilities Proposed for Closure

Facility	Description	AFMC-Proposed Action
Central Inertial Guidance and Test Facility (CIGTF)	Inertial and GPS testing GPS jamming GPS system enhancements	Close or divest
Guided Weapons Evaluation Facility (GWEF)	Tests munitions seekers and sensors Countermeasures EO, IR, RF, millimeter wave (MMW), and laser target signatures	Close or divest
Joint Preflight Integration of Munitions Systems (JPRIMES) Facility	Simulates in-flight electromagnetic conditions Joint Air Force–Army management	Close or divest
McKinley Climatic Laboratory (MCL)	World's largest environmental test chamber Temperature, wind, precipitation, salt, dust, icing, and solar radiation	Mothball
Seeker-Signature T&E Facility (STEF)	Measures target signatures 300 ft tower and turntable	Close or divest
Benefield Anechoic Facility (BAF)	World's largest anechoic chamber Large aircraft or up to four fighters Benefield Anechoic Facility and J-PRIMES only Air Force chambers for full-size aircraft	Reduce
National Full-Scale Aerodynamic Complex (NFAC)	World's largest wind tunnel Leased from the National Aeronautics and Space Administration (NASA) Two tunnels sharing drive Only suitable facility for full-scale rotorcraft Also useful for fixed-wing aircraft at high angles-of-attack	Close or divest

To assess the effects of these proposed closures, RAND visited each facility, interviewed personnel and collected information from Air Force Headquarters, AFMC, TRMC, the test centers, and others knowledgeable about the T&E process and these activities. In addition, questionnaires were sent to selected alternative facilities to attempt to assess their ability to absorb the work displaced from the Air Force facilities.

This chapter provides a general description of each facility, along with relevant background information on the facility and its history. We then list current and near-term customers, recognizing that as much as 50 percent of the business of many T&E facilities may consist of "walk-ins," testing that was not scheduled in the initial planning process. (This is particularly true of the facilities that primarily do short-duration tests, e.g., installed system test facilities.)

We then attempt to identify and discuss the most likely alternatives available to customers, assuming that their test requirements remain constant. To collect this information, we used a combination of written sources (primarily data previously collected by TRMC) and questionnaires sent out along with the 46th Test Wing's summary descriptions of the ongoing and planned work in each facility and responses from the Navy activities involved in the transition planning exercise. It is important to recognize that these assessments should be considered to be notional because of the summary level of information exchanged and the limited time available for coordination and clarification. Still, they do give the participants' view of the available capacity. In general, none of these facilities exactly duplicates the capability of any other, so assuming equivalencies considerably oversimplifies the situation. The true comparability can be determined only by customers and subject-matter experts judging against a specific set of requirements.

The cost data used in this analysis had to be collected directly from the test organizations to get sufficient visibility into the funding of specific activities. When projections had to be made, they were generally based on FY 2006 actual costs, since this was the first year of operation under the NDAA 03 charging policies.[1] Cost estimates of the effects of facility closure or reduction on the unclassified various customers were taken from an AAC customer impact study (AAC, 2006). In most cases, documentation on how these estimates were developed was not available, and limited time and resources did not permit independent verification of estimates from the customers. All costs are presented in constant FY 2007 dollars.

Cost summaries are presented by the average annual recurring infrastructure cost (DBA) from FY 2006 through 2011. This is, effectively, the fixed cost to the Air Force of retaining

[1] The National Defense Authorization Act of 2003 (NDAA 03) changed the way test activities charge for their services. To encourage more-thorough testing, the act directed that DoD test customers would only pay the test activities for the direct (or incremental) costs incurred by testing that program. All infrastructure and overhead costs were to be funded by the military departments or defense agencies. This meant that, while programs had to pay for program-specific test activities, they could not be charged any of the fixed cost of operating, maintaining, or upgrading the test activity. These changes took effect in FY 2006. In Air Force terminology, institutional funding is referred to as DBA, and customer charges are referred to RBA).

these facilities. It includes military personnel costs but excludes improvement-and-modernization costs and customer costs.

The full operating costs of the facilities from FY 2007 through 2011 are presented for both continued operation (status quo) and after the AFMC proposal reductions.[2] These costs include recurring infrastructure, nonrecurring improvement and modernization, closure costs, costs to other services to assume divested workload, and customer test costs (RBA) that include test costs paid by the users and the AAC estimates of additional costs T&E customers would incur as a result of the AFMC proposal. (Customer usage costs are assumed constant across both alternatives per our ground rule that customer test content must be held constant under all alternatives.) Appendix D provides additional detail on the costs for each facility.

Central Inertial and Guidance Test Facility

Description

The CIGTF is located at Holloman AFB, New Mexico, adjacent to the White Sands Missile Range and is operated by the 746th Test Squadron.[3] It provides testing services for GPS and inertial navigation systems in laboratory, ground, flight, and high-speed sled environments. It can provide highly precise time, speed, and position information in clear or jamming environments. It has extensive GPS jamming capabilities and has the open-air range and clearances to conduct these tests. For testing inertial systems, it has rate tables, an environmental test chamber, and a 50-g three-dimensional centrifuge housed in a seismically quiet facility. These high-precision capabilities are needed for testing intercontinental ballistic missile guidance systems (CIGTF's original mission) and directed-energy pointing systems.

The 746th Test Squadron consists of 88 civilians (25 of whom are dedicated to supporting the high-speed test track, flight test instrumentation, and information technology support), 22 military personnel, and 7 contractors. Its location in southern New Mexico provides access to the White Sands Missile Range for open-air jamming tests, use of the 10-mi-long Holloman High-Speed Test Track to verify and calibrate references, and a seismically stable area for precise inertial testing. CIGTF is currently operating at approximately 85 percent of capacity (personnel limited).

Customers

CIGTF has state-of-the-art capability for testing the following:

- inertial navigation systems
- GPS user equipment

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2 For the facilities portion of the analysis, AFMC's reductions were taken as proposed with the exception of delaying action on J-PRIMES until FY 2009 to better coordinate with the timing of the proposed test wing and flight- test consolidation.

3 The information in this section is taken from communications with 746th Test Squadron; AAC, 2006; TRMC, 2006g; AFMC, 2007b.

- integrated or embedded GPS and inertial systems (EGI)
- GPS performance in jamming environments
- GPS precision landing systems
- GPS system enhancements.

Figure 4.1 shows the distribution of test workload for FYs 2004 through 2006. Table 4.2 lists CIGTF's customers for FY 2007.

Alternatives

No alternative facilities perform the range and quality of navigation testing available at CIGTF. The 1995 BRAC commission directed the consolidation of DoD inertial guidance testing at CIGTF. The extreme precision required for inertial systems in ICBM and directed energy pointing applications requires the significant infrastructure and expertise available at CIGTF, particularly the centrifuge and precisely instrumented sled track. CIGTF has also become the primary DoD facility for GPS testing, particularly for high-velocity systems in a jamming environment. The combination of GPS and inertial guidance into an embedded EGI system (installed in F-15, F-16, F-22, F-35) requires robust test capabilities in both areas.

The Naval Air Warfare Center at China Lake, California, has some capability for testing tactical weapon navigation systems but lacks the precision needed for some applications. According to TRMC, China Lake's capacity for GPS jamming tests is restricted because of interference with other range users and the difficulty of getting necessary clearances for GPS jamming. The sled track at China Lake is less than half as long as the one at Holloman and

Figure 4.1
CIGTF Labor by Test Type

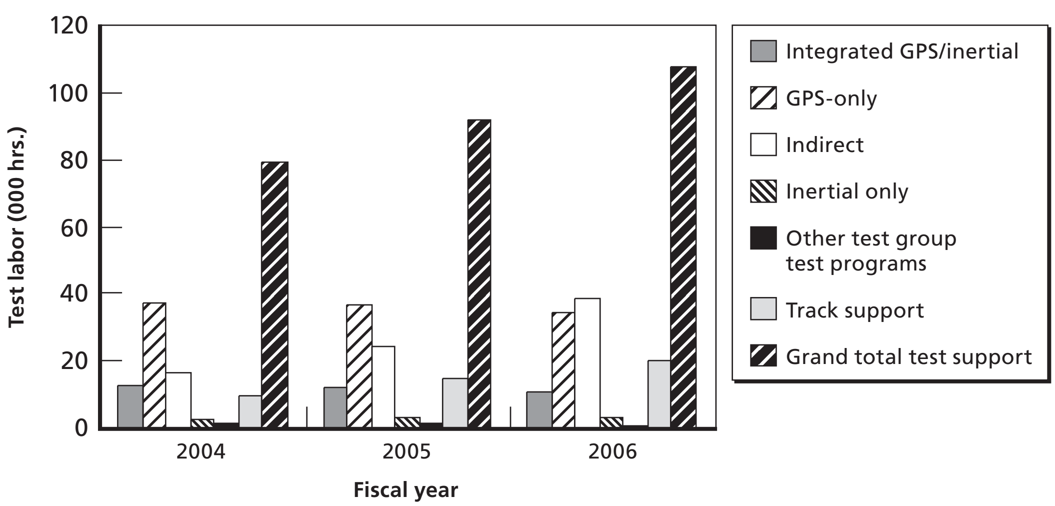

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Table 4.2
CIGTF FY 2007 Customers

Period	Program	Type of Test
October 2006	JPALS	GPS/inertial
	T-38 FLDR	Inertial
	TBC	Inertial
	TELCOM SIM	GPS
November 2006	JPALS	GPS/inertial
	HST	Inertial
	TBC	Inertial
December 2006	ALCM	GPS/inertial
	BTERM	GPS/inertial
	HST	Inertial
	GCCU	GPS/inertial
	Micro GPS Jam	GPS
January 2007	OP32	GPS
	SPACE TELESCOPE	Inertial
	MICRO GPS JAM	GPS
	F16-EGI	GPS/inertial
	MICRO GPS JAM	GPS
	SPACE TELESCOPE	Inertial
	OP32	GPS
	B-52 AMI	GPS/inertial
March–September 2007	MH-53	GPS/inertial
	T-38 FLDR	Inertial
	CV-22	GPS/inertial
	Micro GPS Jam	GPS
	Anomaly Resolution	SMC
	TBC	Inertial
	WSEP	GPS
	F-16 EGI	GPS/inertial
	BTERM GUFT	GPS/Inertial
	SDB	GPS
	EKV IMU	Inertial

Table 4.2—Continued

Period	Program	Type of Test
	AEP	GPS
	Talon Gnarly Head	GPS
	Talon Namath	GPS
	Ginger Doe	GPS/inertial
	RADIX	GPS/inertial
	C-130 AMP	GPS/inertial
	JIPSM	GPS
	MAGR ECP-50	GPS
	GYPSY GOLF	GPS
	TELSIM	GPS

lacks comparable precision measurement capabilities. TRMC also determined that China Lake has limited capacity for additional work because of staffing limitations.

The Army Electronic Proving Ground at Ft. Huachuca, Arizona, can do limited GPS testing for low-dynamic systems (no aircraft or missiles) in a jamming environment. It has no inertial capability.

Neither China Lake nor Ft. Huachuca can provide precise time, speed, and position information in a jamming environment.

Costs

RAND collected cost and staffing data from the 746th Test Squadron. These data were analyzed and used to develop costs for continuing operations as currently planned (status quo) and the AFMC proposal. For the purposes of this analysis, the staffing cuts associated with the AFMC proposal were phased in over FY 2008. A 25-person staff was assumed to remain to provide the required support to the sled track, flight instrumentation, and help desk. The customer cost effect of $13.7 million per year for all customers was taken from the AAC study. This figure could not be independently verified.

As is shown on Table 4.3, the annual cost of operating the CIGTF, exclusive of improvement and modernization projects, is approximately $7.7 million. AFMC's proposed plan results in a negative net savings, due to the substantial effects on customer costs.

Conclusions

The CIGTF performs an important role in an era of increased emphasis on long-range, precision-guided munitions that must frequently operate under the constraint of minimizing collateral damage. Achieving these objectives requires precise navigation for both the weapon and

Table 4.3
CIGTF Cost Results ($000 FY 2007)

	AFMC	Customers	Total
Average annual recurring DBA	7,680		7,680
Status quo operation, FYs 2007–2011	50,193	39,681	89,874
The AFMC proposal, FYs 2007–2011	19,795	94,648	114,443
Savings, FYs 2007–2011	30,398	(54,967)	(24,569)

the platform. In addition, the proliferation of GPS-aided guidance systems raises the need for robust testing against potential countermeasures, such as jamming. The variability of jamming effects that are due to aspect, shadowing, signal strength, and reflections makes the ability to test the complete system under realistic operational conditions essential.

Another important consideration is the specialized knowledge of the 746th Test Squadron staff. The GPS Joint Program Office depends on their expertise to test the GPS space segment signals and to control segment software upgrades.

Considering the uniqueness and importance of the CIGTF testing capabilities, the large number of programs that use its services, and the relatively small infrastructure savings divestment could achieve, it appears that it would not be cost-effective to close this facility.

Guided Weapons Evaluation Facility

Description

The GWEF is an HITL facility with 13 test areas for testing air-to-air, air-to-surface and surface-to-air seekers and sensors.[4] It creates a virtual environment to allow simulation and stimulation of actual hardware operating in the EO, IR, laser, RF, and MMW spectra. The GWEF can provide the following types of test support:

- munitions performance assessment (miss distance, probability of kill, etc.)
- countermeasure effectiveness assessment
- preflight predictions and post-flight analysis
- seeker and sensor parametric characterizations
- high-power microwave effects
- validated target and background models (both ground and aerial)
- EO, IR, RF, MMW, and laser target signatures.

The GWEF is housed in a secure 94,000 ft^2 facility at Eglin AFB and is operated by the 46th Test Wing. The facility has nine flight motion simulators and four high-fidelity IR scene

[4] The information in this section is taken from communications with 46th Test Wing; communications with 412th Test Wing; AAC, 2006; TRMC, 2006c; AFMC, 2007b; NAWCWD briefing; Dyess, 2007f; and Dyess, 2007c.

projectors and is the sole provider of robust imaging IR countermeasure simulators. It can provide validated target, background and countermeasure simulations depending on customer requirements.

The approximately 50-person staff of government employees and contractors has extensive expertise in U.S. and foreign weapon guidance and control. The staff develops validated CHAMP IR target signature models for DoD, the intelligence community, and others. They also maintain all signature data for Eglin activities.

Customers

Because of the nature of the testing done in the GWEF and the effort required to tailor and set-up the test environment, customers typically plan to use the facility for extended periods, often years. Table 4.4 shows GWEF customers for FY 2007 and out, planned durations, manpower, project days and estimated effect on customers of closing the GWEF.

Alternatives

One of the challenges in a study of this type is to compare alternatives with similar but not identical capabilities. A number of other facilities have capabilities similar to the GWEF's. Within the Air Force, the AFEWES at Ft. Worth, Texas, could assume at least some part of the GWEF workload. AFEWES is a smaller government owned, contractor operated facility, emphasizing shorter-duration IR testing for many customers against various threats. RF threats can be simulated via signal injection.

In its response to a data call requesting information on its ability to assume the workload of the GWEF, the 412th EWG's assessment was that, while the AFEWES has the capability to assume most GWEF test activities, it would have capacity constraints. This would result in a shortfall for IR customers of 400 to 600 days per year for the work defined. The additional GWEF workload for classified programs was not provided and thus could not be assessed.

Another potential alternative facility is the Navy's Integrated Battlespace Arena (IBAR) at the Naval Air Warfare Development Center Weapons Division (NAWCWD), China Lake, California. The IBAR is a 50,000 ft^2 integrated weapon-development laboratory consisting of ten interconnected facilities. The IBAR has a broader focus than does GWEF, including mission planning, networking and information exchange, virtual prototyping, operation of unmanned aerial vehicles, and GPS/inertial systems. Its anechoic facilities are smaller but generally comparable to those of the GWEF, with the exception the lack of a MMW capability. The IBAR does not have the GWEF's resistor array technology for target simulation.

The Navy provided rough estimates of what would be required to absorb approximately 70 percent of the GWEF workload at IBAR.[5] The assumption was that two 5-axis tables would be transferred from the GWEF and reinstalled at China Lake. This would require a new pump house and modifications to the existing labs. The modifications are estimated to cost approxi-

[5] These estimates did not include the classified programs, SDB ll, or approximately half the activities of the Eglin Signatures Data Center.

Table 4.4
Affected Customers

Customer	Dates	Type	Man-Hours	Project Days	Anticipated Effect of Closing GWEF
HITL Dynamic Msl Sim	07/06–11/06	DoD	1,500	90	Classified
Direct Infrared Countermeasures Technology Assessment Program—CH53	12/05–11/06	DoD	12,000	240	Cannot complete 20 percent of test matrix, data reduction or reporting. IR countermeasure systems will not be fully tested, putting CH53 crews at risk.
DOME Phase II	09/06–02/07	DoD	1,500	80	Classified
DHS-BAE Commercial	8/06–03/07	Comm	2,800	140	BAE Systems will not complete testing, which will affect ability to produce commercial aircraft protection system.
Large Aircraft Survivability Initiative (LASI) Boeing 747	01/03–06/07	DoD	24,000	1,200	LASI will not complete testing, which will affect assessment of commercial and DoD aircraft survivability. Will directly affect airborne laser live-fire T&E schedule.
LASI/TSA Boeing 737	01/06–12/07	Gov	6,000	300	LASI will not complete the IR model, which will affect TSA's ability to assess commercial/DoD aircraft survivability.
I&M Scene Characterization and Reconstruction for Advanced Munitions	10/01–5/07	AFMC DBA	11,900	1,248	Cannot complete final integration of capabilities, affecting most GWEF customers adversely.
I&M Air Moving Target Indicator	10/08–09/14	AFMC DBA	27,000	624	Cannot execute program. Existing equipment will be obsolete and unsupportable, affecting all GWEF customers. Emerging R&D programs involving GPS, IIR, laser detection and ranging, low-observable technologies will be unsupported, increasing program risk.
Advanced Threat IR Countermeasure	08/05–09/08	DoD	1,500	300	Cannot complete testing and will significantly affect ability to assess effectiveness of its IR countermeasures systems.
LASI/NASA Boeing 757	02/07–09/07	DoD	12,000	250	LASI will not complete testing, which will significantly affect NASA's ability to assess commercial/DoD aircraft survivability.
DHS-Counter MANPADS	11/06–09/07	DoD	7,200	175	DHS will not complete testing, which will affect its schedule to produce commercial aircraft protection system and increase risk.

Table 4.4—Continued

Customer	Dates	Type	Man-Hours	Project Days	Anticipated Effect of Closing GWEF
SDBII	07/06–TBD	DoD	TBD	TBD	Timeline under negotiation. Prime contractor for SDBII will be severely limited in HITL testing options, and will see increased schedule risk.
Eglin Signatures Data Center	10/03–09/08	DoD	12,500+	1,300+	EO/IR/frequency response/MMW/Acoustic community will be without support to obtain signature data, increasing cost and risk to programs.
GTS	10/03–09/12	DoD	150,800+	2,470+	Classified
Large Aircraft IR Countermeasures	10/02–09/12	DoD	115,440+	1,950+	This will not complete significant amount of budgeted testing. Less testing means higher program risk in fielding the current program and highly increased technical risk.
Miniature Air-Launched Decoy (MALD)	10/03–09/08	DoD	41,240	1,180	MALD's prime contractor, Raytheon, will lose its only HITL test capability, greatly increasing technical risk to program.

SOURCE: Dyess (2007f).

mately $4 million to 6 million. No estimate was provided for the cost of moving the rate tablesfrom Eglin and installing them at China Lake. The Navy estimated one-time costs of $2 million to validate the new environment on completion and $0.4 million to manage the details of the transfer and that 10 additional personnel would be required ($2 million per year). It also estimated that these actions would support the transition of one program requiring the use of a rate table and all those not requiring rate tables within six months, with the remaining customers complete in 12 to 18 months.

A third facility that has capabilities similar to the GWEF's is the Redstone Technical Test Center (RTTC) in Huntsville, Alabama. The RTTC has four HWIL facilities and is developing two more. The current facilities can support 11,776 facility hours per year. Although the Army response indicated that RTTC had the relevant capability, it made no specific assessment of capacity, citing the tailoring required for HWIL testing. Without a detailed understanding of the customer requirements and schedule, the Army was unable to estimate the costs of adapting its hardware and software to the needs of GWEF customers.

Costs

RAND collected cost and staffing data from the 46th Test Wing. These data were analyzed and used to develop costs for continuing operations as currently planned (status quo) and the AFMC proposal. For the purposes of this analysis, the staffing cuts associated with the AFMC proposal were phased in during FY 2007. Approximately $4 million was included for deactivation. To reestablish the GWEF workload at the IBAR, the Navy estimate of $6 million in FY 2007 and $1.7 million thereafter was included as an additional institutional cost to the Air Force. The customer cost effects used to calculate the AFMC proposal costs were taken from the AAC study. This number could not be independently verified.

As is shown on Table 4.5, the annual cost of operating the GWEF, exclusive of improvement and modernization projects, is approximately $6.3 million. The the AFMC proposal plan results in a negative net savings because of the substantial effects on projected customer costs.

Conclusions

Given the information available to us, it is not clear that sufficient excess capacity exists to support GWEF customers in the near term. IBAR could, with some investment, assume a significant portion of the GWEF workload. AFEWES has limited additional capacity. The Army was unable to provide an estimate of the RTTC's ability to take on the GWEF workload without detailed requirements for each customer.

The advantages of proximity to the munitions program offices, the Air Force Research Laboratory munitions group, the operational test community, and the various range facilities are real but hard to quantify. The effect on customers is likewise difficult to estimate. Although the user analysis AAC conducted projects cost effects in excess of the institutional funding needed to operate the GWEF, these estimates could not be independently assessed because of the limited documentation and time constraints.

There are other facilities with similar, albeit not identical, capabilities. Since partial capabilities can often be adapted to meet customer demand, the issue comes down to capacity. The GWEF is currently staffed to operate about half of its facilities. Transferring its workload into alternative facilities would undoubtedly save some portion of its fixed costs (approximately $6 million per year). However, assessing this option requires a more-detailed study of the costs and potential effects on specific customers because this would be a complex process with significant potential disruption to ongoing programs. The advantages of continuing to operate the GWEF are that variable customer demand can be met with minimal disruption and that the intellectual capital and infrastructure can be preserved, enabling timely response to emerging threats and a higher confidence in the mission performance of weapons and countermeasures.

Table 4.5
GWEF Cost Results (FY 2007 $000)

	AFMC	Customers	Total
Average annual recurring DBA	6,316	N/A	6,316
Status quo operation, FYs 2007–2011	32,058	13,181	45,239
AFMC proposal, FYs 2007–2011	22,724	101,781	124,505
Savings, FYs 2007–2011	9,335	(88,600)	(79,265)

Joint Preflight Integration of Munitions and Electronic Systems Facility

Description

The J-PRIMES facility, located at Eglin AFB consists of six laboratories that can be linked or operated independently.[6] This facility is part of the overall installed systems testing capability found at Eglin and simulates in-flight scenarios for both fixed- and rotary-wing aircraft. Simulations run at J-PRIMES make it possible to evaluate the performance of various weapon systems within a specified electromagnetic environment. A range of analyses can be conducted, including IR, laser, inertial, and GPS guidance, to assess the operation of the systems and effectiveness of various countermeasures. To conduct these tests, J-PRIMES uses an anechoic chamber large enough to hold and test full-size Air Force and Navy tactical aircraft, as well as Army helicopters. The anechoic chamber is equipped with a 40-ton hoist.

The J-PRIMES facility operates under a joint business model that includes the 46th Test Wing and the Army's RTTC. The 46th Test Wing staff of J-PRIMES consists of six civilians and five contractors. According to TRMC, the workload at J-PRIMES is currently 60-percent Air Force and 40-percent Army testing.

Customers

J-PRIMES is capable of testing

- multispectral moving targets
- GPS satellite constellation
- C4ISR communication links
- dynamic flight motion for aircraft stores
- electromagnetic interference
- electromagnetic compatibility
- communications and navigation noise floors
- antenna pattern measurements.

J-PRIMES customers, schedules, and potential effects of closure for FY 2007 are shown in Table 4.6. It should be noted that, for installed-systems test facilities, such as J-PRIMES, user requirements and schedules tend to vary considerably, so forecasts over 12 months in advance tend to be uncertain.

Alternatives

The primary focus of the testing performed at J-PRIMES is the anechoic chamber, in which all the electromagnetic environmental effects (E3) testing is performed. Inside the chamber is advanced instrumentation for simulating the various threats. Anechoic chambers exist at several other locations. Possible alternatives to Eglin's J-PRIMES include NAWCWD's Air Combat

[6] The information in this section is taken from communications with 46th Test Wing; communications with 412th Test Wing, AAC, 2006; TRMC, 2006c; AFMC, 2007b; Dyess, 2007f; and Dyess, 2007c.

Table 4.6
Affected J-PRIMES Customers, Schedules, and Closure Effects

Customer	Dates	Type	Man-Hours	Project Days	Anticipated Effects of Closing J-PRIMES
MALD	09/06–10/06	DoD	1,920	30	Schedule delay Cost increase Technical development of threat scenarios Customer will likely test at Benefield Anechoic Facility
UC-35D	10/06–10/06	DoD	320	10	Schedule delay Cost increase Customer would test in open air
DJC2	08/06–09/06	DoD	900	15	Schedule delay Cost increase Open-air testing
URE	10/06–10/06	DoD	576	12	Schedule delay Cost increase Instrumentation technical development Customer would test in open air
CH-47F	11/06–11/06	DoD	320	10	Schedule delay Cost increase Customer would test in open air or at RTTC
A-10 SADL	11/06–12/06	DoD	768	12	Schedule delay Cost increase Customer would test in Benefield Anechoic Facility or Patuxent River
Theater High-Altitude Area Defense (THAAD)	12/06–12/06	DoD	720	18	Schedule delay Cost increase Customer would test in open air or at RTTC
UH-60M	12/06–12/06	DoD	320	10	Schedule delay Cost increase Customer would test at RTTC or Patuxent River
HH-60M	01/07–01/07	DoD	320	10	Schedule delay Cost increase Customer would test at RTTC
MH-53	01/07–02/07	DoD	1,920	30	Schedule delay Cost increase Negative effect on threat scenario technical development
Active Radar Homing	02/07–02/07	DoD	600	15	Schedule delay Cost increase Customer would test at RTTC or Patuxent River
URE	03/07–03/07	DoD	960	15	Schedule delay Cost increase Negative effect on instrumentation technical development Customer would test in open air

Table 4.6—Continued

Customer	Dates	Type	Man-Hours	Project Days	Anticipated Effects of Closing J-PRIMES
U2 ALQ 221	Multiple	DoD	1,440	30	Schedule delay Cost increase Negative effect on threat scenario technical development Customer would seek alternate location.
TASKER	Multiple	DoD	480	20	Schedule delay Cost increase
SFW	Multiple	DoD	120	5	Schedule delay Cost increase

SOURCE: Dyess (2007f).

Environment T&E Center (ACETEF), and the Benefield Anechoic Facility at Edwards AFB. The ACETEF is located at the Navy's testing facilities at Patuxent River, Maryland. Both locations have similar chambers and the potential to house the required test equipment.

Capacity at the other facilities could be a constraint. The current facilities at ACETEF would not be able to absorb 100 percent of the testing being conducted at J-PRIMES. A Navy review of the workload indicates that a new anechoic chamber, and the manpower associated with running it, may be required to conduct all J-PRIMES, as well as existing ACETEF testing workload. In addition, these two locations do not house exactly same the instrumentation, and thus some expense would be incurred to bring them up to the level of maturity of J-PRIMES. Another real, but hard-to-quantify, issue at J-PRIMES is the staff, which has a breadth and depth of experience that would probably take considerable time and effort to reconstitute. Also, both alternatives lack the small, specialized laboratories that J-PRIMES uses to conduct unique weapon-specification testing. Yet another significant consideration is collocation of such facilities with the test ranges. The test facilities are often used for pre- and post-flight testing and analysis for tests conducted on adjacent ranges. Separating the installed-system testing from the test range will result in a much less efficient use of time and resources.

The 412th Test Wing EWG has evaluated the J-PRIMES workload and concluded that the Benefield Anechoic Facility, at its current capacity, could assume the J-PRIMES Air Force workload and a small portion of its Army work. In addition, if the flight-testing mission were to be consolidated on the western test ranges, the Benefield Anechoic Facility would become the preferred facility to perform pre- and post-flight testing for flights there.

The availability of the Benefield Anechoic Facility as an alternative, however, depends on the resolution of PBD-720 reductions to that facility. If subject to the 40-percent capacity reduction proposed by AFMC, the Benefield Anechoic Facility would be able to assume less than half the Air Force portion of the J-PRIMES workload.

Costs

RAND collected J-PRIMES cost and staffing data from the 46th Test Wing. These data were analyzed and used to develop costs for continuing operations as currently planned (status quo) and the AFMC proposal. For the purposes of this analysis the staffing cuts associated with the AFMC proposal were phased in FY 2009 to coincide with the proposed shift of flight testing to the western ranges. Approximately $7 million was estimated by the 46th Test Wing for deactivation. The customer cost effect of $2.7 million in the first year and $0.2 million in subsequent years used to calculate the AFMC proposal costs was taken from the SAF/AQ study. This figure could not be independently verified.

As Table 4.7 shows, the annual cost of operating the J-PRIMES, exclusive of improvement and modernization projects, is approximately $1.4 million. The the AFMC proposal plan results in a negative net savings because of the effects on customer costs.

Conclusions

The testing conducted at J-PRIMES is fundamental to evaluating the performance of both fixed- and rotary-wing aircraft electronic systems within a range of electromagnetic environments. The instrumentation located at J-PRIMES can generate a range of conditions that cannot be generated elsewhere and much more effectively than what can be done in flight test. J-PRIMES is particularly valuable for pre- and post-flight evaluations in conjunction with range testing. Its relatively low cost and proximity to the Eglin range would argue against its closure. The Army, which depends heavily on J-PRIMES, has unofficially expressed interest in operating it should the Air Force decide to divest it.

McKinley Climatic Lab

Description

The MCL, with its 200 x 250 x 70 ft main test chamber, is the world's largest environmental test chamber and is DoD's primary climatic test facility.[7] Unlike smaller climatic test cham-

Table 4.7
J-PRIMES Cost Results (FY 2007 $000)

	AFMC	Customers	Total
Average annual recurring DBA	1,407	N/A	1,407
Status quo operation, FYs 2007–2011	7,254	4,586	11,840
The AFMC proposal, FYs 2007–2011	9,667	7,686	17,353
Savings, FYs 2007–2011	(2,412)	(3,100)	(5,512)

[7] The information in this section is taken from communications with 46th Test Wing; AAC, 2006; TRMC, 2006c; AFMC, 2007b; Dyess, 2007f; and Dyess, 2007c.

bers, it can accommodate full-scale test articles up to and including C-5-size aircraft. It can provide test environments with temperatures from –65 to +165°F, relative humidity from 10 to 100 percent, rain up to 25 inches per hour, wind, snow, icing, salt spray, sand, dust, and solar radiation. The advantages of having this variety of test environments in a single accessible location, particularly for such large systems as aircraft, are obvious.

A significant part of the infrastructure of the McKinley Climatic Lab is devoted to the temperature control system and the air make-up system, which allows aircraft and engines to be operated for up to 60 minutes while maintaining the desired environmental conditions. By virtue of its size and open area, personnel can perform normal operational, maintenance, and repair functions with normal support equipment in a full range of stressing operational environments. In addition to the main test chamber, the MCL has five smaller test chambers, one of which can also support aircraft engine operation.

The MCL completed a $100 million renovation in 1997. It is currently staffed to operate two of its six chambers simultaneously. Because of the large number of users desiring environmental testing, customers reimburse nearly 100 percent of MCL direct costs. The Air Force Advanced Cruise Missile and Air-Launched Cruise Missile (ACM/ALCM) program is a long-term user that has invested $30 million in the MCL to conduct its in-service reliability testing. The test facility allows it to operate the selected missile's propulsion system in various environmental conditions without having to expend the missile. This preserves an expensive weapon, which can then be refurbished and returned to service.

Customers

Table 4.8 lists the customers scheduled for the MCL after October 1, 2006.

Alternatives

With the exception of small environmental chambers, the alternative to conducting climatic testing at the MCL is to attempt to find the required conditions in nature. While theoretically possible, the principal drawbacks of open-air testing are the time and travel costs for the test team, the system under test, and the instrumentation to get to remote locations and potentially having to wait to achieve the approximate test conditions. Test quality can also be compromised by the lack of control over naturally occurring conditions, singly or in combination.

The 46th Test Wing examined various alternatives to reducing costs at the MCL. The wing estimated that closing the facility would cost $25 million, primarily because of the requirement to dispose of thousands of gallons of hazardous materials (primarily refrigerants) and subsequent site decontamination. This would also preclude subsequent reactivation.
Another possibility considered was to mothball the facility so that it could be restored to operation at some future date. The 46th Test Wing estimated that the cost to mothball the MCL would be $3.5 million per year to retain the capability to resume normal operations within 6 months. The estimate for retaining any capability to restart was $2.1 million per year. This would allow minimal maintenance and preservation of the facility and equipment. This was

Table 4.8
Affected MCL Customers, Schedules, and Closure Effects

Customer	Dates	Type	Man-Hours	Project Days	Anticipated Effects
MRA4 Nimrod	09/10–11/10	UK Ministry of Defence	5,904	41	Significant No alternative facility available worldwide.
Chem/Bio Shelter	10/10–11/10	U.S. Air Force	1,296	9	Significant No alternative facility available worldwide.
20mm Gun	10/10–10/10	U.S. Air Force	1,728	12	Significant problem for cost and schedule Could be done elsewhere.
Chem/Bio Shelter	10/10–10/10	U.S. Air Force	1,152	8	Significant No alternative facility available worldwide.
FMC Technologies Aircraft Cart	11/10–11/10	U.S. Air Force	1,008	7	Significant problem for cost and schedule Could be done elsewhere.
Army Shelter (28 TS)	11/10–11/10	U.S. Army	720	5	Significant No alternative facility available worldwide.
FAA Prop Icing	11/10–11/10	FAA Government	2,448	17	Significant No alternative facility available worldwide.
Chem/Bio Shelter	11/10–11/10	U.S. Air Force	2,160	15	Significant No alternative facility available worldwide.
Alaska Structures	11/10–11/10	U.S. Air Force	720	5	Significant No alternative facility available worldwide.
Hamilton Sunstrand Auxiliary Power Unit	11/10–12/10	Commercial (Boeing 787)	1,728	12	Significant problem for cost and schedule Could be done elsewhere.
PW545C Jet Engine	11/10–12/10	Commercial	3,744	26	Significant problem for cost and schedule Could be done elsewhere.
Hamilton Sunstrand Auxiliary Power Unit	12/10–12/10	Commercial (Airbus A400M)	1,872	13	Significant problem for cost and schedule Could be done elsewhere.
Honeywell HTS900 Engine	01/11–01/11	Commercial (Sikorsky helicopter)	3,168	22	Significant problem for cost and schedule Could be done elsewhere.
Cruise Missile	01/11–02/11	U.S. Air Force (ACM and ALCM)	6,768	47	Significant No alternative facility available worldwide.
Cessna Aircraft	01/11–02/11	Commercial	2,016	14	Significant No alternative facility available worldwide.

Table 4.8—Continued

Customer	Dates	Type	Man-Hours	Project Days	Anticipated Effects
PW617 Jet Engine	02/11–03/11	Commercial	5,040	35	Significant problem for cost and schedule Could be done elsewhere.
F-22	03/11–05/11	U.S. Air Force	6,624	46	Significant No alternative facility available worldwide
PW617 Jet Engine	04/11–04/11	Commercial	3,024	21	Significant problem for cost and schedule Could be done elsewhere.
C-5	05/11–06/11	U.S. Air Force	6,624	46	Significant No alternative facility available worldwide.
Cessna Aircraft	06/11–06/11	Commercial	864	6	Significant No alternative facility available worldwide.
PW210 Jet Engine	06/11–09/11	Commercial	10,368	72	Significant problem for cost and schedule Could be done elsewhere.
Williams International Jet Engine	09/11–09/11	Commercial	3,024	21	Significant problem for cost and schedule Could be done elsewhere
PW535 Jet Engine	09/11–11/11	Commercial	6,192	43	Significant problem for cost and schedule Could be done elsewhere
Cessna Aircraft	10/11–10/11	Commercial	1,008	7	Significant No alternative facility available worldwide
PW210 Jet Engine	10/11–11/11	Commercial	4,896	34	Significant problem for cost and schedule Could be done elsewhere
C-130	11/11–12/11	U.S. Air Force	4,752	33	Significant No alternative facility available worldwide.
Cruise Missile	See note	U.S. Air Force (ACM and ALCM)			Significant No alternative facility available worldwide
CH-148 Helicopter	01/08–2/08	Commercial (S-92 Variant)	7,200	50	Significant No alternative facility available worldwide.
THAAD	03/12–05/12	U.S. Army	12,960	90	Significant No alternative facility available worldwide.
Honeywell HGT1500 APU	01/13–03/13	Commercial (Airbus A350)	12,816	89	Significant problem for cost and schedule Could be done elsewhere

Table 4.8—Continued

Customer	Dates	Type	Man-Hours	Project Days	Anticipated Effects
JLENS	03/14–05/14	U.S. Army	8,784	61	Significant No alternative facility available worldwide.
SAR Helicopter	06/14–07/14	U.S. Air Force U.S. Coast Guard	8,640	60	Significant; No alternative facility available worldwide.
P-3 Replacement Aircraft	08/14–10/14	U.S. Navy	12,960	90	Significant No alternative facility available worldwide.
F-35	05/15–09/15	U.S. Marines U.S. Navy U.S. Air Force Internationals	19,440	135	Significant No alternative facility available worldwide.

SOURCE: Dyess (2007f).

NOTE: The ACC Cruise Missile Product Group invested approximately $30 million in FYs 2005 and 2006 to develop a unique capability in MCL to conduct functional ground test of ACM and ALCM nuclear cruise missiles at the McKinley Climatic Lab. Tests are currently planned, and closure will negate much of this investment.

the alternative AFMC chose and is shown in our cost analysis. (For comparison, the corresponding cost of operating the facility is given as approximately $1.5 million per year because of the high percentage of costs reimbursed by customers.)

Costs

RAND collected MCL cost and staffing data from the 46th Test Wing. These data was analyzed and used to develop costs for continuing operations as currently planned (status quo) and the AFMC proposal. For the purposes of this analysis, the facility was assumed to be in a mothball status per the AFMC proposal in FY 2007. The 46th Test Wing estimated an annual cost of maintaining the facility in a mothball status of approximately $2.1 million. The customer cost of $10 million to 46 million used to calculate the cost under the AFMC proposal was taken from the AAC study. These figures could not be independently verified.

As Table 4.9 shows, the annual cost of operating the MCL, exclusive of improvement and modernization projects, is approximately $1.5 million. The AFMC proposal plan results in a negative net savings because of the customer costs.

Conclusions

The MCL is the primary DoD facility for climatic testing. It can replicate a full range of environmental conditions and can accommodate large aircraft operating their engines and other installed systems. The variety of users who value this capability can be inferred from examining the MCL customer list in Table 4.8.

The institutional funding required to operate this facility at its current capacity is approximately $1.5 million per year, which is, interestingly, less than the estimated annual cost of

Table 4.9
MCL Cost Results (FY 2007 $000)

	AFMC	Customers	Total
Average annual recurring DBA	1,455	N/A	1,455
Status quo operation, FYs 2007–2011	7,794	17,500	25,294
The AFMC proposal, FYs 2007–2011	10,627	130,000	140,627
Savings, FYs 2007–2011	(2,833)	(112,500)	(115,333)

maintaining the facility in a mothballed but nonoperational state. Setting aside the difficult-to-quantify customer effect of either transitioning to open-air testing, testing at the component level only, or simply reducing climatic testing, it is clear that the financial benefits of closing or mothballing the MCL are negligible, and the risks to DoD and other users are considerable.

Seeker and Signature Test and Evaluation Facility

Description

The STEF is located on the range at Eglin AFB, Florida.[8] This open-air facility enables target signature measurement through its 300-ft seeker evaluation tower, stationary platforms, rail system with turntables, and 2,500-lb capacity hoist that can move at a rate of 25 ft per second. In addition, the STEF permits testing with depression angles from 0 to 81.5 degrees. The STEF has an on-site data analysis system. This combination of equipment allows testing of air-to-ground seeker sensors on targets in all practical positions, including below ground level. This facility is an HITL evaluation center, permitting testing on full-scale targets for full characterization of IR, RF, and MMW signatures. The STEF is one constituent of the 46th Test Wing's portfolio that allows for full-spectrum signal analysis.

The STEF is directly supported by seven people, four civilians and three contractors.

Customers

Table 4.10 lists the customers scheduled for the STEF after October 1, 2006.

Alternatives

No current facility offers the full range of precision measurement testing that is available at STEF. Unique to the STEF are the data collection on low-observable ground vehicles and the availability of Defense Intelligence Agency–Missile and Space Intelligence Center (MSIC)–validated calibration and processing software tools. The 2005 BRAC report recommended

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[8] The information in this section is taken from communications with 46th Test Wing; AAC, 2006; TRMC, 2006c; AFMC, 2007b; Dyess, 2007f..

Table 4.10
Affected STEF Customers, Schedules, and Closure Effects

Customer	Dates	Type	Man-Hours	Project Days
ACC—IR	10/05–09/08	DoD	2,100	75
ACC—MMW	10/05–09/08	DoD	10,368	384
MALD Phase II—MMW	04/07–08/07	DoD	378	14
MSIC—IR	10/05–09/08	DoD	840	30
MSIC—MMW	10/05–09/08	DoD	3,807	141
NASIC—IR	10/05–09/08	DoD	2,520	90
NASIC—MMW	10/05–09/08	DoD	1,620	60
NGIC—IR	10/05–09/08	DoD	1,260	45
NGIC—MMW	10/05–09/08	DoD	1,620	60
SDB—MMW	01/07–09/07	DoD	378	14
SFW—IR	10/05–09/08	DoD	840	30

SOURCE: Dyess (2007f).

NOTE: In all cases, closure will affect the customer's concept of operations, costs, schedule, and test fidelity.

relocating these assets to Eglin, including the creation of an Air Integrated Weapons and Armament testing center including full-spectrum signal measurement capabilities.

The NAWCWD facilities at Etcheron Valley, China Lake, have some capability to perform a subset of the activities found at the STEF. According to NAWCWD, the additional capabilities required to assume the STEF workload are a 100-ft tower, Ka- and W-band radars, and IR hardware, some of which could be relocated from the STEF. TRMC concluded that there would be considerable costs to the Army stemming from the need to deploy for all tests.

The Army Electronic Proving Ground at Ft. Huachuca is listed as another potential alternative. The White Sands facility, as noted by TRMC, is smaller, provides limited ability to cover all angles of air-to-ground target positioning, and has no extended track for constant-distance measurements.

Costs

The 46th Test Wing provided cost and staffing data for the STEF. These data were analyzed and used to develop costs for continuing operations as currently planned (status quo) and the AFMC proposal. For the purposes of this analysis, the facility was assumed to be shut down in FY 2007 and moved to the Etcheron Valley Range (EVR) at China Lake. The 46th Test Wing estimated the shutdown cost as $1.8 million. The NAWC estimate listed the modifications required at EVR to accommodate the STEF workload. The 46th Test Squadron had developed an estimate to rebuild the STEF in a new location. By taking the NAWC list of activities and comparing its estimates with estimates of similar activities by the 46th Test Wing, RAND derived an estimate of $1.5 million to reconstitute the STEF capabilities at EVR. The customer faces an additional consequence, $17.5 million, for not having access to the facility, which is what was used in the AFMC proposal estimate and was taken from the first STEF post-shutdown year estimate in the AAC study. This figure could not be independently verified and probably represents an upper bound.

As Table 4.11 shows, the annual cost of operating the STEF, exclusive of improvement and modernization projects, is approximately $0.5 million. The AFMC proposal plan results in a negative net savings because of the low cost of operating the STEF and customer consequences.

Conclusions

The STEF provides essential support to the weapon development community at a relatively low cost, so there is no compelling reason to relocate it. If other activities were to be removed from Eglin such that the synergies were lost, it could possibly be argued that it should be located to best serve the majority of its users.

Benefield Anechoic Facility

Description

The Benefield Anechoic Facility (BAF) is the world's largest anechoic chamber.[9] The main chamber measures 264 × 250 × 70 ft and can accommodate all current U.S. aircraft, except for the C-5B, or up to four smaller aircraft simultaneously. It is equipped with a 125-ton turntable and two 40-ton ceiling-mounted hoists. The BAF also has a smaller anechoic chamber for component testing.

Table 4.11
STEF Cost Summary (FY 2007 $000)

	AFMC	Customers	Total
Average annual recurring DBA	467	N/A	467
Status quo operation, FYs 2007–2011	2,483	4,263	6,746
the AFMC proposal, FYs 2007–2011	3,571	21,763	25,334
Savings, FYs 2007–2011	(1,088)	(17,500)	(18,588)

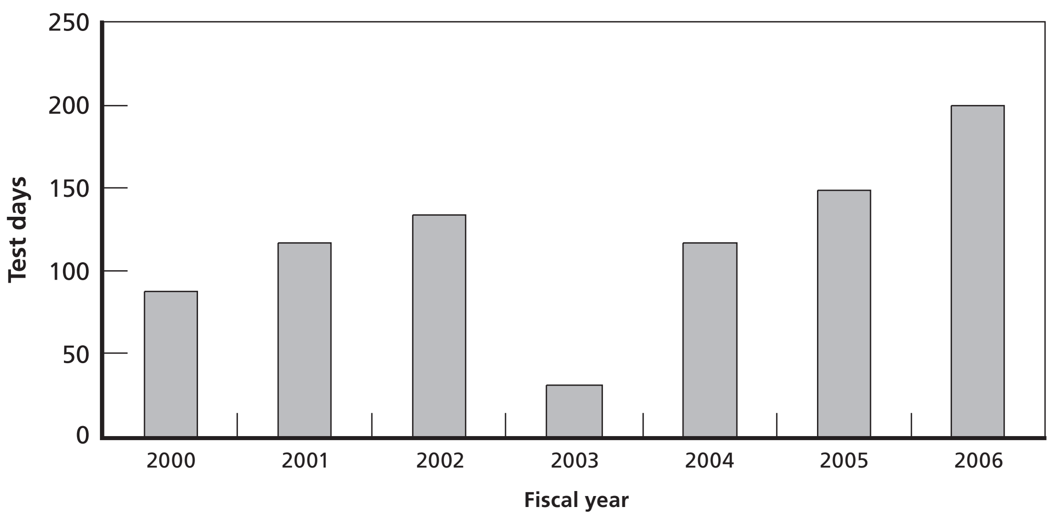
[9] The information in this section is taken from communications with 412th Test Wing; TRMC, 2006f; AFMC, 2007b.

Its primary functions are testing installed electronic-warfare systems, integrated avionics, tactical weapons, and their host platforms. It can provide a dense, representative electromagnetic environment, including simulated integrated air defense systems. It can also support evaluation of electromagnetic interference, electromagnetic compatibility, and antenna radiation patterns. It can link with AFEWES, IFAST and the western test ranges. It and J-PRIMES are the only Air Force anechoic chambers that can accommodate full-size aircraft.

Customers

Figure 4.2 shows the number of test days the BAF supported in FYs 2000 through 2006. In FY 2006, the BAF provided a high of 199 test days to 16 customers. Table 4.12 shows the distribution of each type of testing during 2006. Table 4.13 shows the planned BAF customers through FY 2011. Table 4.14 shows the estimated BAF workload in test days through 2011.

Figure 4.2
BAF Test Days



NOTE: BAF was closed for much of 2003 for installation of the Electronic Combat Integrated Test capability.
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Table 4.12
BAF FY 2006 Workload by Type

BAF Test Type	Days
RWR	93
Calibration	46
EMI/EMC/EEE	32
Antenna Pattern	15
CNI	13
Total	199

The 412th Test Wing estimates that the proposed PBD-720 reductions ($7.8 million, partially offset by 36 additional civilian positions transferred from activities to be closed at Eglin) to the BAF would reduce throughput by approximately 40-percent, e.g., from the FY 2006 level of 199 test days to approximately 151 test days. However, as shown in Table 4.14, these cuts have a smaller effect on the current projections for FY 2008–2011. Other effects of this cut would be to eliminate test capabilities for IR and ultraviolet systems and to limit the ability to test sensor fusion. Communications, navigation, and identification capabilities would also degrade to nil over three to five years. According to the 412th Test Wing, this would have a major effect on the Air Force's ability to support network-centric warfare testing on advanced platforms, such as the F-22A and F-35.

Alternatives

The primary alternative to the BAF is the ACETEF at the Naval Air Warfare Center–Aircraft Division, Patuxent River, Maryland. It has a smaller chamber (180 × 180 × 60 ft) and therefore cannot accommodate bomber or large transport-sized aircraft. It does, however, have an additional fighter-sized chamber. Its lack of a turntable and its smaller size limit its ability to measure far-field effects. Its location makes it practical to use for pre- or post-flight testing only for tests conducted on the local range. According to TRMC, it is currently operating near capacity and has limited surge capability without additional facilities.

A partial alternative to the BAF is J-PRIMES at Eglin AFB. Its suitability as a substitute for the BAF is limited by its smaller size and more-limited threat-presentation capabilities. For geographic reasons, it is impractical to use for pre- and post-flight checkout for anything other than local flight testing.

Another partial alternative to the BAF is open-air testing. The drawbacks are higher cost, lower test efficiency, lack of environmental control, and inability to provide a high-density, threat-representative electronic environment.

Costs

RAND collected BAF cost and staffing data from the 412th Test Wing. These data were analyzed and used to develop costs for continuing operations as currently planned (status quo) and for the AFMC proposal. For the purposes of this analysis, the staffing cuts associated with the AFMC proposal were taken in FY 2008.

As Table 4.15 shows, the annual cost of operating the BAF, exclusive of improvement and modernization projects, is approximately $21 million. The AFMC proposal plan results in a net savings because of the reductions in capability and associated modernization projects.

Conclusions

Unlike the other facilities discussed in this section, the PBD-720 proposal reduced BAF contractor support funding but did not close or divest the facility. Although the IR-ultraviolet and sensor fusion test capabilities would be eliminated and although the CNI capability would

Table 4.13
BAF Customer Projections Through FY 2011

BAF Projected Customers	FY 2007, Quarter 1	2	3	4	FY 2008	FY 2009	FY 2010	FY 2011
MC-130E ALR-69A PLAID	X							
400-Hz converter calibration	X							
F-16 ALR-69A troubleshooting	X							
Installed Test Integration Program (ITIP) IP #16 chamber Temporary Secure Working Area	X							
NASA F-15 antenna pattern		X						
F-16 ALR-69A Precision Location and Identification		X						
Global Hawk RQ-4A Block 10		X						
B-1B ALQ-161 PFS 5.3 test		X						
C-130J ALR-56M		X						
AFOTEC IFF-Mode 5		X						
X-51 Boeing SED Wave Rider			X	X				
DARPA Retro-Directive Ultra-Fast Acquisition Sensor (special access program)			X					
B-52 MALD/MALD-J			X					
UK Trial Smash 6 Typhoon			X					
RF Phenomenology II			X	X				
F-16 Sniper POD video test acceleration				X				
Bavarian Motor Works (BMW) Electromagnetic Environmental Effects (EEE)				X				
F-16 Block 40 Mode S IFF integration				X				
B-1B PACU replacement					X			
BMW EEE					X			
C-17 Block 18 EEE					X			
DARPA I (special access program)					X			
DARPA II (special access program)					X			
F-22A CNI					X			
Global Hawk RQ-4A EEE					X			
ITIP chamber TSWA					X			
Joint Tactical Radio System (JTRS) radio					X			
F-16 MALD/MALD-J					X			
REAPER MQ-9 EEE/CNI					X			
Special access program					X			
UK Trial Smash Typhoon					X			
B-1B JTRS I&I MN-6881						X		
B-1B targeting pod						X		

Table 4.13—Continued

BAF Projected Customers	FY 2007, Quarter 1	2	3	4	FY 2008	FY 2009	FY 2010	FY 2011
B-52 radar warning receiver						X		
BMW EEE						X		
C-130J large-aircraft IR						X		
C-17 Block 19 EEE						X		
CSAR-X EEE						X		
DARPA (special access program)						X		
F-22A sensor fusion						X		
F-35 EEE						X		
Global Hawk RQ-4A EEE						X		
ITIP chamber TSWA						X		
UK Trial Smash Typhoon						X		
Advanced EW T&E capability							X	
B-1B ALQ-161A advanced tracker							X	
B-1B ALQ-161A waveform generator							X	
C-17 Block 2 EEE							X	
CSAR-X ANT PAT/RWR							X	
DARPA (special access program)							X	
E-10 EEE							X	
F/A-22 advanced communication system							X	
F-22A JTRS I&I							X	
F-35 sensor fusion							X	
REAPER MQ-9 EEE/CNI							X	
UK Trial Smash Typhoon							X	
Advanced EW T&E capability								X
B-52 RWR								X
C-17 Block 21 EEE								X
CSAR-X ANT PAT/RWR								X
DARPA (special access program)								X
E-10 EEE								X
F/A-35 advanced communication system								X
F-22A sensor fusion								X
F-35 JTRS I&I								X
F-35 sensor fusion								X
REAPER MQ-9 EEE/CNI								X
UK Trial Smash Typhoon								X

Table 4.14
BAF Projected Workload

	FY 2008	FY 2009	FY 2010	FY 2011
Available time (test days)	252	252	252	252
BAF customer demand (test days)	120	155	170	140
Capacity utilization (%)	48	62	67	56

Table 4.15
BAF Cost Summary (FY 2007 $000)

	AFMC	Customers	Total
Average annual recurring DBA	20,783		20,783
Status quo operation, FYs 2007–2011	192,646	10,133	202,779
The AFMC proposal, FYs 2007–2011	186,514	10,133	196,647
Savings, FYs 2007–2011	6,132	0	6,132

likely atrophy, the BAF could continue to support its approximate projected workload, assuming it received the additional civil service positions. It could not, however, assume the work from J-PRIMES at the reduced funding level.

National Full-Scale Aerodynamic Complex

Description

The NFAC is a large wind-tunnel facility with two tunnels sharing a common drive system.[10] The 40 × 80-ft tunnel was completed in 1944 and is a continuous flow design. It is designed for speeds up to 300 knots and rated for 250 knots. The 80 × 120-ft tunnel was completed in 1982 and is a blow-down design. It is the world's largest wind tunnel and is designed for 100 knots and rated at 80 knots. Both tunnels are acoustically insulated. They are primarily used for rotorcraft and fixed-wing, high-angle-of-attack aircraft testing. Having access to a tunnel of this size is particularly important for rotary-wing development because the aerodynamic and aeroelastic properties of rotors are complex and are not well modeled by subscale testing or computational fluid dynamics. NFAC is the only wind tunnel that can accommodate full-scale rotorcraft.

NFAC is part of NASA's Ames Research Center in Mountain View, California. In 2003 NASA decided to mothball the NFAC, along with a 12-ft tunnel. The DoD was concerned that it would lose a test resource vital for rotorcraft development and considered various options

[10] The information in this section is taken from the communications with NFAC personnel; TRMC, 2006a; AFMC, 2007b; and Arnold Engineering Development Center, 2006a.

to preserve the NFAC. In February 2006, the Air Force signed a lease with NASA to allow it to operate the NFAC. The lease agreement stipulates that NASA retains ownership of the facility and that either side can cancel the lease with six months notice.

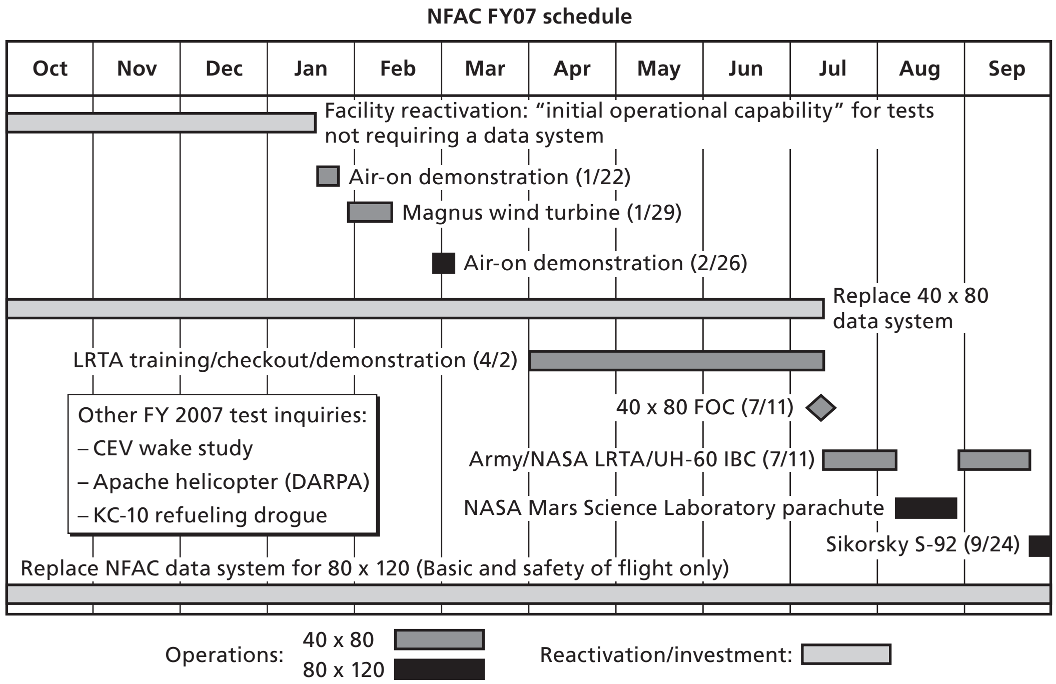
An AEDC detachment operates the NFAC. Staffing is one Air Force officer, three Army-funded personnel, five NASA employees with NFAC experience, five consultants, and 25 contractors. Additional AEDC and NASA personnel provide support as necessary. Current activity focuses on completing the new data system for the 40 × 80-ft tunnel, restoring the supporting subsystems to operational condition, and testing operation. The schedule of activities is shown in Figure 4.3.

Customers

Since the NFAC is in the process of reactivation and since it has not been operating for a number of years, securing customers is an ongoing process. The NFAC commander provided the following list of prospective customers:

- Near-Term Schedule (< 2 years)
  - NASA Mars Parachute (80 × 120)
  - Sikorsky S92 Cross-Wind Starts (80 × 120)
  - Air Force Airborne Icing Tanker Spray Array (40 × 80)
  - Formal Test Requests Received from Army:
    - UH-60 Individual Blade Control (LRTA/40 × 80)
    - UH-60 Scaling (LRTA/40 × 80), Fall 2007
  - Japanese Wind Turbine (40 × 80)
- Possible Near-Term Tests (< 3 years)
  - Defense Advanced Research Projects Agency (DARPA) Heliplane Slowed Rotor (40 × 80)
  - DARPA Heliplane Airframe (40 × 80)
  - Army/Boeing SMART Rotor (40 × 80)
  - Army Active Elevon Rotor (40 × 80)
  - Air Force AMC-X (40 × 80)
  - Navy UH-1Y and UH-1Z Blade Fold (80 × 120)
  - Navy V-22 Departure Resistance (40 × 80)
  - Navy F/A-18 E/F High Alpha (40 × 80)
  - Navy CH-53X (40 × 80)
- Longer-Term Potential Tests (3-5 years)
  - DARPA Helicopter Quieting Program (40 × 80)
  - DARPA TR-40 Rotor (40 × 80 and 80 × 120)
  - DARPA TR-80 Rotor (80 × 120)
  - DoD Joint Heavy Lift Rotorcraft
  - Navy Growth V-22 Rotor (40 × 80)
  - NASA Fundamental Rotor Aerodynamics (40 × 80)

Figure 4.3
NFAC FY 2007 Schedule



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  - NASA Active Rotor Aeromechanics (40 × 80)
- Possible Near-Term Tests (< 3 years)
  - Defense Advanced Research Projects Agency (DARPA) Heliplane Slowed Rotor (40 × 80)
  - DARPA Heliplane Airframe (40 × 80)
  - Army/Boeing SMART Rotor (40 × 80)
  - Army Active Elevon Rotor (40 × 80)
  - Air Force AMC-X (40 × 80)
  - Navy UH-1Y and UH-1Z Blade Fold (80 × 120)
  - Navy V-22 Departure Resistance (40 × 80)
  - Navy F/A-18 E/F High Alpha (40 × 80)
  - Navy CH-53X (40 × 80)
- Longer-Term Potential Tests (3-5 years)
  - DARPA Helicopter Quieting Program (40 × 80)
  - DARPA TR-40 Rotor (40 × 80 and 80 × 120)
  - DARPA TR-80 Rotor (80 × 120)
  - DoD Joint Heavy Lift Rotorcraft
  - Navy Growth V-22 Rotor (40 × 80)

- – NASA Fundamental Rotor Aerodynamics (40 × 80)
- – NASA Active Rotor Aeromechanics (40 × 80)
- – NASA UH-60A Airloads Wake Study (40 × 80)
- – NASA Tilt Rotor Interactional Aerodynamics (40 × 80)
- – NASA Aeroacoustics (40 × 80)
- – Boeing Large-Scale Transport with Active Flow Control (40 × 80).

Alternatives

Other wind tunnels are available, but none of the size of NFAC, including the following:

- NASA Langley 30 × 60 tunnel (managed by Old Dominion University)
- Boeing 20 × 20 tunnel (Philadelphia)
- NASA Langley Transonic Dynamics Tunnel and 14 × 22 tunnel
- Lockheed Martin 16 × 23 tunnel (Marietta)
- NASA Ames 7 × 10 wind tunnel (operated by the Army)
- Various European tunnels.

Of course, another alternative is flight testing, at additional cost and risk.

Costs

NFAC's director provided cost data and a hypothetical closure plan. These data were analyzed and used to develop costs for continuing operations as currently planned (status quo) and divestiture in FY 2007 under the AFMC proposal. The director estimated the costs of terminating contracts and accomplishing other divestiture tasks, depending on when the closure decision was made. For the purposes of this analysis, we assumed a decision to divest would have been made in April 2007. There was no estimate available of the customer consequences of an NFAC shutdown.

As Table 4.16 shows, the annual cost of operating the NFAC, exclusive of improvement and modernization projects, is approximately $11 million. The the AFMC proposal plan for divestiture results in a net savings of $46 million across the FYDP. However, these savings do not reflect any effects on future customers or the cost for another agency to continue NFAC operations, which would reduce the savings shown.

Conclusions

Several recent studies have concluded that NFAC is an important national asset (Anton, 2004; Madl, 2004). DoD has concluded as much by providing the initial funding to the Air Force to reactivate the facility. The anomaly is that the most likely users of the facility are the Army and, to a lesser extent, NASA and other non–Air Force programs. As long as users paid a significant share of the costs of operating T&E facilities, this was not a particularly significant issue. However, with the revised charging policies directed by NDAA 03, the Air Force must now fund a

Table 4.16
NFAC Cost Summary (FY 2007 $000)

	AFMC	Customers	Total
Average annual recurring DBA	11,039	N/A	11,039
Status quo operation, FYs 2007–2011	49,185	19,400	68,585
The AFMC proposal , FYs 2007–2011	2,783	19,400	22,183
Savings, FYs 2007–2011	46,402	0	46,402

test facility that predominately addresses the needs of other services for the foreseeable future. This dilutes the role of the "discipline of the market" in setting investment priorities.

Facilities Summary

In considering the advisability of the proposed PBD-720 reductions to the T&E infrastructure, it is important to keep the cost savings in perspective. In most cases, the cost of maintaining these facilities is a relatively small investment to ensure that test capability and capacity are available when needed to reduce program risk and avoid potential schedule delays, the consequences of which could be much larger than the anticipated savings. In nearly every case, the facility cuts proposed would increase risk and at least near-term costs to DoD programs.

In the case of the NFAC, the Air Force pays the bulk of the costs of maintaining the facility, but the primary customers are distinctly non–Air Force. The appropriateness and advisability of a DoD component providing funding support in these circumstances should be carefully evaluated. Given that the NFAC is the only facility that can support full-scale rotorcraft wind-tunnel testing, this evaluation should be conducted as a policy, rather than budgetary, issue.

If there are lessons to be learned from this experience, it is that substantial realignments of T&E infrastructure should be done as part of a carefully considered and coordinated plan. No category of expenditures should be off limits to informed debate and competition for what will always be limited resources, but when the probability of unintended consequences is high, accurate information and full consideration of all stakeholders' interests becomes imperative.

Our findings relative to the proposed facilities actions are summarized in Table 4.17.

Table 4.17
Summary of Facilities Findings

Facility	AFMC-Proposed Action	RAND Findings	Comments
CIGTF	Close or divest	Retain	No practical alternatives Broad customer base
GWEF	Close or divest	Retain	Insufficient alternative capacity
J-PRIMES	Close or divest	Consider divesting to Army if flight testing moves	Low cost Should be collocated with range
MCL	Mothball	Retain	Unique capability High usage Low cost
STEF	Close or divest	Retain	Low cost
BAF	Reduce	Restore if J-PRIMES divested and/or to retain network-centric test capability	Sole Air Force full-size anechoic chamber if J-PRIMES divested
NFAC	Close or divest	Consider divesting to Army	Not related to core Air Force mission (Policy decision)

CHAPTER FIVE

Conclusions

Our CBA focused on the three major provisions of AFMC's proposal: the consolidation of the 46th and 412th Test Wings, reductions in the ground and open-air test ranges at Eglin AFB, and the divesture or reduction of seven test facilities. We note that the AFMC proposal had more detail on the facilities part of the proposal than on the consolidation and range aspects. Our analysis took account of cross-connections among the three parts of the proposal to ensure that we considered how the effects of decisions in one area might affect another.

Consolidation

We analyzed the cost-benefit effects of consolidation in three areas: the FHP for the 46th and 412th Test Wings, the consolidation of the maintenance of the 46th and 412th Test Wings, and the merging of the test wing support structures. The results of our analysis show a savings of $43.2 million over the FY 2007–2011 FYDP. With respect to maintenance consolidation and the staff support functions, we also show the effect on the currently combined functions with the 53rd Wing.

There are, however, other considerations. With respect to backshop maintenance, the bulk of the maintenance personnel who remain at Eglin are contractors, and the bulk of those transferring to Edwards are enlisted personnel. This means, in part, that Edwards will have to recruit additional civilian workers, and this process will require time and additional resources. With respect to flightline maintenance, the bulk of the personnel transferring to Edwards are again enlisted personnel, but most maintenance personnel at Edwards are civilians. This will alter the composition of the workforce, which may affect Edwards' HPO maintenance approach. The Air Force will need to consider such consequences before implementing a proposal to merge the wings.

Ranges

With respect to ground ranges, we analyzed eight facilities that were primarily dedicated to range ground tests. In its original proposal, AFMC had not intended to close any facilities beyond those explicitly identified among the original options. Because of that, AFMC was unaware that reducing the range capacity would force the shedding of range ground capabilities—RAND uncovered these potential effects during the early stages of the CBA. Our findings can be categorized in three ways:

1. Some facilities are clearly not cost-effective to close, either because they are unique or because the savings garnered by closing them would be minimal, especially when other program costs are taken into account.
2. Closing some facilities may make economic sense.
3. Others might also make economic sense to close, but more data are needed to make an informed judgment.

The ones that make economic sense to close are the Seeker/Sensor/Signature Evaluation Facility and the Static Munitions Test Arenas. Closing these facilities may yield FYDP savings of $9.5 million. Closure will likely generate some additional program costs, which will reduce these savings. Closing the Base Installation Security Systems and the HELLFIRE Test Facility might generate some savings, but we do not have enough data about how these closures might affect customers to make an informed judgment. These facilities could also be transferred to the programs that use them, but in that case, there would be no net savings to DoD.

With respect to OAR flight-test activities, we project a savings of $149 million over the FY 2007–2011 FYDP.[1] To inform this assessment, several stakeholders from Eglin AFB, Edwards AFB, Naval Air Warfare Center (NAWC) China Lake, and NAWC Point Mugu met to understand what types of flight operations could be conducted if OAR activities moved from Eglin to the western test ranges (WTR). This exercise specifically addressed capability (not range capacity) and was predicated on 17 weeks of actual flight testing at Eglin. The stakeholders' results showed that Edwards AFB and its range could not support the entire Eglin workload of this 17-week period. However, the combined capabilities of the WTR—specifically, Edwards, the Point Mugu sea range, and China Lake—could support almost all the Eglin workload, except possibly the telemetry. In the exercise, all the sorties were launched from Edwards. Sixty percent of the missions could be completed with Edwards capabilities alone. Twenty percent required support from the Point Mugu sea range, and another 19 percent required support from China Lake, Edwards AFB, and the R-2508 complex. About 1 percent required support from other ranges, such as White Sands Missile Range. Moving the Eglin open-air developmental testing would provide an opportunity for the Air Force to save substantial resources. These savings come from (a) test wing staff consolidation and (b) increased OAR efficiency.

The range activities cannot be shifted to the WTR in isolation or without risk. Movement of the OAR flight testing to the WTR must be linked with the consolidation of the 46th and 412th Test Wings, and in this light, the costs and benefits of range consolidation and wing consolidation can only be considered together. Wing consolidation can succeed only if the Navy supports expanded Air Force activity at the western Navy ranges. This consolidation of

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1 See Table C.12.

both wing and OAR flight-test activities would require significant planning and coordination to minimize the effects on the customers.

Facilities

Our analysis of the seven facilities outlined in the AFMC proposal leads us to conclude that the Air Force should not divest itself of these facilities, with two exceptions: NFAC and J-PRIMES. NFAC, a wind tunnel, is a specialized facility that few Air Force customers use and that has little direct benefit for the Air Force. J-PRIMES allows an aircraft with radio frequency sensors and emitters to be tested against a simulated threat environment to exercise new and updated software. It is relatively inexpensive and is valuable for Army testing and flight test programs at Eglin. Assuming most flight testing migrates to the WTR, it would make sense for the Air Force to transfer what activities it carries out at J-PRIMES and transfer J-PRIMES to the Army. For the other five facilities considered, we concluded that either (1) the facilities were too unique to allow their closure and there was no adequate substitute or (2) customer costs would likely outweigh any savings if the facilities were closed.

Risk

Throughout this document, we have highlighted potential risks to the Air Force and the DoD of implementing the AFMC proposal. In the aggregate, these risks are not trivial and indicate that the Air Force needs to refine alternatives further and needs to understand how customers, test organizations, and the DoD will be affected. When possible, we included relevant customer effects, in terms of the costs programs may incur. Admittedly, these costs did not include those for classified programs—more analysis and a change in the classification of this document would have been required to consider them.

We also discussed the risks associated with the consolidation of the 46th and 412th Test Wings and the transfer of OAR flight-test activities to the WTR. In both cases, significant coordination would be required to prevent testing from being hampered. The Air Force would need to work out details on how to merge the wings effectively. At the time we conducted this study, the details were not fully refined. Similarly, this effort would require a thorough examination of the types of personnel required, as well as the selection of best practices for testing programs and maintaining and flying aircraft. With respect to the OAR, the Air Force would need to work closely with the Navy to ensure the equitable availability of time on the range schedules at Point Mugu and China Lake. Although Air Force personnel at Edwards AFB routinely work with Navy colleagues to coordinate airspace and range activities in the WTR, the amount of OAR flight-test activities that the AFMC proposal would transfer would require a purposeful approach to ensure that test activities can be accomplished.

As the Air Force looks to the future, there is a broader concern with respect to the risk that the service may incur by divesting itself of T&E infrastructure. If facilities or ranges are divested, the Air Force would be eliminating its capability to conduct future developmental testing at various locations. This in turn could lead to one of two possible outcomes:

1. greater reliance on contractors in the longer term for developmental testing, which could possibly offset savings from divestiture or consolidation
2. fewer tests, which could increase a program's risks over its life cycle.

One of the goals of T&E is to find ways to do better and more-realistic developmental testing earlier to avoid problems later. It is possible that consolidation or divestiture could move the Air Force in the opposite direction, with more reliance on contractors and less-insightful developmental testing overall.

Limitations of This Analysis

As a significant caveat to our work, the results presented in this monograph are driven primarily by cost considerations. We do not attempt the difficult task of quantifying the value of benefits that would be forgone. For example, the Air Force might find it requires more testing in the future at a specific facility or range. If that capacity were already in maximum use or no longer existed, the effects on programs and their ability to test would be significant.

We could not objectively quantify the potential for future operational surges or other associated benefits, such as increased capacity, that are available to the Air Force today. RAND's findings about cost are driven primarily by data and estimates from the Air Force and from other government sources that we contacted and interviewed for this work. In many cases, we were not able to assess the quality of inputs into the cost estimates and savings estimates that were provided to us. As previously stated, we used a series of repetitive inquiries to stakeholders and triangulated across data sources and interviews to develop more-complete picture for the analysis.

Because of the general uncertainty of the details of parts of the AFMC proposal, it was not uncommon for the test organizations to provide updated inputs to us as further consideration matured their thinking about possible consequences. We expect that, with more time and further study of this subject, the test enterprise will be able to continue to refine plans and alternatives.

All the data that was collected and presented in this analysis are unclassified. The AFMC proposal, as stated, addressed programs that were considered to be unclassified. We did not include consequences for classified programs or for facilities that address classified T&E activities. Consideration of how these programs would be affected would likely indicate that the Air Force will face higher costs and risks if the AFMC proposal were implemented.

Finally, we emphasize that not all the cost savings identified in the analysis should be interpreted as being available to meet the $371 million budget decrement that PBD-720 imposes on AFMC T&E over the FY 2007–2011 FYDP. In some cases, the savings are in fact available to to be taken without imposing burdens elsewhere in the DoD budget. In other cases, however, the AFMC proposal may allow the AFMC T&E to meet its savings goal by shifting the burden elsewhere in the Air Force or the DoD.

Summary

In sum, analysis shows that the FYDP savings support consolidation of the 46th and 412th Test Wings discussed earlier. The wing consolidation would involve a substantial amount of effort, and more-detailed planning would be needed to ensure that all parties involved understood the plan and the sequence of events. The effects on the Eglin range are mixed. The demand for use of the ground-test ranges and the consequences for customers if the ranges are closed indicates that the ranges should remain open or be transferred to other services. The analysis of OAR flight testing shows potential savings over the FY 2007–2011 FYDP, but transferring the flight-test activities would require considerable coordination between the Air Force and the Navy and could affect a myriad of other users. It is important to note that the consolidation of the 46th Test Wing and the OAR must be linked—that is, one cannot be done without the other. Analysis of the facilities shows a continuing need for them but not in all cases a need for the Air Force to control them.

The financial savings associated with both the consolidation and the transfer of the open-air flight testing from Eglin to the WTR must be tempered according to the type and amount of risk that the Air Force is willing to accept from the AFMC proposal. These risks are not trivial and include potential schedule delays for program testing, increased customer costs, and decreased T&E capacity. When possible, we have examined how the plan would affect customers but were limited by time and an inability to verify all potential consequences for customers. Many of these risks require further study and could not be captured within the constraints of this analysis.

APPENDIX A

Flight Test Consolidation Scheduling Exercise[1]

1.0. Overview

1.1. When: 30 Jan 07—3 Feb 07

1.2. Where: Edwards AFB

1.3. Participants:

- Gary "Weso" Wesolowski (46 RANMS—Chief, Range Scheduling Flight)
- Maj. Dave Winebrener (780th TS—FTE)
- TSgt Dan Rivers (46 RANMS—Spectrum Managers)
- Mr. Terry Lawton (412th OSS/OSR—Chief of Range Scheduling)

1.4. Purpose:

- Ascertain the most probable distribution (by percentage) of 46 Test Wing flight-test workload between Edwards and the Navy ranges (Pt Mugu & China Lake)
- Ascertain what percentage of 46 Test Wing flight-test workload would the Edwards range complex be able to work into their schedule.

2.0. Workload Distribution

We analyzed 17 weeks of scheduled 46 Test Wing flight-test missions taken from FY 2006. Mission activity was the primary driving factor on where the test had to be conducted. Large weapon footprint missions and missions requiring threat emitters needed to go to China Lake,

[1] This appendix reproduces a report by William Dyess and Gary Weslowski, Consolidation Scheduling Exercise," Eglin AFB, Fla., February 2, 2007. It is included to provide background and visibility into our analytic process. This is not a RAND document. Its conclusions are not the final conclusions of our analysis. Our complete analysis is partly based on important information not available to the authors of this attachment at the time it was written. Other than formatting and layout, the material is presented as received.

SEEK EAGLE missions with test points below 5,000 ft mean sea level would need to go to Pt Mugu, etc. The 17 weeks of data (see Tab A) consisted of a total of 357 missions. 19.07 percent needed to go to Pt Mugu (see Tab B), 18.48 percent needed to go to China Lake (see Tab C), 60.22 percent could be done at Edwards, and 2.23 percent would need to go to other ranges primarily due to full-scale drone support. Table A.1 presents this data.

Table A.1
46 Test Wing Representative Flight Test Workload Spread Across the Western Ranges in Accordance with the Criteria

Week No.	Total Msns	China Lake		Pt. Mugu		Edwards	
		No.	%	No.	%	No.	%
1	17	7	41	3	18	6	35
2	25	10	40	2	8	13	52
3	17	8	47	2	12	7	41
4	23	5	22	4	17	14	61
5	21	3	14	5	24	13	62
6	25	3	14	6	23	15	59
7	35	6	17	5	14	24	69
8	31	5	16	5	16	20	64
9	29	3	10	3	10	22	76
10	21	2	10	4	19	15	71
11	17	3	18	3	18	9	53
12	14	3	21	5	36	6	43
13	19	0	0	8	42	11	58
14	16	2	12	2	12	11	69
15	14	1	7	4	29	9	70
16	17	2	12	3	18	12	70
17	16	2	12	4	25	8	50
Totals	357	65	18.48	68	19.07	215	60.22

3.0. Edwards' Ability to Absorb Workload

3.1. Introduction

A preliminary meeting between the organizations last summer concluded that there were five elements which might become limiting factors in the ability of Edwards AFB and the Navy to absorb the 46th Test Wing workload. These were mission control facilities, manpower, spectrum, physical space, and priorities. Manpower, for this exercise, was assumed to be sufficient to conduct the tests in order to concentrate on the scheduling aspect. The other four will be discussed below.

3.2. Mission Control

412th range personnel believe that control room availability was a manpower issue as they currently have 3 control rooms in mothball status. The anticipation was that should 46 TW flight testing be moved to Edwards AFB, those rooms would be manned and available to use. Since the current capability at Eglin AFB is to conduct a maximum of three missions at one time, we determined that mission control room availability would not be an issue, as long as the plus-up of manning was realized.

3.3. Spectrum

The western ranges utilize the Integrated Frequency Deconfliction System (IFDS) to schedule and deconflict the spectrum for the entire region to include Pt Mugu, China Lake, and Edwards. We were able to obtain 7 weeks of actual S band frequency utilization data from this system. We then took 7 weeks of 46 TW historical mission data and attempted to schedule the TM requirements using the IFDS daily schedules. Keep in mind that the Edwards schedulers often "massage" this schedule in order to get additional missions on their schedule, something we did not have time or resources to do. We felt that this was offset by the fact that the IFDS historical data did not reflect any missions that cancelled and fell off of the schedule. Of the 131 46 TW missions in the 7 weeks of data that required TM, 42 were identified as not being able to be scheduled due to frequency availability. The primary area of concern here is the S Band (upper and lower)

3.4. Physical Space

Airspace is not deconflicted within the Edwards range complex (except for some specific areas), thus that was not addressed. What level of workload could be absorbed in this environment is not proven. However, there seemed to be no concern over this increase in workload over their range or in the additional traffic that the China Lake and Point Mugu-bound aircraft would add.

3.5. Priorities

We did not look at priorities because the process is somewhat different at Edwards. While it does use an AF Precedent Rating as a guideline, it also attaches a local "urgency" code, which could artificially raise or lower the priority. In some cases, it could result in an 2-01 priority being rated higher than a 1-05 priority, depending on the urgency code. We also did not look at how the Navy will handle priorities of AF tests.

4.0. Summary and Findings

- Between 20 percent and 30 percent of the combined workload will not be able to be executed due to spectrum issues.
- Assumption was made that all flights that did not have a spectrum conflict would fit on the range. This needs further analysis/justification.
- Approximately 40 percent of the 46th Test Wing workload can not be accomplished on the Edwards range. The feasibility of moving these tests to the Navy ranges still needs to be studied by the Navy.

Tab A
Data from the 17 Weeks of Flight Testing from the 46 Test Wing

								Resources		
Short Title	**Mission Type**	**Remarks**	**M**	**T**	**W**	**T**	**F**	**TM Relay**	**TSPI**	**Range Sweep**
Week 1										
WCMD-ER	Over Water Drop	WCMD-ER		X				X	X	X
SE ALE-50	Flutter			X				X	X	
SE HTS R7	CFP					X				
Week 2										
SE ALE-50	Flutter		X					X	X	
SE ALE-50	Flutter				X			X	X	
Week 3										
SE ALE-50	Flutter		X							
Week 4										
JDAM TI	Over Water Drop	GBU-31/38	X					X	X	
SE ALE-50	Flutter			X				X	X	
SE 16S350	Flutter			X				X	X	
JDAM TI	Over Water Drop	GBU-31/38				X		X	X	
Week 5										
SE WCMD-ER	CFP/Flutter			X				X	X	
SE 16S350	Flutter			X				X	X	
JDAM Enhance	Over Water Drop			X				X	X	
SE WCMD-ER	CFP				X			X	X	
SE ALE-50	Flutter					X		X	X	
Week 6										
SE F15 Trident	CFP				X			X	X	
SE F15 Trident	CFP					X		X	X	
SE F15 Trident	CFP					X		X	X	
SE F15 Trident	CFP					X		X	X	
PIDSU GBU-38 QRT	CFP					X				
PIDSU GBU-38 QRT	CFP						X			
Week 7										
SE ALE-50	Flutter			X				X	X	
PIDSU GBU-38 QRT	CFP				X					
SE 16S350	Flutter				X			X	X	

Tab A—Continued

								Resources		
Short Title	**Mission Type**	**Remarks**	**M**	**T**	**W**	**T**	**F**	**TM Relay**	**TSPI**	**Range Sweep**
PIDSU GBU-38 QRT	CFP					X				
SE 16S350	Flutter					X		X	X	
Week 8										
SE AIM-9X	Flutter			X				X	X	
SE AIM-9X	Flutter				X			X	X	
SE AIM-9X	Flutter					X		X	X	
PIDSU GBU-38	CFP					X				
SE AIM-9X	Flutter						X	X	X	
Week 9										
Peace Xenia	Flutter					X		X	X	
SE AIM-9X	Flutter						X	X	X	
Peace Xenia	Flutter						X	X	X	
Week 10										
SE AIM-9X	Flutter		X					X	X	
Peace Xenia	Flutter			X				X	X	
SE AIM-9X	Flutter				X			X	X	
Peace Xenia	Flutter						X	X	X	
Week 11										
Peace Xenia	Flutter			X				X	X	
Peace Xenia	Flutter					X		X	X	
JDAM SE	CFP						X	X	X	
Week 12										
Peace Xenia	Flutter			X				X	X	
JDAM SE	CFP				X			X	X	
Peace Xenia	Flutter					X		X	X	
SE HTS R7	CFP					X				
SE HTS R7	CFP						X			
Week 13										
SE HTS R7	CFP		X							
SE HTS R7	CFP		X							
Peace Xenia	Flutter			X				X	X	
SE HTS R7	CFP				X					
SE HTS R7	CFP				X					
Peace Xenia	Flutter					X		X	X	

Tab A—Continued

Short Title	Mission Type	Remarks	M	T	W	T	F	Resources TM Relay	 TSPI	 Range Sweep
Peace Xenia	Flutter					X		X	X	
SE HTS R7	CFP					X				
Week 14										
F15E T-50 Pod	CFP		X					X	X	
F16 MA31	Captive				X					
Week 15										
CBU MI	Over Water Drop	CBU-97/ Boat Targets		X				X	X	X
SE BRU-57	Flutter				X			X	X	
CBU MI	Over Water Drop	CBU-97/ Boat Targets				X		X	X	X
SE BRU-57	Flutter						X	X	X	
SE BRU-57	Flutter			X				X	X	
SE BRU-57	Flutter					X		X	X	
SE GBU-28	CFP						X	X	X	
Week 17										
SE GBU-28	CFP			X				X	X	
SE BRU-57	Flutter			X				X	X	
SE BRU-57	Flutter					X		X	X	
SE ALE-50	Flutter					X		X	X	

Tab B
Portion of the Baseline 46th Test Wing Workload Going to Pt. Mugu

								Resources		
Short Title	**Mission Type**	**Remarks**	**M**	**T**	**W**	**T**	**F**	**TM Relay**	**TSPI**	**Range Sweep**
Week 1										
WCMD-ER	Over Water Drop	WCMD-ER		X				X	X	X
SE ALE-50	Flutter			X				X	X	
SE HTS R7	CFP					X				
Week 2										
SE ALE-50	Flutter		X					X	X	
SE ALE-50	Flutter				X			X	X	
Week 3										
SE ALE-50	Flutter		X							
Week 4										
JDAM TI	Over Water Drop	GBU-31/38	X					X	X	
SE ALE-50	Flutter			X				X	X	
SE 16S350	Flutter			X				X	X	
JDAM TI	Over Water Drop	GBU-31/38				X		X	X	
Week 5										
SE WCMD-ER	CFP/Flutter			X				X	X	
SE 16S350	Flutter			X				X	X	
JDAM Enhance	Over Water Drop			X				X	X	
SE WCMD-ER	CFP				X			X	X	
SE ALE-50	Flutter					X		X	X	
Week 6										
SE F15 Trident	CFP				X			X	X	
SE F15 Trident	CFP					X		X	X	
SE F15 Trident	CFP					X		X	X	
SE F15 Trident	CFP					X		X	X	
PIDSU GBU-38 QRT	CFP					X				
PIDSU GBU-38 QRT	CFP						X			
Week 7										
SE ALE-50	Flutter			X				X	X	
PIDSU GBU-38 QRT	CFP				X					
SE 16S350	Flutter				X			X	X	

Tab B—Continued

Short Title	Mission Type	Remarks	M	T	W	T	F	Resources: TM Relay	Resources: TSPI	Resources: Range Sweep
PIDSU GBU-38 QRT	CFP					X				
SE 16S350	Flutter					X		X	X	
Week 8										
SE AIM-9X	Flutter			X				X	X	
SE AIM-9X	Flutter				X			X	X	
SE AIM-9X	Flutter					X		X	X	
PIDSU GBU-38	CFP					X				
SE AIM-9X	Flutter						X	X	X	
Week 9										
Peace Xenia	Flutter					X		X	X	
SE AIM-9X	Flutter						X	X	X	
Peace Xenia	Flutter						X	X	X	
Week 10										
SE AIM-9X	Flutter		X					X	X	
Peace Xenia	Flutter			X				X	X	
SE AIM-9X	Flutter				X			X	X	
Peace Xenia	Flutter						X	X	X	
Week 11										
Peace Xenia	Flutter			X				X	X	
Peace Xenia	Flutter					X		X	X	
JDAM SE	CFP						X	X	X	
Week 12										
Peace Xenia	Flutter			X				X	X	
JDAM SE	CFP				X			X	X	
Peace Xenia	Flutter					X		X	X	
SE HTS R7	CFP					X				
SE HTS R7	CFP						X			
Week 13										
SE HTS R7	CFP		X							
SE HTS R7	CFP		X							
Peace Xenia	Flutter			X				X	X	
SE HTS R7	CFP				X					
SE HTS R7	CFP				X					
Peace Xenia	Flutter					X		X	X	

Tab B—Continued

								Resources		
Short Title	**Mission Type**	**Remarks**	**M**	**T**	**W**	**T**	**F**	**TM Relay**	**TSPI**	**Range Sweep**
Peace Xenia	Flutter					X		X	X	
SE HTS R7	CFP					X				
Week 14										
F15E T-50 Pod	CFP		X					X	X	
F16 MA31	Captive				X					
Week 15										
CBU MI	Over Water Drop	CBU-97/Boat Targets		X				X	X	X
SE BRU-57	Flutter				X			X	X	
CBU MI	Over Water Drop	CBU-97/Boat Targets				X		X	X	X
SE BRU-57	Flutter						X	X	X	
Week 16										
SE BRU-57	Flutter			X				X	X	
SE BRU-57	Flutter					X		X	X	
SE GBU-28	CFP						X	X	X	
Week 17										
SE GBU-28	CFP			X				X	X	
SE BRU-57	Flutter			X				X	X	
SE BRU-57	Flutter					X		X	X	
SE ALE-50	Flutter					X		X	X	

Tab C
Portion of the Baseline 46th Test Wing Workload Going to China Lake

								Resources				
Short Title	Mission Type	Remarks	M	T	W	Th	F	TM Relay	TSPI	Threats	Impact Cameras	Scoring
Week 1												
RSAF Suite 4S	OFP	Threats/ TM/CCF		X				X	X	X		
A10 PE Suite 3	Hot Drop	Hot Drop		X								X
A10 PE Suite 3	Hot Drop	Hot Drop		X								X
A10 PE Suite 3	Hot Drop	Hot Drop			X							X
PIDSU GBU-38 QRT	Hot Drop	GBU-38			X			X	X		X	
A10 PE Suite 3	OFP	Hot Drop				X						X
PIDSU GBU-38 QRT	Hot Drop	GBU-38				X		X	X		X	
Week 2												
RSAF Suite 4S	OFP	Threats/ TM/CCF	X					X	X	X		
A10 PE Suite 3	OFP	Hot Drop	X									X
Paveway II LGB	Hot Drop	LGB		X				X	X		X	X
TASKER	Captive	Threats/ TM/CCF			X			X	X	X		
A10 PE Suite 3	OFP	Hot Drop			X							X
RSAF Suite 4S	OFP	Threats TM/CCF			X			X	X	X		
PIDSU GBU-38 QRT	Hot Drop	TM/CCF			X			X	X		X	
A10 PE Suite 3	OFP	Hot Drop				X						X
JDAM Enhance	Hot Drop	GBU-31/38				X		X	X		X	X
PIDSU GBU-38 QRT	Hot Drop	TM/CCF					X	X	X		X	
Week 3												
RSAF Suite 4S	OFP	Threats/ TM/CCF	X					X	X	X		
A10 PE Suite 3	OFP	Hot Drop	X									X
MAU-169L/B	Hot Drop	TM/CCF		X				X	X		X	X
Paveway II LGB	Hot Drop	CCF		X				X	X		X	X
A10 PE Suite 3	OFP	Hot Drop		X								X
A10 PE Suite 3	OFP	Hot Drop		X								X
RSAF Suite 4S	OFP	Threats/ TM/CCF			X			X	X	X		
Paveway II LGB	Hot Drop	CCF			X			X	X		X	X

Tab C—Continued

								Resources				
Short Title	**Mission Type**	**Remarks**	**M**	**T**	**W**	**Th**	**F**	**TM Relay**	**TSPI**	**Threats**	**Impact Cameras**	**Scoring**
Week 4												
A10 PE Suite 3	OFP	Hot Drop	X									X
ASEP	Hot Drop	Test Item		X				X	X		X	
A10 PE Suite 3	OFP	Hot Drop			X							X
Paveway II LGB	Hot Drop	LGB			X			X	X		X	X
A10 PE Suite 3	OFP	Hot Drop				X						X
Week 5												
A10 PE Suite 3	OFP	Hot Drop			X							X
CBU Testing	Hot Drop	CBU-97/105				X					X	X
CBU Testing	Hot Drop	CBU-97/105					X				X	X
Week 6												
Paveway II LGB	Hot Drop	LGB	X					X	X		X	X
F15K	Captive	Threats/ TM/CCF		X				X	X	X		
F15K	Captive	Threats/ TM/CCF			X			X	X	X		
Week 7												
ASEP	Hot Drop	Test Item	X					X	X		X	
F15K	Captive	Threats/ TM/CCF	X					X	X	X		
A10 PE Suite 3	OFP	Hot Drop			X							X
Paveway II LGB	Hot Drop	LGB			X			X	X		X	X
ASEP	Hot Drop	Test Item				X		X	X		X	
Paveway II LGB	Hot Drop	LGB					X	X	X		X	X
Week 8												
JDAM Enhance	Hot Drop	GBU-31/38		X				X	X		X	X
A10 PE Suite 3	OFP	Hot Drop		X								X
A10 PE Suite 3	OFP	Hot Drop			X							X
A10 PE Suite 3	OFP	Hot Drop				X						X
A10 PE Suite 3	OFP	Hot Drop					X					X
Week 9												
JDAM Enhance	Hot Drop	GBU-31/38		X				X	X		X	X
A10 PE Suite 3	OFP	Hot Drop		X								X
JDAM Enhance	Hot Drop	GBU-31/38					X	X	X		X	X
Week 10												

Tab C—Continued

Short Title	Mission Type	Remarks	M	T	W	Th	F	Resources: TM Relay	TSPI	Threats	Impact Cameras	Scoring
JDAM Enhance	Hot Drop	GBU-31/38		X				X	X		X	X
JDAM Enhance	Hot Drop	GBU-31/38					X	X	X		X	X
Week 11												
CBU Testing	Hot Drop	CBU-105		X								
MAU-169	Hot Drop	LGB			X			X	X		X	X
WCMD-ER	Hot Drop	WCMD-ER					X	X	X		X	X
Week 12												
WCMD-ER	Hot Drop	WCMD-ER		X				X	X		X	X
CBU Testing	Hot Drop	CBU-105				X		X	X		X	X
CBU Testing	Hot Drop	CBU-105					X	X	X		X	X
Week 13												
None												
Week 14												
JDAM TI	Hot Drop	GBU-31/38		X				X	X		X	X
JDAM TI	Hot Drop	GBU-31/38					X	X	X		X	X
Week 15												
JDAM Enhance	Hot Drop	GBU-31/38					X	X	X		X	X
Week 16												
JDAM TI	Hot Drop	GBU-31/38		X				X	X		X	X
JDAM TI	Hot Drop	GBU-31/38					X	X	X		X	X
Week 17												
CBU Testing	Hot Drop	CBU-105				X		X	X		X	X
JDAM Enhance	Hot Drop	GBU-31/38					X	X	X		X	X

APPENDIX B

Cost Data: Test Wing Consolidation

The cost tables provided in Appendix B supplement the analysis in Chapter Two. Tables B.1 through B.4 show flying hour details for both Eglin AFB and Edwards AFB. Tables B.5 through B.7 document calculations associated with the manpower analysis. Tables B.8 through B.11 show the financial implications for both flightline and backshop maintenance. Table B.12 summarizes personnel implications for the 53rd Wing.

The data were extracted from numerous sources and references. Key information was provided by the test organizations themselves. Where necessary, the numbers provided by the organizations were used as the base from which to construct additional or missing information. Every attempt was made to gather the most recent available data for all portions of the analysis. In addition, members of the organizations have reviewed the tables in order to ensure common understanding and agreement on the method used to arrive at the figures presented here.

The tables in this appendix were built with the intent to capture all relevant information to analyze the costs associated with the parameters of the study. Some tables may show categories that are not present in every other table. The categories of funds shown are those for which a figure was provided in any of the years under consideration. For compactness, if a category had no data for any year, it is not presented in the table. Figures for FY 2006 represent actual expenditures, staffing, billets, and numbers of hours flown (in their respective tables). Figures for years other than FY 2006 are either taken from the organization's budget documentation, or are extrapolations by RAND. All numbers presented have been normalized to a FY 2007 (baseline, including data for FY 2006. All adjustments were made using the appropriate Air Force factors, provided by SAF/FMC.[1] The extrapolations for recurring costs were based on the number in the last year provided, and assumed constant for the remaining years in the analysis. For instance, if RAND was provided a figure of $1,000,000 for FY 2008, this number was adjusted to FY 2007 dollars (if the number provided was not originally in FY 2007 dollars), then extended to the years 2009, 2010, and 2011. While the assumption of constant funding may not reflect actual practice, it is an appropriately conservative assumption to make in the face of the uncertainty of future year budgets.

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[1] USAF Inflation Indices, issued by SAF/FMC on January 19, 2007.

Among the references for the data presented here are reports, presentations, and personal correspondence with organization representatives. Every attempt was made to verify with the respective organizations that the figures used were those that best reflected the position of the organization, or where numbers were constructed, that the method used was appropriate. Of particular concern was the delineation between DBA and RBA funds. In the cases of several facilities, the distinction has been made explicit; some facilities list DBA figures separately from RBA figures, and others may not. When no distinction is made, it should be assumed that the number includes both DBA and RBA. This assumption applies to dollar figures as well as staff, so that numbers of employees that are not otherwise delineated include those paid for through DBA or RBA, or a mixture of both.

The material in this appendix includes calculations for the net present value (NPV) of the savings accrued from undertaking the actions under consideration. The numbers were derived in the typical fashion, multiplying the value for estimated savings by the relevant factor for each year, then summing together for a total savings over the period. This study uses a 30-year horizon and thus employed a factor of 0.03, as directed by OMB Circular A-94 and in accordance with guidance from SAF/FMC on discount rates for economic analyses. It should be noted, however, that performing this calculation expands on an already uncertain assumption. The construction of the study required the assumption that every planned test was to be conserved. When customer impacts were explicitly included in the cost calculations, the behavior of customers is thus assumed to be static, with no accommodations to the changed situation. Considering an NPV figure over 30 years carries this lack of an explicit reaction to the change in costs of testing out over the same horizon. While the assumption is workable, if not entirely realistic, for considering activity over the FY 2007–2011 FYDP, the assumption is even less plausible when considering three decades. For that reason, this study relies most heavily on analysis over the FYDP. The NPV calculations are included for completeness and adherence to standard practice for cost benefit analyses.

Table B.1
46th Test Wing Flying Hour Program, Actual Flying Hours at Eglin AFB, FY 2006

Type and MDS	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Testing													
A-10	4	6	2	5	0	0	17	16	1	8	11	16	85
F-15A/D	25	18	11	6	14	25	9	22	8	4	15	15	171
F-015E	9	23	38	30	32	51	38	41	49	27	55	18	411
F-16AD	81	73	75	94	80	123	73	33	66	55	74	55	882
NC-130	0	0	0	0	0	0	0	0	0	0	0	0	0
UH-01N	6	19	0	0	28	12	15	3	18	19	10	0	129
Total	124	140	126	135	153	211	151	114	143	113	164	104	1,679
Proficiency													
A-10	3	6	14	8	21	17	6	29	12	5	18	14	152
F-15A/D	22	19	11	12	8	9	14	19	20	26	36	14	210
F-015E	18	10	17	16	18	18	28	29	23	21	35	30	263
F-16AD	58	57	60	45	43	78	56	72	89	71	69	66	763
NC-130	0	0	0	6	0	0	0	0	0	0	0	0	6
UH-01N	14	14	12	17	7	32	6	25	20	17	16	11	190
Total	115	106	113	103	97	153	109	174	164	140	175	135	1,584
TPS													
A-10	0	0	0	0	0	0	0	0	0	0	0	0	0
F-15A/D	0	0	0	6	17	0	0	0	0	19	0	0	42
F0-15E	0	0	0	0	25	0	0	0	7	0	0	0	32
F-16AD	0	0	0	0	0	0	0	0	0	0	0	0	0
NC-130	0	0	0	0	0	0	0	0	0	0	0	0	0
UH-01N	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	6	42	0	0	0	7	19	0	0	74
Total per MDS													
A-10	6	12	16	13	21	17	23	44	13	13	29	30	237
F-15A/D	47	38	21	24	38	33	23	41	29	49	51	29	424
F-015E	27	33	55	46	75	68	66	70	79	49	90	47	705
F-16AD	138	129	135	139	123	202	129	105	155	125	143	121	1,645
NC-130	0	0	0	6	0	0	0	0	0	0	0	0	6
UH-01N	19	33	12	17	35	44	20	28	39	36	25	11	320
Overalll total	239	246	239	245	291	364	261	288	314	272	339	239	3,337

SOURCE: 46th Operations Group.

Table B.2
46th Test Wing Flying Hour Program, Actual Flying Hours at Eglin AFB, FY 2005

Type and MDS	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Testing													
A-10	0	0	0	2	5	8	2	9	0	3	3	4	35
F-15A/D	22	15	11	205	25	8	33	28	31	12	7	16	225
F-015E	13	23	35	18	18	35	21	21	35	17	13	33	281
F-16A/D	71	70	66	85	48	105	110	104	97	77	82	113	1,027
NC-130	0	0	0	0	0	0	0	0	0	0	0	0	0
UH-01N	8	0	22	17	4	8	5	7	1	0	0	6	78
Total	114	108	134	140	100	163	169	169	163	109	104	173	1,646
Proficiency													
A-10	0	0	0	0	4	5	5	17	18	17	13	12	90
F-15A/D	9	17	11	20	12	8	8	27	11	19	38	17	197
F-015E	11	16	4	5	17	23	16	15	11	14	20	10	161
F-16A/D	36	51	54	44	50	26	57	46	38	67	90	56	615
NC-130	0	0	0	0	0	0	0	0	3	6	3	0	12
UH-01N	13	5	5	3	18	22	19	5	11	0	23	61	183
Total	68	88	73	72	100	84	104	1106	92	123	187	156	1,257
TPS													
A-10	0	0	0	0	0	0	0	0	0	0	0	0	0
F-15A/D	0	0	0	0	0	0	0	0	0	0	0	0	0
F-015E	0	0	0	0	0	0	0	0	0	0	0	16	16
F-16A/D	0	0	0	0	0	0	0	0	0	0	0	0	0
NC-130	0	0	0	0	0	0	0	0	0	0	0	0	0
UH-01N	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	16	16
Total per MDS													
A-10	0	0	0	2	9	12	7	25	18	19	16	16	125
F-15A/D	31	32	22	40	37	16	40	55	42	32	44	33	423
F-015E	23	38	39	23	34	58	37	37	45	32	33	59	457
F-16A/D	107	121	120	129	98	131	166	150	134	144	172	170	1,642
NC-130	0	0	0	0	0	0	0	0	3	6	3	0	12
UH-01N	21	5	27	20	22	29	24	12	12	0	23	67	260
Overalll total	182	195	207	213	200	247	274	278	255	232	291	344	2,918

SOURCE: 46th Operations Group.

Table B.3
Edwards AFB Flying Hour Program, FY 2006

Type and MDS	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Test and test support													
B-1	8	16	33	9	12	14	7	8			11	5	122
B-2	10	3	7	14			6	12	11	11	6	6	87
B-52			8	8	5		5			2		17	46
C-12	27	10	10	2	4	5	25	9	34	3	5	21	154
C-130	6	7	20	2		15	2	11	5	34			101
C-17	14	37	44	11	40	14	88	57	25	6	41	35	411
F-16	177	204	128	88	119	190	170	147	177	139	253	139	1,930
T-38	31	3	7		5	27	24	12	4	5	20	27	153
Tanker	24	17	22	12	10	33	15	37	26	12	20	18	244
Total	296	297	277	145	194	297	343	291	282	212	346	267	3,247
Proficiency													
B-1	16	3	2	9	8	8	6	10	11		5	20	88
B-2	7	4		2				2	2	8	4		28
B-52	16	13	14	11	12	9	1	20	3	6	5		98
C-12	35	10	15	24	20	29	22	27	12	17	24	25	260
C-130	17	7	8	4	5	17	13	9	8	14			103
C-17	11	17	5	6	8	4	3	14	14	6	3		90
F-16	80	84	85	150	81	119	87	140	101	103	106	105	1,239
T-38	36	61	48	54	45	35	54	35	36	22	39	34	499
Tanker	5	8		2	15	2	8	7	7	11	14	5	84
Total	222	207	177	263	193	224	193	253	194	187	199	178	2,489
TPS													
C-12	47	52	27	50	65	83	47	51	22	73	71	54	643
C-17								9	8				17
F-16	70	81	32	77	68	114	97	108	25	76	113	124	983
T-38	96	143	94	136	120	180	149	169	112	124	193	145	1,659
Tanker		3	4	15				6		9	10	15	63
Total	212	279	158	278	253	377	293	342	167	282	386	337	3,364
Overall total	729	783	612	686	641	898	828	886	642	681	931	783	9,100

SOURCE: AFFTC.

Table B.4
Edwards AFB Flying Hour Program, FY 2005

Type and MDS	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Test and test support													
B-1	7	28	18	16	19	0	9	26	18	6	0	0	148
B-2	15	18	18									8	59
B-52	6		9	21	15	11	23	15	8	35	20	13	177
C-12	20	10	8	6	11	2	17	12	46	7	5	7	149
C-130	16	29	43	11	2	41	37	69	56	40	94	32	471
C-17	23	17	48	42	25	45	49	39	79	41	0	55	462
C-5	3	36	26	21	13	57	54	31	49	39	28	0	356
CV-22	26	9	39	41	32	38	36	31	54	45	29	52	431
F-117	37	38	25	20	19	17	31	5	19	13	15	26	265
F-15	1	8											9
F-16	185	161	183	139	160	182	214	165	279	208	199	144	2,219
F/A-22	40	34	27	11	32	78	113	15	39	18	73	31	512
H-60	13	16	2	7	0	0	0	0	0	0	0	0	38
MQ-1										14	76	62	152
MQ-9										17	22	40	79
RQ-4	7	12	38	9	14	42	35	12	101	62	121	68	521
T-38	7	2	5	2	6	7	10	0	4	3	3	2	51
T-39	0	0	0	0	0								0
Tanker	80	130	68	102	90	104	130	31	75	55	100	54	1,019
Trout	37	38	61	0	20	34	37	35	39	20	2	35	358
Vista	16	3	0	0	0	0	0	0	0	0	0	0	18
X-45	2	4	4	3	3	0	0	2	4	7	2	0	29
YAL-1A		0	6	17	5	16	11	15	18	18	0	0	106
Total	541	592	628	468	463	673	806	502	888	647	790	630	7,628
Proficiency													
B-1	1	7	0	5	7	16	4	2	4	10	9	14	79
B-2	0	0		4								9	13
B-52	8	10	2	3	7	8	10	5	9	20	6	6	93
C-12	15	45	17	15	21	22	14	36	10	23	13	16	245
C-130	18	9	2	14	23	4	4	4	53	33	36	6	205
C-17	9	3	1	2	3	12	8	17	9	27	2	5	97
C-5	0	0	0	0	0	0	0	0	0	0	10	0	10
CV-22	2	5	1	9	2	3	6	8	4	2		1	42
F-117	9	12	15	7	9	20	11	35	29	17	22	11	197
F-15	3	4	8	1	5								21
F-16	97	78	91	93	68	103	110	72	51	53	76	54	945

Table B.4—Continued

Type and MDS	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
F/A-22	2	9	3	6	3	6	2	8	3	13	14	6	75
H-60	6	9	5	6									26
MQ-1										3	9	3	14
MQ-9											1		1
RQ-4	8	0	0	0	3	0	0	2	6	0	0	0	18
T-38	27	39	26	25	27	37	32	19	38	28	28	34	360
Tanker	13	9	9	8	10	5	6	8	7	0	1	5	81
Trout	6	4	13	5	3	17	15	11	4	8	7	15	107
Vista				1									1
YAL-1A											5		5
Total	222	242	192	203	190	252	222	227	226	237	240	183	2,634
TPS													
ASTTA	13												13
C-12	18	48	36	34	72	67	43	61	47	35	72	54	585
C-130			3										3
C-17		7											7
F-16	63	38	19	52	61	106	82	58	47	62	89	91	767
Lear	11	5											16
T-38	60	121	49	82	102	151	129	182	79	82	170	121	1,327
Tanker	6	3	8	0	0	0	0	0	0	8			25
Vista	7	5	0	0	20	0	1	36	8	10	32	4	123
Total	178	227	114	167	254	324	255	337	180	197	364	269	2,867
Overall total	941	1,099	939	838	925	1,248	1,283	1083	1,302	1,097	1,393	1,093	13,239

SOURCE: AFFTC.

Table B.5
Total Support Manpower

	FY 2007	FY 2009			FY 2010			FY 2011		
	Budget	Budget	Proposal	Savings	Budget	Proposal	Savings	Budget	Proposal	Savings
AFFTC center and wing staff										
Civilians	510	510	510	0	510	506	4	510	480	30
Officers	41	41	41	0	41	41	0	41	37	4
Enlisted	21	21	21	0	21	21	0	21	18	3
CME	237	237	73	164	237	69	168	237	52	185
Total	809	809	645	164	809	637	172	809	587	222
46th Test Wing test staff										
Civilians	8	8	2	6	8	2	6	8	0	8
Officers	8	8	2	6	8	2	6	8	0	8
Enlisted	0	0	0	0	0	0	0	0	0	0
CME	1	1	0	1	1	0	1	1	0	1
Total	17	17	4	13	17	4	13	17	0	17
Flight support										
Civilians	6	6	3	3	6	2	4	6	0	6
Officers	2	2	2	0	2	1	1	2	0	2
Enlisted	12	12	9	3	12	2	10	12	0	12
CME	27	27	0	27	27	0	27	27	0	27
Total	47	47	14	33	47	5	42	47	0	47
Misc 46th Test Wing										
Civilians	99	99	58	41	99	58	41	99	58	41
Officers	8	8	4	4	8	4	4	8	4	4
Enlisted	20	20	10	10	20	10	10	20	10	10
CME	97	97	49	48	97	49	48	97	49	48
Total	224	224	121	103	224	121	103	224	121	103
46th Test Wing staff										
Civilians	79	79	14	65	79	14	65	79	14	65
Officers	3	3	5	-2	3	5	-2	3	5	-2
Enlisted	5	5	5	0	5	5	0	5	5	0
CME	58	58	5	53	58	5	53	58	5	53
Total	145	145	29	116	145	29	116	145	29	116

Table B.5—Continued

	FY 2007	FY 2009			FY 2010			FY 2011		
	Budget	Budget	Proposal	Savings	Budget	Proposal	Savings	Budget	Proposal	Savings
Total 46th and Edwards										
Civilians	702	702	628	74	702	591	111	702	552	150
Officers	62	62	57	5	62	53	9	62	46	16
Enlisted	58	58	52	6	58	38	20	58	33	25
CME	420	420	175	245	420	74	346	420	106	314
Total	1,242	1,242	912	330	1,242	756	486	1,242	737	505

CALCULATIONS:
Starting total **= 1,242**

10-percent Reduction		20-percent Reduction		30-percent Reduction	
Baseline (no.)	420	Baseline (no.)	420	Baseline (no.)	420
Less 10 percent of 1,242 (no.)	296	Less 20 percent of 1,242 (no.)	172	Less 30 percent of 1,242 (no.)	64
Resulting savings (no.)	124	Resulting savings (no.)	248	Resulting savings (no.)	373
Cost ($)	12,660,000	Cost ($)	24,940,000	Cost ($)	37,300,000
Nonrecurring costs		Nonrecurring costs		Nonrecurring costs	
124 fewer contractors[a]	–2,484,000	248 fewer contractors[a]	–4,968,000	373 fewer contractors[a]	–7,600,00
20 percent of civilians PCS	–298,166	20% of civilians PCS	–298,166	20% of civilians PCS	–298,166
80% of civilians recruited[a]	–1,680,000	80% of civilians recruited[a]	–1,680,000	80% of civilians recruited[a]	–1,680,000
Total transition costs	–4,462,166	Total transition costs	–6,946,166	Total transition costs	–9,578,166
Total FYDP savings	37,980,000	Total FYDP savings	7,482,0000	Total FYDP savings	111,900,000
Total effect on FYDP	33,517,834	Total effect on FYDP	67,873,834	Total effect on FYDP	102,321,834

[a] At a cost of 20 percent of one year's salary per person.

Table B.6
Total Support Manpower, Cuts From CME Only ($000)

		30 -Percent Cut		20-Percent Cut		10-Percent Cut	
Year	Discount Factor	Cash Flow	PV Cash Flow	Cash Flow	PV Cash Flow	Cash Flow	PV Cash Flow
1	0.970873786	0	0	0	0	0	0
2	0.942595909	0	0	0	0	0	0
3	0.915141659	27,722	25,369	17,994	16,467	8,198	7,502
4	0.888487048	37,300	33,141	24,940	22,159	12,660	11,248
5	0.862608784	37,300	32,175	24,940	21,513	12,660	10,921
6	0.837484257	37,300	31,238	24,940	20,887	12,660	10,603
7	0.813091511	37,300	30,328	24,940	20,279	12,660	10,294
8	0.789409234	37,300	294,454	24,940	19,688	12,660	9,994
9	0.766416732	37,300	28,587	24,940	19,114	12,660	9,703
10	0.744093915	37,300	27,755	24,940	18,558	12,660	9,420
11	0.722421277	37,300	26,946	24,940	18,017	12,660	9,146
12	0.70137988	37,300	26,161	24,940	17,492	12,660	8,879
13	0.68095134	37,300	25,399	24,940	16,983	12,660	8,621
14	0.661117806	37,300	24,660	24,940	16,488	12,660	8,370
15	0.641861947	37,300	23,941	24,940	16,008	12,660	8,1256
16	0.623166939	37,300	23,244	24,940	15,5412	12,660	7,889
17	0.605016446	37,300	22,567	24,940	15,089	12,660	7,660
18	0.587394608	37,300	21,910	24,940	14,650	12,660	7,436
19	0.570286027	37,300	21,272	24,940	14,223	12,660	7,220
20	0.553675754	37,300	20,652	24,940	13,809	12,660	7,010
21	0.537549276	37,300	20,051	24,940	13,406	12,660	6,805
22	0.521892501	37,300	19,467	24,940	13,016	12,660	6,607
23	0.506691748	37,300	18,900	24,940	12,637	12,660	6,415
24	0.491933736	37,300	18,349	24,940	12,269	12,660	6,228
25	0.477605569	37,300	17,815	24,940	11,911	12,660	6,046
26	0.463694727	37,300	17,296	24,940	11,565	12,660	5,870
27	0.450189056	37,300	16,793	24,940	11,228	12,660	5,699
28	0.437076753	37,300	16,303	24,940	10,901	12,660	5,533
29	0.424346362	37,300	15,828	24,940	10,583	12,660	5,372
30	0.41198676	37,300	15,367	24,940	10,275	12,660	5,216
Totals			650,959		434,756		219,834

NOTES: Year 1 is FY 2007.

	30 Percent	20 Percent	10 Percent
Nonrecurring	(9,578)	(6,946)	(4,462)
Recurring	37,300	24,940	12,660

Table B.7
Net Present Value ($000)

Year	Flying Hour Program	Backshop Maintenance	Flightline Maintenance	
			Scenario 1	Scenario 2
1	0	0	0	0
2	0	0	0	0
3	2,856	(33,930)	11,749	11,457
4	2,772	3,397	14,880	15,723
5	2,692	3,298	14,447	20,004
6	2,613	3,202	14,026	23,025
7	2,537	3,109	13,617	22,355
8	2,463	3,019	13,221	21,703
9	2,392	2,931	12,836	21,071
10	2,322	2,845	12,462	20,458
11	2,254	2,762	12,099	19,862
12	2,189	2,682	11,746	19,283
13	2,125	2,604	11,404	18,722
14	2,063	2,528	11,072	18,176
15	2,003	2,454	10,750	17,647
16	1,945	2,383	10,437	17,133
17	1,888	2,313	10,133	16,634
18	1,833	2,246	9,837	16,149
19	1,780	2,180	9,551	15,679
20	1,728	2,117	9,273	15,222
21	1,677	2,055	9,003	14,779
22	1,629	1,995	8,740	14,349
23	1,581	1,937	8,486	13,931
24	1,535	1,881	8,239	13,525
25	1,490	1,826	7,999	13,131
26	1,447	1,773	7,766	12,749
27	1,405	1,721	7,540	12,377
28	1,364	1,671	7,3120	12,017
29	1,324	1,622	7,107	11,667
30	1,286	1,575	6,900	11,329
Total	55,192	156,473	292,637	460,153
Assumed nonrecurring costs	3,823	(38,660)	3,909	3,909
Recurring cash flow	3,120	10,848	416,748	416,748

NOTE: Year 1 is FY 2001.

Table B.8
Backshop Maintenance, Scenario 1

	Baseline		Prop		Annual Savings ($000)
	Personnel (no.)	Cost ($000)	Personnel (no.)	Cost ($000)	
Civilians	7	636	82	8,200	(7,564)
Officers	0	0	0	0	0
Enlisted	2	122	0	0	122
CME	155	13,966	27	2,700	11,266
Total	164	14,723	109	10,900	3,823

NOTES: 27 CME remain at Eglin (manpower necessary to support the UH-1 and C130).
Total starting manpower is 164, from the 5rd Wing and all current

Calculations

Total starting maintenance manpower	164	53rd Wing and 46th Test Wing
Less number remaining at Eglin	27	
Net manpower	137	
Total starting aircraft	27	16 for 46th Test Wing 11 for 53rd Wing
Number of aircraft moving to AFFTC	16	Seven F-16s Seven F-15 Two A-10s
Maintainers per aircraft	5.1	
Total number of maintainers to move with workload	81.2	People per aircraft times the number of aircraft to AFFTC
Annual savings ($000)	3,823	Annual savings
FYDP savings ($000)	(28,630)	Annual cost times 3 years less nonrecurring
Payback period (years)	10.4	Beginning in FY 2009

Assumptions:
- All changes occur in FY 2009
- Hire all new civilian workforce of 82 people at AFFTC
- RIF 40 contractors at Eglin

Nonrecurring Costs	
Hire 82 civilians (82 × 100,000 × 0.50)	(4,100)
SE	(5,000)
Military construction	(31,000)
Total	(40,100)

Table B.9
Backshop Maintenance, Scenario 2

	Baseline		Prop		Annual Savings ($000)
	Personnel (no.)	Cost ($000)	Personnel (no.)	Cost ($000)	
Civilians	7	636	76	7,600	(6,964)
Officers	0	0	0	0	0
Enlisted	2	122	0	0	122
CME	155	13,966	27	2,700	11,266
Total	164	14,723	103	10,300	4,423

NOTES: 27 CME remain at Eglin (manpower necessary to support the UH-1 and C130).
Total starting manpower is 155, from the 5rd Wing and all current

Calculations

Total starting maintenance manpower	155	53rd Wing and 46th Test Wing
Less number remaining at Eglin	27	
Net manpower	128	
Total starting aircraft	27	16 for 46th Test Wing 11 for 53rd Wing
Number of aircraft moving to AFFTC	16	Seven F-16s Seven F-15 Two A-10s
Maintainers per aircraft	4.7	
Total number of maintainers to move with workload	75.9	People per aircraft times the number of aircraft to AFFTC
Annual savings ($000)	4,423	Annual savings
FYDP savings ($000)	(27,849)	Annual cost times 3 years less nonrecurring
Payback period (years)	9.3	Beginning in FY 2009

Assumptions:
All changes occur in FY 2009
Hire all new civilian workforce of 82 people at AFFTC
RIF 40 contractors at Eglin

Nonrecurring Costs	
Hire 73 civilians (73 × 100,000 × 0.50)	(3,800)
RIF 66 CME at Eglin (66 × 100,000 × 0.20)	(1,320)
SE	(5,000)
Military construction	(31,000)
Total	(41,120)

Table B.10
Flightline Maintenance, Scenario 1

	Baseline		Prop		Annual Savings ($000)
	Personnel (no.)	Cost ($000)	Personnel (no.)	Cost ($000)	
Civilians	87	7,900	83	8,300	(400)
Officers	16	1,953	9	1,098	854
Enlisted	553	33,838	325	19,886	13,951
CME	26	2,343	0	0	2,343
Total	682	46,032	417	29,285	16,748

NOTES: 31 CME remain at Eglin (manpower necessary to support the UH-1 and C130).
Total starting manpower is 164, from the 5rd Wing and all current

Calculations

Total starting maintenance manpower level	682	
Number remaining at Eglin	31	
Net manpower	651	
Total starting aircraft	27	16 for 46th Test Wing 11 for 53rd Wing
Number of aircraft moving to AFFTC	16	Seven F-16s Seven F-15 Two A-10s
Maintainers per aircraft	24.1	
Total number of maintainers to move with workload	386	People per aircraft times the number of aircraft to AFFTC
Annual savings ($000)	16,748	
FYDP savings ($000)	46,334	Annual savings times 3 years (FYs 2008–2011) less nonrecurring costs
Payback period (years)	0.2	Nonrecurring costs divided by annual savings

Nonrecurring costs	
PCS (20 percent of the civilians move[a])	589
80 percent of the civilians do not move	66
Hire 66 civilians at Edwards (66 × 100,000 × 0.50)	3,320
Total	3,909

[a] At a cost of $35,496

Table B.11
Flightline Maintenance, Scenario 2

		Baseline		Prop		Annual Savings ($000)
		Personnel (no.)	Cost ($000)	Personnel (no.)	Cost ($000)	
FY 2009[a]	Civilians	87	7,900	84	8,400	(500)
	Officers	16	1,953	12	1,465	488
	Enlisted	553	33,838	344	21,049	12,789
	CME	26	2,343	26	2,600	(257)
	Totals for FY 2009	682	46,032	466	33,513	12,519
FY 2010[b]	Civilians	87	8,700	131	13,100	(4,400)
	Officers	16	1,953	6	732	1,220
	Enlisted	553	33,838	184	11,258	22,579
	CME	26	2,600	0	0	2,600
	Totals for FY 2010	682	47,090	321	25,091	21,999
FY 2011[b]	Civilians	87	8,700	177	17,700	(9,000)
	Officers	16	1,953	0	0	1,953
	Enlisted	553	33,838	31	1,897	31,941
	CME	26	2,600	0	0	2,600
	Totals for FY 2011	682	47,090	208	19,597	27,493

NOTE: Uses the AFFTC HPO Manpower Model. Applying this model to the workload yields a requirement of 177 civilian maintainers.

[a] Note: 31 enlisted remain at Eglin for C-130 and UH-1 maintenance. Rates are higher for Edwards.

[b] Manpower will be reduced from 466 to 177 by military-to-civilian conversion. Assume 50 percent of this savings (144.5 reduction) will occur in FY 2010.

ASSUMPTIONS:
Total number of people required: 177.
All 435 will transfer in the first year (682 total – 216 for 53rd – 31 for remaining Eglin aircraft = 435.

Calculations

FYDP savings ($000)		
Without nonrecurring	62,011	Total for FYs 2009, 2010, and 2011
With nonrecurring	53,405	Same as above reduced by nonrecurring
Payback (years)	less than 1	Nonrecurring divided by annual savings
Nonrecurring costs		
20 percent of the civilians move	17	
PCS Costs	596	
Remaining civilians	160	
Cost to hire civilians ($000)	8,010	Hire civilians (160 × 100,000 × 0.50)
Total nonrecurring cost ($000)	8,606	50 percent (4,303) in FY 2010 50 percent 4,303) in FY 2011

Table B.12
53rd Wing Personnel—Detail

	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Backshop (number)						
Enlisted	0	0	0	0	0	0
Officers	0	0	0	0	0	0
Civilians	0	0	0	0	0	0
Contractors	0	0	0	124	124	124
Personnel cost ($000)[a]	—	—	—	11,259	11,259	11,259
Flightline (number)						
Enlisted	0	0	0	209	209	209
Officers	0	0	0	4	4	4
Civilians	0	0	0	3	3	3
Contractors	0	0	0	23	23	23
Personnel cost ($000)[a]	—	—	—	15,637	15,637	15,637
Operations (number)						
Enlisted	0	0	0	9	9	9
Officers	0	0	0	6	6	6
Civilians	0	0	0	13	13	13
Contractors	0	0	0	12	12	12
Personnel cost ($000)[b]	—	—	—	3,547	3,547	3,547
53rd Wing operations cost ($000)	0	4.35	0	0	(76.89)	(13.04)
53rd Wing maintenance ($000)	0	26.90	0	0	(475.72)	(80.69)

[a] 48 MXG, 2007.
[b] 53 WG/MO, 2007 and AFMC, 2007

Summary	Amount (FY 2007 $)
Nonrecurring cost	—
Annual cost, wing operations	4,347,031
Annual cost, wing maintenance	26,896,669
Nonrecurring savings	—
Annual savings	—

NOTE: This represents the sensitivity analysis that we conducted on the potential for more or less savings of staff personnel.

APPENDIX C

Cost Data: Ranges

The cost tables provided in Appendix C supplement the analysis in Chapter Three of the document. These tables cover the Eglin range (ground and open air) activities. Table C.1 summarizes the ground range activities that are individually articulated in Tables C.2 through C.10. Tables C.11 and C.12 summarize cost information for the OAR.

The data were extracted from numerous sources and references. Key information was provided by the test organizations themselves. Where necessary, the numbers provided by the organizations were used as the base from which to construct additional or missing information. Every attempt was made to gather the most recent available data for all portions of the analysis. In addition, members of the organizations have reviewed the tables in order to ensure common understanding and agreement on the method used to arrive at the figures presented here.

The tables in this appendix were built with the intent to capture all relevant information to analyze the costs associated with the parameters of the study. Some tables may show categories that are not present in every other table. The categories of funds shown are those for which a figure was provided in any of the years under consideration. For compactness, if a category had no data for any year, it is not presented in the table. Figures for FY 2006 represent actual expenditures, staffing, billets, and numbers of hours flown (in their respective tables). Figures for years other than FY 2006 are either taken from the organization's budget documentation, or are extrapolations by RAND. All numbers presented have been normalized to a FY 2007 (baseline, including data for FY 2006. All adjustments were made using the appropriate Air Force factors, provided by SAF/FMC.[1] The extrapolations for recurring costs were based on the number in the last year provided, and assumed constant for the remaining years in the analysis. For instance, if RAND was provided a figure of $1,000,000 for FY 2008, this number was adjusted to FY 2007 dollars (if the number provided was not originally in FY 2007 dollars), then extended to the years 2009, 2010, and 2011. While the assumption of constant funding may not reflect actual practice, it is an appropriately conservative assumption to make in the face of the uncertainty of future year budgets.

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1 USAF Inflation Indices, issued by SAF/FMC on January 19, 2007.

Among the references for the data presented here are reports, presentations, and personal correspondence with organization representatives. Every attempt was made to verify with the respective organizations that the figures used were those that best reflected the position of the organization, or where numbers were constructed, that the method used was appropriate. Of particular concern was the delineation between DBA and RBA funds. In the cases of several facilities, the distinction has been made explicit; some facilities list DBA figures separately from RBA figures, and others may not. When no distinction is made, it should be assumed that the number includes both DBA and RBA. This assumption applies to dollar figures as well as staff, so that numbers of employees that are not otherwise delineated include those paid for through DBA or RBA, or a mixture of both.

The material in this appendix includes calculations for the net present value (NPV) of the savings accrued from undertaking the actions under consideration. The numbers were derived in the typical fashion, multiplying the value for estimated savings by the relevant factor for each year, then summing together for a total savings over the period. This study uses a 30-year horizon and thus employed a factor of 0.03, as directed by OMB Circular A-94 and in accordance with guidance from SAF/FMC on discount rates for economic analyses. It should be noted, however, that performing this calculation expands on an already uncertain assumption. The construction of the study required the assumption that every planned test was to be conserved. When customer impacts were explicitly included in the cost calculations, the behavior of customers is thus assumed to be static, with no accommodations to the changed situation. Considering an NPV figure over 30 years carries this lack of an explicit reaction to the change in costs of testing out over the same horizon. While the assumption is workable, if not entirely realistic, for considering activity over the FYDP, the assumption is even less plausible when considering three decades. For that reason, this study relies most heavily on analysis over the FYDP. The NPV calculations are included for completeness and adherence to standard practice for cost benefit analyses.

Table C.1
Summary Facility Data—Costs and Savings (FY 2007 $M)

	Cost		Savings			
Facility	Nonrecurring	Annual	Nonrecurring	Annual	30-Year NPV	FY 2007–FY 2011 FYDP
Base Installation Security Systems (BISS)	3.91	0.00	0.00	4.37	81.79	9.21
Gunnery and Ballistics Test Facilities (GBTF)	19.45	0.36	0.00	1.55	3.76	(15.90)
HELLFIRE Test Facility (HTF)	0.69	0.00	0.00	0.91	17.15	2.04
Kinetic Energy Munitions Test Facility (KEMTF)	1.36	0.85	0.00	0.82	(1.87)	(1.43)
Operational/Functional Ground Test (OGT/FGT)	0.60	0.00	0.00	0.45	8.30	0.77
Portable Seeker/Sensor/Signature Evaluation Facility (PSSSEF)	1.84	0.00	0.00	3.24	61.73	7.89
Simulated Test Environment for Munitions (STEM)	0.76	0.12	0.00	0.27	2.24	(0.30)
Static Munitions Test Arenas (SMTA)	0.36	0.16	0.00	0.82	12.51	1.61

Table C.2
Base Installation Security Systems (BISS)—Detail

	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Personnel (number)						
Enlisted	0	0	0	0	0	0
Officers	0	0	0	0	0	0
Civilians	0	0	0	0	0	0
Contractors	48	48	48	0	0	0
Personnel cost ($000)[a]	4,358	4,358	4,358	872	—	—
Other costs ($000 FY 2006)						
BOS change	Unk.	Unk.	Unk.	Unk.	Unk.	Unk.
Closure and cleanup[b]	—	—	3,036	—	—	—
Additional program costs	Unk.	Unk.	Unk.	Unk.	Unk.	Unk.
Alternative site upgrades	Unk.	Unk.	Unk.	Unk.	Unk.	Unk.
Avoided modernization[a]	—	—	—	—	—	—
Avoided sustainment[a]	14	14	14	—	—	—

[a] 46 TW/XPR, 2007c.
[b] Dyess, 2007c.

Summary	Amount (FY 2007 $)
Nonrecurring cost	3,907,993
Annual cost	—
Nonrecurring savings	—
Annual savings	4,372,409

Table C.3
Gunnery and Ballistics Test Facilities (GBTF)—Detail

	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Personnel (number)						
Enlisted	0	0	0	0	0	0
Officers	0	0	0	0	0	0
Civilians	0	0	0	0	0	0
Contractors	17	17	17	0	0	0
Personnel cost ($000)[a]	1,544	1,544	1,544	309	—	—
Other costs ($000 FY 2006)						
BOS change	Unk.	Unk.	Unk.	Unk.	Unk.	Unk.
Closure and cleanup[b]	—	—	18,623	—	—	—
Additional program costs	Unk.	Unk.	Unk.	Unk.	Unk.	Unk.
Alternative site upgrades[c]	—	—	523	363	363	363
Avoided modernization[a]	—	—	—	—	—	—
Avoided sustainment[a]	4	4	4	—	—	—

[a] 46 TW/XPR, 2007c.
[b] Dyess, 2007c.
[c] Knight and Taylor, 2007.

Summary	Amount (FY 2007 $)
Nonrecurring cost	19,454,847
Annual cost	363,200
Nonrecurring savings	0
Annual savings	1,547,609

Table C.4
HELLFIRE Test Facility (HTF)—Detail

	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Personnel (number)						
Enlisted	0	0	0	0	0	0
Officers	0	0	0	0	0	0
Civilians	10	10	10	0	0	0
Contractors	0	0	0	0	0	0
Personnel cost ($000)[a]	908	908	908	182	—	—
Other costs ($000 FY 2006)						
BOS change	Unk.	Unk.	Unk.	Unk.	Unk.	Unk.
Closure and cleanup[b]	—	—	506	—	—	—
Additional program costs	Unk.	Unk.	5.	120	Unk.	Unk.
Alternative site upgrades	Unk.	Unk.	Unk.	Unk.	Unk.	Unk.
Avoided modernization[a]	—	—	—	—	—	—
Avoided sustainment[a]	2	2	2	—	—	—

[a] 46 TW/XPR, 2007c.
[b] Dyess, 2007c.

Summary	Amount (FY 2007 $)
Nonrecurring cost	687,652
Annual cost	—
Nonrecurring savings	—
Annual savings	909,888

NOTE: Here, and in the following pages, the subtable represents the sensitivity analysis we conducted on the potential for more or less savings of staff personnel.

Table C.5
Kinetic Energy Munitions Test Facility (KEMTF)—Detail

	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Personnel (number)						
Enlisted	0	0	0	0	0	0
Officers	0	0	0	0	0	0
Civilians	0	0	0	0	0	0
Contractors	9	9	9	—	—	—
Personnel cost ($000)[a]	817	817	817	163	—	
Other costs ($000 FY 2006)						
BOS change	Unk.	Unk.	Unk.	Unk.	Unk.	Unk.
Closure and cleanup[b]	—	—	—	—	—	—
Additional program costs	Unk.	Unk.	Unk.	Unk.	Unk.	Unk.
Alternative site upgrades	—	—	1,252	846	846	846
Avoided modernization[a]	—	—	—	—	—	—
Avoided sustainment[a]	3	3	3	—	—	—

[a] 46 TW/XPR, 2007c.
[b] Dyess, 2007c.

Summary	Amount (FY 2007 $)
Nonrecurring cost	1,415,250
Annual cost	846,400
Nonrecurring savings	—
Annual savings	820,171

Table C.6
Operational/Functional Ground Test (OGT/FGT)—Detail

	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Personnel (number)						
Enlisted	0	0	0	0	0	0
Officers	0	0	0	0	0	0
Civilians	0	0	0	0	0	0
Contractors	5	5	5	0	0	0
Personnel cost ($000)[a]	454	454	454	91	—	—
Other costs ($000 FY 2006)						
BOS change	Unk.	Unk.	Unk.	Unk.	Unk.	Unk.
Closure and cleanup[a]	—.	0	506	—	—	—
Additional program costs	Unk.	Unk.	Unk.	Unk.	Unk.	Unk.
Alternative site upgrades	Unk.	Unk.	Unk.	Unk.	Unk.	Unk.
Avoided modernization	Unk.	Unk.	Unk.	Unk.	Unk.	Unk.
Avoided sustainment	Unk.	Unk.	Unk.	Unk.	Unk.	Unk.

[a] Dyess, 2007c.

Summary	Amount (FY 2007 $)
Nonrecurring cost	596,852
Annual cost	—
Nonrecurring savings	—
Annual savings	454,000

Table C.7
Portable Seeker/Sensor/Signature Evaluation Facility (PSSSEF)—Detail

	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Personnel (number)						
Enlisted	0	0	0	0	0	0
Officers	0	0	0	0	0	0
Civilians	34	34	34	0	0	0
Contractors	0	0	0	0	0	0
Personnel cost ($000)[a]	3,087	3,087	3,087	617	—	—
Other costs ($000 FY 2006)						
BOS change	Unk.	Unk.	Unk.	Unk.	Unk.	Unk.
Closure and cleanup[b]	—	—	1,225	—	—	—
Additional program costs	Unk.	Unk.	Unk.	Unk.	Unk.	Unk.
Alternative site upgrades	Unk.	Unk.	Unk.	Unk.	Unk.	Unk.
Avoided modernization[a]	36	36	36	36	36	36
Avoided sustainment[a]	119	118	118	118	118	118

[a] 46 TW/XPR, 2007c.
[b] Dyess, 2007c.

Summary	Amount (FY 2007 $)
Nonrecurring cost	1,842,087
Annual cost	—
Nonrecurring savings	—
Annual savings	3,243,373

Table C.8
Simulated Test Environment for Munitions (STEM)—Detail

	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Personnel (number)						
Enlisted	0	0	0	0	0	0
Officers	0	0	0	0	0	0
Civilians	0	0	0	0	0	0
Contractors	3	3	3	0	0	0
Personnel cost ($000)[a]	272	272	272	54	—	—
Other costs ($000 FY 2006)						
BOS change	Unk.	Unk.	Unk.	Unk.	Unk.	Unk.
Closure and cleanup[b]	—	—	658	—	—	—
Additional program costs	Unk.	Unk.	Unk.	Unk.	Unk.	Unk.
Alternative site upgrades[c]	—	—	60	121	121	121
Avoided modernization[a]	—	—	—	—	—	—
Avoided sustainment[a]	1	1	1	—	—	—

[a] 46 TW/XPR, 2007c.
[b] Dyess, 2007c.
[c] Knight and Taylor, 2007.

Summary	Amount (FY 2007 $)
Nonrecurring cost	772,748
Annual cost	120,800
Nonrecurring savings	—
Annual savings	273,670

Table C.9
Static Munitions Test Arenas (SMTA)—Detail

	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Personnel (number)						
Enlisted	0	0	0	0	0	0
Officers	0	0	0	0	0	0
Civilians	0	0	0	0	0	0
Contractors	9	9	9	0	0	0
Personnel cost ($000)[a]	817	817	817	163	—	—
Other costs ($000 FY 2006)						
BOS change	Unk.	Unk.	Unk.	Unk.	Unk.	Unk.
Closure and cleanup[b]	—	—	111	—	—	—
Additional program costs	Unk.	Unk.	Unk.	Unk.	Unk.	Unk.
Alternative site upgrades[c]	—	—	83	163	163	163
Avoided modernization[a]	—	—	—	—	—	—
Avoided sustainment[a]	2	2	2	—	—	—

[a] 46 TW/XPR, 2007c.
[b] Dyess, 2007c.
[c] Knight and Taylor, 2007.

Summary	Amount (FY 2007 $)
Nonrecurring cost	356,492
Annual cost	163,440
Nonrecurring savings	—
Annual savings	819,705

Table C.10
Range Analysis Base Case

Cost Elements	Eglin	Edwards	China Lake	Point Mugu	Total
Cost per person ($000)	91	64	10	5	(619)
Employees (no.)	(698)	100	91	100	
Personnel transition ($000)	12,676	3,200	454	250	
Other transition ($000)		1,000	250	100	
Recurring costs ($000)			70		
Total transition costs ($000)	12,676	4,200	704	350	17,930
Total recurring costs ($000)	(63,378)	6,400	978	500	(55,500)

COST SUMMARY
FYDP: (148,572)
NPV (infinite): (1,723,807)
NPV (30-year): (981,939)

Table C.11
Range Analysis Worst-Case Excursion

Cost Elements	Eglin	Edwards	China Lake	Point Mugu	Total
Cost per person ($000)	91	100	91	100	
Employees (no.)	(459)	64	30	15	(350)
Personnel transition ($000)	8,335	3,200	1,362	750	
Other transition ($000)		1,000	250	100	
Recurring costs ($000)			70		70
Total transition costs ($000)	8,335	4,200	1,612	850	14,997
Total recurring costs ($000)	(41,677)	6,400	2,794	1,500	(30,983)

COST SUMMARY
FYDP: (77,952)
NPV (infinite): (957,625)
NPV (30-year): (543,475)

Table C.12
FYDP Savings ($000)

Cost Type	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	Total
Nonrecurring	0	0	17,930	0	0	17,930
Recurring	0	0	(55,500)	(55,500)	(55,500)	(166,500)
Total						148,572

APPENDIX D

Cost Data Tables

The cost tables provided in Appendix D supplement the analysis in Chapter Four. These tables cover the seven facilities that were examined in the chapter. Table D.1 summarizes the total cost and net present value calculations for the facilities that are individually examined in Tables D.2 through D.8.

The data were extracted from numerous sources and references. Key information was provided by the test organizations themselves. Where necessary, the numbers provided by the organizations were used as the base from which to construct additional or missing information. Every attempt was made to gather the most recent available data for all portions of the analysis. In addition, members of the organizations have reviewed the tables in order to ensure common understanding and agreement on the method used to arrive at the figures presented here.

The tables in this appendix were built with the intent to capture all relevant information to analyze the costs associated with the parameters of the study. Some tables may show categories that are not present in every other table. The categories of funds shown are those for which a figure was provided in any of the years under consideration. For compactness, if a category had no data for any year, it is not presented in the table. Figures for FY 2006 represent actual expenditures and staffing. Figures for years other than FY 2006 are either taken from the organization's budget documentation, or are RAND extrapolations from FY 2006 or FY 2007 values. All numbers presented have been normalized to a FY 2007 (baseline, including data for FY 2006. All adjustments were made using the appropriate Air Force factors, provided by SAF/FMC.[1] While the assumption of constant funding may not reflect actual practice, it is an appropriately conservative assumption to make in the face of the uncertainty of future year budgets.

Among the references for the data presented here are reports, presentations, and personal correspondence with organization representatives. Every attempt was made to verify with the respective organizations that the figures used were those that best reflected the position of the organization, or where numbers were constructed, that the method used was appropriate. Of particular concern was the delineation between DBA and RBA funds. When no distinction is

[1] USAF Inflation Indices, issued by SAF/FMC on January 19, 2007.

made, it should be assumed that the number represents DBA only. This convention was also intended to apply to staff; however, personnel head counts are included primarily for information only and may not reflect DBA effort in all cases.[2]

The material in this appendix includes calculations for the net present value (NPV) of the projected savings accrued from undertaking the actions under consideration. The numbers were derived in the typical fashion, multiplying the value for estimated savings by the relevant factor for each year, then summing together for a total savings over the period. This study uses a 30-year horizon and thus employed a factor of 0.03, as directed by OMB Circular A-94 and in accordance with guidance from SAF/FMC on discount rates for economic analyses. It should be noted, however, that performing this calculation expands on an already uncertain assumption. The construction of the study required the assumption that every planned test was to be conserved. When customer impacts, as estimated by AAC, were explicitly included in the cost calculations, the behavior of customers is thus assumed to be static, with no accommodations to the changed situation. Considering an NPV figure over 30 years carries this lack of an explicit reaction to the change in costs of testing out over the same horizon. While the assumption is workable, if not entirely realistic, for considering activity over the FYDP, the assumption is even less plausible when considering three decades. For that reason, this study relies most heavily on analysis over the FYDP. The NPV calculations are included for completeness and adherence to standard practice for cost benefit analyses.

2 Because personnel costs were collected directly, this has little effect on the analysis.

Table D.1
Total Costs and Net Present Value for Facilities ($000)

	FY 2006 Actuals	FY 2007–2011 Total	FY 2007–2011 Proposal	Savings	Net Present Value, 30-Year Horizon
CIGTF	15,832	89,874	114,443	(24,569)	(481,564)
GWEF	8,978	45,239	124,505	(79,265)	(1,553,633)
J-PRIMES	2,290	11,840	17,353	(5,512)	(108,043)
MCL	4,741	25,294	140,627	(115,333)	(2,260,579)
STEF	1,336	6,746	25,334	(18,588)	(364,339)
BAF	38,263	202,779	196,647	6,132	120,190
NFAC	17,046	68,585	22,183	46,402	909,503

Table D.2
Central Inertial and Global Positioning System Test Facility

	FY 2006	FY 2007		FY 2008		FY 2009		FY 2010		FY 2011		Totals	
	Actual	Budg.	Prop.	Budg.	Prop.	Budg.	Prop.	Budg.	Prop.	Budg.	Prop.	2007–2011	Proposed
Personnel (no.)													
Civilians	88	87	87	87	43.5	87	25	87	25	87	25		
Officers	15	13	13	13	6	13	0	13	0	13	0		
RBA officers	7	7	7	7	4	7	0	7	0	7	0		
Moves (no.)													
Civilian							62						
Officer							20						
Costs (constant FY 2007 $000)													
Recurring DBA													
Labor [a]													
In-house civilians	4,353	4,353	4,353	4,353	2,177	4,353	1,695	4,353	1,695	4,353	1,696	21,766	11,615
Other	718	784	784	784	0	784	0	784	0	784	0	3,918	784
Contract	725	824	824	725	0	725	0	725	0	725	0	3,723	824
Officers	1,874	1,587	1,587	1,587	733	1,587	0	1,587	0	1,587	0	7,933	2,319
Facilities													
Sustainment [b]	153	0	0	20	0	20	0	20	0	20	0	80	0
Restoration and modernization [c]	236	200	200	0	0	400	0	0	0	0	0	600	200
Nonrecurring DBA													
I&M CTEIP [d]				1,989		2,284		4,700		3,200		12,173	0
Civilian moves	0	0	0	0	440	0	0	0	0	0	0	0	440
Civilian RIF	0	0	0	0	2,903	0	0	0	0	0	0	0	2,903
Military moves	0	0	0	0	710	0	0	0	0	0	0	0	710
DBA subtotal	8,059	7,748	7,748	9,457	6,962	10,152	1,695	12,169	1,696	10,668	1,696	50,193	19,795
RBA	7,773	7,936	8,103	7,936	7,936	7,936	7,936	7,936	7,936	7,936	7,936	39,681	39,848
Additional costs to users	0	0	0	0	13,700	0	13,700	0	13,700	0	13,700	0	54,800
Total cost	15,832	15,684	15,851	17,393	28,598	18,088	23,331	20,104	23,331	18,604	23,331	89,874	114,443

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Table D.2—Continued

SOURCES: Additional costs to users were taken from ACC study of the effects on user costs (ACC, 2006). Because the available documentation was not sufficient to identify the assumptions for these estimates, they should be considered preliminary and should be used with caution. All other data were provided by 746th Test Squadron personnel.

[a] PE 65807F/Appns 3600 and 3500.

[b] PE 65978F.

[c] PE 65976F.

[d] PE 64759F, 64256F.

GENERAL NOTES:

Civilian personnel, other in-house, and contract costs were estimated by extrapolation from FY 2006 actual costs or FY 2007 budgeted costs, as appropriate. For FY 2008, we estimated 50 percent of normal personnel costs to provide for orderly transition and closure of the facilities.

Military personnel costs are calculated by multiplying head counts by $122,042, the FY 2007 Total Annual Average Standard Composite Rate (AFI 65-503, Table A19-2, April 2006).

Facility sustainment, restoration and modernization, and improvement and modernization costs are taken from 746th Test Squadron budget projections.

Civilian and military moves and RIF costs were calculated using updated standard factors for the BRAC COBRA model from AFMC:

- cost of an average civilian move: $35,496
- cost of an average military officer move: $14.998
- RIF costs as a percentage of civilian pay (86.32 percent)
- average civilian pay: $67,806.83 (taken from the FY 2006 Median Civilian Standard Composite Rate, AFI 65-503, Table 26-1, March 1, 2006, multiplied by the March 2007 raw inflation factor of 1.025).

As discussed with AFMC, our calculations assume the BRAC percentages for personnel who would move (20 percent) versus RIF (80 percent). (Officials from various T&E centers consider this assumption optimistic.)

RBA consists of FY 2006 actuals and 746th Test Squadron projections. (In accordance with the ground rule that test requirements would remain constant, RBA was assumed to be constant between alternatives.)

Table D.3
Guided Weapons Evaluation Facility

	FY 2006	FY 2007		FY 2008		FY 2009		FY 2010		FY 2011		Totals	
	Actual	Budg.	Prop.	Budg.	Prop.	Budg.	Prop.	Budg.	Prop.	Budg.	Prop.	2007–2011	Proposed
Civilians (no.)	33	33	16.5	33		33		33		33			
Costs (constant FY 2007 $000)													
Recurring DBA													
Labor [a]													
In-house civilian	3,604	3,604	1,802	3,604	0	3,604	0	3,604	0	3,604	0	18,020	1,802
In-house other	816	1,033	517	1,033	0	1,033	0	1,033	0	1,033	0	5,167	517
Contract	1,417	1,209	605	406	0	1,417	0	1,417	0	1,417	0	5,868	605
Facilities													
Sustainment [b]	0	45	0	111	0	111	0	111	0	111	0	489	0
Restoration and modernization [c]	0	443	0	453	0	381	0	1,101	0	137	0	2,514	0
Nonrecurring DBA													
Civilian moves	0	0	234	0	0	0	0	0	0	0	0	0	234
Civilian RIF	0	0	2,489	0	0	0	0	0	0	0	0	0	2,489
Facility deactivation and disposal	0	0	4,030	0	0	0	0	0	0	0	0	0	4,030
DBA Reimbursement	0	0	6,129	0	1,729	0	1,729	0	1,729	0	1,729	0	13,047
DBA subtotal	5,838	6,334	15,806	5,608	1,729	6,547	1,729	7,267	1,729	6,303	1,729	32,059	22,724
RBA	3,140	244	244	3,234	3,234	3,234	3,234	3,234	3,234	3,234	3,234	13,181	13,181
Additional costs to users	0	0	0	0	53,500	0	14,100	0	12,700	0	8,300	0	88,600
Total cost	8,978	6,578	16,050	8,842	58,464	9,781	19,064	10,501	176,64	9,537	13,264	45,239	124,505

Table D.3—Continued

SOURCES: Facility sustainment and restoration and modernization costs are taken from 46th Test Wing budget projections. Additional costs to users were taken from ACC study of the effects on user costs (ACC, 2006). Because the available documentation was not sufficient to identify the assumptions for these estimates, they should be considered preliminary and should be used with caution. A RBA consists of FY 2006 actuals and 46th Test Wing projections. (Note that, in accordance with the ground rule that test requirements would remain constant, RBA was assumed to be constant between alternatives.) All other data were provided by 46th Test Wing personnel.

[a] PE 65807F/Appns 3600 and 3500.

[b] PE 65978F.

[c] PE 65976F.

[d] PE 64759F, 64256F.

GENERAL NOTES:

Civilian personnel, Other In-House and Contract costs were estimated by extrapolation of FY 2006 actual costs or FY 2007 budgeted costs, as appropriate. Closure assumed in mid-FY 2007, so costs under proposal are reduced by 50 percent.

Civilian Moves and RIF costs were calculated using updated standard factors for the BRAC COBRA model from AFMC:

- cost of an average civilian move: $35,496
- RIF costs as a percentage of civilian pay (86.32 percent)
- average civilian pay as calculated from actual GWEF costs.

As discussed with AFMC, our calculations assume the BRAC percentages for personnel who would move (20 percent) versus RIF (80 percent). From discussions with officials from various T&E centers, this assumption is probably optimistic.

DBA reimbursement is an estimate of the costs for NAWC China Lake to assume part of the GWEF workload at IBAR (NAWC, 2007). The estimate includes the following:

- modifications to IBAR: $400,000,000
- costs of managing transfer of equipment: $400,000
- DBA salaries of 6 of 10 additional personnel: $1,229,460
- recurring maintenance of new equipment: $500,000.

Table D.4
Joint Preflight Integration of Munitions and Electronic Systems

	FY 2006	FY 2007		FY 2008		FY 2009		FY 2010		FY 2011		Totals	
	Actual	Budg.	Prop.	Budg.	Prop.	Budg.	Prop.	Budg.	Prop.	Budg.	Prop.	2007–2011	Proposed
Civilians (no.)	6	6	6	6	6	6	0	6	0	6	0		
Enlisted	5	5	5	5	5	5	0	5	0	5	0		
Costs (constant FY 2007 $000)													
Recurring DBA													
Labor [a]													
In-house civilian	210	210	210	210	210	210	0	210	0	210	0	1,051	420
Other in house	163	167	167	167	167	167	0	167	0	167	0	833	333
Contract	346	282	282	282	282	282	0	282	0	282	0	1,412	565
Enlisted	313	306	306	306	306	306	0	306	0	306	0	1,530	612
Facilities													
Sustainment [b]	55	54	54	54	54	54	0	54	0	54	0	268	107
Restoration and modernization [c]	100	129	129	132	132	489	0	141	0	1,269	0	2,160	261
Nonrecurring DBA													
Civilian moves	0	0	0	0	0	0	43	0	0	0	0	0	43
Civilian RIF	0	0	0	0	0	0	281	0	0	0	0	0	281
Military moves							44						44
Deactivation and disposal	0	0	0	0	0	0	7,000	0	0	0	0	0	7,000
DBA subtotal	1,186	1,148	1,148	1,151	1,151	1,508	7,368	1,160	0	2,288	0	7,254	9,667
RBA	1,104	71	71	1,104	1,104	1,137	1,137	1,137	1,137	1,137	1,137	4,586	4,586
Additional costs to users	0	0	0	0	0	0	2,700	0	200	0	200	0	3,100
Total cost	2,290	1,218	1,218	2,255	2,255	2,645	11,205	2,297	1,338	3,425	1,337	11,840	17,353

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Table D.4—Continued

SOURCES: Facility sustainment and restoration and modernization costs are taken from 46th Test Wing budget projections. Additional costs to users were taken from ACC study of the effects on user costs (AAC, 2006). Because the available documentation was not sufficient to identify the assumptions for these estimates, they should be considered preliminary and should be used with caution. RBA consists of FY 2006 actuals and 46th Test Wing projections. (Note that, in accordance with the ground rule that test requirements would remain constant, RBA was assumed to be constant between alternatives.) Facility deactivation and disposal cost estimate is from Dyess, 2007f. All other data were provided by 46th Test Wing personnel.

[a] PE 65807F/Appns 3600 and 3500.

[b] PE 65978F.

[c] PE 65976F.

GENERAL NOTES:

Civilian personnel, Other In-House, and Contract costs were estimated by extrapolation from FY 2006 actual costs or FY 2007 budgeted costs, as appropriate.

Military personnel costs are calculated by multiplying head counts by $61,189, the FY 2007 Total Annual Average Standard Composite Rate (AFI 65-503, Table A19-2, April 2006)

Other Facilities Nonrecurring are civilian and military moves and RIF costs. They are calculated using updated standard factors for the BRAC COBRA model from AFMC.

- cost of an average civilian move: $35,496
- cost of an average enlisted military move: $8,877
- RIF costs as a percentage of civilian pay (86.32 percent)
- average civilian pay: $67,806.83 (taken from FY 2006 Median Civilian Standard Composite Rate, AFI 65-503, Table 26-1, March 1, 2006, multiplied by a raw inflation factor of 1.025).

As discussed with AFMC, our calculations assume the BRAC percentages for personnel who would move (20 percent) versus RIF (80 percent). (Officials from various T&E centers consider this assumption optimistic.)

For this analysis, closure of the J-PRIMES was assumed to be delayed until FY 2009 to coordinate with the relocation of flight testing, since one of J-PRIMES principal benefits to the Air Force is pre- and postflight analysis.

Table D.5
McKinley Climatic Laboratory

	FY 2006	FY 2007		FY 2008		FY 2009		FY 2010		FY 2011		Totals	
	Actual	Budg.	Prop.	Budg.	Prop.	Budg.	Prop.	Budg.	Prop.	Budg.	Prop.	2007–2011	Proposed
Civilians (no.)	3	3		3		3		3		3			
	Costs (constant FY 2007 $000)												
Recurring DBA													
Labor [a]													
In-house civilian	79	77	0	77	0	77	0	77	0	77	0	384	0
Contract	603	1,978	0	603	0	603	0	603	0	603	0	4,390	0
Facilities												6	0
Sustainment [b]	0	54	0	256	0	256	0	256	0	256	0	1,076	0
Restoration and modernization [c]	256	770	0	788	0	0	0	386	0	0	0	1,944	0
Mothball maintenance	0	0	2,125	0	2,125	0	2,125	0	2,125	0	2,125	0	10,627
DBA subtotal	938	2,879	2,125	1,723	2,125	935	2,125	1,322	2,125	935	2,125	7,794	10,627
RBA	3,803	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	17,500	17,500
Additional costs to users	0	0	0	0	35,500	0	10,500	0	20,500	0	46,000	0	112,500
Total cost	4,741	6,379	5,625	5,223	41,125	4,435	16,125	4,822	26,125	4,435	51,625	25,294	140,627

Table D.5—Continued

SOURCES: Deactivation costs are from Dyess, 2007f. Under facilities sustainment and restoration and modernization, costs were taken from 46th Test Wing budget projections. The mothball maintenance cost is the 46th Test Wing's estimate of the annual cost of maintaining the facility in a mothball status (Dyess, 2007f). RBA consists of FY 2006 actuals and 46th Test Wing projections. (Note that, in accordance with the ground rule that test requirements would remain constant, RBA was assumed to be constant between alternatives.) Additional costs to users were taken from the ACC study of the effects on user costs (ACC, December 2006). Because the available documentation was not sufficient to identify the assumptions for these estimates, they should be considered preliminary and should be used with caution. All other data were provided by 46th Test Wing personnel.

[a] PE 65807F/Appns 3600 and 3500.

[b] PE 65978F.

[c] PE 65976F.

GENERAL NOTES:

Civilian, and contract labor costs were estimated by extrapolation from FY 2006 actual costs or FY 2007 budgeted costs, as appropriate.

The 46th Test Wing estimated $10 million in additional costs per aircraft program for testing in multiple environments. THAAD impact estimated at $9 million because the complete system cannot be tested at any location other than the MCL.

Table D.6
Seeker/Signature Test and Evaluation Facility

	FY 2006	FY 2007		FY 2008		FY 2009		FY 2010		FY 2011		Totals	
	Actual	Budg.	Prop.	Budg.	Prop.	Budg.	Prop.	Budg.	Prop.	Budg.	Prop.	2007–2011	Proposed
Civilians (no.)	4	4	0	4	0	4	0	4	0	4	0		
CME (no.)	3	3	0	3	0	3	0	3	0	3	0		
	Costs (constant FY 2007 $000)												
Recurring DBA													
Labor [a]													
In-house civilian	58	57	0	57	0	57	0	57	0	57	0	284	0
In-house other	83	299	0	82	0	82	0	82	0	82	0	629	0
Contract	180	176	0	176	0	176	0	176	0	176	0	880	0
Facilities													
Sustainment [b]	0	13	0	19	0	19	0	19	0	19	0	88	0
Restoration and modernization [c]	0	116	0	118	0	135	0	116	0	118	0	602	0
Nonrecurring DBA													
Facilities													
Deactivation and disposal	0	0	1,800	0	0	0	0	0	0	0	0	0	1,800
Other nonrecurring	0	0	211	0	0	0	0	0	0	0	0	0	211
DBA reimbursement	0	0	1,560	0	0	0	0	0	0	0	0	0	1,560
DBA subtotal	321	660	3,571	452	0	469	0	450	0	452	0	2,483	3,571
RBA	1,015	205	205	1,015	1,015	1,015	1,015	1,015	1,015	1,015	1,015	4,263	4,263
Additional costs to users	0	0	0	0	17,500	0	0	0	0	0	0	0	17,500
Total cost	1,336	865	3,776	1,467	18,515	1,484	1,015	1,464	1,015	1,466	1,015	6,746	25,334

Table D.6—Continued

SOURCES: Facility deactivation and disposal cost estimate is from the 46th Test Wing (Dyess, 2007f). Additional costs to users were taken from the ACC study of the effects on user costs (ACC, 2006). Because the available documentation was not sufficient to identify the assumptions for these estimates, they should be considered preliminary and should be used with caution. Only the first-year estimate was used to account for the cost of disruption of moving user testing in the near term. For the second year and out, we assumed no difference in user costs. All other data were provided by 46th Test Wing personnel. RBA consists of FY 2006 actuals and 46th Test Wing projections. (Note that, in accordance with the ground rule that test requirements would remain constant, RBA was assumed to be constant between alternatives.)

[a] PE 65807F/Appns 3600 and 3500.

[b] PE 65978F.

[c] PE 65976F.

GENERAL NOTES:

Civilian personnel, Other In-House, and Contract costs were estimated by extrapolation of FY 2006 actual costs or FY 2007 budgeted costs, as appropriate.

Facility sustainment and restoration and modernization costs are taken from 46th Test Wing budget projections.

Other facilities nonrecurring costs are civilian moves and RIFs. They are calculated using updated standard factors for the BRAC COBRA model from AFMC:

- cost of an average civilian move: $35,496
- RIF costs as a percentage of civilian pay (86.32 percent)
- average civilian pay: $67,806.83 (taken from FY 2006 Median Civilian Standard Composite Rate, AFI 65-503, Table 26-1, March 1, 2006 multiplied by the March 2007 a raw inflation factor of 1.025.)

DBA Reimbursement is an estimate of the costs for NAWC China Lake to assume the STEF workload (NAWC, 2007). In this case, we had an estimate from the 46th Test Wing for recreating the entire facility (ACC, December 2006) and an estimate from NAWC China Lake for modifying its Etcheron Valley Range to assume the STEF workload. The 46th Test Wing estimate was $5,100,000 nonrecurring. The NAWC estimate to modify the Etcheron Valley Range was $1,560,000 nonrecurring. NAWC estimated recurring costs of $1,950,000 per year, all of which was assumed to be RBA.

Table D.7
Benefield Anechoic Facility

	FY 2006	FY 2007		FY 2008		FY 2009		FY 2010		FY 2011		Totals	
	Actual	Budg.	Prop.	Budg.	Prop.	Budg.	Prop.	Budg.	Prop.	Budg.	Prop.	2007–2011	Proposed
Civilians (no.)	32	38	38	38	74	38	74	38	74	38	74		
Officers (no.)	18	24	24	24	24	24	24	24	24	24	24		
Enlisted (no.)	3	2	2	2	2	2	2	2	2	2	2		
CME (no.)	54	62	62	62	23	62	23	62	23	62	23		
Costs (constant FY 2007 $000)													
Recurring DBA													
Labor													
In-house civilian	3,028	3,508	3,508	3,508	7,108	3,508	7,108	3,508	7,108	3,508	7,108	17,538	31,938
Other in house	2,758	4,815	4,815	4,815	4,815	4,815	4,815	4,815	4,815	4,815	4,815	24,077	24,077
Contract	5,079	6,351	6,351	6,351	3,351	6,351	6,351	6,351	6,351	6,351	6,351	31,755	19,755
Other contract support	1,819	2,046	2,046	2,046	1,046	2,046	1,046	2,046	1,046	2,046	1,046	10,232	6,232
Officers	2,197	2,929	2,929	2,929	2,929	2,929	2,929	2,929	2,929	2,929	2,929	14,646	14,646
Enlisted	184	122	122	122	122	122	122	122	122	122	122	612	612
Facilities													
Sustainment	960	812	812	1,135	1,135	1,020	1,020	1,020	1,020	1,020	1,020	5,007	5,007
Restoration and modernization	812	1,312	1,312	1,285	1,285	1,000	1,000	1,000	1,000	1,000	1,000	5,597	5,597
Nonrecurring DBA													
I&M CTEIP	14,716	21,312	21,312	20,626	18,094	16,879	14,879	12,113	12,113	12,252	12,252	83,182	78,650
Other Mission	4,693	0	0	0	0	0	0	0	0	0	0	0	0
DBA subtotal	36,245	43,208	43,208	42,818	39,886	38,671	36,271	33,905	33,505	34,044	33,644	192,646	186,514
RBA	2,018	1,747	1,747	2,096	2,096	2,096	2,096	2,096	2,096	2,096	2,096	10,133	10,133
Total cost	38,263	44,955	44,955	44,915	41,983	40,767	38,367	36,001	35,601	36,140	35,740	202,779	196,647

Table D.7—Continued

SOURCES: Except as noted, all data were provided by 412th Test Wing personnel.

GENERAL NOTES:

Civilian personnel, Other In-House and Contract costs provided by 412th Test Wing personnel. Reduction of 39 contractor positions and addition of 36 civil service positions at $100,000 annual cost per position in FY 2008 and subsequent proposal years.

Military personnel, Facility Sustainment, Restoration and Modernization, and Improvement and Modernization provided by the 412th Test Wing.

Other Mission in FY 2006 is funding received for unfunded requirements in that year.

RBA consists of FY 2006 actuals and 412th Test Wing projections. (Note that RBA assumed constant between alternatives in accordance with the ground rule of holding test requirements constant.)

Table D.8
National Full-Scale Aerodynamic Complex

	FY 2006	FY 2007		FY 2008		FY 2009		FY 2010		FY 2011		Totals	
	Actual	Budg.	Prop.	Budg.	Prop.	Budg.	Prop.	Budg.	Prop.	Budg.	Prop.	2007–2011	Proposed
Officers (no.)	1	1	1	1		1		1		1			
Costs (constant FY 2007 $000)													
Recurring DBA													
Labor [a]													
Contract	3,806	2,024	1,000	7,629	0	7,461	0	7,304	0	7,156	0	31,575	1,000
Officers	0	122	61	122	0	122	0	122	0	122	0	610	61
Facilities													
Sustainment [b]	2,440	0	707	3,000	0	3,000	0	3,000	0	3,000	0	12,000	707
Restoration and modernization [c]	10,800	2,000	0	3,000	0	0	0	0	0	0	0	5,000	0
Nonrecurring DBA													
Contract award or termination	0	0	900	0	0	0	0	0	0	0	0	0	900
Military moves	0	0	15	0	0	0	0	0	0	0	0	0	15
Facilities environmental	0	0	100	0	0	0	0	0	0	0	0	0	100
DBA subtotal	17,046	4,146	2,783	13,751	0	10,583	0	10,426	0	10,278	0	49,185	2,783
RBA	0	1,400	1,400	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	19,400	19,400
Total cost	17,046	5,546	4,183	18,251	4,500	15,083	4,500	14,926	4,500	14,778	4,500	68,583	22,183

Table D.8—Continued

SOURCES: Except as noted, all data were provided by NFAC personnel.

GENERAL NOTES:

The divestiture decision was assumed to be made in October 2006, followed by a six-month transition period.

Contract costs were estimated by NFAC, with a phase-out over six months to permit orderly transition and closure of the facilities.

Military personnel costs are calculated by multiplying the head count by $122,042, the FY 2007 Total Annual Average Standard Composite Rate (AFI 65-503, Table A19-2, April 2006).

Facility Sustainment, Restoration and Modernization, and Improvement and Modernization costs were taken from NFAC budget projections. For the FY 2007 proposed budget, $707,000 is included to account for seven months of payments to NASA for the lease ("Institutional Share Pool") and for demand services.

Contract Award or Termination costs include a termination cost of $400,000 for the data system contract and $500,000 for the rotor test assembly contract.

Military Move costs are calculated using updated standard factors for the BRAC COBRA model from AFMC (the cost of moving a military officer averages $14,998).

Nonrecurring Facilities include seven months of NASA lease payments ($497,000) and seven months of NASA facility support ($210,000).

Environmental costs cover the required environmental baseline survey ($100,000).

RBA costs are NFAC projections. (Note that, in accordance with the ground rule that test requirements would remain constant, RBA was assumed to be constant between alternatives.)

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MG-619-AF

Congressional Report

Air Defense Mission

HRpt 109-676, page 134

U.S. AIR FORCE

Introduction

This report is being provided to Congressional Defense Committees as directed in House Report 109-676-134.

Executive Summary

The scope, duration and resourcing of Operation Noble Eagle (ONE), the federal mission which ensures the Air Sovereignty of the United States, is determined by the National Command Authority and Commander US Northern Command.

Background

Some California constituents are concerned the 144th Fighter Wing, of the California Air National Guard, is to close in the year 2012. These same constituents further express concern that this supposed 2012 expiration date for the 144th FW would result in an unacceptable gap in coverage in the Air Defense of the South Western United States.

Report

There are no plans, within any US Air Force or Air National Guard initiative, to close the 144th FW. The year 2012 was perceived as a closing date for the 144th FW because of the wing's aging fleet of Block 25 F16's. These Block 25 F16's, based on current utilization rates, are programmed for retirement in the 2012 timeframe.

As part of a long envisioned formal US Air Force plan, the 144th FW is already in possession of the first 3 of 18 Block 32 F16's. The 144th FW will be fully converted to a fleet of Block 32 F16's by the end of FY07. These Block 32 F16's should, based on current utilization rates, remain operational through FY18.

Air Defense of the United States as set forth in the Operation Noble Eagle Execution Order does not refer to the term "Main Operating Base," and as such is a non-term with no significance.

Within the confines of the Goldwater-Nichols Department of Defense Reorganization Act of 1986, it would be doctrinally incorrect for a Combatant Commander to provide an individual unit with any particular capability. It is the responsibility of the US Air Force to organize, train and equip its units in accordance with Combatant Commander requirements.

Evolving US Air Force plans extend the 144th FW's capability to perform the Air Defense mission to the year 2018, as described above. The duration of Operation Noble Eagle, or whether the 144th FW is utilized in the execution of Operation Noble Eagle, is completely at the discretion of the National Command Authority and Commander US Northern Command.

JOINT REPORT TO CONGRESS

ON

USE OF THE NAVAL POSTGRADUATE SCHOOL

AND THE AIR FORCE INSTITUTE OF TECHNOLOGY

TO MEET REQUIREMENTS FOR ENLISTED GRADUATE DEGREES

Jointly prepared by:

United States Navy
Deputy Chief of Naval Operations for
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Washington, DC

March 2007

Report Requirement

Subsection 543(f) of the John Warner National Defense Authorization Act for Fiscal Year 2007, Public Law 109-364, directed the following:

"Report on Use of NPS and AFIT- Not later than March 30, 2007, the Secretary of the Navy and the Secretary of the Air Force shall submit to the Committee on Armed Services of the Senate and the Committee on Armed Services of the House of Representatives a joint report on the manner by which each Secretary intends to use the Naval Postgraduate School and the Air Force Institute of Technology during fiscal years 2008 through 2013 to meet the overall requirements of the Navy and Marine Corps and of the Air Force for enlisted members with graduate degrees. The report shall include the following:

(1) The numbers and occupational specialities of enlisted members that each Secretary plans to enroll as candidates for graduate degrees each year in each of the two schools.

(2) A description of the graduate degrees that those enlisted members will pursue at those schools.

(3) Other matters that the two Secretaries jointly consider to be useful for the committees to better understand the future role that the two schools will each have in meeting service requirements for enlisted members with graduate degrees."

NAVY

Currently, the Navy has no enlisted billets that require the incumbent to have a graduate degree. Consistent with our strategic imperatives, the Navy has no plans to send enlisted members to the Naval Postgraduate School or the Air Force Institute of Technology for graduate degrees until specific requirements are identified and validated. We are in the midst of important work to define the Navy workforce of the future through linking specific knowledge, skills and abilities to capabilities. This work is fundamental to enabling us to determine the types and levels of education required to develop competencies needed to deliver capabilities in a cost efficient manner.

As part of a larger evolving strategy to develop strategically-minded, critical thinkers who are better prepared to operate tomorrow's Fleet, and assume key naval and joint leadership roles, the Navy does provide some education opportunities for senior enlisted members. At the graduate level, five senior enlisted members per year are selected to complete masters' degrees through funded off-duty education at civilian academic institutions. Available areas of study in FY07 included: Disaster Management, Human Performance Improvement, Engineering and Technology, Systems Engineering and Analysis, Homeland Defense and Security, Leadership and Management, and Business Administration. Additionally, we select up to four academically qualified Command Master Chiefs per year for enrollment in the Naval War College (NWC) resident senior level course. The purpose of the program is development of skilled joint leaders and strategically-minded thinkers, but it also results in award of a Master of Arts Degree in National Security and Strategic Studies.

As part of our overall personnel strategy, the Navy will continue to evaluate and support education needed to develop the competencies, professional knowledge and critical thinking skills needed by 21st century leaders to meet the demands of fast-paced, multi-mission environments.

Marine Corps

Currently, the Marine Corps has no enlisted billets that require the incumbent to have a graduate degree. The requirement does exist for certain billets to be staffed with enlisted Marines who possess an undergraduate degree. These billets are filled through the Staff Noncommissioned Officer Degree Completion Program. The related disciplines are: Safety, Education, Psychology, Music and Accounting.

Although there are no current requirements for graduate degrees, there are some Occupational Fields that would benefit from additional education. Those fields include, but are not limited to Intelligence (PMOS 02xx), Signals Intelligence (PMOS 26xx), and Ground Electronics (28xx). Graduate degrees may also be beneficial to those assigned to high-level staffs such as Occupation Field sponsors. Marine Corps needs would dictate the support of any graduate degree opportunities.

In recent years, the Marine Corps has sent enlisted Marines with the Primary Military Occupational Specialty of Information

Assurance Technician (PMOS 0689) to the Air Force Institute of Technology (AFIT) for graduate degrees in Information Assurance. The assignment of these Marines to AFIT has been not designed to fulfill requirements of a specific billet. Rather, the intent has been to bolster the Information Assurance community within the Marine Corps through exposure to broadened instruction at AFIT. Upon graduation, these Marines have been assigned based upon existing occupational needs.

Air Force

The Air Force process to select enlisted personnel to obtain graduate degrees and then assign graduates to jobs that put their newly acquired education to work has developed since its inception in 2002 to a very effective one. Enlisted personnel are nominated through command channels and selected by a committee of Career Field Managers (CFMs). The CFM's selection puts the heaviest weight on the identification of a short list of appropriate post-graduation assignments. Firm assignments are finalized later. All personnel participating in this program must agree to an Active Duty Service Commitment of three years beyond graduation.

Forty-seven enlisted personnel have participated in this program. Nine are still early in their studies with projected graduation in March 2008. Ten will graduate in March 2007 and twenty-five are working for the Air Force. Three program graduates, all from the initial group in 2002, have left the Air Force. Twenty-four of the forty-seven participants represent the Communications-Computer Systems Operations, Communications-Electronics System Maintenance, and Aircraft Maintenance career fields.

Thirty-eight of the forty-seven participants are enrolled in four degree programs: Logistics Management, Computer Science, Information Systems Management, and Information Resource Management. Graduates' assignments include Senior Enemy Integrated Air Defense Systems Analyst; Functional Manager, Aircraft and Equipment Maintenance; Acquisition Logistics Manager (C-130E, H, and P & HC-130 H/N); Command Manager, Information Satellite Communication Systems; and C4 Computer Security Engineer.

The expanded eligibility for enlisted members to attend the Naval Postgraduate School (NPS) provides future options for the Air Force to enhance its mission capability in Joint Information

Operations; Homeland Defense and Security; National Security Affairs—Middle East, Africa, and South Asia; Special Operations and Irregular Warfare; and Meteorology. The Air Force has not yet identified any personnel to pursue degrees at NPS although several degree programs may be considered on a limited basis in the future. The need to program funding to support expanded NPS opportunities dictates that we carefully consider the priorities given to educational opportunities for all members. The Air Force will continue to send 10 enlisted members per year to these graduate programs.

Congressional Report

Report on Air Force Safety Requirements for Air Force Flight Training Operations at Pueblo Memorial Airport, Colorado

House Report 109-702, page 404

U.S. AIR FORCE

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Introduction

This report is being provided to the congressional defense committees as directed in House Report 109-702, page 404, dated 22 June 2006.

Executive Summary

This report highlights safety requirements for flight operations at Pueblo Memorial Airport, Colorado. Several Air Force units from within and around Colorado utilize the airport with the primary participant being the 302 Airlift Wing (AW), Air Force Reserve Command (AFRC), at Peterson Air Force Base, CO. This report addresses crash, fire and rescue (CFR) requirements at Pueblo Memorial Airport, possible funding assistance to the city of Pueblo for those services and alternatives to flight operations at the airport.

Background

HR 5122, FY07 National Defense Authorization Act, dated 22 Jun 06, as passed by the Senate requires a report on Air Force Safety Requirements for Air Force Flight Training Operations at Pueblo Memorial Airport, Colorado. The original issue was a proposal to move the existing fire station from Pueblo Memorial Airport grounds to a location where it could provide response to both the airport and a new housing development. However, relocating the existing fire station would not meet crash, fire and rescue response times required for use of the field by Air Force aircraft. The city of Pueblo felt it could not afford to build, maintain and operate both the existing airport fire station and a separate new one specifically for the development. The city of Pueblo has requested assistance in funding a portion of the cost to maintain the fire department at Pueblo Memorial Airport, due to the use of the field for training purposes by the 302 AW.

Report

Report on Air Force Safety Requirements for Air Force Flight Training Operations at Pueblo Memorial Airport, Colorado

Elements
1. Description of the range of Air Force flight operations at Pueblo Memorial Airport.
- Several Air Force units from within Colorado and the bordering southern states utilize Pueblo Airport.
- The 302 Airlift Wing (AFRC C-130s) based at Peterson Air Force Base (AFB) is currently the heaviest military user of Pueblo Memorial Airport with the 58th Special Operations Wing (SOW), Air Force Special Operations Command MC/HC-130s, being the next heaviest user. The facility is also used by an Army helicopter unit at Fort Carson in Colorado Springs.
- Training includes proficiency, instrument approach/landing, simulated emergency, formation, tactical arrival/departure, short field (assault), and night vision device (or goggle) (NVD, NVG) terminal area operations.
- Pueblo Memorial Airport is of particular utility to the 302 AW due to its proximity (10-15 minute flight time), availability of approaches, limited commercial civilian traffic, location out of Denver arrival/departure corridors, and length and orientation of runways.
- City of Colorado Springs Airport (Peterson AFB) does not have an available runway which can be considered an “assault” strip (3500 feet long and/or 60 – 80 feet wide), has considerable commercial traffic to deconflict with, and growing noise abatement concerns.
- On 1 Oct 06, Air Force Initial Flight Screening (IFS) training began moving operations from Hondo, TX, to Pueblo Memorial Airport. This will greatly increase traffic pattern activity at the

airport to the point that much of the daytime activity of the 302 AW and other military units at Pueblo airport will be curtailed. There currently is no night flying requirement in the IFS syllabus so night flying activities of the 302 AW and other units will not be affected.

2. Assessment of the effect of Air Force flight operations at Pueblo Memorial Airport on non-Air Force activities at the airport.

- The Air Force and the 302 AW have a particularly positive relationship with the operators and users of Pueblo Memorial Airport. Over the years a very professional and productive relationship has been cultivated between the airport management and Air Force controllers.
- Pueblo-based fixed base operators and flight schools enjoy equal or higher traffic priority than Air Force aircraft and very little competition for airspace exists.
- Current impact of Air Force flight operations on non-Air Force activities is less than the impact of non-Air Force flight operations on Air Force activities. Pilot-controlled after hours lighting on airfield ceases operation at 2200L, making it difficult to accomplish NVG airland operations after that time due to effects of airport lighting on the NVGs.
- On 1 Oct 06, the move of the Air Force IFS program to Pueblo, CO greatly increased Air Force (actually civilian contract through Doss Aviation) activity at Pueblo Memorial Airport. The full impact of this Air Force activity on non-Air Force flying operations at the airport and surrounding area is unknown at this time, as the IFS training will not reach full capacity until the end of the year, but measures to reduce the anticipated impact are being investigated.

3. Description of the Air Force safety requirements at Pueblo Memorial Airport with respect to Air Force flight operations at the airport.

- Crash/fire/rescue (CFR) requirements for airlift aircraft are detailed in Air Mobility Command Instruction (AMCI) 11-208, Airlift/Tanker Operations. Requirements for AETC aircraft are similar based on size of the aircraft.
- The original issue was the proposal to move the existing fire station from Pueblo Memorial Airport grounds to a location where it could provide response to both the airport and a new housing development. The city of Pueblo felt it could not afford to build, maintain and operate both the existing airport fire station and a separate new one specifically for the development.
- The location to which the airport fire station would be moved would increase the response time for an aircraft emergency from the current 1-2 minutes to approximately 15 minutes. This is well above the 3-minute response required for Air Force aircraft. FAA rules for non-air carrier, general aviation aircraft of the type/size typically operating at Pueblo would still be met.

4. Assessment of the necessity of providing for a continuous fire-fighting capability at Pueblo Memorial Airport.

- As stated above, for Air Force airlift flight operations at Pueblo airport, continuous, on-station (to affect a 3-minute or less response time) CFR support must be in place for the airport to "qualify" as an additional training base for Air Force aircraft. Relocation of the fire station outside the 3-minute response area would curtail Air Force activity at the airport unless a waiver was coordinated or substitute CFR presence was arranged for the period of Air Force activity at the airport. A waiver to CFR response time would be undesirable.
- The 302 AW does not have its own CFR element and relies on 21st Space Wing (host unit) CFR assets for operation at Peterson AFB. The 21 SW CFR assets are also used to provide CFR coverage for the City of Colorado Springs Airport and all civilian operations on the airport grounds. Detailing of 21 SW CFR assets to Pueblo would be impossible. If 302 AW was assigned its own CFR element, those assets could be detailed to Pueblo as needed (a totally separate but related issue).

5. Description and assessment of alternatives to Air Force flight operations at Pueblo Memorial Airport, including cost and availability of such alternatives.

- The two Air Force units most affected by loss of Pueblo operations are the 302 AW and 58 SOW due to runway length, weight bearing capacity, and surrounding terrain. The nearest suitable airport (other than Colorado Springs) capable of supporting C-130 aircraft, yet not within Denver's arrival/departure area, is Cheyenne, WY. For 302 AW, Cheyenne is a 40-minute flight (one way) away. For 58 SOW, one-way transit time would be approximately 1.5 hours; most likely they would opt for some other airport, e.g. Amarillo, TX.

- The increased transit time, roughly 1 hour round-trip, would cost an additional 5000 pounds of fuel per mission; roughly 1000 gallons with no added training.
- In addition to increased operating cost for the aircraft, cost for the crewmembers would also increase. Due to transit time, sortie duration would have to be increased to the point crewmembers would require two training periods to complete the sortie. This would cut in half the number of times per fiscal year a crew member would be able to use inactive duty periods to complete his/her required flying training events, which in turn would mean a doubling of the required active duty "man-days" required in the unit's annual budget in order for aircrew to get their required training done. At the same time, the transit time is relatively useless in fulfilling training events.
- Two alternative sites for "assault" takeoff/landing practice are located within the area local to the 302 AW: Butts Army Airfield (AAF) at Fort Carson and the "Bullseye" auxiliary field operated by the US Air Force Academy. Butts AAF can allow only 5 takeoffs/landings per sortie due to runway surface conditions. Bullseye's weight bearing capacity is suspect for C-130 size aircraft, though upgrades are being planned and could include stressing for C-130s and even C-17s if the Air Force (Air Mobility Command, Air Education and Training Command) are willing to add funds to the project. These alternative sites do not have sufficient instrument approach availability to make up for the loss of Pueblo as a training site for 302 AW.

6. Description of the funding required to assist the City of Pueblo, Colorado, in meeting Air Force safety requirements for Air Force flight operations at Pueblo Memorial Airport.

- The original figure arrived at and conveyed to the Pueblo City Council as a (very) rough estimate, was $750,000 per year ($525K for 302 AW and $225K for 58 SOW). This was based on the average monthly time the 302 AW and 58 SOW assets were training at Pueblo multiplied by the hourly cost per person and vehicle for the Pueblo CFR assets. This included both daytime and nighttime operations there by both wings and included hours where either wing's aircraft could potentially be there based on mission timing. It also assumed the AF assumed the full cost of funding the Pueblo CFR assets for the entire time period, which meant the AF would be funding CFR coverage for non-Air Force activity occurring in the same time period. With the impact on Pueblo airport's local traffic as the AF IFS program reaches full capacity, 302 AW will most likely reduce its presence at Pueblo airport to night operations only, essentially cutting its time there by 60%. The 58 SOW primarily operates at Pueblo at night already so its impact would be considerably less. Eliminating daytime operations would significantly reduce the amount that might be provided.
- Any estimate of funding assistance would have to be negotiated between the city of Pueblo, the Air Force Reserve Command and other users.

Congressional Report

Multi-Spectral Imaging Capabilities on the Global Hawk Unmanned Aircraft System

House Report 109-702, page 561

U.S. AIR FORCE

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5 February 2007

Introduction

This report is being provided to the congressional defense and intelligence committees as directed in House Report 109-702, page 561, dated 29 September 2006.

Executive Summary

The current Air Force plan does not migrate Senior Year Electro-optical Reconnaissance System (SYERS)-2 from the U-2 to the Global Hawk in the Global Hawk baseline program. The SYERS-2 sensor has been reviewed twice by the Global Hawk program to understand the integration requirements. The SYERS-2 sensor is significantly larger than the Global Hawk optical sensor, and would require a significant redesign of the front end of the Global Hawk fuselage in order to accommodate this larger sensor.

The Global Hawk Capability Development Document (CDD) includes spectral sensor technology as a "future" potential solution for difficult targets. The program will likely "compete" the research, development, and integration since more than one domestic vendor is available. Although a spectral collection gap may occur between U-2 and Global Hawk, we believe other service or agency assets are available to mitigate the loss of the U-2 multi-spectral capability.

Background

The John Warner National Defense Authorization Act for Fiscal Year 2007, directs the Secretary of the Air Force to develop a plan for:

"…migrating the multi-spectral imaging capability provided by the SYERS-2 capabilities from the U-2 to the Global Hawk, and provide the results of that plan to the congressional defense committees with the submission of the fiscal year 2008 budget request."

The SYERS-2 sensor is an optical, high-resolution, multi-spectral imaging sensor. It can provide images at very long ranges, day or night, and in marginal weather. It collects in seven spectral bands from the visible, short-wave infrared, and mid-wave infrared. It can also provide multi-band products useful in finding camouflaged and hidden targets. The SYERS-2 sensor is carried on the U-2 Dragon Lady aircraft, and is used in the high altitude intelligence surveillance and reconnaissance (ISR) mission area around the world today.

The U-2 has been identified by the Air Force for recapitalization and is preparing for retirement in 2012. The RQ-4B Global Hawk is identified as the replacement for the U-2. The RQ-4B is designed to carry optical, radar, and signals intelligence sensors simultaneously in order to accomplish a multi-intelligence (multi-INT) mission like the U-2. The Global Hawk's optical sensor collects in the visible and mid-wave infrared bands, but does not sub-divide those bands into multi-spectral products.

Report

- The Global Hawk program completed a Nunn-McCurdy certification in 2006, during which the program was restructured to reduce program risk for fielding baseline capability on time
- The updated Global Hawk requirements document states the optical imagery need is a dual-band, visible and infrared capability

  - o The requirements document was reviewed as part of the Nunn-McCurdy certification
  - o Multi-spectral capability is not a funded part of the restructured baseline program
  - o The Global Hawk CDD has a section which identifies spectral sensor technologies as a potential future solution for finding and identifying difficult targets

- Deployment of the RQ-4B to global forward operating locations to begin replacing the U-2 is linked to successful, on time, completion of initial operational test and evaluation (IOT&E)

- If Global Hawk IOT&E is successful, research and development activities for sensor capabilities beyond the approved baseline systems could be incorporated into the Global Hawk budget as soon as fiscal year 2010

- SYERS-2 is larger than the current or planned Global Hawk optical sensors and would cause a redesign of the fuselage front end

  - o Migration of the SYERS-2 to Global Hawk has been reviewed by the Global Hawk program office on two previous occasions and determined it is a significant engineering effort
  - o Significant systems integration work, engineering staff resources, schedule time, and systems integration lab facilities would be required to complete the work
  - o The time required to integrate SYERS-2 into the baseline program would result in a program schedule deviation of the initial operational test and evaluation (IOT&E) planned for the beginning of fiscal year 2009

- While the Goodrich SYERS-2 sensor is the most advanced airborne spectral sensor today, there are on-going developments that will exceed its performance

  - o British Aerospace Engineering (BAE) is developing a hyper-spectral airborne sensor for Air Force Laboratories called the Spectral Infrared Remote Imaging Transition Testbed (SPIRITT)
  - o Hyper-spectral provides hundreds of bands for better spectral resolution and improved performance in finding and identifying difficult targets
  - o Goodrich has approached the Air Force discussing a Next Generation SYERS (NGS) sensor, also referred to as SYERS-3, with multi- and hyper-spectral options

- Since more than one vendor is available, the Air Force would most likely compete the development of a spectral sensor when it starts that activity for Global Hawk

Conclusion

The Air Force has identified spectral sensor capability as a potential future growth path for Global Hawk. In order to control development schedule risk, it will not pursue that capability until after the baseline capabilities successfully completes IOT&E. When the Air Force begins the development of a spectral capability for Global Hawk, it will choose a competitive approach.

John Warner National Defense Authorization Act for Fiscal Year 2007,

Conference Report 109-702, page 561:

Multi-spectral imaging capabilities

The Senate amendment contained a provision (sec. 148) that would: (1) express the sense of the Senate that the Air Force should investigate ways to retain the multi-spectral imaging capabilities of the Senior Year Electro-optical Reconnaissance System (SYERS-2)that would otherwise be lost with the retirement of the U-2 aircraft; and (2) require that the Secretary of the Air Force provide a plan for migrating these multi-spectral capabilities to the Global Hawk unmanned aerial vehicle.

The House bill contained no similar provision.

The Senate recedes.

The conferees expect the Secretary to develop a plan for migrating the multi-spectral imaging capability provided by the SYERS-2 capabilities from the U-2 to the Global Hawk, and provide the results of that plan to the congressional defense committees with the submission of the fiscal year 2008 budget request.

Global Hawk RQ-4A/B Capabilities Development Document, CAF 353-92-C – I/II/III,

Section 6.5 (U) Future Applications. The Global Hawk system provides a platform for future payloads representing a broad spectrum of missions. This CDD and its classified payload appendices identify a number of future attributes that are not yet considered part of the Global Hawk program. Specific requirements for these future payloads or missions will be published in separate requirements documents as they become firm. Envisioned future Global Hawk configurations may include hyperspectral, laser, and foliage penetrating radar. Additional capabilities desired (not necessarily on a single aircraft) include: the capability to detect, locate, and identify obscured targets; a communications relay capability; a blue force tracking capability; the capability to select an image from an onboard server or storage unit and transmit that image at a selectable resolution and size (such as retrieving a "thumbnail" or "chip"); broad area synoptic coverage from a sensor that provides imagery releasable and acceptable to foreign nations, international organizations, or alliances; the capability to conduct psychological operations broadcast missions as described in the Long Range Broadcast System (LRBS) CDD; and the ability to accept technology insertion/special purpose built systems. Current and future signature requirements and signatures developed in support of or needed for this acquisition will be provided to/by the National Signatures Program, Signatures Program Management Office (POC: DIA/NSP SPMO).

FY2008 Congressional Report
On
C-5 Reliability Enhancement and Re-engining Program (RERP)

A. BACKGROUND

C-5 Reliability Enhancement and Re-engining Program (RERP) consists of two parts--Reliability Enhancements and Re-engining--and has the overall objective of improving C-5B/C Fleet Availability while reducing Total Ownership Cost (TOC). To reduce risk and the time required to develop and test an integrated solution, various system and subsystem enhancements will maximize the use of commercial items and minimize development of new equipment.

C-5 RERP will contribute to the required strategic airlift fleet capacity by improving the following capabilities. RERP will achieve the required wartime 61% Aircraft Availability (AA) and wartime 75% Mission Capable Rate (MCR) through the combined efforts of the Air Force (AF) and contractor team. This will be accomplished by integrating a new commercial-off-the-shelf (COTS) propulsion system; upgrading 70 C-5 subsystems/components, including 50 reliability enhancements (RE); providing proper spares (RERP and legacy) levels necessary for an 85% issue effectiveness rate; and improving the C-5 logistics system. Integration of General Electric (GE) CF6-80C2 turbofan engines (military designation F138-GE-100) will increase take-off thrust, climb performance, and fuel efficiency. The C-5M will have improved range and payload capability for AMC mission profiles. The new engine will also facilitate access to Communication / Navigation / Surveillance and Air Traffic Management (CNS/ATM) airspace and meet the intent of FAR Part 36-mandated aircraft Stage III noise requirements and FAR Part 34-engine emissions level requirements.

The government has entered into a long-term business arrangement with the RERP prime contractor, Lockheed Martin Aeronautics Company (LM-Aero), to design, manufacture, install, and support the RERP modification. Sustainment support will be aggressively pursued through Performance Based Logistics (PBL). These PBL contracts encourage partnering on core workloads to ensure organic depot support and allocation of all other (Core Plus) workloads based on the government's or the contractor's ability to meet performance based requirements at best value to the AF.

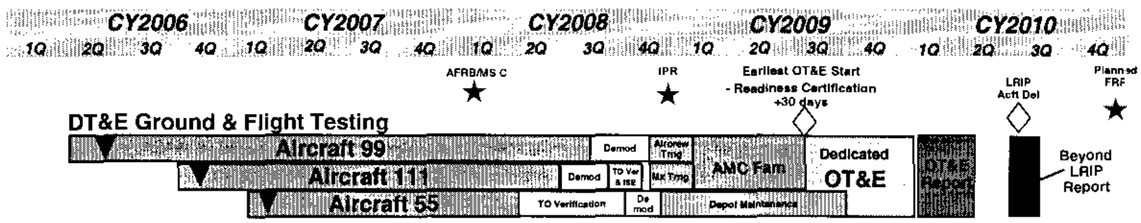
B. CURRENT RERP QUALIFICATION TESTING ASSESSMENT

1. Qualification Test and Evaluation (QT&E)

System Development and Demonstration (SDD) began in Dec 01 and modification of the first aircraft began in Oct 04. LM Aero modified two C-5B aircraft and one C-5A aircraft to the RERP configuration to support the test program. In addition to the RERP modifications, these aircraft are specially modified with instrumentation required to acquire data during ground and flight-test missions to verify specification compliance and support other test evaluations.

RERP Qualification Test and Evaluation (QT&E) ground testing began in Nov 05, leading to first flight of a RERP modified aircraft in Jun 06. The second and third test aircraft began test operations in Nov 06 and Mar 07, respectively. Integrated testing is being conducted with Air Force Operational Test and Evaluation Center (AFOTEC) involved and supporting the Combined Test Force (CTF). AFOTEC provided Operational Assessments (OA) during RERP QT&E (OA-1 released Nov 06 and OA-2 released Jan 08).

Test Schedule



2. Qualification Test Assessment

The QT&E effort has completed 73 percent of the planned test points while accomplishing 243 flights and 752 flight hours (a/o 19 Feb 08). Testing accomplished to date has indicated that the RERP modifications are performing as expected. Testing to date has included evaluation of the initial 1-g envelope; dynamic taxi testing to validate structural modeling of the modified pylon and wing; stall speed determination; initial flight and climb performance; climatic testing at the McKinley Climatic Laboratory at Eglin AFB, FL, and in a hot weather natural environment at Yuma, AZ; minimum control airspeed and ground speed determination; and initial structural loads testing.

Key performance parameters (KPP) are established for C-5 RERP to address reliability and maintainability, time to climb, obstacle clearance, noise compliance, and emissions compliance. Current projections are that all KPPs will be met, and the test data collected during QT&E will support this. Reliability and Maintainability (R&M) data are being collected throughout the test program (discussed below). Airfield performance testing at Edwards AFB in Mar-Apr 08 is necessary to complete verifications of time to climb and obstacle clearance. Climb performance testing was conducted in Oct-Nov 07, those results were satisfactory. Airfield performance testing is also a necessary step leading to far-field noise testing that will be done to verify compliance with the FAA Stage 3 noise requirements. Analytical results based on engine measurements are that the C-5M will meet the Stage 3 noise standards. The CF6 engine has received an FAA certification showing it meets the emission compliance standards.

R&M data is being collected and analyzed during QT&E ground and flight testing by a joint team consisting of the program office, developmental and operational testing agencies, the using command, and the contractor. Overall, RERP components are performing well, although minor problem areas with specific components have been noted and are being addressed. Most recent data, as reported by the AF developmental test organization, indicate that R&M requirements will be met as indicated below. Note that these data are from developmental flight and ground test activities that can be more rigorous than normal operational use and further improvement in the results are expected when the aircraft become operational.

R&M Requirements

Measure		Req'mt	Test Hours			
			215	305	440	675
Mean Time Between Failure - Inherent	Overall Aircraft	>31 min	52.8	42.0	31.2	36.6
	RERP Components	>51 min	244.2	167.4	134.4	133.2
Mean Time Between Maintenance - Total	Overall Aircraft	>24 min	31.8	27.6	21.0	26.3
	RERP Components	>67 min	140.4	117.0	96.6	105.4
Mean Maintenance Hours per Test Hour	Overall Aircraft	<17 hrs	2.90	4.38	5.45	5.20
	RERP Components	<10.8 hrs	0.90	1.25	1.44	1.50

Remaining testing is expected to be completed in August 08 and will include the following testing:

Flying Qualities (Stall Speed Multiplier Validation)	Jan-Mar 08
Maneuvering Envelope Expansion	Jan-Apr 08
Hot Fuel Testing (JP-8)	Mar 08
Reduced Vertical Separation Minimums (RVSM)	Mar 08
Airfield Performance (Ship 111 at Edwards AFB)	Mar-Apr 08
Structures (Phase II and III)	Apr- Jun 08
Far-Field Noise testing	May 08
Stallimiter, Stall Characteristics	May 08
Hot Fuel Testing (Alternate Fuel JP-8)	May 08
Auto Takeoff/Go-Around Testing	Jun 08
Final Operational Flight Program Software Release	Jul 08
Embedded Diagnostic System Verification	Jul 08
Aerial Refueling Testing	Jun 08
Wind Dependent Testing	Jun 08
Integrated System Evaluation	Jun 08
Structures Part IV	Jul 08
Flight Test Scheduled Completion	Aug 08

C. ESTIMATED PROJECTED IN-SERVICE PERFORMANCE OF C–5 AIRCRAFT WITH THE RERP MODIFICATION

The QT&E effort is ongoing. Recent testing has indicated that the RERP modifications are performing as expected. The 70 C-5 subsystems/components, including 50 reliability enhancements (RE) items, were specifically selected to improve the MCR with the greatest payback with respect to TOC. While the AFOTEC Operational Assessment-2 report identified some shortfalls associated with meeting the suitability requirements, current modeling predictions and test data collected during the current development program indicate we are on track to meet reliability and maintainability requirements for the RERP modification. Analysis indicates RERP-modified aircraft will meet the required 75% wartime MCR.

D. COSTS

The C-5 RERP Nunn-McCurdy certification process culminated on 14 Feb 08. Under Secretary of Defense for Acquisition, Technology, and Logistics USD(AT&L) certified a restructured program modernizing 49 Production aircraft, 47 B-models and 2 C-models for a total of 52 aircraft (including the three SDD aircraft).

1. Outline Of The Current Estimated Program Costs

The Office of the Secretary of Defense (OSD) Cost Analysis Improvement Group (CAIG) completed an evaluation of the restructured C-5 RERP and developed an independent estimate (ICE) of the Research, Development, Test, and Evaluation (RDT&E) and Procurement costs, as well as the Future Years Defense Program (FYDP) resource requirements to support the Nunn-McCurdy certification process. The OSD CAIG estimate of the acquisition costs for the restructured C-5 RERP is $7,694 million (Then Year Dollars (TY$)), significantly less than the $17,506 million estimate reported in the quarterly Selected Acquisition Report (SAR) dated 30 Sep 07. The CAIG estimate is based on a reduced quantity (52) of aircraft modernized within the RERP, from the (111) quantity reported in the quarterly SAR.

Overall, $294 million in additional resources are required within the FY 2009-13 FYDP for the C-5 RERP program. Resource adjustments necessary to properly fund the RERP program to the annual resource requirements for the restructured program will be accomplished in the development of the FY 2010-15 FYDP. No adjustments are necessary for FY 2009. Based on the CAIG ICE for the restructured C-5 RERP, the Program Acquisition Unit Cost (PAUC) and Average Procurement Unit Cost (APUC) figures below were deemed reasonable:

OSD CAIG Estimate of the Acquisition Costs for the Restructured C-5 RERP Program

Restructured C-5 RERP Date: Jan 2008	BY 2000 $	TY $
PAUC (Program Acquisition Unit Cost)		
Cost ($M)	$ 6,082.1	$ 7,694.1
Quantity	52	52
Unit Cost ($M)	$ 117.0	$ 148.0
APUC (Average Procurement Unit Cost)		
Cost ($M)	$ 4,607.6	$ 6,042.1
Quantity	49	49
Unit Cost ($M)	$ 94.0	$ 123.3

2. Causes for Cost Growth

The C-5 RERP experienced critical APUC growth of 75.9% from the Nov 01 APB estimate of $60.5 million (Base Year 2000 Dollars (BY00$)) to the Sep 07 SAR estimate of $106.4 million (BY00$). The OSD CAIG independent cost estimate of RDT&E and Procurement costs resulted in a critical APUC growth of 52.7% to $92.4 million (BY00$). The CAIG determined four major factors account for the APUC growth:

a. Material Cost Growth. The cost of material to the prime contractor in the May 07 production proposal is significantly greater than that estimated at Milestone B on the basis of the development proposal. The higher material cost reflects price escalation for certain raw materials, especially strategic or specialty metals, at higher than expected levels projected at Milestone B. Material cost growth accounts for $11.0 million (BY00$), or 18.2%, growth to the original APUC.

b. Estimation. Two elements of program content were significantly underestimated at Milestone B: (1) spares to support initial deployment, and (2) other government costs, especially government furnished equipment and mission support. Increases in the program cost for elements underestimated at Milestone B accounts for $10.0 million (BY00$), or 16.5%, growth to the original APUC.

c. Labor Cost Growth. Labor cost growth follows from two factors: (1) increased hours to perform installation of prime mission equipment and "over & above" repairs based on experience to modernize three aircraft in the development program, and (2) a significant increase in labor rates reflected in the prime contractor's latest Forward Pricing Rate Agreement. Labor cost growth accounts for $7.5 million (BY00$), or 12.3%, growth to the original APUC.

d. Production Rate. The annual procurement quantities for the baseline program increases to an economic order quantity at a slower rate than originally planned at Milestone B. The reduced production rate follows several years of budget cuts and the one-year extension to the development program. Cost growth as a result of the reduced production rate accounts for $3.4 million (BY00$), or 5.7%, growth to the original APUC.

3. The Air Force's Strategy To Employ Lessons Learned With The Developmental RERP Aircraft To Reduce Cost Risk For RERP Production

C-5 RERP Production risks are primarily cost risks associated with the General Electric (GE) engine, Goodrich pylon, and LM Aero installation labor. The 716 AESG and LM Aero have a risk management and mitigation process in place for both RDT&E and Production. The lessons learned with the developmental RERP aircraft, however, do not translate one for one into relevant cost reduction methods for RERP Production aircraft, as the cost risks for RERP Production are unique to Production.

The AF strategy to contain and reduce costs during RERP production is multi-faceted. In partnership with the prime contractor and its subcontractors, the AF strategy includes a cost containment acquisition strategy; application of selected RERP SDD manufacturing lessons learned; and the implementation/application of a continuous process improvement program.

The AF C-5 RERP acquisition strategy is based on the lessons learned in the SDD Cost Plus Award Fee phase and is designed as a cost containment process to manage costs throughout the production program through the use of Fixed Price contracts. Following Nunn-McCurdy certification, the AF and LM Aero signed a contract modification for Lots 1 – 7 that includes:

- All terms and conditions agreed upon, including full cost reporting under the Fixed Price contracts to be negotiated and a detailed Earned Value Management System
- Not-to-Exceed (NTE) prices for all lots
- 47 C-5Bs and two C-5Cs at an annual procurement profile of 1, 3, 5, 7, 11, 11, 11
- Plans to negotiate Lots 1-3 as Fixed Priced options by 30 Apr 08
- Lots 4 - 7 to be negotiated as Fixed Priced prior to annual option exercise

As NTEs are subject to potential price changes that could occur from unique re-openers, the AF included detailed contract terms and conditions and mitigation processes for re-openers. These actions are designed to mitigate and reduce program cost and schedule risk.

The contract modification enhances the AF ability to manage costs going forward into production as follows:

- Signed mod from LM Aero committing to NTEs for all production lots—reduces cost risk
- NTEs will be converted to Fixed Priced options
  - Using Fixed Priced contracts for all production lots minimizes government cost risk
- Obtaining full Earned Value Management System cost reporting will provide timely, detailed insight into all cost areas and risks
- AF scrubbed spares and support equipment requirements and established accurate NTEs for these items—reduces cost risk
- AF aggressively working a Diminishing Manufacturing Sources strategy for Lots 4-7
  - Includes Life-of-Type Buys, redesign, and no-cost solutions
  - Minimizes government exposure to DMS-related cost growth
- Budgeting to CAIG ICE which includes risk dollars

The second facet of the AF and contractor strategy to employ SDD lessons learned is the application of selected producibility, engineering, and planning efforts through RERP manufacturing and production lessons learned that include cost reduction initiatives and value stream mapping.

RERP is following a focused, long-term improvement strategy to create systems, processes, and procedures for a lean, cost effective and repeatable production line. The strategy will identify 12 projects which:

- Reduce rework and repair, refine manufacturing and manufacturing support processes to assure efficient process capability.
- Reduce potential program risk from design changes, mature manufacturing and manufacturing support process and improve overall program performance.
- Provide the ability to install the first production aircraft for 19,613 labor hours less than if this project was not identified and accomplished.
- Will be accomplished prior to the induction of the first RERP production aircraft and will allow LM to achieve a "step function" in learning.

Examples of projects include:

- Wing Web Redesign: Redesigned shear plate to reduce number of parts (from 256 to 180) to install and subsequently, the number of holes (from 3,600 to 1,200) to drill. Reduces technician hours and rework, and decreases installation span time.
- Pylon Fitting Laser Location Fixture: Designed a new and improved Location Fixture that reduces human intervention with Semi-Auto position and electronic feedback through laser alignment. Increases accuracy in boring operation and efficiency in locating and installing Pylon. Reduces span time and technician hours.
- Development of Wire Harnesses: This includes two systems, Lockheed Advanced Wiring System (LAWS) and Connector Light Array Designator System (CLADS). LAWS develops wiring databases, reducing quantity of wire harnesses and termination aids. CLADS will aid in connector pinning speed and accuracy. Both of these systems minimize rework, increase "First Try" accuracy, and reduce installation span time.

Examples of productivity projects that have identified a further reduction potential of 11,664 labor hours include:

- Functional Test Review: Streamline Functional Test documents and sequence of flow. Create aircraft wire continuity matrix using the LAWS database to provide improved wire continuity checking span. Create a sequence of Functional Test Review Plans (FTRPs) to coincide with production schedule milestones. Review FTRPs to identify improvements/opportunities. Results in a reduction of technician hours and span time
- Tool Management: Update Controlled Tool Box, Control Tool Kits, and consumable kits to provide a more effective inventory of tools in mobile kits to the mechanics and electricians. Also, derive a plan for storage, quantity, refurbishment, and location for all standard tooling. This will decrease travel time and search time for the technicians

- One Piece C-Fitting: Eliminate build-up of parts on aircraft and reduce material and fabrication costs. The aft pylon attach fitting (C-Fitting) is a two piece machined assembly with a bearing added prior to installation on the aircraft. A single part would eliminate assembly time and reduce labor hours

The third facet of the AF and contractor strategy to employ SDD lessons learned is the implementation/application of continuous process improvement throughout the production program. The first process improvement step for the AF is in developing and implementing a production induction process for the 47 C-5B and 2 C-5C aircraft that avoids unnecessary over and above charges (i.e., TCTO completions, inspections, etc.).

The contractor is incentivized to continue the application of selected producibility, engineering, and planning efforts, listed in the second facet, in a continuous process improvement. Profit motive and the nature of the Fixed Price contracting arrangement drive the contractor to a cost reduction position to optimize profits. The desire to increase profits within allowable contractual limits can be achieved only by reducing costs and this will require continuous improvement throughout the production program.

Department of Defense

Primary Office for Coordination:
National Security Space Office (NSSO)
1670 Air Force Pentagon
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Progress Report for Operationally Responsive Space

A Report to Congressional Defense Committees

July 29, 2008

(U) This report describes the progress DoD has made since establishing the ORS Office. The report explains further actions taken to advance the ORS initiative and meet expectations set forth by Congress. The report details progress made as well as issues encountered in the initial phases of standing up a new program. Examples of progress in process and infrastructure advancements are provided. The report concludes with a recommendation for legislative support through continued funding flexibility to enhance and further develop critical ORS capabilities within the National Security Space (NSS) community.

(U) Progress toward implementing ORS

(U) The DoD is committed to implement the Congressional direction on ORS. To that end, the Deputy Secretary of Defense published department-wide guidance on July 9, 2007 entitled "Department of Defense Operationally Responsive Space Memorandum." That document declares DoD's policy on ORS by unequivocally linking ORS to national space policy. Specifically, the memorandum designates ORS as the initiative to meet the National policy goal to "demonstrate an initial capability for operationally responsive access to and use of space to support national security requirements." Furthermore the memorandum establishes a formal definition for ORS within DoD as ***"assured space power focused on timely satisfaction of Joint Force Commanders' needs."***

(U) This formal definition characterizes ORS as a subset of the total range of space activities that is uniquely focused on satisfying the needs of Joint Force Commanders. Beyond DoD, the Department also acknowledges the fundamental ability for ORS to address other users' needs and, thus, posture the nation for improving the responsiveness of space capabilities to meet a wide range of national security requirements. By endorsing the applicability of ORS to support other users and the broader space enterprise, DoD recognizes the synergy necessary to fulfill its vision for ORS and strives for strong, effective collaboration among military, intelligence, civil, commercial, and academic partners to realize ORS objectives.

(U) The Deputy Secretary of Defense memorandum on ORS is a call for action. DoD has taken fundamental steps to define ORS, establish a common vision for ORS, set the stage for collaboration, and articulate the way ahead. With similar purposes in mind, the memorandum directed that the DoD EA for Space develop an implementation plan for ORS. Using the Report to Congress on ORS, USSTRATCOM's Initial ORS CONOPS, and the Deputy Secretary of Defense guidance, the ORS Office began developing a strategy for evolving ORS capabilities. The recently-developed Implementation Plan (I-Plan) for ORS incorporates this baseline strategic approach. The Deputy Secretary of Defense approved the I-Plan for ORS on April 28, 2008. Elements of this progress report benefit from the discussion, collaboration, and insight gained from that effort.

(U) From work on the Implementation Plan, the Department has matured its vision of ORS as a dynamic, multi-faceted solution set of space capabilities. When appropriately applied, these capabilities include the ability to generate effects at the front lines in all mediums and across the full spectrum of conflict. The Department is committed to aggressively pursuing ORS as a means to respond to unexpected loss or degradation of selected capabilities and/or provide timely availability of tailored or new capabilities. The pursuit of these two facets of ORS, urgent needs and enablers, are highlighted in the Implementation Plan and provide the foundation for action by the ORS Office. The ORS solution set must enable our ability to reconstitute, augment or surge, fill gaps, exploit innovation, respond to episodic events, or enhance deterrence.

(U) As advised by the ORS EXCOM, the DoD EA for Space endorsed the ORS strategic framework which became the foundation for programming actions and a means to establish how to best allocate resources to pursue ORS capabilities. This framework is grounded in the Congressional direction from the FY07 NDAA; the Department of Defense's April 2007 Plan for Operationally Responsive Space, the July 2007 Deputy Secretary of Defense memorandum defining Operationally Responsive Space, and the May 2007 United States Strategic Command Initial ORS Concept of Operations. The strategy balances objectives in order to achieve tier readiness as defined by USSTRATCOM in the ORS Initial Concept of Operations. Principles of the strategic framework have been captured in the ORS Implementation Plan in order to identify the mission-essential tasks for the ORS Office, thereby providing the overarching basis for ORS activities and informing ORS investment decision-making.

(U) Consistent with the high level guidance and NSS community input, the ORS Office has developed and continues to evolve a 2015 ORS end-state vision that delivers responsive space capabilities to the warfighter. This end-state vision depicted in Figure 1 clarifies the purpose and provides focus for the ORS Office. All ORS efforts (described later in this report) support the pursuit of this 2015 end-state. USSTRATCOM defines the end state of the ORS as "the ability to address emergent, urgent, and/or unanticipated needs through the timely augmentation, reconstitution and exploitation of space force enhancement, space control, and space support capabilities." In achieving this end-state, the DoD will be ready to exploit new technical or operational innovations; to augment or surge existing capabilities to meet urgent, unforeseen, unfulfilled or emergent warfighter needs; and to reconstitute critical degraded or lost capabilities.

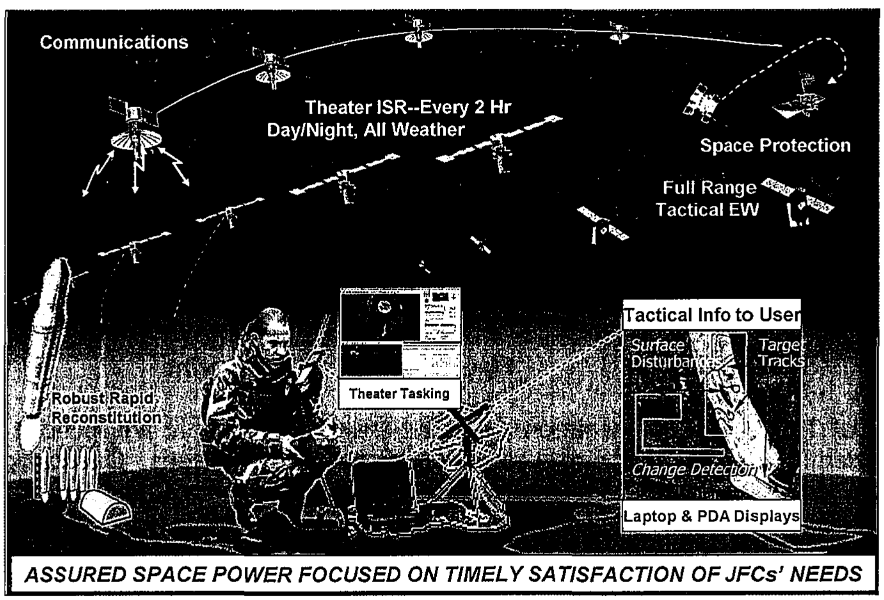

Figure 1: ORS 2015 End-State Vision

(U) The blueprint for how ORS intends to reach the USSTRATCOM-specified 2015 end state is shown in Figure 2. When an ORS urgent need is received from STRATCOM the Concepts/Solutions Group will first seek a "Tier 1" solution; that is a capability already in operation (government, commercial, or foreign) that can be leveraged to meet the urgent need. ORS will develop a "playbook" that will contain information on the capabilities of on-orbit assets and how to quickly gain access to them in the event they are urgently needed. If no Tier 1 solution is available, the STRATCOM urgent need will be passed to a Tier 2 rapid spacecraft required to deliver highly responsive space capabilities to the warfighter. As shown in Figure 3, these ORS enablers are depicted as pillars of the total responsive space capability and include: affordable launch vehicles and responsive launch range infrastructure; standard, plug and play satellite bus platforms and payloads; standard, multi-mission satellite telemetry, tracking, command and control; satellite payload tasking and sensor data processing, exploitation and dissemination (TPED) / payload tasking and sensor data posting, processing and using (TPPU) that is primarily responsive to JFC needs; overarching responsive space concepts of employment and the broad range of authorities necessary for achieving ORS objectives.

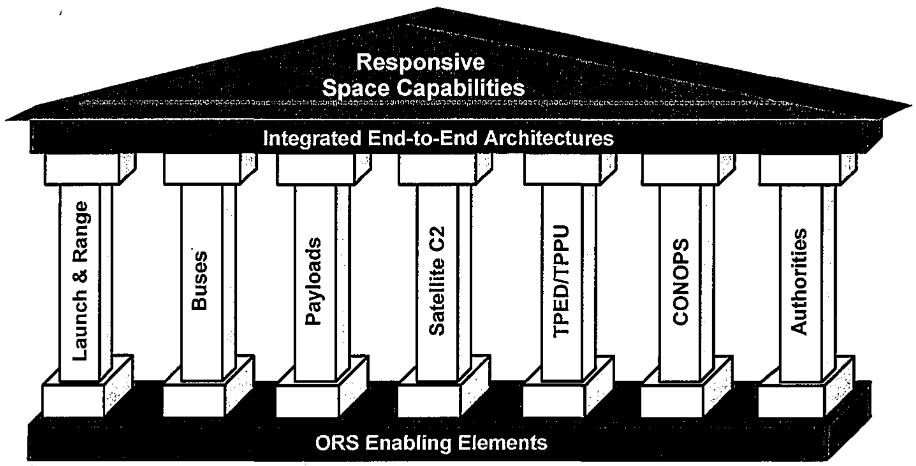

Figure 3: ORS Enabling Elements

(U) Working with the ORS and national security space communities, the ORS Office quickly assessed the readiness of the various enabling "pillars". That assessment provided insight and rationale for where best to focus near term ORS Office attention and investments to mature the enablers. In March 2008, the ORS Office released three Broad Area Announcements (BAAs) soliciting proposals from industry, academia, and government organizations to advance the state-of-the-art and scientific knowledge in responsive launch, range and system architecture and modeling technologies; responsive spacecraft buses and payloads; and LEO multi-mission modular spacecraft buses and optical payloads. Other BAAs addressing the maturation needs of other enabling pillars are planned to follow. Response to the first three BAAs was impressive with over 200 proposals submitted. Organizations from across the NSS community have provided over 80 evaluators including personnel from Air Force Space Command (AFSPC), Army Space and Missile Defense Command (SMDC), Naval Research Lab (NRL), Air Force Research Lab (AFRL), National Reconnaissance Office (NRO), and National Aeronautics Space Administration (NASA) Centers. Government evaluations are underway with expected contract awards during the summer of 2008.

(U) The resulting projects chosen from the BAA submissions will complement other on-going ORS efforts focused on maturing the ORS enablers. Some of these efforts are wholly funded by the ORS Office, while a number of efforts involve the ORS Office leveraging on-going activities in other organizations and combining ORS Office resources for synergistic effect.

(U) TacSat Series of Operational Experiments: TacSats originated with the Office of Force Transformation and have leveraged the Air Force and Naval Research Labs' exceptional focus on ORS. They remain the single most important precursor to the ORS program and, consequently, have been incorporated into the ORS Office's investment strategy and critical path to reach the 2015 end state vision. Specifically, the ORS Office procures the TacSat

(U) TacSat-3. TacSat-3 will demonstrate tactical tasking of a hyper spectral imagery payload on-orbit. It is being built by AFRL and is currently scheduled for launch on a Minotaur I from Wallops Island in October 2008.

(U) TacSat-4. TacSat-4 will demonstrate communications-on-the-move and blue force tracking from a Highly-Elliptical Orbit that allows long satellite dwell times over a theater of interest. It is being built by NRL and is scheduled for launch on a Minotaur IV from Kodiak, Alaska in September 2009.

(U) TacSat-5. Scheduled to fly in late FY 2010, TacSat-5 will demonstrate plug-and-play bus technology using a Self-Awareness Space Situational Awareness (SASSA) payload similar to the "black box" RADAR warning receivers on aircraft.

(U) Jumpstart. Jumpstart is a multi-pronged effort that will fly a responsive payload on the SpaceX Falcon 1 Flight 003 mission, currently scheduled for a late July/early August 2008 launch from Kwajalein Atoll in the Marshall Islands. This mission will demonstrate several ORS enablers such as streamlined payload processing to enable a rapid call up to launch, low cost access to orbit for ORS-class vehicles, and software encryption. It will also establish a preliminary framework for responsive processes to include rapid contracting, procedure development, and spacecraft development, integration and test.

(U) The Low Earth Orbit Nano-satellite Integrated Distributed Alert System (LEONIDAS). The FY08 Appropriations Act directed $4M move from the Army R&D at SMDC to the ORS Office for the LEONIDAS project. Through a partnership with the ORS Office, the University of Hawaii and Sandia National Laboratory, the project aims to develop a mission that enables Hawaii to complete an entire low-earth-orbiting satellite mission. LEONIDAS will serve as a test bed and includes creating an orbital satellite fabrication capability and a low-cost, rapid-response launch vehicle that will provide an inexpensive, reliable path to mature critical space-borne technologies for the DoD.

(U) RADARSAT II. ORS is evaluating the military utility of commercial imagery provided from the Canadian RADARSAT II system launched in Spring 2008. ORS is evaluating new tactical tasking methods and the military utility of commercial RADAR imagery using the Canadian RADARSAT II system launched in Spring 2008. ORS purchased 1500 minutes of SAR imaging time and has "chopped" that capability to CENTCOM to provide them assured tasking, like they have for apportioned airborne ISR assets. CENTCOM has used RADARSAT II for ongoing real-world military operations and Myanmar cyclone relief efforts and received some SAR products less than 3 hours after tasking. SMC/XR and NGA have been evaluating the CONOPS and RADARSAT II capabilities.

(U) Joint Reconnaissance Program. This classified effort is focused on the demonstration of direct Combatant Commander tasking of national technical means capabilities.

(U) Addressing Urgent Needs

(U) A primary objective of the ORS Office is to execute rapid, end-to-end capability efforts to meet urgent operational needs of the Joint Force Commanders. The ORS Office has dedicated considerable effort to developing a means to effectively address how best to satisfy this objective. In collaboration with USSTRATCOM, the office has put in place an ORS Requirements and Solutions Generation Process to rapidly process identified needs and arrive at potential solutions. The process consists of two major phases: rapid capability requirements definition and conceptual solution development. To date, both phases have used established centers of excellence to accomplish the appropriate analysis. Likewise, user input is incorporated to ensure consistency and verify appropriate focus throughout.

(U) To date, the ORS Office has received three urgent needs from CDRUSSTRATCOM. Included below is a short description and status:

(U) Status: Open. The ORS Office, working with CENTCOM/JFCC-ISR and solution providers, has completed a Concept Requirements Document translating the urgent need into a set of requirements against which proposed systems can be evaluated. The team has just begun the Concept Solution phase and is working on pace to deliver solution alternatives and recommendations to decision-makers in June. SMC/XR provided a reference design based on the CENTCOM requirements and has filtered that design against 20 concepts. This urgent need is likely to result in the building of an ORS satellite.

(U) Challenges / Issues Encountered

(U) While much progress has occurred since the standup of the ORS Office in May 2007, challenges remain and are being addressed by the Department. The principal challenge facing the ORS Office is meeting the stringent timelines in all three ORS tiers as identified in the CONOPS for ORS. With the current level of ORS funding, this will be an ongoing concern as the community strives for a desired 2015 end state and pushed beyond to greater achievements. The ORS Office has taken a realistic approach by adopting a "crawl, walk, run" strategy. The speed at which DoD is able to reach each succeeding phase will be determined by the resources and organizational support dedicated to some of the issues discussed below.

(U) Manpower

(U) Government manning of the ORS Office has been slow, with only 7 government personnel currently assigned to the ORS Office: Army (2), Navy (1), Air Force (2), NASA (1), and NSA (1). The recently-signed ORS Implementation Plan directs the Services to provide 10 Air Force, 6 Army, and 4 Navy personnel to the Office by August 1, 2008. In the interim, the ORS Office is making good use of available Inter-Governmental Personnel Agreements (IPAs), FFRDC and SETA contractors to round out the current staff. However, some functions are inherently governmental, and the limited government staffing has created a reliance on part-time matrix support, which delayed the office's ability to create key partnerships, slowed the initiation of several enabling projects, and inhibits oversight of executing agent project management. Renewed department leadership focus on this issue should improve the ORS Office government manning by the end of the summer 2008. Despite the under-manning situation, the Office has made significant progress with the interim support and assistance provided by SDTW, AFRL, and other partner organizations.

(U) Communications

(U) The ORS message is still not understood by everyone. We have clarified the message over the past year with the DoD ORS Definition, the Plan for ORS, the Initial ORS CONOPS, and the ORS Implementation Plan, still more education and out-reach is needed, especially within government circles. The ORS Office will develop and execute a strategic communications plan to unify the community's awareness and understanding of the ORS objectives, vision, desired end-state, and on-going efforts.

(U) Identification and Use of Executing Agents

(U) Because of its small size (by design), the ORS Office is very dependent on others for success. Because of the ORS operating principle of maintaining a small ORS Office, we will continue to reach out to identify and grow a stable of best athlete government organizations for execution of ORS efforts. With this approach, the ORS Office is critically dependent on existing organizations (e.g. the Space Development & Test Wing, Air Force

(U) Legislative Support

(U) The Department appreciates the strong support of Congress and its help in defining and establishing a solid foundation for ORS. One specific additional legislative action that would permit ORS to be more responsive to urgent needs would be granting the flexibility to spend appropriated R&D funds on procurement, facilities, personnel, and operations/maintenance as needed for ORS purposes. Specific "color of money" funding requirements for urgent needs cannot be accurately predicted at the time of President's Budget submission. Similar flexibility enabled the Missile Defense Agency to quickly field their capabilities.

(U) Summary

(U) DoD is firmly intent on establishing ORS as a viable tool for Joint Force Commanders in dealing with persistent and emerging threats to our nation. The ORS Office has made great progress over the past year and continues to evolve the vision of an ORS end state to one that further refines the timeliness and inherent value of space capabilities. Implementation has been at a measured, steady pace with much more ground still to be covered. Under proactive leadership from the DoD Executive Agent for Space and CDRUSSTRATCOM, the ORS Office continues to foster strong collaboration on ORS from all sectors of the space community. The ORS Office will steadfastly champion the case for ORS and looks to Congress for continued strong advocacy in delivering these essential capabilities.

Congressional Report

Plan for Niagara Air Reserve Base, New York

House Report 110 - 477, pages 550 – 551

March 2008

U.S. AIR FORCE

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Introduction

This report is being provided to the Congressional Defense Committees as directed in pages 550-551 of the Conference Report dated December 6, 2007, to accompany Report 110-477, National Defense Authorization Act for Fiscal Year 2008. This report addresses the Congressional request to submit a report on the Air Force's plan for Niagara Air Reserve Base (ARB), New York. Specific to the request, the Air Force detailed the future plans for Niagara ARB in concurrence with Base Realignment and Closure language. The report language follows:

"Not later than March 1, 2008, the Secretary of the Air Force shall submit to the congressional defense committees a report containing a detailed plan of the current and future aviation assets that the Secretary expects will be based at Niagara Air Reserve Base, New York. The report shall include a description of all of the aviation assets that will be impacted by the series of relocations to be made to or from Niagara Air Reserve Base and the timeline for such relocations." The report went on to say *"The plan should review C-130 aircraft which could be available in the future as additional Primary Assigned Aircraft at Niagara Air Reserve Base, beyond the 12 currently programmed for the installation, and should contain an analysis of the support structure available at Niagara Air Reserve Base to accommodate such additional force structure".*

Executive Summary

The 2005 Base Realignment and Closure (BRAC) commission directed the Air Force to realign Niagara Air Reserve Base, New York. As part of this realignment, all 107th Air Refueling Wing (ANG) KC-135 aircraft will be reassigned and the related manpower will form an Air Reserve Component (ARC) Associate Unit. The 914th Airlift Wing, Air Force Reserve Command (AFRC), will be the host unit for the association. The 914th Airlift Wing currently conducts the Intra-theater mission with 8 C-130 aircraft. The Air Force plans to increase the Primary Aircraft Authorization (PAA) from 8 to 12 C-130 aircraft and utilize existing manpower. Growth beyond 12 PAA is resource constrained in both aircraft and manpower at this time. Consideration of any future growth must be weighed against National Security Requirements. The Air Force plan complies with BRAC legislation and creates synergies and efficiencies using the ARC Association concept.

Report

The 2005 Base Realignment and Closure (BRAC) commission affected all of the Department of Defense (DOD). The recommendations were based on eight statutory selection criteria intended to transform DOD, provide cost savings, and ensure stability while in the midst of a conflict in Southwest Asia and the redeployment of service members from Europe and Asia to the United States. One of the most difficult issues faced by the BRAC commission was closure or realignment of Air National Guard bases nationwide. The BRAC commission worked closely with the United States Air Force, the National Guard Bureau, and Adjutants General to form courses of action that would comply with the BRAC process and respond to the concerns of the affected states.

Under the BRAC process, Niagara Air Reserve Base was chosen for realignment. The text of the recommendation reads:

"Realign Niagara Falls Air Reserve Station (ARS), NY, Distribute the KC-135R/T aircraft assigned to the 107th Air Refueling Wing (ANG) to meet the Primary Aircraft Authorizations (PAA) requirements established by the Base Closure and Realignment recommendations of the Secretary of Defense, as amended by the Base Closure and Realignment Commission.

- *Establish 10 PAA KC-135R/T at the 101st Air Refueling Wing (ANG), Bangor International Airport Air Guard Station, Maine. The 101st Air Refueling Wing KC-135E aircraft will be transferred to the Aircraft Maintenance and Regeneration Center (AMARC) at Davis-Monthan AFB, Arizona, for appropriate disposal as economically unserviceable aircraft.*

All personnel allotted to the 107th Air Refueling Wing (ANG), including the unit's Expeditionary Combat Support (ECS) elements, will remain in place and form an Air National Guard/Air Force Reserve associate wing with the 914th Airlift Wing. Establish a contiguous enclave for the 107th Air Refueling Wing (ANG) sufficient to support operation of that unit, including flight operations, and compatible with joint use of the Air Reserve Station as a civilian airport. Guard personnel will be provided the training necessary to support the airlift mission. This recommendation does not effect a change to the authorized end-strength of the New York Air National Guard. The distribution of aircraft currently assigned to the 107th Air Refueling Wing (ANG) is based upon a resource-constrained determination by the Department of Defense that the aircraft concerned will better support national security requirements in other locations and is not conditioned upon agreement of the state"

Of note, the BRAC commission determined that closure of the Niagara Air Reserve Base was not appropriate and struck any language pertaining to closure.

USAF Plan

The USAF plan for Niagara Air Reserve Base is an ARC Association, with the 914th AW, AFRC as the host unit, and the 107th ARW, New York Air National Guard as the associate unit. This ARC association provides synergy to the Intra-theater mission of the 914th Airlift Wing by adding the significant capability of the patriots of the New York ANG. As part of the BRAC 2005 implementation, all 8 KC-135 aircraft will depart Niagara Air Reserve Base in FY08. Concurrently, New York ANG personnel remain in place to begin their association with the 914th Airlift Wing. The 914th Airlift Wing will grow from an 8 PAA C-130 unit to a 12 PAA C-130 unit. This action will occur through Air Force Programmatic Action, transferring four ANG C-130's to AFRC, making all 12 PAA aircraft 914th Airlift Wing assets. Manpower authorizations will remain the same for both the Air Force Reserve and the Air National Guard.

As Niagara Air Reserve Base transitions from a KC-135 and C-130 base to a homogeneous C-130 base, former ANG KC-135 aircrew and maintainers will transition to the C-130 mission. Individual aircrew member training time required for this transition will vary from 4 months to 6 months, dependent upon C-130 formal training capacity. Conversion training for individual maintenance personnel ranges from 2 to 4 months. Niagara ANG personnel training slots will be phased to ensure a smooth transition from the KC-135 to the C-130. As aircrews are trained, they will maintain currency and proficiency in the aircraft assigned to the 914th AW. As NY ANG crews become qualified on the C-130 the Air Force will add aircraft 9, 10, 111 and 12 to the ARC Association. Transition training from the KC-135R to the C-130 for NY ANG personnel will take up to two years.

The four additional C-130 aircraft, sourced from the 118th AW, TN ANG at Nashville, will be transferred to the 914th Airlift Wing, AFRC at Niagara Air Reserve Base during FY08. These aircraft, sourced from the 118th AW, TN ANG at Nashville, will begin physically transferring in FY08 with completion by the end of FY09. This action will increase the force structure from 8 PAA to 12 PAA. These aircraft will ensure that assigned Air Force Reserve and Air National Guard personnel have a sufficient number of aircraft to conduct the mission of the Air Reserve Component Association. The Air Force has no plans to go beyond 12 PAA at this time.

Aircraft (PAA)	Start FY08/2	Start FY08/3	Start FY8/4
KC-135	**8**	**4**	**0**
C-130	**8**	**8**	**12**

The Air Force is committed to a successful ARC Association at Niagara ARS, NY. Further details of the association were developed by the Site Activation Task Force

(SATAF). The SATAF process handled not only operational and support issues, but all the support issues involved with unit stand-ups, conversions and closures. The team included experts from the Air Force Reserve Command (AFRC) and the National Guard Bureau, NY ANG State Headquarters, and strong participation from both wings. The product of the SATAF will be a report with specific action items and timelines for the conversion. The FY10 Program Objective Memorandum process will address appropriate funding required for the Niagara Air Reserve Station transition.

The BRAC process proved to be very challenging for the Services, the Department of Defense, and the affected states. The Air Force fully expects a positive outcome as the 107th Air Refueling Wing transitions into its future as a provider of combat airlift capacity for the vital mission of the ARC Association at Niagara Air Reserve Station.

United States Air Force

Report to Congressional Defense Committees

Master Plan for Warren Grove Gunnery Range, New Jersey

November 2008

P.L. 110-181, Section 359b

Introduction

This report is submitted as directed by the following language from House Report 110-181, Section 359b:

SEC. 359. REPORTS ON SAFETY MEASURES AND ENCROACHMENT ISSUES AND MASTER PLAN FOR WARREN GROVE GUNNERY RANGE, NEW JERSEY.

(a) Annual Report on Safety Measures- Not later than March 1, 2008, and annually thereafter for 2 additional years, the Secretary of the Air Force shall submit to the congressional defense committees a report on efforts made by all of the military departments utilizing the Warren Grove Gunnery Range, New Jersey, to provide the highest level of safety.

(b) Master Plan for Warren Grove Gunnery Range-

(1) IN GENERAL- Not later than 180 days after the date of the enactment of this Act, the Secretary of the Air Force shall submit to the congressional defense committees a master plan for Warren Grove Gunnery Range.

(2) CONTENT- The master plan required under paragraph (1) shall include measures to mitigate encroachment of the Warren Grove Gunnery Range, taking into consideration military mission requirements, land use plans, the surrounding community, the economy of the region, and protection of the environment and public health, safety, and welfare.

(3) INPUT- In establishing the master plan required under paragraph (1), the Secretary shall seek input from relevant stakeholders at the Federal, State, and local level.

Executive Summary

On May 15, 2007, a fire occurred at Warren Grove Gunnery Range caused by the release of flares from a 177th Fighter Wing F-16 aircraft. The fire burned 18,000 acres of land adjacent to the range and destroyed four homes, damaging several others. The range ceased operations at that time. Prior to that closure, Warren Grove Gunnery Range was the busiest of the 14 Air National Guard ranges (3,192 sorties in FY06.)

The Warren Grove Gunnery Range Master Plan is comprised of two documents, the Warren Grove Comprehensive Range Plan (CRP) and the Warren Grove Risk Mitigation Plan (RMP). The CRP is the New Jersey Air National Guard's plan to manage safety and encroachment issues during future operations. The RMP, as summarized in the earlier report, identifies a comprehensive set of command and control procedures that reduce the potential for mishaps at the range. These procedures will be strictly enforced by both the New Jersey Air National Guard and by all agencies engaged in operations at the range.

Warren Grove Gunnery Range halted all operations while this plan was under development with the New Jersey Governor's Office and New Jersey's Congressional Delegation. With the Governor's approval, the range opened under new restrictions on October 1, 2008.

Warren Grove Gunnery Range is an extremely important resource for air to ground training vital to the defense of the United States. Both the Air Force and the Air National Guard support the re-opening of the range. By implementing new safety, communication, and operational procedures, it is possible to minimize risks to the immediate and surrounding areas, while maintaining an essential training resource.

Attachments:
1) Warren Grove Comprehensive Range Plan
2) Warren Grove Risk Mitigation Plan
3) Appendices to RMP

177th Fighter Wing

Detachment 1

Warren Grove Range

Comprehensive Range Plan

21 March 2008

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Executive Summary

The next generation relevant range must continue to enable, as well as continuously improve, our ability to achieve a desired effect through synergistic application of the fully developed skills of our Airmen, employing the most sophisticated technology, in a coherent warfighting cycle. To that end, Warren Grove Range must continue to evolve to provide the training environment users require to prepare for warfighting and homeland defense roles.

Status

Warren Grove Range's proximity to numerous users, combined with the scarcity of training resources in the northeast, puts it in a unique position to significantly add to future ANG and other services' capabilities. This is accentuated by the proximity to and utilization by numerous non-fighter aviation and ground personnel customers. Properly structured, funded and managed, the range will be invaluable to all these users' training, thereby securing viability, growth and transition to next generation airframes.

Transformation

From AF/A3O-AR *Transforming the Air Force Range*:

> *"A relevant range enables* ***Developing Airmen****, across multiple functional disciplines, to hone their skills during full spectrum training or tactics development…These operations will include Command and Control integration of Intelligence, Surveillance and Reconnaissance assets with traditional strike, Battlefield Airmen, airlift, CSAR, space, and information operations to achieve a desired effect in combat."*

Transformation requires a specific vision of the future and strategy for execution of that vision.

> "Warren Grove Range will evolve to provide a multi-command training environment where current and future air and ground warfighters can execute as much of the F2T2EA warfighting cycle as possible (Find, Fix, Track, Target, Engage, and Assess) against a realistic and evolving target array, or be able to conduct airlift operations to an austere field while defending against realistic threats, and to provide top quality training to JFACs, Special Forces, and Homeland Defense and First Responder personnel."

Vision

The Vision can be realized by capturing capabilities necessary to accommodate changing missions, modified tactics, and new weapons systems:

- Reliable low-end threat emitters for EP training
- Modular and radar/thermal signature Red and Blue Force target systems
- Remote firing capability for Smoky SAMS
- GPS integrated to support mobile target and no-drop scoring
- Dynamic yet predictable restricted airspace connecting R-5002 with W-107 Warning Area
- Airspace that will support high altitude release of unguided bombs, inert LGBs, and simulated IAMs
- Infrared SAM simulator

- Connectivity to CRTCC and DTOC for Distributed Mission Operation (DMO)'s "network centric" training.
- Complete SADL coverage of training airspace to accommodate air and ground users.
- High quality No-Drop Bomb Scoring capability
- Homeland Defense / First Responder ground training environment

Strategy

The mission of WGR leadership is to leverage its strengths to take advantage of opportunities to achieve objectives while minimizing threats to weaknesses which may be harmful to achieving objectives. Strategy for realizing the Vision is to use a time-phased investment program to achieve objectives and reach overarching goals:

- Provide mobile target training opportunities
- Provide NTISR training opportunities
- Provide first responder training opportunities
- Provide next generation aircraft systems training opportunities
- Support training in ISR and Act segments of the IADA Cycle
- Support training in Assess and Decide segments of the IADA Cycle
- Improve EP training environment for CAF, AMC, and non-traditional users
- Improve regional joint, interagency, and community partnerships

Vision, Strategy, Goals, and Objectives are merely words without proper execution managing progress towards success. Warren Grove Range will achieve its goals through the time phased approach outlining stated objectives supporting individual goals through a timeline that parallels AF/A3O-AR's Relevant Range Review Cycle. Specific investment area objectives support overarching vision goals. Successful completion of objectives and corresponding goals is achieved through leveraging WGR strengths to take advantage of opportunities while minimizing weaknesses to avoid potential threats to success. Oversight of completion of objectives and subsequent attainment of goals is accomplished through quarterly review of objective status and annual review / revision of the time-phased investment program.

Conclusion

Warren Grove Range can succeed in transformation for next generation aircraft and evolving missions. Range relevance can be assured through a time-phased investment program focused on investment areas, specific objectives that support long term goals, and a vision that supports the complete T2F2EA warfighting cycle. Failure to focus on and execute this strategy threatens a lack of relevance and threatens long term viability.

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A. Range Investment Areas

A-1. Land

Warren Grove Range was originally leased in 1942 by the United States Navy for a Test Site. Ownership and responsibility transferred to the United States Air Force and to the New Jersey Air National Guard in 1960. The range proper is totally enclosed in the Pine Barrens, which is regulated by the New Jersey Pinelands Commission. Additionally, the Stafford Forge Wildlife Refuge, Bass River, Wharton, and the Penn State Forests, surround the range property. All forests are owned by the state of New Jersey with more acreage being purchased for land preservation.

Warren Grove Range is on 9416 acres of Air Force land licensed to the ANG. The Range is located within the heart of the New Jersey Pinelands National Reserve and is approximately 12 square miles with an impact area of approximately 900 acres (Figure 1 – Range Diagram). The geography of WGR is characterized by low-lying, flat to gently rolling terrain with limited topographical relief and less than 75 feet vertical differential throughout range property.

Range property consists of mostly soft, sandy soil with scrub brush and pygmy pine dominating the landscape. The soil does not support growth of other vegetation although there are pockets of hardwood swamps, wetlands, white cedar, and pine-oak forests. The range is predominantly a natural ecosystem with several sate and federal Threatened and Endangered (T&E) species found within range boundaries (T&E animal species include but are not limited to the Peregrine Falcon, Bald Eagle, Bog Turtle, Corn Snake, and Northern Pine Snake). WGR Integrated Natural Resources Management Plan (INRMP) lists T&E animal and vegetative species found on range property.

Land modifications to include target development, road maintenance, firebreak system development and management, and real property improvements/modifications are impacted by environmental concerns of T&E species and habitat, and Pinelands Comprehensive Management Plan restrictions. WGR land management must comply with CMP requirements. Approval for required waivers to the CMP must be obtained as required prior to specific land management activities.

Range leased property is within the airspace restricted area R-5002 (Figure 2 – Airspace Diagram). The range is principally neighbored by state forestlands and uninhabited private forest underlying R-5002. State forestlands is primarily owned by Bass River Township, Stafford Township, or the NJ Conservation Foundation. There are a few parcels of land below R-5002 outside of the range boundary which are privately and/or commercially owned and targeted for acquisition through the REPI program (Figure 3 – REPI Parcels). The purpose of the REPI program is to secure an easement on land surrounding WGR property to establish buffer lands which will restrict land development and facilitate land management to support WGR operations. In FY 08, $500,000 has been allocated to REPI purchases with over $2M projected for future years.

The 177th FW Real Property Manager maintains WGR Property Surveys, Titles, etc. WGR utilizes an ArcView land database included in the INRMP for strategic and tactical land management activities. Arc-Geographic Information System (GIS) overlays have been added to the Weapons Danger Zone (WDZ) program utilized by WGR for weapons footprint analysis.

In addition to WGR property, the 177FW/Det 1 leases approximately 500 acres of Coyle Airfield five miles north of WGR. This area is leased for the expressed purpose of providing a Drop Zone for air-drop training or other activities in support of the National Defense. Coyle Airfield does not lie within R-5002 boundaries. Activities at Coyle Drop Zone are the responsibility of the Delaware Air National Guard IAW DANG published operating procedures.

A-2. Airspace

R-5002 overlays WGR and the immediate surrounding land, covering a roughly rectangular area of approximately five by six nautical miles (see attached airspace diagram). The area is approximately 10NM north of Atlantic City IAP, home to the 177th Fighter Wing (F-16s) and approximately 15NM southeast of McGuire AFB, home to the 108th Air Refueling Wing and the 514th and 305th Air Mobility Wings (KC-135, KC-10, C-17). Other fixed and rotory wing users include but are not restricted to the following table of users:

UNIT	TYPE	SERVICE	AIRCRAFT	LOCATION	DISTANCE
111FW	Regular	ANG	OA-10	Willow Grove, PA	45 NM
113FW	Regular	ANG	F-16C+	Andrews AFB, MD	126 NM
175FW	Regular	ANG	A/OA-10A	Baltimore, MD	96 NM
177FW	Regular	ANG	F-16C+	Atlantic City, NJ	17 NM
DARPA	Regular	US Army	UAVs	Ft Monmouth, NJ	45 NM
PAX River TPS	Regular	USN	FA-18/F-14	Patuxent River, MD	127 NM
Air Mobility Warfare Center	Regular	AMC	C-5, 17, 21 & 130; KC-10, KC-135	Ft Dix NJ	20 NM
305/614AMWs	Regular	AMC	C17	McGuire AFB	20 NM
166AW	Regular (Coyle)	ANG	C130	New Castle DE	54 NM
106RQW	Regular	ANG	HH60	Westhampton Beach NY	107 NM
Numerous	Regular	Army, USMC & USCG	Helos	Various	N/A

The restricted area lies within GARS grid zones 212LV17 – 19 and 212LV31 – 36 (Figure 4 - GARS Diagram). The vertical limits of R-5002 vary by sub-area as depicted. The main portion of the restricted area extends to 14000’ MSL. A proposal has been submitted to and is under review by the FAA to extend the current airspace to FL230 and to add a FL200 to FL230 shelf extending northeast for approximately 15NM (see attached airspace proposal diagram).

R-5002 lies within the horizontal coverage of NY ARTCC, although outside of FAA controlled airspace. To the north lies McGuire AFB Approach Control Alert Area (Sfc – 4,500’ MSL). To the south lies Atlantic City IAP Approach Control Class C airspace (1,300 – 4,100’ MSL). The range is surrounded by the following Victor Routes – V1 to the west, V312 to the north, V184/229 to the east, and V577 to the south. Eagles Nest private airfield is approximately 1NM from the restricted area’s eastern boundary. To accommodate civilian traffic utilizing this airfield, the floor of neighboring R-5002E is 3,500’MSL. There are no other classes of airspace which are in close proximity to the restricted area.

Restricted area airspace is activated through NY ARTCC IAW FAA Letter of Procedure dated 25 Jan 99. Normal operating hours for the restricted area are Tuesday through Saturday, 0900 –

1600L. During night weeks, normal operating hours are 1200 – 2200L. On average, the restricted area is scheduled on a daily basis 62% of the year. Utilization is 82% of the days scheduled, and the airspace is utilized 95% of the time activated. Restricted area reports are completed annually and filed with Eastern US AFREP office.

WGR supports two visual low altitude routes terminating at the range. VR-1709 enters from the south and VR-1709B enters from the north. Operating hours for VR-1709 and VR-1709B are from sunrise to sunset.

A-3. Environmental

The natural infrastructure of WGR is impacted by both internal and external factors. Both have short and long term impacts on the military value of the range and future relevance. An interservice Agreement between the New Jersey Air National Guard and the Pinelands Commission, finalized in 1985, specifies all the responsibilities of both parties pertaining to natural and man-made resources. All subjects are covered in the *Warren Grove Weapons Range Cooperative Agreement and Land Management Plan*, dated 4 January 1985.

Internally, the range is impacted by T&E species, presence of designated wetland areas, and a variety of UXOs present from previous land usage which are periodically found on range property. Vegetative and animal T&E species thrive in the natural ecosystem of the pine barrens. Impact on these species must be evaluated prior to action which may harm species or potential habitat for these species. These impacts may affect the ability to develop or maintain target areas, access ways, firebreaks and fuel break systems, and the ability to execute prescribed burns to reduce potential wildland fire fuel loads. The 177th FW Environmental Office is the land manager for WGR and evaluates potential impacts prior to issuing recommendations for action. Drexel University staff and students are occasionally relied upon to further evaluate potential impact on T&E species and habitat as resident experts on pine barren eco-systems.

The WGR INRMP identifies T&E species resident on WGR. The INRMP also identifies several areas of designated wetlands which pose additional problems to land management. Wildland fire fuel levels cannot be managed within wetland areas by prescribed burns due to the nature of wetlands. Resources are not available to reduce fuel loads within wetlands by selective thinning or other methodologies. Additionally, road maintenance in wetland areas is hindered by drainage road material restrictions.

The prior use of WGR property exposed the land to a variety of unexploded ordnance objects. Although no live munitions have been found on WGR, there remains the potential that any UXO found on range is a live object posing explosive and/or chemical discharge danger. All UXOs found on range must be evaluated by EOD personnel prior to movement or in-place destruction. Areas where UXOs are found become inaccessible until EOD personnel clear the area, potentially impacting ability to maintain range property or execute weapons delivery operations.

Externally, WGR is impacted by the dense frequency environment the New England area, the Pinelands Comprehensive Management Plan, fractured land ownership in neighboring areas, and continued housing growth near R-5002. Frequency management for WGR is complicated by the density of the electromagnetic spectrum in the New England area. Spectrum density restricts the ability of the range to obtain authorization to utilize any EA training systems restricting this training opportunity in R-5002.

The Pinelands CMP and waiver process is restrictive in nature. It can take many years to obtain waiver authority to modify land within the Pinelands. The NJSFFS has only recently received approval to proceed with fireshed management activities to reduce the likelihood of out of control wildland fire in the East Plains Regional Fireshed (WGR lies within the EPRF).

Installation of additional firebreaks on WGR property is hampered by the requirement to obtain waiver approval from the Pinelands Commission.

Fractured land ownership in areas neighboring WGR has complicated the ability to manage wildland fire fuel loads, increasing risk from wildfire. The lack of legal land surveys in the area further complicates land ownership. Some areas around the range have more than 50 land owners within several square miles. Many of the land owners cannot be located or refuse to cooperate with land management activities. The NJ Conservation Foundation is actively pursing purchase of private, commercial, and segmented government owned parcels surrounding WGR property. Land purchase is being accomplished through the REPI program with shared costs between AFREP and the NJCF. Land purchase through REPI will provide an easement on the land to restrict development and permit fireshed land management activities.

There continues to be an explosion in civilian population in towns neighboring WGR. The tremendous increase in population increases the likelihood that a mishap resulting from range operations could result in civilian personal property damage or personal injury. In 2005, an aircraft operating on WGR expended TP rounds that impacted off-range, landing on top of a neighboring school. In 2007, a wildfire ignited by an aircraft self-protection flare resulted in a wildfire that burned nearly 20,000 acres, caused civilian evacuation of neighboring areas, and destroyed/damaged several nearby homes. The following is a partial list of surrounding communities which may be impacted by WGR operations:

Warren Grove	Little Egg Harbor TWP	Tuckerton
Giffordtown	Nugentown	Parkerton
Wading River	New Gretna	

The necessity to protect local residents from potential range mishaps combined with encroaching population required a major revision to range operating procedures and severe restrictions on the type of weapons and training that may be accomplished on the range. These restrictions can negatively impact the range's potential relevance as weapons types and target arrays are further restricted.

Reference Section E for environmental documents that address current environmental issues for WGR.

A-4. Unexploded Ordnance / Range Debris

Live munitions are not authorized on WGR. Authorized ordnance that may contain an explosive hazard includes BDUs with marking charges, un-expended TP rounds, rockets, and smoky SAMs. However, prior operations on WGR property may have included other munitions that could present an explosive hazard. Therefore, any weapon found on WGR is considered a 'hot' or live weapon until inspected and certified safe by qualified EOD personnel.

Material inspected by EOD personnel is classified into the following areas: UXOs, BDU-33s, inert heavyweight munitions, MPPEH range residue, and non-MPPEH range residue. These items are segregated by type until cleared from the range by a qualified materials processor. All items are considered MPPEH until certified as non MPPEH by qualified EOD personnel. Used target materials certified as non-MPPEH are collected and held within the range compound until processed for salvage material.

UXOs are munitions that may or may not contain un-expended explosive material. UXOs will be left in place, marked accordingly, and either destroyed in place or removed by a qualified handler. BDU-33s will be inspected and collected by EOD or qualified contract or military personnel and held in the BDU-33 collection area. BDU-33s will remain in the holding area until processed by qualified clean-up contract personnel. Heavyweight munitions will be inspected by and certified safe by EOD personnel prior to being segregated in Central Park residue collection point. Used target materials that remain MPPEH will be collected and held in Central Park residue collection point until cleared as non-MPPEH or until destroyed/removed by qualified military or contract personnel.

EOD clearance of WGR is conducted on an annual plus 20% basis. Annually, the main circle target area is cleared by EOD personnel out to a radius of 300 feet. Access ways to the main circle out to 50 feet either side of the road is cleared annually. In addition, every year 20% of the remaining target area is cleared within 1000' of targets within the area. Range residue removal is programmed through NGB when funding is available and as prioritized through the ANG range community. Range Decontamination and Cleanup are scheduled with the periodic users of Warren Grove Range and deconflicted with other SUA to ensure adequate range space is available for training.

Annual and pent annual EOD are addressed in the 177th FW Supp to AFI 13-212. Explosive Ordnance Disposal is accomplished annually in May. The next 5 years of EOD are scheduled as follows (Figure 5 – EOD Maps).

1. May 2008 Annual + West 1/5th
2. May 2009 Annual + North 1/5th
3. May 2010 Annual + East 1/5th
4. May 2011 Annual + South 1/5th
5. May 2012 Annual + Interior 1/5th

Specific procedures for Range Cleanup and Decontamination is maintained by the NCOIC in a single volume (SOP/EOD). The Warren Grove Range NCOIC is responsible to the 177th FW/Det 1 CC for the maintenance of this volume for currency. The contents of this volume include:

a. SOP WGR/177th EOD.
b. Checklists and notification lists of local agencies, including:
    1. Bass River State Forest
    2. Stafford Police Department
    3. Little Egg Harbor Police Department
    4. NJ State Police
c. 177th FW Range Operation Guide
d. EOD training at the range
e. AFI 32-3006: *Explosive Ordnance Disposal Operations on Warren Grove Bombing/Gunnery Range*

A-5. Physical Plant

Range facilities include a main operations building, Pole Barn, Main and Flank Towers, and a munitions storage ARMAG. The main operations building incorporates office space for range members, an exercise room, radio room and radio maintenance room, WISS room, a vehicle maintenance bay and a parking garage for a single wildland fire fighting vehicle. The range does not have a range residue facility or target fabrication facility as authorized (military construction request submitted through CE Nov -07). WGR does not have covered areas for vehicle parking or equipment storage.

Range security consists of fencing that encompasses the main range complex (main building, parking area, and Pole Barn), the munitions storage ARMAG, and the BDU-33 range residue area. The range boundary perimeter (approximately 54NM) is not fenced due to fiscal and environmental constraints.

The range operations facility is accessed by an improved, unpaved, county road (1.5 miles). Range property includes 43 miles of dirt, unimproved roads, which are maintained by range personnel for target and wildland fire fighting access. WGR utilizes a comprehensive range maintenance plan to maintain roads as required. The range has a single road grader with a scraper blade. The grader lacks sufficient attachments for long-term road maintenance. Significant road degradation is expected baring sourcing of road grader attachments.

The range facility is connected to 'city' electrical power and maintains back-up generators sufficient to power the main building and range towers in the event of electrical failure. During inclement weather, primary electrical power is frequently lost to the range complex. Range facilities primarily utilize propane heating elements fueled by two on-site propane tanks. Water is obtained by an on-site well, and is only available in the main operations building. WGR utilizes a septic system for sewage disposal.

Real-property facility maintenance is the responsibility of the 177th Fighter Wing. However, availability of service personnel to range facilities is extremely limited and most facility maintenance is either accomplished via contract or self-help by range personnel. FOMA SRM is insufficient to maintain range facilities (approximately $3,500/annum), and WGR compensates by aggressive participation in FW and NGB 'unfunded' programs.

The range operations building is a relatively new facility (approximately 10 years old) with range towers approximately 15 years old. Range towers are in need of repair/replacement. The main tower control cab is in poor condition and insufficient in size to house equipment required of next-generation range users.

A-6. Scoring and Feedback Systems

WGR utilizes WISS for scoring unguided training munitions within the main impact area. M2A2 sighting scopes and trained personnel are available for use in the event of equipment failure. The range utilizes IRSSS for scoring of low and high angle TP strafe on scoreable strafe targets. WGR can evaluate laser spots with SEESPOT which incorporates day/night and recording capability. WGR can evaluate manually evaluate IR marker capability through available NVDs.

WGR does not have any air-combat mission record system or electronic counter measures analysis systems for mission feedback. The range does not have any simulated weapons delivery scoring capability. The range does not have Rover or video downlink capability to provide real-time assessment of aircrew NTISR or targeting via aircraft systems capabilities.

A-7. Communications Systems

WGR ground-to-air communication capability includes UHF and VHF radios in the main operating tower. DNCO position maintains a programmable UHF/VHF radio which can be broadcast throughout the facility. Mobile UHF/VHF radio capability is available for down-range and alternate location operations. Primary radio frequencies are digitally recorded IAW AFI 13-212.

Point-to-point communication is accomplished through LMR and 'pool' line telephones. LMR FM radios broadcast in analog, which is amplified and transmitted digitally through a FM repeater located in the main tower radio room. Telephones throughout the range including WISS operating room, DNCO and range building offices, and main and flank towers can access the 'range line' which operates like a conference call system. WGR also maintains hot-line capability to FAA facilities, ACY and WRI approach control, and NY and Washington Center ARTCCs.

LMR capability encompasses the entire range complex negating any need for microwave capability within the complex. WGR is connected to the 177th FW via a T-1 line which serves as both a LAN connection and the primary telephone capability for the range. T-1 line is halved between LAN and phone services, severely degrading LAN and internet connectivity. The range is also serviced by several direct dial commercial phone lines primarily used as back-up communication capability as well as providing Fire and IDS connectivity to monitoring agencies.

The range has no STU/STE or SIPR capability. The range has no current cryptographic or encryption capability. WGR has a SSE/Gateway for SADL connectivity, however no SADL radio is currently available to WGR to enable data-link.

A-8. Integrated Air Defense / Counter-air Defense Systems

Due to size, the frequency environment, and ecological and public safety concerns, WGR IAD and CAD systems are severely limited. The range has a Smoky SAM simulator and RWR Lite for EA training. However, there is no current frequency authorization for the RWR Lite, and due to frequency congestion in the New England Region, it is unlikely to be resolved in the near future. No other emitter capability or threat simulators are currently available to WGR users. R-188 chaff is authorized on WGR. Due to recent events and the nature of WGR environment, the authorization to employ self-protection flares was eliminated in May, 2007. Towed Decoys are not authorized on WGR.

A-9. Targets and Target Arrays

WGR contains a mix of highly visible and camouflaged targets. Targets include (Figure 6 – Target Diagram):

- scorable conventional bomb circle
- four acoustic-scored strafe panels including scorable High Angle strafe
- various scorable arrays of tactical targets
- three urban/village arrays (1 for LGB)
- moveable "haji" trucks
- mobile SCUD target with missile stowed and erect capability
- illuminated night strafe
- three columns of vehicles
- runway target set including revetted aircraft, hanger and POL area
- heated targets
- IED emplacements (movable) and NTISR targets
- two night-capable drop areas are available and may be certified for tactical airlift drop zone operations
- rotary wing landing pad
- two rotory wing landing areas are available and may be certified for tactical rotory wing landing zone operations
- In addition to established and developing target arrays, WGR supports the full warfighting cycle with SOFLAM laser designator and IZLID IR target marking devices

Target construction and maintenance is accomplished IAW the WGR maintenance plan. WGR utilizes DRMO target materials, local sources of target materials, JMGTs, and crew member constructed targets (wood, metal, concrete, earthen, etc) to construct and emplace targets. High-fidelity targets are constrained to DRMO materials due to funding limitations for realistic military target simulators.

Target development focuses on realistic target arrays including CCD and MOUT facilities (camouflage, concealment, and deception; military operations in urban terrain). WGR continues to focus on providing target sets that reflect developing CAF operational requirements to include improvised explosive devices, RCIED, VBIED, mobile targets, and targets with collateral damage limitations.

A-10. Management

Range operating procedures are detailed in 177FW/Det 1 ROI 10-01. This ROI details procedures in the following areas: General Concepts, Responsibilities, Range Mission Operations, Laser Operations, Scoring System Operations, Threat Simulators, Range Maintenance, Fire Risk Mitigation and Fire Fighting Response, Abnormal Procedures, Safety, Training, and Security. Commander policies are issued through Policy Letters as required.

Administrative functions at the range are the responsibility of the range NCOIC. These include duty scheduling and assignment and leave program administration. The Range Operations Officer is responsible for the day-to-day operations at the range to include daily scheduling, range utilization reporting, EOD program management, visitor program management, and weapons footprint analysis. Additional duties are assigned as required and are summarized on an additional duty roster. The ROO is responsible for daily supervision of range operations. The range NCOIC is responsible for supervision of all crew duty positions and enlisted crew members. The ROA is responsible for supervision of all personnel and range operations and administrative actions. The ROA, ROO, and NCOIC utilize HQ AF/A3O-AR R-MAST for guidance and references to manage the range more effectively and efficiently.

Range scheduling is accomplished by pre-assigned scheduling blocks for primary range users. Primary users confirm pre-assigned blocks through a monthly scheduling process through the range airfield manager. Scheduling procedures and programming resources are provided to primary and secondary users through the WGR .mil accessible web site.

Range modernization is accomplished through a time-phased investment program (Section D. Strategy) reviewed annually. The objective of the time-phased program is to identify long term goals (five year) and short term objectives which can be achieved through periodic strategic and tactical investment programs. Goals are determined and achieved through an annual modernization program in support of the time-phased modernization plan.

WGR current configuration does not necessitate mission control functionality. However, range mission operations are coordinated through the DNCO duty position which serves as the central clearing house of daily range information. The centralized information structure ensures range personnel and range users exercise operations in parallel with a single source for range information data integrity.

Safety at WGR is a primary concern. Un-safe operations threaten life, critical assets, and the potential for continued future range operations. The range employs a full-time Ground Safety Specialist who reports directly to the range commander for all safety related matters. The GSS is the eyes and ears of the commander and serves as the primary evaluator and quality assurance member for WGR. All crew members retain the responsibly for safe range fight and ground operations. All crew members have the authority to 'knock-it-off' for any safety related item at any time without fear of retribution.

Aircrew safety is assured by distribution and implementation of an R-5002 Course Rules Briefing and Examination program. The program is administered either through Road-Show process, or locally administered through unit Stan/Eval or QA sections. Unit supervisors are responsible for tracking and ensuring crew member compliance with the Course Rules requirements. Range regulatory guidance as well as range operating information is distributed through CD to all users and is available via the WGR web site.

Ground safety is assured through a comprehensive ground safety program. Safety training is detailed for duty position, duty tasks, and equipment operators. Safety training is documented on required AF Forms for all crew members.

Noise management and public affairs issues are handled by the host wing through the 177th FW/PA office. Range and 177FW leadership members are actively involved in the WGR Community Council whose charter is to encourage community support for WGR operations and develop synergistic effects of community involvement in mitigation of conflicts between range operations and public encroachment. Full disclosure requirements for new communities will potentially limit future adverse community impact.

The following circumstances threaten range sustainment and require significant effort to mitigate impact on range operations and future relevance:

- Manning. Minimum manning requirements for flying require all assigned personnel to be available or individual working double shifts.
- Airspace: Airspace restrictions have and will continue to have a detrimental impact on sustainability. J-series weapons employment (simulated) is not supported by current airspace (lateral and vertical) limits; LGB deliveries are supported but with very restricted headings and altitudes; HARB deliveries are not supported due to vertical airspace limitations. R-5002 expanded airspace proposal will partially alleviate this situation. Additional SUA initiatives by WGR – ATCAA, "Super Base" MOA, Nighttime Low Levels – will require NGB support.
- Threat Simulators: Future operations may require WGR to possess, operate and maintain a robust threat array. Currently, no northeast range is suitable for an IADS campaign. JSF, UCAV and F/A-22s all have or are expected to have SEAD/DEAD capability.
- WGR will continue to be very fire-sensitive. Adverse environmental acts have extremely high visibility and significant adverse impact on WGR operations, the NJANG and the USAF. The development of non-sparking training munitions will reduce this factor.

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B. Situation

B-1. General

WGR has been closed since the fire of May, 2007. Major land improvements have been made in target arrays, target area and range access, range security, and the firebreak system. Further real property improvements have been requested to modernize the range to support mission operations and increase range relevance. Future target arrays and airspace enlargement requests are on-going to support current and future CAF requirements, fifth generation aircraft capabilities, and homeland defense/first responder operations.

WGR has had no flight operations since May '07. Future range utilization is anticipated to be reduced from historic (five year average) rates due to the reduction of secondary air-to-ground users (Barnes and Bradley A-10 units, expected FY 10 closure of Willow Grove A-10 unit). Historically, WGR supported approximately 2200 sorties per year. Usage is projected to drop by 20% to 1800 sorties per year (expected to remain one of the three highest usage ranges in ANG). Ground personnel trained on WGR has been steadily increasing since 2001 (367 JTAC/ground personnel trained in FY 07) and is a major focus for expanding mission types at the range.

The range's proximity to numerous users, combined with the scarcity of training resources in the northeast, puts WGR in a unique position to significantly add to future ANG and other services' capabilities. This is accentuated by the proximity to and utilization by numerous non-fighter customers, notably McGuire and Dover AFB AMC units, the AMC Warfare Center, several US Army and USMC units and a USCG group. Properly structured, funded and managed, WGR will be invaluable to all these users' training, thereby securing their viability, growth and transition to next generation airframes.

- C-17 training. Proximity to McGuire AFB combined with the capabilities of WGR and the Coyle Drop Zone/Airfield will generate increased usage by the C-17 community. The C-17 Weapons School program will generate requirements for robust tactical training with threat simulation and countermeasures use.
- In current fighter airframes, the users' training missions reflect their combat employment, which has been heavily weighted to PGM employment in CAS and TST scenarios. WGR expects this trend to continue. Future fighter airframes will require, in addition to current mission types, operations against an IADS. AMC will increase its requirements for OBCM/MWS training, random-steep approaches and prepared and semi-prepared assault strip operations.
- WGR expects a sustained demand for all services' JTAC/SOF operations.
- The Fort Dix/McGuire AFB/Lakehurst NAS "Mega Base" will generate unique requirements for Joint training exercises within which WGR will play a part.

With the exception of REPI, there are no significant funded improvements programmed for WGR. Several military construction requests have been submitted and are awaiting disposition. Unfunded improvements which are programmed for the next year include new target development and implementation of SADL/Gateway connectivity to CRTCC and DTOC for distributed operations training opportunities.

B-2. Transformation

Requisite transformation for these operations will require:

- Manning: The expected operations at WGR will increase from approximately 2700 hours of operation/yr to approximately 3500 hours of operation/yr. Enlisted positions will be required to support follow on AMC missions. The amount of additional manpower will be directly tied to the amount of support required to support AMC Missions. This number is unknown as the amount of support desired by AMC is yet to be determined.
- Funding: In addition to funding for the increased manpower, WGR will require additional funding for target improvement, land and target management and target maintenance. Funding for follow on AMC support TBD.
- An IADS may be crucial to training support of units in the northeast. Currently no capability for this kind of training exists in this region. An IADS will require land and/or sea platform lease or purchase and additional manpower.
- Infrastructure: A readily adaptable target array will facilitate the above missions. Additional facilities or the expansion of current facilities will be required. An IADS, enhancing all mission types, will best be met through the acquisition of threat locations, preferably on offshore platforms.
- Airspace: For LGB and J-Series weapons employment training, as well as SEAD/DEAD and UCAV/RPV missions, contiguity to other SUAs in our vicinity (Warning Area 107) is essential. An ATCAA is proposed. The National Airspace Redesign must address Northeast US training airspace deficiencies. The Ft Dix/McGuire/Lakehurst "Super Base" will require a MOA for Joint UAS/RPV operations.

B-3. Investment Area Baseline Assessment

Land

Current range property is sufficient to accommodate weapons footprints for unguided, general purpose munitions training within the current airspace structure and by current user airframes. Range property is sufficient to accommodate limited LGB employment from current airframes within the current airspace structure. Range property is insufficient to accommodate LGB training from multi-axis or from tactical employment altitudes and/or ranges. Property is insufficient to accommodate footprint of inertially aided munitions. Property is insufficient to accommodate weapons deliveries, UGB or PGM, from tactical delivery ranges and altitudes for fifth generation aircraft.

Airspace

R-5002 vertical and horizontal limits are insufficient to provide airspace necessary for tactical PGM deliveries from current and future aircraft. A proposal for additional airspace above and beyond the current vertical and horizontal limits has been submitted for FAA approval. The proposal is currently being reviewed by for acceptance by FAA

Eastern Sector. This additional airspace will permit users the needed environment for tactical employment of LGB training munitions and simulated employment of IAMs munitions.

Development of dynamic yet predictable airspace connecting R-5002 with W-107 will permit use of Warning Area airspace while executing air-to-ground operations on WGR. Tactical ranges of fifth generation aircraft will necessitate this capability.

VR1709 is daylight only. However, the environmental survey for the route was conducted for operations up to and including 2000L. A FLIP revision request has been submitted to amend VR-1709 operating ours to include operations after sunset up to 2000L.

Environmental

Environmental stewardship is strong at WGR. The range has received multiple stewardship awards and has an outstanding partnership with Drexel University environmental experts to aid protection of environmental assets. Multiple T&E species and wetland areas exist on WGR which can affect land management for wildland fire risk mitigation as well as target development and road maintenance. Restrictive nature of Pinelands Commission CMP negatively impacts ability to perform desired land management activities.

Unexploded Ordnance / Range Debris

WGR executes a comprehensive range residue collection and removal program. However, there is limited EOD support for daily UXO/EOD requirements. A process to allow crewmembers to mechanically harvest/move identified training munitions has been developed and forwarded for approval to AFSA. This process will greatly facilitate daily operations removing the requirement for host base support for isolated incidents of BDU-33 presence on target access ways.

WGR does not currently have a range residue structure. BDU-33s are crated, yet exposed to the environment until contracted residue removal is realized (approximately every five years). While exposed, BDU residue can leach into underlying soil negatively impacting the environment with the potential to contaminate land and water supply.

Physical Plant

Facility maintenance is the responsibility of 177th FW. The wing provides limited support for facility maintenance with most efforts being completed through self-help or self-contracted operations. Annual SRM funding is insufficient to maintain current facilities (FY 08 SRM – $3,500). O&M funds are often used to maintain facilities for health, welfare, and security of range personnel.

WGR has no range residue or target fabrication facility. Both facilities have been requested through the military construction program. Range towers are in need of corrosion control due to deteriorating steps and railings which are rusting due to exposure to airborne salts (resulting from close proximity to Atlantic Ocean). Proposal submitted for military construction of new main tower versus corrosion control on current facility due to the poor condition of the tower and tower cab. Tower cab is insufficient to support nature and quantity of electronic and communications equipment required for the evolving tactical training environment.

Scoring and Feedback System
Recent installation of WISS and integration of IRSSS into WISS operations greatly improves scoring efficiency and reduces RCO and Main Tower operator workloads. SEESPOT permits visual acquisition of laser spot, but manual scoring of the spot. LGB training would benefit from effective laser scoring system. WGR is eagerly pursuing no-drop technology to effectively score simulated weapons deliveries to obviate the need for actual weapons delivery.

Communications Systems
Communications capability at WGR is sufficient for current operations. The range has no frequency authorization for RWR Lite use. Potential for EW frequency authorizations is limited due to frequency congestion in the New England region. LMR frequency authorization is temporary – future disposition prognosis is undeterminable.

The range does not currently have SADL radio capability resulting in non-use of SSE/Gateway capability. DTO opportunities rely on connectivity with CRTCCs. Connectivity may be possible with SADL radio, or microwave capability direct to JRE/JTEP at 177FW, Atlantic City.

Telephone and LAN/Internet capability limited due to the sharing of a single T-1 line between WGR and the host base system, 177th FW, Atlantic City.

Integrated Air Defense / Counter-air Defense Systems
WGR IAD/CAD systems are limited to Smoky SAM operations. WGR desires to enhance SSS capability to include multiple launch and remote launch operations. However, future capability to expend Smoky SAMS, IR launch simulators, and aircraft self-protection flares is tenuous due to political sensitivity and wildfire potential.

WGR assault strip not authorized for fixed wing aircraft landings. There is limited opportunity to modify landing strip to accommodate FW landings to provide assault landing training to AMC aircraft. Random Steep approaches are being increasingly utilized. WGR is working with AMC to ensure the runway environment meets their training need.

Lease of Coyle airfield provides opportunity for IAD/CAD training for AMC aircraft. Operations concept under development.

Targets and Target Arrays
Current target arrays are optimized for current CAF operations. Target arrays include comprehensive set of different target environments including MOUT and CCD type targets. WGR continues to focus on providing target sets that reflect developing CAF

operational requirements to include improvised explosive devices, RCIED, VBIED, mobile targets, and targets with collateral damage limitations.

Target sets include illuminated and non-illuminated areas for increased variety of night operations. LGB target area provides sufficient targets for complex delivery environments. WGR does not currently have any moving targets for strafe or LGB employment.

Management

WGR leadership is focused on ensuring safe range operations and 100% compliance with governing directives. The political landscape and historical mishap incidents have created an environment where any future incident may result in permanent closure of WGR. Closure of this critical asset would greatly degrade training opportunity for primary aviation users as well as eliminating the potential for future mission opportunities (homeland defense and first responder training, ASOS support). Compromises in safety cannot be made to obviate expense of tactics or other objectives.

Current manning supports single shift operations. Two shift operations is required to accommodate extended operating windows in excess of 10 hours. The range is not currently manned to support two shift operations. Although range usage by number of sorties is expected to decrease, the complexity and diversity of range operations is expected to increase, correspondingly increasing workload on assigned crew members. Two un-funded full time positions are currently staffed with part-time (traditional) employees. Sufficient man-days must be made available to effectively utilize these part-time employees in the critical fields of Vehicle Maintenance and Heavy Equipment.

WGR leadership is actively pursuing new missions for range operations to support the wide variety of military, state, local, non-DOD, and non-traditional range users. Missions including homeland defense operations, first responder training for partially collapsed structures and vehicles, foreign material and terrorist response teams, and ASOS training will continue to increase range workload and challenge scheduling processes. Range scheduling currently being accomplished autonomously. The range is pursuing Center Scheduling Enterprise (CSE) tool to increase scheduling efficacy and improve utilization. This tool will be increasingly important as the range migrates to support the wide variety of mission types and users who require range assets for training opportunities.

The investment areas baseline outlined above is merely a starting point for improving range capability to provide training opportunities for current and future users of Warren Grove Range. The current interface between local agencies and communities neighboring WGR has been instrumental in achieving the ranges goals and will continue to be instrumental in future development and future relevance. Evolving missions associated with homeland defense and first responder organizations will increase in relevance and will become a growth area for range missions and utilization. WGR continues to lead the WGR Community Council which serves to enhance community awareness of range operations and stem potential encroachment or public affairs issues. WGR is an eager participant in the East Plains Regional Fireshed and continues to work closely with NJSFFS in developing a congruent fireshed management plan which will synergize WGR wildland fire risk mitigation with efforts of neighboring land managers.

The evolution of ANG ranges required to meet user needs depends upon these continued viable interfaces. These interfaces will significantly effect the environment in which the range operates and its ability to execute a fundamental gameplan for evolution.

B-4. SWOT – Strengths, Weaknesses, Opportunities, Threats

The evolution of WGR will depend greatly on the interaction of its Strengths, Weaknesses, Opportunities, and Threats. The mission of WGR leadership is to leverage its strengths to take advantage of opportunities to achieve objectives while minimizing threats to weaknesses which may be harmful to achieving objectives.

		Helpful to achieving objectives	Harmful to achieving objectives
Internal Origin	(attributes of the organization)	**Strengths** ▪ Land management and environmental stewardship ▪ Aggressive airfield manager to facilitate airspace opportunities ▪ Comprehensive Firebreak system ▪ Close proximity to user units ▪ Close proximity to Warning Areas ▪ Relatively new operations complex ▪ WISS and IRSSS ▪ Proximity of host unit JTEP and JRE Gateways ▪ Comprehensive target arrays ▪ Large acreage available for target development ▪ Leadership culture	**Weaknesses** ▪ Limited property ownership ▪ Limited vertical and horizontal airspace ▪ Wetlands and T&E species presence ▪ No range residue structure ▪ Tower Cab and Main Tower structure poor condition ▪ Shared T-1 line for LAN / internet and phone connectivity ▪ No SIPR capability ▪ No SADL ▪ No moving target capability ▪ No live weapons capability ▪ Manning
External Origin	(attributes of the environment)	**Opportunities** ▪ REPI for fireshed management and potential weapons footprints ▪ Airspace expansion proposal ▪ Dynamic yet predictable airspace, W-107 to R-5002 utilizing GARS ▪ VR-1709 night operations revision ▪ Drexel University partnership ▪ No-drop system development ▪ SADL or microwave capability procurement to connect WGR to net-centric information network ▪ VOIP to increase apparent T-1 BW ▪ Development of IR launch simulators ▪ Center Scheduling Enterprise ▪ New Mission Development ▪ ASOS stand-up at 177th FW ▪ Joint Land Use Study	**Threats** ▪ Encroachment ▪ Fractured property ownership of neighboring land ▪ Dense commercial air traffic area ▪ Pinelands Commission ▪ Mil-con $s limited – priority for mil-con undetermined ▪ Congested Frequency environment ▪ Wildfire potential from Smoky SAM and self-protection flares ▪ Congressional Tasking

C. Vision

C-1. Vision Statement

The transformation vision of WGR is to a multi-command training site, in which users in current and future airframes, can fight their way through a robust threat array in W107 and employ air-to-surface weapons (training or simulated) against a realistic and evolving target array in R5002, conduct airlift operations to an austere field while defending against realistic threats and providing top quality training to JFACs, Special Forces, and Homeland Defense and First Responder personnel.

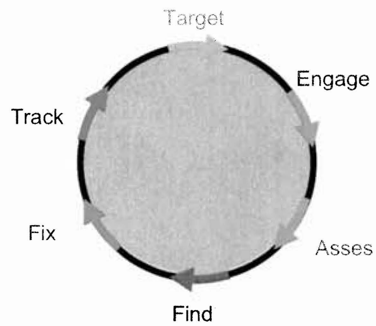
C-2. Future Capabilities

The following future capabilities are necessary for WGR to accommodate changing missions, modified tactics, and new weapons systems (capability / investment area):

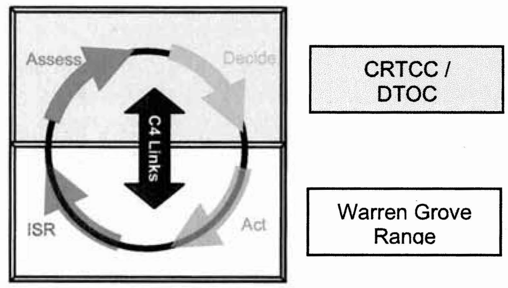
- Reliable low-end threat emitters for EP training (Integrated Air Def/Counter Air Systems)
- Modular and radar/thermal signature Red and Blue Force target systems (Targets and Target Arrays)
- Remote firing capability for Smoky SAMS (Integrated Air Def/Counter Air Systems)
- GPS integrated to support mobile target and no-drop scoring (Scoring and Feedback Systems) (Integrated Air Def/Counter Air Systems)
- Dynamic yet predictable restricted airspace connecting R-5002 with W-107 Warning Area
- Airspace that will support high altitude release of unguided bombs, inert LGBs, and simulated IAMs
- Infrared SAM simulator (Integrated Air Defense/Counter-Air Defense Systems)
- Connectivity to CRTCC and DTOC for Distributed Mission Operation (DMO)'s "network centric" training. (Communications)
- Complete SADL coverage of training airspace to accommodate air and ground users. (Communications)
- High quality No-Drop Bomb Scoring capability (Scoring and Feedback Systems)
- Homeland Defense / First Responder ground training environment

C-3. Range Focus

The vision for future development is for WGR to evolve to provide a training environment where current and future air and ground warfighters can execute as much of the F2T2EA warfighting cycle as possible (Find, Fix, Track, Target, Engage, and Assess) with realistic scenarios on realistic target arrays.



F2T2EA Cycle



IADA Cycle

The focus is to produce a relevant range where users can execute ISR and Act phases on an every-day basis while providing the infra-structure necessary for advanced training opportunities utilizing C4 links to effect Assessment and Decision phases of the cycle.

C-4. Range Goals

The overarching goals for Warren Grove Range are (FY, Investment Area):

1) Provide mobile target training opportunities (FY-09, Land, Environment, Targets)

2) Provide NTISR training opportunities (FY-08, Airspace, Targets, Scoring and Feedback Systems, Communications)

3) Provide first responder training opportunities (FY-09, Land, UXOs, Targets, Management)

4) Provide next generation aircraft systems training opportunities (FY-11, Land, Airspace, Targets, Communication, Scoring and Feedback Systems)

5) Support training in ISR and Act segments of the IADA Cycle (FY-08, Airspace, Scoring and Feedback Systems)

6) Support training in Assess and Decide segments of the IADA Cycle (FY-10, Scoring and Feedback Systems, Communication Systems, Management)

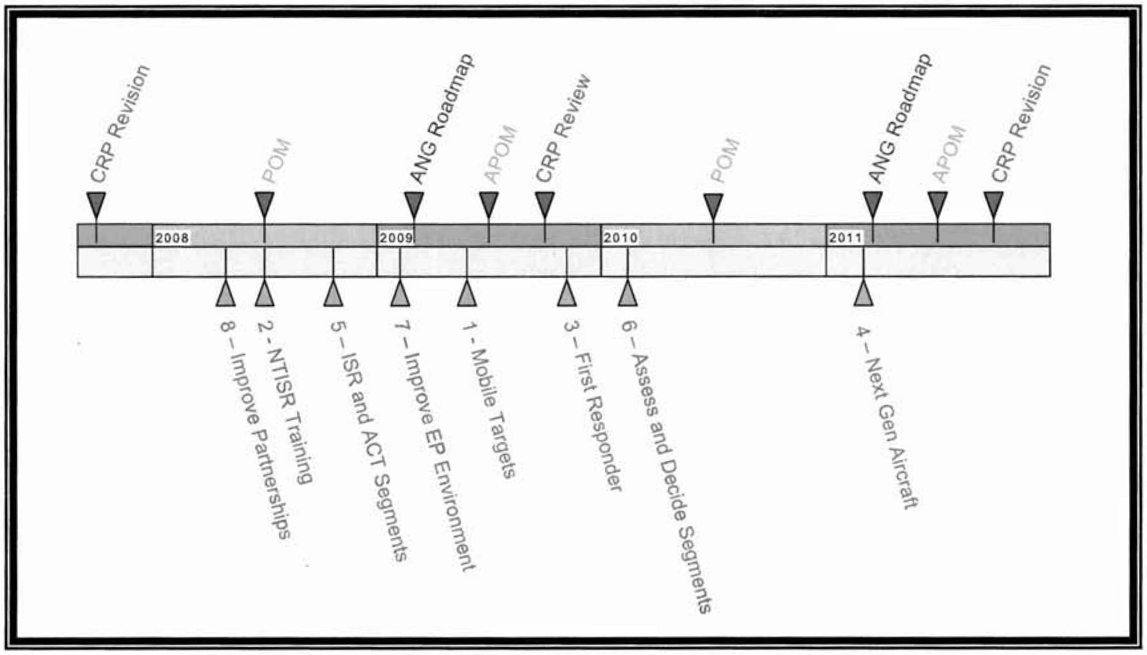
7) Improve EP training environment for CAF, AMC, and non-traditional users (FY-09, Airspace, IADS/CADS)

8) Improve regional joint, interagency, and community partnerships (FY-08, Environment, Targets, Management)

D. Strategy

D-1. Time Phased Investment Program

A time-phased investment program approach in concert with AF/A3O-AR Relevant Range Review Cycle is used as a tool to achieve objectives and reach overarching goals. The timeline below depicts desired projection toward completion of overarching goals to outline and prioritize resource requirements necessary to meet objectives and attain goals.



Phased Investment Timeline

D-2. Investment Area Objectives (FY, Goal):

Land

- Maximize REPI program to consolidate ownership of lands neighboring WGR (FY-09, Goals 3, 4)
- Establish easement on and 'otherwise control' neighboring lands increasing land available for footprint safety zones (FY-11, Goals 1, 4)
- Restrict access to 'otherwise controlled' property for future weapon and weapon system operations (FY-11, Goal 4)

Airspace

- Integrate GARS in airspace activation processes (FY-08, Goal 2)
- Define additional airspace proposals in GARS (FY-09, Goals 2, 4)
- Develop dynamic yet predictable airspace (ATCAA) proposal for airspace connection between R-5002 to W107 (FY-11, Goals 4,5)
- Revise VR-1709 operating hours to include operations from sunrise to 2000L (FY-09, Goal 7)

Environmental

- Partner in East Plains Regional Fireshed Management Plan (FY-08, Goal 8)
- Realize Joint Land Use Study (FY-08, Goal 8)
- Maximize land management effects of REPI (FY-09, Goal 1)

UXO/Residue Removal

- Develop AFSA approved sub-scale practice munition gathering process (FY-09, Goal 3)

Physical Plant (continuous, supports all goals)

- Construct range residue facility
- Construct target fabrication facility
- Construct new tower and cab facility

Scoring / Feedback Systems

- Obtain laser scoring system (FY-08, Goals 2, 5)
- Obtain Rover down-link capability (FY-09, Goals 2, 6)
- Obtain no-drop scoring system (FY-11, Goals 2, 4, 5)
- Integrate GPS to support mobile target and no-drop scoring (FY-11, Goals 1, 4, 5)

Communication Systems

- Implement VOIP phone system to reduce bandwidth load on T-1 line (FY-08, Goal 6)
- Obtain SADL radio and Gateway connectivity through microwave direct to 177th FW/CP (FY-08, Goal 6)
- Obtain SIPRNET capability (FY-09, Goals 2, 4, 6)
- Establish security system and processes to support cryptographic programs (FY-09, Goals 2, 4, 6)
- Obtain connectivity to CRTCC and DTOC for Distributed Mission Operation (DMO)'s 'network centric' training (kill chain training) (FY-10, Goals 2, 6)
- Complete SADL coverage of training airspace to accommodate air and ground users (FY-08, Goals 1, 2, 6)

IAD/CADS

- Obtain reliable low-end threat emitters for EP training (FY-09, Goal 7)
- Obtain remote firing capability for Smoky SAMS (FY-09, Goal 7)

Targets

- Obtain and implement high fidelity target arrays (FY-11, Goals 4, 5)
- Develop NTISR / TCT/TST mobile target training arrays and programs for user NTISR training (FY-08, Goals 1, 2)
- Obtain target arrays that support organic sensor platforms (FY-11, Goal 4)
- Obtain no-drop simulated weapons delivery scorable target arrays (FY-11, Goals 4, 5)
- Obtain modular and radar/thermal signature Red and Blue Force target systems (FY-09, Goals 2, 4, 5)
- Infrared SAM simulator (FY-10, Goals 4, 7)
- Homeland Defense / First Responder ground training environment (FY-09, Goals 3, 8)

Management

- Implement Center Scheduling Enterprise (FY-09, Goals 3, 6)
- Force manage for projected losses (FY-09, Goals 3, 6, 8)
- Establish ASOS liaison / POC for synergistic effects from local ASOS / JF training environment (FY-10, Goals 1, 2, 3, 8)
- Establish target development team across ANG ranges to effect fifth generation PTR target types and arrays (FY-09, Goal 4)

D-3. Managing Progress

Investment area objectives support overarching vision goals. Successful completion of objectives and corresponding goals is achieved through leveraging WGR strengths to take advantage of opportunities while minimizing weaknesses to avoid potential threats to success. Oversight of completion of objectives and subsequent attainment of goals is accomplished through quarterly review of objective status and annual review / revision of the time-phased investment program.

Attainment of many WGR objectives are dependant upon availability of resources both internal and external to range operations. Support from the 177th FW, NJANG, NGB, and ACC will be required to successfully complete objectives and reach overarching goals. The ROA is responsible for identifying required resources to appropriate external agencies and modifying timelines as necessary when resources are committed or are not available to meet objectives IAW the above strategy

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E. CRP Supporting Documents

The following supporting documents are available electronically on the Warren Grove Range network file server:

177th FW/Det 1 Range Operating Instruction ROI 10-01, March 2008

177th FW/Det 1 Sup 1 to AFI 13-212, Range Planning and Operations, October 2007

AFI 32-3006: *Explosive Ordnance Disposal Operations on Warren Grove Bombing/Gunnery Range*

Biological Survey at Warren Grove Range, NJ, 12 June 1997

Compliance Site Inventory and Compliance Assurance and Pollution Prevention Management Action Plan for the Atlantic City, NJ Air National Guard, October 2000

Cultural Properties Evaluation: Warren Grove Gunnery Range, NJANG, February 2001

Drexel University Memorandum of Understanding, October 2007

East Plains Fireshed Region Hay Road Project, February 2008

Environmental Assessment: Military Training Use of the Air-To-Ground Weapons Range at Warren Grove Gunnery Range, September 2000

Environmental Baseline Survey: 177 FW, NJANG (Coyle Field Drop Zone), May 2001

Federal Aviation Administration Letter of Procedure for R-5002, January 1999

Integrated Natural Resources Plan, December 2006

NJ Pinelands Commission Comprehensive Management Plan

Warren Grove Range Pinelands Commission Cooperative Agreement and Land Management Plan, January 1985

Warren Grove Range R-5002 Course Rules Briefing and Roadshow, October 2007

Wildland Fire Mitigation Plan, March 2008

Wildlife Hazard Assessment: Warren Grove Air-To-Ground Range, conducted and written in 2000 by The USDA Animal and Plant Health Inspection Service, Wildlife Services

The following referenced Figures are available electronically on the Warren Grove Range network file server:

F-1 Range Diagram

F-2 Airspace Diagram

F-3 REPI Parcels

F-4 GARS Map

F-5 EOD Maps

F-6 Target Diagram

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F. Acronyms

ACC	Air Combat Command
ACY	Atlantic City IAP
AFB	Air Force Base
AFREP	Air Force Real Estate Program
AFSA	Air Force Standards Agency
AMC	Air Mobility Command
ANG	Air National Guard
ARMAG	Armory Magazine
ARTCC	Air Route Traffic Control Center
ASOS	Air Support Operations Squadron
ATCAA	Air Traffic Control Assigned Airspace
BDU	Bomb, Dummy Unit
CAD	Computer Aided Design
CAF	Combat Air Forces
CCD	Charge-Coupled Device (electro-optical device)
CD	Compact Disk
CMP	Pinelands Comprehensive Management Plan
CRP	Comprehensive Range Plan
CRTC	Combat Readiness Training Center
CSAR	Combat Search and Rescue
CSE	Central Scheduling Enterprise
DANG	Delaware Air National Guard
DEAD	Destruction of Enemy Air Defenses
DMO	Distributed Mission Operation
DNCO	Duty Non-Commissioned Officer
DRMO	Defense Re-utilization Management Office
DTOC	Distributed Training Operations Center
EA	Electronic Attack
EOD	Explosive Ordnance Disposal
EP	Electronic Protection
EPRF	East Plains Regional Fireshed
F2T2EA	Find, Fix, Track, Target, Engage, and Assess
FAA	Federal Aviation Administration
FLIP	Flight Information Publication
FM	Frequency Modulation
FOMA	Facility Operations and Maintenance Activities
FW	Fighter Wing
GARS	Global Area Reference System
GIS	Arc-Geographic Information System
GPS	Global Positioning System
HARB	High Altitude Release Bomb
IADA Cycle	ISR, Act, Decide, Assess Cycle
IADS	Integrated Air Defense System
IAMs	Inertially Aided Munitions

IAP	International Airport
IDS	Intrusion Detection System
IED	Improvised Explosive Device
INRMP	Integrated Natural Resources Management Plan
IR	Infrared
IZLID	Infrared Zoom Laser Illuminator Designator
JF	Joint Forces
JFAC	Joint Forward Air Controllers
JMGT	Joint Modular Ground Target
JRE/JTEP	Joint Range Extension / Joint Range Extension TMPG Package
JSF	Joint Strike Fighter
LAN	Local Area Network
LGBs	Laser Guided Bombs
LMR	Land Mobile Radio
MOA	Military Operations Area
MOUT	Military Operations in Urban Terrain
MPPEH	Material Potentially Possessing Explosive Hazard
NCOIC	Non-Commissioned Officer in Charge
NGB	National Guard Bureau
NJANG	New Jersey Air National Guard
NJCF	New Jersey Conservation Foundation
NJSFFS	New Jersey State Forest Fire Service
NM	Nautical Mile
NTISR	Non-Traditional ISR
NVD	Night Vision Device
O&M	Operation and Maintenance
PGM	Precision Guided Munition
POL	Petroleum
QA	Quality Assurance
RCIED	Remote Control IED
REPI	Readiness and Environmental Protection Initiative
RMAST	Range Management Software Tool
ROA	Range Operating Agency
ROI	Range Operating Instruction
ROO	Range Operations Officer
RPV	Remotely Piloted Vehicle
RWR	Radar Warning Receiver
SADL	Situational Awareness Data Link
SAM	Surface-to-Air Missiles
SCUD	Western Name for Early Soviet Missile Series
SEAD	Suppression of Enemy Air Defenses
SIPR	Secret Internet Protocol, Routed
SOFLAM	Special Operations Forces Laser Marker
SOP	Standard Operating Procedure
SRM	Sustainment, Refurbishment, and Maintenance
SSE	System Support Equipment

SSS	Smokey SAM Simulator
STU/STE	Secure Telephone Unit / Equipment
SUA	Special Use Airspace
SWOT	Strengths, Weaknesses, Opportunities, and Threats
T&E	Threatened and Endangered
TBD	To Be Determined
TCT/TST	Time Critical/Sensitive Tasking (Target)
TP	Training Projectile
UAS	Unmanned Aircraft System
UCAV	Unmanned Combat Air Vehicle
UGB	Un-guided Bomb
UHF/VHF	Ultra/Very High Frequency
USAF	United States Air Force
NAS	Naval Air Station
USCG	United States Coast Guard
USMC	United States Marine Corps
USN	Unites States Navy
UXO	Un-exploded Ordnance
VBIED	Vehicle Born IED
VOIP	Voice Over Internet Protocol
WGR	Warren Grove Range
WISS	Weapons Impact Scoring System
WRI	McGuire AFB

AIR NATIONAL GUARD

Warren Grove Range

Risk Mitigation Plan

4 Jan 08

Table of Contents

Section A - Executive Summary

Overview

Warren Grove Range (the range), located within restricted airspace designated as R-5002, is managed and operated by the 177th Fighter Wing. Entry into the airspace is restricted to provide approved users with a controlled environment in which to train for military and non-department of defense operations in support of military missions including Homeland Defense and the Global War on Terror. The range includes over 9,400 acres of federally owned/controlled land which is secured from public access to prevent inadvertent entry by unauthorized personnel.

In continuous operation since 1942, Warren Grove Range provides critical training opportunities for a variety of governmental agencies including the US Air Force, US Navy, US Army, the Air and Army National Guards, and other department of defense, federal, and state users. The use of Warren Grove Range and R-5002 is an important component for the training of federal forces in their mission of defending the US at home and overseas. The continued use of Warren Grove Range is contingent upon the ability to apply safety measures and risk management procedures to the existing range operations. The range's close proximity to civilian populations and the New Jersey Pinelands increases the need to insure safety considerations and minimize risk to civilians and their property adjacent to the range.

Objective

The objective of this Risk Mitigation Plan is to identify a comprehensive set of command and control procedures aimed at reducing the potential for mishaps at the range. These procedures will be strictly enforced by both the NJ Air National Guard and by all agencies engaged in training missions at the range.

- *This will demand changes in leadership, changes in procedures and rigorous education and training, both initial and ongoing.*

Four Pillars of Risk Mitigation

Minimizing Warren Grove Range operating risk can be accomplished through four essential, interrelated pillars of risk management (detailed in Section B):

1. Reorganization and restructuring of the range Command and Leadership
2. Development and strict enforcement of operating procedures focused on approval processes, communications, and fire risk mitigation
3. Quality assurance procedures and oversight to ensure user compliance with range operating procedures
4. Extensive training at all levels aimed at fostering a culture of safe range operations

Approval

This plan will be coordinated with and approved by all of the following offices: the Commander of the New Jersey Air National Guard, The Adjutant General, New Jersey National Guard, New Jersey Governor's office, the Director of the Air National Guard, and the United States Air Force.

Action Items for Implementation

The items listed below briefly describe the actions necessary for the successful implementation of the mitigation plan (detailed in Section C):

1. Reorganize the Warren Grove Range Command Structure
2. Increase oversight and quality assurance procedures for daily range operations
3. Restrict the types of devices that may be used for training at the range
4. Implement an extensive education program for all units and agencies utilizing the range
5. Institute a two-way communications process to restrict range use to users who have been fully briefed concerning the hazards of operation for current day use of the range
6. Increase resources allocated for safe range operations including improved training of range monitor personnel
7. Embed a safety specialist at the Warren Grove Range
8. Increase the timeliness and size of the response force when fire is possible or probable

Conclusion

Warren Grove Range is the busiest range in the Air National Guard inventory and is considered an extremely important resource for aerial and ground training vital to the defense of the United States. Both the Air Force and the Air National Guard support the re-opening of the range. By implementing new safety, communication, and operational procedures, it is possible to minimize risks to the immediate and surrounding areas, while maintaining an essential training resource.

Section B - The Four Pillars of Risk Mitigation

1. Organizational and Leadership Changes

a. Leadership: Changes in leadership were made to effect a change in unit culture focusing on range safety, compliance with governing directives, stewardship of critical assets, and risk mitigation. The following leadership changes were made within the 177th Fighter Wing:

1) Vice Wing Commander
   Formerly a Group Commander, the new Vice Wing Commander has significant experience in both the Maintenance and Support groups, and has become familiar with the operation over 25 years.

2) Operations Group Commander
   Formerly the Operations Support Flight Commander, the new Group Commander has over 3000 hours in various fighter and attack aircraft. He is current and qualified in the general purpose mission with significant surface attack experience, and is formerly qualified as a Forward Air Controller.

3) Warren Grove Range Commander
   Formerly the Chief of Operations Group Standardization / Evaluation, the new Range Commander has over 3,000 hours in the F-16 and has been an Air-to-Ground Instructor Pilot for many years. He is also a Forward Air Controller with significant Close Air Support experience.

4) Warren Grove Range Control Officer
   Formerly a Marine, the new Range Operations Officer has significant Surface Attack experience, to include operating with Terminal Area Control Party in both aerial and surface roles.

5) Wing Safety Officer / Flight Safety Officer
   A qualified Flight Safety Officer and graduate of Safety School has been appointed to the position of Wing Safety Officer.

6) A ground safety specialist will be assigned fulltime to the Warren Grove Range
   A qualified ground safety officer has been detailed to the range pending hiring of permanent personnel to position

b. Organization: The Warren Grove Range has been removed as a Detachment assigned directly to the Wing Commander supervised by the Vice Commander and has been placed under the supervision of the Operations Group Commander.

1) Reorganization places all operational elements in the 177th Fighter Wing under the Operations Group Commander's supervision and responsibility.

2) Placing Warren Grove Range in the Operations Group facilitates meeting the support requirements of the range – group commander support necessary for

successful inter-agency, inter-group, and inter-wing coordination better met with reorganization.

3) Operational Risk Management and Safety measures applied to the Operations Group have been incorporated in Warren Grove Range Operations.

4) The Operations Group Commander supervises the Warren Grove Range Commander to guarantee that the range rapidly identifies and resolves operational problems and issues.

5) Warren Grove Range is now viewed as part of the Operations community and, as such, afforded better access to personnel and resources.

6) As the primary range user, the Operations Group takes pride in ownership of the Warren Grove Range.

7) Unity of Command fosters improved communications between range user and range management personnel, correcting the Accident Investigation Board's highlighted problem of inadequate communications.

2. Changes to Procedures at Warren Grove Range and 177th Fighter Wing

a. Changes to Warren Grove Range operating procedures have been made to mitigate risk of wildfire and other potential range mishaps. The culture of range operations has changed from one of "approved until prohibited" to one of "prohibited unless approved." Requirements for user coordination with range operations for events and expenditures have been clarified and delineated. The critical impact of this culture change is that there is a prohibitive response in the event of any communications failure (see Appendix 7).

b. These changes include but are not limited to the following measures (refer to Appendix 6 for detailed description of aircraft expendable devices referenced below):

   1) Prohibit the use of aircraft flares

   2) Prohibit the routine use without prior, written approval of rockets and surface-to-air simulator devices

      a) This measure would effectively restrict use of any device that emits a spark or charge

      b) Exceptions to permit use of rockets and surface-to-air simulator devices will be made on a case-by-case basis and may include pre-deployment Tactical Air Control Party training, weapons allocations and availability, and night operations

      c) Rockets and surface-to-air simulator devices may only be approved for use when the range Fire Danger Classification is 1, 2, or 3

      d) The authority to approve the use of rockets or surface-to-air simulator devices rests with the 177th Fighter Wing Commander

e) Exceptions to permit use of rockets or surface-to-air simulator devices must be made in writing and reported along with device expenditure(s) as required by governing directives.

3) Range control officers are prohibited from requesting aircrew to perform actions which have not been planned and coordinated unless those actions are necessary for safe range operation or range control operator training

4) Embed a Ground Safety Specialist at Warren Grove Range

   a) A senior non-commissioned officer at the range has attended Safety School and functions as an on site Safety Monitor. This individual is tasked to identify and pre-empt potential safety issues and serve as the Commander's "safety" eyes on the range.

   b) The specialist is responsible for monitoring range control officer training and evaluation as required by governing directives.

   c) ***This specialist is in place as a pre-requisite to the re-opening of the range.***

5) Increased oversight and quality assurance procedures for daily range operations have been implemented

   a) The Range Commander or designated representative will brief 177th Fighter Wing leadership on range safety metrics in addition to all range reports and data currently required by governing directives

   b) Warren Grove Range utilization metrics will include the number and type of weapons, number and type of aircraft, range mission cancellations, and airspace denials

6) Institute mandatory Operational Risk Management procedures at the Warren Grove Range with a focus on wildfire potential

   a) The range control officer will ascertain the range fire condition and employment restrictions prior to commencing range operations

   b) Employment restrictions will be passed to range users, along with the altimeter setting, upon initial check-in prior to users being permitted to enter range airspace

   c) Receipt of fire condition and employment restrictions must be acknowledged by aircrew prior to expenditure of any device on the range

7) Institute requirement for written and/or verbal communications between Warren Grove Range personnel and user personnel for all units utilizing the range on a daily basis (see Appendix 7 for coordination/communication requirements flow diagram)

   a) A standardized range mission profile sheet for all Warren Grove Range users will be completed prior to users being granted permission to enter the range airspace. This sheet will include aircraft type, number/type of expendables, approval for required devices (as appropriate), and planned/ alternate delivery events

b) The range control officer is responsible for ensuring the mission profile sheet is complete prior to employment of any expendables.

c) Range personnel will inform range user supervisors of range fire conditions and restrictions prior to users being permitted to enter range airspace

d) Range personnel will inform range user supervisors of any changes to fire conditions or range restrictions (as applicable) prior to users being granted permission to enter range airspace

e) Two-way communication is required between all scheduled range users and the Range Control Officer, Duty Non-commissioned Officer, or designated representative prior to users being granted permission to enter range airspace

f) Confirmation of applicable fire conditions, range restrictions, aircraft expendable devices, and planned events is required prior to users being granted permission to enter range airspace

g) Lack of appropriate coordination outlined above will result in denial of approval to utilize Warren Grove Range

8) Incorporate guidance into the Warren Grove procedures and regulations to eliminate the potential for bullet impact outside federally owned property

a) Forward firing weapons will be mechanically or electrically inhibited, or "safed," until the weapon is pointed in a direction that will allow expendable devices to land within the range impact area (federally owned land designated for weapons impact)

b) For aircraft with a gun or a cannon, aircrew are prohibited from selecting the gun weapon system while the Master Arm switch is in the "Arm" position until the gun is aimed at the ground within the impact area

c) Aircrew are prohibited from pointing a gun that is neither electrically nor mechanically "safed" at any manned location

9) Develop detailed fire prevention and response plan to mitigate fire risk potential and standardize fire fighting response for incidental fires on Warren Grove Range (see Appendix 5 for Wildland Fire Prevention and Response Plan)

a) Delineate guidelines to aid in prevention, containment and suppression of range wildland fires.

b) Plan incorporates fire prevention, general fire response guidance, selective fire response guidance, response plan for incidental fires outside range property, and aviation fire fighting response guidance

c) For any fire that occurs as a result of range operations, the following guidance will be followed:

- Warren Grove Range personnel will immediately contact NJSFFS and coordinate appropriate fire fighting response
- Range operations cease with all attention and range fire fighting assets directed at controlling/extinguishing fire
- The range control officer will coordinate fire fighting response as the initial incident commander until relieved by the NJSFFS incident commander
- During fire fighting response, no personnel shall be permitted to enter the Range Complex without the ability to maintain constant two-way communication with the range main tower and/or the Incident Commander's established base of operations
- A selective response plan for fire fighting response will be executed as outlined in Appendix 5

3. Assuring Compliance with Range Operating Procedures

a. Procedural changes to range and user operational procedures will not mitigate range operations risk nor will it improve range safety without assurance that users are aware of, and can comply with, range restrictions and operating requirements. To assure user compliance with the Warren Grove Range operating instructions, the 177 Fighter Wing:

  1) Developed and implemented a range procedures briefing (course rules brief – see Appendix 8) for all users; individual users must receive the briefing prior to utilizing Warren Grove Range

  2) Provides "road show" academics on range procedures on an as requested/desired basis

  3) Developed and implemented a standardized range procedures examination for all users; individual users must successfully complete the examination prior to being granted permission to utilize the range

  4) Successfully completed a National Guard Bureau staff assistance visit October 15th – 19th validating range operations, safety measures, and compliance with governing instructions

b. Range procedures briefing and examination are updated and provided to users as required to address changes to operating procedures

c. User units are required to provide range operations a list of users who have completed the range procedures briefing and passed the range procedures examination. Failure to complete the briefing, pass the examination, or failure of the unit to provide information confirming the above is cause for range denial.

4. Extensive Training at all Levels Aimed at Fostering a Culture of Safe Range Operations

The three preceding Pillars are applicable to all Warren Grove Range users and will mitigate risk for the range itself. This final Pillar of risk mitigation is directed towards mitigating risk for 177th Fighter Wing flight operations regardless of range/airspace being utilized for training. The Accident Investigation Board president concluded the cause of the mishap fire was pilot error – a failure of a 177th Fighter Wing pilot to comply with established range restrictions. This Pillar emphasizes that risk mitigation starts and ends with the pilot in command.

a. The 177th Fighter Wing Operations Supervisor or Supervisor of Flying must contact the range control officer or duty non-commissioned officer before the first flight of the day to obtain Range conditions and restrictions. Lack of coordination prohibits 177th Fighter Wing assigned or attached pilots use of Warren Grove Range.

b. Implemented a directed review of range operating procedures and applicable Air Force governing instructions and training rules with specific emphasis on minimum altitude requirements, fire condition procedures, simulated weapons employment restrictions, and flight briefing requirements.

c. Established a prohibition of Show of Force and other undefined maneuvers either on or off-range. Events otherwise undefined must be defined in writing prior to execution before being executed by 177th Fighter Wing assigned/attached pilots.

d. The Operations Group Commander has restricted flying training to basic operations until the wing completes the F-16 Block 25 to Block 30 aircraft conversion.

e. Executed a commander's briefing detailing the risks associated with expenditure of any item from the aircraft and the critical nature to ensure compliance prior to expenditure.

f. Implemented range safety operational risk management as directed into mass, flight, and step briefings.

Section C – Action Items for Implementation

Action items were identified as necessary to achieve the Four Pillars of Risk Mitigation in Section B. Action items provided a focus for implementing change and were deemed critical to achieving a sustainable culture of safe range operations. Detailed description of results from action items can be found in the respective Pillars of Section B.

1. [Pillar I] Reorganize the Warren Grove Range Command Structure
    a. Replace key leadership positions within Warren Grove Range and those with direct oversight of range and flight operations
    b. Remove the range as a Detachment of the 177th FW and place it directly under the supervision of the 177th FW Operations Group Commander providing closer supervision of range operations

STATUS – COMPLETED

2. [Pillar I and II] Increase oversight and quality assurance procedures for daily range operations
    a. Develop utilization and range safety metrics to include number and type of weapons, number and type of aircraft, range mission cancellations, and airspace denials
    b. Brief 177th Fighter Wing leadership on range safety metrics in addition to all range reports and data currently required by governing directives

STATUS – COMPLETED

3. [Pillar II] Restrict the types of devices that may be used for training at the range
    a. Prohibit the use of aircraft flares
    b. Prohibit the routine use of other devices that have the potential to create a spark which may ignite combustible materials
    c. Modify arming procedures to eliminate the likelihood of off-range weapons release

STATUS – COMPLETED

4. [Pillar III] Implement an extensive education program for all units and agencies utilizing the range
    a. Develop range procedures briefing
    b. Develop "road-show" academic program for primary users and other users upon request
    c. Develop and implement range rules examination requirement

STATUS – COMPLETED

5. [Pillar II and IV] Institute a two-way communications process to restrict range use to users who have been fully briefed concerning the hazards of operation for current day use of the range
    a. Develop and institute mandatory pre-mission coordination requirement and process
    b. Develop and implement range mission profile sheet to document coordination completion and provide range personnel with mission data required for safe range operations
    c. Develop coordination process which ensures coordination/communication failures result in disapproval to enter range airspace
    d. Develop feedback mechanisms for user operations supervisors to ensure range conditions/restrictions changes are delivered to aircrew

STATUS – COMPLETED

6. [Pillar I and II] Increase resources allocated for safe range operations including improved training of range monitor personnel
    a. Develop and implement formal training programs for range duty positions to include Range Control Officer, Tower Operators, Ground Crew, and Duty NCO
    b. Successfully execute NGB Staff Assistance Visit and correct noted deficiencies or non-compliant items

STATUS – COMPLETED

7. [Pillar I and II] Embed a safety specialist at the Warren Grove Range

STATUS – COMPLETED

8. [Pillar II] Increase the timeliness and size of the response force when fire is possible or probable
    a. Clearly define range fire fighting response capabilities
    b. Obtain additional fire fighting equipment to enhance range personnel ability for immediate fire fighting response
    c. Improve range fire break, fire lane, fire line system
    d. Establish procedures to facilitate NJ Army Guard aviation fire fighting aid during NJSFFS response as required

STATUS – COMPLETED

9. [Pillar IV] Develop range restrictions and operations re-training and supervision program for 177th FW assigned and attached pilots
    a. Direct a review of range operating procedures and applicable Air Force range directives
    b. Brief aircrew on risks of all potential aircraft expenditures
    c. Implement range safety operational risk management as directed into mass, flight, and step briefings
    d. Implement 177th FW mandatory range coordination process

STATUS – COMPLETED

177th Fighter Wing

Detachment 1

Warren Grove Range

Comprehensive Range Plan

21 March 2008

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Executive Summary

The next generation relevant range must continue to enable, as well as continuously improve, our ability to achieve a desired effect through synergistic application of the fully developed skills of our Airmen, employing the most sophisticated technology, in a coherent warfighting cycle. To that end, Warren Grove Range must continue to evolve to provide the training environment users require to prepare for warfighting and homeland defense roles.

Status

Warren Grove Range's proximity to numerous users, combined with the scarcity of training resources in the northeast, puts it in a unique position to significantly add to future ANG and other services' capabilities. This is accentuated by the proximity to and utilization by numerous non-fighter aviation and ground personnel customers. Properly structured, funded and managed, the range will be invaluable to all these users' training, thereby securing viability, growth and transition to next generation airframes.

Transformation

From AF/A3O-AR *Transforming the Air Force Range*:

> *"A relevant range enables* ***Developing Airmen****, across multiple functional disciplines, to hone their skills during full spectrum training or tactics development…These operations will include Command and Control integration of Intelligence, Surveillance and Reconnaissance assets with traditional strike, Battlefield Airmen, airlift, CSAR, space, and information operations to achieve a desired effect in combat."*

Transformation requires a specific vision of the future and strategy for execution of that vision.

> "Warren Grove Range will evolve to provide a multi-command training environment where current and future air and ground warfighters can execute as much of the F2T2EA warfighting cycle as possible (Find, Fix, Track, Target, Engage, and Assess) against a realistic and evolving target array, or be able to conduct airlift operations to an austere field while defending against realistic threats, and to provide top quality training to JFACs, Special Forces, and Homeland Defense and First Responder personnel."

Vision

The Vision can be realized by capturing capabilities necessary to accommodate changing missions, modified tactics, and new weapons systems:

- Reliable low-end threat emitters for EP training
- Modular and radar/thermal signature Red and Blue Force target systems
- Remote firing capability for Smoky SAMS
- GPS integrated to support mobile target and no-drop scoring
- Dynamic yet predictable restricted airspace connecting R-5002 with W-107 Warning Area
- Airspace that will support high altitude release of unguided bombs, inert LGBs, and simulated IAMs
- Infrared SAM simulator

- Connectivity to CRTCC and DTOC for Distributed Mission Operation (DMO)'s "network centric" training.
- Complete SADL coverage of training airspace to accommodate air and ground users.
- High quality No-Drop Bomb Scoring capability
- Homeland Defense / First Responder ground training environment

Strategy

The mission of WGR leadership is to leverage its strengths to take advantage of opportunities to achieve objectives while minimizing threats to weaknesses which may be harmful to achieving objectives. Strategy for realizing the Vision is to use a time-phased investment program to achieve objectives and reach overarching goals:

- Provide mobile target training opportunities
- Provide NTISR training opportunities
- Provide first responder training opportunities
- Provide next generation aircraft systems training opportunities
- Support training in ISR and Act segments of the IADA Cycle
- Support training in Assess and Decide segments of the IADA Cycle
- Improve EP training environment for CAF, AMC, and non-traditional users
- Improve regional joint, interagency, and community partnerships

Vision, Strategy, Goals, and Objectives are merely words without proper execution managing progress towards success. Warren Grove Range will achieve its goals through the time phased approach outlining stated objectives supporting individual goals through a timeline that parallels AF/A3O-AR's Relevant Range Review Cycle. Specific investment area objectives support overarching vision goals. Successful completion of objectives and corresponding goals is achieved through leveraging WGR strengths to take advantage of opportunities while minimizing weaknesses to avoid potential threats to success. Oversight of completion of objectives and subsequent attainment of goals is accomplished through quarterly review of objective status and annual review / revision of the time-phased investment program.

Conclusion

Warren Grove Range can succeed in transformation for next generation aircraft and evolving missions. Range relevance can be assured through a time-phased investment program focused on investment areas, specific objectives that support long term goals, and a vision that supports the complete T2F2EA warfighting cycle. Failure to focus on and execute this strategy threatens a lack of relevance and threatens long term viability.

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A. Range Investment Areas

A-1. Land

Warren Grove Range was originally leased in 1942 by the United States Navy for a Test Site. Ownership and responsibility transferred to the United States Air Force and to the New Jersey Air National Guard in 1960. The range proper is totally enclosed in the Pine Barrens, which is regulated by the New Jersey Pinelands Commission. Additionally, the Stafford Forge Wildlife Refuge, Bass River, Wharton, and the Penn State Forests, surround the range property. All forests are owned by the state of New Jersey with more acreage being purchased for land preservation.

Warren Grove Range is on 9416 acres of Air Force land licensed to the ANG. The Range is located within the heart of the New Jersey Pinelands National Reserve and is approximately 12 square miles with an impact area of approximately 900 acres (Figure 1 – Range Diagram). The geography of WGR is characterized by low-lying, flat to gently rolling terrain with limited topographical relief and less than 75 feet vertical differential throughout range property.

Range property consists of mostly soft, sandy soil with scrub brush and pygmy pine dominating the landscape. The soil does not support growth of other vegetation although there are pockets of hardwood swamps, wetlands, white cedar, and pine-oak forests. The range is predominantly a natural ecosystem with several sate and federal Threatened and Endangered (T&E) species found within range boundaries (T&E animal species include but are not limited to the Peregrine Falcon, Bald Eagle, Bog Turtle, Corn Snake, and Northern Pine Snake). WGR Integrated Natural Resources Management Plan (INRMP) lists T&E animal and vegetative species found on range property.

Land modifications to include target development, road maintenance, firebreak system development and management, and real property improvements/modifications are impacted by environmental concerns of T&E species and habitat, and Pinelands Comprehensive Management Plan restrictions. WGR land management must comply with CMP requirements. Approval for required waivers to the CMP must be obtained as required prior to specific land management activities.

Range leased property is within the airspace restricted area R-5002 (Figure 2 – Airspace Diagram). The range is principally neighbored by state forestlands and uninhabited private forest underlying R-5002. State forestlands is primarily owned by Bass River Township, Stafford Township, or the NJ Conservation Foundation. There are a few parcels of land below R-5002 outside of the range boundary which are privately and/or commercially owned and targeted for acquisition through the REPI program (Figure 3 – REPI Parcels). The purpose of the REPI program is to secure an easement on land surrounding WGR property to establish buffer lands which will restrict land development and facilitate land management to support WGR operations. In FY 08, $500,000 has been allocated to REPI purchases with over $2M projected for future years.

The 177th FW Real Property Manager maintains WGR Property Surveys, Titles, etc. WGR utilizes an ArcView land database included in the INRMP for strategic and tactical land management activities. Arc-Geographic Information System (GIS) overlays have been added to the Weapons Danger Zone (WDZ) program utilized by WGR for weapons footprint analysis.

In addition to WGR property, the 177FW/Det 1 leases approximately 500 acres of Coyle Airfield five miles north of WGR. This area is leased for the expressed purpose of providing a Drop Zone for air-drop training or other activities in support of the National Defense. Coyle Airfield does not lie within R-5002 boundaries. Activities at Coyle Drop Zone are the responsibility of the Delaware Air National Guard IAW DANG published operating procedures.

A-2. Airspace

R-5002 overlays WGR and the immediate surrounding land, covering a roughly rectangular area of approximately five by six nautical miles (see attached airspace diagram). The area is approximately 10NM north of Atlantic City IAP, home to the 177th Fighter Wing (F-16s) and approximately 15NM southeast of McGuire AFB, home to the 108th Air Refueling Wing and the 514th and 305th Air Mobility Wings (KC-135, KC-10, C-17). Other fixed and rotory wing users include but are not restricted to the following table of users:

UNIT	TYPE	SERVICE	AIRCRAFT	LOCATION	DISTANCE
111FW	Regular	ANG	OA-10	Willow Grove, PA	45 NM
113FW	Regular	ANG	F-16C+	Andrews AFB, MD	126 NM
175FW	Regular	ANG	A/OA-10A	Baltimore, MD	96 NM
177FW	Regular	ANG	F-16C+	Atlantic City, NJ	17 NM
DARPA	Regular	US Army	UAVs	Ft Monmouth, NJ	45 NM
PAX River TPS	Regular	USN	FA-18/F-14	Patuxent River, MD	127 NM
Air Mobility Warfare Center	Regular	AMC	C-5, 17, 21 & 130; KC-10, KC-135	Ft Dix NJ	20 NM
305/614AMWs	Regular	AMC	C17	McGuire AFB	20 NM
166AW	Regular (Coyle)	ANG	C130	New Castle DE	54 NM
106RQW	Regular	ANG	HH60	Westhampton Beach NY	107 NM
Numerous	Regular	Army, USMC & USCG	Helos	Various	N/A

The restricted area lies within GARS grid zones 212LV17 – 19 and 212LV31 – 36 (Figure 4 - GARS Diagram). The vertical limits of R-5002 vary by sub-area as depicted. The main portion of the restricted area extends to 14000' MSL. A proposal has been submitted to and is under review by the FAA to extend the current airspace to FL230 and to add a FL200 to FL230 shelf extending northeast for approximately 15NM (see attached airspace proposal diagram).

R-5002 lies within the horizontal coverage of NY ARTCC, although outside of FAA controlled airspace. To the north lies McGuire AFB Approach Control Alert Area (Sfc – 4,500' MSL). To the south lies Atlantic City IAP Approach Control Class C airspace (1,300 – 4,100' MSL). The range is surrounded by the following Victor Routes – V1 to the west, V312 to the north, V184/229 to the east, and V577 to the south. Eagles Nest private airfield is approximately 1NM from the restricted area's eastern boundary. To accommodate civilian traffic utilizing this airfield, the floor of neighboring R-5002E is 3,500'MSL. There are no other classes of airspace which are in close proximity to the restricted area.

Restricted area airspace is activated through NY ARTCC IAW FAA Letter of Procedure dated 25 Jan 99. Normal operating hours for the restricted area are Tuesday through Saturday, 0900 –

1600L. During night weeks, normal operating hours are 1200 – 2200L. On average, the restricted area is scheduled on a daily basis 62% of the year. Utilization is 82% of the days scheduled, and the airspace is utilized 95% of the time activated. Restricted area reports are completed annually and filed with Eastern US AFREP office.

WGR supports two visual low altitude routes terminating at the range. VR-1709 enters from the south and VR-1709B enters from the north. Operating hours for VR-1709 and VR-1709B are from sunrise to sunset.

A-3. Environmental

The natural infrastructure of WGR is impacted by both internal and external factors. Both have short and long term impacts on the military value of the range and future relevance. An interservice Agreement between the New Jersey Air National Guard and the Pinelands Commission, finalized in 1985, specifies all the responsibilities of both parties pertaining to natural and man-made resources. All subjects are covered in the *Warren Grove Weapons Range Cooperative Agreement and Land Management Plan*, dated 4 January 1985.

Internally, the range is impacted by T&E species, presence of designated wetland areas, and a variety of UXOs present from previous land usage which are periodically found on range property. Vegetative and animal T&E species thrive in the natural ecosystem of the pine barrens. Impact on these species must be evaluated prior to action which may harm species or potential habitat for these species. These impacts may affect the ability to develop or maintain target areas, access ways, firebreaks and fuel break systems, and the ability to execute prescribed burns to reduce potential wildland fire fuel loads. The 177th FW Environmental Office is the land manager for WGR and evaluates potential impacts prior to issuing recommendations for action. Drexel University staff and students are occasionally relied upon to further evaluate potential impact on T&E species and habitat as resident experts on pine barren eco-systems.

The WGR INRMP identifies T&E species resident on WGR. The INRMP also identifies several areas of designated wetlands which pose additional problems to land management. Wildland fire fuel levels cannot be managed within wetland areas by prescribed burns due to the nature of wetlands. Resources are not available to reduce fuel loads within wetlands by selective thinning or other methodologies. Additionally, road maintenance in wetland areas is hindered by drainage road material restrictions.

The prior use of WGR property exposed the land to a variety of unexploded ordnance objects. Although no live munitions have been found on WGR, there remains the potential that any UXO found on range is a live object posing explosive and/or chemical discharge danger. All UXOs found on range must be evaluated by EOD personnel prior to movement or in-place destruction. Areas where UXOs are found become inaccessible until EOD personnel clear the area, potentially impacting ability to maintain range property or execute weapons delivery operations.

Externally, WGR is impacted by the dense frequency environment the New England area, the Pinelands Comprehensive Management Plan, fractured land ownership in neighboring areas, and continued housing growth near R-5002. Frequency management for WGR is complicated by the density of the electromagnetic spectrum in the New England area. Spectrum density restricts the ability of the range to obtain authorization to utilize any EA training systems restricting this training opportunity in R-5002.

The Pinelands CMP and waiver process is restrictive in nature. It can take many years to obtain waiver authority to modify land within the Pinelands. The NJSFFS has only recently received approval to proceed with fireshed management activities to reduce the likelihood of out of control wildland fire in the East Plains Regional Fireshed (WGR lies within the EPRF).

Installation of additional firebreaks on WGR property is hampered by the requirement to obtain waiver approval from the Pinelands Commission.

Fractured land ownership in areas neighboring WGR has complicated the ability to manage wildland fire fuel loads, increasing risk from wildfire. The lack of legal land surveys in the area further complicates land ownership. Some areas around the range have more than 50 land owners within several square miles. Many of the land owners cannot be located or refuse to cooperate with land management activities. The NJ Conservation Foundation is actively pursing purchase of private, commercial, and segmented government owned parcels surrounding WGR property. Land purchase is being accomplished through the REPI program with shared costs between AFREP and the NJCF. Land purchase through REPI will provide an easement on the land to restrict development and permit fireshed land management activities.

There continues to be an explosion in civilian population in towns neighboring WGR. The tremendous increase in population increases the likelihood that a mishap resulting from range operations could result in civilian personal property damage or personal injury. In 2005, an aircraft operating on WGR expended TP rounds that impacted off-range, landing on top of a neighboring school. In 2007, a wildfire ignited by an aircraft self-protection flare resulted in a wildfire that burned nearly 20,000 acres, caused civilian evacuation of neighboring areas, and destroyed/damaged several nearby homes. The following is a partial list of surrounding communities which may be impacted by WGR operations:

Warren Grove	Little Egg Harbor TWP	Tuckerton
Giffordtown	Nugentown	Parkerton
Wading River	New Gretna	

The necessity to protect local residents from potential range mishaps combined with encroaching population required a major revision to range operating procedures and severe restrictions on the type of weapons and training that may be accomplished on the range. These restrictions can negatively impact the range's potential relevance as weapons types and target arrays are further restricted.

Reference Section E for environmental documents that address current environmental issues for WGR.

A-4. Unexploded Ordnance / Range Debris

Live munitions are not authorized on WGR. Authorized ordnance that may contain an explosive hazard includes BDUs with marking charges, un-expended TP rounds, rockets, and smoky SAMs. However, prior operations on WGR property may have included other munitions that could present an explosive hazard. Therefore, any weapon found on WGR is considered a ‘hot’ or live weapon until inspected and certified safe by qualified EOD personnel.

Material inspected by EOD personnel is classified into the following areas: UXOs, BDU-33s, inert heavyweight munitions, MPPEH range residue, and non-MPPEH range residue. These items are segregated by type until cleared from the range by a qualified materials processor. All items are considered MPPEH until certified as non MPPEH by qualified EOD personnel. Used target materials certified as non-MPPEH are collected and held within the range compound until processed for salvage material.

UXOs are munitions that may or may not contain un-expended explosive material. UXOs will be left in place, marked accordingly, and either destroyed in place or removed by a qualified handler. BDU-33s will be inspected and collected by EOD or qualified contract or military personnel and held in the BDU-33 collection area. BDU-33s will remain in the holding area until processed by qualified clean-up contract personnel. Heavyweight munitions will be inspected by and certified safe by EOD personnel prior to being segregated in Central Park residue collection point. Used target materials that remain MPPEH will be collected and held in Central Park residue collection point until cleared as non-MPPEH or until destroyed/removed by qualified military or contract personnel.

EOD clearance of WGR is conducted on an annual plus 20% basis. Annually, the main circle target area is cleared by EOD personnel out to a radius of 300 feet. Access ways to the main circle out to 50 feet either side of the road is cleared annually. In addition, every year 20% of the remaining target area is cleared within 1000’ of targets within the area. Range residue removal is programmed through NGB when funding is available and as prioritized through the ANG range community. Range Decontamination and Cleanup are scheduled with the periodic users of Warren Grove Range and deconflicted with other SUA to ensure adequate range space is available for training.

Annual and pent annual EOD are addressed in the 177th FW Supp to AFI 13-212. Explosive Ordnance Disposal is accomplished annually in May. The next 5 years of EOD are scheduled as follows (Figure 5 – EOD Maps).

1. May 2008 Annual + West 1/5th
2. May 2009 Annual + North 1/5th
3. May 2010 Annual + East 1/5th
4. May 2011 Annual + South 1/5th
5. May 2012 Annual + Interior 1/5th

Specific procedures for Range Cleanup and Decontamination is maintained by the NCOIC in a single volume (SOP/EOD). The Warren Grove Range NCOIC is responsible to the 177th FW/Det 1 CC for the maintenance of this volume for currency. The contents of this volume include:

a. SOP WGR/177th EOD.
b. Checklists and notification lists of local agencies, including:
    1. Bass River State Forest
    2. Stafford Police Department
    3. Little Egg Harbor Police Department
    4. NJ State Police
c. 177th FW Range Operation Guide
d. EOD training at the range
e. AFI 32-3006: *Explosive Ordnance Disposal Operations on Warren Grove Bombing/Gunnery Range*

A-5. Physical Plant

Range facilities include a main operations building, Pole Barn, Main and Flank Towers, and a munitions storage ARMAG. The main operations building incorporates office space for range members, an exercise room, radio room and radio maintenance room, WISS room, a vehicle maintenance bay and a parking garage for a single wildland fire fighting vehicle. The range does not have a range residue facility or target fabrication facility as authorized (military construction request submitted through CE Nov -07). WGR does not have covered areas for vehicle parking or equipment storage.

Range security consists of fencing that encompasses the main range complex (main building, parking area, and Pole Barn), the munitions storage ARMAG, and the BDU-33 range residue area. The range boundary perimeter (approximately 54NM) is not fenced due to fiscal and environmental constraints.

The range operations facility is accessed by an improved, unpaved, county road (1.5 miles). Range property includes 43 miles of dirt, unimproved roads, which are maintained by range personnel for target and wildland fire fighting access. WGR utilizes a comprehensive range maintenance plan to maintain roads as required. The range has a single road grader with a scraper blade. The grader lacks sufficient attachments for long-term road maintenance. Significant road degradation is expected baring sourcing of road grader attachments.

The range facility is connected to 'city' electrical power and maintains back-up generators sufficient to power the main building and range towers in the event of electrical failure. During inclement weather, primary electrical power is frequently lost to the range complex. Range facilities primarily utilize propane heating elements fueled by two on-site propane tanks. Water is obtained by an on-site well, and is only available in the main operations building. WGR utilizes a septic system for sewage disposal.

Real-property facility maintenance is the responsibility of the 177th Fighter Wing. However, availability of service personnel to range facilities is extremely limited and most facility maintenance is either accomplished via contract or self-help by range personnel. FOMA SRM is insufficient to maintain range facilities (approximately $3,500/annum), and WGR compensates by aggressive participation in FW and NGB 'unfunded' programs.

The range operations building is a relatively new facility (approximately 10 years old) with range towers approximately 15 years old. Range towers are in need of repair/replacement. The main tower control cab is in poor condition and insufficient in size to house equipment required of next-generation range users.

A-6. Scoring and Feedback Systems

WGR utilizes WISS for scoring unguided training munitions within the main impact area. M2A2 sighting scopes and trained personnel are available for use in the event of equipment failure. The range utilizes IRSSS for scoring of low and high angle TP strafe on scoreable strafe targets. WGR can evaluate laser spots with SEESPOT which incorporates day/night and recording capability. WGR can evaluate manually evaluate IR marker capability through available NVDs.

WGR does not have any air-combat mission record system or electronic counter measures analysis systems for mission feedback. The range does not have any simulated weapons delivery scoring capability. The range does not have Rover or video downlink capability to provide real-time assessment of aircrew NTISR or targeting via aircraft systems capabilities.

A-7. Communications Systems

WGR ground-to-air communication capability includes UHF and VHF radios in the main operating tower. DNCO position maintains a programmable UHF/VHF radio which can be broadcast throughout the facility. Mobile UHF/VHF radio capability is available for down-range and alternate location operations. Primary radio frequencies are digitally recorded IAW AFI 13-212.

Point-to-point communication is accomplished through LMR and 'pool' line telephones. LMR FM radios broadcast in analog, which is amplified and transmitted digitally through a FM repeater located in the main tower radio room. Telephones throughout the range including WISS operating room, DNCO and range building offices, and main and flank towers can access the 'range line' which operates like a conference call system. WGR also maintains hot-line capability to FAA facilities, ACY and WRI approach control, and NY and Washington Center ARTCCs.

LMR capability encompasses the entire range complex negating any need for microwave capability within the complex. WGR is connected to the 177th FW via a T-1 line which serves as both a LAN connection and the primary telephone capability for the range. T-1 line is halved between LAN and phone services, severely degrading LAN and internet connectivity. The range is also serviced by several direct dial commercial phone lines primarily used as back-up communication capability as well as providing Fire and IDS connectivity to monitoring agencies.

The range has no STU/STE or SIPR capability. The range has no current cryptographic or encryption capability. WGR has a SSE/Gateway for SADL connectivity, however no SADL radio is currently available to WGR to enable data-link.

A-8. Integrated Air Defense / Counter-air Defense Systems

Due to size, the frequency environment, and ecological and public safety concerns, WGR IAD and CAD systems are severely limited. The range has a Smoky SAM simulator and RWR Lite for EA training. However, there is no current frequency authorization for the RWR Lite, and due to frequency congestion in the New England Region, it is unlikely to be resolved in the near future. No other emitter capability or threat simulators are currently available to WGR users. R-188 chaff is authorized on WGR. Due to recent events and the nature of WGR environment, the authorization to employ self-protection flares was eliminated in May, 2007. Towed Decoys are not authorized on WGR.

A-9. Targets and Target Arrays

WGR contains a mix of highly visible and camouflaged targets. Targets include (Figure 6 – Target Diagram):

- scorable conventional bomb circle
- four acoustic-scored strafe panels including scorable High Angle strafe
- various scorable arrays of tactical targets
- three urban/village arrays (1 for LGB)
- moveable “haji” trucks
- mobile SCUD target with missile stowed and erect capability
- illuminated night strafe
- three columns of vehicles
- runway target set including revetted aircraft, hanger and POL area
- heated targets
- IED emplacements (movable) and NTISR targets
- two night-capable drop areas are available and may be certified for tactical airlift drop zone operations
- rotary wing landing pad
- two rotory wing landing areas are available and may be certified for tactical rotory wing landing zone operations
- In addition to established and developing target arrays, WGR supports the full warfighting cycle with SOFLAM laser designator and IZLID IR target marking devices

Target construction and maintenance is accomplished IAW the WGR maintenance plan. WGR utilizes DRMO target materials, local sources of target materials, JMGTs, and crew member constructed targets (wood, metal, concrete, earthen, etc) to construct and emplace targets. High-fidelity targets are constrained to DRMO materials due to funding limitations for realistic military target simulators.

Target development focuses on realistic target arrays including CCD and MOUT facilities (camouflage, concealment, and deception; military operations in urban terrain). WGR continues to focus on providing target sets that reflect developing CAF operational requirements to include improvised explosive devices, RCIED, VBIED, mobile targets, and targets with collateral damage limitations.

A-10. Management

Range operating procedures are detailed in 177FW/Det 1 ROI 10-01. This ROI details procedures in the following areas: General Concepts, Responsibilities, Range Mission Operations, Laser Operations, Scoring System Operations, Threat Simulators, Range Maintenance, Fire Risk Mitigation and Fire Fighting Response, Abnormal Procedures, Safety, Training, and Security. Commander policies are issued through Policy Letters as required.

Administrative functions at the range are the responsibility of the range NCOIC. These include duty scheduling and assignment and leave program administration. The Range Operations Officer is responsible for the day-to-day operations at the range to include daily scheduling, range utilization reporting, EOD program management, visitor program management, and weapons footprint analysis. Additional duties are assigned as required and are summarized on an additional duty roster. The ROO is responsible for daily supervision of range operations. The range NCOIC is responsible for supervision of all crew duty positions and enlisted crew members. The ROA is responsible for supervision of all personnel and range operations and administrative actions. The ROA, ROO, and NCOIC utilize HQ AF/A3O-AR R-MAST for guidance and references to manage the range more effectively and efficiently.

Range scheduling is accomplished by pre-assigned scheduling blocks for primary range users. Primary users confirm pre-assigned blocks through a monthly scheduling process through the range airfield manager. Scheduling procedures and programming resources are provided to primary and secondary users through the WGR .mil accessible web site.

Range modernization is accomplished through a time-phased investment program (Section D. Strategy) reviewed annually. The objective of the time-phased program is to identify long term goals (five year) and short term objectives which can be achieved through periodic strategic and tactical investment programs. Goals are determined and achieved through an annual modernization program in support of the time-phased modernization plan.

WGR current configuration does not necessitate mission control functionality. However, range mission operations are coordinated through the DNCO duty position which serves as the central clearing house of daily range information. The centralized information structure ensures range personnel and range users exercise operations in parallel with a single source for range information data integrity.

Safety at WGR is a primary concern. Un-safe operations threaten life, critical assets, and the potential for continued future range operations. The range employs a full-time Ground Safety Specialist who reports directly to the range commander for all safety related matters. The GSS is the eyes and ears of the commander and serves as the primary evaluator and quality assurance member for WGR. All crew members retain the responsibly for safe range fight and ground operations. All crew members have the authority to 'knock-it-off' for any safety related item at any time without fear of retribution.

Aircrew safety is assured by distribution and implementation of an R-5002 Course Rules Briefing and Examination program. The program is administered either through Road-Show process, or locally administered through unit Stan/Eval or QA sections. Unit supervisors are responsible for tracking and ensuring crew member compliance with the Course Rules requirements. Range regulatory guidance as well as range operating information is distributed through CD to all users and is available via the WGR web site.

Ground safety is assured through a comprehensive ground safety program. Safety training is detailed for duty position, duty tasks, and equipment operators. Safety training is documented on required AF Forms for all crew members.

Noise management and public affairs issues are handled by the host wing through the 177th FW/PA office. Range and 177FW leadership members are actively involved in the WGR Community Council whose charter is to encourage community support for WGR operations and develop synergistic effects of community involvement in mitigation of conflicts between range operations and public encroachment. Full disclosure requirements for new communities will potentially limit future adverse community impact.

The following circumstances threaten range sustainment and require significant effort to mitigate impact on range operations and future relevance:

- Manning. Minimum manning requirements for flying require all assigned personnel to be available or individual working double shifts.
- Airspace: Airspace restrictions have and will continue to have a detrimental impact on sustainability. J-series weapons employment (simulated) is not supported by current airspace (lateral and vertical) limits; LGB deliveries are supported but with very restricted headings and altitudes; HARB deliveries are not supported due to vertical airspace limitations. R-5002 expanded airspace proposal will partially alleviate this situation. Additional SUA initiatives by WGR – ATCAA, "Super Base" MOA, Nighttime Low Levels – will require NGB support.
- Threat Simulators: Future operations may require WGR to possess, operate and maintain a robust threat array. Currently, no northeast range is suitable for an IADS campaign. JSF, UCAV and F/A-22s all have or are expected to have SEAD/DEAD capability.
- WGR will continue to be very fire-sensitive. Adverse environmental acts have extremely high visibility and significant adverse impact on WGR operations, the NJANG and the USAF. The development of non-sparking training munitions will reduce this factor.

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B. Situation

B-1. General

WGR has been closed since the fire of May, 2007. Major land improvements have been made in target arrays, target area and range access, range security, and the firebreak system. Further real property improvements have been requested to modernize the range to support mission operations and increase range relevance. Future target arrays and airspace enlargement requests are on-going to support current and future CAF requirements, fifth generation aircraft capabilities, and homeland defense/first responder operations.

WGR has had no flight operations since May ’07. Future range utilization is anticipated to be reduced from historic (five year average) rates due to the reduction of secondary air-to-ground users (Barnes and Bradley A-10 units, expected FY 10 closure of Willow Grove A-10 unit). Historically, WGR supported approximately 2200 sorties per year. Usage is projected to drop by 20% to 1800 sorties per year (expected to remain one of the three highest usage ranges in ANG). Ground personnel trained on WGR has been steadily increasing since 2001 (367 JTAC/ground personnel trained in FY 07) and is a major focus for expanding mission types at the range.

The range’s proximity to numerous users, combined with the scarcity of training resources in the northeast, puts WGR in a unique position to significantly add to future ANG and other services’ capabilities. This is accentuated by the proximity to and utilization by numerous non-fighter customers, notably McGuire and Dover AFB AMC units, the AMC Warfare Center, several US Army and USMC units and a USCG group. Properly structured, funded and managed, WGR will be invaluable to all these users’ training, thereby securing their viability, growth and transition to next generation airframes.

- C-17 training. Proximity to McGuire AFB combined with the capabilities of WGR and the Coyle Drop Zone/Airfield will generate increased usage by the C-17 community. The C-17 Weapons School program will generate requirements for robust tactical training with threat simulation and countermeasures use.
- In current fighter airframes, the users’ training missions reflect their combat employment, which has been heavily weighted to PGM employment in CAS and TST scenarios. WGR expects this trend to continue. Future fighter airframes will require, in addition to current mission types, operations against an IADS. AMC will increase its requirements for OBCM/MWS training, random-steep approaches and prepared and semi-prepared assault strip operations.
- WGR expects a sustained demand for all services’ JTAC/SOF operations.
- The Fort Dix/McGuire AFB/Lakehurst NAS “Mega Base” will generate unique requirements for Joint training exercises within which WGR will play a part.

With the exception of REPI, there are no significant funded improvements programmed for WGR. Several military construction requests have been submitted and are awaiting disposition. Unfunded improvements which are programmed for the next year include new target development and implementation of SADL/Gateway connectivity to CRTCC and DTOC for distributed operations training opportunities.

B-2. Transformation

Requisite transformation for these operations will require:

- Manning: The expected operations at WGR will increase from approximately 2700 hours of operation/yr to approximately 3500 hours of operation/yr. Enlisted positions will be required to support follow on AMC missions. The amount of additional manpower will be directly tied to the amount of support required to support AMC Missions. This number is unknown as the amount of support desired by AMC is yet to be determined.
- Funding: In addition to funding for the increased manpower, WGR will require additional funding for target improvement, land and target management and target maintenance. Funding for follow on AMC support TBD.
- An IADS may be crucial to training support of units in the northeast. Currently no capability for this kind of training exists in this region. An IADS will require land and/or sea platform lease or purchase and additional manpower.
- Infrastructure: A readily adaptable target array will facilitate the above missions. Additional facilities or the expansion of current facilities will be required. An IADS, enhancing all mission types, will best be met through the acquisition of threat locations, preferably on offshore platforms.
- Airspace: For LGB and J-Series weapons employment training, as well as SEAD/DEAD and UCAV/RPV missions, contiguity to other SUAs in our vicinity (Warning Area 107) is essential. An ATCAA is proposed. The National Airspace Redesign must address Northeast US training airspace deficiencies. The Ft Dix/McGuire/Lakehurst "Super Base" will require a MOA for Joint UAS/RPV operations.

B-3. Investment Area Baseline Assessment

Land

Current range property is sufficient to accommodate weapons footprints for unguided, general purpose munitions training within the current airspace structure and by current user airframes. Range property is sufficient to accommodate limited LGB employment from current airframes within the current airspace structure. Range property is insufficient to accommodate LGB training from multi-axis or from tactical employment altitudes and/or ranges. Property is insufficient to accommodate footprint of inertially aided munitions. Property is insufficient to accommodate weapons deliveries, UGB or PGM, from tactical delivery ranges and altitudes for fifth generation aircraft.

Airspace

R-5002 vertical and horizontal limits are insufficient to provide airspace necessary for tactical PGM deliveries from current and future aircraft. A proposal for additional airspace above and beyond the current vertical and horizontal limits has been submitted for FAA approval. The proposal is currently being reviewed by for acceptance by FAA

Eastern Sector. This additional airspace will permit users the needed environment for tactical employment of LGB training munitions and simulated employment of IAMs munitions.

Development of dynamic yet predictable airspace connecting R-5002 with W-107 will permit use of Warning Area airspace while executing air-to-ground operations on WGR. Tactical ranges of fifth generation aircraft will necessitate this capability.

VR1709 is daylight only. However, the environmental survey for the route was conducted for operations up to and including 2000L. A FLIP revision request has been submitted to amend VR-1709 operating ours to include operations after sunset up to 2000L.

Environmental
Environmental stewardship is strong at WGR. The range has received multiple stewardship awards and has an outstanding partnership with Drexel University environmental experts to aid protection of environmental assets. Multiple T&E species and wetland areas exist on WGR which can affect land management for wildland fire risk mitigation as well as target development and road maintenance. Restrictive nature of Pinelands Commission CMP negatively impacts ability to perform desired land management activities.

Unexploded Ordnance / Range Debris
WGR executes a comprehensive range residue collection and removal program. However, there is limited EOD support for daily UXO/EOD requirements. A process to allow crewmembers to mechanically harvest/move identified training munitions has been developed and forwarded for approval to AFSA. This process will greatly facilitate daily operations removing the requirement for host base support for isolated incidents of BDU-33 presence on target access ways.

WGR does not currently have a range residue structure. BDU-33s are crated, yet exposed to the environment until contracted residue removal is realized (approximately every five years). While exposed, BDU residue can leach into underlying soil negatively impacting the environment with the potential to contaminate land and water supply.

Physical Plant
Facility maintenance is the responsibility of 177th FW. The wing provides limited support for facility maintenance with most efforts being completed through self-help or self-contracted operations. Annual SRM funding is insufficient to maintain current facilities (FY 08 SRM – $3,500). O&M funds are often used to maintain facilities for health, welfare, and security of range personnel.

WGR has no range residue or target fabrication facility. Both facilities have been requested through the military construction program. Range towers are in need of corrosion control due to deteriorating steps and railings which are rusting due to exposure to airborne salts (resulting from close proximity to Atlantic Ocean). Proposal submitted for military construction of new main tower versus corrosion control on current facility due to the poor condition of the tower and tower cab. Tower cab is insufficient to support nature and quantity of electronic and communications equipment required for the evolving tactical training environment.

Scoring and Feedback System
Recent installation of WISS and integration of IRSSS into WISS operations greatly improves scoring efficiency and reduces RCO and Main Tower operator workloads. SEESPOT permits visual acquisition of laser spot, but manual scoring of the spot. LGB training would benefit from effective laser scoring system. WGR is eagerly pursuing no-drop technology to effectively score simulated weapons deliveries to obviate the need for actual weapons delivery.

Communications Systems
Communications capability at WGR is sufficient for current operations. The range has no frequency authorization for RWR Lite use. Potential for EW frequency authorizations is limited due to frequency congestion in the New England region. LMR frequency authorization is temporary – future disposition prognosis is undeterminable.

The range does not currently have SADL radio capability resulting in non-use of SSE/Gateway capability. DTO opportunities rely on connectivity with CRTCCs. Connectivity may be possible with SADL radio, or microwave capability direct to JRE/JTEP at 177FW, Atlantic City.

Telephone and LAN/Internet capability limited due to the sharing of a single T-1 line between WGR and the host base system, 177th FW, Atlantic City.

Integrated Air Defense / Counter-air Defense Systems
WGR IAD/CAD systems are limited to Smoky SAM operations. WGR desires to enhance SSS capability to include multiple launch and remote launch operations. However, future capability to expend Smoky SAMS, IR launch simulators, and aircraft self-protection flares is tenuous due to political sensitivity and wildfire potential.

WGR assault strip not authorized for fixed wing aircraft landings. There is limited opportunity to modify landing strip to accommodate FW landings to provide assault landing training to AMC aircraft. Random Steep approaches are being increasingly utilized. WGR is working with AMC to ensure the runway environment meets their training need.

Lease of Coyle airfield provides opportunity for IAD/CAD training for AMC aircraft. Operations concept under development.

Targets and Target Arrays
Current target arrays are optimized for current CAF operations. Target arrays include comprehensive set of different target environments including MOUT and CCD type targets. WGR continues to focus on providing target sets that reflect developing CAF

operational requirements to include improvised explosive devices, RCIED, VBIED, mobile targets, and targets with collateral damage limitations.

Target sets include illuminated and non-illuminated areas for increased variety of night operations. LGB target area provides sufficient targets for complex delivery environments. WGR does not currently have any moving targets for strafe or LGB employment.

Management
WGR leadership is focused on ensuring safe range operations and 100% compliance with governing directives. The political landscape and historical mishap incidents have created an environment where any future incident may result in permanent closure of WGR. Closure of this critical asset would greatly degrade training opportunity for primary aviation users as well as eliminating the potential for future mission opportunities (homeland defense and first responder training, ASOS support). Compromises in safety cannot be made to obviate expense of tactics or other objectives.

Current manning supports single shift operations. Two shift operations is required to accommodate extended operating windows in excess of 10 hours. The range is not currently manned to support two shift operations. Although range usage by number of sorties is expected to decrease, the complexity and diversity of range operations is expected to increase, correspondingly increasing workload on assigned crew members. Two un-funded full time positions are currently staffed with part-time (traditional) employees. Sufficient man-days must be made available to effectively utilize these part-time employees in the critical fields of Vehicle Maintenance and Heavy Equipment.

WGR leadership is actively pursuing new missions for range operations to support the wide variety of military, state, local, non-DOD, and non-traditional range users. Missions including homeland defense operations, first responder training for partially collapsed structures and vehicles, foreign material and terrorist response teams, and ASOS training will continue to increase range workload and challenge scheduling processes. Range scheduling currently being accomplished autonomously. The range is pursuing Center Scheduling Enterprise (CSE) tool to increase scheduling efficacy and improve utilization. This tool will be increasingly important as the range migrates to support the wide variety of mission types and users who require range assets for training opportunities.

The investment areas baseline outlined above is merely a starting point for improving range capability to provide training opportunities for current and future users of Warren Grove Range. The current interface between local agencies and communities neighboring WGR has been instrumental in achieving the ranges goals and will continue to be instrumental in future development and future relevance. Evolving missions associated with homeland defense and first responder organizations will increase in relevance and will become a growth area for range missions and utilization. WGR continues to lead the WGR Community Council which serves to enhance community awareness of range operations and stem potential encroachment or public affairs issues. WGR is an eager participant in the East Plains Regional Fireshed and continues to work closely with NJSFFS in developing a congruent fireshed management plan which will synergize WGR wildland fire risk mitigation with efforts of neighboring land managers.

The evolution of ANG ranges required to meet user needs depends upon these continued viable interfaces. These interfaces will significantly effect the environment in which the range operates and its ability to execute a fundamental gameplan for evolution.

B-4. SWOT – Strengths, Weaknesses, Opportunities, Threats

The evolution of WGR will depend greatly on the interaction of its Strengths, Weaknesses, Opportunities, and Threats. The mission of WGR leadership is to leverage its strengths to take advantage of opportunities to achieve objectives while minimizing threats to weaknesses which may be harmful to achieving objectives.

		Helpful to achieving objectives	Harmful to achieving objectives
Internal Origin	(attributes of the organization)	**Strengths** ▪ Land management and environmental stewardship ▪ Aggressive airfield manager to facilitate airspace opportunities ▪ Comprehensive Firebreak system ▪ Close proximity to user units ▪ Close proximity to Warning Areas ▪ Relatively new operations complex ▪ WISS and IRSSS ▪ Proximity of host unit JTEP and JRE Gateways ▪ Comprehensive target arrays ▪ Large acreage available for target development ▪ Leadership culture	**Weaknesses** ▪ Limited property ownership ▪ Limited vertical and horizontal airspace ▪ Wetlands and T&E species presence ▪ No range residue structure ▪ Tower Cab and Main Tower structure poor condition ▪ Shared T-1 line for LAN / internet and phone connectivity ▪ No SIPR capability ▪ No SADL ▪ No moving target capability ▪ No live weapons capability ▪ Manning
External Origin	(attributes of the environment)	**Opportunities** ▪ REPI for fireshed management and potential weapons footprints ▪ Airspace expansion proposal ▪ Dynamic yet predictable airspace, W-107 to R-5002 utilizing GARS ▪ VR-1709 night operations revision ▪ Drexel University partnership ▪ No-drop system development ▪ SADL or microwave capability procurement to connect WGR to net-centric information network ▪ VOIP to increase apparent T-1 BW ▪ Development of IR launch simulators ▪ Center Scheduling Enterprise ▪ New Mission Development ▪ ASOS stand-up at 177th FW ▪ Joint Land Use Study	**Threats** ▪ Encroachment ▪ Fractured property ownership of neighboring land ▪ Dense commercial air traffic area ▪ Pinelands Commission ▪ Mil-con $s limited – priority for mil-con undetermined ▪ Congested Frequency environment ▪ Wildfire potential from Smoky SAM and self-protection flares ▪ Congressional Tasking

C. Vision

C-1. Vision Statement

The transformation vision of WGR is to a multi-command training site, in which users in current and future airframes, can fight their way through a robust threat array in W107 and employ air-to-surface weapons (training or simulated) against a realistic and evolving target array in R5002, conduct airlift operations to an austere field while defending against realistic threats and providing top quality training to JFACs, Special Forces, and Homeland Defense and First Responder personnel.

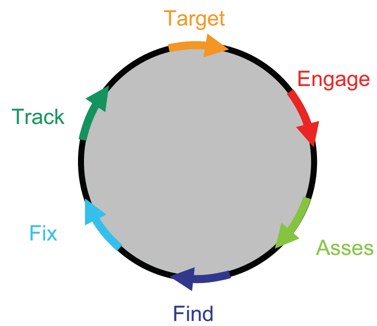
C-2. Future Capabilities

The following future capabilities are necessary for WGR to accommodate changing missions, modified tactics, and new weapons systems (capability / investment area):

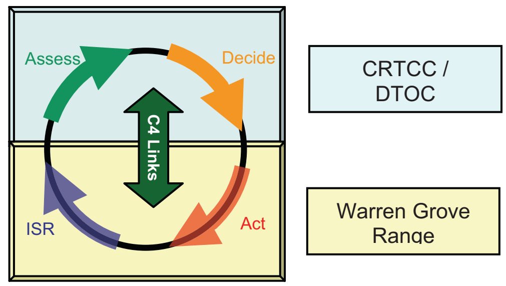
- Reliable low-end threat emitters for EP training (Integrated Air Def/Counter Air Systems)
- Modular and radar/thermal signature Red and Blue Force target systems (Targets and Target Arrays)
- Remote firing capability for Smoky SAMS (Integrated Air Def/Counter Air Systems)
- GPS integrated to support mobile target and no-drop scoring (Scoring and Feedback Systems) (Integrated Air Def/Counter Air Systems)
- Dynamic yet predictable restricted airspace connecting R-5002 with W-107 Warning Area
- Airspace that will support high altitude release of unguided bombs, inert LGBs, and simulated IAMs
- Infrared SAM simulator (Integrated Air Defense/Counter-Air Defense Systems)
- Connectivity to CRTCC and DTOC for Distributed Mission Operation (DMO)'s "network centric" training. (Communications)
- Complete SADL coverage of training airspace to accommodate air and ground users. (Communications)
- High quality No-Drop Bomb Scoring capability (Scoring and Feedback Systems)
- Homeland Defense / First Responder ground training environment

C-3. Range Focus

The vision for future development is for WGR to evolve to provide a training environment where current and future air and ground warfighters can execute as much of the F2T2EA warfighting cycle as possible (Find, Fix, Track, Target, Engage, and Assess) with realistic scenarios on realistic target arrays.



F2T2EA Cycle



IADA Cycle

The focus is to produce a relevant range where users can execute ISR and Act phases on an every-day basis while providing the infra-structure necessary for advanced training opportunities utilizing C4 links to effect Assessment and Decision phases of the cycle.

C-4. Range Goals

The overarching goals for Warren Grove Range are (FY, Investment Area):

1) Provide mobile target training opportunities (FY-09, Land, Environment, Targets)

2) Provide NTISR training opportunities (FY-08, Airspace, Targets, Scoring and Feedback Systems, Communications)

3) Provide first responder training opportunities (FY-09, Land, UXOs, Targets, Management)

4) Provide next generation aircraft systems training opportunities (FY-11, Land, Airspace, Targets, Communication, Scoring and Feedback Systems)

5) Support training in ISR and Act segments of the IADA Cycle (FY-08, Airspace, Scoring and Feedback Systems)

6) Support training in Assess and Decide segments of the IADA Cycle (FY-10, Scoring and Feedback Systems, Communication Systems, Management)

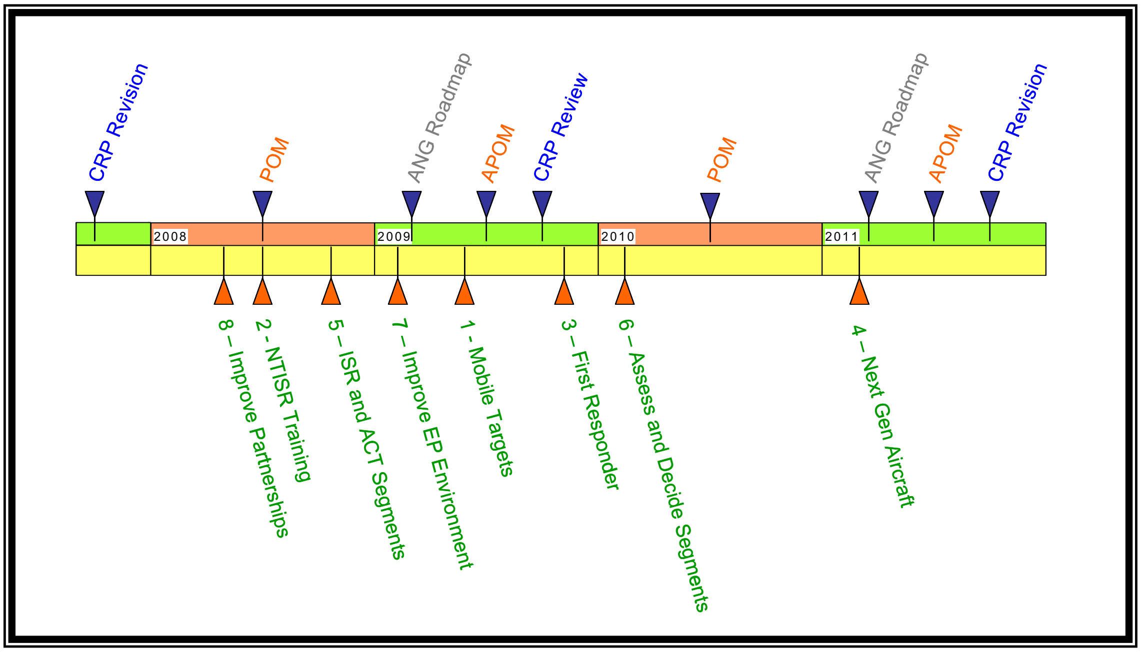
7) Improve EP training environment for CAF, AMC, and non-traditional users (FY-09, Airspace, IADS/CADS)

8) Improve regional joint, interagency, and community partnerships (FY-08, Environment, Targets, Management)

D. Strategy

D-1. Time Phased Investment Program

A time-phased investment program approach in concert with AF/A3O-AR Relevant Range Review Cycle is used as a tool to achieve objectives and reach overarching goals. The timeline below depicts desired projection toward completion of overarching goals to outline and prioritize resource requirements necessary to meet objectives and attain goals.



Phased Investment Timeline

D-2. Investment Area Objectives (FY, Goal):

Land

- Maximize REPI program to consolidate ownership of lands neighboring WGR (FY-09, Goals 3, 4)
- Establish easement on and 'otherwise control' neighboring lands increasing land available for footprint safety zones (FY-11, Goals 1, 4)
- Restrict access to 'otherwise controlled' property for future weapon and weapon system operations (FY-11, Goal 4)

Airspace

- Integrate GARS in airspace activation processes (FY-08, Goal 2)
- Define additional airspace proposals in GARS (FY-09, Goals 2, 4)
- Develop dynamic yet predictable airspace (ATCAA) proposal for airspace connection between R-5002 to W107 (FY-11, Goals 4,5)
- Revise VR-1709 operating hours to include operations from sunrise to 2000L (FY-09, Goal 7)

Environmental
- Partner in East Plains Regional Fireshed Management Plan (FY-08, Goal 8)
- Realize Joint Land Use Study (FY-08, Goal 8)
- Maximize land management effects of REPI (FY-09, Goal 1)

UXO/Residue Removal
- Develop AFSA approved sub-scale practice munition gathering process (FY-09, Goal 3)

Physical Plant (continuous, supports all goals)
- Construct range residue facility
- Construct target fabrication facility
- Construct new tower and cab facility

Scoring / Feedback Systems
- Obtain laser scoring system (FY-08, Goals 2, 5)
- Obtain Rover down-link capability (FY-09, Goals 2, 6)
- Obtain no-drop scoring system (FY-11, Goals 2, 4, 5)
- Integrate GPS to support mobile target and no-drop scoring (FY-11, Goals 1, 4, 5)

Communication Systems
- Implement VOIP phone system to reduce bandwidth load on T-1 line (FY-08, Goal 6)
- Obtain SADL radio and Gateway connectivity through microwave direct to 177th FW/CP (FY-08, Goal 6)
- Obtain SIPRNET capability (FY-09, Goals 2, 4, 6)
- Establish security system and processes to support cryptographic programs (FY-09, Goals 2, 4, 6)
- Obtain connectivity to CRTCC and DTOC for Distributed Mission Operation (DMO)'s 'network centric' training (kill chain training) (FY-10, Goals 2, 6)
- Complete SADL coverage of training airspace to accommodate air and ground users (FY-08, Goals 1, 2, 6)

IAD/CADS
- Obtain reliable low-end threat emitters for EP training (FY-09, Goal 7)
- Obtain remote firing capability for Smoky SAMS (FY-09, Goal 7)

Targets
- Obtain and implement high fidelity target arrays (FY-11, Goals 4, 5)
- Develop NTISR / TCT/TST mobile target training arrays and programs for user NTISR training (FY-08, Goals 1, 2)
- Obtain target arrays that support organic sensor platforms (FY-11, Goal 4)
- Obtain no-drop simulated weapons delivery scorable target arrays (FY-11, Goals 4, 5)
- Obtain modular and radar/thermal signature Red and Blue Force target systems (FY-09, Goals 2, 4, 5)
- Infrared SAM simulator (FY-10, Goals 4, 7)
- Homeland Defense / First Responder ground training environment (FY-09, Goals 3, 8)

Management

- Implement Center Scheduling Enterprise (FY-09, Goals 3, 6)
- Force manage for projected losses (FY-09, Goals 3, 6, 8)
- Establish ASOS liaison / POC for synergistic effects from local ASOS / JF training environment (FY-10, Goals 1, 2, 3, 8)
- Establish target development team across ANG ranges to effect fifth generation PTR target types and arrays (FY-09, Goal 4)

D-3. Managing Progress

Investment area objectives support overarching vision goals. Successful completion of objectives and corresponding goals is achieved through leveraging WGR strengths to take advantage of opportunities while minimizing weaknesses to avoid potential threats to success. Oversight of completion of objectives and subsequent attainment of goals is accomplished through quarterly review of objective status and annual review / revision of the time-phased investment program.

Attainment of many WGR objectives are dependant upon availability of resources both internal and external to range operations. Support from the 177th FW, NJANG, NGB, and ACC will be required to successfully complete objectives and reach overarching goals. The ROA is responsible for identifying required resources to appropriate external agencies and modifying timelines as necessary when resources are committed or are not available to meet objectives IAW the above strategy

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E. CRP Supporting Documents

The following supporting documents are available electronically on the Warren Grove Range network file server:

177th FW/Det 1 Range Operating Instruction ROI 10-01, March 2008

177th FW/Det 1 Sup 1 to AFI 13-212, Range Planning and Operations, October 2007

AFI 32-3006: *Explosive Ordnance Disposal Operations on Warren Grove Bombing/Gunnery Range*

Biological Survey at Warren Grove Range, NJ, 12 June 1997

Compliance Site Inventory and Compliance Assurance and Pollution Prevention Management Action Plan for the Atlantic City, NJ Air National Guard, October 2000

Cultural Properties Evaluation: Warren Grove Gunnery Range, NJANG, February 2001

Drexel University Memorandum of Understanding, October 2007

East Plains Fireshed Region Hay Road Project, February 2008

Environmental Assessment: Military Training Use of the Air-To-Ground Weapons Range at Warren Grove Gunnery Range, September 2000

Environmental Baseline Survey: 177 FW, NJANG (Coyle Field Drop Zone), May 2001

Federal Aviation Administration Letter of Procedure for R-5002, January 1999

Integrated Natural Resources Plan, December 2006

NJ Pinelands Commission Comprehensive Management Plan

Warren Grove Range Pinelands Commission Cooperative Agreement and Land Management Plan, January 1985

Warren Grove Range R-5002 Course Rules Briefing and Roadshow, October 2007

Wildland Fire Mitigation Plan, March 2008

Wildlife Hazard Assessment: Warren Grove Air-To-Ground Range, conducted and written in 2000 by The USDA Animal and Plant Health Inspection Service, Wildlife Services

The following referenced Figures are available electronically on the Warren Grove Range network file server:

F-1 Range Diagram

F-2 Airspace Diagram

F-3 REPI Parcels

F-4 GARS Map

F-5 EOD Maps

F-6 Target Diagram

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F. Acronyms

ACC	Air Combat Command
ACY	Atlantic City IAP
AFB	Air Force Base
AFREP	Air Force Real Estate Program
AFSA	Air Force Standards Agency
AMC	Air Mobility Command
ANG	Air National Guard
ARMAG	Armory Magazine
ARTCC	Air Route Traffic Control Center
ASOS	Air Support Operations Squadron
ATCAA	Air Traffic Control Assigned Airspace
BDU	Bomb, Dummy Unit
CAD	Computer Aided Design
CAF	Combat Air Forces
CCD	Charge-Coupled Device (electro-optical device)
CD	Compact Disk
CMP	Pinelands Comprehensive Management Plan
CRP	Comprehensive Range Plan
CRTC	Combat Readiness Training Center
CSAR	Combat Search and Rescue
CSE	Central Scheduling Enterprise
DANG	Delaware Air National Guard
DEAD	Destruction of Enemy Air Defenses
DMO	Distributed Mission Operation
DNCO	Duty Non-Commissioned Officer
DRMO	Defense Re-utilization Management Office
DTOC	Distributed Training Operations Center
EA	Electronic Attack
EOD	Explosive Ordnance Disposal
EP	Electronic Protection
EPRF	East Plains Regional Fireshed
F2T2EA	Find, Fix, Track, Target, Engage, and Assess
FAA	Federal Aviation Administration
FLIP	Flight Information Publication
FM	Frequency Modulation
FOMA	Facility Operations and Maintenance Activities
FW	Fighter Wing
GARS	Global Area Reference System
GIS	Arc-Geographic Information System
GPS	Global Positioning System
HARB	High Altitude Release Bomb
IADA Cycle	ISR, Act, Decide, Assess Cycle
IADS	Integrated Air Defense System
IAMs	Inertially Aided Munitions

IAP	International Airport
IDS	Intrusion Detection System
IED	Improvised Explosive Device
INRMP	Integrated Natural Resources Management Plan
IR	Infrared
IZLID	Infrared Zoom Laser Illuminator Designator
JF	Joint Forces
JFAC	Joint Forward Air Controllers
JMGT	Joint Modular Ground Target
JRE/JTEP	Joint Range Extension / Joint Range Extension TMPG Package
JSF	Joint Strike Fighter
LAN	Local Area Network
LGBs	Laser Guided Bombs
LMR	Land Mobile Radio
MOA	Military Operations Area
MOUT	Military Operations in Urban Terrain
MPPEH	Material Potentially Possessing Explosive Hazard
NCOIC	Non-Commissioned Officer in Charge
NGB	National Guard Bureau
NJANG	New Jersey Air National Guard
NJCF	New Jersey Conservation Foundation
NJSFFS	New Jersey State Forest Fire Service
NM	Nautical Mile
NTISR	Non-Traditional ISR
NVD	Night Vision Device
O&M	Operation and Maintenance
PGM	Precision Guided Munition
POL	Petroleum
QA	Quality Assurance
RCIED	Remote Control IED
REPI	Readiness and Environmental Protection Initiative
RMAST	Range Management Software Tool
ROA	Range Operating Agency
ROI	Range Operating Instruction
ROO	Range Operations Officer
RPV	Remotely Piloted Vehicle
RWR	Radar Warning Receiver
SADL	Situational Awareness Data Link
SAM	Surface-to-Air Missiles
SCUD	Western Name for Early Soviet Missile Series
SEAD	Suppression of Enemy Air Defenses
SIPR	Secret Internet Protocol, Routed
SOFLAM	Special Operations Forces Laser Marker
SOP	Standard Operating Procedure
SRM	Sustainment, Refurbishment, and Maintenance
SSE	System Support Equipment

SSS	Smokey SAM Simulator
STU/STE	Secure Telephone Unit / Equipment
SUA	Special Use Airspace
SWOT	Strengths, Weaknesses, Opportunities, and Threats
T&E	Threatened and Endangered
TBD	To Be Determined
TCT/TST	Time Critical/Sensitive Tasking (Target)
TP	Training Projectile
UAS	Unmanned Aircraft System
UCAV	Unmanned Combat Air Vehicle
UGB	Un-guided Bomb
UHF/VHF	Ultra/Very High Frequency
USAF	United States Air Force
NAS	Naval Air Station
USCG	United States Coast Guard
USMC	United States Marine Corps
USN	Unites States Navy
UXO	Un-exploded Ordnance
VBIED	Vehicle Born IED
VOIP	Voice Over Internet Protocol
WGR	Warren Grove Range
WISS	Weapons Impact Scoring System
WRI	McGuire AFB

Warren Grove Range

Risk Mitigation Plan

4 Jan 08

Table of Contents

Section A - Executive Summary

Overview

Warren Grove Range (the range), located within restricted airspace designated as R-5002, is managed and operated by the 177th Fighter Wing. Entry into the airspace is restricted to provide approved users with a controlled environment in which to train for military and non-department of defense operations in support of military missions including Homeland Defense and the Global War on Terror. The range includes over 9,400 acres of federally owned/controlled land which is secured from public access to prevent inadvertent entry by unauthorized personnel.

In continuous operation since 1942, Warren Grove Range provides critical training opportunities for a variety of governmental agencies including the US Air Force, US Navy, US Army, the Air and Army National Guards, and other department of defense, federal, and state users. The use of Warren Grove Range and R-5002 is an important component for the training of federal forces in their mission of defending the US at home and overseas. The continued use of Warren Grove Range is contingent upon the ability to apply safety measures and risk management procedures to the existing range operations. The range's close proximity to civilian populations and the New Jersey Pinelands increases the need to insure safety considerations and minimize risk to civilians and their property adjacent to the range.

Objective

The objective of this Risk Mitigation Plan is to identify a comprehensive set of command and control procedures aimed at reducing the potential for mishaps at the range. These procedures will be strictly enforced by both the NJ Air National Guard and by all agencies engaged in training missions at the range.

- *This will demand changes in leadership, changes in procedures and rigorous education and training, both initial and ongoing.*

Four Pillars of Risk Mitigation

Minimizing Warren Grove Range operating risk can be accomplished through four essential, interrelated pillars of risk management (detailed in Section B):

1. Reorganization and restructuring of the range Command and Leadership
2. Development and strict enforcement of operating procedures focused on approval processes, communications, and fire risk mitigation
3. Quality assurance procedures and oversight to ensure user compliance with range operating procedures
4. Extensive training at all levels aimed at fostering a culture of safe range operations

Approval

This plan will be coordinated with and approved by all of the following offices: the Commander of the New Jersey Air National Guard, The Adjutant General, New Jersey National Guard, New Jersey Governor's office, the Director of the Air National Guard, and the United States Air Force.

Action Items for Implementation

The items listed below briefly describe the actions necessary for the successful implementation of the mitigation plan (detailed in Section C):

1. Reorganize the Warren Grove Range Command Structure
2. Increase oversight and quality assurance procedures for daily range operations
3. Restrict the types of devices that may be used for training at the range
4. Implement an extensive education program for all units and agencies utilizing the range
5. Institute a two-way communications process to restrict range use to users who have been fully briefed concerning the hazards of operation for current day use of the range
6. Increase resources allocated for safe range operations including improved training of range monitor personnel
7. Embed a safety specialist at the Warren Grove Range
8. Increase the timeliness and size of the response force when fire is possible or probable

Conclusion

Warren Grove Range is the busiest range in the Air National Guard inventory and is considered an extremely important resource for aerial and ground training vital to the defense of the United States. Both the Air Force and the Air National Guard support the re-opening of the range. By implementing new safety, communication, and operational procedures, it is possible to minimize risks to the immediate and surrounding areas, while maintaining an essential training resource.

Section B - The Four Pillars of Risk Mitigation

1. Organizational and Leadership Changes

a. Leadership: Changes in leadership were made to effect a change in unit culture focusing on range safety, compliance with governing directives, stewardship of critical assets, and risk mitigation. The following leadership changes were made within the 177th Fighter Wing:

1) Vice Wing Commander
   Formerly a Group Commander, the new Vice Wing Commander has significant experience in both the Maintenance and Support groups, and has become familiar with the operation over 25 years.

2) Operations Group Commander
   Formerly the Operations Support Flight Commander, the new Group Commander has over 3000 hours in various fighter and attack aircraft. He is current and qualified in the general purpose mission with significant surface attack experience, and is formerly qualified as a Forward Air Controller.

3) Warren Grove Range Commander
   Formerly the Chief of Operations Group Standardization / Evaluation, the new Range Commander has over 3,000 hours in the F-16 and has been an Air-to-Ground Instructor Pilot for many years. He is also a Forward Air Controller with significant Close Air Support experience.

4) Warren Grove Range Control Officer
   Formerly a Marine, the new Range Operations Officer has significant Surface Attack experience, to include operating with Terminal Area Control Party in both aerial and surface roles.

5) Wing Safety Officer / Flight Safety Officer
   A qualified Flight Safety Officer and graduate of Safety School has been appointed to the position of Wing Safety Officer.

6) A ground safety specialist will be assigned fulltime to the Warren Grove Range
   A qualified ground safety officer has been detailed to the range pending hiring of permanent personnel to position

b. Organization: The Warren Grove Range has been removed as a Detachment assigned directly to the Wing Commander supervised by the Vice Commander and has been placed under the supervision of the Operations Group Commander.

1) Reorganization places all operational elements in the 177th Fighter Wing under the Operations Group Commander's supervision and responsibility.

2) Placing Warren Grove Range in the Operations Group facilitates meeting the support requirements of the range – group commander support necessary for

successful inter-agency, inter-group, and inter-wing coordination better met with reorganization.

3) Operational Risk Management and Safety measures applied to the Operations Group have been incorporated in Warren Grove Range Operations.
4) The Operations Group Commander supervises the Warren Grove Range Commander to guarantee that the range rapidly identifies and resolves operational problems and issues.
5) Warren Grove Range is now viewed as part of the Operations community and, as such, afforded better access to personnel and resources.
6) As the primary range user, the Operations Group takes pride in ownership of the Warren Grove Range.
7) Unity of Command fosters improved communications between range user and range management personnel, correcting the Accident Investigation Board's highlighted problem of inadequate communications.

2. Changes to Procedures at Warren Grove Range and 177th Fighter Wing

a. Changes to Warren Grove Range operating procedures have been made to mitigate risk of wildfire and other potential range mishaps. The culture of range operations has changed from one of "approved until prohibited" to one of "prohibited unless approved." Requirements for user coordination with range operations for events and expenditures have been clarified and delineated. The critical impact of this culture change is that there is a prohibitive response in the event of any communications failure (see Appendix 7).

b. These changes include but are not limited to the following measures (refer to Appendix 6 for detailed description of aircraft expendable devices referenced below):
   1) Prohibit the use of aircraft flares
   2) Prohibit the routine use without prior, written approval of rockets and surface-to-air simulator devices
      a) This measure would effectively restrict use of any device that emits a spark or charge
      b) Exceptions to permit use of rockets and surface-to-air simulator devices will be made on a case-by-case basis and may include pre-deployment Tactical Air Control Party training, weapons allocations and availability, and night operations
      c) Rockets and surface-to-air simulator devices may only be approved for use when the range Fire Danger Classification is 1, 2, or 3
      d) The authority to approve the use of rockets or surface-to-air simulator devices rests with the 177th Fighter Wing Commander

e) Exceptions to permit use of rockets or surface-to-air simulator devices must be made in writing and reported along with device expenditure(s) as required by governing directives.

3) Range control officers are prohibited from requesting aircrew to perform actions which have not been planned and coordinated unless those actions are necessary for safe range operation or range control operator training

4) Embed a Ground Safety Specialist at Warren Grove Range

    a) A senior non-commissioned officer at the range has attended Safety School and functions as an on site Safety Monitor. This individual is tasked to identify and pre-empt potential safety issues and serve as the Commander's "safety" eyes on the range.

    b) The specialist is responsible for monitoring range control officer training and evaluation as required by governing directives.

    c) ***This specialist is in place as a pre-requisite to the re-opening of the range.***

5) Increased oversight and quality assurance procedures for daily range operations have been implemented

    a) The Range Commander or designated representative will brief 177th Fighter Wing leadership on range safety metrics in addition to all range reports and data currently required by governing directives

    b) Warren Grove Range utilization metrics will include the number and type of weapons, number and type of aircraft, range mission cancellations, and airspace denials

6) Institute mandatory Operational Risk Management procedures at the Warren Grove Range with a focus on wildfire potential

    a) The range control officer will ascertain the range fire condition and employment restrictions prior to commencing range operations

    b) Employment restrictions will be passed to range users, along with the altimeter setting, upon initial check-in prior to users being permitted to enter range airspace

    c) Receipt of fire condition and employment restrictions must be acknowledged by aircrew prior to expenditure of any device on the range

7) Institute requirement for written and/or verbal communications between Warren Grove Range personnel and user personnel for all units utilizing the range on a daily basis (see Appendix 7 for coordination/communication requirements flow diagram)

    a) A standardized range mission profile sheet for all Warren Grove Range users will be completed prior to users being granted permission to enter the range airspace. This sheet will include aircraft type, number/type of expendables, approval for required devices (as appropriate), and planned/ alternate delivery events

b) The range control officer is responsible for ensuring the mission profile sheet is complete prior to employment of any expendables.

c) Range personnel will inform range user supervisors of range fire conditions and restrictions prior to users being permitted to enter range airspace

d) Range personnel will inform range user supervisors of any changes to fire conditions or range restrictions (as applicable) prior to users being granted permission to enter range airspace

e) Two-way communication is required between all scheduled range users and the Range Control Officer, Duty Non-commissioned Officer, or designated representative prior to users being granted permission to enter range airspace

f) Confirmation of applicable fire conditions, range restrictions, aircraft expendable devices, and planned events is required prior to users being granted permission to enter range airspace

g) Lack of appropriate coordination outlined above will result in denial of approval to utilize Warren Grove Range

8) Incorporate guidance into the Warren Grove procedures and regulations to eliminate the potential for bullet impact outside federally owned property

a) Forward firing weapons will be mechanically or electrically inhibited, or "safed," until the weapon is pointed in a direction that will allow expendable devices to land within the range impact area (federally owned land designated for weapons impact)

b) For aircraft with a gun or a cannon, aircrew are prohibited from selecting the gun weapon system while the Master Arm switch is in the "Arm" position until the gun is aimed at the ground within the impact area

c) Aircrew are prohibited from pointing a gun that is neither electrically nor mechanically "safed" at any manned location

9) Develop detailed fire prevention and response plan to mitigate fire risk potential and standardize fire fighting response for incidental fires on Warren Grove Range (see Appendix 5 for Wildland Fire Prevention and Response Plan)

a) Delineate guidelines to aid in prevention, containment and suppression of range wildland fires.

b) Plan incorporates fire prevention, general fire response guidance, selective fire response guidance, response plan for incidental fires outside range property, and aviation fire fighting response guidance

c) For any fire that occurs as a result of range operations, the following guidance will be followed:

- Warren Grove Range personnel will immediately contact NJSFFS and coordinate appropriate fire fighting response
- Range operations cease with all attention and range fire fighting assets directed at controlling/extinguishing fire
- The range control officer will coordinate fire fighting response as the initial incident commander until relieved by the NJSFFS incident commander
- During fire fighting response, no personnel shall be permitted to enter the Range Complex without the ability to maintain constant two-way communication with the range main tower and/or the Incident Commander's established base of operations
- A selective response plan for fire fighting response will be executed as outlined in Appendix 5

3. Assuring Compliance with Range Operating Procedures

a. Procedural changes to range and user operational procedures will not mitigate range operations risk nor will it improve range safety without assurance that users are aware of, and can comply with, range restrictions and operating requirements. To assure user compliance with the Warren Grove Range operating instructions, the 177 Fighter Wing:

   1) Developed and implemented a range procedures briefing (course rules brief – see Appendix 8) for all users; individual users must receive the briefing prior to utilizing Warren Grove Range

   2) Provides "road show" academics on range procedures on an as requested/desired basis

   3) Developed and implemented a standardized range procedures examination for all users; individual users must successfully complete the examination prior to being granted permission to utilize the range

   4) Successfully completed a National Guard Bureau staff assistance visit October 15th – 19th validating range operations, safety measures, and compliance with governing instructions

b. Range procedures briefing and examination are updated and provided to users as required to address changes to operating procedures

c. User units are required to provide range operations a list of users who have completed the range procedures briefing and passed the range procedures examination. Failure to complete the briefing, pass the examination, or failure of the unit to provide information confirming the above is cause for range denial.

4. Extensive Training at all Levels Aimed at Fostering a Culture of Safe Range Operations

The three preceding Pillars are applicable to all Warren Grove Range users and will mitigate risk for the range itself. This final Pillar of risk mitigation is directed towards mitigating risk for 177th Fighter Wing flight operations regardless of range/airspace being utilized for training. The Accident Investigation Board president concluded the cause of the mishap fire was pilot error – a failure of a 177th Fighter Wing pilot to comply with established range restrictions. This Pillar emphasizes that risk mitigation starts and ends with the pilot in command.

a. The 177th Fighter Wing Operations Supervisor or Supervisor of Flying must contact the range control officer or duty non-commissioned officer before the first flight of the day to obtain Range conditions and restrictions. Lack of coordination prohibits 177th Fighter Wing assigned or attached pilots use of Warren Grove Range.

b. Implemented a directed review of range operating procedures and applicable Air Force governing instructions and training rules with specific emphasis on minimum altitude requirements, fire condition procedures, simulated weapons employment restrictions, and flight briefing requirements.

c. Established a prohibition of Show of Force and other undefined maneuvers either on or off-range. Events otherwise undefined must be defined in writing prior to execution before being executed by 177th Fighter Wing assigned/attached pilots.

d. The Operations Group Commander has restricted flying training to basic operations until the wing completes the F-16 Block 25 to Block 30 aircraft conversion.

e. Executed a commander's briefing detailing the risks associated with expenditure of any item from the aircraft and the critical nature to ensure compliance prior to expenditure.

f. Implemented range safety operational risk management as directed into mass, flight, and step briefings.

Section C – Action Items for Implementation

Action items were identified as necessary to achieve the Four Pillars of Risk Mitigation in Section B. Action items provided a focus for implementing change and were deemed critical to achieving a sustainable culture of safe range operations. Detailed description of results from action items can be found in the respective Pillars of Section B.

1. [Pillar I] Reorganize the Warren Grove Range Command Structure
    a. Replace key leadership positions within Warren Grove Range and those with direct oversight of range and flight operations
    b. Remove the range as a Detachment of the 177th FW and place it directly under the supervision of the 177th FW Operations Group Commander providing closer supervision of range operations

STATUS – COMPLETED

2. [Pillar I and II] Increase oversight and quality assurance procedures for daily range operations
    a. Develop utilization and range safety metrics to include number and type of weapons, number and type of aircraft, range mission cancellations, and airspace denials
    b. Brief 177th Fighter Wing leadership on range safety metrics in addition to all range reports and data currently required by governing directives

STATUS – COMPLETED

3. [Pillar II] Restrict the types of devices that may be used for training at the range
    a. Prohibit the use of aircraft flares
    b. Prohibit the routine use of other devices that have the potential to create a spark which may ignite combustible materials
    c. Modify arming procedures to eliminate the likelihood of off-range weapons release

STATUS – COMPLETED

4. [Pillar III] Implement an extensive education program for all units and agencies utilizing the range
    a. Develop range procedures briefing
    b. Develop "road-show" academic program for primary users and other users upon request
    c. Develop and implement range rules examination requirement

STATUS – COMPLETED

5. [Pillar II and IV] Institute a two-way communications process to restrict range use to users who have been fully briefed concerning the hazards of operation for current day use of the range
    a. Develop and institute mandatory pre-mission coordination requirement and process
    b. Develop and implement range mission profile sheet to document coordination completion and provide range personnel with mission data required for safe range operations
    c. Develop coordination process which ensures coordination/communication failures result in disapproval to enter range airspace
    d. Develop feedback mechanisms for user operations supervisors to ensure range conditions/restrictions changes are delivered to aircrew

STATUS – COMPLETED

6. [Pillar I and II] Increase resources allocated for safe range operations including improved training of range monitor personnel
    a. Develop and implement formal training programs for range duty positions to include Range Control Officer, Tower Operators, Ground Crew, and Duty NCO
    b. Successfully execute NGB Staff Assistance Visit and correct noted deficiencies or non-compliant items

STATUS – COMPLETED

7. [Pillar I and II] Embed a safety specialist at the Warren Grove Range

STATUS – COMPLETED

8. [Pillar II] Increase the timeliness and size of the response force when fire is possible or probable
    a. Clearly define range fire fighting response capabilities
    b. Obtain additional fire fighting equipment to enhance range personnel ability for immediate fire fighting response
    c. Improve range fire break, fire lane, fire line system
    d. Establish procedures to facilitate NJ Army Guard aviation fire fighting aid during NJSFFS response as required

STATUS – COMPLETED

9. [Pillar IV] Develop range restrictions and operations re-training and supervision program for 177th FW assigned and attached pilots
    a. Direct a review of range operating procedures and applicable Air Force range directives
    b. Brief aircrew on risks of all potential aircraft expenditures
    c. Implement range safety operational risk management as directed into mass, flight, and step briefings
    d. Implement 177th FW mandatory range coordination process

STATUS – COMPLETED

Section D - Ten Point Summary of Risk Mitigation Plan

1. **Re-align the chain of command for the Warren Grove Range to report to the 177th Fighter Wing Operations Group Commander and implement changes in leadership for the range and the operations group.**
   What: Addresses the communications issue with the operations personnel in all mission planning.
   Why: Eliminates the possibility of deviations in mission planning that are not properly communicated to all personnel concerned both range and operations.
   When: Accomplished prior to re-opening the range.
   STATUS – COMPLETED

2. **Embed a full-time Ground Safety Specialist at Warren Grove Range (WGR)**
   What: Trained Air Force professional Ground Safety Specialist.
   Why: Identify and pre-empt potential safety issues serve as commander's "safety" eyes on the range.
   When: Safety Specialist must be in-place prior to the re-opening of Warren Grove Range.
   STATUS – COMPLETED

3. **Institute new mandatory Operational Risk Management procedures at the Warren Grove Range with a focus on wildfire potential and a risk assessment as part of the Operational Risk Management worksheet. Educate all other users on the requirements for utilizing the range. Develop and implement a standardized range procedures examination for all users.**
   What: Wing and range procedures that specifically focus the user on that day's range wildfire potential.
   Why: Ensures an active redundant ORM program for all range users and range control personnel.
   When: Immediately upon resumption of training missions at Warren Grove Range
   STATUS – COMPLETED

4. **Eliminate the use of flares and limit the routine use of rockets and smokey SAM simulator devices unless approved by the 177th Fighter Wing Commander.**
   What: Eliminate aircraft flares. Prohibit the use of rockets and surface-to-air simulators without approval by the 177th Fighter Wing Commander. Approval may only be granted under during Fire Danger Classification 1, 2, or 3
   Why: Will minimize the potential of an inadvertent wild fire as a result of range operations.
   When: Immediately upon resumption of training missions at Warren Grove Range
   STATUS – COMPLETED

5. **Eliminate all show of force maneuvers unless required by Air Force training.**
   What: Eliminate the ability for any show of force maneuver regardless of the training unless specifically required by the Air Force for pre-deployment training. This is currently not required and if performed must be approved by the 177th Wing Commander.
   Why: Minimizes the potential for risks associated with high performance maneuvers.
   When: Immediately upon resumption of training missions at Warren Grove Range (WGR). **STATUS – COMPLETED**

6. **Increase daily oversight at the range. Modify range operating instructions and procedures to reflect clear, written and/or verbal communications between the Warren Grove Range personnel and the 177th Fighter Wing Operations Group personnel for all units utilizing the range for training on a daily basis. These communications must be acknowledged and approved by the Range Control Officer. Policies must clearly reflect that the Range Control Officer cannot request an event.**
   What: Written procedures must be clear, concise and unambiguous.
   Why: Operating procedures must be clear to implement all changes and lines of communications at the Warren Grove Range.
   When: Accomplished prior to re-opening the range.
   STATUS – COMPLETED

7. **Incorporate guidance into the Warren Grove procedures and regulations to reduce the likelihood of a bullet impact outside federally owned property.**
   What: Any forward firing ordnance will be mechanically or electrically inhibited, or “safed,” until the weapon is pointed in a direction that will allow any ordnance fired to land within the Warren Grove impact area.
   Why: For aircraft with a gun or a cannon, the gun will not be selected while the Master Arm switch is in the “Arm” position until the gun is aimed at the ground within the impact area. At no time will an armed gun be pointed at a manned site.
   When: For immediate implementation.
   STATUS – COMPLETED

8. **National Guard Bureau to facilitate a staff assistance visit in October and visits to other Air National Guard ranges for the Warren Grove Range Commander and the Range Control Officer to observe and be certified in range operations and procedures.**
   What: Range personnel will visit two other Air National Guard ranges to compare Warren Grove Range procedures with other well established ranges that have zero mishaps.
   Why: Allows personnel to glean Best Practices from other ranges
   When: Accomplished prior to re-opening the range.
   STATUS – COMPLETED

9. **Work with the Air National Guard Director to place the Warren Grove Range at the top of the list of the Air Force program for Range Modernization.**
   What: This program creates bombing ranges where training can be accomplished without actually dropping practice ordnance.
   Why: Increases safety and decreases the potential for incidents.
   When: Begin coordination with the National Guard Bureau as program comes on line.

STATUS – IN PROGRESS

10. **Conduct a comprehensive joint land use study**
    What: Examination of the compatibility of range activity and private property interests in the WGR area.
    Why: Identify and mitigate potential incompatibilities to ensure Warren Grove Range is a good neighbor.
    When: Legislative process is progressing.

STATUS – IN PROGRESS

[redacted]

Appendix 1

Glossary of References and Supporting Information

References

177FW/Det 1 Sup 1 to AFI 13-212, *Warren Grove Range Operations*

AFI 11-202V3 *General Flight Rules*

AFI 11-214, *Air Operations Rules and Procedures*

AFI 11-2MDS *Operations Procedures*

AFI 13-212V1, V2, V3, *Range Planning and Operations*

AFM 91-201, *Explosives Safety Standards*

Air Force Occupational and Environmental Safety, Fire Protection, and Health (AFOSH), AFI 91-301

Integrated Natural Resources Management Plan (INRMP) for the Warren Grove Range

Major Range and Test Facility Base, DoDD 3200.11

Operational Risk Management, Air Force Policy Directive 90-9

T.O. 11L1-2-23-1, Smokey SAMs

US Air Force Aircraft Accident Investigation Board Report, F-16, S/N 83-1148, 177th Fighter Wing

US Air Force Mishap Prevention Program, AFI 91-202, 1 August 1998, ANG Supplement, 27 Jan 2006

"Wildlife Hazard Assessment" Warren Grove Air to Ground Range

Abbreviations and Acronyms

AFI – Air Force Instruction

BDU – Bomb, Dummy Unit

DNCO – Duty NCO

EOD – Explosive Ordnance Disposal

FAA – Federal Aviation Administration

FW – Fighter Wing

NCO – Non-Commissioned Officer

NJSFFS – New Jersey State Forest Fire Service

OG – Operations Group

RCO – Range Control Officer

SAM – Surface-to-Air Missile

SOF – Supervisor of Flying

SSS – Smokey SAM Simulator

WGR – Warren Grove Range

Glossary

Armed – Condition of a weapon system with all safety systems removed. In an "armed" state, devices can be expended when commanded by the pilot.

Bombing Range – (Weapons Range) federally controlled land certified for weapons deliveries in accordance with governing regulations. Unauthorized entry into WGR restricted by fencing, gates, and signage to prevent unauthorized entry into weapons impact area.

Bomb, Dummy Unit (BDU) – an inert training device used to simulate an actual weapon for training purposes, but which includes no explosive material

Cold-Spot – a training device that does not include a flash charge or produce any spark upon impact with the ground

Expendable – a device that can be expended or delivered from an aircraft to the ground

Incendiary – device specifically designed to ignite a fire upon ground impact

Incident Commander – On-scene individual maintaining general oversight responsibility of all activities controlling an incident

Impact Area – area on a bombing range containing all range targets and a minimum of 1,000 ft of land around all range targets.

Inert – weapon or expendable device that includes no explosive or incendiary material

Maneuver – prescribed aircraft actions commonly used in training operations

Non-Incendiary – device that is not designed to ignite fire upon ground impact

Ordnance – devices or weapons expended from aircraft

R-5002 – Restricted area above Warren Grove Range controlled by Warren Grove Range personnel.

Restricted Area – Airspace that is controlled to prevent unauthorized aircraft from entering without permission from controlling agency.

Safed – Condition of a weapon system with electrical and/or mechanical safety devices installed. In a "safed" state, devices cannot be expended when commanded by the pilot.

Summary of Changes to WGR RMP Appendices

18 Jan 08 to 26 Feb 08

Appendix 1

Modified Cold Spot definition – included chemical compound used to generate mark

Added Hot Spot definition

Added Pyrotechnic definition

Appendix 2

Deleted "and Smokey SAM threat simulators" from last bullet, para 4.

Deleted last three bullets (asterisked items) from para 6

Appendix 3

No changes

Appendix 4

Added appendix 6 numeration to bullet after first table

Removed bullet after second table (no longer differentiated operations by fire class as no fire danger devices included in plan)

Appendix 5

Deleted remainder of sentence after "in effect" of para 2.d.

Deleted para 2.e. and renumbered remaining paragraphs

Modified reference in para 2.g. (new 2.f.) from "unauthorized rockets, flares …" to "unauthorized devices"

Appendix 6

Deleted para 2.e. and 2.f.

Deleted para 3. and renumbered remaining paragraphs

Clarified chemical compound used in Cold Spot BDUs (para 4.d.4, new para 3.d.4.)

Deleted para 4.e.6. and 4.e.7. (new para 3.e.6 and 3.e.7). Replaced with new para "Not authorized on WGR"

Deleted para 4.f.5, 4.f.6. and 4.f.7. (new para 3.f.5, 3.f.6. and 3.f.7.). Replaced with new para "Not authorized on WGR"

Modified Table A6-1 – Approved Ordnance

Deleted para 5.b. and renumbered remaining paragraphs

Deleted note following Table A6-2

Appendix 7

Modified Figures A7-1 and A7-2 to comply with new recommended restrictions

Corrected Footer reference to Appendix 7 vs Appendix 12

Appendix 8

Modified verbiage on Slide 28 – Ordnance Restrictions

Modified verbiage on Slide 29 – Fire Class Restrictions (1, 2, or 3)

Modified verbiage on Slide 30 – Fire Class Restrictions (4 or 5)

Appendix 9

No Changes

Appendix 10

No Changes

Appendix 11

No Changes

Appendix 12

Reformatted page 3 to portrait view for better viewing

Appendix 13

Modified verbiage on Slide 15 – Point 4, authorized ordnance

Modified verbiage of first bullet on Slide 16 – Point 4, authorized ordnance

Modified table on Slide 16

Deleted last bullet on Slide 16

Modified verbiage on Slide 17 – Point 4, authorized ordnance

Deleted second and third bullets on Slide 27 – The Way Ahead

Appendix 1

Glossary of References and Supporting Information

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177FW/Det 1 Sup 1 to AFI 13-212, *Warren Grove Range Operations*

AFI 11-202V3 *General Flight Rules*

AFI 11-214, *Air Operations Rules and Procedures*

AFI 11-2MDS *Operations Procedures*

AFI 13-212V1, V2, V3, *Range Planning and Operations*

AFM 91-201, *Explosives Safety Standards*

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NJSFFS – New Jersey State Forest Fire Service

OG – Operations Group

RCO – Range Control Officer

SAM – Surface-to-Air Missile

SOF – Supervisor of Flying

SSS – Smokey SAM Simulator

WGR – Warren Grove Range

Glossary

Armed – Condition of a weapon system with all safety systems removed. In an "armed" state, devices can be expended when commanded by the pilot.

Bombing Range – (Weapons Range) federally controlled land certified for weapons deliveries in accordance with governing regulations. Unauthorized entry into WGR restricted by fencing, gates, and signage to prevent unauthorized entry into weapons impact area.

Bomb, Dummy Unit (BDU) – an inert training device used to simulate an actual weapon for training purposes, but which includes no explosive material

Cold-Spot – an inert training device which generates a temporary smoke mark with 17 cc's of titanium tetrachloride. Cold spots do not include a flash charge nor do they produce any spark upon impact with the ground. Cold spots are not incendiary nor are they pyrotechnic.

Expendable – a device that can be expended or delivered from an aircraft to the ground

Hot-Spot – a training device including a small flash charge, approximately the size of a shotgun shell, which produces a flash of light upon impact with the ground

Incendiary – device specifically designed to ignite a fire upon ground impact

Incident Commander – On-scene individual maintaining general oversight responsibility of all activities controlling an incident

Impact Area – area on a bombing range containing all range targets and a minimum of 1,000 ft of land around all range targets.

Inert – weapon or expendable device that includes no explosive or incendiary material

Maneuver – prescribed aircraft actions commonly used in training operations

Non-Incendiary – device that is not designed to ignite fire upon ground impact

Ordnance – devices or weapons expended from aircraft

Pyrotechnic – a device which includes materials capable of undergoing self-contained chemical reactions for the production heat or light. Example pyrotechnic devices include but are not restricted to non-incendiary rockets, Smokey SAM Simulators, and Hot-Spot BDUs.

R-5002 – Restricted area above Warren Grove Range controlled by Warren Grove Range personnel.

Restricted Area – Airspace that is controlled to prevent unauthorized aircraft from entering without permission from controlling agency.

Safed – Condition of a weapon system with electrical and/or mechanical safety devices installed. In a "safed" state, devices cannot be expended when commanded by the pilot.

Appendix 2

Background and History

1. The 177th Fighter Wing has been in existence since 1917 at the Newark Airport (as the 119th Flying Squadron) and at the Pomona location (outside Atlantic City) for 49 years. Currently, the unit flies the F-16C+ for the Air Sovereignty Alert and General Purpose missions, including Precision Guided Munitions delivery. The unit is currently in conversion to a more modern engine (Block 25 to Block 30). Because Atlantic City is uniquely positioned between New York City, Philadelphia, and the nation's capitol, (in less than 10 minutes) the 177th Fighter Wing routinely provides on-scene air dominance to our most vital population, political and economic centers.

2. The 177 Fighter Wing has continuously flown combat air patrol for Operation Noble Eagle since 11 Sept 2001. Overseas the 177th deployed support for Operation Enduring Freedom in Afghanistan and Operation Iraqi Freedom as well as participating in a rotational Air Expeditionary Force. The 177th Fighter Wing has won numerous awards and accolades, including many environmental awards, and has passed every scheduled inspection with exceptional or outstanding results. The 177th Fighter Wing is responsible for the operations at the Warren Grove Range.

3. The Warren Grove Range has been in continuous operation since 1942. It is located on 9,416 acres of Air Force land under license to the New Jersey Air National Guard and operations are limited to an impact area of 900 acres. The Warren Grove Range is the busiest range in the Air National Guard inventory.

4. Training capabilities include:

   - Practice bomb target array
   - Night training, Night Vision aided training
   - Scoreable strafe pits
   - No-drop, heat-seeking weapons targets
   - Laser-guided bomb target, laser marking target capability
   - Urban target array, mobile targets,
   - Helicopter gunnery and landing zone, airdrop on drop zones
   - Unmanned aerial vehicle training
   - Combat search and rescue training
   - Electronic threat emitters, and Smokey SAM threat simulators

5. Users include:

   - Air National Guard fighter units
   - Air Force transport and search and rescue units
   - Army Aviation, ground and UAV units
   - Marine Corps units
   - Coast Guard
   - Non-Department of Defense
   - Department of Justice and the FBI

6. Authorized Ordnance and Expendables (*asterisked items require prior approval from the 177th FW Commander) (see Appendix 6 for detailed description of expendable devices)

   - Inert heavyweight bombs (non-explosive, non-incendiary)
   - RR-188 training chaff
   - 30mm, 20mm, 7.62mm, and 50cal bullets (training rounds only, non-incendiary)
   - Practice bombs without flash marking charges
   - *Practice bombs with flash marking charges
   - *MK-66 2.75 inch rockets (inert training rounds only)
   - *Smokey SAM Simulators

7. There are ten personnel assigned with two officers—the Range Commander and a Range Control Officer. The Warren Grove Range has been the recipient of numerous awards: 2001/2004/2006 Air National Guard Natural Resources for an Installation and 2002 for a Team; 2002 Air Force General Thomas D. White for the Best Overall Environmental Program in the Air Force; 2000/2002/2004 Air National Guard Environmental Quality; and 2003 NJ Department of Environmental Protection (NJDEP) Environmental Award for Healthy Ecosystems.

8. Adjacent property owners are mostly State parcels managed by NJDEP Fish and Wildlife Service and State Parks with a couple of large private owners as well. There are also some smaller private, preserved land owners belonging to various conservation groups.

9. Since 2002, the 177th Fighter Wing has had a contract with Drexel University for environmental studies and projects. The lead professor from Drexel, Dr. Walt Bien, also serves as a consultant on a multitude of environmental issues.

10. A review of Air National Guard data for the last 15 years reflects the inherent risk associated with various airborne missions. Since 1992, Warren Grove Range has had four mishaps resulting from weapons expenditures.

11. Summary of Mishaps:

    1999 A BDU-33 (Bomb Dummy Unit) was dropped from an A-10 aircraft outside range boundaries due to an aircraft mechanical malfunction. The ensuing fire burned 1600 acres.

    2000 A BDU-33 dropped from an F-16 aircraft outside range boundaries due to an aircraft mechanical malfunction. The ensuing fire burned 12,000 acres.

    2005 An F-16 aircraft, not assigned to the New Jersey Air National Guard unintentionally fired a 20mm gun outside the range boundary. The bullets impacted a school, with minor damage. This Maryland based F-16 experienced a software problem that had not been properly identified in two previous incidents that did not occur on Warren Grove Range.

2007 A flare dropped from an F-16 aircraft inside the range boundary and impacted the ground while still burning. The ensuing fire burned over 15,000 acres.

12. The most recent incident at the Warren Grove Range resulted in a fire that caused evacuations in the thousands with two personal injuries and destroyed or damaged numerous homes. An Accident Investigation Board convened by the Air Force determined pilot error to be the cause and also identified a number of communication and procedural issues at both the 177th Fighter Wing and the Warren Grove Range (see Appendix 7)

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   - Electronic threat emitters

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Appendix 3

Air Force Accident Investigation Board Report Summary

1. An Air Force Accident Investigation Board was convened to investigate the fire ignited on Warren Grove Range on 15 May 2007 which spread rapidly beyond the boundary of the Warren Grove Range due to extreme environmental factors and consumed between 15,500 and 18,000 acres. The Accident Investigation Board president found by clear and convincing evidence that:

- The cause of the mishap fire was pilot error, committed when the mishap pilot deployed flares at an altitude that allowed the flares to contact the range while still burning.

2. The Accident Investigation Board president also found certain factors substantially contributed to the mishap.

- The failure of the lead pilot to communicate with the mishap pilot concerning the use of flares and to properly coordinate the mishap pilot's intent to use flares during the flight substantially contributed to the Range Control Officer's failure to convey additional restrictions concerning flare use to the pilots of the flight.

- The failure of the range control officer to convey additional restrictions concerning flare use to the pilots of the flight substantially contributed to the mishap pilot's lack of information concerning additional restrictions on flare use.

- The mishap pilot's performance of the unplanned show of force maneuver substantially contributed to the mishap pilot's low altitude flare deployment.

EXECUTIVE SUMMARY
AIRCRAFT ACCIDENT INVESTIGATION
F-16C, S/N 83-1148
177th FIGHTER WING
ATLANTIC CITY INTERNATIONAL AIRPORT, NEW JERSEY
15 MAY 2007

On 15 May 2007 at 1408 hours, Eastern Daylight Time (EDT), the pilot of an F-16C (F-16), serial number (S/N) 83-1148, deployed several MJU-7A/B flares during flight training maneuvers at the Warren Grove Range (WGR), a detachment of the 177th Fighter Wing (177 FW). The mishap pilot (MP) was the wingman in a flight of two F-16s assigned to the 177 FW, New Jersey Air National Guard. During this training mission, each pilot of the flight conducted a "show of "force" maneuver, as requested by the WGR range control officer (RCO). While executing this maneuver, the MP deployed multiple self protection flares below the WGR minimum release altitude of 500 feet above ground level (AGL). Several of these flares contacted the range while still burning and ignited fires. One of these fires spread rapidly beyond the boundary of the WGR due to extreme environmental factors and consumed between 15,500 and 18,000 acres. Reports have indicated the fire destroyed four homes, damaged other structures and vehicles, and resulted in injuries to two individuals. The accident investigation board (AIB) president found by clear and convincing evidence that the cause of the mishap fire was pilot error, committed when the MP deployed flares at an altitude that allowed the flares to contact the range while still burning.

The AIB president also found certain factors substantially contributed to the mishap. The lead pilot (LP) for the flight did not communicate with the MP concerning the MP's intended use of flares and therefore failed to properly coordinate with the WGR concerning the MP's intent to use flares. Furthermore, there should have been no flare deployment on the WGR on the afternoon of 15 May 2007 based on the extreme environmental factors at the WGR. The RCO failed to convey this additional restriction concerning flare use to the pilots of the mishap flight prior to the mishap. The MP was unaware of any additional imposed restrictions on the range for the flight and indicated if he had known of additional restrictions concerning flare use at the range, he would not have used flares at all during the flight at the range. Finally the RCO requested a show of force maneuver, an event that led the MP to perform a low altitude simulated bombing pass that was not planned or briefed prior to the flight.

The failure of the LP to communicate with the MP concerning the use of flares and to properly coordinate the MP's intent to use flares during the flight substantially contributed to the RCO's failure to convey additional restrictions concerning flare use to the pilots of the flight. Further, the failure of the RCO to convey additional restrictions concerning flare use to the pilots of the flight substantially contributed to the MP's lack of information concerning additional restrictions on flare use. The MP's lack of information concerning additional restrictions on flare use that were in place on the WGR substantially contributed to the MP's deployment of flares during the mishap flight. Finally, the MP's performance of the unplanned show of force maneuver substantially contributed to the MP's low altitude flare deployment.

Appendix 4 – Fire Classification System

New Jersey Forest Fire Service
Fire Danger Rating System

Classification	Qualification	Characterization
1	Low	Fires will not spread beyond heat of camp fire or brush fire.
2	Moderate	Fires will start from open flame, camp or brush fire. Spreads slowly.
3	High	Fires will start from a lighted match and spread in dry grass, slower with moisture. Will continue to spread until extinguished.
4	Very High	Fires will start readily from match or glowing embers, and spreads rapidly as it increases in size. May crown young conifers.
5	Extreme	Fires start readily from sparks or cigarette butts, spread and crown rapidly. Spot fires common. All burn fiercely and may blow up unless controlled promptly.

- Warren Grove Range operating procedures and expendable device restrictions (see Appendix for device restrictions) virtually eliminate the fire danger potential of an inadvertent fire starting from range operations. The application of NJSFFS fire classification to the range's immediate fire fighting response and fire break system is illustrated below. Expendable device restrictions in Appendix are derived from the fire spread/fire response capabilities outlined below.

Warren Grove Range
Application of Fire Danger System

Classification	Characterization
1	Fires will self extinguish or are readily extinguished by range personnel without propagation.
2	Fires are readily extinguishable by range personnel prior to fire propagation beyond immediate vicinity of fire source.
3	Fires are controllable or extinguishable by range personnel within confines of the range fire break system (see Figure A12-4, Appendix 12).
4	Fires may be controllable by range personnel within range fire break system. Fires may propagate beyond immediate response fire fighting capability of range personnel and may exceed the range fire break system without assistance from NJSFFS.
5	Fires may spread rapidly beyond capability of immediate response fire fighting capability of range personnel. Fires may propagate beyond range fire break system.

- Authorized aircraft expenditures under Fire Danger Classification 4 or 5 are severely restricted (see Appendix 6)

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4	Fires may be controllable by range personnel within range fire break system. Fires may propagate beyond immediate response fire fighting capability of range personnel and may exceed the range fire break system without assistance from NJSFFS.
5	Fires may spread rapidly beyond capability of immediate response fire fighting capability of range personnel. Fires may propagate beyond range fire break system.

Appendix 5

Wildland Fire Prevention and Response Plan

1. The purpose of this plan is to detail guidelines to aid in prevention, containment and suppression of range wildland fires.
2. Wildland fire Prevention.
   a. High hazard times for wildland fires are usually March through May and September thru November. Regardless of the fire season, the following precautions and procedures will be taken on a daily basis.
   b. The DNCO will contact the NJSFFS, B Division Headquarters, Lebanon or the Cedar Bridge Fire Tower and obtain the current Fire Danger Classification Rating for the Warren Grove Range area. If Fire Danger Classification cannot be confirmed, the range will assume Fire Danger Classification 5 until a lower fire condition can be confirmed.
   c. NJSFFS Fire Tower performs wildland Fire Danger Classification Rating updates at approximately 10 a.m. and 1 p.m., when manned.
   d. When the Fire Danger Classification is Very High (Classification 4), or Extreme (Classification 5), DNCO will contact and inform all units scheduled for range use that Classification 4 or 5 conditions are in effect.
   e. The range control officer will inform users upon range check-in of fire condition and applicable range restrictions resulting from the fire condition. Users are required to read-back fire condition restrictions. Failure to read-back fire condition restrictions will result in range denial.
   f. Any aircraft observed employing unauthorized devices, when applicable, descending below the imposed minimum altitude restriction, will be directed to discontinue weapons delivery operations, safe weapons systems, and depart the range complex.
3. General Fire Response Guidance
   a. Warren Grove Range personnel will limit response to fight fires to providing initial response and first aid fire fighting actions. Whenever suppressing any fire on Warren Grove Range, prudence and sound judgment will be exercised
   b. In the event the NJSFFS is called to fight the wildland fire, upon arrival the NJSFFS will assume the role of Incident Commander, the range control officer will direct the cessation of all flying activity involving training. Range fire fighting teams will remain to assist the NJSFFS unless relieved by the Incident Commander.
   c. During fire fighting response, the main tower will be manned until the fire crew is in the compound and the fire is contained and extinguished, unless prudence dictates evacuation of the main tower.
   d. During fire fighting response, no personnel shall be permitted to enter the Range Complex without the ability to maintain constant two-way communication with the range main tower and/or the Incident Commander's established base of operations.

4. Selective Response Plan for Wildland Fires Within Range Complex.
   a. Warren Grove Range personnel will immediately contact NJSFFS and coordinate appropriate fire fighting response as outlined below for any fire on the range.
   b. Range weapons delivery operations will be terminated for any fire that occurs on the range with all priority given to extinguishing/controlling the fire.
   c. Response to incidental fires depends upon the Fire Danger Classification for the day, the location of the fire, and wind speed as outlined below.
   d. Fire location is delineated by color coded area, Green, Yellow, and Red Zones as shown in Figure A5-1 below.
   e. Under Fire Danger Classification 1, 2, or 3
      1) Fire fighting response under Fire Danger Classifications 1, 2, or 3 will be the same
      2) The range control officer will notify NJSFFS, Cedar Bridge Tower that the Range is working a wildland fire and will request aid if necessary depending upon fire location.
      3) Fire location (see Figure A5-1)
         a) Green Zone: Grassy area which, upon assessment of RCO, Fire Chief or designated representative and first responders, may be allowed to burn while being monitored by on site fire response personnel with equipment sufficient to extinguish fire if necessary.
         b) Yellow Zone: A cautioned/standby response area; the area will only be allowed to burn if wind speed is less than or equal to 10 knots and if the area has had a successful prescribed burn IAW the range Hazard Reduction Burn Plan. Request for NJSFFS assistance will be based upon assessment of first responders, range control officer, and Fire Chief or designated representative.
         c) Red Zone: Range fire fighting personnel will immediately respond to extinguish/control fires outside of the red lines (adjacent to the Yellow area but still within Range Boundaries). Request for NJSFFS assistance will be based upon assessment of range control officer and Fire Chief or designated representative.
   f. Under Fire Danger Classification 4 or 5
      1) Fire fighting response under Fire Danger Classifications 4 or 5 will be the same
      2) The range control officer will notify NJSFFS, Cedar Bridge Tower that the Range is working a wildland fire and will request aid as defined below. Fire location (see Figure A5-1):
         a) Green Zone: A cautioned/standby response area; the area will only be allowed to burn if wind speed is less than or equal to 10 knots and if the area has had a successful prescribed burn IAW the range

Hazard Reduction Burn Plan. Request for NJSFFS assistance will be based upon assessment of range control officer and Fire Chief or designated representative.

b) Yellow Zone: Range fire fighting personnel will immediately respond to extinguish/control fires in readily accessible areas. The range control officer contact NJSFFS and request fire fighting assistance. NJSFFS will assume role of Incident Commander upon arrival. Range personnel will continue suppressing fire until NJSFFS assistance arrives and coordinate further actions with NJSFFS representative upon arrival.

c) Red Zone: Range fire fighting personnel will immediately respond to readily accessible areas to assist NJSFFS personnel in extinguishing/ controlling fires in the red zone. Range personnel will not attempt to attack fires outside the red line without NJSFFS assistance.

5. Response Plan for Wildland Fires Outside the Range Complex.

   a. Warren Grove Range personnel will immediately contact NJSFFS and coordinate appropriate fire fighting response for any fire outside the range boundaries that result from range operations.

   b. Range weapons delivery operations will be terminated for any fire outside the range boundaries that result from range operations with all priority given to extinguishing/ controlling the fire.

   c. There is no intent that WGR personnel would provide, or are capable of providing, any fire fighting actions outside range boundaries, except for those life saving actions that would be prudent for any competent individual.

6. Aviation Fire Fighting Response.

   a. NJSFFS may determine the necessity of requesting fire fighting assistance from NJ Army National Guard.

   b. Upon request, the range control officer may aid in coordinating NJ National Guard Aviation fire fighting support through the NJ Department of Homeland Security.

   c. NJ National Guard Aviation may be activated and detailed to aid Warren Grove Range fire fighting efforts.

   d. Coordinated aviation fire fighting response will be at the discretion of the NJSFFS incident commander

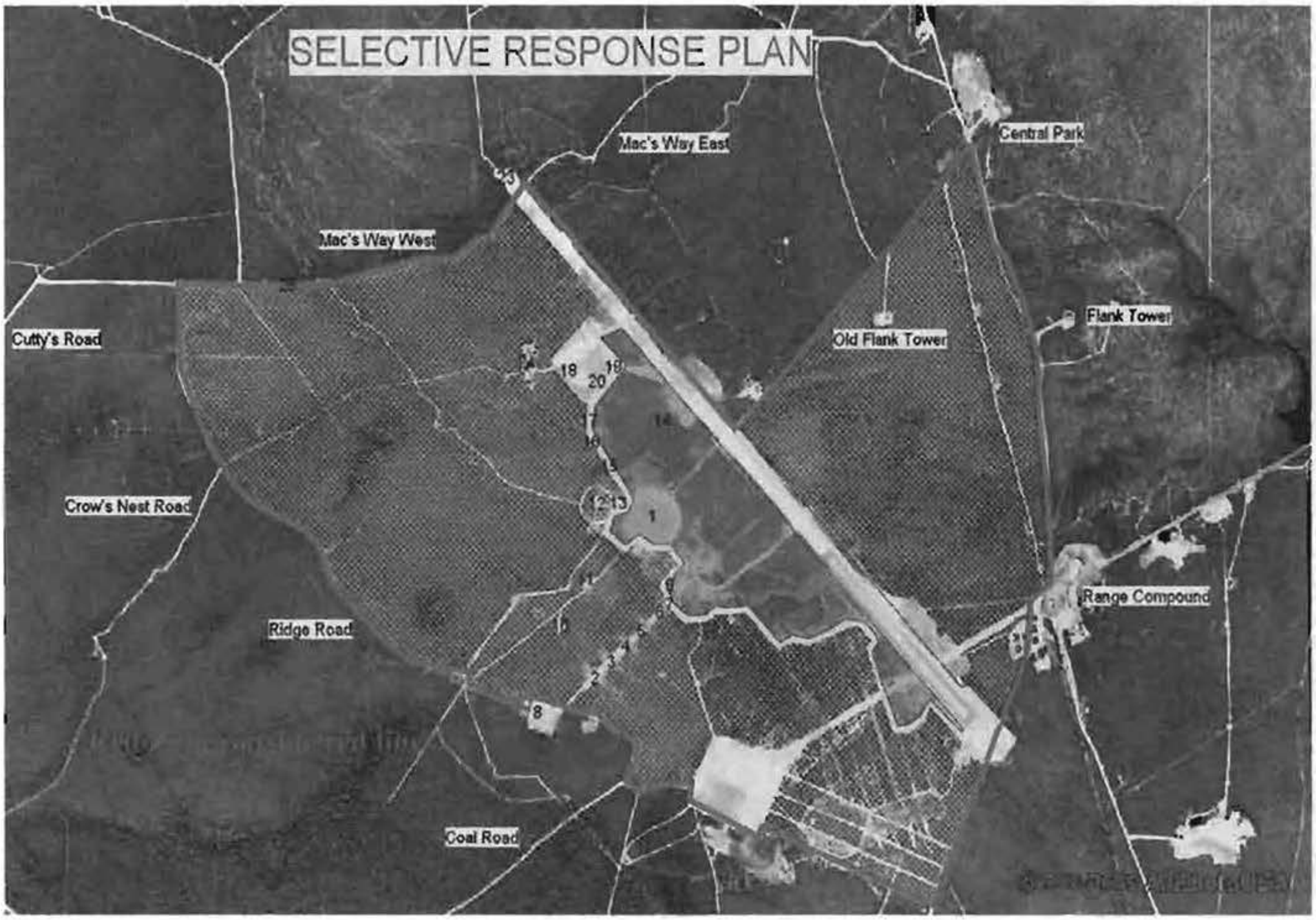
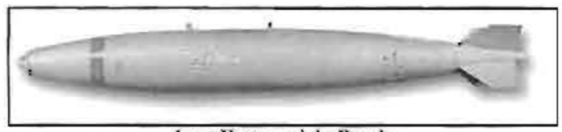


Figure A5-1 – Selective Response Plan Map

Appendix 6

Approved Devices for Use on Warren Grove Range

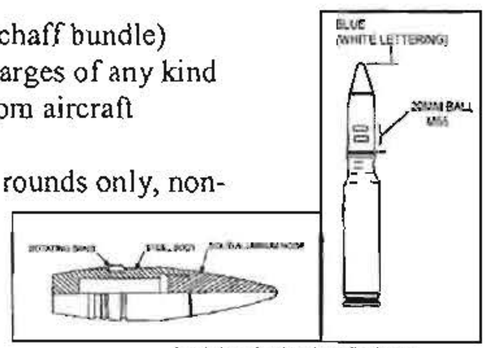
1. All explosive and incendiary devices of any kind are prohibited for use at Warren Grove Range. Any "bomb" approved for use on WGR is a simulated weapon that contains no explosive or incendiary material of any kind. Similarly, all bullets, rockets, and missile simulators approved for use on the range include no explosive or incendiary material of any kind.
2. The following devices may be expended on Warren Grove Range (pending appropriate approval and Fire Danger Classification restrictions outlined in subsequent sections, this Appendix).
   a. Inert heavyweight bombs (non-explosive, non-incendiary)
   b. RR-188 training chaff
   c. 30mm, 20mm, 7.62mm, and 50cal bullets (training rounds only, non-incendiary)
   d. "Cold Spot" BDU-33s
3. Description of Devices
   a) Inert heavyweight bombs (non-explosive, non-incendiary)
      1) Weight – 500 lbs
      2) Concrete and Steel
      3) No explosive, incendiary, or pyrotechnic charges of any kind
      4) Painted blue to differentiate from actual explosive bomb (painted yellow, red, or orange)



Inert Heavyweight Bomb

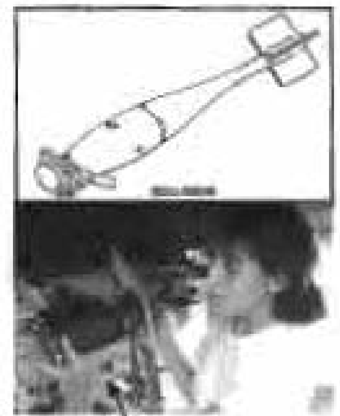
   b) RR-188 training chaff
      1) Weight – negligible (less than .0042 oz per chaff bundle)
      2) No explosive, incendiary, or pyrotechnic charges of any kind
      3) Material floats to ground when expended from aircraft

   c) 30mm, 20mm, 7.62mm, and 50cal bullets (training rounds only, non-incendiary)
      1) Weight – ¼ - ¾ lb
      2) Aluminum and steel slug (5-7 inches long)
      3) No explosive, incendiary, or pyrotechnic charges of any kind



Training Projectiles (bullets)

d) "Cold Spot" BDU-33s



1) Weight – 24 lbs
2) Cast iron and steel
3) No explosive, incendiary, or pyrotechnic charges of any kind
4) Contains 17 cc's of titanium tetrachloride which produces white smoke upon BDU impact with the ground
5) White smoke cannot be seen during night operations nor with certain ground conditions (snow covered ground, heavy rains/muddy ground conditions)
6) Precise impact point can be difficult to determine reducing training effectiveness

Practice Bomb (BDU-33)

e) MK-66 2.75 inch rockets (inert training rounds only)

Inert Training Rocket

1) Weight – 18 lbs
2) Length – 4ft Width – 2.75in
3) Cast iron projectile accelerated by short-burn (1.05 – 1.10 seconds), solid fuel rocket motor
4) Rocket motor stops burning before impact with the ground – approximately 1,280ft from launch platform (launch range between aircraft and ground impact point varies from one to three miles)
5) No explosive or incendiary charges of any kind
6) Not authorized on WGR

f) Smokey SAM Simulators
   1) Weight – 1 ½ lbs
   2) Length – 15in
   3) Paper and foam projectile launched to approximately 1,500ft in altitude by a one pound of low thrust solid propellant
   4) Propellant burns for up to five seconds, burns out well prior to device falling back to the ground
   5) Not authorized on WGR

Smokey SAM Simulator

Smokey SAM Simulator
Launch Location

4. Approved devices restrictions under Fire Danger Classifications

   a) Devices are restricted from employment on the range based table A6-1 below

WARREN GROVE RANGE STANDARD ORDNANCE RESTRICTION CRITERIA				
ORDNANCE	GREEN (CLASS 1-3)	YELLOW (CLASS 4)	RED (CLASS 5)	BLACK
BDU-33	COLD or NO SPOTS	COLD or NO SPOTS	COLD or NO SPOTS	DRY ONLY
2.75 ROCKETS	NOT PERMITTED	NOT PERMITTED	NOT PERMITTED	NOT PERMITTED
FLARES	NOT PERMITTED	NOT PERMITTED	NOT PERMITTED	NOT PERMITTED
STRAFE -TP	NO TRACERS	NO TRACERS	NO TRACERS	NOT PERMITTED
SMOKEY SAMS	NOT PERMITTED	NOT PERMITTED	NOT PERMITTED	NOT PERMITTED
EOD EXPLOSIVE OPS	NO RESTRICTIONS	NO RESTRICTIONS	NOT PERMITTED	NOT PERMITTED

Table A6-1 – Approved Ordnance
Restrictions by Fire Danger Classification

b) Surface winds and availability of fire fighting equipment may increase Warren Grove Range Fire Danger Classification above the NJSFFS reported condition based on Tables A6-2 below.

RESOURCES		FIRE WEATHER RESTRICTIONS UPGRADE																			
Firefighting Personnel	R2 (2.5 ton)	Class 1				Class 2				Class 3				Class 4				Class 5			
4	4	G	G	Y	R	G	G	Y	R	G	G	Y	R	Y	Y	R	B	R	R	B	B
3	3	G	G	Y	R	G	G	Y	R	G	G	Y	R	Y	Y	R	B	R	R	B	B
2	2	G	G	Y	R	G	G	Y	R	G	G	Y	R	Y	Y	R	R	R	R	R	R
SURFACE WINDS: SUSTAINED OR GUSTS (Knots)		< 25	26-34	35-49	> 50	< 25	25-34	35-49	> 50	< 25	25-34	35-49	> 50	< 25	25-34	36-49	> 50	< 25	25-34	35-49	> 50

Table A6-2 – Fire Danger Classification
Upgrades for Surface Wind

Appendix 7

Range Scheduling and Range Entry Approval Coordination

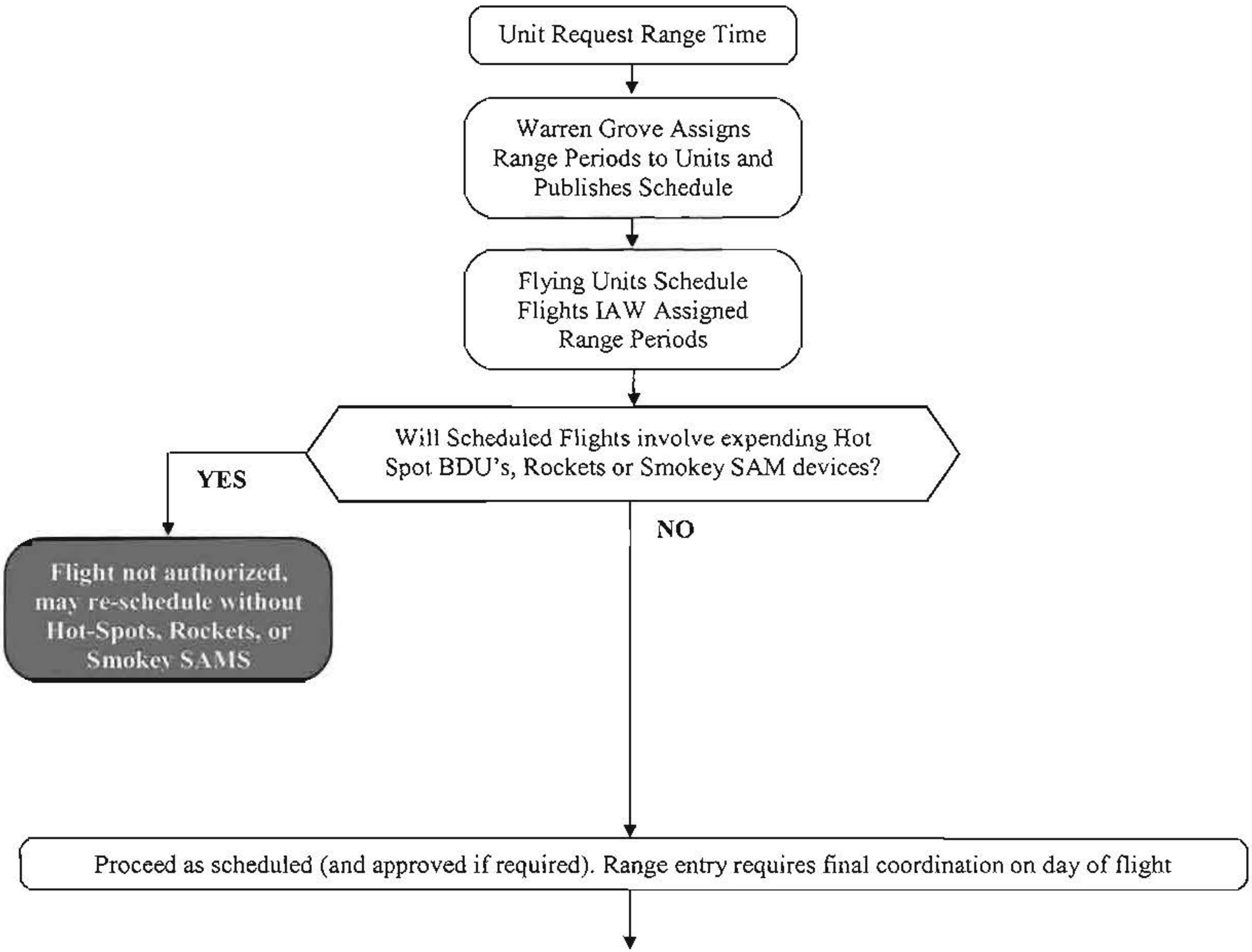


Figure A7-1 – Range Scheduling Coordination Diagram

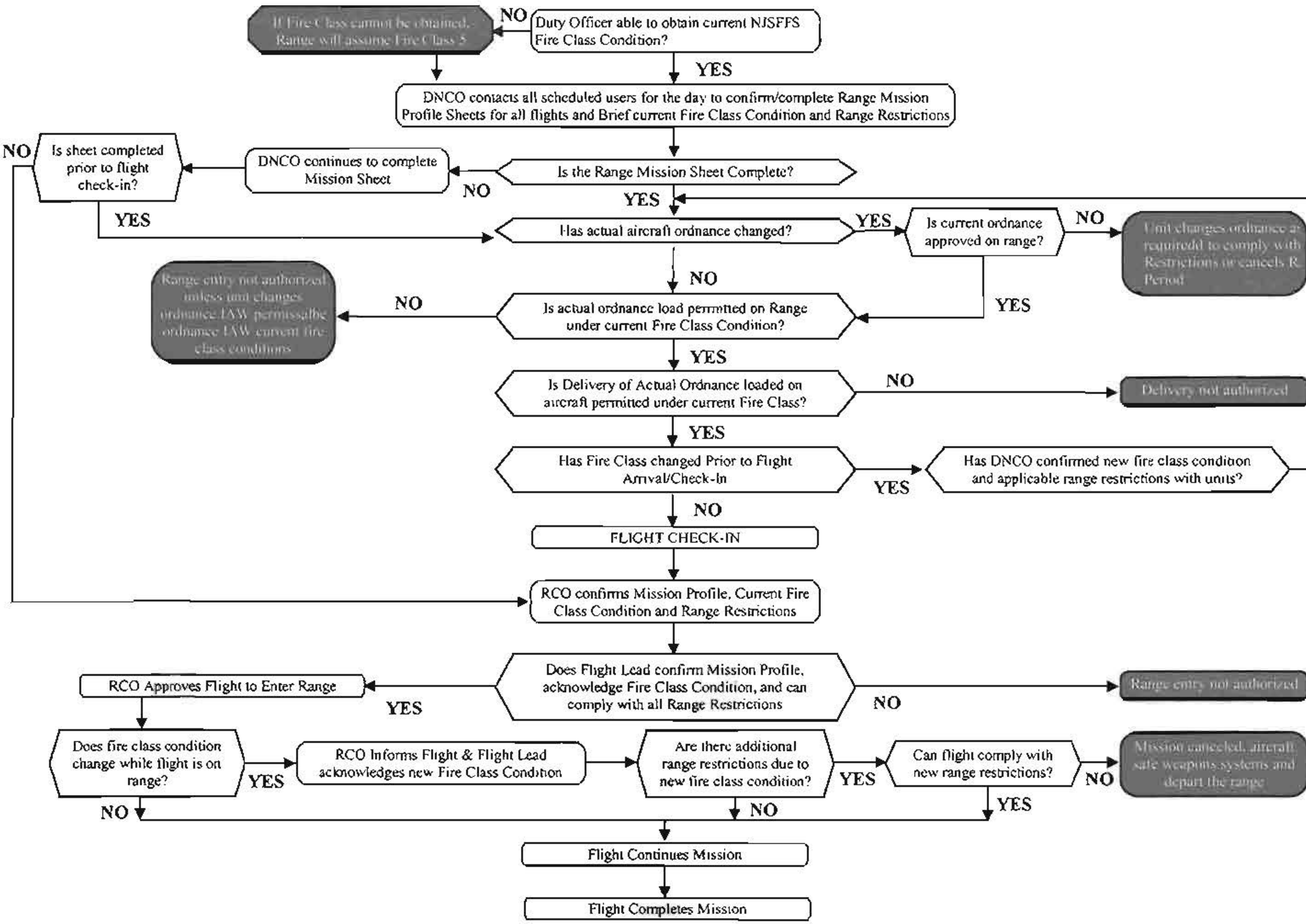


Figure A7-2 – Daily Range Coordination Diagram

Appendix 9

Warren Grove Range Strategic Vision

1. Work with Air National Guard Director to place the Warren Grove Range at the top of the list of the Air Force Program for Range Modernization. This program includes the requirement to create bombing ranges where training can be accomplished without actually dropping practice ordnance. The National Guard Chief of Airspace Ranges and Combat Readiness Training (National Guard Bureau/A3A) is currently working on upgrading to meet this requirement. The 177 Fighter Wing will aggressively pursue this upgrade to Warren Grove Range.

2. Obtain funding for the active/guard/reserve positions currently unfunded at the Warren Grove Range with a priority on the safety specialist position. The second position will be utilized longterm to provide a full time position dedicated to developing future uses for the Warren Grove Range, to include Air Support Operations Squadron integration and future "non-drop" missions.

3. Incorporate Warren Grove Range into the National Guard Bureau Integrated Planning Process (IPP) in order to participate in the National Guard Bureau range modernization program. As training systems improve, the emphasis may shift to advanced technology methods which increase safety and decrease the potential for incidents. As part of this program, the 177th Fighter Wing Operations Group Commander will endeavor to:

   a. Emphasize the use of instrumented ranges for air-to-surface training and the application of Global Positioning System technology can provide a quantum increase in the quality of training.

   b. Establish complete Tactical Data Link coverage of training airspace to accommodate Link-16 and situational awareness data link systems.

   c. Support development and procurement of modular and thermal signature Red and Blue Force Target Systems.

   d. Acquire advanced weapon scoring systems.

Appendix 10

Integrate Risk Management into Training and Operations

1. Risk Management must become a routine part of everyday business. It must incorporate some basic principles: institutionalizing risk management training; integrating safety protection into a commander's mission essential task listing training assessment; making awareness of wartime and peacetime accidents a condition of training; instituting safety performance indicators on Officer Performance Ratings; integrating safety assessments into after-action reviews and lessons learned. There are a number of training opportunities and tools available through the Air Force and Department of Defense. All education and training is ongoing. Recommendations focus on officer and senior enlisted professional development to instill a culture of safety throughout the organization.

2. Education/Training and Tools
   a. 177th Fighter Wing Commander will conduct a Command Climate Survey.
   b. Request a cultural workshop (one day) for all wing leadership from the squadron commander-level and up on site at the 177th. Emphasize need for diversity awareness and incorporation of zero tolerance into existing safety procedures to eliminate any obstacles to complete compliance with safety guidelines and practices.
   c. Initiate Air Force Culture Assessment Safety Tool participation.
   d. Request a National Guard Bureau Staff Assistance Visit on safety.
   e. Request Safety School slots for commanders and key personnel:
      1) Operational Safety Suitability and Effectiveness Course
         - Wing Commander, Operations Group Commander, Range Commander, Range Operations Officer, Safety Specialist
      2) Senior Safety Professional Course
         - Wing Commander, Operations Group Commander, Range Commander
      3) Ground Safety Course
         - Range Safety Specialist, Range Senior NCO
   f. Request an Operational Safety Assessment (OSA) from National Guard Bureau.
   g. Evaluate leadership needs for attendance at the Commander Development Course.
   h. Visit two Air National Guard ranges with zero mishaps to allow Warren Grove Key personnel to compare Warren Grove Range current procedures to another unit's Best Practices with the goal of identifying possible areas for improvement within the Warren Grove Range.
   i. New Jersey Air National Guard Commander will provide oversight of the Wings' Safety program/issues through the Joint Force Headquarters/A3 (Director of Operations). Specifically, the Joint Force Headquarters/A3 will facilitate a quarterly meeting attended

by both 177th Fighter Wing and 108th Air Refueling Wing Chiefs of Safety. This meeting will provide both formal cyclic review of each wing safety program/issues and provide a forum for standardization and information share between both wings as well as the development of metrics. Additionally, Joint Force Headquarters/A3 will provide "eyes and ears" regarding Safety to New Jersey Air National Guard Commander through ongoing direct contact with each wing's flying organizations. Oversight of the recommendations in this Risk Mitigation Plan will be provided by the Joint Force Headquarters Chief of Staff-Air on a daily basis.

j. Encourage senior raters to incorporate safety indicators in Officer Performance Reports.

k. Schedule an Inspector General Climate Assessment (long term).

Appendix 11

Interagency Coordination for Wildfire Management

1. Since 2001, with funding provided by the Air National Guard, the New Jersey Air National Guard has annually developed an Integrated Natural Resources Management Plan and the latest is dated December 2006 for the Warren Grove Range. The Integrated Natural Resources Management Plan is a practical guide for the management and stewardship of all natural resources present on the Warren Grove Range, while ensuring the successful accomplishment of the military mission. To develop this plan, a Task Force was formed that included: key range and 177th Fighter Wing personnel, the US Fish and Wildlife Service, NJ Dept of Environmental Protection (DEP) Div of Fish and Wildlife, NJDEP Office of Land Management, NJ Pinelands Commission, and the NJ DEP Forest Fire Service.

2. By statute, the Pinelands Commission has the authority to approve the safety fire breaks necessary to conduct controlled burns. Historically, the Pinelands Commission has been reluctant to approve the further development of fire breaks contributing significantly to the lack of controlled burns, and therefore increasing the overall fuel load and volatility of the pinelands. In order to increase any fire breaks, whether on Warren Grove Range or off, the Pinelands Commission must issue the approvals.

3. Recommendations range from the high Bird-Aircraft Strike Hazard (BASH) threat species to fireshed management activities required to manage fire danger and the health and productivity of the Pine Barrens. Controlled burns are conducted with regularity on the Warren Grove Range by the range personnel in conjunction with the NJ Forest Fire Service. The lack of fuel breaks and controlled burns off the range property is identified as an issue in the INRMP.

4. The following recommendations are offered:

   a. Working with the NJ DEP, fast track the development of a Regional Fireshed Management Plan. Utilize technology to map high forest fuel loads and increase the size of the firebreaks outside of the Warren Grove Range proper.

   b. Following approval from the Pinelands Commission, increase the size of the firebreaks within the Warren Grove Range proper and around the entire perimeter. The size of the fire break to be considered may be from 150 to 300 feet, but will be based on consultation and recommendations from the NJ Forest Fire Service and Drexel University.

   c. The FY-03 Defense Authorization Act (Title 10 U.S. Code § 2684a) included a provision that authorized the military to enter into agreements with eligible entities to acquire real estate interests in the vicinity of military installations. The purpose is to limit incompatible land use near a military installation by creating conservation buffers to protect natural features, endangered. This program became known as the Readiness and Environmental Protection Initiative. Under the Readiness and Environmental Protection Initiative program Warren Grove Range received funding for FY2007 in the amount of $253,000 in initial funding in partnership with the New Jersey Conservation Foundation.

   d. Conduct a comprehensive joint land use study at the Warren Grove Range and incorporate information from an Air Installation Compatible Use Zone study for the 177th

Fighter Wing. The joint land use study is a cooperative land use planning effort between the affected military installation, state government, county government, local government, land use planning entities, the State Department of Environmental Protection, local environmental groups, and other stakeholders with specific interests in the region. The joint land use study product allows the stakeholders to revise land use plans to address compatibility with military missions, direct development to suitable locations, maintain the economic value of the region and protect valuable ecosystems and habitat areas. The recommendations also provide a policy framework to support adoption and implementation of compatible development measures designed to prevent urban encroachment, safeguard the military mission, and protect the public health, safety, and welfare.

e. The Air Installation Compatible Use Zone study identify aircraft landing and take-off accident potential zones that often extend off a base into the neighboring community. The Range Air Installation Compatible Use Zone developed by the Navy and Marines reviews the compatibility of ranges and range activities inside an installation and the surrounding region.

f. Following the completion of a joint land use study, many installations are opting to continue the planning process on a regional basis through *Regional Sustainability Partnerships*. Regional Sustainability Partnerships are ongoing planning groups comprised of selected joint land use study stakeholders who work in an advisory capacity to insure that the recommendations agreed upon in the joint land use study are fulfilled.

g. Establish a mutual aid agreement between the range and the NJ Forest Fire Service for equipment and personnel fire support for the range personnel to assist off range.

Appendix 12

Warren Grove Range Maps

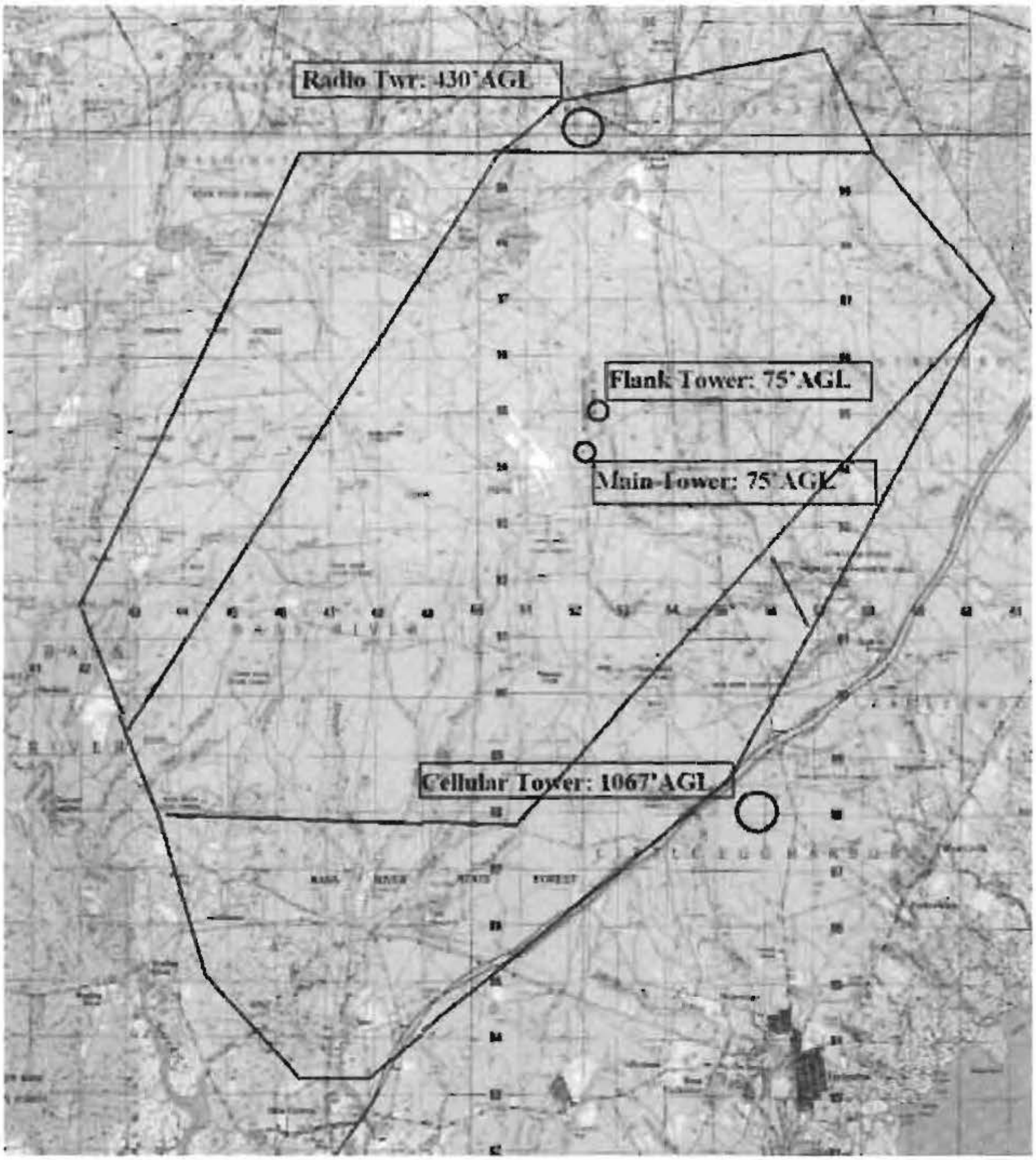


Figure A12-1. Warren Grove Range Airspace

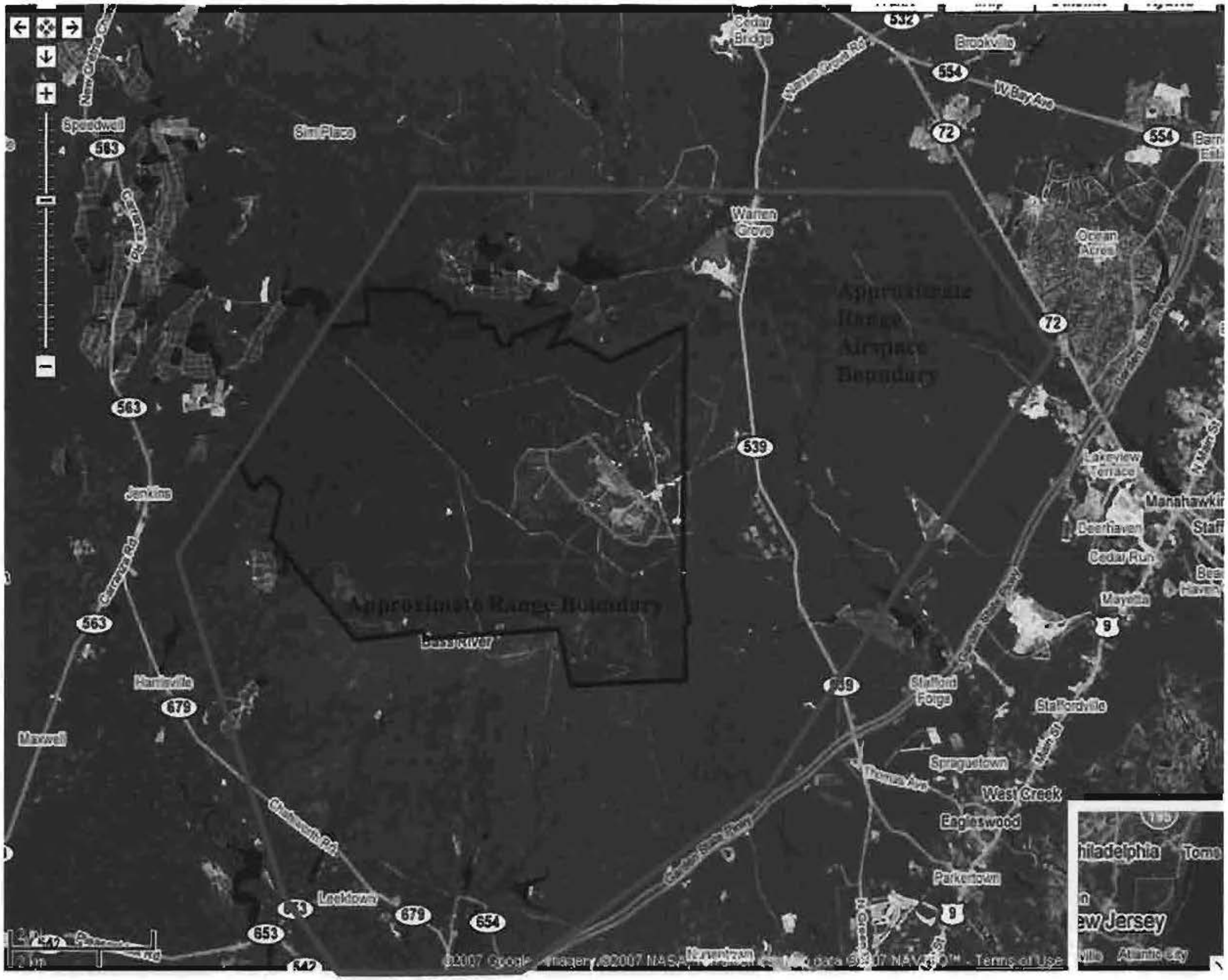


Figure A12-2. Aerial Image of Range Area and

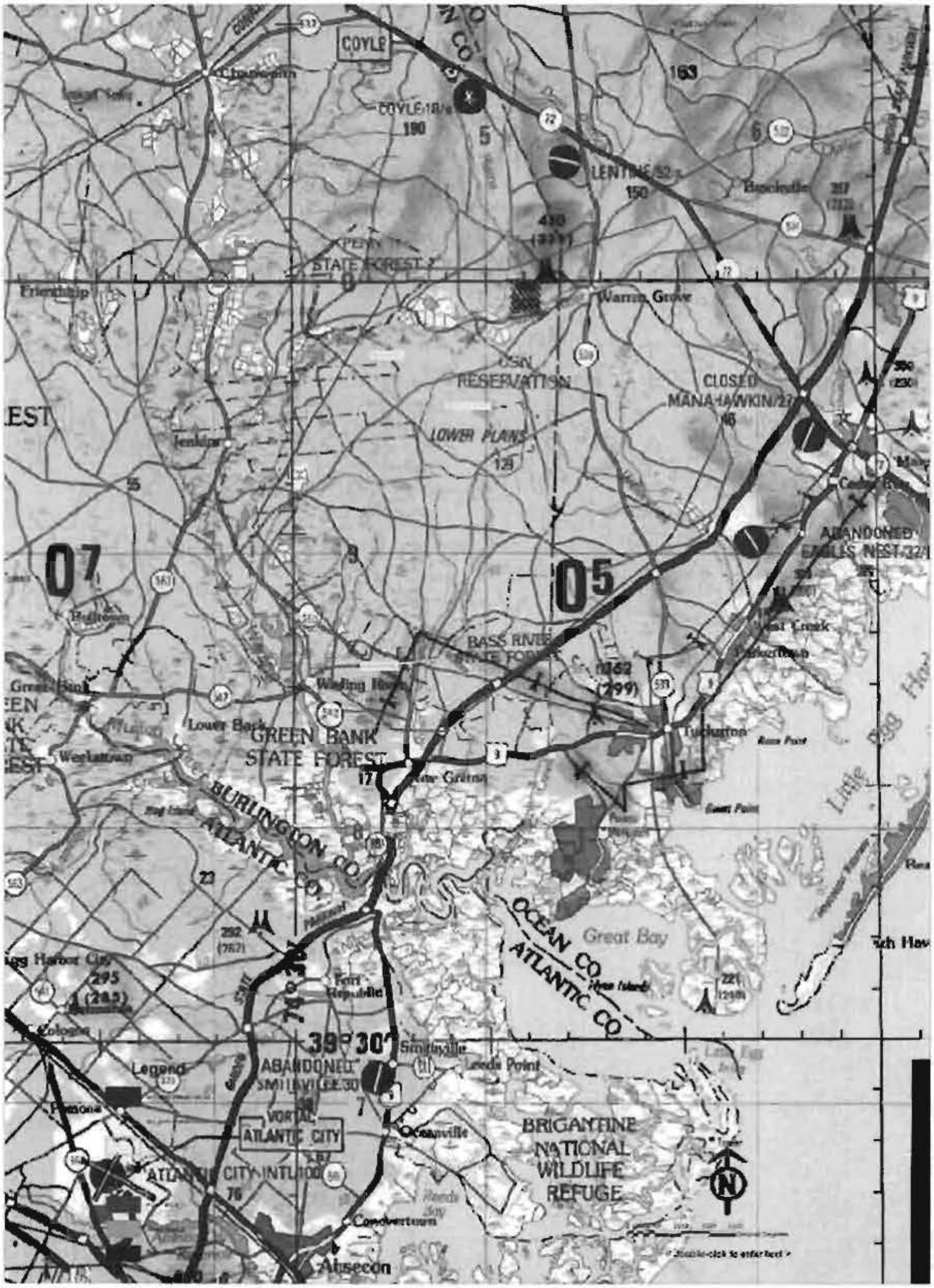


Figure A12-3. Range Local Area Map

Warren Grove Range

Risk Mitigation Plan Executive Brief

26 Feb 08

Overview

- Investigative Summary
- Warren Grove Range (WGR) Environment
- Four Pillars of Risk Mitigation
- 10 Point Plan
  - What, Why, When, Where are We
- Results
- Ensuring Completion – The Way Ahead
- Congressional Oversight

Investigative Summary

- **Recent incidents at Warren Grove Range have highlighted:**
  - Improper or inadequate operations procedures
  - Failure to execute proper procedures
- **Resulting in potential devastating impact to the public and the environment**

Investigative Summary Continued...

- **Risk to the public can be mitigated by:**
  - Changes to operations procedures
  - Leadership changes
  - Changes in command relationship
  - Installation of proper safeguards
  - Increasing the oversight of range operations
  - Increasing the timeliness and size of resources dedicated to incident response

Physical Environment

- Protected Pinelands National Reserve
- Close proximity to populated areas
- Safety of local population preservation of Pinelands require:
  - Proactive risk management incorporating 'fail-safe' methodologies
- Risk mitigation objective is to minimize risks to the public and property

Operational Environment

- WGR is the most heavily used range in the ANG
- Supports the following users:
  - Air National Guard Fighter Units
  - Air Force transportation and search and rescue units
  - Army Aviation , ground and unmanned aerial vehicle units
  - Marine Corps units
  - Coast Guard units
  - Non-Department of Defense users
  - Department of Justice and the FBI
- Training offered at WGR is critical to the New Jersey Air National Guard, the United States Air Force and other military users rotating into OIF/OEF
- Continued use of Warren Grove Range is contingent upon the ability to safely execute range operations

Four Pillars of Risk Mitigation

Four Pillars of Risk Mitigation

- **Organization and Leadership Changes**
  - Enacted to effect a change in the unit culture focusing on range safety, compliance with governing directives, stewardship of critical assets, and risk mitigation
- **Changes to Procedures at Warren Grove Range**
  - Implemented to mitigate risk of wildfire and other potential range mishaps. Culture change from "approved until prohibited" to "prohibited unless approved" provides fail-safe mechanisms

Four Pillars of Risk Mitigation

- **Assuring Compliance with Range Operating Procedures**
  - Developed and implemented Course Rules briefing and examination to ensure aircrew are aware of and can comply with critical operating procedures. Additional coordination requirements installed to assure accurate information required for valid daily Operational Risk Management
- **177FW Pilot Operations and Operations Supervisor Procedures**
  - Implemented coordination requirements, pilot re-training, directed reviews of operating procedures, and focused training program to mitigate risk for 177FW flight operations regardless of range/airspace being utilized

Ten Point Plan

- Ten Point Plan
  - What will be accomplished (has been accomplished)
  - Why was it necessary, what effect will be realized from implementation
  - When will it be implemented
  - Where are We towards completing implementation

Point 1

- Re-align command relationship and implement changes to range leadership personnel
  - What: Range operations fall directly under 177th Operations Group Commander; personnel in all range leadership positions have been replaced with highly qualified personnel focused on stringent range safety
  - Why: Streamlines communication and coordination processes that were deficient, eliminates possible deviations in communication between range users and range operators
  - When: Required to be complete prior to re-opening WGR
  - Where are We: Completed 20 Aug 07; provided sufficient time for new leadership to modify operating procedures, install oversight mechanisms, and validate safe range procedures

Status - COMPLETE

Point 2

- Embed a full time Ground Safety Specialist at WGR
  - What: Assign a full-time trained Air Force Ground Safety Specialist to WGR
  - Why: To pre-empt potential safety issues; safety specialist has commander's authority to cease range operations at any time to ensure safety; standardizes safety operations and assures quality of processes
  - When: Prior to re-opening the range
  - Where are We: Completed 9 Oct 07; specialist has validated risk management and fire prevention measures

Status - COMPLETE

Point 3

- Institute new mandatory Operational Risk Management (ORM) procedures at WGR
  - What: **Wildfire risk management procedures established to assure the highest level of wildfire prevention.**
    - Range procedures changed from permissive to non-permissive
    - Established fail-safe mechanisms which default to most restrictive procedures as necessary
    - Established mandatory training (Course Rules brief and examination) for aircrews prior to utilizing the range
    - Established mandatory coordination requirements for aircrews prior to utilizing the range
    - Instituted procedure to deny airspace entry to any user who does not comply with established mandatory procedures

Point 3 Continued...

- Institute new mandatory Operational Risk Management (ORM) procedures at WGR
  - Why: Ensures active redundant measures for all range users and range control personnel; coordination requirements provide foundation for Range Control Officers to execute responsibility of safe conduct of range operations
  - When: Immediately upon resumption of training missions at the range
  - Where are We: Completed 1 Oct 07; new range operating instructions, user training, user examination, and coordination requirements to be distributed to users prior to range utilization

Status - COMPLETE

Point 4

- **Eliminate the use of flares and prohibit the use of all other incendiary and pyrotechnic devices at WGR**
  - What: Establish strict controls on what type of ordnance can be expended on the range during designated fire danger conditions and establish a high level of approval authority for delivery of any device which has the potential to start a wildland fire.
  - Ordnance currently approved for use on WGR includes:
    - Inert heavyweight bombs (non-explosive/non-incendiary
    - 30mm, 20mm, 7.62mm, and 50cal bullets (training rounds only, non-incendiary)
    - Cold-Spot practice bombs

Point 4 Continued...

- Eliminate the use of flares and prohibit the use of all other incendiary and pyrotechnic devices at WGR

Ordnance	[redacted]	Fire Class 4 (Very High)	Fire Class 5 (Extreme)
Inert Heavyweights	[redacted]	[redacted]	ALLOWED
Training Bullets	ALLOWED	ALLOWED	[redacted]
Cold Spot* Practice Bombs	ALLOWED	ALLOWED	ALLOWED
Hot Spot Practice Bombs	PROHIBITED	PROHIBITED	PROHIBITED
Rockets	PROHIBITED	PROHIBITED	PROHIBITED
Flares	PROHIBITED	PROHIBITED	PROHIBITED

Do not incorporate pyrotechnic charges

Point 4 Continued...

- **Eliminate the use of flares and prohibit the use of all other incendiary and pyrotechnic devices at WGR**
  - Why: virtually eliminates the potential for expended ordnance to initiate an uncontrollable wildfire
  - When: Immediately upon resumption of training missions at the range
  - Where are We: Completed 1 Oct 07; ordnance restrictions consider the possibility of unintentional and inadvertent release of all expendable devices from range users thus mitigating risk for conceivable pilot errors or aircraft weapons malfunctions

Status - COMPLETE

Point 5

- Eliminate un-briefed aircraft maneuvers at WGR
  - What: Range personnel are prohibited from requesting un-briefed, un-scheduled, or known prohibited maneuvers from any range user
  - Why: To minimize the potential for aircrew error due to performance of maneuvers for which the aircrew is un-prepared, un-trained, or un-qualified to perform
  - When: Immediately upon resumption of training missions at the range
  - Where are We: Completed 1 Oct 07; prohibition published in range regulation and operating instruction; compliance assured via established training programs and periodic evaluation of all range control personnel in performance of operational duties

Status - COMPLETE

Point 6

- Increase daily oversight of WGR operations, modify range operating instructions to reflect clear 'fail safe' operating procedures
  - What:
    - Established written operating procedures outlining coordination requirements, communication methodologies, and internal processes
    - Established checklists for all duty positions and mission events including daily flight operations and emergency response actions
  - Why: Prior guidance was conflicting, incomplete, and un-written. The cohesive range operating instruction clearly defines all responsibilities and duties facilitating safe operations
  - When: Prior to re-opening the range
  - Where are We: Completed 1 Oct 07; personnel in all duty positions have received training on new operating instructions; training requirement established for all newly assigned personnel

Status - COMPLETE

Point 7

- Incorporate guidance into WGR procedures to reduce the likelihood of weapons impact outside of range property
  - What:
    - Established requirement that all ordnance must be mechanically or electrically inhibited from coming off the aircraft until in a position from which unintentional or inadvertent release will occur within the range impact area
    - Includes the requirement for all forward firing ordnance to be pointed at the ground within the impact area when safety mechanism is removed from the weapon system
    - Includes the restriction for no armed gun to be pointed at any manned site on or off the range property
  - Why: To preclude inadvertent or unintentional off-range weapons impact
  - When: Immediately
  - Where are We: Completed 1 Oct 07; requirements of above included in aircrew training and evaluation programs

Status - COMPLETE

Point 8

- Perform a Staff Assistance Visit at WGR in addition to Range Commander and Range Operations Officer visits to ANG ranges with exceptional safety records
  - What:
    - An NGB consolidated team of experienced range specialists performed an assistance visit to WGR providing expertise in all areas of range operations
    - Range Commander and Operations Officer performed a one week visit to NGB recommended ranges gaining knowledge of best practices and providing baseline for safe range operations
  - Why: Provides the "how-to" for range supervision with well established and effective programs
  - When: Prior to re-opening the range
  - Where are We: Range visits completed 17-21 Sep / 1 – 5 Oct; SAV completed 15-19 Oct 07; results indicate compliance with governing directives, application of assistance visit programs, and viability of established risk mitigation procedures

Status - COMPLETE

Point 9

- Facilitate WGR modernization into electronically scored/no (low) drop range
  - What: Create a weapons delivery training environment which requires little or no actual weapons deliveries while still providing required training for war fighters and non-Department of Defense range users
  - Why: Continues to reduce risk of wildfire and weapons incidents that could affect the environment and local population
  - When: Begin coordination as technology and systems become available
  - Where are We: 177 FW request submitted to NGB; awaiting response/action; Range Commander continues to independently explore options to facilitate no-drop/low drop capabilities to assure future range relevance

Status - INCOMPLETE

Point 10

- **Conduct a comprehensive Joint Land Use Study of WGR property and surrounding area**
  - What:
    - A consultative study of range activities, private property concerns, public safety, and future encroachment mitigation
    - An 'outside' look at above issues enables development of unbiased Range Comprehensive Plan
  - Why: Identifies and mitigates potential conflicts between range operations and surrounding community; promotes 'good neighbor' policy improving relations and maximizing training opportunities while minimizing risks to range users, range personnel, and the public
  - When: As federal resources are availed to execute the process
  - Where are We: 177 FW submitted JLUS request for study 14 Aug 07; initial meeting to establish objectives and scope of project programmed for last quarter of the CY; study timeframe may exceed two years

Status - INCOMPLETE

Results Overview

Mitigation Plan Point #	Complete	Incomplete	Estimated Completion Date	OPR
1	Complete			
2	Complete			
3	Complete			
4	Complete			
5	Complete			
6	Complete			
7	Complete			
8	Complete			
9		Incomplete	2012	NGB
10		Incomplete	2009	NGB

Results

- 10 Point Risk Mitigation Plan has been jointly developed by the 177 FW, the New Jersey National Guard, and the National Guard Bureau
- Major portions of this plan were completed during development to expedite re-opening of WGR in order to minimize the adverse impact of extended range closure
- Eight of ten Risk Mitigation Plan action points have already been completed
- Remaining action points are long-term, resource intensive projects affecting future viability of Warren Grove Range and do not impact current range operations or range safety

Congressional Oversight

- Annual report on WGR safety measures
  - <90 days after act enactment
  - Annually for two years
  - Efforts made by all military departments to provide highest level of safety on WGR
- Study on Encroachment at WGR
  - <180 days after act enactment
  - Master plan for WGR and surrounding community
  - Includes region economy, environment, public health, military mission, land use plans
  - All affected parties and relevant stakeholders at Federal, State, and local levels

The Way Ahead

- Mitigation Points required to safely execute operations at Warren Grove Range have been completed
- Upon approval of NJANG/CC, WGR shall open to weapons deliveries as established and restricted by governing directives in compliance with the Risk Mitigation Plan
- Action plan required to facilitate satisfaction of congressional tasking items as per amendment to appropriations bill

WGR Risk Mitigation Communications Plan

What	When	By Whom
Communication with local elected leaders	7 – 10 days prior to opening	NJANG/CC FW/CC / CV
Press Release to local (WGR) area media	One weekly news cycle prior to opening	177 FW/PA
Town Council Briefings	At opening	NJANG/CC FW/CC / CV FW/DET 1/CC
Brighton, Pinewood Estates, and Ocean Acres Town Hall Meetings	After Town Council Briefings	NJANG/CC FW/CC / CV
WGR Community Council Meeting	After Town Hall Meetings	NJANG/CC FW/CC / CV
Media Flights	After full ops commence	OG/CC; FW/DET 1/CC / PA
Focused Media Pieces / Events	After full ops commence	177 FW/PA
First Responder / Community Service Recognition Events	Continue seeking opportunities to deliver recognition	NJANG/CC FW/CC / CV / PA

Congressional Report

Report on Selecting an Initial Flight Screening (IFS) Program

U.S. AIR FORCE

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Introduction

This report supplements the Congressional reporting requirement from House Report 109-702, page 76 delivered to the Congress on 29 March 2007. It specifically addresses the request to provide the cost analysis conducted to support the Air Force's decision to use a contract to fulfill its Initial Flight Screening (IFS) requirement.

The objectives of the IFS requirement were to reduce Specialized Undergraduate Pilot Training (SUPT) attrition, provide military rigor, discipline and standardization, motivate students to become career AF aviators, and instill scheduling predictability to allow students to be "pipelined" from one school to another. Specific to these objectives, in 2002-03 the Air Force investigated the overall costs versus benefits of the following four options:

1. No IFS: Not having an IFS program
2. Private Pilot License (IFT) Program: Continuing the existing IFT program
3. Military IFS: Acquiring aircraft and using military pilots with civilian maintenance
4. Contractor IFS: Contracting for a military-supervised, contractor-run schoolhouse

The specific Congressional request language follows:

> *"The conferees are also aware that the Secretary of the Air Force entered into a service contract for the Initial Flight Screening program at Pueblo Memorial Airport, Pueblo, Colorado, without conducting a full economic analysis to determine the best alternative for meeting the Air Force flight screening requirement. Therefore, the conferees direct the Secretary of the Air Force to perform an economic analysis as described in this section and provide the congressional defense committees written certification, not later than 180 days after the date of the enactment of this Act, whether such analysis supports continuation of the service contract."*

Executive Summary

In 1997 the Air Education and Training Command (AETC) senior leadership grounded the T-3 aircraft fleet as a result of several Class A accidents. In 1998, after a one year break in screening, accompanied by a doubling of the Specialized Undergraduate Pilot Training (SUPT) attrition rate, senior AETC leadership implemented Introductory Flight Training (IFT), a 40-hour program using civilian FAA-certified flight instructors, and cancelled the T-3 contractor-run, flight screening program at Hondo, Texas. IFT was a temporary quick-start measure conducted in civilian flight schools to give aviation candidates flight familiarization prior to attending formal military flying training. In 1999 the IFT program was expanded to 50 hours and included an FAA check ride. Program graduates were inadequately screened and trained in an environment lacking military discipline, rigor and oversight. This proved to be poor preparation for SUPT. To correct this situation, in 2003 AETC leadership explored alternative courses of action. A review of military requirements and initial analysis resulted in AETC leadership's decision to return to a demonstrably successful, single-site, military-supervised flight screening schoolhouse solution. Based on military requirements and available resources, AETC senior leadership decided to pursue a military-supervised, contractor-run IFS program. This Initial Flight Screening Program Report supports the 2003 decision.

Report

The following information addresses specific requests highlighted in the FY 2007 National Defense Authorization Act with respect to AETC IFS and AETC's decision.

Provide: "A clear explanation of the need for flight screening."

AETC senior leadership discontinued the successful T-3 contractor-run flight screening program at Hondo, Texas when the T-3 aircraft was grounded in 1997. Most assumed back in the 1997/8 timeframe that a schoolhouse would soon be reestablished at Hondo, Texas with a different aircraft to replace the grounded T-3. However, buying an airplane to replace the Air Force's fleet of 100 T-3s turned out to be a contentious issue which leadership at the time felt could not be successfully undertaken given the T-3's unfortunate history.

After the grounding of the T-3, no screening program existed at all. New lieutenants went directly from their commissioning sources to SUPT. The negative results of this were felt immediately in doubled SUPT attrition rates. As a temporary stop gap measure, senior leadership implemented IFT, a 40-hour program using civilian FAA-certified flight instructors, as a method that could be started quickly and would give the aviation candidates a degree of flight familiarization prior to attending formal SUPT. Subsequently, IFT was expanded to 50 hours, which included obtaining an FAA private pilot certificate. A degree of standardization which was missing in the 40-hour program was now included with the addition of an FAA private pilot check ride. Staff personnel who actually implemented IFT at the time indicated it was not intended to be a permanent solution to flight screening. It was incorrectly taken as a given that students who could successfully earn a private pilot's license would also be successful in completing SUPT. Additionally, students were relatively free to select an FAA accredited civilian flight school of their choosing as long as the quoted price to attain the IFT was judged to be within reason by the administering office. In late 2002, because of the problems evident with the IFT program, AETC senior leadership directed AETC/XP to explore the possibility of reestablishing a formal flight screening schoolhouse. The following alternatives where explored: No IFS, Continue IFT program, Military IFS, and Contract IFS.

No IFS: Not having a flight screening program was analyzed to determine if flight screening was more effective than none at all. Having no flight screening program could not meet the stated program objectives due to its lack of positive developmental influence on the potential pilot candidates. Over decades, data showed screened student pilots did better in SUPT than unscreened student pilots. The most telling data was the SUPT (T-37s) attrition rate after T-3 IFS in 1997 (7.8%) which doubled in one year without flight screening in 1998 (15.6%) (Source: AETC/HO, DSN 487-6564). Therefore, a decision was made to press forward with some type of screening program. While direct screening costs are zero without screening, the costs to send an extra 90-120 students each year to SUPT (to cover anticipated *additional* 7+% of roughly 1300 to 1700 total students who would annually washout of the program under a No IFS approach) would greatly disrupt instructor manpower, accession assignments, force structure, as well as increase operations and maintenance costs. Flight screening was determined to be effective, thus the No IFS alternative could not meet the program objectives.

Continue IFT Program: Continuing the existing IFT program was reexamined due to the fact it was in place and the Navy had begun a similar system (~25 flight hours vs. 50 to 60 per student for IFT) (source: AETC/DOF, DSN 487-2524)—yet neither program could meet the program objective. It was not foreseen at the implementation of the IFT program that the civilian flight school students would be treated like “customers” of the numerous flight schools and would be “carried” through to course completion almost without regard to their demonstrated flying ability. This is unsurprising in retrospect because there was no financial incentive for the flight school to send an incapable candidate home short of course completion. Candidates flew with instructors who treated them as “customers,” allowing flight in a very informal atmosphere, instead of a prescribed military flight suit or other more suitable flight-specific clothing. Their service orientation tended to deteriorate as well in this formative stage of their military careers as shown by high drop-on-request (DOR) numbers after arrival at SUPT. When a student quits after finding he or she doesn’t like “military style” flight training, the potential of that training slot is lost forever. That slot should be filled by a well-motivated individual. AETC leadership wanted the unmotivated individual to DOR in a rigorous, military style IFS, not be cajoled and coached to completion in the IFT program. The civilian flight school system has no hard start dates and no known-in-advance graduation dates. Therefore, students were more or less self paced and completed training when able. Such haphazard production had potential for disrupting more critical downstream training schedules as well.

Additionally, before ruling out the IFT program, the team looked at the Navy’s similar civilian program for flight screening. The Navy utilized fewer “authorized” flight schools than the Air Force but the candidates were still “customers” and very little, if any, meaningful screening actually occurred. This is verifiable through the diminishingly small numbers of students who “washed out” for cause. The old Hondo program screened out approximately ten percent of the attending candidates, whereas the USAF IFT program washed out less than one percent (with SUPT T-37s averaging 12-13% washouts) (Sources: AETC/DOR, DSN 487-5276, and USN/CINATRA). The Navy screening program at the time experienced similar civilian washout rates with their actual screening taking place in their T-34 program.

Based upon the findings above, AETC senior leadership determined the option to continue IFT program could not meet the program objectives.

Provide: “An examination of at least two alternatives for fulfilling the requirement and rationale for including the alternatives”

The following two alternatives were deemed capable of meeting the program objectives: Acquiring an aircraft and using military pilots with civilian maintenance for Military IFS, and contracting for a military supervised, contractor run, schoolhouse for Contractor IFS. Different basing options were explored such as locating a schoolhouse near each SUPT location, creating regional screening centers, or establishing a single location as was the case with the old Hondo schoolhouse.

Military IFS: Acquiring a new aircraft and using military pilots with civilian maintenance for a Military IFS was examined since the earlier T-41 screening program had worked well for decades. Establishing a System Program Office, arranging a fly-off, and acquiring 100 new aircraft, even if commercial off-the-shelf, would be a very time consuming process and require a large capital investment. As previously stated, buying an airplane to replace the Air Force's fleet of 100 T-3s turned out to be a contentious issue that leadership at the time felt could not be successfully undertaken given the unfortunate history of the T-3. Furthermore, Air Force manpower could not support the additional strain of reassigning or acquiring *an additional* 125+ instructor pilots (Source: AETC/DOR, DSN 487-5276) to man the Military IFS program. Lastly, due to the lack of available facilities at any Air Force Base remotely capable of continuously supporting the program, extensive military construction would be required. While not dismissed outright, the Military IFS alternative was only evaluated at a macro level given its improbable selection due to its programmatic hurdles.

Contract IFS: Contracting for a military supervised, contractor run schoolhouse was examined given limited barriers to implementation, minimal USAF manpower requirements, streamlined acquisition, and probable capability to meet the program's objectives. The Contractor IFS costs would include ground and flight training/screening, billeting, dining, physical fitness, anti-terrorism/force protection security, transportation, infrastructure maintenance, all risk insurance, and a Department of Labor wage determination of a GS-12 step one base salary for FAA Certified Flight Instructors (CFI). In early 2003, AETC/CONS published a formal Request for Information (RFI) to solicit input from interested contractors. The contractors that responded offered ideas and universally stated the least expensive option would be a single-site program. This solution minimized the logistical and manpower challenges inherent in multiple locations. A single screening location also minimized the military manpower required to provide program oversight.

Provide: "A cost estimate of the alternatives, a detailed explanation of the life-cycle cost calculations used in the determination, and a discussion of the benefits to be realized from the alternatives."

Costs:

Alternative (Net Present Value)	Aircraft Cost	CLS	Milcon	Manpower	BOS	Contract Cost	Life Cycle (10 yr)
Military IFS	**~$24M**	**~$30M**	**~$14M**	**~$111M**	**~$9M**	**0**	**~$188M**
Contractor IFS	**0**	**0**	**0**	**~$12M**	**0**	**~$127M**	**~$139M**

(Cost Information Sources: AETC/XPPB, DSN 487-8013, and AETC/DORI, DSN 487-9652, based on extrapolations from other aircraft programs)

Economic Analysis for IFS Program

Contract IFS Alternative

Discount Rate 2.80%

Period	Year	Aircraft Cost	CLS/MX	MILCON	Manpower Cost	Annual Operating Cost	Total Cost	Discount Rate	Net Present Value	Cumm NPV
1	2007	$0	$0	$0	$ 638,595	$ 6,260,000	$ 6,898,595	0.986287	$ 6,803,997	$ 6,803,997
2	2008	$0	$0	$0	$ 1,232,571	$ 12,390,000	$ 13,622,571	0.959423	$ 13,069,814	$ 19,873,811
3	2009	$0	$0	$0	$ 1,565,893	$ 15,960,000	$ 17,525,893	0.933291	$ 16,356,763	$ 36,230,574
4	2010	$0	$0	$0	$ 1,565,893	$ 15,960,000	$ 17,525,893	0.907871	$ 15,911,248	$ 52,141,822
5	2011	$0	$0	$0	$ 1,565,893	$ 15,960,000	$ 17,525,893	0.883143	$ 15,477,868	$ 67,619,690
6	2012	$0	$0	$0	$ 1,565,893	$ 15,960,000	$ 17,525,893	0.859088	$ 15,056,292	$ 82,675,982
7	2013	$0	$0	$0	$ 1,565,893	$ 15,960,000	$ 17,525,893	0.835689	$ 14,646,198	$ 97,322,181
8	2014	$0	$0	$0	$ 1,565,893	$ 15,960,000	$ 17,525,893	0.812927	$ 14,247,275	$ 111,569,455
9	2015	$0	$0	$0	$ 1,565,893	$ 15,960,000	$ 17,525,893	0.790785	$ 13,859,217	$ 125,428,672
10	2016	$0	$0	$0	$ 1,565,893	$ 15,960,000	$ 17,525,893	0.769246	$ 13,481,728	$ 138,910,400
NPV Summary		$ -	$ -	$ -	$ 12,448,006	$ 126,462,394				
						Total	**$ 138,910,400**			

Economic Analysis for IFS Program

Military IFS Alternative

Discount Rate 2.80%

Period	Year	Aircraft Cost	CLS/MX	MILCON	Manpower Cost	BOS	Total Cost	Discount Rate	Net Present Value	Cumm NPV
1	2007	$6,000,000	$1,050,000	$38,000,000	$ 4,084,492	$309,000	$49,443,492	0.986287	$ 48,765,488.42	$ 48,765,488.42
2	2008	$13,000,000	$2,850,000	$0	$ 11,529,390	$813,000	$28,192,390	0.959423	$ 27,048,440.00	$ 75,813,928.43
3	2009	$6,000,000	$3,900,000	$0	$ 14,181,846	$1,107,000	$25,188,846	0.933291	$ 23,508,530.61	$ 99,322,459.04
4	2010	$0	$3,900,000	$0	$ 14,181,846	$1,107,000	$19,188,846	0.907871	$ 17,420,995.00	$ 116,743,454.04
5	2011	$0	$3,900,000	$0	$ 14,181,846	$1,107,000	$19,188,846	0.883143	$ 16,946,493.19	$ 133,689,947.23
6	2012	$0	$3,900,000	$0	$ 14,181,846	$1,107,000	$19,188,846	0.859088	$ 16,484,915.56	$ 150,174,862.78
7	2013	$0	$3,900,000	$0	$ 14,181,846	$1,107,000	$19,188,846	0.835689	$ 16,035,910.07	$ 166,210,772.86
8	2014	$0	$3,900,000	$0	$ 14,181,846	$1,107,000	$19,188,846	0.812927	$ 15,599,134.31	$ 181,809,907.17
9	2015	$0	$3,900,000	$0	$ 14,181,846	$1,107,000	$19,188,846	0.790785	$ 15,174,255.17	$ 196,984,162.34
10	2016	$0	$3,900,000	($30,400,000)	$ 14,181,846	$1,107,000	($11,211,154)	0.769246	$ (8,624,138.63)	$ 188,360,023.71
NPV Summary		$ 23,989,976	$ 30,258,920	$ 14,093,830	$ 111,413,734	$ 8,603,564				
						Total	**$ 188,360,024**			

In 2002-03, HQ AETC/XP conducted market research to acquire the data used in this analysis.

Benefits: The table below indicates a higher total benefit for Contract IFS than for Military IFS.

Benefits	Weight	Benefit Description	Military		Contract	
Fosters a millitary environment	5	Ability to promote teamwork and discipline	95%	4.8	85%	4.3
Equality of opportunity	5	Equal training, standardization and screening criteria	95%	4.8	95%	4.8
Reducing SUPT Attrition	4	Ability to lower attrition at SUPT	90%	3.6	87%	3.5
Quick implementation	4	Current flight screening ineffective; benefits of new program immediately realized	40%	1.6	85%	3.4
Scheduling predictability	4	Allow students to be “pipelined” from one school to another	90%	3.6	90%	3.6
Minimizes USAF manpower requirements	4	Low demand on existing USAF instructor pilot manning	10%	0.4	90%	3.6
Minimizes time in casual status	2	Retention of training; minimizes time of 'deblueing'; cost effective	80%	1.6	80%	1.6
Total				**20.3**		**24.7**

Weight Scale
Critical - 5
Very Important - 4
Valuable - 3
Helpful - 2
Plus - 1

Provide: "A best value determination of each alternative"

AETC initially explored the four alternatives previously mentioned and narrowed it down to the two alternatives that met the flight screening program objectives. After comparing the cost to benefits, Contract IFS received a $5,623,902 cost per benefit point rating and Military IFS received a $9,278,818 cost per benefit point rating. Additionally, three main points stood out in Contract IFS' favor: 1) Its ability to start quickly with minimal mobilization costs, 2) Its low requirement for USAF manpower, and 3) Its estimated lower life-cycle cost. While the Military IFS and Contractor IFS programs share many of the same benefits, based on military requirements and available resources, AETC senior leadership decided to pursue a contractor-run, military-supervised IFS program.

Sensitivity Analysis:

Three cost sensitivity analyses were conducted using ECONPACK Army Economic Analysis Software,. These three sensitivity analyses allowed the cost of military construction, manpower and contract cost to vary +/- 25% in the economic analysis. This variance in cost did not impact the net present value ranking of the two alternatives. Additionally, sensitivity analysis of plus/minus 25% of discount rate shows no impact to the net present value ranking either.

Conclusion

In summary, AETC senior leadership recognized that the IFT program did not provide the Air Force with a screened, Air Force "blued," career motivated aviation candidate with a demonstrated ability and desire to succeed in military aviation. The Contractor IFS program will properly screen, train, "blue", and motivate the young Air Force officer to succeed in a demanding career path in a cost effective manner, thereby meeting Air Force military requirements and AETC's stated objectives for the program.

Congressional Report

Report on Counter-Man Portable Air Defense Systems (MANPADS) for the Civil Reserve Air Fleet (CRAF)

Senate Report 110-155, page 245

U.S. AIR FORCE

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Introduction

This report is being provided to the Congressional Defense Appropriations Subcommittees as directed in Senate Report 110-155 page 245, dated September 14, 2007. This report addresses the Congressional request to submit a report on the analysis of putting counter-MANPADS systems on CRAF aircraft, including a cost estimate and schedule for equipping the fleet. The specific language follows:

"Counter-Man Portable Air Defense Systems (MANPADS) for the Civil Reserve Air Fleet (CRAF). - The committee is concerned that the CRAF aircraft are not protected from MANPADS, which inhibits their ability to operate efficiently oversees and puts our troops, cargo and CRAF in hazardous operating environments. The Committee directs the Air Force to provide a report to the Defense Appropriations Subcommittees within 30 days of the passage of this Act that provides an analysis of putting counter-MANPADS systems on the CRAF aircraft, including a cost estimate and schedule for equipping the fleet."

Executive Summary

Civil Reserve Air Fleet (CRAF) aircraft are assets that are used to augment, not substitute for, organic airlift resources. CRAF aircraft are utilized only when there is a high probability that they will not be exposed to high threat areas. Current CRAF aircraft employment doctrine is to first utilize defensive system (DS) equipped organic aircraft, then non-DS equipped organic aircraft before employing the CRAF. There is currently no requirement for CRAF aircraft to be DS equipped, nor is there any intent for United States Transportation Command (USTRANSCOM) or Air Mobility Command (AMC) to institute policy changes that would require CRAF aircraft to operate in locations requiring defensive systems. Consequently, due to the high costs associated with such a program, the unknown willingness of air-carriers that participate in the CRAF program to fly into areas of higher threat (even if DS equipped), and the criticality of equipping organic airlift assets with defensive systems first, the Air Force does not support equipping the CRAF with counter-MANPADS defensive systems.

Report

There are significant and complex issues involved in the proposal for DoD/USAF to equip contract carriers and/or Civil Reserve Air Fleet aircraft with counter-MANPADS defensive systems.

First and foremost is the fundamental policy not to send civilian aircraft into threat areas. If defensive systems were installed on contract carriers, AMC does not envision operating them any differently than we do today – no further forward. The defensive systems would quite simply be an unnecessary addition for normal operations into FAA-approved countries (i.e., Kuwait Int'l).

Second is the fact that MANPADS are only one of many potential threats to operations in forward areas. When organic AMC aircraft operate in these areas, they are protected on several fronts; (1) the military airframe is inherently more hardened than a commercial airframe, (2) aircrew and critical systems are protected by armor against small/medium munitions (including fuel inerting), and (3) aircrew tactical arrival/departure profiles are used to minimize threat exposure. These tactical arrival/departure measures are also critical for aircraft protection, and require extensive training for safe execution. Even the most effective defensive systems become vulnerable if threat exposure times are extensive. It is doubtful that civilian airlines participating in CRAF would be capable of providing, or willing to provide, the necessary initial and follow-on tactics training required to truly provide CRAF operators what is necessary to minimize threats in a combat zone.

Because of the limited time allotted to prepare the cost/schedule portion of this report to Congress, the USAF leveraged a detailed analysis currently underway at the Department of Homeland Security (DHS) Counter-MANPADS program office. These data and analyses covers several options for outfitting commercial aircraft with counter-MANPADS defensive systems, one of which focuses on equipping a combination of all CRAF (Stage III) aircraft and a "historical norm" of eighty aircraft to fulfill AMC contract requirements.

Emerging results of this study indicate the rough capability, cost and schedule as follows:

- CRAF Stage III and 80 DoD Contract Airlift Option:
- Number of Civilian Passengers Protected: None (only Military)
- *Aircraft Modified: 1,755 with A-kits
    - 921 Specific Wide-body and 834 Specific Narrow-body Passenger and Cargo Aircraft
- **Number of B-kits Acquired: 1,755
- Number of B-kits Installed: 80
- Time to Complete: 6 Years
- ***Acquisition Cost: $3.7B
- ***Ops & Sustainment Cost (20 Years): $1.6B

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* A-kit refers to aircraft modification (hardpoints and wiring).
** B-kit refers to the actual defensive hardware which is selectively installed to the A-kit.
*** Costs should be considered rough-order-of-magnitude due to the in-work status of DHS' analysis.

These data are based on several assumptions. First, 1,382 A-kits would be required to equip all CRAF stage III aircraft. 80 A-kits would also be needed to outfit the "historical norm" to fulfill DoD contract airlift requirements. Therefore, a total of 1,462 A-kits would be required. Assuming a 20% buffer to accommodate fluctuations and/or potential growth in DoD airlift requirements:

$$1{,}462 + (0.20)(1{,}462) = 1{,}754.4 \text{ total A-kits installed, and B-kits acquired}$$

Additionally, it is assumed that 80 B-kits are installed on a combination of 45 wide-body and 35 narrow-body airframes, with the rest in "ready-reserve."

It is important to note that when USTRANSCOM reviewed the preceding figures, their estimate was that the acquisition and O&S costs were underestimated by a factor of at least ten. Based on the Air Force experience with structurally modifying 19 Pan Am B-747 aircraft in 1983-4 with heavier floors for military missions, probably the greatest cost segment for such a project is the increased fuel cost. The USAF paid Pan Am $560M upfront, most for increased fuel expenses (1980s prices) for flying with the increased weight on the aircraft for the 12 years the aircraft would be committed to CRAF. All but $100M out of a remaining $382M advance was lost when Pan Am filed for bankruptcy in 1991. The weights of the installed A-kits for 1,257 aircraft and the heavier B-kits for 80 aircraft are unknown, thus increased fuel costs cannot be calculated. However, no matter how light weight, it is estimated that $1.6B could not possibly pay the fuel costs for the 80 B-kits, much less the thousand aircraft modified with the A-kits for a period of 20 years, based on the Pan Am experience.

Beyond the high costs of such a program, other difficulties that would be faced in equipping CRAF aircraft with defensive systems include "technology transfer" issues, international agreements, and aircraft owner lease concerns. CRAF operators are not currently equipped to provide security for classified systems at all locations. It is not feasible for a CRAF operator to dedicate a CRAF aircraft with defensive systems from "start to finish." That is, typically, once a CRAF mission is complete, the CRAF operator reverts to flying standard revenue generating flights into worldwide locations that may or may not have requisite security to protect DS technology. Additionally, it is unknown whether foreign countries into which AMC's CRAF partners operate on "non-CRAF" missions would even allow a DS equipped aircraft to land. This would obviously be an area of great concern to an airline. Finally, the majority of the aircraft committed to the CRAF program are not owned by the airlines. They are leased from a variety of sources. While some lease owners might be willing to allow their aircraft to be structurally modified, and thereby limited to leasing and use by only US airlines, it is extremely doubtful that all aircraft owners may be willing to make a 20 year commitment on a standard 5 to 10 year lease.

Bottom line: The USAF does not plan to employ CRAF assets in areas of high threat from MANPADS, and, therefore, is not seeking funding to equip the CRAF with defensive systems. Priority within DoD must be given to the organic airlift fleet which operates in this threat environment on a daily basis. Therefore, it is the position of the USAF that equipping CRAF aircraft with counter-MANPADS defensive systems is not in the best interest of the nation in this time of limited resources.

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON DC

APR 2 5 2008

HQ USAF/SG
1780 Air Force Pentagon
Washington, DC 20030-1780

The Honorable Robert Byrd
Chairman
Committee on Appropriations
United States Senate
Washington, DC 20510

Dear Mr. Chairman

I am pleased to provide the number of nurses assigned to the Graduate School of Nursing's Doctoral program at the Uniformed Services University of the Health Sciences as requested in Senate Report 110-155, page 280, "Making Appropriations for the Department of Defense for the Fiscal Year Ending September 30, 2008."

Thank you for your continued support of the Nurse Corps. The Air Force currently has three students enrolled in the Doctoral program. Two are in the full-time and one is in the part-time program.

A similar letter has been sent to the Ranking Minority Member of your committee, and to the Chairmen and Ranking Minority Members of the other congressional defense committees.

Sincerely

JAMES G. ROUDEBUSH
Lieutenant General, USAF, MC, CFS
Surgeon General

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON DC

APR 2 5 2008

HQ USAF/SG
1780 Air Force Pentagon
Washington, DC 20030-1780

The Honorable Thad Cochran
Ranking Minority Member
Committee on Appropriations
United States Senate
Washington, DC 20510

Dear Senator Cochran

I am pleased to provide the number of nurses assigned to the Graduate School of Nursing's Doctoral program at the Uniformed Services University of the Health Sciences as requested in Senate Report 110-155, page 280, "Making Appropriations for the Department of Defense for the Fiscal Year Ending September 30, 2008."

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Surgeon General

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON DC

APR 2 5 2008

HQ USAF/SG
1780 Air Force Pentagon
Washington, DC 20030-1780

The Honorable Daniel K. Inouye
Chairman
Subcommittee on Defense
Committee on Appropriations
United States Senate
Washington, DC 20510-6028

Dear Mr. Chairman

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Surgeon General

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON DC

APR 2 5 2008

HQ USAF/SG
1780 Air Force Pentagon
Washington, DC 20030-1780

The Honorable Ted Stevens
Ranking Minority Member
Subcommittee on Defense
Committee on Appropriations
United States Senate
Washington, DC 20510-6028

Dear Senator Stevens

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DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON DC

APR 2 5 2008

HQ USAF/SG
1780 Air Force Pentagon
Washington, DC 20030-1780

The Honorable David Obey
Chairman
Committee on Appropriations
United States House of Representatives
Washington, DC 20515-6015

Dear Mr. Chairman

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Surgeon General

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON DC

APR 2 5 2008

HQ USAF/SG
1780 Air Force Pentagon
Washington, DC 20030-1780

The Honorable Jerry Lewis
Ranking Minority Member
Committee on Appropriations
United States House of Representatives
Washington, DC 20515-6015

Dear Mr. Lewis

I am pleased to provide the number of nurses assigned to the Graduate School of Nursing's Doctoral program at the Uniformed Services University of the Health Sciences as requested in Senate Report 110-155, page 280, "Making Appropriations for the Department of Defense for the Fiscal Year Ending September 30, 2008."

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DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON DC

APR 2 5 2008

HQ USAF/SG
1780 Air Force Pentagon
Washington, DC 20030-1780

The Honorable John P. Murtha
Chairman
Subcommittee on Defense
Committee on Appropriations
United States House of Representatives
Washington, DC 20515-6018

Dear Mr. Chairman

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JAMES G. ROUDEBUSH
Lieutenant General, USAF, MC, CFS
Surgeon General

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON DC

APR 25 2008

HQ USAF/SG
1780 Air Force Pentagon
Washington, DC 20030-1780

The Honorable C.W. Bill Young
Ranking Minority Member
Subcommittee on Defense
Committee on Appropriations
United States House of Representatives
Washington, DC 20515-6018

Dear Mr. Young

I am pleased to provide the number of nurses assigned to the Graduate School of Nursing's Doctoral program at the Uniformed Services University of the Health Sciences as requested in Senate Report 110-155, page 280, "Making Appropriations for the Department of Defense for the Fiscal Year Ending September 30, 2008."

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Lieutenant General, USAF, MC, CFS
Surgeon General

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON DC

APR 25 2008

HQ USAF/SG
1780 Air Force Pentagon
Washington, DC 20030-1780

The Honorable Carl Levin
Chairman
Committee on Armed Services
United States Senate
Washington, DC 20510-6050

Dear Mr. Chairman

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JAMES G. ROUDEBUSH
Lieutenant General, USAF, MC, CFS
Surgeon General

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON DC

APR 25 2008

HQ USAF/SG
1780 Air Force Pentagon
Washington, DC 20030-1780

The Honorable John McCain
Ranking Minority Member
Committee on Armed Services
United States Senate
Washington, DC 20510-6050

Dear Senator McCain

I am pleased to provide the number of nurses assigned to the Graduate School of Nursing's Doctoral program at the Uniformed Services University of the Health Sciences as requested in Senate Report 110-155, page 280, "Making Appropriations for the Department of Defense for the Fiscal Year Ending September 30, 2008."

Thank you for your continued support of the Nurse Corps. The Air Force currently has three students enrolled in the Doctoral program. Two are in the full-time and one is in the part-time program.

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Washington, DC 20515-6035

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Ballistic Missile Range Safety Technology (BMRST) Operations Acceptance Plan

1 Feb 08

Brig Gen Ted Kresge
AFSPC Dir of Air, Space and Info Ops

Brig Gen Joe Balskus
Asst Adjutant Gen FLANG

Congressional Mandate

- *"The Committee* believes that BMRST has developed the opportunity for a more flexible national launch complex…"*
- **Directed AFSPC to:**
  - *"…pursue this opportunity… …perform the certification process for the BMRST system…"*
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***HAC-D report accompanying FY08 appropriations bill**

AFSPC's Challenge…

- **Challenges…**
  - **…establish a team captain to lead the AF/ANG team**
  - **…align Active/Guard operators', developers', and testers' execution of a non-traditional acquisition/deployment**
  - **…forge an Air Force interpretation of the "Certification" mandate**

Building a disparate list of players into an effective team focused on one objective…
…ops acceptance decision for BMRST

The Challenge's Answer…

- **Gen Chilton in Jun 07:**
  - **Continue BMRST development**
  - **Test for ops acceptance decision**
  - **Assign system to Space Dev Test Wg**

- **AFSPC-ANG Gen Officer Steering Grp:**
  - ✓ **Build O-6 test working group**
  - ✓ **Establish a test plan**
  - ✓ **Resolve development/support contract issues**
  - ✓ **Gain consensus between all players**

HQ AFSPC has taken the lead—built one team, gained consensus, and paved a road to an ops acceptance decision on BMRST

BMRST Plan

- Conduct Force Development Evaluation (FDE)
  - How AFSPC certifies a system for fielding
- Eastern Range host integrated telemetry & cmd destruct test
  - Executed cooperatively by SDTW, 45 SW, 17 TS, FLANG
- Process Objective: Gain sufficient data to determine system's suitability and effectiveness
  - AFSPC/CC will use FDE to make ops acceptance decision

5 FDE Scenarios

1. Range integrated telemetry (receive/record)
2. Range integrated command destruct
3. Range integrated telemetry & command destruct
4. Stand-alone telemetry
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Comprehensive evaluation to support an ops acceptance decision

Ops Overview

- BMRST capability will:
  - Provide stand-alone “range in a box”
    - Potential future ORS requirements
  - Backfill existing range infrastructure
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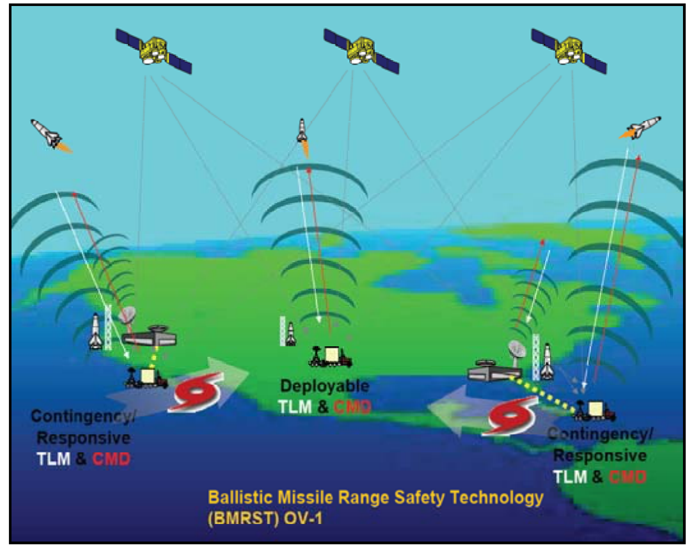
  - Enable non-traditional trajectories
  - Support asset-intensive surge needs



- BMRST Ops:
  - FLANG ops/maintenance
  - AFSPC managed/developed

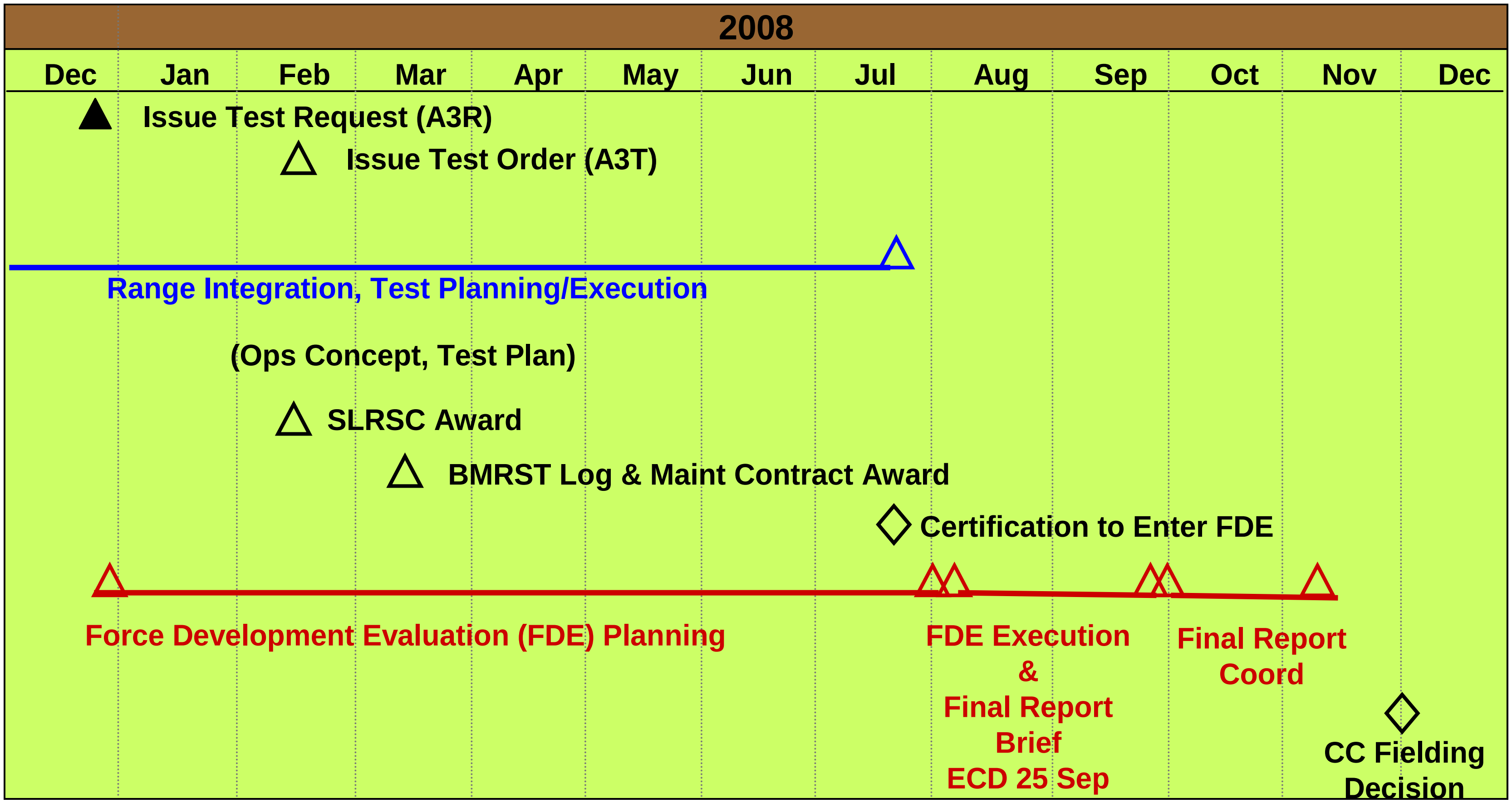
ADCON (T10)

AFSPC → SMC → SDTW → Space Test Operations Squadron → BMRST Deployed Unit

ANG ADCON (T32)

FL ANG → 125 Fighter Wing → 114 ROPS → BMRST DET

Ops Acceptance Test Timeline



The Way Ahead

- ✓ **Gain AF/FLANG consensus for FDE**
- ✓ **Draft Test Plan**
- ❑ **Develop & Test Integration H/W, S/W(Jul 08)**
- ❑ **Initiate BMRST FDE (Aug 08)**
- ❑ **Culminate BMRST FDE (Sep 08)**
- ❑ **Inform Congress FDE complete (Sep 08)**
- ❑ **AFSPC/CC fielding decision (Nov 08)**

Space Command teaming with the Florida Air National Guard to effectively develop and evaluate BMRST for an ops acceptance decision

DEPARTMENT OF THE AIR FORCE
WASHINGTON DC 20330-1000

OFFICE OF THE UNDER SECRETARY

MAR 17 2008

Mr. Gary E. Payton
Deputy Under Secretary (Space Programs)
1670 Air Force Pentagon
Washington DC 20330-1670

The Honorable Daniel K. Inouye
Chairman
Subcommittee on Defense
Committee on Appropriations
United States Senate
Washington, DC 20510-6028

Dear Mr. Chairman:

Attached is a briefing on the Ballistic Missile Range Safety Technology (BMRST) operations acceptance plan established by the Air Force. I am forwarding this briefing in response to House Report 110-434, page 320 of the Fiscal Year 2008 Defense Appropriations Act, which directs the Department of the Air Force to notify the defense committees of the results from the BMRST certification process 30 days before obligating or expending $3,000,000 of the funds made available for Spacelift Range Systems.

As shown in the briefing, Air Force Space Command and the Florida Air National Guard have established a partnership to expeditiously and comprehensively integrate and evaluate BMRST at the Eastern Range for operational use. The ongoing integration and certification process demonstrates the Air Force's commitment to fully assess the operational utility of BMRST in a comprehensive set of scenarios.

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Sincerely,

Gary E Payton

GARY E. PAYTON
Deputy Under Secretary (Space Programs)

Attachment:
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DEPARTMENT OF THE AIR FORCE
WASHINGTON DC 20330-1000

OFFICE OF THE UNDER SECRETARY

MAR 17 2008

Mr. Gary E. Payton
Deputy Under Secretary (Space Programs)
1670 Air Force Pentagon
Washington DC 20330-1670

The Honorable Ted Stevens
Ranking Minority Member
Subcommittee on Defense
Committee on Appropriations
United States Senate
Washington, DC 20510-6028

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United States Senate
Washington, DC 20510-6050

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The Honorable John P. Murtha
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Subcommittee on Defense
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Washington, DC 20515-6018

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Washington DC 20330-1670

The Honorable C.W. Bill Young
Ranking Minority Member
Subcommittee on Defense
Committee on Appropriations
U.S. House of Representatives
Washington, DC 20515-6018

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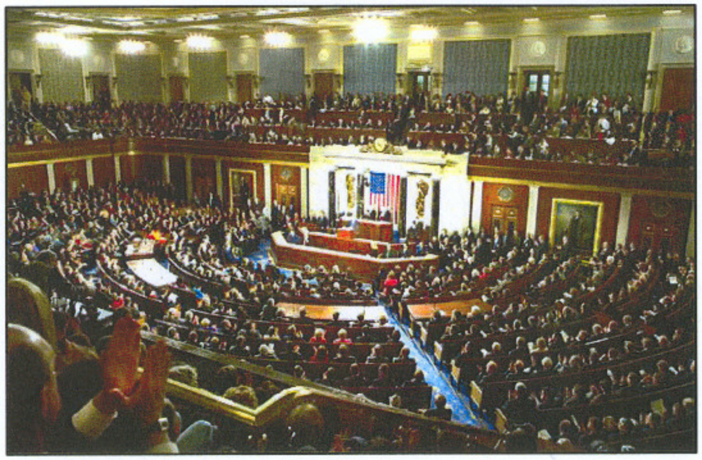

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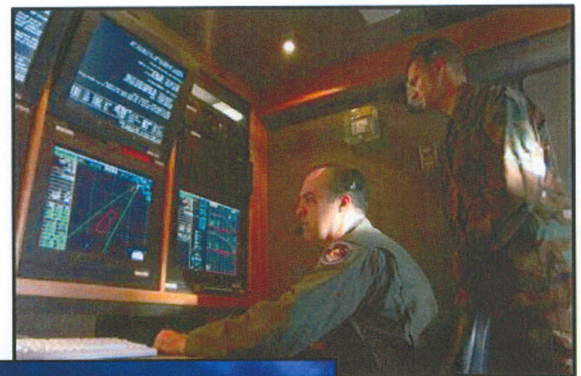

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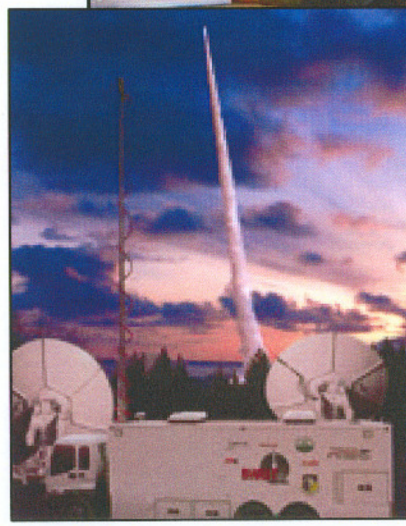

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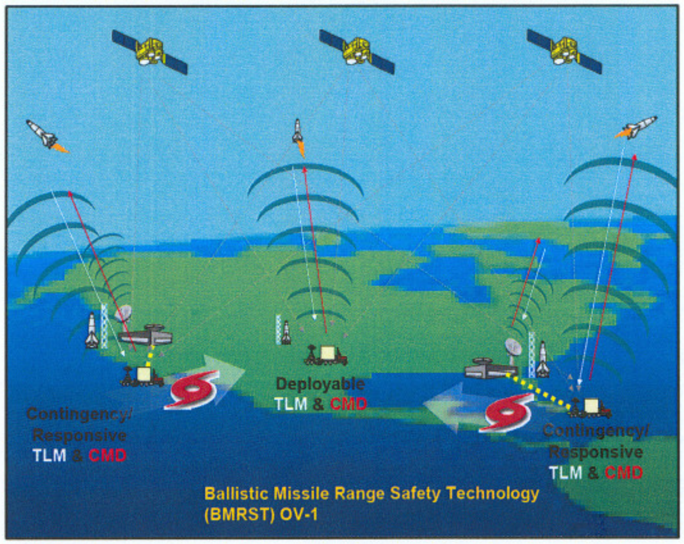

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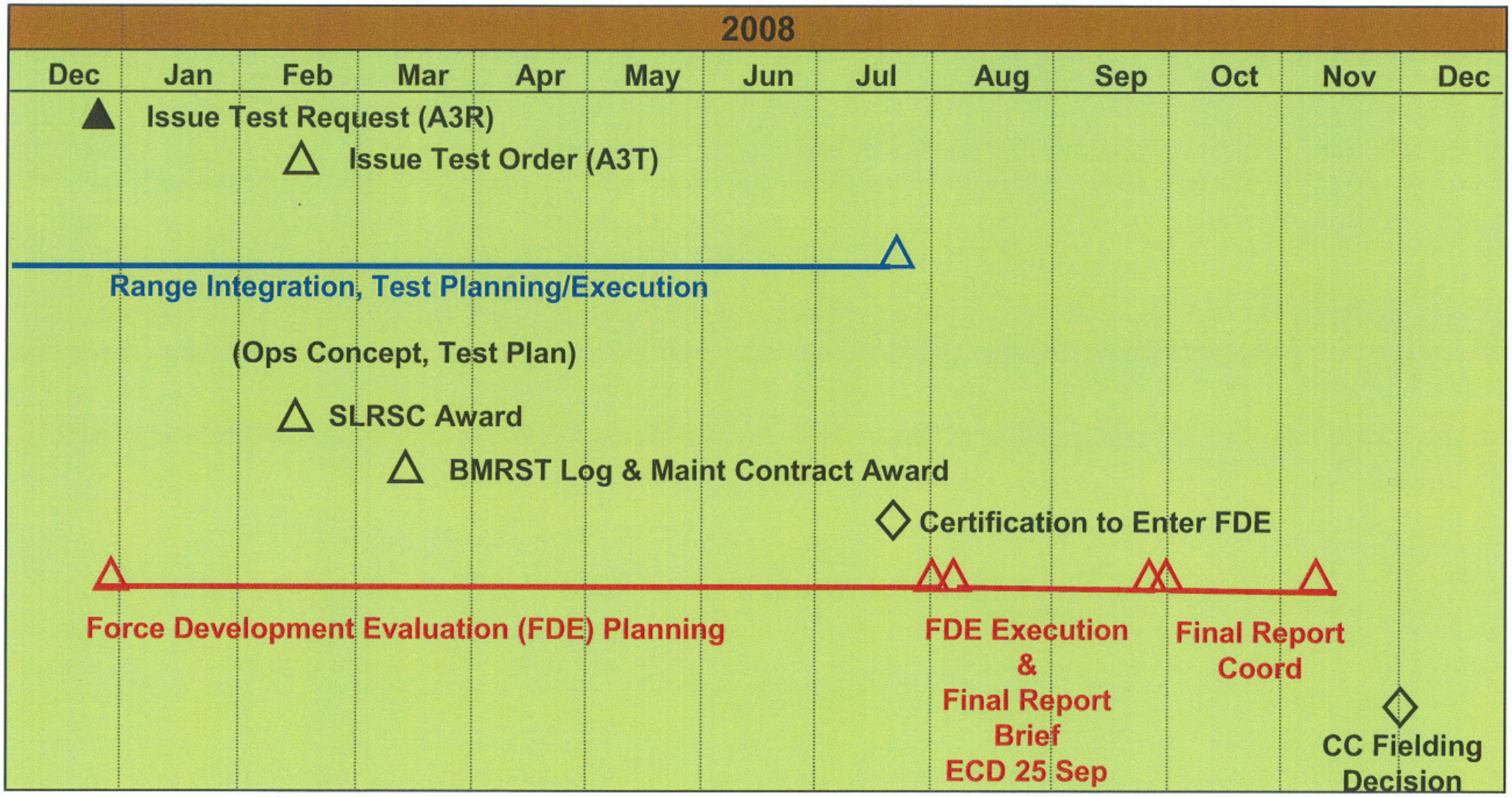
Ops Acceptance Test Timeline



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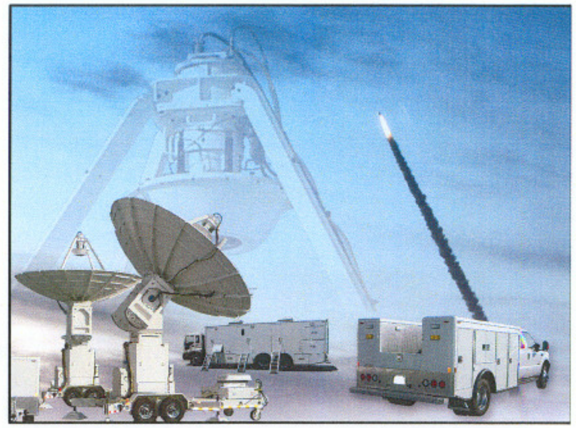

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Space Command teaming with the Florida Air National Guard to effectively develop and evaluate BMRST for an ops acceptance decision

United States Air Force

Report to Congressional Committees

Material Handling Equipment Study

May 2009

Introduction

This report is being provided to the congressional defense committees as directed in SRpt 110-335 to accompany S 3001, P13.

MATERIAL HANDLING EQUIPMENT STUDY

The committee understands that the U.S. Transportation Command (TRANSCOM) has previously identified significant shortfalls in Air Force material handling equipment (MHE) capable of deploying and operating in austere expeditionary environments. In response, Congress increased funding for the Halvorsen Air Cargo Loader for a number of years. The committee is concerned that ongoing attrition of older MHE units, increased Army combat end strength potentially requiring increased through put, and procurement of additional strategic and theater lift aircraft including the JCA and KC–X tanker with increased cargo capacity may serve to further exacerbate the operational requirements versus availability of MHE. Therefore, the committee directs the Secretary of the Air Force, in consultation with the Secretary of the Army, to conduct a comprehensive analysis of current and future MHE requirements across the Air Force, Army, and National Guard, and report to Congress on the findings of the study with the budget request for fiscal year 2010.

Executive Summary

The current Air Force aircraft loader inventory includes 60K (Tunner) and 25K (Halvorsen) high-reach capable loaders. The aircraft loader inventory also includes "legacy" 40K and 25K loaders that are not high-reach capable and cannot service commercial aircraft and the Air Force KC-10 cargo missions. These legacy loaders are older models that are increasingly difficult to maintain and sustain. The Air Force strategy is to ultimately replace legacy loaders with high-reach capable loaders.

Enterprise wide requirements for aircraft loaders and other Material Handling Equipment (MHE) are developed at the biennial Worldwide MHE Conference. The July 2008 conference recommended requirements for an additional 23 Tunner 60K and 174 Halvorsen 25K high-reach capable loaders, which represents a requirements increase of approximately 7.5 percent over the current high-reach capable loader inventory. AMC is concerned with the growth in requirements—particularly for 25K high-reach capable loaders—given low operating hours worldwide and the absence of reported readiness impacts.

The Senate Report 110-335, which requested the MHE study, specified three sources of potential future requirements for aircraft loaders: ongoing attrition of older MHE units; increased Army end strength; and procurement of additional strategic and theater airlift aircraft, specifically the C-27J Joint Cargo Aircraft (JCA) and the KC-X tanker. The Air Force strategy to address attrition of older MHE is to replace legacy 40K and 25K loaders with high-reach capable models, based on validated requirements. In terms of increasing Army end strength, Army planning on the basing of additional soldiers is not mature enough to determine an emerging requirement for additional aircraft loaders. Preliminary basing studies for the JCA and KC-X also do not indicate an increased requirement for aircraft loaders.

The Air Force is validating a revised aircraft loader requirements methodology that promises to better define the optimal mix of high-reach aircraft loader types, e.g., 60K, 25K, across the enterprise. The Air Force is also standardizing the requirements process across all major commands (MAJCOMs) to add rigor and produce a more objective requirement. A new requirement will be produced in summer 2009 using the standard methodology. Combined with the ongoing Mobility Capability and Requirements Study (MCRS-16) later in the year, the Air Force will have a newly validated MHE requirement by the close of 2009.

Recommend aggressively pursuing aircraft loader requirements generated by the MCRS-16 based requirement in the FY11 budget to systematically field a high-reach capable fleet of aircraft loaders. Further recommend continuing assessment of potential requirements in support of KC-X and JCA as operating concepts mature.

Report

The current Air Force aircraft loader inventory includes high-reach capable 60K and 25K Next Generation Small Loader (NGSL) loaders, as well as legacy 40K and 25K loaders, which are not high-reach capable. High-reach capable loaders offer the capability to transport cargo to and from the aircraft and raise it to reach the cargo hold of all military and wide-body commercial cargo aircraft. High-reach loaders also have a powered conveyor system versus rollers, which helps increase throughput by accelerating cargo load/unload times. Prior to the acquisition of high-reach capable loaders, legacy 40K and 25K loaders required a stationary Wide Body Elevator Loader (WBEL) to lift cargo from the loader to wide-body commercial cargo aircraft and the KC-10. The Air Force began a systematic replacement of legacy 40K loaders and WBELs in 1997 with the introduction of Tunner loader. The Air Force has completed the systematic replacement of all WBELs and 233 legacy 25K loaders since the introduction of the Halvorsen loader in 2001. The legacy and high-reach capable aircraft loaders are illustrated in Figure 1 below.

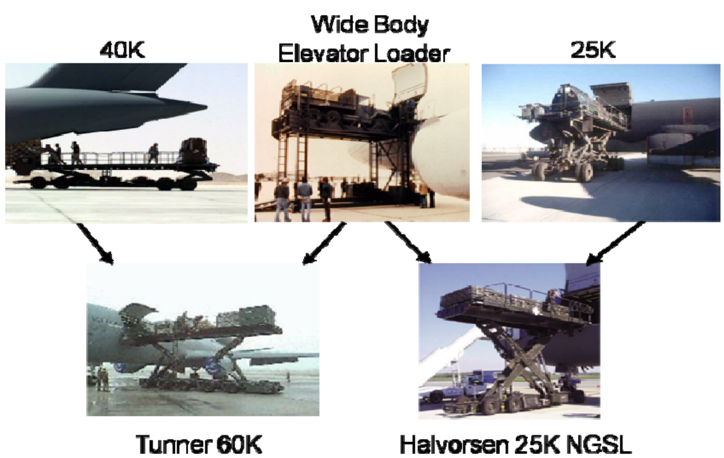

Figure 1. Legacy and High Reach Capable Loaders:

Worldwide inventory figures are provided in Table 1 below.

Type Loader	Pallet Capacity	Inventory	Aircraft Serviced
60K High Reach Capable	6	319	All military/commercial cargo aircraft
40K	5	21	All military aircraft (excluding KC-10), lower hold of B747
25K High Reach Capable	3	407	All military/commercial cargo aircraft
25K (Legacy)	3	403	All military aircraft (excluding KC-10), lower hold of B747

Table 1. USAF Aircraft Loader Inventory

Current MHE requirements.

Worldwide MHE Conference. Day-to-day and war reserve requirements for aircraft loaders are developed at the biennial Worldwide MHE Conference, which is chaired by Headquarters Air Force (HAF) and hosted by the Air Mobility Command (AMC). Attendees include all Air Force major commands (MAJCOMs), US Air Forces Central (AFCENT) and the Warner Robins Air Logistics Center (WR-ALC). Results from the July 2008 Worldwide MHE conference are provided in Table 2.

Type Loader	*Authorized*	*Assigned*	*Net Requirement*
60K High Reach Capable	342	319	23
40K	5	21	(16)
25K High Reach Capable	581	407	174
25K (Legacy)	26	403	(377)
Total—All Loaders	**954**	**1,150**	**(196)**

Table 2. Worldwide MHE Conference Results, July 2008

Computation Methodology. AMC employs an objective requirements methodology to compute its MHE requirement, which represents approximately 60 percent of the worldwide 60K high reach capable loader requirement and 70 percent of the worldwide 25K high reach capable loader requirement. AMC uses the US Transportation Command's (USTRANSCOM) Joint Flow and Analysis System for Transportation (JFAST) tool to compute its aircraft loader requirement, considering war plan requirements, working "maximum on the ground" (MOG) capability by location and other data elements to project day-to-day and wartime air cargo throughput by location. Working MOG reflects how many aircraft can be off-loaded and serviced at any given time. Day-to-day and war reserve requirements are derived from the expected air cargo throughput. Other MAJCOMs and AFCENT use a "best estimate" approach based on field experience.

Analysis of Loader Requirements. At first glance it appears worldwide inventory exceeds authorizations by nearly 200 aircraft loaders. It should be noted that all WBELs have been retired from the inventory, and 159 legacy 40K and 233 legacy 25K loaders have also been retired since August 1997. Residual requirements for the 40K and 25K loaders reflect preferences of non-AMC MAJCOMs in their best estimate requirements. Differences in both 40K and 25K loaders authorized versus assigned figures reflect both planned replacements by high-reach loaders and loaders that will be retired from the inventory through attrition. Desired end state is a worldwide MHE fleet consisting almost entirely of high-reach capable loaders. This end state would be achieved with the retirement of all legacy 40K loaders and all legacy 25K loaders (with the possible exception of the newer Southwest Mobile 25K loaders) and replacement with high-reach capable loaders.

Depot Overhaul. The 30-year strategy to sustain high-reach capable loaders involves depot-level overhaul versus replacement. An ongoing Tunner overhaul demonstration completes in February 2009 with low-rate overhaul of 7 loaders beginning in May 2009 and

18 more in FY10, reaching full rate of 32 overhauls in FY11 and beyond. The NGSL overhaul demonstration is planned for FY11 with the first loader scheduled for overhaul in FY14. With service life extensions provided by depot-level overhauls, replacements for Tunners and NGSLs in the active inventory would not be addressed until the late 2020s and 2030s, respectively.

Future requirements.

Senate Report 110-335, which requested this MHE study, specified three sources of potential future requirements for aircraft loaders: ongoing attrition of older MHE units; increased Army end strength; and procurement of additional strategic and theater airlift aircraft, specifically the C-27J Joint Cargo Aircraft (JCA) and the KC-X tanker.

Attrition and Combat Wear and Tear. Legacy loaders still provide a valuable service to global air mobility. But with an average age of 19 years, diminished manufacturing source availability for the 40K and 25K legacy loaders require increasing amounts of maintenance and spare parts to sustain; hence, the aforementioned strategy to replace these loaders with new, high-reach capable loaders. The Tunner and NGSL loaders were designed with an average life span of 30 years, in moderate working and climate conditions, with regular preventive maintenance and two scheduled depot overhauls. However, 39 Tunners and 51 NGSL loaders have been operating in extreme conditions in support of Operations ENDURING FREEDOM (OEF) and IRAQI FREEDOM (OIF). WR-ALC, in conjunction with AFCENT, devised and implemented a plan to refurbish loaders in place and ahead of the planned overhaul schedule to address combat wear and tear in lieu of early replacement. Five loaders from two locations were refurbished by the depot level repair team in January 2009. The remaining inspections are ongoing and all refurbishments will be completed in FY09.

Increased Army End Strength. Although planning is preliminary, initial discussions with Headquarters Army indicate no additional loader requirements to support the proposed troop beddown strategy. Additionally, the MCRS-16 incorporates growth of Army end strength into the foundational assumptions and scenarios. The new requirement based on MCRS-16 results will therefore capture potential loader requirements not yet identified by the Army. As an interim safeguard, the number of legacy 25K loaders in the active inventory provides flexibility to re-position loaders to meet unforeseen Army requirements in the near term. AMC will continue to partner with USTRANSCOM and the Army to validate emerging aircraft loader requirements due to increasing Army end strength.

Procurement of Additional Strategic and Theater Airlift Aircraft. Future procurement of the KC-X tanker will afford additional cargo space for strategic airlift and will require high-reach loader capability. Based on the preliminary KC-X basing strategy, the current fleet of Tunners and NGSL loaders in current locations would support KC-X operations. The acquisition strategy to replace legacy loaders with high-reach capable loaders worldwide should be complete prior to the introduction of the KC-X to the active inventory. The C-27J JCA does not require a high-reach capable loader and thus drives no requirement for additional high-reach loaders. Air Force JCAs can be serviced by the existing fleet of 60K, 40K and 25K loaders. Army JCAs can also be supported by the existing loader fleet, but they have commissioned a Joint Capability Technology Demonstration to evaluate the Joint Recovery and Distribution System (JRaDs) as an alternative or companion to existing loaders. The JRaDs is a family of system trailers with the capability to self-load/offload in a tactical environment. Bottom line is the current aircraft loader acquisition strategy will support the future procurement of additional strategic and theater airlift aircraft.

Emerging Requirements Methodology.

Need for Enterprise Wide Requirements Computation Methodology. Several factors drive the need to reassess the requirements methodology for aircraft loaders. First, nearly 40 percent of the worldwide requirement for 60K high-reach capable loaders and 30 percent of the worldwide requirement for 25K high-reach capable loaders is derived by “best estimate” in lieu of an objective methodology. We believe data is available to improve on a “best estimate” computation of any portion of the worldwide requirement. We are also concerned with the growth in requirements at the July 2008 Worldwide MHE Requirements Conference. With an overhaul versus replace strategy for the Tunner and NGSL loaders and a “pre-overhaul” process in place in the US Central Command Area of Responsibility to mitigate combat wear and tear, what is driving an increase in requirements from the original Operational Requirements Document figure of 319 Tunners and 538 NGSLs to 342 60K high-reach capable loaders and 581 25K high-reach capable loaders? This increase is especially questionable with the NGSL, given the extremely low operating hours worldwide and the absence of reported operational impacts. A comparison of Tunner and NGSL loader operating hours worldwide and in key Global War on Terrorism locations is provided in Figures 2 and 3 below.

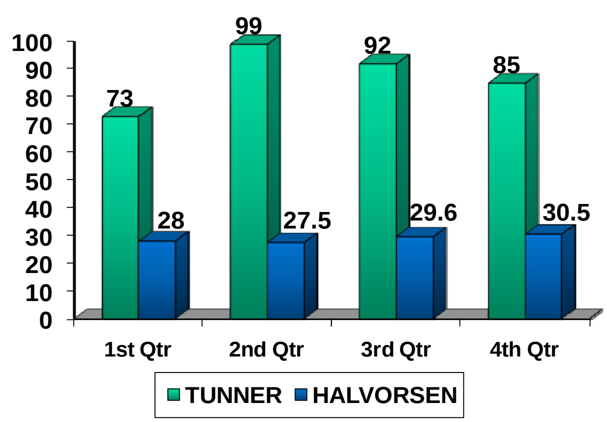

Figure 2. Tunner and NGSL Average per Loader Worldwide FY08 Operating Hours

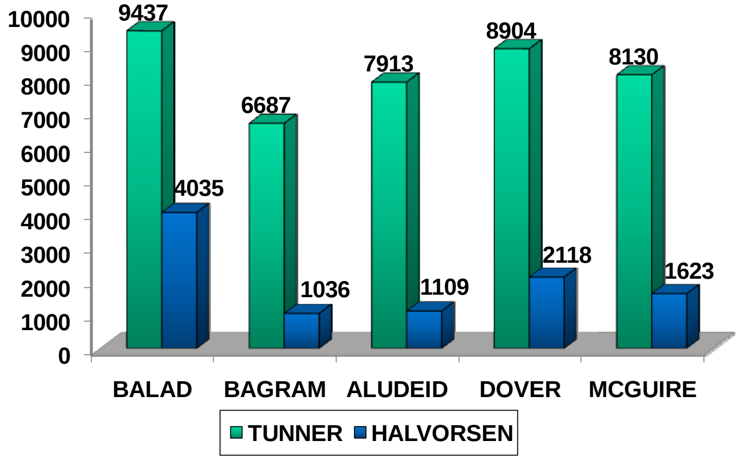

Figure 3. Tunner and NGSL Total FY08 Operating Hours in Key GWOT Locations

Revised AMC Methodology. AMC is validating variables used in determining aircraft loader mix by location. They are also validating USTRANSCOM's Airport Simulation Tool as means of providing additional fidelity to the optimal mix of loaders by location to maximize throughput at high traffic locations. We expect to have an updated requirement for AMC and worldwide war reserve in spring 2009.

Revised Worldwide MHE Requirement. AMC introduced its revised requirements methodology at the July 2008 Worldwide MHE Conference and it was well received. The AMC Vice Commander published a 19 December 2008 memo to all MAJCOM Vice Commanders instituting the AMC requirements methodology as a standard approach to "…add rigor to the process and produce a more objective and defendable worldwide MHE requirement." Following a final evaluation of the requirements methodology by the HAF Directorate of Analyses, Assessments and Lessons Learned (HAF/A9), AMC initiated a data call to MAJCOMs in February 2009 to implement the standard process. The results of the data call will be used to produce a preliminary worldwide MHE requirement by location at an out-of-cycle Worldwide MHE Conference in summer 2009. Conferees will validate the computed worldwide MHE requirement and MAJCOMs will be challenged to justify any variances. This approach promises to produce a consistent and objective worldwide MHE requirement.

Recommendation. The MCRS-16 is ongoing with scheduled completion in November 2009. This study will produce informed recommendations with respect to our airlift force structure, to include aircraft loaders, by assessing requirements to support the National Military Strategy as it relates to conventional campaigns, homeland defense, irregular warfare operations, and small scale security postures that define our future requirements. The Air Force will merge results from the revised worldwide MHE requirement with results of the MCRS-16 and publish an updated requirement by the close of 2009. Recommend aggressively pursuing requirements generated by the MCRS-16 based requirement in the FY11 budget to systematically replace all legacy aircraft loaders with cutting edge technology, high-reach capable loaders. Further recommend continuing assessment of potential requirements to support the KC-X aircraft and continued partnership with the Army to assess future requirements in support of increased end strength and the JCA.

Distribution

The Honorable Daniel K. Inouye
Chairman
Committee on Appropriations
United States Senate
Washington, DC 20510

The Honorable Thad Cochran
Vice Chairman
Committee on Appropriations
United States Senate
Washington, DC 20510

The Honorable Daniel K. Inouye
Chairman
Subcommittee on Defense
Committee on Appropriations
United States Senate
Washington, DC 20510-6028

The Honorable Thad Cochran
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The Honorable Carl Levin
Chairman
Committee on Armed Services
United States Senate
Washington, DC 20510-6050

The Honorable John McCain
Ranking Minority Member
Committee on Armed Services
United States Senate
Washington, DC 20510-6050

The Honorable David Obey
Chairman
Committee on Appropriations
United States House of Representatives
Washington, DC 20515-6015

The Honorable Jerry Lewis
Ranking Minority Member
Committee on Appropriations
United States House of Representatives
Washington, DC 20515-6015

The Honorable John P. Murtha
Chairman
Subcommittee on Defense
Committee on Appropriations
United States House of Representatives
Washington, DC 20515-6018

The Honorable C.W. Bill Young
Ranking Minority Member
Subcommittee on Defense
Committee on Appropriations
United States House of Representatives
Washington, DC 20515-6018

The Honorable Ike Skelton
Chairman
Committee on Armed Services
United States House of Representatives
Washington, DC 20515-6035

The Honorable John McHugh
Ranking Minority Member
Committee on Armed Services
United States House of Representatives
Washington, DC 20515-6035

SECRETARY OF THE AIR FORCE
WASHINGTON

MAR 13 2009

The Honorable Carl Levin
Chairman
Committee on Armed Services
United States Senate
Washington, DC 20510-6050

Dear Mr. Chairman:

I am pleased to provide the following response as directed in Senate Report 110-335-346, from the National Defense Authorization Act for Fiscal Year 2009.

The committee had received reports of officers qualified for aviation service missing their ''gate'' thresholds for continued eligibility for receipt of Aviation Career Incentive Pay (ACIP), or "flight pay," due to non-flying assignments, including Joint Expeditionary Taskings, formerly called ''in lieu of,'' or individual augmentee assignments in Operations ENDURING FREEDOM and IRAQI FREEDOM. Due to these reports, the committee directed we review our ACIP program, our assignment of officers qualified for aviation service to non-flying duty assignments, and the effect of these assignments on these officers' continued eligibility for ACIP.

In Fiscal Year 2008, six individuals requested a waiver for flying gate credit. One of them fell into the category discussed above and the waiver was approved. In addition, a review of the flying gate waiver requests and approvals data from Fiscal Years 2006 and 2007 showed no evidence of this non-flying assignment/gate credit issue.

As part of this review, we also examined Air Force policies with respect to gate thresholds and reporting procedures. It is Air Force policy that as many members as possible perform flying duties to meet their first and second "gate" thresholds. The table below defines these "gate" thresholds. These "gates" define how many months a member must be actively flying to receive ACIP. For example, to meet the first "gate" an aviator must have flown 96 months by the time they reach 12 years of active service for continued ACIP.

Flying Gate	**Gate Months Required**	**Required by**	**Ensures ACIP until**
< 1st			12 YAS
1st	96	12 YAS	18 YAS
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3rd	144	18 YAS	25 YAS

Flying to meet the third flying gate depends upon operational needs of the Air Force. If an officer takes a non-flying assignment prior to reaching their third flying gate, Air Force

regulations require the member to sign a flying gate letter before they receive the assignment. Signing this letter does not mean the member is volunteering to lose their ACIP. Rather, the member is simply acknowledging if he or she does not return to fly in time to make their respective flying gate, their flight pay could be lost in the future.

Due to concern over the possible effects of non-flying assignments and deployments on members receiving ACIP, on April 28, 2008, the Chief of Operational Flight Training Division, Directorate of Air Operations signed a memorandum providing interim policy guidance for Air Force Instruction (AFI) 11-401, *Aviation Management*, which we are currently incorporating into the next revision of AFI 11-401. This guidance directed Host Aviation Resource Management offices to assign Flying Status Code (FSC) "K" to aircrew members deployed via Contingency, Exercise, and Deployment orders to perform non-flying duties for more than 90 days. Previously, these members would have been assigned FSC "S" for non-performance of flying duties while deployed. This coding caused issues, as it was not evident the member was not flying due to deployment. This improved policy guidance benefits members as it properly accounts for these deployments and provides documentation in case members do not meet flying gates and must request waivers.

Our Air Force policy and assignment personnel at the Air Force Personnel Center take our ACIP program very seriously when considering assignments and non-flying deployments. We will continue to make every attempt to make every assignment and deployment work within our improved ACIP policy and will consider waivers when the needs of our fighting force to support the joint war fighter take precedence.

A similar letter has been sent to the Ranking Minority Member of your Committee and to the Chairman and Ranking Minority Member of the House Armed Services Committee.

Sincerely,

Michael B Donley

Michael B. Donley

SECRETARY OF THE AIR FORCE
WASHINGTON

MAR 13 2009

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Ranking Minority Member
Committee on Armed Services
United States Senate
Washington, DC 20510-6050

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U.S. House of Representatives
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Michael B. Donley

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SECRETARY OF THE AIR FORCE
WASHINGTON

MAR 13 2009

The Honorable John McHugh
Ranking Minority Member
Committee on Armed Services
U.S. House of Representatives
Washington, DC 20515-6035

Dear Representative McHugh:

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Sincerely,

Michael B. Donley

Michael B. Donley

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON, DC

28 APR 2008

MEMORANDUM FOR All MAJCOM A3Ts

FROM: HQ USAF/A3O-AT

SUBJECT: Flying Status Code (FSC) "K" for Aircrew Deployed to Non-flying Positions

Effective immediately, Host Aviation Resource Management offices will assign FSC "K" to aircrew members assigned to an active flying Aircrew Position Indicator (API) coded billet that are deployed via Contingency, Exercise, and Deployment (CED) orders to perform non-flying duties for more than 90 days. Assignment of FSC "K" will be effective the day following the date of departure from home station. Upon return from the non-flying deployment aircrew members will be assigned FSC "A".

This policy letter will be incorporated in the next revision to AFI 11-401. Air Force point of contact for this matter is [redacted] (b)(6) (b)(2)

MICHAEL E. MCKINNEY, Col, USAF
Chief, Operational Training Division
Directorate of Air Operations

United States Air Force

Report to Congress

Air Force Nuclear Security Report

August 2009

Senate Report 110-355, page 391

Introduction

This report is being provided to the Congress as directed in FY09 NDAA (Senate Report 110-335 to accompany S 3001).

> "In the wake of the Labor Day weekend unauthorized transfer of nuclear weapons from Minot Air Force Base, North Dakota, to Barksdale, Louisiana, discussed in more detail elsewhere in this report, the Air Force included a long list of nuclear security related items on its unfunded priorities list of the Chief of Staff of the Air Force. The long list totals approximately $122 million and ranges from $30,000 to operate security cameras that have already been installed, to building roads. Many of these items have significant out-year costs as well. The committee is aware that there are needed security enhancements but has declined to include additional funds for any of the items on the list. The committee directs the Secretary of the Air Force to develop a rational plan to fund needed nuclear security enhancements and to submit that plan to the congress with the fiscal year 2010 budget. The committee expects that the funding to support the plan will be included in the Air Force fiscal year 2010 budget request."

Executive Summary

Strategic deterrence, with credible nuclear deterrent capability as the essential foundation, is as relevant today as it was 60 years ago. As a significant provider of this capability, the United States Air Force embraces this mission as a core function, and is taking all necessary steps to fully reclaim the trust and confidence required of stewards of nuclear capabilities. Credible nuclear deterrence hinges upon a safe, secure and reliable nuclear enterprise.

Over the last several months, the Air Force senior leadership team, along with our Office of the Secretary of Defense (OSD) and Inter-agency partners, has closely examined the Air Force nuclear enterprise and identified several areas for improvement. A comprehensive approach to problem solving with broad institutional support was conducted, codified in a roadmap for action that confronts and addresses not just symptoms, but more importantly, root causes.

We have identified certain areas that require additional resources to safely and securely carry out our solemn responsibility as good stewards of the nuclear enterprise. The fiscal year 2009 Air Force Unfunded Requirements List (URL) lists approximately $122 million of nuclear surety items. These items include the materiel, personnel, and procedures that contribute to the safety, security, reliability, and control of nuclear assets. All of the items listed except one that was mitigated have been funded in the Air Force fiscal year 2010 President's Budget request.

In the fiscal year 2010 President's Budget request, the Air Force is funding an additional $50 million in nuclear security initiatives, covering a wide variety of Security Forces items enterprise-wide.

We are confident that with Congressional support, we can effectively and efficiently reinvigorate the Air Force nuclear enterprise.

Report

A series of internal and external assessments have closely examined the management of the nuclear enterprise in the Air Force and Department of Defense as a whole. The Air Force has synthesized the findings from these commissions in order to identify and confront root causes. This synthesis formed the basis for the Air Force Nuclear Roadmap, which is a comprehensive approach to problem solving across the Air Force nuclear enterprise that: rebuilds our culture of accountability and rigorous self-assessment, rebuilds nuclear expertise training and career paths for personnel, ensures we have a solid, end-to-end sustainment systems, develops comprehensive investment plans for nuclear mission requirements, sustains nuclear deterrent mission advocacy, and aligns authorities and responsibilities to meet nuclear deterrent mission requirements. The results have also helped the Air Force ascertain a clearer picture of the capability gaps in the nuclear enterprise across the Joint Capability Areas – to better focus re-prioritization of effort. The Air Force embraces the nuclear deterrence mission as a core function. The top priority of the Air Force is reinvigorating the nuclear enterprise and we are re-committed to our stewardship role.

The following is a comprehensive list of reports and assessments that have shaped the Air Force's action plans to reinvigorate the nuclear enterprise:

Commander Directed Investigation Concerning an Unauthorized Transfer of Nuclear Warheads, 30 August 2007 (CDI);

Blue Ribbon Review of Nuclear Weapons Policies and Procedures, 8 February 2008 (BRR);

The *Defense Science Board* (DSB) *Permanent Task Force on Nuclear Weapons Surety – Report on Unauthorized Movement of Nuclear Weapons, April 2008 (Revised);*

Admiral (ADM) Donald Investigation into the Shipment of Sensitive Missile Components to Taiwan, 22 May 2008 (ADM Donald Report)

Air Force Inventory and Assessment: Nuclear Weapons and Nuclear Weapons-Related Materiel, 25 May 2008 (AFRIT);

Air Force Comprehensive Assessment of Nuclear Sustainment Report, 26 July 2008 (CANS).

The *Defense Science Board* (DSB) *Permanent Task Force on Nuclear Weapons Surety – Report on Nuclear Deterrence Skills, September 2008;*

Report of the Secretary of Defense Task Force on DoD Nuclear Weapons Management, Phase I: the Air Force's Nuclear Mission, September 2008 (Schlesinger Report)

Report of the Air Force Nuclear Task Force on Reinvigorating the Air Force Nuclear Enterprise, October 2008 (AF Nuclear Roadmap)

The *Defense Science Board* (DSB) *Permanent Task Force on Nuclear Weapons Surety – Report on Nuclear Weapons Inspections for the Strategic Nuclear Forces, December 2008;*

Report of the Secretary of Defense Task Force on DoD Nuclear Weapons Management, Phase II: Review of the DoD Nuclear Mission, December 2008;

The Congressional Commission on The Strategic Posture of The United States Interim Report, 11 December 2008;

U.S. Nuclear Command and Control System Comprehensive Review Final Report, ongoing – May 2009 (estimated);

Department of Defense Inspector General Report, ongoing - August 2009 (estimated)

Nuclear Weapons Security is the total spectrum of procedures, facilities, equipment, and personnel employed to provide the protection against loss of custody, theft, or diversion of a nuclear weapon system, the protection against unauthorized access, and the protection against unauthorized actions, vandalism, sabotage, and malevolent damage. Security involves active and passive protective measures laid out by the DOD and executed by the individual Services. This is accomplished through the implementation of the Nuclear Weapons Security

Standard: Deny unauthorized access to nuclear weapons; prevent damage or sabotage to nuclear weapons; prevent loss of custody; and prevent, to the maximum extent possible, radiological contamination caused by unauthorized acts.

The fiscal year 2009 Air Force Unfunded Requirements List (URL) lists approximately $122 million of nuclear surety items. Nuclear surety refers to the materiel, personnel, and procedures that contribute to the safety, security, reliability, and control of nuclear assets. The nuclear surety items included: Remote Visual Assessment (RVA), ICBM Payload Transporter (PT) High Security Locks, Common Vertical Lift Support Platform (CVLSP), Radiation Sensors, ICBM Cryptography Upgrade (Increment II), Nuclear Storage Structures/Areas Upgrades, New ICBM Payload Transporter (PT), Nuclear Surety Second Destination Transportation (SDT), Nuclear Surety Test Equipment, Nuclear Surety Procure Non-powered munitions trailer, Nuclear Surety Powered Munitions trailer, and ICBM Defense Access Roads. Reference: Table 1

In the fiscal year 2010 President's Budget request, the Air Force is funding an additional $50 million in nuclear security initiatives, primarily covering a wide variety of Security Forces items enterprise-wide. Efforts include: Air Force Space Command (AFSPC) Regional Training Center ($5.4 million), missile field security forces equipment ($4.3 million), physical security improvements ($9.2 million), Air Base Ground Defense upgrades ($1.2 million); development and procurement of base security systems (sensors, wide-area detection, etc) in all nuclear environments including Weapon Storage Areas ($19 million); general purpose equipment & training increases ($5.8 million), nuclear security general purpose vehicles ($3.7 million), Federal convoy support enhancement ($1.5 million), small arms training ammunition increase ($225 thousand), and an additional nuclear security information technology & training ($450 thousand). These nuclear security additions to the budget represent a portion of the over $4 billion the Air Force plans to invest in reinvigorating the Nuclear Enterprise over the Future Years Defense Program.

"We take this responsibility very seriously and fully intend to implement the recommendations from several reviews that followed the incident last year. Since the timing of those reviews did not allow us to incorporate their recommendations into the budget request, those requirements are also included in this unfunded list."

General T. Michael Moseley, Air Force Chief of Staff, letter to Congress on Air Force FY09 unfunded requirements, 8 Feb 2008

'From the outset of our tenures as Secretary and Chief of Staff of the Air Force, the Air Force Nuclear Enterprise has been our top priority. Our stewardship of a portion of the Nation's nuclear arsenal forms the core of our deterrence mission – a role that America's Air Force has proudly accepted for over 60 years."

"...As a significant provider of this capability, the United States Air Force embraces this mission as a core function, and is taking all necessary steps to fully reclaim the trust and confidence required of stewards of nuclear capabilities. We are recapturing the stature of our culture of accountability and rigorous self-assessment. We are rebuilding nuclear expertise training and career paths for personnel. We are ensuring that we have solid end-to-end, sustainable systems. We are developing investment plans to ensure nuclear surety and other continuing mission requirements. We are reinvigorating our institutional focus, and we are aligning authorities and responsibilities to ensure focused leadership and oversight, building on the Air Force's 60-plus years of operational experience. In the end, we will keep our promise to the Nation to provide effective and uncompromising stewardship of this mission."

Michael B. Donley, Secretary of The Air Force and General Norton A. Schwartz, Chief of Staff, United States Air Force, testimony to the United States House of Representatives Subcommittee on Defense Appropriations, February 11, 2009.

Table 1: Air Force Fiscal Year 2009 Unfunded Requirements List (URL) Nuclear Security Items

Requirement	FY09 Amount ($M)	Item Description
Remote Visual Assessment (RVA)	0.3	Funds Contractor Logistics Support (CLS) of deployed RVA systems and pays commercial satellite lease costs for operations; operations costs beyond FY09 will increase as AFSPC deploys more RVA systems. In accordance with Blue Ribbon Review.
ICBM Payload Transporter (PT) High security locks	4.2	Adds High-security locks to Payload Transporter III System (current PT), reduces/eliminates security vulnerabilities. Locks enclosed in tamper resistant steel enclosures. 7 locks placed on each PT, including the personnel access door (1), emergency egress door (1), front interior compartment (1), rear cargo doors (2), and small arms protection doors (2). Keyed in "A" and "B" sets of two keys each. No additional funds required in FYDP. In accordance with Blue Ribbon Review.
Common Vertical Lift Support Platform (CVLSP)	4.5	For FY09, additional funds further refine initial development efforts and accelerate the development of requirements documentation. Requested funds would complement $4.2M funded by CSAF in FY09 to stand up the SPO. Current UH-1N helicopter cannot meet key performance parameters (Range, Speed, Payload, Endurance) for ICBM Security capability. CVLSP develops and purchases replacement helicopter. In accordance with Blue Ribbon Review.
Radiation Sensors	5.8	Places 12 portal monitoring devices at vehicle entry points and primary/alternate convoy routes for CONUS WSAs. (Minot: 2, Whiteman: 3, F.E. Warren: 2, Malmstrom: 1, Kirtland: 2, Nellis: 2). Cost $400K per sensor plus $1M per year in sustainment (maintenance, repair, calibration). In accordance with Blue Ribbon Review.
ICBM Cryptography Upgrade, Increment II	7.5	Funds initial design/development of weapon system modifications required to fully implement remote code change and irreversible transformation. Remote code change capability eliminates the requirement to penetrate 450 launch facilities during annual and emergency code change, eliminates transportation of critical nuclear codes and the associated security vulnerabilities, and reduces security vulnerabilities from site penetrations. Irreversible transformation of enable and launch codes reduces a potential nuclear surety vulnerability. In accordance with Blue Ribbon Review.
Nuclear Storage Structures/Areas Upgrades	15.4	Nuclear Facility Security Upgrades -- Modernizes the Kirtland AFB (AFMC) restricted area security system by integrating security detection, assessment and surveillance and delay. Shooter Detection System -- Procure shot spotter technology for nuclear weapons storage areas at Minot AFB, ND and Whiteman AFB, MO. Massive Modular Block Berming -- Redeploys existing MMBs from Barksdale AFB to Whiteman and Minot AFBs. Storage Structure Assessment -- Modernizes our ability to assess resources located within storage structures by alleviating the requirement to respond to structures in alarm status so long as the alarm resets and security of the resource can be verified through assessment versus immediate response. Wide Area Assessment -- Enhances current area assessment capabilities by expanding the view beyond the WSA perimeter. The capability would reduce a potential adversary's ability to dominate time and space around WSA Areas of Interest (AI). Wide Area Assessment interferes with the enemy's ability to move, plan or observe the WSA without being detected. In accordance with Blue Ribbon Review.
New ICBM Payload Transporter (PT)	20.0	Vehicle age of existing PT drives a need for full replacement (33 PTs) to sustain the weapon system through 2030. Existing PT does not meet required security standard because current vehicles cannot support the weight of security enhancements. DTRA has invested $1.8M in a security prototype. In accordance with Blue Ribbon Review.
Nuclear Surety: SDT	6.0	Funds transportation costs to realign nuclear assets based on force reductions and stock-pile adjustments. Also, to ship munitions trailers to undergo modification to meet nuclear cert requirements. Requirements are in accordance with Blue Ribbon Review.
Nuclear Surety: Test Equipment	9.0	Accelerates procurement of Re-entry System Test Set (RSTS), and funds calibration devices for Electronic Sys Test Set (ESTS). Requirements are in accordance with Blue Ribbon Review.
Nuclear Surety: Procure non-powered munitions trailer	22.8	Replacement recapitalization for electric munitions loaders and non-powered munitions trailers. Requirements are in accordance with Blue Ribbon Review.
Nuclear Surety: Powered Munitions Trailers	4.0	Funds service life assessment, engineering analysis, out-year supportability assessments, and propose equipment recapitalization (modernize or replace) options. Requirements are in accordance with Blue Ribbon Review.
ICBM Defense Access Roads	21.7	Keeps ICBM Transporter/Erector routes capable of supporting transit of key maintenance vehicles. Accomplishes necessary work to maintain 310 miles of gravel roads per year, addresses structural deficiencies and completes assessment of 3 missile wings road inventory.
Total	121.0	

Table 2: Overview of AF FY 2009 URL Nuclear Security Item Funding

Item #	Item Name ($ in Millions)	FY09 URL Amount	FY09 Amount	FY10 PB	FY10 Amount
1	ICBM Remote Visual Assessment (RVA)	$0.3	---	Y	$1.0
2	ICBM Payload Transporter (PT) High Security Locks	$4.2	---	N	---
3	Common Vertical Lift Support Platform (CVLSP)	$4.5	---	Y	$9.7
4	Radiation Sensors	$5.8	---	Y	$0.0
5	ICBM Cryptography Upgrade, Increment II	$7.5	---	Y	$19.0
6	Nuclear Storage Structures/Areas Upgrades	$15.4	---	Y	$34.8
7	New ICBM Payload Transporter (PT)	$20.0	---	Y	$0.0
8	Nuclear Surety: SDT	$6.0	---	Y	$1.0
9	Nuclear Surety: Test Equipment	$9.0	$2.0	Y	$23.7
10	Nuclear Surety: Procure Non-powered munitions trailer	$22.8	---	Y	$0.0
11	Nuclear Surety: Powered Munitions trailer	$4.0	---	Y	$2.0
12	ICBM Defense Access Roads	$21.5	---	Y	$15.7
	Total	**$121.0**	**$2.0**	---	**$106.9**

Additional detail on individual items is provided in the following section.

#1 ICBM REMOTE VISUAL ASSESSMENT (RVA)

PROGRAM ELEMENT 0101213F - MINUTEMAN SQUADRONS

Air Force Blue Ribbon Review (BRR) of Nuclear Weapons Policy and Procedures recommendation

- Funding provided for ICBM Remote Visual Assessment (RVA) operations that include satellite lease costs of commercial satellite support and contractor logistics support for camera maintenance and sustainment
- RVA design will migrate to a ground terrestrial system that will enable improved system performance and physical protection
  - -- Ground terrestrial technology will provide improved system performance by leveraging off Land Mobile Radio infrastructure and reduce costs by reducing/eliminating recurring satellite lease costs. It will provide increased system protection by utilizing a smaller equipment processing unit and elevating all equipment thirty feet to discourage unauthorized access. Additionally, wireless video hotspots will be added that can be accessed inside Security Forces' vehicles
  - -- Beginning with Malmstrom AFB, ground terrestrial RVA is scheduled to begin deployment in Apr 2009 and complete in one year. AF plans to retrofit Minot and FE Warren beginning in FY11
  - -- AF will contract satellite support until ground terrestrial capability fielded at all units

Program	PE	APPN	FY10
Remote Visual Assessment (RVA)	0101213F	OMAF	1.0

#2 ICBM PAYLOAD TRANSPORTER (PT) HIGH SECURITY LOCKS

- ICBM Payload Transporter (PT) High Security locks were not funded in FY09 or included in the FY10PB
- Associated security vulnerabilities were mitigated with procedural changes and other security efforts
  - -- AF funded a complete replacement of all PT vehicles as part of its effort to sustain the weapon system to 2030

#3 COMMON VERTICAL LIFT SUPPORT PLATFORM (CVLSP)

PROGRAM ELEMENT 0604263F - COMMON VERTICAL LIFT SUPPORT PLATFORM

Air Force Blue Ribbon Review (BRR) of Nuclear Weapons Policy and Procedures recommendation

- The Common Vertical Lift Support Platform (CVLSP) core missions are to provide nuclear convoy weapon escort, 24/7 adverse weather capable Intercontinental Ballistic Missile (ICBM) emergency security response /operational support, and mass passenger transport/Operational Support Airlift (OSA) in the National Capital Region.

  - -- Other assigned missions include Pacific Air Forces (PACAF) OSA, survival school support, test and range support, and combat aviation advisor training.
- FY10 funding will continue development of statutory and regulatory acquisition documentation required for a Milestone B decision.
  - -- Continue Program Office stand-up and conduct activities associated with the Request for Proposal (RFP) development and release.
- Capability Development Document (CDD) directs Initial Operational Capacity (IOC) in FY15.

Program FY10PB ($, M)	PE	APPN	FY10
COMMON VERTICAL LIFT SUPPORT PLATFORM	0604263F	RDTE	9.7
		APAF	0.0
		OMAF	0.0
	Total		9.7
	Quantity		---

#4 RADIATION SENSORS

PROGRAM ELEMENT 0202834F - SUPPORT EQUIPMENT & VEHICLES – GENERAL

Air Force Blue Ribbon Review (BRR) of Nuclear Weapons Policy and Procedures recommendation

- Funding is currently programmed in FY12 to procure twelve (12) monitoring devices to provide capability to detect nuclear material transported outside of weapons storage or maintenance areas at vehicle entry points and primary/alternate convoy routes for CONUS Weapon Storage Areas (WSAs). Also includes funding for radiation sensor maintenance, repair, and calibration.

Program FY10PB ($, M)	PE	APPN	FY10
RADIATION SENSORS	0202834F	OPAF	0.0
		OMAF	0.0
	Total		0.0
	Quantity		*0*

#5 ICBM CRYPTOGRAPHY UPGRADE, INCREMENT II

PROGRAM ELEMENT 0604851F – ICBM ENGINEERING & MANUFACTURING DEVELOPMENT (EMD)

PROGRAM ELEMENT 0101213F - MINUTEMAN SQUADRONS

Air Force Blue Ribbon Review (BRR) of Nuclear Weapons Policy and Procedures recommendation

- Increment II of the Intercontinental Ballistic Missile Cryptography Upgrade (ICU) program implements the KS-60 capabilities of remote key/code change and irreversible transformation.

- Funds provided to design, develop and test the software upgrades/changes to the Console Operating Program, Launch Facility hardware/software modification and Wing Code Processing System.
  - -- Increases security during code changes by reducing the frequency of open sites by 75 days annually and reducing associated resource costs for 450 launch facilities (LF) and 45 launch control centers (LCC).
- Fulfills Nuclear Weapon System Safety Group Operational Safety Review (NWSSG OSR) requirements 98-2, 00-1 & 02-2. ICU Capabilities Development Document (CDD) approved 04 Jan 05.

Program FY10PB ($, M)	PE	APPN	FY10
ICBM CRYPTOGRAPHY UPGRADE, INCREMENT II	0604851F	RDTE	19.0
	0101213F	MPAF	0.0
		Total	19.0

#6 NUCLEAR STORAGE STRUCTURES/AREAS UPGRADES

PROGRAM ELEMENT 0207589F - BASE PHYSICAL SECURITY SYSTEMS

Air Force Blue Ribbon Review (BRR) of Nuclear Weapons Policy and Procedures recommendation

- Program focused on upgrade/replacement of physical security systems on a 5 year cycle to maintain system currency and integrate enhancements as technology develops to fill capability gaps.
- Procures and installs exterior/interior intrusion detection, assessment and alarm reporting systems, video storage systems, identification management systems, fence and ground sensor technologies, explosive detection systems, and remotely operated weapons.
  - -- Note: FY10 OPAF includes $60 million for installation of physical security systems to support activation of nuclear mission at Barksdale AFB, LA.

Program FY10PB ($, M)	PE	APPN	FY10
NUC STORAGE STRUCTURES / AREAS UPGRADES	0207589F	OPAF	90.2
		OMAF	3.5
		Total	93.7

#7 NEW ICBM PAYLOAD TRANSPORTER (PT)

PROGRAM ELEMENT 0604851F – ICBM ENGINEERING & MANUFACTURING DEVELOPMENT (EMD)

PROGRAM ELEMENT 0101213F - MINUTEMAN SQUADRONS

Air Force Blue Ribbon Review (BRR) of Nuclear Weapons Policy and Procedures recommendation

- Funding is programmed in the FYDP to design and develop a vehicle that will be used in a fleet-wide replacement of Minuteman III Payload Transporter that continues to impact reliability and availability due to age-related degradation.
    - -- Payload Transporters are required for propulsion downstage, Propulsion System Rocket Engine (PSRE), Missile Guidance Set, and Reentry System/Reentry Vehicles (RS/RV) assembly maintenance.
    - -- Normal weapon system maintenance efforts require approximately sixty Payload Transporter missions per month.
    - -- Four Payload Transporter missions are required to support each solid rocket motor deployment.
    - -- Thirty three Payload Transporters in current inventory: Minot AFB, ND (9); Malmstrom AFB, MT (9); F.E. Warren AFB, WY (9); Vandenberg AFB, CA (5) and Hill AFB, UT (1).
- New vehicle will improve maintenance capability and will transport Minuteman III assets with increased safety and security

Program FY10PB ($, M)	PE	APPN	FY10
PT III REPLACEMENT	0604851F	RDTE	0.0
	0101213F	MPAF	0.0
		Total	0.0
	Quantity		*0*

#8 SECOND DESTINATION TRANSPORTATION

PROGRAM ELEMENT 0708010F - SECOND DESTINATION TRANSPORTATION (SDT)

Air Force Blue Ribbon Review (BRR) of Nuclear Weapons Policy and Procedures recommendation

- The Second Destination Transportation programs funds APO Mail, Port Handling, non-Working Capital Fund movement of equipment, and movement of nuclear munitions.
- Funds $1 million for transportation of 64 Munitions Handling Units (MHUs) and 226 munitions trailers to a contractor to install a modification required for nuclear certification. The modification was previously funded, but the transportation cost was omitted.
  -- This is a one-time requirement. There is no logistics tail associated with this requirement.

Program FY10PB ($, M)	PE	APPN	FY10
SECOND DESTINATION TRANSPORTATION	0708010F	OMAF	1.0

#9 TEST EQUIPMENT

- The Air Force has requested reprogramming authority approval for $2M of RD&TE funds in FY09 to accelerate the start of the Reentry System Test Set (RSTS) replacement program.

PROGRAM ELEMENT 0604851F – ICBM ENGINEERING & MANUFACTURING DEVELOPMENT (EMD)

PROGRAM ELEMENT 0101213F - MINUTEMAN SQUADRONS

Air Force Blue Ribbon Review (BRR) of Nuclear Weapons Policy and Procedures recommendation

- Minuteman Re-entry System Support Equipment - test equipment is critical to the build-up/assembly of Minuteman III MK 12A re-entry systems.
- Minuteman Test Support Equipment program replaces two failing test station critical to the safety of flight ICBM test launch program. Test stations verify operation of flight safety wafer prior to launch operations at manufacturer and launch site.

Program FY10PB ($, M)	PE	APPN	FY10
Re-entry System Support Equipment	0604851F	3600	18.1
	0101213F	3020	0.0
	Quantity		*0*
Test Support Equipment	0604851F	3600	5.6
	0101213F	3020	0.0
	Quantity		*0*
		Total	23.7

#10 NON-POWERED MUNITIONS TRAILER

PROGRAM ELEMENT 0202834F - SUPPORT EQUIPMENT & VEHICLES – GENERAL

Air Force Blue Ribbon Review (BRR) of Nuclear Weapons Policy and Procedures recommendation

- Funding is programmed in FY11 to procure next generation Munitions Handling Unit (MHU)-226 Non-Powered Munitions Trailers that improve munitions transportation capability by providing more reliable & sustainable trailer to conduct movements.

Program FY10PB ($, M)	PE	APPN	FY10
NON-POWERED MUNITIONS TRAILERS	0202834F	OPAF	0.0
	Quantity		---

#11 POWERED MUNITIONS TRAILERS

PROGRAM ELEMENT 0202834F - SUPPORT EQUIPMENT & VEHICLES – GENERAL

Air Force Blue Ribbon Review (BRR) of Nuclear Weapons Policy and Procedures recommendation

- Funds supportability and recapitalization studies for the MHU-196 and MHU-204, which continue to impact reliability and availability due to age-related degradation.
  - -- The Munitions Handling Unit (MHU)-196 and MHU-204 are large, powered munitions trailers that transport nuclear and conventional munitions for the bomber fleet.
  - -- FY10 ($2 million) funds sustaining engineering studies for out-year supportability assessments for MHU-196 & MHU-204 Powered Munitions Trailers.

Program FY10PB ($, M)	PE	APPN	FY10
POWERED MUNITIONS TRAILERS	0202834F	OMAF	2.0

#12 ICBM DEFENSE ACCESS ROADS

PROGRAM ELEMENT 0101979F – FACILITIES OPERATIONS – GENERAL PURPOSE

- Defense Access Roads (DAR) program maintains local roads at a higher than local standard to allow movement of defense assets. AFSPC authorized DAR under Title 23, U.S. Code Section 210, AFMAN 32-1017 (DOD Transportation Engineering Program), Air Force Space Command is responsible for 1,858 miles of primary DAR to include drainage structures and bridges. Roads are owned by counties and States—public roads.
- Accomplishes necessary work to maintain 310 miles of gravel road per year, addresses structural deficiencies, and completes assessment of three missile wings road inventory totaling 1,858 miles.
- Funds provide for extraordinary maintenance, extraordinary snow removal, and re-graveling on routes used by Transporter-Erector (T-E) and Payload Transporter (PT)

where needed work is determined to be in excess of that required for normal public traffic.

-- Maintain road and bridge serviceability for maintenance vehicle transit, two key heavy weight vehicles; Transporter Erector – 73 tons, and Payload Transporter – 25 tons.

-- Missile field convoys travel over 18.9 million miles per year.

Program FY10PB ($, M)	PE	APPN	FY10
ICBM DEFENSE ACCESS ROADS	0101979F	OMAF	15.7

Credible nuclear deterrence hinges upon a safe, secure and reliable nuclear enterprise. To effectively reinvigorate the Air Force nuclear enterprise we are recapturing our culture of accountability, rebuilding nuclear expertise, ensuring sustainable weapon systems, sharpening our institutional focus, properly aligning authorities and responsibilities to ensure focused leadership and oversight, and developing investment plans to ensure nuclear surety and other continuing mission requirements. The plans outlined in this report are essential to maintaining safe, secure and reliable nuclear deterrence forces. In the end, we will keep our promise to the Nation to provide effective and uncompromising stewardship of this mission.

Distribution

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The Honorable Nancy Pelosi
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The Honorable Daniel K. Inouye
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CONGRESSIONAL REPORT ON AIR FORCE NURSE RECRUITING AND RETENTION AND PROPOSED TROOPS TO NURSE TEACHERS PROGRAM SUBMITTED BY U.S. AIR FORCE MEDICAL SERVICE FEBRUARY 2008

INTRODUCTION

This report is being provided to the congressional defense committees as directed in House Report 110-434, page 59, on H.R. 3222, Defense Appropriations Act FY08.

EXECUTIVE SUMMARY

A United States Department of Health and Human Services report projects demand shortfalls for nurses will reach 17 percent by 2010 and 27 percent by 2015 (http://bhpr.hrsa.gov/nursing/). As the disparity between supply and demand increases, Air Force (AF) Nursing must capitalize on every opportunity to recruit and retain nurses. The AF Nurse Corps (NC) appreciates congressional interest in the impact of the nursing shortage on military healthcare delivery and efforts to alleviate the national nursing shortage.

BACKGROUND

Over the past five years, NC manning has fluctuated between 85 percent in FY06 and 94 percent in FY04. As of the end of FY07, overall AF NC manning was 88 percent. This reflects a 3 percent increase over the previous year, but it is also the third consecutive year manning fell under 90 percent. Our most critically manned nursing specialties are Operating Room Nurses (76 percent), Critical Care Nurses (78 percent), Emergency/Trauma Nurses (85 percent) and Flight Nurses (88 percent). Despite these concerning figures, there has been no degradation in our capability to meet deployment requirements. However, impact has been felt in-garrison where increased contract dollars are needed to backfill vacant military positions or to shift workload to network healthcare facilities.

REPORT

Accession Sources and Incentives

Nurse accession sources include direct commission, Reserve Officers' Training Corps (ROTC), Airman Enlisted Commissioning Program (AECP) and Nurse Enlisted Commissioning Program (NECP). The majority of nurse accessions (80 percent) come in via direct commission, which typically attracts newly graduated novice nurses. In FY07, we achieved only 68 percent (222) of our recruitment goal (355). The 53 graduates of our scholarship programs brought overall accessions up to 85 percent of our goal. Although this represents a 5 percent decrease from the FY06 accession success rate, it remains 10-15 percent higher than FY01 – FY05 figures.

Improvement in direct commission accessions is attributed to the Nurse Accession Bonus (NAB) and the Health Professions Loan Repayment Program (HPLRP). In FY07 we offered the

$25,000 NAB in exchange for a four-year active duty obligation (ADO) - one additional year over the baseline three-year ADO for direct commission. Of the 222 eligible recruits in FY07, 89 (40 percent) took advantage of this offer. The NAB continues to be offered in FY08. The HPLRP is offered alone for a three-year ADO or in addition to the NAB for a six-year ADO. The HPLRP provides funding for repayment of an individual's eligible education loans up to $37,000. In FY07, 67 HPLRP quotas were executed.

Early FY08 recruiting shows encouraging signs. To date, 38 nurses have been commissioned with another 149 selected for commission – 57 percent of our goal (325). Quotas for NAB (117 of 144) and HPLRP (76 of 76) have nearly been exhausted.

Nurse accessions through ROTC scholarships have increased in recent years from 30 in FY05 to 32 in FY06 to 57 in FY07. We desire a steady state of 50 per year.

The Airman Enlisted Commissioning Program (AECP) is a two-year scholarship program for enlisted members to complete a bachelor's degree and be commissioned as AF officers. AECP has been effective but inconsistent in the production of NC officers with 12 in FY04, 4 in FY05, 6 in FY06, and 17 in FY07.

New for FY08, the Nurse Enlisted Commissioning Program (NECP) is similar to AECP but specifically targeted to nursing. Forty-one (medical and non-medical) enlisted candidates were selected to start in Fall 2007 or Spring 2008 semesters. These Airmen will complete their Bachelor of Science in Nursing Degrees and be commissioned as NC officers within two years. We project a steady state of 50 NECP graduates per year. We are currently assessing the interest of Line of the Air Force (LAF) officers vulnerable to Reduction in Forces actions for a similar nursing degree scholarship program followed by continued service as NC officer.

Retention Methods and Incentives

Nurse Corps attrition rates spike at the four to five year point as nurses complete their initial service commitment and again at seven to nine years when nurses face disparate promotion opportunity. In response, a Critical Skills Retention Bonus (CSRB) of $15,000 for an additional three-year ADO was offered in FY07 for nurses in the final year of their initial ADO. Of 235 eligible NC officers, 104, or 47 percent, accepted the CSRB. The CSRB is being offered again in FY08.

Addressing the second attrition spike is more difficult. Respondents (nurses with less than 10 years time in service) to the 2006 Development Team Assessment Tool (DTAT) cited "lack of promotion opportunity" as the number one reason for company grade NC officers to separate. Historically, NC promotion opportunity and timelines have lagged behind the LAF. NC promotion opportunity is 10 to 15 percent lower than the LAF, and promotion timing is two to four years behind the LAF. Current projections over the next five years show little improvement. In an effort to improve disparate promotion opportunity and timing, we resubmitted a legislative proposal through the FY09 AF Unified Legislation and Budgeting process requesting Defense Office of Personnel Management Act relief for the NC.

Additionally, we are participating in an AF-wide Top Down Grade Review and will continue to work with the LAF to achieve equitable grade allocation.

Incentive and Special Pay (ISP) has been used effectively to retain fully qualified Certified Registered Nurse Anesthetists (CRNAs). Since the ISP was introduced in FY02, retention of CRNAs has improved manning of this critical specialty from 76 percent to 103 percent today. We continue to work with our Sister Services for overall ISP for nurses targeting specific specialties and year groups.

According to results of the 2006 DTAT, 75 percent of respondents stated education as a positive influence for retention. Each year, five percent of NC officers are funded for advanced academic degrees and specialty training. These programs produce advanced practice graduate level nurses, such as nurse practitioners (Women's Health, Family, Psychiatric/Mental Health, Pediatric, Midwifery, CRNA) and clinical nurse specialists (Critical Care/Trauma, Medical-Surgical, Neonatal, Obstetrics, Operating Room, Mental Health), as well as other advanced degrees (Community Health, Public Health, Education, Master's in Business Administration, Master's in Science of Nursing, Health Administration) and doctorate level degrees, such as Nursing Science Researcher and CRNA.

Troops to Nurse Teachers (TNT) Program

The Surgeon General and the Chief of the Air Force Nurse Corps support the congressionally directed study to determine whether a program to provide incentives to retired military nurse corps officers to serve as faculty at civilian nursing schools, sometimes referred to as `Retired Troops to Nurse Teachers,' could help to alleviate the current and projected nursing shortage in the military services. The NC projects 176 Bachelor's of Science in Nursing Degree, 145 Master's of Science in Nursing Degree, and 3 doctoral degree potential candidates annually.

Congressional Report

Review of Air Force End Strength

House Report 110-434, page 72

February 2008

Introduction

House Conference Request

This report is being provided to the Congressional Defense Committees as directed in House Report 110-434, page 72, dated November 2007

> Review of Air Force End strength.
>
> —*The conferees direct the Secretary of the Air Force to conduct a thorough review of its total force end strength requirements and provide a report to the congressional defense committees in conjunction with the President's fiscal year 2009 budget request. The report should explain the capabilities that the current force structure provides the nature of any shortfalls for new and emerging missions, and an explanation on how the Air Force could balance the budgetary demands necessary to implement any corrective policy action within its own budget.*

Executive Summary

The Air Force has prepared this document as directed within House Conference Report 110-434, page 72, to accompany the President's Budget for FY 2009. This report describes the current total force end strength level of funding at 95% to operate, maintain, and support 86 modernized Combat Wings (CWs) required to accomplish the Air Force's core competencies as identified in the FY 2006 Quadrennial Review (QDR). This report will discuss in some detail; end strength requirement determination methods, current end strength, 86 CWs end strength shortfall, shortfalls by weapon system/mission capability, and ability for the Air Force to offset the cost for the needed required additional end strength.

Report

End Strength Requirement Determination

The Air Force manpower requirements determination process systematically identifies minimum essential manpower required for the most effective and economical accomplishment of approved Air Force missions and functions. The Air Force's Management Engineering Program (MEP) provides the framework for manpower requirement's determination via Air Force Capability-based Manpower Standards (CMSs). The MEP tool kit includes numerous accepted engineered tools. Air Force CMSs include both conventional standards based on classic industrial engineering tools and techniques and modeling/simulation derived standards based Logistic Composite Modeling Studies (LCOM computer simulation). Additionally, the MEP use tools such as Post Manning Factors, Aircrew Ratios/Compliments and Staffing Patterns. Models are also developed as part of the MEP to determine at the aggregate level manpower requirements for both common base support and training. All of the tools in the MEP tool kit are used as required during the development of the Manpower Estimate Reports (MER) used in the acquisition process.

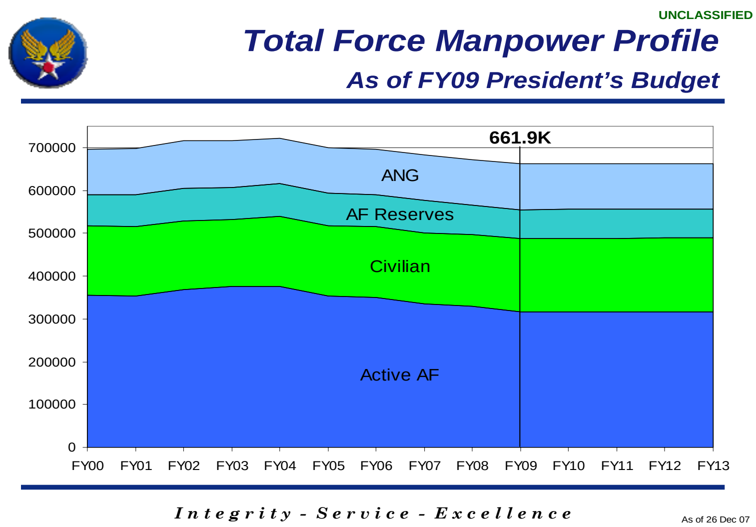
These engineered tools provide the ability to determine end strength requirements based on established concepts of operations, force structure, directed mission requirements, organizational structure, etc. The above MEP tools were used in determining the end strength requirement to support an 86 CWs capable Air Force. All weapon system requirements were determined using LCOM computer simulation studies, conventional standards, Aircrew Ratios/Compliments, Staffing Patterns, etc. Non-weapon system requirements were determined using conventional standards, Staffing Patterns, and Post Manning Factors. Once the mission requirement was determined then Base Support and Training Models were used to capture the full mission impact to the Air Force. For new systems acquisition, such as CSAR-X, KC-X, JSF, and F-22, the Defense Acquisition Board approved MERs were used to determine the required additional end strength. MERs are based on concept of operation, maintenance, and organizational structure at a minimum. In acquisition of replacement systems it is expected that the new systems be equal to or greater in reliability and maintainability while providing greater capabilities. It is not uncommon to use end strength requirements of the legacy system being replaced and extrapolate the new requirement based on a given operational/logistical criteria.

Air Force used long established MEP tools to determine and validate the end strength requirement to support an 86 CWs capable Air Force. Based on that requirement comparison to Air Force's FY 09 President's Budget programmed end strength submission, end strength is funded at ~95% of its Requirement Force for 86 CWs.

Background

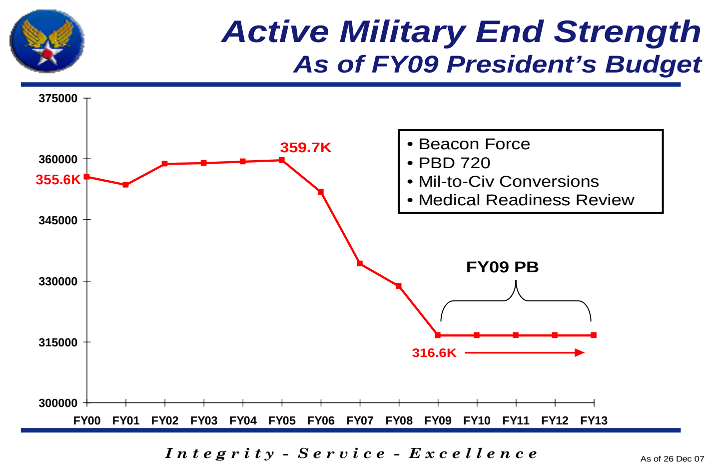
The 2006 QDR identified an Air Force Required Force of 86 modern CWs capabilities able to dominate any adversary in all aspects of the battle space and to meet 21st Century challenges. To fly, fight, and win in the air, space, and cyberspace domains and provide combatant commanders the full spectrum of expeditionary, joint warfighting capabilities they need, the Air Force needs more resources. Without additional resources, the Air Force is compelled to program a portfolio that balances risk. For several years, modernization and recapitalization has been the target of choice for mitigating reduced buying power, resulting in unacceptable aging of our weapon systems decreasing reliability and maintainability while dramatically reducing our domination of the battle space. Without a fundamental shift in strategy the ability of our infrastructure to meet future calls to action is problematic. In Fiscal Year (FY) 2005, prior to our latest round of reductions, we had ~700,000 people in the total force; that breaks out to approximately 359,700 Active Duty, 106,800 Guard, Reserve 76,100, and 163,000 civilians. In FY 2006, 2007, and 2008 Air Force reduced military/civilian end strength and used the dollars to stem the tide of rapidly aging hardware. If planned end strength reductions (plus all other program content) continue as they were presented in the FY 2006, 2007, 2008 and FY 2009 President's Budget submission, by FY 2009 the Air Force would fall to 316,600 Active Duty, Reserve to 67,400. Guard end strength remained at 106,700 and civilian grew to 171,300 due to converting non military essential positions to civilians. As a result of BRAC and Air Force's Total Force integration, the Guard has transitioned its end strength from 'Cold War' legacy missions to new and emerging missions required to meet the challenges of the 21st Century.

This decision to reduce end strength sought to halt the intolerable risk of continued deferment of fielding modern battle systems, shifting more risk to the increasingly costly yet precious personnel accounts, and in turn, to our Total Force.



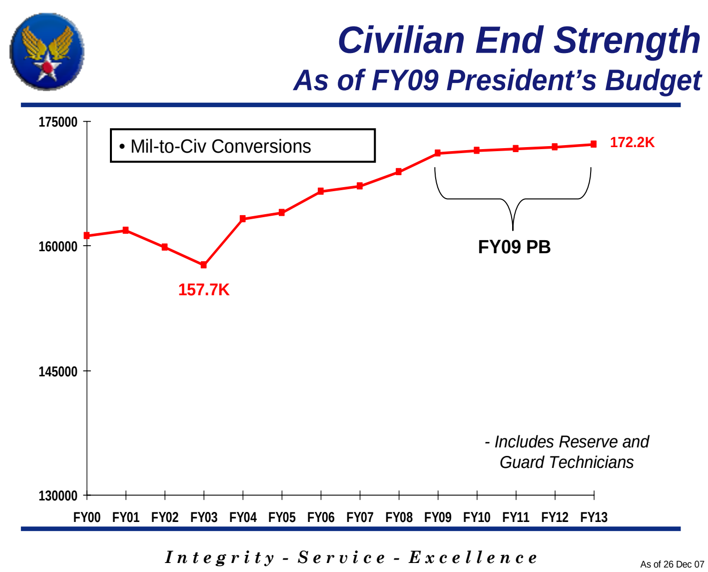
Current Active Military End Strength

Active duty end strength has been impacted primarily by the following initiatives; Beacon Force, FY 2007 PBD 720 (reduced 33K active, 2K civilians, and 2K reserve FTEs), Military to Civilian Conversions, and the Medical Readiness Review. Beacon Force and PBD 720 were major initiatives to reduce active military, civilian, and reserve end strength in order to reprogram the monies into modernization and recapitalization. To maintain a balanced budget, Air Force had to make a difficult choice between People, Readiness, and Modernization in order to transform from a 'cold war' legacy to a modern force capable of meeting the challenges of the 21st century. Military to Civilian conversions is an ongoing effort to convert non military essential positions to US civilians and to free up military to realign to selected military skills enhancing warfighting skills and reducing stress on high tasked skill sets. The Medical Readiness Review is an initiative to convert non military essential positions and replace them with a civilian workforce.



U.S. Civilian End Strength

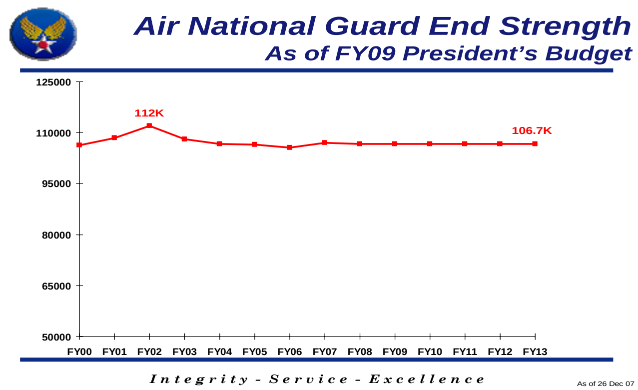
Through the PBD process U.S. Civilian end strength has increased due to the aggressive effort by the Defense Department to reduce/eliminate the use of military personnel in non military essential position and replace them with either U.S. Civilians or contractors. Military are then realigned to warfighting skills reducing the stress on high demand military skill sets. When converting to a contractor to ensure it is the most cost efficient the Air Force uses the OMB Circular A-76 process.



Air Guard End Strength

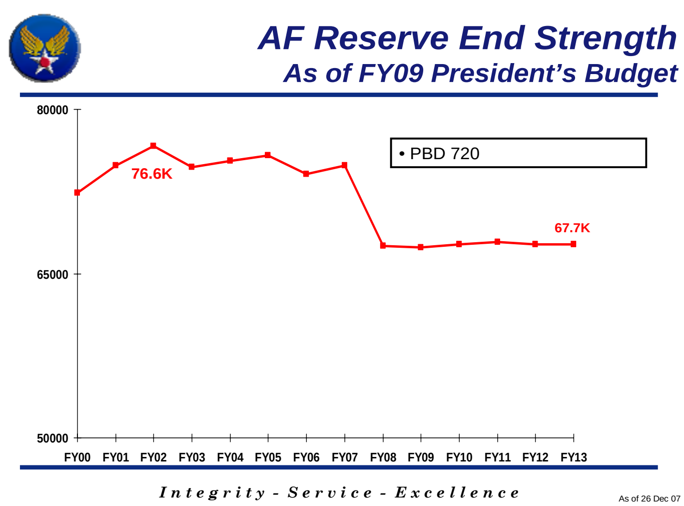
Given the choices Air Force had to make to recapitalize its aging fleets, in the 2007 President's Budgets, Air Force reduced Total Force end strength by 37K Full time Equivalents (FTE) and reprogrammed active military, civilian, and reserve end strength monies into the modernization and recapitalization accounts while the Guard maintained its end strength at 106,700. Initially the Guard was included in PBD 720 plan by reducing its end strength by 3K FTEs but because of its impact to the Guard post BRAC and at the same time Air Force was executing its Total Force Initiative, the Guard reductions were reversed. However, due to the impacts of 2007 BRAC and Total Force Integration (TFI), the Guard has transitioned a significant number of its end strength from operating, maintaining, and supporting 'Cold War' legacy system to new and emerging missions such as Predator, Global Hawk, Falconer Air Operations Centers, and Distributed Common Ground Systems. A major impact on the TFI transition from legacy to new missions is the training cost.

The end strength training cost is addressed in the 'Total Force End Strength 5 % Shortfall by Mission Capability' section of this report.



AF Reserve End Strength

In the 2006 and 2007 President's Budgets, Air Force reduced Total Force end strength by 37,000 FTEs and reprogrammed active military, civilian, and reserve end strength monies into the modernization and recapitalization accounts while the Reserves reduced its end strength 76,800 to 67,700. This reduction was the result of Air Force making tough decisions on reducing people to pay for modernization. In addition, due to the impacts of BRAC and TFI the Reserve has transitioned a significant number of its end strength from operating, maintaining, and supporting legacy system to new and emerging missions such as CYBER, Predator, Global Hawk, Falconer Air Operations Centers, and Distributed Common Ground Systems. A major impact on the TFI transition from legacy to new missions is the training cost. The end strength training cost is addressed in the 'Force End Strength 5 % Shortfall by Mission Capability' section of this report.



86 Combat Wings Total Force End Strength Requirement

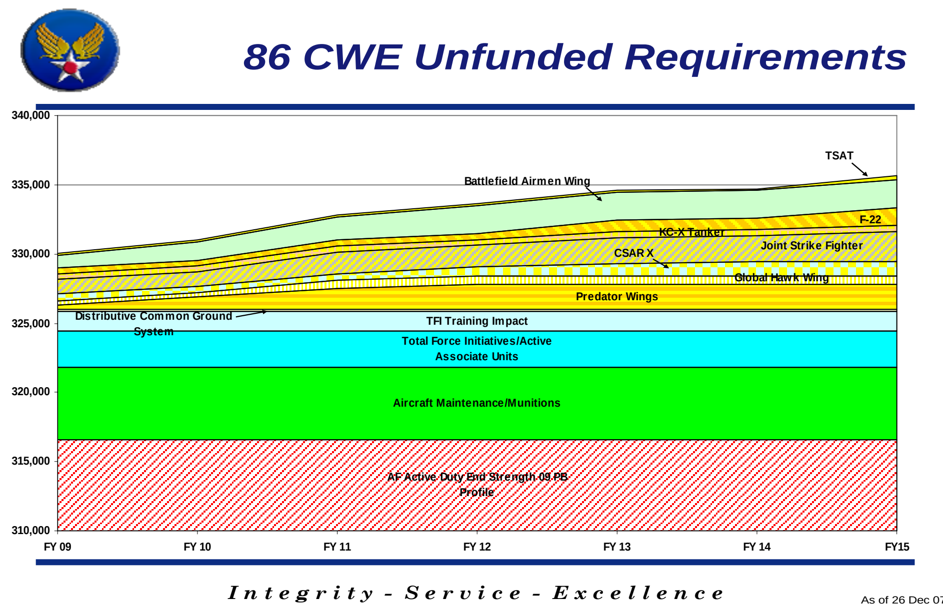
In the 2006 QDR the Department of Defense stated the need for Air Force to operate, maintain, and support 86 modern CWs capabilities. This need is based on the current and future requirement to provide the United States with overwhelming dominance in Global Vigilance, Global Reach, Global

Power, Space and CYBER, and Agile Combat Support with the ability to operate 24/7 in the full spectrum of the battle space. The 86 CWs total force end strength requirement consists of 330,154 Active ramping to 335,661 in FY 15, 173,130 Civilian ramping to 174.200 in FY 15, 106,700 Guard, and 71,100 Reserve ramping to 71,956 in FY 15 versus the current FY 09 funded end strength of 316,600 Active, 171,300 Civilian, 106,700 Guard, and 67,700 Reserves. The Programmed Force end strength is 95% of the Air Force's Requirement Force which will have a significant impact on the Air Force's ability to provide Global Vigilance, Global Reach, Global Power, Space and CYBER, and Agile Combat Support capabilities that will dominate in all spectrums of the battle space. To overcome this critical capability gap will require funding for an increase of end strength top line of 13,554 ramping to 19,061 active, 1,830 civilian, and 3,400 ramping to 4,256 reserve forces.

Total Force End Strength 5% Shortfall by Mission Capability

The following provides program detail by each Air Force Component

Active Duty Military End Strength Requirement



Active Military End Strength Requirement Shortfall by Year (FY 09-15)

86 CWs Shortfall Requirement

	Active Duty Requirements for FY10 POM						
	FY 09	FY 10	FY 11	FY 12	FY 13	FY 14	FY15
Predator Wing (MQ1 and MQ9)	329	879	1,506	1,833	1,833	1,833	1,833
Global Hawk Wing (RQ4)	283	283	566	566	566	566	566
Distributive Common Ground System (DCGS)	162	162	162	162	162	162	162
CSAR X Force Structure Growth	493	493	493	644	913	1,039	1,039
Battlefield Airmen Wing	905	1,345	1,645	2,015	2,015	2,015	2,015
Total Force Integration	2,640	2,640	2,640	2,640	2,640	2,640	2,640
TFI Training - AETC	1,384	1,384	1,384	1,384	1,384	1,384	1,384
Joint Strike Fighter (Force Structure Growth)	1,050	1,050	1,585	1,585	1,868	1,868	2,193
F-22 (Force Structure Growth - Lots 10/11)	419	419	419	419	419	419	419
KC-X	428	428	428	428	828	828	1,261
Aircraft Maintenance/Munitions	5,223	5,223	5,223	5,223	5,223	5,223	5,223
TSAT	238	238	238	238	238	238	326
09 PB Profile	**316,600**	**316,600**	**316,600**	**316,600**	**316,600**	**316,600**	**316,600**
86 CW Required Force	**330,154**	**331,144**	**332,889**	**333,737**	**334,689**	**334,815**	**335,661**

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Predator Wings
86 CWs require the addition of 4 Predator Wings (MQ-1/9). End strength requirement is based on the operational need for additional 24 hour 7 days a week combat air patrol capability for persistent intelligence, surveillance, and reconnaissance with strike capability.

Global Hawk Wing
86 CWs require the addition of a Global Hawk Wing. End strength requirement is based on the operational need for additional 24 hour 7 days a week combat air patrols capability for persistent intelligence, surveillance, and reconnaissance.

Distributed Common Ground System
With the addition of 4 Predator Wings and one Global Hawk Wing require additional intelligence exploitation capability. End strength requirement is based on the operational need for exploitation of 24/7 combat air patrols capability providing persistent, intelligence surveillance, and reconnaissance capability.

CSAR-X
End strength requirement is based on the CSAR-X MER. CSAR-X is a replacement system for current HH-60 legacy system. Reason for the additional end strength is due to the acquisition of an additional 40 aircraft beyond the current 101 HH-60s. This end strength will be required to operate, maintain, and support the additional 40 aircraft.

Battle Field Airman Wing
The transformation of the Army into Brigade Combat Teams and their associated programmed end strength growth of 65,000 drive a requirement for the Air Force to provide additional combat weather and Tactical Air Control Party battle field airman.

Total Force Integration
Over the last 3 years the Air Force has implemented over 139 TFI initiatives. These initiatives will better integrate Active, Guard, and Reserve Forces while the Air Force transforms from a 'Cold War' legacy force to a modern integrated 86 CWs capable Air Force. One of the many initiatives is to create several Active Associate Units at Guard and Reserve bases. End strength requirements were determined by aircrew ratio/crew compliments and LCOMs. In the chart below the Secretary and Chief of Staff of the Air Force approved the first six initiatives while Air Combat Command is in the process of finalizing the proposed establishment of the remaining active associates units.

TFI Active Associates

Command	MDS	PAA	Total (OFF)	Total (ENL)	BOS	AD Total	Total
AFRC	F-16 B30	24	10	139	15	**164**	164
AFRC	F-16 B30	24	10	139	15	**164**	328
ANG	F-16 B30	18	6	76	9	**91**	419
ANG	F-16 B30	18	6	76	9	**91**	510
AFRC	A-10	24	10	139	15	**164**	674
AFRC	A-10	24	10	139	15	**164**	838
ANG	F-16 B40	24	10	139	15	**164**	1002
ANG	F-15/F-22	24	10	139	15	**164**	1166
ANG	F-16 B30	18	6	76	9	**91**	1257
ANG	F-15	24	10	139	15	**164**	1421
ANG	F-16 B30	18	6	76	9	**91**	1512
ANG	F-16/F-22	24	10	139	15	**164**	1676
ANG	F-16 B42	24	10	139	15	**164**	1840
ANG	F-16 B30	18	6	76	9	**91**	1931
ANG	F-16 B30	18	6	76	9	**91**	2022
ANG	F-16 B30	18	6	76	9	**91**	2113
ANG	F-22	24	10	139	15	**164**	2277
ANG	F-22	24	10	139	15	**164**	2441
			152	**2061**	**228**	**2441**	

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TFI Training Impact
The Air Force implemented 139 TFI initiatives over the last two years that re-roll a significant number of Guard and Reserve personnel from 'Cold War' legacy missions to new and emerging missions resulting is an increased training requirement for AETC. Requirement was determined by conventional student training manpower standard.

Joint Strike Fighter
End strength requirement based on the JSF MER, the JSF force structure ramp up, and the F-16 drawdown. Current JSF force structure profile exceeds offsetting F-16 end strength. Therefore, additional end strength is required to transition from the F-16 to JSF program.

F-22
End strength requirement based on the F-22 MER, current F-22 operations, the F-22 force structure ramp up, and the F-15 drawdown. Current F-22 force structure profile exceeds offsetting F-15 end strength. Therefore, additional end strength is required to transition from the F-15 to F-22 program.

KC-X Tanker
End strength requirement based on the KC-X MER, the KC-X force structure ramp up, and the KC-135 drawdown. Major reason for increased end strength requirement is the acquisition of additional aircraft above and beyond the KC-135 force structure.

Aircraft Maintenance/Munitions
Historically Air Force weapon systems are funded to 100% requirement to ensure our Air Force is capable to fly, fight, and win in all spectrums of the battle space. Based on the latest Weapon System LCOM reports (F-15,F15E, A-10, F-16, B-1, B-2, B-52, C-130, C-40, E-3, EC-130, Tactics & Training) aircraft maintenance/munitions are short ~5,300 billets (include BOS/Training Tails) to meet its required peacetime, wartime surge, and wartime sustained missions. Primary reasons for the increase in requirement from previous funded LCOM reports are increased operations, lower mean time between failures for parts (lower reliability and maintainability because of aging aircraft flying more), availability of part because of vendor availability (increases cannibalization of aircraft for parts). This additional maintenance manpower requirement provides further evidence that aging aircraft weapon systems is more expensive to maintain and support the need to modernize the fleet.

TSAT
End strength requirement is based on the TSAT MER

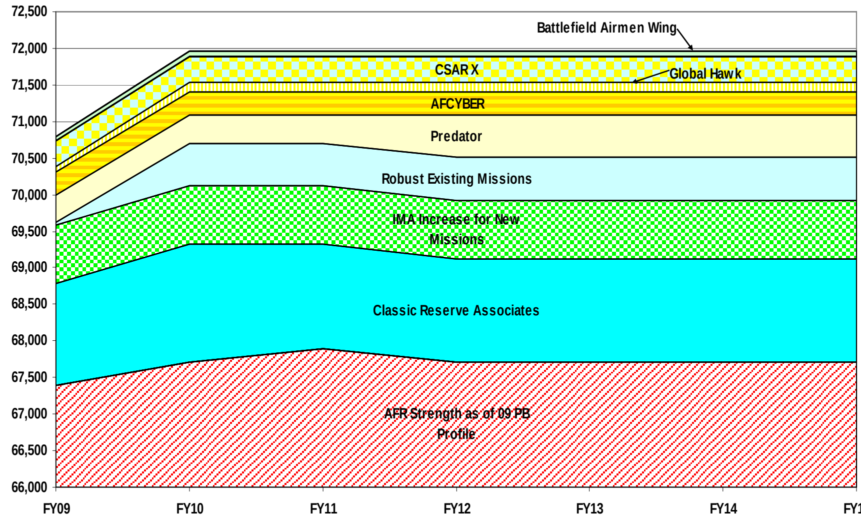
Civilian End Strength
Civilian end strength based on the requirement identified in each weapon system MER.

MER	ES Requirement
CSAR-X	178
JSF	583
KC-X	16
TSAT	73
ARTs	980
Total	1,830

Air Reserve's 86 Combat Wing End Strength Requirement Short Fall
As a result of the 2006 QDR, 2007 BRAC and Air Force's TFI the Air Reserve had major adjustments to it end strength. BRAC and TFI directed a significant mission re-roll from 'Cold War' legacy systems to 21st Century Air Force transformation to its 86 modern CWs. At the same time the Air Reserve end strength was reduced by over 9,000 positions as part of FY 2007 PBD 720 transferring end strength monies into the modernization and recapitalization accounts.

As the Air Force and its components move from its 'Cold War' legacy capabilities, the Air Force will seamlessly integrate its components via the TFI process. The Air Reserve end strength shortfalls were determined using all afore mentioned MEP tools. Breakout of mission and numbers are as follows:

AFR 86 CW Requirements



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Air Reserve Military End Strength Requirement Shortfall by Year (FY 09-15)

AFR 86 CW Unfunded Requirements

	FY09	FY10	FY11	FY12	FY13	FY14	FY15
AFCYBER	316	316	316	316	316	316	316
Global Hawk	69	144	144	144	144	144	144
Predator	376	376	376	576	576	576	576
CSAR X Force Structure Growth	347	347	347	347	347	347	347
Battlefield Airmen Wing	69	69	69	69	69	69	69
Classic Reserve Associates	1,393	1,625	1,425	1,425	1,425	1,425	1,425
Robust Existing Missions	30	579	579	579	579	579	579
IMA Increase for New Missions	800	800	800	800	800	800	800
Total Unfunded AFR Requirements	**3,400**	**4,256**	**4,056**	**4,256**	**4,256**	**4,256**	**4,256**
FY09 PB Profile	**67,400**	**67,700**	**67,900**	**67,700**	**67,700**	**67,700**	**67,700**
86 Combat Wing Required Force	**70,800**	**71,956**	**71,956**	**71,956**	**71,956**	**71,956**	**71,956**

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Special Operations, Defense Health Program, and the National Intelligence Program (NIP)
In addition to the effort of the Air Force requirement to increase end strength to close the funding gap to operate, maintain, and support an 86 CWs capable Air Force, Air Force Special Operation command through its MFP-11 program has a requirement to increase Air Force MFP-11 end strength by 3,200 in support of USSOCOM growing end strength and mission requirements (provides enhanced capability in Predator, AC-130s, CV-22, MC-130s, U-28A, Special Tactics, Combat

Control Teams, Distributed Common Ground Stations). According to the MOA between USSOCOM and Air Force, USSOCOM provide the MFP-11 mission monies through Congress, OSD, or USSOCOM to fund the Air Force provided end strength while Air Force is responsible to fund and provide Base Operating Support end strength. Cost for this increase of MFP-11 end strength and its associated BOS is $317.6M

Also, any growth in end strength will drive a corresponding growth in the Defense Health Program to provide care for the 86 CWs requirements and this report also does not account for the growing demand for Air Force NIP end strength.

Resourcing within Air Force Baseline Budget
The FY 2009 budget cost of increasing Air Force's Total Force end strength (not including MFP-11) to 330K active ramping to 335K, 173K civilian, 106.7K Guard, and 71+K Reserves is:

FY 09 $.69B
FY10 $1.5B
FY11 $1.65B
FY12 $1.84B
FY13 $2B
FY14 $2.1B
FY15 $2.2B

Note, not included in the above end strength and dollars are the 3,200 MFP-11 end strength to enhance mission capability which is normally funded by Congress, OSD, or USSOCOM for Air Force Special Operations Command. This would require OSD/USSCOM to provide an additional $317.6M a year.

Air Force's ability to offset the $.69B in FY 09 ($11.9B FY 09-13) to increase its Total Force end strength from 661.9K to 681.9K ramping to 688.5K within its current baseline budget would be extremely difficult at best and reprogramming dollars from our Readiness and Modernization accounts will significantly impact readiness and accelerate the aging and obsolescence of our weapon systems. Over the past three budgets Air Force has had to make tough choices in respect to its People, Readiness, Infrastructure, and Modernization and Procurement accounts. Of particular concern are our aging weapon systems that will rapidly become operationally obsolete with the advancement of technologies. Reprogramming dollars from our Readiness and Modernization accounts will significantly impact readiness and accelerate the aging and obsolescence of our weapon systems. Failure to accelerate recapitalization will drive tremendous cost extending the life of current systems that will quickly become obsolete. To maintain a dominate edge in the battle space AF must modernize it capabilities and keep them in a high readiness state. For the Air Force to realign existing end strength or buy new end strength to operate, maintain, and support 86 modern CWs within existing Air Force top line would require a major BRAC (closing 15 major bases) and or terminating major programs. As to BRAC and/or terminating any program has met with resistance at many levels of our government to include Congress. The Air Force needs the additional budget top line and end strength increases to 335K Active Duty, 174K Civilian, 106.7K Guard, and 71.9K Reserves in order to perform existing mission requirements.

CONGRESSIONAL REPORT ON ANTIBIOTIC RESISTANT BACTERIA SUBMITTED BY U.S. AIR FORCE MEDICAL SERVICE FEBRUARY 2008

INTRODUCTION

This report is being provided to the congressional defense committees as directed in House Report 110-434, page 358.

EXECUTIVE SUMMARY

Infections from multi-drug resistant organisms have been identified in combat wounded service members who return to the United States for further treatment. While there are still antibiotics in use against these organisms, active research on the diagnosis and treatment of multi-drug resistant organism infections continues in the Department of Defense. Clinical practice guidelines are being developed for best care for the prevention of colonization and infection in combat-wounded personnel. Active communication between all levels of care from the combat theater to rehabilitation centers remains essential in ongoing surveillance of these infectious diseases.

BACKGROUND

Combat wounded service members are returning to the United States with multidrug-resistant organism (MDRO) colonizations and infections, chiefly due to the bacteria *Klebsiella*, *Acinetobacter*, *Pseudomonas*, and *Staphylococcus*. Accumulating data supports that these MDROs are spread nosocomially (within the healthcare system) from multiple in-theater sources, most likely secondary to cross-contamination from non-US patients in level III facilities. This nosocomial transmission does not appear to have a single source or involve a single strain of bacteria, suggesting system issues and not a focal exposure or breakdown of care at a single site. It has also been recognized that worldwide civilian medical facilities not involved in the care of combat wounded are also confronted with infections due to these same MDROs.

REPORT

Antibiotic Regimens Currently Used to Treat Service Members with Infections Due to Multidrug-Resistant Organisms

Current antibiotic regimens are based on the susceptibility patterns of the bacteria recovered in individual patients. The most frequent gram-positive bacteria infecting our wounded warriors is methicillin-resistant *Staphylococcus aureus* (MRSA). MRSA is treated with a variety of older and newer antimicrobial agents including vancomyin, trimethoprim/sulfamethoxazole, clindamycin, linezolid, daptomycin and tigecycline. There are a number of new agents active against gram-positive pathogens in final stages of Federal Drug Administration (FDA) approval.

While there is a selection of effective antimicrobial agents available for managing gram-positive bacteria, there are not as many agents to use against the most resistant gram-negative bacteria. The more resistant *Klebsiella* species are treated effectively with a class of antimicrobial agents known as carbapenems. Another gram-negative bacteria infecting combat casualties, *Acinetobacter* species, has a unique ability to develop resistance to a broad range of antimicrobial agents. This resistance has increased remarkably over the last five years. At this time, the only agent effective against 85 percent or more of the *Acinetobacter* isolates infecting our war wounded is an older antimicrobial agent known as colistin. There are no antimicrobial agents with enhanced gram-negative activity far enough in development to expect a new FDA approved agent to be available in the near future if further resistance to these antibiotics develops.

Availability of New Antibiotics

All FDA approved antimicrobial agents are screened for efficacy against the various infecting bacteria and, if effective, are being implemented in the treatment of infections among our combat casualties. All currently-approved FDA antibiotics are tested and utilized if the pathogens are proved sensitive, based on local laboratory testing. There are no known Phase III Investigational New Drugs (IND) available for use (on protocol) against the gram-negative MDROs.

Research Initiatives

Research on the diagnosis and treatment of MDRO infections is underway in the U. S. Army and Department of Defense. The United States Army Institute of Surgical Research (USAISR) has implemented a number of strategies to evaluate alternative diagnostic platforms for the detection of infection through field expedient rapid molecular techniques. In addition, USAISR has supported intramural and extramural research to develop models of wound and bone infections to investigate alternative treatment and prevention strategies, such as novel orthopedic devices used to stabilize bone injuries. Groups of Tri-Service infectious disease and surgical researchers have published observations on the epidemiology and nature of MDRO bacteria and the infections they cause (US Military Pubs). The newly formed Infectious Disease Clinical Research Program (IDCRP) has made the study of MDRO infections of combat-injured personnel a focus of their research portfolio. An Acinetobacter Epidemiological Consultation (EPICON) (Acinetobacter EPICON 2005), published in the medical literature, is one example of a study which has highlighted the epidemiology of an MDRO in military personnel.

A consensus conference supported by the U. S. Army Office of the Surgeon General, entitled "Prevention and Management of Combat-related Infections" was held 11-12 June 2006 at the U. S. Army Institute of Surgical Research. The conference, hosted by Colonel Duane Hospenthal (Army Infectious Disease Consultant) and Colonel John Holcomb (Army Trauma Consultant), brought together military (U.S. Army, Air Force, and Navy) and civilian experts in the specialties of trauma, general surgery and subspecialties, and infectious disease (J Trauma CRI supplement) to review the current evidence and determine best care practices which should be employed to prevent colonization and infection in combat-wounded personnel. These clinical practice guidelines (CPGs) and evidence-based medicine reviews are anticipated to be published in a *Journal of Trauma* supplement in March 2008.

Continuing Needs

Active, bi-directional communication between all levels of care from the combat theater to Veterans Affairs rehabilitation centers is essential. The military infectious disease and surgical communities have made continual efforts to improve the care of our combat casualties with an emphasis on mitigating the short and long-term complications associated with MDRO infections. The Clinical Practice Guidelines for prevention of colonization and infection in combat-wounded personnel, as illustrated above, provide our health care personnel direct guidance in the management of the combat wounded to decrease infections.

There also has been an increased emphasis on the role of infection control both in and out of the combat zone. Successful implementation of a ventilator-associated pneumonia (VAP) prevention program has been demonstrated at the U. S. Air Force hospital in Balad (publication in press). Supported in part by this study, the Joint Theater Trauma Surgeon (JTTS) has produced in-theater VAP prevention guidelines.

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Prevention and Management of Combat-related Infections

Clinical Practice Guidelines Consensus Conference

June 11-12, 2006

United States Army Institute of Surgical Research

Fort Sam Houston, Texas

Sponsored by the US Army Office of the Surgeon General

Supplement Editors

Clinton K. Murray, MD

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Prevention and Management of Combat-related Infections

Clinical Practice Guidelines Consensus Conference

Sponsored by the US Army Office of the Surgeon General

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CONFERENCE GOALS

To develop clinical practice guidelines (CPG) to prevent the infections associated with traumatic combat injuries based on available evidence-based medicine (EBM) and expert opinion, both within and outside of the US military medical community. The resultant CPG are meant to provide guidance to US military health care providers caring for individuals wounded in combat, with emphasis on the care provided within the combat zone. Consideration as to the type of care deliverable at each level of medical support and based on evacuation times (or in the case of non-US personnel, whether evacuation is possible) were also to be included.

The invited participants were comprised of a core of US Army specialty consultants (surgical and infectious disease) with participation by other US Army, US Air Force, US Navy, and civilian surgical, trauma, infectious disease, infection control, and preventive medicine experts.

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ABSTRACT

Management of combat-related trauma is derived from skills and data collected in past conflicts and civilian trauma, and from information and experience obtained during ongoing conflicts. The best methods to prevent infections associated with injuries observed in military combat are not fully established. Current methods to prevent infections in these types of injuries are derived primarily from controlled trials of elective surgery and civilian trauma as well as retrospective studies of civilian and military trauma interventions. The following guidelines integrate available evidence and expert opinion, from within and outside of the US military medical community, to provide guidance to US military health care providers (deployed and in permanent medical treatment facilities) in the diagnosis, treatment, and prevention of infections in those individuals wounded in combat. These guidelines may be applicable to non-combat traumatic injuries under certain circumstances. Early wound cleansing and surgical debridement, antibiotics, bony stabilization, and maintenance of infection control measures are the essential components to diminish or prevent these infections. Future research should be directed at ideal treatment strategies for prevention of combat-related injury infections, including investigation of unique infection control techniques, more rapid diagnostic strategies for infection, and better defining the role of antimicrobial agents, including the appropriate spectrum of activity and duration.

Guidelines for the Prevention of Infection following Combat-related Injuries

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INTRODUCTION

Infections have complicated the care provided to those wounded in war throughout recorded history.[1-3] In addition to the protection afforded by personal body armor, there have been numerous advances in the care provided to combat casualties. These include enhancement in the training and expertise of combat medics, enabling life saving care to be provided at the point of injury, and the rapid evacuation of casualties to surgical care that is provided in close proximity to the point of injury. These advances have enabled personnel to survive near catastrophic injuries; however, they have also placed a greater demand on the healthcare infrastructure by increasing the numbers of patients needing optimal functional rehabilitation and long-term care.

The patterns of injury sustained in combat are predominately extremity injuries (~65%), followed by head and neck (~15%), thorax (~10%), and abdomen (~7%) injuries; burns complicate approximately 5-10% of all combat casualties (Table 1).[4-6] Infectious risks associated with these injuries include those from initial wound contamination and from nosocomial infections associated with long-term care. The latter often involving multiply drug resistant bacteria (multidrug-resistant organisms, MDROs), as has been seen in the current US military conflicts.[7-12]

GUIDELINE DEVELOPMENT

Our committee was established to evaluate the current military and civilian literature and to provide recommendations for a clinical pathway to manage combat casualties using the best available medical evidence recommendations. The committee members consisted of military and civilian experts in infectious disease, trauma, preventive medicine, infection control, and surgical specialties including general surgery, critical care, orthopaedic surgery, neurosurgery, oral maxillofacial surgery, otolaryngology, and burn surgery. Physicians included personnel recently deployed to Iraq and Afghanistan as well as several with military medical experience in the Vietnam conflict. Clinical experience ranged from caring for combat casualties at the point of injury and throughout the evacuation chain, including initial field stabilization, initial surgical stabilization, care in the combat zone, at US military hospitals in Germany and in the US.

Five teams reviewed the military and civilian trauma literature prior to the guideline conference to draft recommendations for the treatment of casualties based on the available evidence. At the conference, sponsored by the United States Army Office of the Surgeon General and hosted by the United States Army Institute of Surgical Research at Fort Sam Houston, Texas on June 11-12, 2007, all participants discussed the presented data and draft guidelines. The medical literature and current surgical practices were reviewed by these five subgroups according to anatomical site or type of injury: extremity, central nervous system, thoracic and abdominal cavity, head and neck, and burns. Experts involved in the development of the guidelines were asked to review the literature and develop recommendations for the reduction or prevention of infections in combat-related injuries. The first priority was to evaluate military trauma related articles with an emphasis on well-conducted randomized control trials or cohort studies that could be incorporated into the guidelines. In addition, civilian trauma articles, primarily randomized control trials and then cohort studies, were evaluated. An attempt was made to assign a level to denote both the strength of recommendations and quality of the evidence available to support those recommendations. The Infectious Diseases Society of America (IDSA)/US Public Health Service (USPHS) rating system was utilized (Table 2). Limitations in using any rating system were noted early in this review process. For our guidelines, these included the fact that randomized controlled trials have not been performed in combat zones and that generalizing civilian trauma care data to combat trauma care may not be valid due to differences in mechanisms of injury, time to access, diagnostic capabilities at initial receiving facilities and the austere nature of many of those facilities, and access to and type of medical care systems.

Efforts also were made to ensure that these recommendations could be applied across all the different levels of medical care in a combat zone, and could be modified based on the equipment and medical expertise available at each level. Finally, management strategies had to incorporate possible differing evacuation times, and the management of personnel not evacuated out of the combat zone. After the guidelines were summarized, they were again disseminated to all participants for discussion. Additional discussion of the data supporting specific recommendations is provided in the reviews (by anatomical site/type of injury) within this *Journal of Trauma* supplement.

Current Situation

The management of combat casualties within a combat zone and throughout the evacuation chain from point of injury to definitive rehabilitative care in the US is a complex system. Casualties are managed by numerous physicians at varying levels of medical care in and out of the combat zone. These injured patients may pass through as many as 5 medical treatment facilities from the time of injury to their return to the US, spending only a few days at each facility.[7,13] The average evacuation time has been 7 days from injury to arrival in the US.[7,13] This results in numerous hand-offs, fragmentation of care, and loss of continuity. A particular example of this related to infection is the fact that culture results are available only after the casualty has been evacuated. Additionally, medical personnel assigned to care for combat-related trauma have varying clinical trauma experience and training prior to arrival in the combat zone. Deployments range from as short as 3-4 months for Air Force and Army Reservist physicians to 15 or more months for Army medical personnel (typically 6 months for surgeons) resulting in various levels of experience and sometimes conflicting management strategies.

Combat casualties are often colonized or infected with MDROs, likely due to nosocomial transmission in and out of the combat zone.[9-11,13,14] Few antimicrobial agents reliably cover these pathogens, necessitating rigorous antibiotic stewardship and infection control strategies in order to minimize their impact on the health of the injured.

At this time, the only summary of treatment strategies for managing combat casualties is the *Emergency War Surgery* textbook. Unfortunately, it is limited by summary statements without evidence-based recommendations and does not incorporate many of the lessons learned from current conflicts.[15] By reviewing and summarizing the best current evidence and expert opinion we hope to reduce practice variation inside and outside of the combat zone to further optimize care for injured personnel. It is expected that these guidelines will need to be updated periodically to incorporate advances in trauma management and to ensure the recommendations are appropriate for future combat environments and medical evacuation systems.

Target Patient Population

The pool of potential patients in the combat zone includes both military (US and coalition) and civilian (US Government, foreign contractor, and indigenous) personnel. The patterns of trauma associated with combat include all anatomical regions and are most commonly the result of either explosive devices with associated fragmentation injuries or gun shot wounds.[5,16-18] Military trauma patients are more likely to have multiple etiologies for their injuries; that is, they may present with a combination of blunt and penetrating trauma, often with burns and occasionally blast overpressure injuries. US military casualties are predominately young men without co-morbid illnesses.[5] In contrast, the civilian victims of combat zone trauma more frequently have co-morbidities such as hypertension and diabetes that complicate wound care.[19] A distinct management difference between these two populations is the rapid evacuation of US casualties out of the combat zone. Although there are some drawbacks to the rapid evacuation policy, it allows for long-term definitive care and prolonged follow up to begin in the US quickly, often within several days of injury. Civilian personnel managed in the combat zone often receive initial damage control surgeries and care with one primary team of physicians. Although long-term follow up is not provided, transfer of civilian patients to local facilities is often delayed until the patient is stabilized, often requiring days in US military intensive care units (ICUs).

Target Provider Audience

The target audience is all healthcare providers rendering care to patients with combat-related injuries in the combat zone as well as military and civilian medical professionals caring for returning casualties. Recommendations are focused on initial care provided in the combat zone at Levels I through III (see Epidemiology of Infections Related to Combat Injuries in Iraq and Afghanistan manuscript in this supplement for definitions). Care provided at Level IV and V is discussed in the reviews that follow by anatomical site/type of injury (also in this *Journal of Trauma* Supplement).

Scope of These Guidelines

Management strategies for the care of combat casualties begin with the control of hemorrhage and definitive control of the airway and breathing using the concepts of Tactical Combat Casualty Care (TCCC).[20] The primary method to prevent the development of infection in penetrating trauma is rapid surgical evaluation and management. Treatment strategies vary by anatomical location; however, overall treatment strategies include an emphasis on irrigation, debridement, antimicrobial therapy, coverage of wounds, and stabilization of underlying bony structures.

Numerous strategies proposed to modify the rate of surgical site infections, including minimizing blood transfusion, controlling hyperglycemia, minimizing hypothermia, and providing adequate oxygenation will not be addressed in this guideline. These guidelines also do not address the treatment of nosocomial infections associated with war trauma. All treatment facilities should establish and regularly update local antibiograms to direct empiric antimicrobial therapy for nosocomial infections. Timely microbiology support with susceptibility testing should be available to allow rapid de-escalation to directed short-course antimicrobial monotherapy, when possible. The role of an effective infection control program in modifying the risk of nosocomial transmission, especially of multidrug-resistant bacteria, cannot be over emphasized (Table 3). Although institution of infection control procedures in the combat zone is challenging, certain key infection control methods can be readily implemented; these include institution of hand hygiene compliance, proper use of gloves, patient cohorting, appropriate isolation (contact, droplet, airborne), standard protocols for disinfection and/or sterilization of patient care equipment in a war setting and appropriate environmental cleaning.[13,21] Antibiotic control programs should be put in place in the combat zone to limit use of broad spectrum antimicrobial agents. These methods have been shown to be attainable and effective in the combat zone.[21] Finally, although these guidelines are designed to be applicable to various combat environments, many of the recommendations herein are based upon the current conflicts in Iraq and Afghanistan.

PREVENTION OF INFECTION

Care at Point of Injury (Level I)

Initial care provided in the combat zone near or at the time of injury should emphasize safety of the patient and the personnel caring for the patient, controlling hemorrhage, and stabilization of breathing and airway per TCCC.[20] Wound care at this point consists of wound coverage and rapid evacuation. Casualty evaluation by a surgeon should occur within 6 hours of injury based on current doctrine (BII). If the intensity of battle and the environment allow, wounds should be covered with sterile bandages and the underlying bony structures stabilized to prevent further tissue injury (AII). If evacuation to surgical care is expected to be longer than 3 hours, antibiotics should be provided to the casualty as soon as possible (AII). The TCCC committee makes recommendations of which antibiotics to use in the combat environment in the setting of delayed evacuation.[22] The selection of these agents is based on spectrum, ease of administration, stability, and storage limitations. These antibiotic recommendations are not applicable to patients who can be rapidly removed from the battlefield or to those who have reached care at established medical facilities such as a battalion aid station (BAS). Based on mission, oral moxifloxacin has been placed into some personal medical kits (that also hold individual use items such as tourniquets, bandages, and pain medications) along with medic/corpsman medical kits. In the case of penetrating abdominal injury, shock, or when patients are unable to tolerate oral medication, the

TCCC also has provided recommendations for intravenous or intramuscular agents to use in those wounded who cannot be evacuated immediately (Table 4).

Professional Medical Care without Surgical Support (Levels I and IIa)

Care at a BAS (Level I) is typically provided by a physician assistant and/or a general medical officer (GMO- physician with at least 1 year of postgraduate medical education, but typically a board-certified internist or internal medicine subspecialist, pediatrician or pediatric subspecialist, family physician, or emergency medicine physician). Level I facilities have no holding capability and are designed for routine sick call and trauma stabilization only. Typically patients are evacuated from these facilities within 1-2 hours of injury in Iraq, with slightly longer delays in Afghanistan. Although enhanced casualty care can be provided, the primary goal for most injuries is stabilization and evacuation to a surgeon within 6 hours of injury (BII). Primary wound management consists of wound irrigation with removal of gross contamination (BIII). The type of fluid ideally used for irrigation is normal saline or sterile water, but potable water (AI) may used in the event these solutions are not available, with no change in outcome. Additives such as soap or antibiotics should not be included with irrigation fluids (DII). There is no “ideal” quantity of fluid, based upon size and location of injury, but 1-3 liters is typically considered effective (BIII). The fluid should be delivered under low pressure (e.g., 1 liter plastic bottles with several holes punched in the lid, applied by squeezing the bottle to propel fluid into the wound) (BII). High pressure irrigation devices actually are associated with tissue damage. Wounds should be bandaged with a sterile dressing and underlying bony structures should be stabilized with available splinting materials to prevent further injury (AII). Eye injuries should be covered with hard protection (e.g., fox shield or similar improvised device). Pressure dressings over the eye should be avoided if a penetrating injury is suspected. Antibiotics, typically intravenous, should be given within 3 hours following injury (Table 5) (AII). The agent of choice should reflect the injury site requiring the broadest spectrum of bacterial activity (AI); excessively broad empiric antimicrobial therapy should be avoided (DIII). For example, if the casualty has a penetrating abdominal injury and an extremity injury, the antibiotic recommended for abdominal injury has activity in excess of those recommended for extremity injury and is adequate for both. If rapid evacuation of the casualty to surgical care is expected (less than 3 hours), provision of antibiotics can be deferred to the receiving facility, although many feel antibiotics should be as soon as possible. Tetanus immunoglobulin or toxoid should be given as indicated (see below) (AII). It is acceptable to leave small, retained metal fragments in soft tissues; these may not require evacuation or evaluation by a surgeon (BII) [23]. However, x-ray evaluation is necessary to adequately determine location and extent of injury and this is not typically available at this level of care (see below).

Level IIa is typically a US Army medical company that has physician assistants and GMOs providing care with a holding capacity of up to 72 hours; no surgical care is available. Management strategies at Level I (BAS) apply here as well. Care should still emphasize wound management and evacuation to a surgeon within 6 hours of injury (BII). Limited x-ray capability is available (plain films only, no radiologist), so local management of retained metal fragments in soft tissue may be possible.

Care with Surgical Support (Levels IIb and III)

Surgical care provided in the combat zone is available at Level IIb facilities via forward surgical teams, which are designed for damage control surgery and short-term holding of patients. Level

III facilities are tertiary care referral facilities in the combat zone that provide resuscitation, initial surgery, and post-operative care (ICU, mechanical ventilation, and extended inpatient care) with enhanced diagnostic capabilities that include expanded laboratory support (including limited microbiology) and CT scans. Although casualties should be evaluated by a surgeon within 6 hours of injury (BII), there is no requirement for surgery to occur within that time window (CIII).

At initial surgery there is no indication for pre- or post-procedure microbial cultures (EII). Unless there is gross evidence of infection at subsequent debridements, wound cultures do not adequately predict subsequent infections or infecting pathogens. Wound cultures may lead to unnecessary courses of broad spectrum antibiotics and are thus highly discouraged.

Wounds should be aggressively debrided at the time of surgery (AII). Wound debridement should include removal of necrotic tissue, removal of readily retrieved foreign bodies, and careful evaluation of the remaining soft tissue. The goal of debridement is not to remove every small fragment (BII). For abdominal injuries, all non-viable solid and hollow viscera should be debrided and most solid organ (i.e., liver and pancreas) injuries drained. Small wounds to hollow viscus may be primarily repaired but caution should be applied for resection and reanastomosis, especially in those with significant physiologic derangement. For colon wounds requiring resection, diversion is recommended in most cases. Skin should rarely be closed due to excessive infectious complications (BIII). Burns should be debrided early, typically at the initial presentation to the surgeon or within the first 24 hours as the eschar serves as a major source of subsequent infections (AIII).

Certain injuries have a higher associated morbidity with immediate surgical intervention by an untrained subspecialist, that outweigh the infection preventing benefits of immediate debridement. Debridement of eye structures should wait until ophthalmologic surgical expertise is available. Not all foreign bodies introduced into the eye require urgent removal as infectious risks are small as long as removal of the foreign body occurs in a reasonable amount of time (BII). Foreign bodies can remain in the spine if there is no evidence of infection or neurological decline (CIII). Not all foreign material introduced into the brain requires removal (BII). The destruction associated with attempts to completely debride the brain may have substantial negative functional impact.

Wounds should be adequately irrigated with copious fluid. For extremity injuries, 3 liters of fluid are typically used for type I fractures, 6 liters for type II fractures, and 9 liters for type III fractures (Table 6) (BIII). For other wounds the recommendation is irrigation until the wounds are “clean.” For abdominal injuries this is typically 6 liters (BIII). The recommended irrigation fluids are normal saline or sterile water unless these are not available; then potable water is adequate (AI). There are no data supporting fluid additives and there is some data indicating they negatively impact wound healing (such as the toxic nature of betadine), and they can impair host defenses (DII). Fluid should be delivered under low pressure (typically less than 14 PSI) as high pressure has potential tissue and bone destructive properties (Low pressure irrigation (BIII); high pressure irrigation (DII)).

Antibiotics should be given intravenously within 3 hours of injury and as soon as possible following injury (AII). The agent(s) used should cover the pathogens likely to be contaminating the wounds at the time of injury; these may include normal cutaneous and enteric flora such as *Staphylococcus*, *E. coli*, and alimentary tract anaerobes (AI). Initial antibacterial activity should not be directed at multidrug-resistant pathogens such as *Acinetobacter baumannii*, *Pseudomonas aeruginosa*, or *Klebsiella pneumoniae* (DII). Given the low number of methicillin-resistant

Staphylococcus aureus (MRSA) infections and clinical data indicating that drainage and not antibiotics is the primary therapy of abscesses (even those secondary to community-acquired MRSA), empiric MRSA therapy with vancomycin does not appear necessary (DII). Agents should again reflect overlapping activity focused on the injury that requires the broadest spectrum of bacterial activity. Burn patients do not require systemic antibiotics unless there is evidence of infection or if antibiotics are indicated for treatment of other injuries (DI). There are data that suggest the use of broad spectrum antibiotics often leads to the development of subsequent infection with resistant pathogens. The duration of antibiotic therapy should be minimized as indicated in the Table 5 (BII). Prolonged therapy has been shown to worsen outcomes. Antibiotics should not be used just because the wound is “open” or because a drain remains in place (BIII). The presence of a chest tube alone does not require ongoing antimicrobial therapy. The role of topical antimicrobial therapy is clear for burn patients (AII). For full-thickness burn wounds, mafenide acetate every morning and silver sulfadiazine every evening is recommended. Silver sulfadiazine once daily is acceptable for partial thickness burns or for burns of limited extent. When twice daily dressing changes are impossible, once per day changes will still provide significant benefit. It is essential to thoroughly debride and cleanse the wound at each dressing change using chlorhexidine gluconate (4%). For partial thickness burns, biobrane is adequate for simple coverage of clean wounds. For burns of limited extent (e.g., < 30% total body surface area (TBSA)), silver impregnated dressings are adequate. Antibiotic impregnated beads for open fractures may be an appropriate therapy for personnel not being evacuated out of the combat zone who will also have an appropriate follow up (BII); they are not indicated for US personnel being evacuated 1-3 days after injury (DIII). Tetanus immunotherapy should be implemented as described in a subsequent section (AII).

Combat wound management includes delayed primary closure for extremity wounds; however, injuries to the face and brain require early closure of the mucosal lining or dura to decrease infections, which are significantly higher in the central nervous system without early closure, and cosmetic complications (BII). Early primary repair of complex or destructive colonic injuries is not recommended (BII), especially if associated with massive blood transfusion, on-going hypotension, hypoxia, reperfusion injury, multiple other injuries, high velocity injury, or extensive local tissue damage. However, simple, isolated colon injuries may be repaired primarily (AI). Skin should not be closed if there is a colon injury or extensive devitalized tissue due to excessive infectious complications (BIII). Vacuum-assisted closure (VAC) has been shown to be effective for personnel not being evacuated out of the combat zone when used in extremity and abdominal injuries (BII). The role of VAC in personnel being evacuated is currently being evaluated and initial results are encouraging. At this time, wound VAC should be cautiously used during air evacuation until further data are available (CIII). It is currently postulated that limitations of VAC usage in this setting are largely secondary to a need for proper training in their use during flight. In the past cranial bone has been retained in the abdominal wall, but given high infection rates and successful use of cranial prosthetics, this procedure has been discontinued (EIII).

Underlying bony structures should be stabilized to prevent subsequent infections. External fixation is currently recommended at Level III care for extremity wounds (AII); however, there are data reporting infectious complications with transcutaneously placed pins, so close clinical monitoring is necessary.

To prevent long-term infectious complications associated with trauma, patients requiring splenectomy should receive immunization against encapsulated organisms (e.g., *Haemophilus* *influenzae*, pneumococcal and meningococcal vaccines), ideally at 14 days of injury as this provides optimal immune reconstitution (CIII).

Care of Personnel not Evacuated Rapidly out of the Combat Zone

In the current combat zones, there is a large non-US patient population that is receiving damage control surgery and definitive therapy without evacuation to higher levels of care. This population frequently represents 60-80% of all injured casualties admitted to the Level III facilities. These patients should be managed according to the guidelines for Level IV and V in the adjoining articles, applying criteria for therapy based upon nosocomial, not community-acquired infections after admissions of greater then 72 hours. These patients may be at significant risk for multidrug-resistant colonization and infection as they often remain in facilities for long periods and have higher risks of developing MDRO infection, especially if aggressive infection control procedures are not followed. As such, they should be carefully managed to prevent nosocomial transmission within the facility, and indirectly, throughout the evacuation chain. In the combat zone, these patients should be evaluated for signs and symptoms of infection, and aggressive management strategies for the prevention of nosocomial infections should be implemented. This should include infection control procedures outlined above and aggressive antibiotic control programs.

Other Issues

Tetanus Immunotherapy

Therapy for tetanus is well-founded and should be standard of care. Immunized individuals should receive a booster dose of tetanus toxoid based on standard guidelines. Those subjects who have not been immunized should receive anti-tetanus human immunoglobulin in most cases, unless wounds are clean and care not delayed. In addition, these casualties should receive tetanus toxoid at the time of injury and again 4 weeks and 6 months later.

Small Retained Fragments

The weaponry commonly used in ground combat operations can result in numerous small fragments lodged into the soft tissue of the body. Often, the sheer numbers of fragments make them difficult or impossible to remove. Non-operative management is recommended in these patients if they have soft tissue injuries only (no fractures, no major vascular involvement and no break of pleura or peritoneum), wound entry/exit lesions less than 2 cm in maximum dimension, and do not show evidence of frank infection (BII). Management should include wound irrigation if possible, cleaning and dressing the wound, and administration of anti-tetanus immunoglobulin and toxoid as necessary. A single dose of antibiotics may be employed for management of these wounds as described in the Table 5 for extremity injury. Some suggest a 5 day course of antimicrobial therapy, but this is not likely needed. Removal of intraocular fragments may be delayed in the absence of infection (endophthalmitis); but consultation with an ophthalmologist as soon as possible is required.

AREAS FOR FUTURE RESEARCH

At this time, there are countless areas needing further randomized, controlled studies to determine the best treatment strategies for prevention of combat-related injury infections. The best infection control measures to prevent subsequent nosocomial infections are also needed. Priorities should include focus on evaluation of ideal antimicrobial regimens for use at the time of injury and the ideal duration of antibiotic therapy. Further assessment of the role of wound VAC and use of earlier closure of some lower risk injuries is also needed. There needs to be a method to provide physicians the ability to rapidly detect pathogens that are associated with infection to not only initiate therapy as early as possible but also to limit the exposure of patients to prolonged overly broad spectrum antibiotics, especially in an environment associated with rapid evacuation.

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Table 1 Historical overview of injury patterns, mechanisms of injury, time to presentation, died of wounds rates, and infection rates

	World War I	World War II	Korean War	Vietnam War	Gulf War	Somalia	OIF/OEF
Injury Site (%)							
Extremity	70	58-75	67	61-74	56-65	75	54
Head and neck	17	4	17	14	11	14	16
Thorax and Abdomen	6	12	14	12	6-15	11	N/A
Mechanism of Injury (%)							
Explosive devices	--	--	--	--	--	--	36
Bullet	--	33	--	30	5-20	42	16
Mortar	--	39	--	19	--	--	9
Artillery	--	11	--	3	--	--	8
Grenade, including rocket-propelled (RPG)	--	13	--	23	--	--	16
Land mine/booby trap	--	2	--	17	--	--	2
Fragments[a]	--	--	--	--	63-95	43	--

Time to evacuation (hours)							
	12-18	10	4-6	1 hour- 31% 4 hours- 86%	0.67[b] 4.41[c]	Up to 14	1-2
Died of wounds (%)							
	8 (of 153,000 wounded)	4.5 (of 599,724 wounded)	2.5 (of 77,788 wounded)	3.6 (of 96,811 wounded)	2.1 (of 143 wounded)	6.4 (of 62 wounded)	--
Wound infection rate (%)							
	--	--	--	4	--	19	--

Adapted from references 3-5, 15, and 24-27.

[a]Somalia and Gulf War study grouped all mechanisms into bullets, fragments, or other

[b] Prior to the ground war

[c] During the ground war

Table 2 Strength of recommendation based on quality of evidence rating system

STRENGTH OF RECOMMENDATION		QUALITY OF EVIDENCE	
Category	Definition	Grade	Definition
A	Good evidence to support a recommendation for use	I	Evidence from at least one properly randomized controlled trial (RCT)
B	Moderate evidence to support a recommendation for use		
C	Poor evidence to support a recommendation for or against use	II	Evidence from at least one well-designed clinical trial without randomization or from cohort or case-controlled studies
D	Moderate evidence to support a recommendation against use		
E	Good evidence to support a recommendation against use	III	Expert opinion

Adapted from the IDSA/USPHS rating system.

Table 3 Infection control techniques to reduce nosocomial transmission of multidrug-resistant organisms (MDROs)

Standard precautions
- Hand hygiene - always perform before and after each patient contact (whether gloves are worn or not) - Gloves - when contact with non-intact skin or body fluids is anticipated - Gowns - when changing dressings on open wounds - Masks and eye protection - based on anticipated or potential exposure
Contact precautions[a]
- Gloves and gowns - with all patient care
Cohorting
- Separation of long-term (>72 h) and short-term (≤72 h) admissions should be considered
Antibiotic control
- Avoid unnecessary empiric use of broad spectrum antimicrobials - Establish local antibiogram to guide initial empiric therapy - Limit antibiotic duration

[a]Used with patients with known or suspected MDRO infection or colonization.

Table 4 Antimicrobial therapy for prevention of infection in combat-related trauma during the care of casualties under tactical situations when evacuation is expected to be delayed (> 3 hours)

TCCC	PREFERRED AGENT	ALTERNATE AGENT	DURATION
Open extremity wounds	Moxifloxacin 400 mg PO	Levofloxacin 500 mg PO	1 dose
Penetrating abdominal injury, shock, or unable to tolerate oral medication	Ertapenem 1 gm IV/IM	Cefoxitin 2 gm IV/IM	1 dose

Tactical Combat Casualty Care (TCCC). The three phases of TCCC in which these antibiotic choices apply are “Care Under Fire” which is the care rendered by the medic or first responder at the scene while still under effective hostile fire, “Tactical Field Care” which is care rendered by the medic once no longer under effective hostile fire and medical equipment is still limited, and “Combat Casualty Evacuation Care” which is the care rendered once the casualty has been picked up by evacuation vehicles but has not reached a higher level of care including a Battalion Aid Station (BAS) or Forward Surgical Team (FST).

Table 5 Selection and duration of antimicrobial therapy for prevention of infection in combat-related trauma

INJURY	PREFERRED AGENT(S)	ALTERNATE AGENT(S)	DURATION
	SKIN, SOFT TISSUE, BONE		
Skin, soft tissue, no open fractures	Cefazolin, 1 gm IV q8h	Clindamycin 900 mg IV q8h	72 hours
Skin, soft tissue, with open fractures, exposed bone, or open joints	Cefazolin 1 gm IV q8h[a]	Clindamycin 900 mg IV q8h[a]	72 hours
	THORACIC CAVITY		
Penetrating chest injury, with chest tube	Based on wound (see Skin, soft tissue above)	Based on wound	NA
	ABDOMEN		
Penetrating abdominal injury with suspected/known hollow viscus injury and soilage; may apply to rectal injuries as well	Antibiotics with broad spectrum activity, including anaerobic activity. Options include cefoxitin 1-2 gm IV q6-8h, or piperacillin/tazobactam 4.5 gm IV q6h	Levofloxacin 750 mg IV once daily, or ciprofloxacin 400 mg IV q8-12h AND metronidazole 500 mg IV q6h, OR moxifloxacin 400 mg IV	24 hours after definitive cleaning

		(monotherapy)	
MAXILLOFACIAL			
Open maxillofacial fractures, or maxillofacial fractures with foreign body or fixation device	Cefazolin 2 gm IV q8h (higher dose recommended because of failures at 500 mg)	Clindamycin 900 mg IV q8h	24 hours
CENTRAL NERVOUS SYSTEM			
Penetrating brain injury	Cefazolin 1 gm IV q8h. Consider extending bacterial activity if gross contamination. Options included cefazolin AND gentamicin AND penicillin	Ceftriaxone 2 gm IV q24h. Consider extending bacterial activity if gross contamination. Options include cefazolin AND gentamicin AND penicillin. For penicillin allergic patient Vancomycin 1 gm IV q12h and ciprofloxacin 400 mg IV q8-12h	5 days
Penetrating spinal cord injury	As above. Add anaerobic bacterial activity if abdominal cavity is involved. Options include	As above. Add anaerobic bacterial activity if abdominal cavity is involved. Options include	5 days

	metronidazole 500 mg IV q6-8h	metronidazole 500 mg IV q6-8h	
EYE			
Eye injury, burn or abrasion	**Topical:** Erythromycin or Bacitracin ophthalmic ointment QID and PRN for symptomatic relief **Systemic:** No systemic treatment required	Fluoroquinolone 1 drop QID	Until epithelium healed (no fluoroescein staining)
Eye injury, penetrating	Prior to primary repair, no topical agents should be used unless directed by ophthalmology	Levofloxacin 750mg IV/PO once daily	3-5 days
BURNS			
Burns	**Topical:** Large full thickness and contaminated burns should be treated with mafenide acetate once daily (mornings) and silver sulfadiazine once daily (afternoons).	Mafenide acetate or silver sulfadiazine to wounds twice daily. More limited (clean) full thickness burns may be treated with silver-impregnated dressings. Biobrane can	

	Systemic: No systemic treatment required	be used in partial thickness burns.	

[a]These guidelines do not advocate adding enhanced gram-negative bacterial activity in type III fractures (ciprofloxacin 400 mg IV q8h or amikacin 15-20 mg/kg IV once daily)

Table 6 Grading of extremity injuries with fracture and their infection risk

Type of open fracture	**Description**	**Infection Risk**[a]
Type I	Puncture wound $\leq$ 1 cm	0-2%
Type II	Laceration wound $\geq$ 1 cm Moderate soft-tissue damage and crushing Bone coverage adequate and comminution is minimal	2-10%
Type III		10-50%
A	Extensive soft tissue damage, severe crushing, adequate bone coverage	
B	Periosteal damage and bone exposure with severe contamination and bone comminution, flap needed	
C	Arterial injury requiring repair	

[a]Based on data from civilian trauma. Tibial fractures have up to 2 times higher risk of infection than other injury sites with similar types of open fracture.

CLINICAL PRACTICE GUIDELINE FOR THE PREVENTION OF INFECTION FOLLOWING COMBAT-RELATED INJURIES

I. Care at point of injury (Level I)

A. Evacuate to surgical care within 6 hours (BII)

B. Bandage wound with sterile dressing; stabilize for evacuation to Level IIb/III (AII)

C. Single dose of oral or IV/IM antibiotics (within 3 hours of injury) (Table 4) should only be given if evacuation is delayed (AII)

II. Patient Care without surgical support (Level I and IIa)

A. Level I (BAS, battalion aid station)

1. Evacuate to surgical evaluation within 6 hours (BII)
2. Primary wound management consist of irrigation to remove gross contamination (BIII); use normal saline, sterile or potable water (AI); under low pressure (BII) with no additives (DII)
3. Bandage wound with sterile dressing (avoid pressure dressings over eyes) (AII)
4. Intravenous antibiotics within 3 hours of injury (AII); IV infusion of antibiotics is preferred over IM in hemodynamically compromised patients
5. Antibiotic choice per Table 4 (AI) without enhanced gram-negative activity (DIII)
6. Tetanus immunoglobulin and toxoid as appropriate (AII)

B. Level IIa - (medical company)

1. Same as level I (BAS)
2. Consider treating at the local facility with a single dose of antibiotics, without surgical evaluation for small retained fragments that only involve soft tissue injury (x-ray

confirmation of no bone involvement, no vascular involvement, and no break of pleura or peritoneum), wound entry/exit lesions less than 2 cm in maximal dimension, wound not frankly infected (BII)

III. Care with surgical support (Level IIb and III)

A. Casualties should undergo surgical evaluation within 6 hours of injury (BII); surgical intervention can be delayed past 6 hours based on tactical reasons (CIII)

B. Do not obtain routine pre- or post-procedure microbial cultures (EII); cultures should only be obtained when there is clinical evidence of infection

C. Wounds should be aggressively debrided with removal of all necrotic tissue and foreign bodies easily reached (AII); eye (BII) and spine injuries without neurological compromise (CIII) can await surgical debridement until surgical expertise is available; cerebral foreign bodies may remain if removal would cause excess damage (BII)

D. Wounds should be irrigated until clean; extremity injuries should be irrigated based upon type of fracture (type I (3 L), type II (6 L), and type III (9 L)) (BIII); abdominal trauma typically requires 6 L of fluid (BIII). Irrigation fluids can include normal saline or sterile water; potable water may used in the event these solutions are not available (AI). Fluid additives are not recommended (DII); no high pressure irrigation should be performed (BIII low pressure (less than 14 PSI), DII high pressure)

E. Antibiotics should be infused within 3 hours of injury (AII); avoid overly broad spectrum antibiotics and minimize duration (Table 5) (for extremity injuries with fracture: first generation cephalosporin (AI); enhanced gram-negative activity agent is not recommended (DIII)); antibiotics activity should best reflect the most contaminated site (abdominal>face>CNS/eye/extremity); duration should be short (Table 5) (BII) and not extended for open wounds, drains, or external fixation devices (BIII); antibiotic cement can be used for extremity injuries in patients not evacuated (BII), but should not used for patients expected to be evacuated or transferred in 1-3 days (DIII); topical wound therapy is recommended for burn patients (AII), but not other injuries; retained foreign body in the eye, spine or brain should receive antibiotics as indicated in the table

F. Adjunct therapy includes tetanus immunoglobulin and toxoid as necessary (AII); immunization against encapsulated organisms at 14 days after trauma for patients who have their spleen removed (CIII)

G. Extremity wounds should undergo delayed primary closure (EII, immediate primary closure); skin should not be closed if there is a colon injury or extensive devitalized tissue due to excessive infectious complications (BIII); early primary repair of complex or destructive colonic injuries is not recommended (BII), especially if associated with massive blood transfusion, on-going hypotension, hypoxia, reperfusion injury, multiple other injuries, high velocity injury, or extensive local tissue damage; simple, isolated colon injuries may be repaired primarily (AI).VAC appears effective in the combat zone (BII) but its role during air evacuation is unclear at this time (CIII); if no evacuation at 3-5 days consider closing wounds if no evidence of infection (BII); injuries to the face (BII) and brain (BIII) require early closure of the mucosal lining and dura or skin covering the brain

H. Extremities can be stabilized by external fixation if required but close clinical monitoring for infection is recommended (AII)

IV. Care associated with personnel not evacuated rapidly out of the combat zone

Should reflect Level IV and V care outlined in the accompanying reviews; facility specific antibiograms should be developed (AII); infection control procedures should be implemented (AII); management strategies after 72-hours of admission should emphasize nosocomial infections

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Abstract

Despite the innumerable variations in war-making weaponry employed over the millennia, wounds have always been characterized by devitalized tissue, the presence of foreign bodies, clots, fluid collection, and contamination by microorganisms. Even in the post-antibiotic era, infections of these wounds remain a significant contributor to both morbidity and mortality. Shifts in causal organisms and their resistance profiles continue to challenge each new generation of therapeutics. This article reviews the history of war wound infections, with an emphasis on wound microbiology and combat casualty management during US conflicts from World War I through the end of 20th century.

History of Infections Associated with Combat-related Injuries

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The Role of Infections During War

In the history of war, disease and non-battle injuries have resulted in the vast majority of lost combat days. Prior to the 19th century, infectious diseases unrelated to trauma were responsible for a much greater proportion of the deaths during war than battle-related injuries. During the Mexican War (1845-1848) and the Spanish-American War (1898) disease-related deaths outnumbered battle-related deaths by seven to one.[1] With the introduction of military hygiene and disease control at the beginning of the 20th century, there was a steady decline in the number of wartime deaths attributable to diseases classically known as “war pestilence,” including cholera, dysentery, plague, smallpox, typhoid, and typhus fever. The ratio of battle and wound deaths to infectious disease from “war pestilence” deaths during the major 20th century US wars was 1:0.4 in World War I (1914-1918), 1:0.1 in World War II (1939-1945), 1:0.13 in the Vietnam War (1964-1973), and 1:0.01 in the first Gulf War (1991).[1]

As the prevention and management of infectious diseases during combat has advanced, there has been a parallel movement to improve treatment of battlefield casualties. These advances in the US military have included the establishment of a formal medical department in 1814, the introduction of dedicated medical transportation and ambulances in 1859, the establishment of medical readiness and evacuation of wounded by the “Letterman Plan” during the American Civil War, and numerous other innovations throughout the 20th century.[2] We describe here some of the different strategies for managing combat wounds to prevent infection, from those of the ancient Egyptians and Greeks, following the introduction of gunpowder, and up to present day major US conflicts, with an emphasis on the impact of modern microbiology and antimicrobial agents.

Ancient Origins of Wound Management

The earliest written records of wound management date to Sumerian carvings over 4,000 years ago. The carvings describe three treatment strategies: washing, making plaster, and bandaging.[3] Wounds were washed with beer or hot water and then bandaged with poultices. Engraved in King Hammurabi's Code from approximately 1700 BC are descriptions of payment and punishment for errors associated with surgeries.[3] Egyptian writings describing wounds and their management include the Edwin Smith and Ebers Papyri, dated 1550-1600 BC.[3, 4] The Egyptians were noted for their diagnostic approaches, with management decisions based upon these diagnoses.[4] Reportedly, they were able to differentiate between infected and uninfected wounds with some accuracy. A cornerstone of therapy was topical treatment. Lint or vegetable fibers served as an absorbent, grease formed a barrier against external contamination, and honey was used for its antibacterial effects, all of which have been shown to have some efficacy.[3-5] The Egyptians often applied excrement, notably donkey feces, on wounds. Donkeys were important in Egyptian mythology, and this particular application may have been an attempt to ward off invasion by evil spirits.[4] Surgical management included removing pus from the wounds with the belief that complete evacuation prevented reoccurrence.[4] As is evident from remains of mummies, bandaging was an art form at this time. There are descriptions of fly excrement and saliva being mixed into topical therapies that were applied to wounds, although maggot therapy *per se* does not appear to have been used.[4]

Homer's *Iliad* and *Odyssey*, from the 8th century BC, contains some of the earliest reports of wound management by the Greeks.[6] Wounding patterns and outcomes were correlated with mechanism of injury: 100% mortality with injuries due to swords, 80% for spears, 67% for slingshots, and 42% for arrows. Management strategies for an arrow injury included removal of the arrow, rinsing the wound with warm water, and applying analgesic and styptic herbal medicines to the wound.[6]

The most well known figure in Greek medicine was Hippocrates, born around 460 BC.[3, 6] He produced a vast number of medical texts, whose compilation is referred to as *Corpus Hippocraticum*.[7] He described setting fractures, debridement, bandaging, traction, correction of dislocations, and the use of casts and splints. He recognized the association between fingernail length and disease transmission, which is considered relevant to infection control today. In Hippocrates' book, *On Wounds*, he stated that the keys to proper healing include washing the wound in clean water or wine (noted today for antibacterial activity), not allowing the wound to remain moist, and rest and immobility for the afflicted.[3, 6, 8] He also indicated that sutures should be soaked in hot olive oil prior to use. For compound fractures, he recommended tightly bound bandages to achieve necrosis and autoamputation with subsequent placement of a prosthesis. There are also descriptions of surgical drainage of pus, with a tin pipe known as a "pus-puller" placed into the abscess cavity.[3] Fundamental to his teaching was the reduction in inflammation of the wound, although he encouraged the development of pus to meet this goal.[7]

One of the dominant figures in Roman medicine was Galen of Pergamum (120-201 AD), a surgeon of Roman gladiators. He was the author of over 400 works pertaining to medicine. But his overall impact on surgical progress may have been negative as he believed the presence of pus, referred to as "laudable pus," was beneficial to wounds.[7] This premise would persist for centuries. Surgical progress in the Middle Ages was modest for a number of reasons, one of which was the widespread acceptance of Galen's teaching of the benefit of pus. Equally contributory was the divestment of religious involvement from medical practice, at a time when the majority of physicians were clergymen. It was not until 1267 that the presence of pus was judged to be unnecessary for wound healing, although this idea would not gain mainstream acceptance for almost six more centuries.[7]

1300-1800s

The introduction of gunpowder to Europe in the 14th and 15th centuries marked a new era of wound patterns and thereby a shift in wound management. Injuries became more complex, with a rising prevalence of shattered extremities, as well as associated burn injuries further complicating wound management, and ushering in the era of amputations. Surgical techniques of the 14th century focused on the removal of foreign objects, rejoining severed tissue, maintaining tissue continuity, preserving organ substance, and preventing complications.[7]

Fundamental to the management of injuries at this time was the belief that gunpowder was poisonous and that bullets were contaminated prior to firing. This prompted therapy to revolve around cautery of the wound with a red-hot iron or hot oil.[7, 9] It was not until the 1500s that this belief would dissipate.[7, 9] The poisonous nature of gunshot was questioned after Ambrose Paré, a battlefield surgeon, ran out of hot oil and substituted egg yolk, turpentine, and rose oil, and bandaged the wounds.[10] He found that wound healing with this method was superior to that obtained with the cautery approach.[7, 9, 10] He also introduced debridement, adopted special tools and new techniques in fracture reduction, and developed a simple tourniquet with vessel ligation.[11] Paré also noted the utility of maggot therapy in 1557, which was later supported by Baron D. J. Larrey, Napoleon's military surgeon in 1829; this therapy is still used today.[9, 12] Unfortunately, however, Paré still believed in the importance of pus to wound healing.

During the Revolutionary War (1775-1781), trauma surgery was greatly influenced by John Hunter, the Surgeon General of the English army. One of his early proposals was that not all wounds need aggressive debridement. Although this application was often used at the time for large wounds, which allowed progression of infection, it is an idea that is supported today for small fragmentation injuries.[7, 13] John Jones, one of the founders of King's College Medical School, the precursor of the Columbia University College of Physicians and Surgeons, published a textbook on the management of wounds and injuries for young military surgeons based upon his volunteer surgical experience during the French and Indian Wars (1754-1763).[7, 9] The primary emphasis was on removal of bullets within easy reach and avoidance of primary wound closure. If a wound was to be closed, an onion was placed in the wound prior to closure, and the wound reopened at 24-48 hours.[7] The wound was expected to develop swelling and pus by the fourth day post-injury, which were thought to be signs of proper wound “digestion” necessary for healing. Amputation continued to be the therapy for compound fractures. Superficial burns were treated with wine and deep full-thickness burns with hog’s lard.

Wound care during the War of 1812 (1812-1815) continued to emphasize early amputations to shorten hospital stays, reduce the risk of infection, and to reduce the trauma caused by transportation on horse-drawn vehicles. Management continued to rely upon incision and removal of foreign bodies, with fasciotomy to prevent further tissue damage. During the Napoleonic Wars (1803-1815), amputations were also the standard of care. It was reported that Napoleon’s surgeon, Dominique-Jean Larrey, could perform 200 surgeries a day, or one every 7.2 minutes. Hip and shoulder joint amputations apparently took 15 and 11 seconds, respectively.[7] Larrey believed early amputation created a clean viable wound, and was reported to have had a 75% success rate in preventing infection.

During the American Civil War (1861-1865) some of the key components of wound care included general anesthesia, delay of primary amputation to reduce the effect of wound shock, bromine to prevent hospital gangrene, use of well-trained physicians, and the development of pavilion-type hospitals.[7] Over 50,000 amputations were preformed during this conflict.[11] In one report Confederate Army troops undergoing primary amputation had a 38% mortality rate (among 1142 patients) in contrast to secondary or delayed amputation, which had 53% mortality (among 546 patients).[7] Although carbolic acid and sodium hypochlorite were available, they were used for treatment, and not prevention, of gangrene. Infections included erysipelas, with a mortality rate of 8%, and hospital gangrene, with a mortality rate of 38-62% if untreated, but which fell to 2.6% with the use of topical bromine.[14] Patients with these types of infections were housed together to prevent disease transmission.[15] Tetanus was rare, but had a mortality rate of 89%. Mortality for pyemia was even higher at 97%. Although pyemia, or sepsis, resulted from only 1% of wounds, it caused 6% of deaths. Typically, penetrating abdominal injuries were not operated on due to an 87% overall mortality, ranging from 59% for colon injuries to 100% for small bowel involvement. Maggot therapy was also used during the American Civil War.[9, 12]

During the Russo-Turkish War (1877-1878), Russian military surgeon Carl Reyher emphasized immediate wound debridement. This was supported by Paul Leopold Friedrich, who recognized that surgery within 4-6 hours after wounding usually prevented the development of wound infection.[14] Data by Reyher revealed immediate wound excision and antiseptic treatment performed on the battlefield had a mortality of 24% (13 deaths in 55 patients), whereas the same techniques applied after delayed evacuation resulted in 54% mortality (42 deaths in 92 patients). If the delay was days, the mortality was 55% (11 deaths in 20 patients).[14]

Around the time of the Spanish-American War (1898) there was acceptance of the germ theory, antiseptic techniques, and more effective anesthesia delivery mechanisms on the battlefield. Antiseptics were carried in first aid pouches on each soldier’s cartridge belt.[7] It was also noted that septic shock had a major impact on outcome. At the dawn of the modern microbiology era, it was recognized that wounds were infected with the anaerobic bacteria, *Bacillus aerogenes capsulatus* (other names used in the literature for the next 50 years included *Bacillus welchii*, *Clostridium welchii*, and *Clostridium perfringens*), resulting in gas gangrene.[16]

Modern Microbiology and Antiseptics

Although it had been postulated that infections were associated with contamination of wounds, were contagious, and could be spread by people and instruments, prior to the germ theory this remained a controversial issue.[14] With the introduction of modern microbiology, there was a rapid transition of the care provided to combat casualties. Louis Pasteur in 1861 identified bacteria as the cause of putrefication and toxic effects, and proposed the germ theory of disease. Joseph Lister advanced the care of combat casualties using carbolic acid spray as a method of antisepsis.[17] This intervention was reported in 1867 to reduce the amputation mortality rate from 16 of 35 cases to 6 of 40 cases.[7, 17, 18] In 1865 Lister was also disinfecting instruments with carbolic acid and using antiseptics in dressings for wounds.[10, 17, 19] Robert Koch's confirmation that bacteria caused disease in 1877 further advanced the field. In 1881 Koch was able to grow bacteria on solid media. The gram stain was developed by Christina Gram in 1884. Although van Leeuwenhoek had been able to describe 'animalcules' using the microscope in 1716, the importance of this instrument was not realized until the germ theory came into being.

Gowns, masks, and gloves were introduced as a means of infection control in the 1880s.[20] Florence Nightengale and her cadre of 37 nurses emphasized sanitation and hygiene in the hospital after it was noted in the Crimean War (1853-1856) that two-thirds of the original 25,000-man force died of cholera, dysentery, and scurvy within a year.[7]

World War I (1914-1918)

Numerous advances in surgical techniques occurred during World War I. Appropriate debridement of combat wounds is credited to Belgian Army Surgeon, Antoine Depage, who recognized that wounds needed to have foreign bodies, contaminated, and contused, necrotic tissues removed.[9] Use of silver foil dressings for wounds was implemented, reminiscent of the Roman use of silver and nitrate metal filings in wounds.[9] Blood transfusions with ABO compatibility testing became available. Laparotomies were performed in World War I for abdominal injuries, although mortality remained high (~50%), likely due to delayed evacuation, inadequate resuscitation, and other factors.[7] Harvey Cushing was a key physician and researcher during World War I.[7] He noted that an increase in trench depth between 1915 and 1917 resulted in more head injuries.[7] Cushing found topical antiseptics containing dichloramine-T to be effective in preventing the development of infection.[21] The invention of x-ray technology by Wilhelm C. Roentgen in 1895 helped in the management of trauma and localization of foreign bodies. The need for rapid surgical care of war wounds was also confirmed. Rapid evacuation was associated with improved outcome; with a mortality rate of 10% if evacuation occurred within 1 hour, and 75% if evacuation occurred in 8 hours.[16] Finally, tetanus antitoxin, first described in 1890, had wide-scale distribution and application during World War I, causing tetanus rates to drop from 9 per 1,000 wounded to 1.4 per 1,000.[22] Further progress in tetanus antitoxin purification brought about further reductions, with only 12 cases reported among 2,734,819 hospital admissions for wounds and injuries during WWII.[23, 24]

The ability to describe the involved microorganisms was fundamental to developing appropriate wound management strategies. In 1915, Fleming described the bacteriological history of war wounds (Figure 1).[25] The first phase was a watery, foul-smelling, reddish-brown discharge notable for anaerobes but also including fecal pathogens and streptococci. After approximately seven days, these were largely replaced by pyogenic streptococci, although anaerobes were still present.[26] The wound drainage lost its bloody character and became more purulent with less foul odor over the next two weeks. The third phase, beginning at about 20 days, was characterized by the proliferation of pyogenic bacteria, predominantly streptococcci and staphylcococci. It was notable that about a quarter of the patients whose blood was cultured by Fleming were bacteremic.

Fleming noted *C. welchii* (now *C. perfringens*) in 81% of wounds from 1-9 days after injury, 34% from 8-20 days, and 18% at 20 days or more after injury. Pettit noted that the interval from injury to surgical intervention had a substantial impact on the incidence of gas gangrene.[27] The presence of gas gangrene among 137 patients was 2.9% after treatment at a casualty clearing station and evaluation at a base hospital.[26]

Fleming also reported on the use of topical antiseptic therapy of wounds, finding an early benefit on infection rates but a negative overall impact on healing.[28] He concluded that topical therapy should not be used and that the surgeon should rely “on his skill alone.” He said, “… it seems a pity that the surgeon should wish to share his glory with a chemical antiseptic of more than doubtful utility.” Despite this, Dakins solution (hypochlorite) remained a common therapy during World War I.[29]

One of the primary papers detailing gunshot wound management in World War I described the outcomes of patients treated at a casualty clearing station.[30] Observations were made regarding wound bacteriology in relation to primary suturing results. Cultures were obtained from 215 of the 224 wounds that were primarily sutured. Twenty-one of these cultures

(9.7%) were negative, all of which healed completely by primary intention. The remaining 194 (90.3%) contained anaerobes (61.3%), hemolytic streptococci (10.3%), non-hemolytic streptococci (32.4%) or “other organisms” (48.9%). Those with hemolytic streptococci typically became infected and resulted in failed primary closure (95% of 20 wounds), while failure was rare among wounds containing anaerobes alone. Wounds infected with hemolytic streptococci were described as “violently” suppurating, and accompanied by “severe constitutional disturbances.” In contrast, wounds with non-hemolytic streptococci were, in general, found to be less virulent with minimal complications; 71% still healed with primary closure, and those that did not heal showed milder suppuration than wounds infected with hemolytic streptococci. The average interval between wounding and intervention was 11.7 hours. This interval was shorter among the successful cases of primary closure than those failing primary closure (10.7 hours versus 12.1 hours), though no statistical comparisons were made.

In the study 106 gunshot wounds to the head, infections were serious complications of injury and had a great impact on outcomes.[31] There were 43 infected with *S. aureus* recovered from the wounds, of which nine died. Sixteen cases of streptococci recovered from wounds were reported, of which eleven died. Overall, streptococci were associated with a higher mortality rate regardless of the severity of the injury.

Introduction of Antimicrobial Therapy

The first commercially available antibacterial was the sulfonamide prontosil with accounts of its efficacy published in 1935. This agent became widely used but was mass-produced under uncontrolled standards. Its use resulted in numerous deaths from poisoning due to the diethylene glycol in the elixir. These deaths led to the enactment of the Federal Food, Drug and Cosmetic Act. Sulfonamide was widely available during the early years of World War II and was often used as a topical wound agent. Other more active antimicrobials, notably penicillin, were developed, which quickly replaced the sulfonamides in therapy of combat injuries.

The discovery of a *Penicillium* mould producing an antimicrobial substance is credited to Alexander Fleming after his accidental recognition of the mould inhibiting the growth of staphylococci.[32] However, the use of moulds to treat wounds and infections dates back to the Greeks and Romans. Throughout the late 1800s numerous scientists, including Louis Pasteur, William Roberts, John Tyndall and others recognized that the presence of mould prevented the growth of bacteria.[33] Howard Walter Florey, a chemist, was able to isolate and produce the substance in 1939, enabling it to be used in the first patient in 1941 and by the military in Africa in 1942, with remarkable success.[34-36] Since the mass-production of penicillin was not available during the initial stages of the war, it was recrystallized from the urine of treated patients for the purposes of reuse.[34, 37]

World War II (1939- 1945)

Chemotherapeutics and introduction of antibiotics such as sulfanilamide and penicillin distinguished World War II from previous wars. Lessons learned during World War I were applied during World War II, including delayed primary closure, pedicle flaps, and external fixation devices.[36] Although external and internal fixation devices were used, the concern for the development of infection prevented their widespread application.[38] Mortality from abdominal injuries decreased from 66% in World War I to 24% in World War II, likely related to delayed primary closure and the separate exteriorization of injured large intestines.[7] Chest injuries, which had 62% mortality in the Civil War and 25% in World War I, had only 10% mortality in World War II.[7]

On December 5, 1941, Dr. John J. Moorhead, chief surgeon for the New York subway system, presented a series of lectures on the treatment of trauma to the Honolulu Medical Society.[39] As part of that lecture series, he presented techniques on debridement, delayed primary closure, and the use of sulfanilamide powder in wounds.[2, 39] This lecture was attended by Army and Navy medical personnel stationed in Hawaii. The Japanese attacked Pearl Harbor approximately 36 hours later. Dr. Moorhead, along with military and civilian physicians, used these techniques with remarkably good results in the aftermath of the attack. Topical sulfanilamide became part of the standard of care, and individual soldiers carried sulfanilamide with them. This reliance on sulfanilamide powder replaced, rather than augmented, appropriate debridement.[2] In addition, under field conditions the powder was dumped, not sprinkled, into the wound as was done in Hawaii.

One of the lessons learned during World War II was the role that the environment and healthcare personnel played in hospital-associated infections and nosocomial transmission.[40] Recommendations to prevent transmission in the hospitals promoted masks for patients and healthcare workers, dressings changed with clean dry hands, all material handled with sterile instruments, and thoroughly cleaning baths. Leaders were trained to enforce the rules. These techniques appeared especially effective with the most problematic pathogen, *S. pyogenes*.[40, 41]

Researchers confirmed many of the findings of World War I and the role of infections during the care of casualties.[42] Wounds treated within six hours had substantially lower infection rates than those delayed for eight hours or more. Hospital-associated infections occurred in 86% of wounds. There was also recognition of the increasing role of staphylococci and the gram-negative bacilli, *Proteus* and *B. pyocyaneus* (now *Pseudomonas aeruginosa*) in wound infections.[43] These pathogens appeared to be of low virulence but had significant impact on impairing wound healing.

Study of head injuries revealed that *Staphylococcus* were commonly recovered, but *S. aureus* was not typically present in deep wounds.[44, 45] As these wounds matured there was more recovery of *S. pyogenes*, with occasional recovery of *Proteus* species and *P. aeruginosa*. Of 700 consecutive neurosurgical cases in the Italian campaign, 28 became infected.[46] The difference in infection rates in patients treated with penicillin and sulfa-powder versus sulfa-powder alone was remarkable (17 of 184 (9.2%) in the PCN and sulfa-powder group; 10 of 32 (31.2%) in the sulfa-alone group). The infectious complications reported included abscess (11), meningitis (8), encephalitis (1), anaerobic infections (2), uncomplicated fungal infections (3), and superficial wound infections (3). The highest mortality rate was in the meningitis group (6 of 8 died), despite routine use of systemic sulfadiazine. A follow-up of 200 patients with cranial injuries in the US revealed 47 (23%) had evidence of infection.[47] Of these, 21 (44.6%) had retained bone or metal fragments in their wounds. Among the remaining 153 men who did not develop infections, 73 (47%) were shown to have retained bone or metal fragments on subsequent X-rays. It was thereby assumed that retained material had little effect on rates of subsequent infection in patients with head injuries.

The first reported use of penicillin in World War II was in Oran, Africa, in November 1942.[36] Patients arriving in Bristol, England, after transport by hospital ships from Africa, had no evidence of infection.[36] Initially, the British Army used penicillin in wounds while the American policy was to reserve the limited supply for systemic administration.[48] This resulted in Americans being more aggressive in surgical techniques and the British focusing on attempts at bacteriologic sterilization of wounds. In the Italian theater, it was shown that surgery was fundamental for wound management and that penicillin was an adjunct for the control of invasive infection.

Korean War (1950-1953)

The Korean War introduced Mobile Army Surgical Hospitals (MASH units) and the rapid evacuation of casualties from the battlefield using helicopters. Forward surgical care in combination with helicopter evacuations enabled patients to arrive for surgical care between 2 and 4 hours after injury. Other notable advances were vascular repairs, lower amputation rates, and hemodialysis. Wounded mortality rates improved from 4.5% during World War II to approximately 2.5% during the Korean War.[11] Surgical research teams in theater also allowed for more rigorous study of combat casualties.[7]

Microbiology reports from the Korean War indicate that at the time injured personnel presented to medical care their wounds were already contaminated with bacteria.[49]There were seasonal differences in bacteria recovered during the Korean War, with staphylococci and streptococci predominating in winter months, replaced with fecal bacteria during the summer. In addition, summer months had more *Clostridium* species recovered from wounds.[50]

The rates of clostridial infections during the Korean War continued the downward trajectory begun after World War I. Among 4,900 wounds there was a reported 0.08 incidence of gas gangrene and no gangrene-associated mortality.[51] During World War I, by comparison, there had been a 5% incidence of gas gangrene, with 28% mortality; during World War II the incidence ranged between 0.3% and 1.5%, depending upon the theater, with 15% mortality.[27, 52-54] This decrease was largely attributable to decreasing the time from injury to definitive care.

Those developing gas gangrene during World War I waited an average of 42 hours from injury to surgery, in contrast to those who never developed gangrene, who underwent surgery within 25 hours of injury. In a study assessing clostridial infection in the Korean War, the average evacuation time was 3.5 hours and all the patients who developed gas gangrene had inadequate initial debridements.[51]

Microbiological evaluation of neurosurgical cases from the Tokyo Army Hospital between 1951 and 1952 revealed gram-positive bacteria, including hemolytic and nonhemolytic streptococci, and gram-negative bacteria in the wounds.[55] Standard therapy in Korea prior to evacuation to Tokyo consisted of surgical debridement and the use of penicillin with streptomycin. Of the isolates recovered in Tokyo, resistance to penicillin was demonstrated in 48 of 58 cases, and to streptomycin in 49 of 58 cases. Seven cases were resistant to all agents tested (penicillin, streptomycin, tetracyclines, and chloramphenicol). Inadequate debridement was the most commonly cited cause of infection in 25 of 58 cases, with sixteen reported cases of inadequate closure of the scalp and dura mater. The authors concluded that antibiotics were an adjunct to appropriate surgical care and that prophylactic antibiotics were associated with a high incidence of drug-resistant microorganisms. An analysis of air sinus wounds associated with craniocerebral injuries revealed a high infection rate (47 of 163), especially with delayed surgery.[56] Prompt and radical surgical debridement of the structures along the missile tract with appropriate dural repair prevented subsequent infections.

There was a 5% bacteremia rate in combat casualties (total of 170 casualties evaluated); however, the degree of shock, type of injury, the time lag to care, and previous antibiotic therapy did not appear to impact the incidence of positive blood cultures.[57]

Vietnam War (1959-1975)

Continued advancement occurred in the management of combat casualties in Vietnam. Routine helicopter evacuations reduced times from injury to surgical care by one to two hours. In addition, well-trained surgeons were in abundant supply, working in state-of-the-art facilities closely located to the battlefield. A research team was also in theater enabling a more complete and rapid assessment of research findings.[58] Rates for wound infection were as low as 2%, although reports of these rates typically only included complications occurring in theater and not after evacuation.[59] Injury patterns were consistent with previous wars, with 67% involving the extremities, 13% the thorax, 12% the abdomen, and 8% the head and/or neck.

In 1969, an assessment was undertaken to evaluate the medical care provided in theater. This study included nineteen different military hospitals in Vietnam, with a total of 132,996 admissions.[60] Surgical patients comprised 46% of the admissions, but accounted for 93% of the deaths. Septic shock was the third leading cause of death (12%), after hemorrhagic shock (24%) and head injuries (43%). Another assessment of mortality among nearly 7000 casualties between January 1966 and June 1968 revealed that among 121 deaths, sepsis (predominantly gram-negative) was the second most common cause of death after hemorrhage, and was the primary cause of death 24 hours after injury.[61]

Hardaway's assessment of 17,726 American soldiers injured in Vietnam between March 1966 and July 1967 provides a comprehensive review of the injuries, practices, and complications seen during the war.[62] The in-hospital mortality rate was 1.81% compared to 3.3% in World War II and 2.4% in the Korean War. The mortality from abdominal wounds improved from 21% in World War II to 12% in Korea to 4.5% in the Vietnam War. Overall, 31% of wounded patients arrived at the hospital within one hour of injury and 86% were admitted within four hours. However, the mortality increased from 10% if patients were admitted within one hour, to 12% at three hours, 33% at four hours and 75% at eight hours. There was a 3.9% wound infection rate reported, but this included only patients managed in Vietnam and not the 68% of wounded that were evacuated out of Vietnam. Sharp pungi sticks placed in the ground caused a unique lower extremity injury pattern with a 10% infection rate. The mean duration of hospitalization was 9.6 days; however, 39% were evacuated in less than five days and 71% were evacuated in less than fifteen days. Abdominal and lower extremity wounds were more likely to become infected and there were no reported cases of gas gangrene. Seventy percent of wounded personnel received antibiotics, typically intravenously. The most common agent used was penicillin, with 51% also receiving streptomycin and 27% receiving chloromycetin. Eighty percent of injuries underwent debridement and only 2% were treated with topical antibiotics.

There was continued emphasis on characterization of the bacteria infecting wounds, and the impact of new antibiotics on outcomes and subsequent infections. An assessment of the bacteria the wounds of 30 Marines at the time of injury and over the following five days was undertaken in Vietnam (Figure 2).[63] The study evaluated wound cultures at the time of presentation, and again on days three and five after injury. Therapy included penicillin, typically combined with a second agent; most frequently streptomycin, followed by chloramphenicol and colistimethate. In addition to wound cultures, blood cultures were obtained every eight hours daily or if temperature was greater than 38.5^{o}C. Eighteen patients required amputation and 10 required laparotomies. The usual flora on day one was a mixture of gram-positive and gram-negative bacteria, which became predominantly gram-negative by day five. *Pseudomonas aeruginosa* became the most commonly recovered bacteria by day five. Eight of 12 patients had bacteria recovered in their blood that matched their wound cultures. All bacteria recovered in blood were resistant to penicillin and streptomycin. This article is often cited supporting *Acinetobacter* as the most common pathogen recovered in wounds from Vietnam. The data in this study and others do not support this proposal, and Dr. Tong, the author of the original work, does not recall if the taxonomy would be equivalent to *Acinetobacter* today.[64] Noyes found similar changes in bacteria over eight days of monitoring with increasing rates of *Pseudomonas*.[65] Another study evaluating wounds in Vietnam revealed the most common pathogen of 112 wound cultures were *Enterobacter (Aerobacter) aerogenes* (33), *S. aureus* (30), *Pseudomonas* (14), *Proteus* spp. (14) and *E. coli* (11); 34 wounds had no growth in this study.[66] There was resistance to broad spectrum antibiotics (of the day) demonstrated among all gram-positive and gram-negative pathogens recovered.

As patients were evacuated out of theater, they often were managed at the General Hospital in Japan. A study performed during 1967 and 1968 of 1531 wound cultures revealed *S. aureus* in 29% of the cultures, followed by *P. aeruginosa* (18%), *E. coli* (17%), and *Proteus* spp. (6%); 13% were culture negative.[67] There were no *Acinetobacter* species recovered. There were seasonal differences in flora noted, with *S. epidermidis* most commonly recovered in January, *P. aeruginosa* in July, and *E. coli* in June. Autopsy blood cultures were positive in 19 of 65 patients, with seven *P. aeruginosa* and seven *K. pneumoniae*. The most common wound pathogens were *P. aeruginosa* and *S. aureus* followed by *Enterobacter* spp. There was increased resistance against almost all antibiotics tested.

In the US, the bacteria recovered from wounds were predominantly gram-negative pathogens. An assessment of 100 tissue specimens from casualties evacuated to Brooke General Hospital at Fort Sam Houston, TX revealed 92 with a single bacteria species on culture; eight wounds were polymicrobial.[68] The most common bacteria recovered were *P. aeruginosa* (43%), *S. aureus* (18%), *Proteus* spp (12%), and *Klebsiella-Enterobacter* group (11%).

A study looking at tibial shaft fractures at Brooke General Hospital between January 1965 and September 1968 revealed that patients arrived on average three weeks after injury.[69] Of the 84 open tibial fractures, only one of 23 patients with high velocity injuries developed an infection with *S. aureus*, while six lower velocity wounds developed infections with *Pseudomonas* (3), *S. aureus* (2) and *Enterobacter (Aerobacter)* spp. (1), requiring an average of 22 weeks to heal.

Patients with maxillofacial injuries treated in Vietnam without evacuation had an infection rate of 7.1% in a review of data from over 2,000 of these injuries.[70, 71] Of patients stabilized in Vietnam and evacuated to the Philippines with avulsive mandibular defects, all 31 evacuated patients had infections, of which 10% developed osteomyelitis.[72] Bacteria noted upon arrival in every case included *Pseudomonas*, *Aerobacter-Klebsiella*, or both. *Staphylococcus aureus* and *E. coli* were also recovered. Another study of maxillofacial injuries evaluated 168 patients evacuated from Vietnam to the US. Forty-two percent developed an infection, typically presenting late in their care. Infections presented in only 13% of patients early in their care in contrast to 25% during an intermediate time of their care and 62% during their late care.[73]

Among craniocerebral missile wounds in Vietnam presenting to care within two to four hours of injury, superficial wound cultures documented bacteria in 44 of 45 wounds, predominantly gram-positive alone (68%) or mixed gram-positive and gram-negative bacteria (16%).[74] Only six of 90 brain cultures were positive. *Staphylococcus* spp were the only bacteria recovered from bone driven into the brain, consistent with the presence of *Staphylococcus* on skin cultures. An analysis of 1,221 personnel with penetrating craniocerebral trauma revealed 3%

incidence of brain abscess, with 54% mortality and 82% morbidity.[75] The most common pathogens were *S. aureus* and *S. epidermidis* followed by *Klebsiella* spp. and *E. coli*. Deaths were more commonly associated with gram-negative than gram-positive pathogens (56% versus 14%). Overall, there was a 1.6% infection rate of neurosurgical wounds cared for while in Vietnam, 14% while in Japan, and 4% while in the US.[76-78]

The burn flight team for evacuation of burn patients from around the world to Brooke General Hospital was established in 1951.[79] The 106th General Hospital in Japan was established to manage burn patients due to the number of burns associated with incendiary devices and large total body surface are burns. The first burn patients admitted for care on 1 January 1966.[80] The number of patients increased from 144 in 1966, to 1,639 in 1967, to 1,180 in 1968.

During the Vietnam War there was substantial work undertaken to assess the utility of topical antiseptics or antimicrobial agents in the management of wounds.[65, 81-84] Despite their historical use during World War I and World War II and animal and human studies, the application of topical therapy never became accepted as standard care and its utility is still debated today.

Operation Just Cause (Panama- 1989-1990), Operation Desert Storm/Shield (Iraq- 1990-1991) and Operation Restore Hope (Somalia- 1992-1993)

In the last decade of the 20th century the US military was involved in three significant conflicts. Data is available from each conflict detailing wounds and their infectious complications. During Operation Just Cause there were 37 open fractures, nine of which became infected.[85] The predominant bacteria recovered were coagulase negative staphylococci, with one patient infected with *S. aureus* and two infected with *P. aeruginosa*. Only twelve of the initial

37 injuries underwent debridement in Panama; the others were transported to the US for debridement. Of the nine type III open fractures debrided in Panama, only two became infected. In contrast, six of the nine type III open fractures first debrided in the US became infected likely due to surgical delay due to evacuation policies.

There are limited reports of combat related infections during Operation Desert Storm/Shield; however, it is notable that the average evacuation time for injured casualties was one hour during the pre-war period and four hours during the actual war.[86] An assessment of casualties evacuated to a military treatment facility in the US revealed that one of ten closed fractures and five of eleven open fractures developed infections.[87] The majority of the injuries were not combat related. In the aforementioned report, there was no description of the fracture type or bacteria causing the infection.

There were a number of infections among casualties of Operation Restore Hope at the Battle of the Black Sea, commonly known as Blackhawk Down.[88] This battle offers a classic example of the types of injuries and care provided during urban operations. There were 125 combat casualties, resulting in 49 carded for record only, 18 deaths and 58 wounded in action, 11 of whom developed an infection. The time from injury to surgery typically ranged from five to 22.5 hours, although some did not undergo surgery until evacuation to Germany. One of the 11 casualties who developed an infection was a prisoner of war who underwent surgery 11 days after injury. This soldier developed a *P. aeruginosa* infection of an open femur fracture. Only one other patient had a specific organism described, which was also *P. aeruginosa.* One of the proposed lessons learned from this operation was that delayed evacuation may become a common scenario in modern urban combat environments, and that perhaps injured soldiers should self-administer antibiotics in situations were evacuation may be delayed.

Summary

Historically, infectious diseases have been responsible for the majority of deaths during war; however, numerous medical and military advances have reversed this trend, resulting in more deaths from battle than infectious diseases in the 20th century. In addition, there have been remarkable improvements decreasing the mortality rate from combat wounds during each major US conflict during the 20th century: 8% (total wounded 153,000) in World War I, 4.5% (total wounded 599,724) in World War II, 2.5% (total wounded 77,788) in the Korean War, 3.6% (total wounded 96,811) in Vietnam, 2.1% (total wounded 143) in Desert Storm (7th Corps), and 6.4% (total wounded 62) in Somalia.[88] Major advances in clinical microbiology, wound management, and antimicrobial therapy have had a remarkable impact on combat casualty care. However, with each successive conflict, the ability to manage wound infections becomes more challenging as pathogens become more resistant. Many of the lessons learned from previous wars can be applied to the management of combat casualties in the current wars in Iraq and Afghanistan and future conflicts.

Figure 1. Bacteria recovered from combat-related injuries during World War I. (adapted from Reference 25)

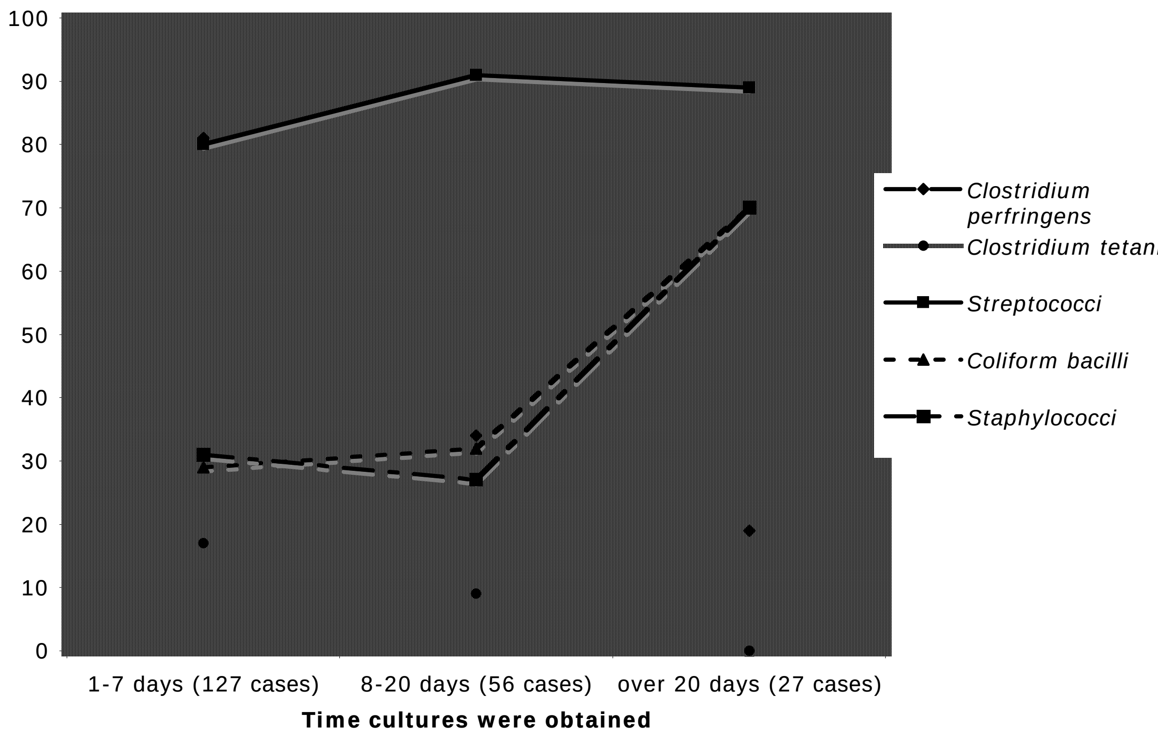
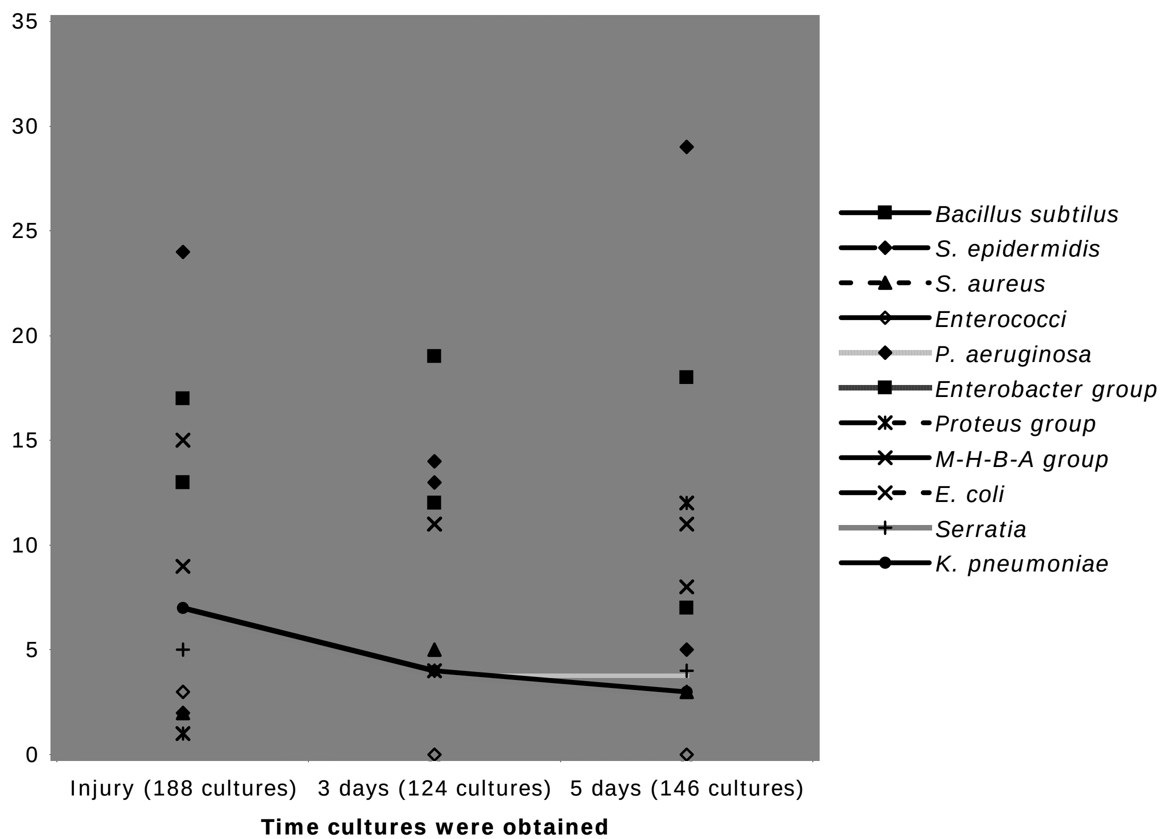


Figure 2. Bacteria recovered from wounds during the Vietnam War. (adapted from Reference 61)



S. epidermidis (Staphylococcus epidermidis), P. aeruginosa (Pseudomonas aeruginosa), M-H-B-A group *(Mimeae-Hereliea-Bacterium-Alcaligenes* group*), K. pneumoniae (Klebsiella pneumoniae)*

Figure 3. Casualties lying on stretchers in the Southwest Pacific during World War II (from http://www.army.mil/cmh/photos/WWII/ErlyYrs/SC180534.jpg)

Figure 4. Evacuation of a Korean War Casualty on a stretcher (from http://www.army.mil/cmh/photos/Korea/kor1951/SC373303.jpg)

Figure 5. Helicopter landing during Vietnam War (from http://www.army.mil/cmh/art/A&I/vietnam/cc44261.jpg)

Figure 6. Evacuation of casualties during Operation Iraqi Freedom

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Abstract

Enhanced medical training of front line medical personnel, personal protective equipment, and the presence of far forward surgical assets have improved the survival of casualties in the current wars in Iraq and Afghanistan. As such, casualties are at higher risk of infectious complications of their injuries including sepsis, which was a noted killer of casualties in previous wars. During the current conflicts, military personnel who develop combat-related injuries are at substantial risk of developing infections with multidrug resistant bacteria. Herein, we describe the bacteriology of combat-related injuries in Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF) that develop infections with particular attention to injuries of the extremities, central nervous system, abdomen and thorax, head and neck, and burns. In addition, the likely sources of combat-related injuries with multidrug resistant bacteria infections are explored.

Epidemiology of Infections Associated with Combat-related Injuries in Iraq and Afghanistan

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Running Title: Infections of combat casualties- OIF/OEF epidemiology

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By September 30, 2006, approximately 1.4 million military personnel had been deployed to Iraq and Afghanistan in support of Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF) (http://www1.va.gov/opa/fact/docs/amwars.pdf, accessed 14 June 2007). In total, 29,531 were wounded in action, of which 13514 did not return to duty (http://www.defenselink.mil/news/casualty.pdf, accessed 21 September, 2007). The number of casualties died of wounds has gradually declined from 8% in World War I, to 4.5% in World War II, 2.5% in Korea, 3.6% in Vietnam, 2.1% in Desert storm and 6.4% in Somalia.[1] The total number of died of wounds has not yet been determined for OIF/OEF. Deployment of forward surgical assets, rapid evacuation to medical care, enhanced training and expertise of combat medics and corpsmen, and improved body armor has culminated in a greater number of casualties surviving initial injuries.

Extremity injuries account for the majority of wounds (~65%), followed by head and neck (~15%), thorax (~10%), and abdomen (~7%). This has remained stable throughout the last century of warfare and during OIF/OEF.[2-6] Historically, burns complicate 5-10% of combat casualties; this has been true in OIF/OEF.[7, 8] Although there are differences between combat theaters and over time as individual theaters mature, wounding is most frequently caused by explosive devices.[4, 9, 10] Gunshots, grenades (including rocket-propelled), and mortars are also responsible for a number of injuries. Patients typically suffer multiple injuries, involving, on average, 1.6 different body parts.[4] Explosive devices typically result in a greater number of injury sites and greater severity of injuries.

Despite our extensive knowledge of wounding patterns, we have not adequately characterized the trends of infectious complications and associated outcomes of personnel injured in OIF/OEF. During the Vietnam War, sepsis was the third leading cause of death for combat casualties in theater.[11] Among the casualties of the Vietnam War, 2-4% developed wound infections during hospitalization in that country. Data regarding infections that developed after transportation out of theater are more difficult to come up with.[12] Factors influencing the development of wound infections in a combat theater include wound type and severity, the presence of embedded foreign material or fragments (such as soldier's clothing, dirt and debris), evacuation time from point of injury to medical care, initiation of antimicrobial agents, adequacy of initial wound debridement, immediate wound care, definitive surgical care, rehabilitative care, prior antimicrobial pressure, and the presence of nosocomial pathogens, (especially multidrug resistant pathogens) at treatment facilities. The appropriate management of injury and subsequent infection should be influenced by the mechanism and type of injury, whether caused by low- or high-velocity weaponry, mines, mortars, or explosive devices. Some systems, such as mines and other explosive devices, can increase the risk of infection due to contamination of wounds from ground material or other matter placed in the devices (e.g., animal carcasses, discarded dirty syringes, or fecal material). Although it has been argued that the heat generated from firing high-velocity weapons sterilizes bullets, this has proven not to be true.[13] Overall, the management of combat casualties and finding methods to prevent infections is challenging to healthcare providers throughout the military medical system.

Levels of Medical Care

Medical care capability increases as a casualty is transported from point of injury to level (formerly echelon) I through level II and outside the combat zone to level IV and V (Figure 1). Level I provides care as close as possible to the time of injury, and consists of immediate stabilization and evacuation to an initial aid station. Level II offers short-term holding capacity and initial resuscition.[3] This level of care is currently subdivided into IIa and IIb, reflecting the absence or presence of acute, life-saving surgical care. The Army can augment a level II facility with a Forward Surgical Team (FST).[14] The Navy supports the Marines with Forward Resuscitative Surgical Systems (FRSS) to improve care at forward Surgical Shock Trauma Platoons (SSTP).[15] The Air Force has Mobile Field Surgical Teams (MFST) to provide level II surgical care. Level III, such as the Army's Combat Support Hospital (CSH), the Air Force Theater Hospital (AFTH), and Navy's hospital ship that provided care during the early stages of OIF, supply complete resuscitative and hospital care. Assets at this level of care include a myriad of surgical specialties and support and are equivalent to a well-staffed community hospital.[16] Care provided at level IV during the current conflict is delivered at the Landstuhl Regional Medical Center, Germany, rendering more definitive surgical care outside the combat zone.[6] Level V care is the most definitive rehabilitative and tertiary level of care and is provided in military and Veterans Affairs medical centers located in the US.

Medical care within the combat theater is provided to both US and non-US personnel, including coalition forces, host nation personnel, and detainees.[17] The AFTH at Balad Air Base, Iraq, had 10,953 total hospital admissions between September 2004 and August 2006.[18] Of these admissions, 4,323 were not US or coalition patients. Typically, US and coalition forces are evacuated out of country in as little as 48 to 72 hours from time of injury in Iraq to arrival in the US for definitive care. Usually, evacuation time to the patient's final US facility is around seven days. This contrasts sharply to evacuation times in many previous US conflicts.[18, 19] Non-US personnel receive therapy at level III until they are stable for transfer to a local healthcare facility or until care is completed, which take weeks.[20, 21]

Wound Bacteriology

Staphylococcus aureus and aerobic gram-negative bacteria such as *Pseudomonas aeruginosa* have traditionally complicated battlefield injuries.[11, 22, 23] Near the early stages of OIF/OEF, there was a notable increase in casualties developing infections with resistant bacteria (multidrug resistant organisms (MRDO) such as *Acinetobacter baumannii calcoaceticus* complex (ABC).[24] At one US military treatment facility, the incidence of blood-stream infection with ABC in 2005 was 0.3 cases per 1,000 admissions in contrast to 2002, when the incidence was 0.087 cases per 1,000 admissions (personal communication, Kim Moran). Other notable gram-negative bacteria infecting combat casualties in the these US facilities included multidrug resistant *P. aeruginosa* and *Klebsiella pneumoniae*. Infections with multidrug resistant bacteria were also reported on the USNS Comfort at the beginning of OIF, mostly among non-US personnel.[25] A total of 211 trauma patients were managed from March to May 2003 of which 56 were infected. Of these infected patients, 85% were Iraqi, with an average of 4.2 days elapsing from injury to presenting to the Comfort. Sites of infection were wounds in 84% of cases and blood in 36%. The most common pathogens recovered were ABC (33%), *Escherichia coli* (14%), and *P. aeruginosa* (14%). Assessments of bacteria from blood, urine, wound and other sites during 2003 and 2004 at a CSH in Iraq revealed a preponderance of gram-positive bacteria among US patients.[26] In contrast, non-US patients mostly had gram-negative bacteria, including *P. aeruginosa*, *K. pneumoniae*, *E. coli*, and ABC, largely multidrug resistant in nature.

One of the most disconcerting facts about the bacteria complicating combat casualties is their increasing antimicrobial resistance.[27, 28] Between 2002 and 2005, in ABC, *P. aeruginosa*, and *K. pneumoniae* there was increased resistance to nearly all antibiotics tested at one treatment facility.[28] This has resulted in a steady decline in the number of available antimicrobial agents. In

ABC isolates collected between 2003 and 2005 in a US military treatment facility, the difference in broad spectrum antimicrobial resistance between personnel injured in OIF/OEF and nondeployed patients was statistically significant, with higher resistance in those with OIF/OEF injuries.[27] Over time, resistance increased against all antimicrobial agents tested; however, only imipenem resistance was statistically significant at the end of the study period in comparison to the beginning (56% vs. 87% susceptible). In isolates recovered from deployed personnel, only colistin and minocycline agents were effective more than 75% of the time. Minocycline is not currently available in the US in an intravenous form, limiting its application in the severely ill. Colistin is associated with toxicity and ABC can develop resistance during treatment with to this agent.

Infectious Complications of Combat Trauma

Extremity Injuries

Extremity injuries have been seen in the greatest number of casualties from OIF/OEF, but small single hospital reviews suggest that a large percentage of these wounds are complicated by infections. Data obtained from Brooke Army Medical Center (BAMC) reveal that between January and June of 2006, 223 OIF/OEF persons were evaluated at BAMC with 66 (30%) evaluated for orthopaedic-related trauma, of which 26 (40%) received courses of antibiotics for various bacteria, including ABC (13), *Klebsiella* spp. (9), *P. aeruginosa* (6), *Enterobacter* spp. (5) and methicillin resistant *S. aureus* (MRSA) (6). Antibiotics included expensive and potentially toxic medications such as colistin, imipenem-cilastatin, and vancomycin for extended periods of time. Another study evaluated 62 open tibial fractures in combat casualties injured between 2003 and 2006. This study identified 40 patients with type III fractures, in whom 35 had data available for analysis.[29] Twenty-seven of the 35 patients had at least one organism present in initial deep wound cultures at admission. The most frequently identified pathogens were ABC, *Enterobacter* spp, and *P. aeruginosa*. Thirteen of the 35 patients had healing times longer than nine months, which appeared to be associated with infections. None of the gram-negative bacteria identified in the initial wounds were recovered again at the time of repeat operation; however, all patients had at least one staphylococcal organism and three had *P. aeruginosa* at that time. Five of 35 patients ultimately required limb amputation, with infectious complications cited as the reason in four. Interestingly, another study early in the conflict (2001-2003) out of Afghanistan assessed 52 casualties with orthopaedic injuries revealed only a 3.8% infection rate.[30] One patient was infected with *Pseudomonas* and a second was infected with *Acinetobacter* and MRSA. In an unpublished study that assessed osteomyelitis among combat casualties from OIF/OEF from 2003-2006, 110 patients with 139 hospitalizations were identified (personal communication, CKM). Ninety-nine of these patients had lower extremity, 44 had upper extremity, and two had axial injuries. The pathogens initially noted in the wounds were ABC (71%), *K. pneumoniae* (24%), *P. aeruginosa* (26%), methicillin susceptible *S. aureus* (MSSA) (15%), and MRSA (10%). After adequate surgical and antimicrobial therapy, those with recurrent or relapses had a clear transition from predominantly gram-negative bacteria to gram-positive bacterial infections. ABC, *K. pneumoniae*, and *P. aeruginosa* each represented 5% of these latter infections, while MSSA produced 22% and MRSA 28%.

Although ABC has received substantial emphasis as a key pathogen complicating combat casualty care, associated outcomes reveal low virulence. In an assessment of 232 active duty soldiers (151 were OIF/OEF) admitted with injuries to one military treatment facility between March 2003 and May 2004, ABC was recovered in 48 of 84 soldiers cultured, of which 30 were clinical infections, including 23 with osteomyelitis and/or wound infections. In this group, all patients cleared their infection even if they received inadequate antimicrobial therapy.[31]

Unfortunately, because of the scarcity of data regarding care and associated infectious complications of non-US personnel treated in Iraq or Afghanistan, it is difficult to determine the extent of infection in that population. Among non-US personnel treated between September 2004 and August 2006 at the AFTH in Iraq, there were 134 extremity injuries with vascular damage. In that report, there were five wound infections among 192 major vascular injuries.[18] Another study assessed 88 injuries to non-US personnel treated at the AFTH that included 59 with upper or lower extremity wounds treated with standard surgical techniques, antibiotics, and wound VAC.[20] There were no reported infectious complications of these extremity injuries, although follow up was limited.

Central Nervous System Injuries

Numerous casualties have had central nervous system (CNS) penetrating trauma during OIF/OEF.[32] Although there have been no systematic evaluations of the infectious complications of these wounds, there are two case reports of multidrug resistant bacteria CNS infections.[33, 34] Both describe ABC infections that cleared with appropriate management including the use of broad spectrum antimicrobial agents.

Head and Neck Injuries

Rates of infectious complications for US head and neck casualties has not been described. Among Iraqi patients treated at an Iraqi facility between September 2003 and August 2004 there were 100 patients with multiple and comminuted mandibular fractures.[35] Fifty-three injuries were due to missiles and 54 patients had comminuted fractures. Three of the patients with comminuted and one with multiple fractures developed infection, for an overall infection rate of 4%. The specific bacteria infecting the wounds were not reported. Of the infected injuries, three were from missiles and one from a motor vehicle accident.

Thoracic and abdominal cavity injuries

An assessment of casualties treated on the USNS Comfort during the early stages of OIF revealed on multivariate analysis that abdominal injuries had an odds ration of 2.7 for developing an infection while extremity injuries had a 2.4 odds ratio.[25] The bacteria complicating these injuries were multidrug resistant and included ABC and *P. aeruginosa*. Thoracic injury was not associated with infection on univariate or multivariate analysis. There were 175 (5.1%) colon and rectal injuries among 3,442 patients treated between September 2003 and December 2004 at a CSH in Iraq.[36] Sepsis developed in 27 patients (16%) and had significant impact upon mortality. Specific bacterial pathogens were not reported in that report.

Burn infections

Burn patients have comprised approximately 5% of US military casualties in OIF/OEF.[7, 8] Since the onset of these conflicts, there have been numerous burn casualties infected with multidrug resistant bacteria. A retrospective study of all patients admitted to the US Army Institute of Surgical Research (USAISR) burn center from January 2003 to May 2006 was undertaken to evaluated the impact of bacteremia in that population.[37] One hundred twenty-nine of 1,258 patients admitted to the burn center became bacteremic during their hospitalization. Fifty-one of 414 OIF/OEF burn patients had episodes of bacteremia. Ninety-two of the 129 burn patients had bacteremia with *P. aeruginosa*, *K. pneumoniae*, *S. aureus* and ABC. Bacteremia with *K. pneumoniae* was independently associated with a statistically significant increase in mortality and prolonged ventilator use when controlled for age and total body surface area burned. This was not true for the other pathogens. Infectious outcomes for OIF/OEF burn injuries did not differ from the outcomes of non-military burn patients.

The incidence of ABC infection increased from 2.3% in 2001 to 11.9% in 2005 at the USAISR.[38] A retrospective study examined the clinical impact of ABC.[38] Among the 802 patients included in this study, 59 patients were infected between January 2003 and November 2005, with an additional 52 patients found to be colonized with ABC during that time period. Bacteremia was the most common type of infection (31 of 59 infections). In general, patients with ABC infection had more severe burns, more co-morbidities, and longer lengths of stay than those patients with colonization or no ABC recovered. ABC infection was associated with 22% mortality in contrast to 7.7% in those without infection; however, on multivariant analysis there was no mortality attributable to ABC. Most of the ABC isolates had broad spectrum antimicrobial resistance; however, there was no statistical difference in mortality between those treated with effective antimicrobial agents (24.5%) versus those who were not (10%) ($p = 0.432$).

Epidemiological Source of MDRO Infections

Traditionally, gram-positive bacteria and anaerobes predominate in wounds at the time of injury, and are replaced by gram-negative bacteria after 5-7 days, followed by *Streptococci* and *Staphylococci* after 2-3 weeks.[39-41] Resistant bacteria complicated wounds of combat casualties after the use of prophylactic or preemptive antibiotics given at the time of injury in previous wars.[23, 42-44] Proposed sources of these multidrug resistant bacteria include preexisting colonization of the patient at the time of injury, inoculation into the wounds at the time of the injury from environmental contamination, and nosocomial transmission during the care of patients within the military healthcare system.

It is known that a person's skin is colonized with approximately 180 different types of bacteria at any one time.[45] Typically, 25% of persons are colonized with *S. aureus*, and 3% with MRSA. This is true within our military population, and it has been recognized that colonization can lead to infections.[46] *S. aureus*, including MRSA, are associated with colonization at the time of injury and may be introduced into the wound directly from skin colonization.[47] MRSA is also a known nosocomial pathogen.

Several studies have investigated whether ABC colonizes the skin of casualties prior to injury. An assessment of healthy soldiers with no prior deployment history visiting a troop medical clinic in the US revealed soldiers were occasionally colonized with ABC, but these isolates were not genetically or phenotypically related to the bacteria recovered from combat casualties of OIF/OEF.[48] In addition, cultures of non-injured military personnel in Iraq or upon arrival to Germany after leaving Iraq without prior exposure to theater healthcare facilities have not recovered ABC.[49, 50] Therefore, it is unlikely that casualties are colonized with ABC prior to injury.

One study attempted to evaluate if bacteria from environmental contamination were inoculated into the wounds at the time of injury.[47] Forty-nine casualties with 61 wounds were screened at the CSH in Baghdad for wound contamination at the time of injury. Most bacteria recovered were gram-positive (93%). There were only three gram-negative bacteria detected; none were multidrug resistant and this group did not include *P. aeruginosa* or ABC. Although inconclusive based on the small size of the study mentioned, it is unlikely that patients have their wounds inoculated with environmental material such as dirt or debris containing multidrug resistant gram-negative bacteria at the time of injury.

Another possibility for etiology of resistant gram-negative bacteria infecting combat casualties is nosocomial transmission. At the onset of OIF/OEF, ABC and other multidrug resistant bacteria were increasingly being described worldwide as nosocomial pathogens. ABC has been reported to infect injuries of non-combat trauma victims.[51, 52] In addition, ABC was noted to be a nosocomial pathogen in countries surrounding Iraq, including Turkey, Saudi Arabia, and Kuwait.[53, 54] In Jerusalem, recovery of ABC went from 6% of nosocomial bacteremia cases in 1999 to 17% in 2002, representing the most common pathogen producing bacteremia in one hospital.[55] An analysis of the bacteria recovered from a CSH in Baghdad during 2003 and 2004 revealed that non-US personnel had more multidrug resistant gram-negative bacteria than US personnel.[26] This is notable, as non-US patients spend prolonged periods of time within the CSH, possibly serving as a reservoir of these bacteria for nosocomial transmission, especially in the combat zone where implementation of infection control procedures can often be challenging.

Scott et al. performed a key study that supports the role of nosocomial transmission contributing to infections of combat casualties with multidrug resistant bacteria.[50] That study screened dirt obtained in Iraq and environmental samples from treatment areas within CSHs in Iraq for the presence of ABC. It also attempted to link any environmental samples with ABC isolates recovered from patients cared for in Iraq, on the USNS Comfort, at Landstuhl, and/or WRAMC. All field hospitals screened had ABC recovered from treatment areas. By molecular typing, there were 66 different ABC strains noted among 170 clinical isolates and 25 different strains among 34 environmental samples. Although one could not point to one CSH or one particular strain as the cause of the outbreak, there were five cluster groups that matched environmental field hospital isolates to patient isolates. The largest cluster included 45 isolates from 43 patients at four different US military hospitals that matched an isolate recovered from an operating room at a CSH. That cluster included non-US patients and US patients with no deployment history that were OIF and non-OIF inpatients with no deployment history in military hospitals in the US. These isolates were related to isolates from the United Kingdom.[56] In addition, ABC strains were similar to some of the isolates previously found infecting patients in Europe.[57] Isolates have also been recovered from hospitals taking care of Canadian soldiers injured in Afghanistan and evacuated to Canadian hospitals.[58]

Although ABC does not appear to cause great harm in healthy military personnel, when transferred too older or immunosuppressed ill inpatients, this bacteria can cause death.[59] In the US military burn unit, despite aggressive infection control measures, 50 patients (6% of all admissions during the study period) acquired ABC colonization or infection during their hospital stay, suggesting nosocomial spread.[38]

At this time it is not clear what is leading to the increasing antimicrobial resistance in bacteria recovered from our military treatment facilities. One of the major concerns is that greater use of broad spectrum antibiotics to empirically treat wounds of combat casualties in the combat zone or along the evacuation chain is resulting in selection of more resistant pathogens. In addition, the use of broader spectrum agents used to treat multidrug resistant infections of non-US personnel within our hospitals in Iraq is likely driving increasing resistance of bacteria in this reservoir of patients for potential nosocomial transmission.

Conclusions

As the care of combat casualties continues to improve, allowing enhanced survival after initial injuries, infectious complications will remain a major cause of short- and long-term morbidity. At this time, casualties are undergoing therapy for wounds that are often colonized or infected with multidrug resistant bacteria such as ABC, *P. aeruginosa*, *K. pneumoniae*, and *S. aureus*. The role of nosocomial transmission and the over use of broad spectrum antibiotics resulting in more resistant pathogens should not be ignored. Continuing to improve our understanding of wounding patterns, infectious complications, and modes of transmission will improve care for casualties.

Figure. Levels* of medical care provided by the US military.

	Level I	Level II	Level III	Level IV	Level V
Facility	Point of care- self-aid, buddy aid, combat lifesaver, combat medic, corpsman Army- Battalion aid station (BAS) Marines- Shock Trauma Platoon (STP)	Army- treatment platoon within a medical company (IIa) that can be augmented with a Forward Surgical Team (FST) (IIb) Air Force- Mobile Field Surgical Team (MFST) (IIb) that can be augmented with Expeditionary Medical Support (EMEDS) or Small Portable Expeditionary Aeromedical Rapid Response (SPEARR) team Marines- Surgical Company with Forward Resuscitative Surgical System (FRSS) (IIb)	Army- Combat Support Hospital (CSH) Air Force- EMEDS+25 Navy- Fleet hospital and Hospital Ships	Army- Field hospitals and General hospitals have been replaced by CSH Outside combat zone facility- Landstuhl, Germany	Care within the US
Purpose	Point of care- immediate first aid on the scene; including early tourniquet Battalion aid station- triage, treatment, evacuation	Increased medical capacity with limited inpatient bed space Basic primary care with life saving surgical support Army must augment the medical company for surgical support	Highest level of medical care within a combat zone Resuscitation, initial surgery, post-op care, return to duty or evacuation	Definitive medical and surgical care along with convalescent care outside of the combat zone	Ultimate treatment capability
Unique features	No holding capacity	Holding capacity (72 hours) Blood support (type-O or whole blood donation) X-ray capability Dental Basic laboratory Basic pharmacy	Inpatient beds with holding capacity (CSH- 250-300 beds; Fleet hospital- 500 beds; Hospital ship- 1000 beds; EMEDS+25- 25 beds) Surgical subspecialists Typically modular Intensive Care Units Operating rooms Blood bank Laboratory support X-ray/CT scan Physical therapy Pharmacy Large footprint- CSH ~30 acres	Permanent or semipermanent hospital	Includes Department of Defense hospitals and Department of Veterans Affairs hospitals

* Formerly termed echelons

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Abstract

Orthopaedic injuries suffered by casualties during combat constitute approximately 65% of the total percentage of injuries and are evenly distributed between upper and lower extremities. The high-energy explosive injuries, environmental contamination, varying evacuation procedures, and progressive levels of medical care make managing combat-related injuries challenging. The goals of orthopaedic injury management are to prevent infection, promote fracture healing, and restore function. It appears that 2-15% of combat-related extremity injuries develop osteomyelitis, although lower extremity injuries are at higher risk of infections than upper extremity. Management strategies of combat-related injuries primarily focus on early surgical debridement and stabilization, antibiotic administration, and delayed primary closure. Herein, we provide evidence-based recommendations from military and civilian data to the management of combat-related injuries of the extremity. Areas of emphasis include the utility of bacterial cultures, antimicrobial therapy, irrigation fluids and techniques, timing of surgical care, fixation, antibiotic impregnated beads, wound closure, and wound coverage with negative pressure wound therapy. Most of the recommendations are not supported by randomized control trials or adequate cohorts studies in a military population and further efforts are needed to answer best treatment strategies.

Prevention and Management of Infections Associated with Combat-related Extremity Injuries

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There are greater numbers of casualties surviving their combat-related injuries in part due to the use of body armor, better trained combat medics and corpsmen providing care at the point of injury, rapid evacuation of the wounded to medical care, and the application of forward surgical assets. These advances have not, however, changed the injury patterns seen, and there has in particular been no appreciable change in the percentage of injuries that are orthopaedic in nature among US military personnel. From World War I to operations in Somalia approximately 65% of the total number of injuries suffered by casualties were orthopaedic.[1] This has remained true in Operation Iraqi Freedom (OIF) and Operation Enduring Freedom in Afghanistan (OEF), during the early stages of the conflict as well as during stability operations.[2-4] An evaluation of the Joint Theater Trauma Registry from October 2001-January 2005 revealed 1281 soldiers with 3575 extremity combat wounds.[5] Of these wounds 53% were penetrating soft-tissue wounds. There was a relatively even distribution between the upper and lower extremities, with hand trauma representing 36% of upper extremity injuries and tibia and fibula injuries 48% of lower extremity injuries.

Despite our extensive knowledge of wound patterns, the infectious complications and their associated outcomes of the war wounded during OIF/OEF are not currently well described. Infectious complications of extremity injuries are often associated with comorbidities and are reflective of the degree of injury.[6] Military personnel are typically young without comorbidities, therefore the injury pattern has a great ability to predict complications. Gustilo and Anderson classified open fractures into three types.[7] Type I fractures are defined as those with a laceration of less than 1 cm with minimal soft tissue damage and no gross contamination. Type II fractures have lacerations of greater than 1 cm with moderate soft tissue damage. Type III fractures are high-energy injuries typically with bone comminution or loss. There are three subtypes of III:

IIIa, characterized by extensive soft tissue injury but with adequate soft tissue coverage; IIIb, which includes extensive soft tissue injury along with bone exposure requiring soft tissue coverage; and IIIc, which has extensive soft tissue damage and the need for arterial repair.

The Gustilo and Anderson classification system correlates relatively well with infectious complications in civilian extremity trauma.[8-10] The percentage of patients who develop infection is approximately 0-2% in type I, 2-5% in type II, 5-10% in type IIIa, 10-50% in type IIIb and 25-50% in type IIIc. While type III tibial fractures typically have the highest infection rates (between 6% and 39%), the amputation rate with these injuries has historically been less than 10%.[11-14] The typical infecting bacteria of open fractures include gram-positive staphylococci and gram-negative rods.[7, 8, 15-17]

Early and aggressive management of these extremity wounds starting with interventions near the battlefield have resulted in improved outcomes. Although wound and bone infections remain an important source of morbidity, the total number of infectious complications in OIF/OEF is not currently available.[18] At the time of injury in a combat zone, the bacteria contaminating the wound are typically gram-positive in nature with no resistant gram-negative bacteria.[2] However during care further in the evacuation chain, more resistant gram-negative pathogens are recovered, likely influenced by the administration of broad spectrum systemic antibiotic prophylaxis and nosocomial transmission.[19] Among OEF evacuees with orthopaedic injuries admitted to a military treatment facility between 2001-2003, two of 52 casualties had infectious complications.[20] One patient was reported to be infected with *Pseudomonas* spp. and the other with MRSA and *Acinetobcter* spp. Johnson et.al. assessed 62 open tibial fractures admitted to a single US military hospital between March 2003 and September 2006.[21] Forty patients met inclusion criteria as type III diaphyseal tibial fractures of which 35 were included in analysis. Twenty-seven of these 35 patients had at least one organism present from initial deep wound cultures taken upon admission. All patients were treated for infection, typically osteomyelitis based upon clinical impression of the wound. *Acinetobacter* spp, *Enterobacter* spp. and *P. aeruginosa* were the most commonly recovered bacteria. None of the initially recovered gram-negative bacteria were cultured again after being treated for a deep infection or osteomyelitis, although many patients required a repeat operation due to nonunion. Staphylococcal organisms were found in every wound at the time of repeat operation along with *P. aeruginosa* in three samples. Five of 35 patients ultimately required limb amputation with infectious complications cited as the reason in four. A retrospective study from February 2003 through August 2006 at a single US military hospital revealed 2,854 admissions among OIF/OEF veterans of which 664 were admitted to the orthopaedic service with a total of 103 initial admissions with a diagnosis of osteomyelitis.[22] There was a two to one ratio of lower to upper extremities injuries having osteomyelitis. Eight-four (83%) of these patients did not relapse during a follow-up that ranged from two weeks to 36 months (median 16 months). *Acinetobacter baumannii-calcoaceticus* complex, *Klebsiella pneumoniae* and *Pseudomonas aeruginosa* were more likely to be isolated during an original episode than at recurrence, while gram-positive cocci were significantly more likely to be cultured during recurrences.

The current therapy of extremity injuries whether in the civilian community or in the military setting is to prevent infection, promote fracture healing, and restore function. Traditional civilian management includes wound debridement and irrigation, initial stabilization, tetanus prophylaxis, systemic antimicrobial therapy, timely wound closure, thorough rehabilitation, and appropriate follow up. Certain adjuvants including local antibiotic therapy, open wound management, flap closure, and bone grafting are also implemented. The management of combat casualties is more complicated because of the mechanisms of injury including high-energy explosive devices resulting in extensive contamination, patients being evacuated through multiple levels of medical care, and variability in the timing of these evacuations. In this review we provide evidence-based recommendations from systematic review of military and civilian data to optimize the varying management strategies of open fractures. We emphasize utility of microbial culture, antimicrobial therapy, irrigation fluid and techniques, timing of operative procedures, fixation, antibiotic beads, wound closure, and wound coverage with negative pressure wound therapy.

Utility of Pre- and Post-debridement Culture

Studies assessing the utility of cultures obtained from combat casualties at the time of injury are limited. An assessment of cultures in 30 marines with 63 extremity injuries during the Vietnam War revealed a mixture of gram-positive and gram-negative bacteria at the time of injury.[23] The bacteria recovered from the wounds over the five days after injury transitioned in character to primarily gram-negative rods. Although there was not a description of infection versus colonization among the marines' wound cultures, eight of twelve bacteremic patients had matching wound cultures.

There is only one report of wound cultures from casualties at the time of injury in OIF. Fifteen of 24 extremity injuries revealed a predominance of gram-positive bacteria including occasional MRSA, but recovered no multidrug-resistant gram-negative bacteria.[2] These patients were not followed throughout the evacuation chain, thus the implication of the cultures cannot be determined. Patients present at US military hospitals with a much higher percentage of multidrug-resistant gram-negative bacteria. It is remarkable that gram-positive pathogens are often found later in a patient's hospital course and typically after eradicating their initial colonization or infection with gram-negative pathogens.[21] It is not clear if these gram-positive bacteria were the same pathogens initially seen at the time of injury or reflective of nosocomial transmission.

Available civilian data supports similar findings with gram-positive bacteria predominating at the time of injury and a transition to gram-negative bacteria causing ultimate infection. Empiric therapy can modify the bacteria recovered.[16, 17] Pre- or post-debridement cultures do not appear to be predictive of infection. In one report of civilian extremity injuries, 119 of 225 patients had positive wound cultures of which only 8% of pre-debridement cultures identified the etiologies of subsequent infections. Conversely, 7% of those with negative cultures went on to develop infection.[16] Only 22% of the time did the pre-debridement culture grow the eventual infecting organism. Of post-debridement cultures, only 32 of 118 were positive, with 9 patients with positive cultures eventually becoming infected. Ten of 86 patients with negative post-debridement cultures became infected. Another study revealed that 76% of initial wound cultures were negative while the other 24% grew skin flora.[24] A total of 6% (7 of 117) of injuries became infected with five of the seven not having demonstrated growth on these initial cultures. None of the bacteria noted on initial culture were the organisms ultimately recovered from the infected wounds.

Additional studies have revealed that positive culture before surgery and at the time of surgery might be predictive of subsequent infection but not of the infecting species, which typically are nosocomial pathogens.[17] In addition, the choice of antimicrobial agent can result in infections with bacteria that escape the initial spectrum of activity of prescribed antimicrobials used for prophylaxis.[9, 17]

Based upon available literature regarding combat-related and civilian open fractures, routine collection of pre- or post-debridement cultures is not recommended at any level of care for combat-related extremity injuries (EII) (grading outlined in this supplement of Journal of Trauma- Guidelines for the Prevention of Infection following Combat-related Injuries). If wound surveillance cultures are obtained at Level IV or V medical care as part of infection control procedures, these findings should not be used as part of clinical decision making. Only cultures obtained due to concern for an ongoing wound infection- systemic signs or symptoms of infection, appearance of wound, persistently elevated inflammatory markers, or concerning radiographic imaging studies- should be used to make clinical decisions.

Antibiotics

The administration of antimicrobial agents at the time of injury is considered standard of care, however the best agent to use and their duration of use is not clearly defined. There have been no combat associated randomized controlled trials of antimicrobials, however, there are a number of expert opinion publications on the agents of choice. A panel of military trauma experts published a list of antibiotics that were recommended as part of tactical combat care or care provided at the time of injury.[25, 26] The International Committee of the Red Cross (ICRC) recommends penicillin for compound fractures, amputations, and major soft tissue wounds in an intravenous form for 48 hours and then orally until delayed primary closure.[27] The recommended duration is for a total of five days.[27] If redebridement is performed instead of delayed primary closure, antibiotics should be stopped if there are no signs of infection or local inflammation. If patients present after 72 hours or are injured as a result of antipersonnel land mines then the addition of metronidazole in an intravenous form for 48 hours followed by oral therapy until delayed primary closure is suggested.

The use of antibiotics in the management of open fractures in the civilian community has been extensively analyzed. A Cochrane review published in 2004 revealed that antibiotics had a protective effect against early infection compared to no antibiotics (relative risk 0.41, 95% confidence interval (CI) 0.27 to 0.63, absolute risk reduction of 0.08, 95% CI 0.04 to 0.12 and number needed to treat 13, 95% CI 8 to 25).[28] This effect was, however, solely due to the high activity of β-lactams against streptococci and staphylococci.

A literature review by the EAST practice management guidelines working group scored the available literature and concluded that antibiotics were useful but that further work was needed especially with regard to type IIIb fractures.[29] The most recent review of the literature was performed by the Surgical Infection Society. That group concluded that the current standard of care for implementation of antibiotic prophylaxis is based on very limited data with no direct evidence in some cases.[30] In addition, the studies suffered from methodological and statistical flaws and include many older publications not reflective of the current strategies in today's healthcare environment. The studies also do not adequately reflect the bacterial resistance or the available antimicrobial agents used today.

One of the major areas of discussion includes which antibiotic is to be used and the role of additional gram-negative coverage at the time of injury. Given the multidrug-resistant nature of the gram-negative bacteria found to be subsequently infecting combat casualties' injuries after broad spectrum regimens are used (e.g., cefazolin and levofloxacin), it is currently not clear if the use of fluoroquinolones with enhanced gram-negative activity or aminoglycosides are resulting in the selection of these resistant pathogens. Worse yet, this practice may be leading to the development of resistance.[9, 30, 31] Patsakis et al have published various assessments of cephalosporins, penicillins, aminoglycosides and ciprofloxacin alone or in combination in various randomized controlled trials. Overall, cephalosporins alone performed as well as cephalosporins or penicillin in combination with aminoglycosides.[9, 31] Ciprofloxacin monotherapy had higher failure rates in comparison to cephalosporin in combination with an aminoglycoside for type III fractures.[32] Overall, it is unclear if additional gram-negative coverage is required or if it is potentially complicating wound care. Although not rigorously evaluated, from data derived from the Yom Kippur War, one group proposed that overly broad spectrum antimicrobial agents had led to the development of infections with resistant bacteria.[33] Those authors proposed that the severity of combat trauma wounds and contamination “leads toward the temptations to ‘sterilize’ the wound with massive doses of antibiotics and favors a false security with less reliance on good surgical technique.”

Other controversial issues include the use of penicillin in addition to standard therapy for open fractures to prevent clostridial infections. Of increasing concern is the rise in in vitro resistance to penicillin of the etiologic agents, which cause gas gangrene and limited animal data revealing no improved outcome for gas gangrene in comparison to untreated controls.[34]

Although the timing of antibiotics has not been rigorously studied, one study noted a higher infection rate (7.4%, 49 of 661 patients) if antibiotics were given after three hours versus a lower infection rate (4.7%, 17 of 364) when antibiotics were given within three hours.[9] This three hour window was supported during the Falklands Campaign in 1982.[35] Although the number of type III injuries was not reported, 0 of 17 patients with extremity injuries who received antibiotics within three hours became infected. In contrast 6 of 18 casualties who received antibiotic between four and nine hours after injury became infected.

The ideal duration of antibiotics is also not currently clear. Prospective studies have revealed therapy as short as one day may be as effective as the traditionally recommended five days of therapy.[36-38] There is data suggesting that prolonged courses of antibiotics are associated with resistant systemic infection.[39, 40]

Further assessments of antimicrobial agents also need to be conducted to determine the potential adverse effect of antimicrobial therapy on wound healing. Some agents have effects on cartilage, fracture healing, and inhibitory effects on bone in vitro.[41-45]

Overall the current literature predominately includes data from open fractures secondary to low-velocity gunshot wounds. In that population, a first-generation cephalosporin (or similar agent active against gram-positive bacteria) is administered for 72 hours perioperatively in patients with type I and II fractures. Given the concern for the development of infections with resistant bacteria and the role that drug pressure on selection of resistant pathogens, it is discouraged to provide enhanced gram-negative coverage (DII).

At Level I/IIa medical care in the combat zone early use of cefazolin or another intravenous first generation cephalosporin should be given for all extremity injuries (AII) (Table), although substitutions should be considered if other injuries including central nervous system or abdominal/thoracic injury necessitate alternative agents with enhanced gram-negative and anaerobic activity. Enhanced gram-negative therapy even for type III fractures is discouraged (DII) (Table). At Level IV/V medical care, antibiotics should include those agents started earlier in the evacuation chain but these should be stopped after 72 hours if there is not evidence of infection upon evaluation of the wound. Overall, Level I/IIa/IIb/III should emphasize wound preemptive therapy while Level IV/V should be treating only infected wounds and using periprocedure antibiotics as part of routine care. There is also no evidence to support continuing antibiotics during evacuation or continuing antibiotics until the wound is covered or until all drains are removed.

Irrigation

A hallmark of combat casualty wound management is aggressive surgical debridement and wound irrigation. Four major areas of wound irrigation are typically debated: 1. type of fluid, 2. amount of fluid, 3. method of fluid delivery and 4. additives. At this time there are no randomized controlled studies or well characterized outcome data of wound irrigation among combat casualties. Although not the primary focus of a recent study evaluating negative wound pressure wound therapy or vacuum-assisted closure (VAC®, KCI, San Antonio, TX) performed on casualties in Iraq, the use of pulsatile jet irrigation with at least three liters of saline was part of the very successful management strategies that improved combat-related injury infection rate.[46] There has been one recent review of the literature assessing irrigation of wounds in open fractures that highlights the studies addressing type of fluid, additives and method of delivery.[47] Overall, normal saline was recommended for irrigation with limited use of additives and the use of low-pressure irrigation.

Within the civilian literature, a recently published multicenter, prospective, randomized trial undertaken at two urban and suburban community level I trauma hospitals compared normal saline versus tap water for simple lacerations.[48] Of the 300 subjects who received tap water, twelve (4%) had wound infections compared to 11 (3.3%) of the 334 subjects in the saline group (relative risk 1.21, 95% confidence interval, 0.5 to 2.7). In another study, the utility of irrigation fluid with bacitracin solution or nonsterile castile soap solution was compared in open fractures.[49] The volume of fluid included the traditionally recommended three liters for type I fractures, six liters for type II fractures, and nine liters for type III fractures. There was no difference between the two groups in terms of infections or bone healing, but the group that received bacitractin had more wound healing complications.

There are no definitive trials assessing the quantity of fluid or method of delivery to adequately remove contamination from a wound. An intriguing animal model compared varying volumes of normal saline irrigation utilizing bulb syringe versus pulsed lavage on reducing wound bacterial counts.[50] Pulsed lavage irrigation with three liters resulted in a similar reduction of bacteria as irrigation with nine liters with a bulb syringe. While high pressure pulsatile lavage might appear to be superior for clearing bacteria from a wound, animal data indicates that pulsative lavage might push bacteria deeper into wounds.[51] In addition, high pressure pulsed lavage was shown to be associated with macroscopic bone and soft tissue damage.[52, 53] Although there is no clear definition of high pressure irrigation, generally high pressure flow is between 35 and 70 PSI while low pressure is between 1 and 15 PSI. Bulb syringe has a pressure of 2 PSI while squeezing a 250ml bottle with a perforated cap delivers 4.5 PSI.

Finally, timing of irrigation might influence outcome. One study found that at three hours after injury, low and high pressure pulsatile lavage were both effective at preventing wound infection but at six hours only high pressure pulsatile lavage was effective.[52] Although varying methods may have different abilities to irrigate a wound, the volume of fluid may be able to overcome the method used. A recent publication in an animal model revealed that irrigation within 3 hours decreased bacteria counts by 70% in contrast to 52% if irrigation was delayed to 6 hours or 37% if delayed to 12 hours.[54]

Based upon the currently available data, the traditional volumes (BIII) should be used to irrigate a wound with normal saline or lactated ringers (AI) while avoiding the use of additives to the fluid (DII) (Table). Potable water if the others fluids are not available is adequate (AI). The utility of high pressure pulsatile lavage needs further assessment and is not recommended (DII) while low pressure lavage is recommended (BII).

Timing of operative procedure

Traditionally it has been recommended that open fractures undergo operative procedures within six hours of injury. The time to evacuation in Iraq and Afghanistan to initial surgical care has not been well characterized but appears to occur within an hour, but can be substantially delayed due to the environmental and combat conditions. Historically evacuation times have continued to improve with World War II evacuations taking approximately eleven hours, decreasing to four hours during the Korean War and three hours during the Vietnam War.[55-57] Data assessing outcomes based on time to procedures is limited for combat casualties. Among those with extremity injuries during the Falkland Campaign there were two septic patients among twenty who underwent surgery within six hours in contrast to seven of the 29 patients treated after six hours. Nine of those 29 went to surgery after fifteen hours, three of whom became septic.[35] The US military experience in Somalia documented that casualties spent prolonged periods on the battlefield prior to evacuation and when they reached military treatment facilities in the combat zone, the resulting mass casualty situation overwhelmed the surgeons ability to take all patients into the operating room.[58] Fourteen of the sixteen casualties that developed infection were treated either outside of Somalia or were treated after six hours but long-term infectious outcomes are not described.

There are a number of publications addressing time to surgery in the civilian trauma literature. A retrospective analysis of open tibia and femur fractures revealed no difference in outcome between those treated within six hours and those treated later. However, that study excluded gun shot injuries.[59] Another evaluation of type IIIa fractures revealed one of sixteen became infected if treated within six hours and two of 41 became infected when treated between seven and 24 hours. An assessment of open tibial fractures from the Australian outback revealed no difference in infection rate if therapy was performed within six hours or after six hours (two of twelve and four of 36, respectively).[60] Ten of the twelve fractures treated within six hours and 25 of the 36 treated after six hours were type IIIa or IIIb. In an attempt to control for severity of injury and other factors that might bias the results, a larger retrospective study controlling for type of injury revealed similar infection rates with 53 infections in 184 patients treated within six hours and 51 infections in 199 patients treated after six hours.[61] Another larger study assessing the impact of various parameters revealed that type of fracture had a greater impact on infection than timing to procedure.[62] These findings have been supported in children and in other large retrospective studies.[63, 64]

Although data supports that delayed surgical procedures may be acceptable, these studies are flawed in their retrospective nature and lack of military type high-energy injuries (CIII). Therefore, patients should be evacuated to surgical care as soon as possible based upon a thorough risk benefit analysis of the combat environment with a goal of initial evaluation by a surgeon within six hours (BII).

Coverage and closure of wounds

It is currently recommended that closure of wounds in combat environments be delayed because of the high contamination rate and the risk of *Clostridium* infection.[27] This is based upon lessons learned during the World Wars.[65] The most recent publication addressing this approach was described for non-US casualties receiving care at a combat support hospital in Iraq with the use of VAC® after surgical debridement for two to four days.[46] There were no infections with this approach among 88 wounds in 77 Iraqi patients. The mean number of operations to wound closure was two and the mean time from injury to wound closure was 4 days. A short follow up time limits the conclusions of the study but the findings are remarkable given the stated infection rate of approximately 80% prior to instituting these management strategies.

There have been an increased number of civilian trauma centers evaluating early closure of wounds due to the findings that nosocomial bacteria are typically infecting wounds. A retrospective evaluation of early closure of wounds after standard irrigation and antibiotics revealed no difference in immediate closure versus those with second-look closures or delayed primary closure.[66] Only one of nineteen type IIIa fractures developed an infection after immediate primary closure in contrast to zero of five that underwent delayed primary closure. Another study evaluating type IIIb and IIIc fractures revealed eight of 84 patients developed deep bone infection.[67] One of the 33 patients that underwent immediate closure (<24 hours) developed a deep infection, three of the 30 treated with early closure (>24, <72 hours) and six of twenty-one with late closure (>72 hours) who developed deep infection.

Wound coverage with negative pressure wound therapy has become a standard of care in many facilities. A prospective randomized study evaluating the use of negative pressure wound therapy in 20 calcaneous fractures, four pilon fractures and twenty tibial plateau fractures found no infectious differences between negative pressure wound therapy and standard wound care.[68] An evaluation of negative pressure wound therapy in the treatment of lower extremity wounds revealed improved healing with decreased bacterial colony counts.[69] An interesting prospective study looked at bacterial density among patients treated with negative pressure wound therapy versus conventional moist gauze therapy.[70] The density of nonfermentative gram-negative bacilli significantly decreased in the negative pressure wound therapy treated wounds in contrast to *S. aurues*, which significantly increased in negative pressure wound therapy treated wounds. Another study of wound care without associated open fractures, revealed that bacterial burden during VAC® use increased during therapy but was not predictive of poor wound healing.[71] An animal trauma study performed at the US Army Institute of Surgical Research revealed substantial decrease in *Pseudomonas* in wounds with VAC® usage in comparison to traditional wet to dry dressing changes.

Currently, there is data supporting early closure of open fractures sustained in the civilian setting, including type III fractures. However, given the fact that there have been no assessments performed in combat-related injuries, early closure of open fracture wounds cannot be recommended (EII) (Table). Wound negative pressure wound therapy appears very effective in promoting healing and preventing infectious complications but the data currently is inadequate especially during air evacuations. The use of silver impregnated negative pressure wound therapy devices has not been adequately studied to date. Wound negative pressure wound therapy is recommended for casualties not evacuated or those with delayed evacuation (BII) but it is unclear if it is to be used in patients being evacuated rapidly out of theater (CIII) (Table).

Fixation

Fixation of open fractures has a number of beneficial effects including protecting against further damage of soft tissue, improved wound care and tissue healing and possibly reducing infection despite the presence of foreign material.[72] There are a number of methods used for bony stabilization, although internal fixation has traditionally been contraindicated in war surgery.[1, 27] Methods include plaster casting to prevent movement and external fixation. Trials comparing these techniques have not been reported in combat casualties. Based upon an analysis of the conflict in Somalia, external fixation was the preferred stabilization method.[73] External fixation has been used in many instances with success in combat-related injuries, however no trials have been performed.[20, 74-80] Two reviews assessing the use of fixation in the management of war wounds have been published emphasizing the role of external fixation.[81, 82] Recently an evaluation of the complications of fixation during OIF reported a high rate of early complications with external fixation and cautioned against its universal acceptance.[83]

In addition to improving pain control and facilitating transportation of wounded patients with fractured extremities, temporary external fixation (TEF) in combat-related injuries may provide systemic benefits similar to those reported in poly-traumatized civilian patients undergoing "damage control orthopaedics."[84, 85]

While debridement and immediate internal fixation appears to be an increasing practice preference in the civilian literature, it is still considered "ill-advised" in combat-related injuries.[86-92] In fact, urgent or emergent internal fixation of femoral neck fractures and talar neck fractures has been called into question in civilian trauma care. Delay of treatment for femoral neck fractures greater than 48 hours in one recent publication of 102 fractures in young adults was not correlated with osteonecrosis.[93] Similarly, delayed treatment of talar neck fractures does not seem to correlate with osteonecrosis.[94-96]

Frequently, TEF is converted to definitive internal fixation in civilian trauma care. Great care should be taken when extrapolating this data to combat related injuries, since 75% of combat injuries are secondary to explosive munitions.[5] Significantly increased infectious complications have been reported with conversion of femur external fixation to intramedullary nails after 14 days in some series.[97] An evidence based review of the literature demonstrated that plausible infection rates for conversion of external fixation to intramedullary nails in femurs and tibias were 3.6% (95% CI: 1.8–7.4%) and 9% (95% CI: 7–12%) respectively. This review also found that limiting the duration of external fixation for the tibia to 28 days decreased the infection rate by 83% (95% CI: 62–93%).[98] A pin tract infection is a significant predictor of subsequent deep infection with internal fixation.[99]

Internal fixation of femur fractures primarily involves intramedullary nailing for the past 20 years in the United States with union rates of 98-99% and infection rates around 1%.[100, 101] Reaming femur fractures has demonstrated clear benefits in decreasing rates of nonunion and implant failure.[102, 103] The safety of reaming prior to intramedullary nailing in open femur fractures has also been demonstrated.[86, 89-91] Immediate reamed intramedullary nailing of open femur fractures demonstrates infection rates of 1.8% to 5%.[86-91] Most infections in open femur fractures occur in type III open injuries.[86, 90] In one series, 11% of type IIIb open fractures became infected and accounted for all the infections in the entire series.[90] 80% of the infections reported in another series were in type III open injuries.[86] Multivariate analysis of this series by Noumi et al. revealed that only Gustilo type was significantly associated with infection. Factors such as age, timing of debridement, and reaming did not affect infection rates.[86]

Based upon available literature on femur fractures, temporary spanning external fixation should be placed at Level IIb-III medical facilities (AII). Conversion to definitive fixation at Level IV remains controversial. Delayed conversion of external fixation to a reamed, locked intramedullary nail can be performed at Level V facilities after appropriate wound management.

Open tibia fractures typically have higher infection rates than open femur fractures when converted to internal fixation.[88, 98] Despite these moderate infection rates, the intramedullary nailing of open tibia fractures after external fixation has demonstrated significantly faster union and greater range of motion with less malunion and shortening compared to casting in one randomized trial.[104]

Immediate traditional plate fixation of open tibial shaft fractures has an unacceptably high osteomyelitis rate compared to external fixation (19% vs. 3%).[105-108] Definitive management of open tibia fractures with traditional external fixation (unilateral-type constructs) has mixed results in the literature. Some series report good results with this type of external fixation.[108, 109] However, one series reported a 43% pin sepsis rate and a 38% incidence of malalignment greater than 5 degrees.[110] Plate and screw fixation for open proximal and distal periarticular fractures has shown acceptable outcomes and risks of infection with careful management of the associated soft tissue.[111, 112]

Much of the recent civilian trauma literature supports immediate nailing of open tibia fractures due to fewer re-operations and better alignment compared to external fixation.[113-116] In contrast, some studies continue to demonstrate worrisome infection rates, as high as 12.5-35% in type IIIb open injuries.[105, 107, 115, 117] Reaming does not seem to increase the infection rate in open tibia fractures while demonstrating the benefits of fewer nonunions and hardware failures.[103, 105, 113, 114, 116, 118]

Circular external fixation has been used in several small series with favorable results in type III open injuries of the tibia in military conflicts.[5, 119-123] A series of 24 patients with combat-related type III open tibia fractures were treated with circular (Ilizarov) external fixation. One of these patients went on to amputation (4.2%) and another developed a deep infection (4.2%).[123] Moreover, a recent review of 38 severe open tibia fractures sustained during OIF/OEF and treated in circular fixators to completion at a military hospital, showed a moderate (7.9%)

deep infection rate and a 97% union rate with the benefit of no retained hardware (personal communication JJK and RCA). In contrast, a recent review of 35 tibia fractures from OIF/OEF treated at a single institution with intramedullary nailing demonstrated an overall infection rate of 17.9% although this study included deep wound infections and osteomyelitis.[119] All of the infections occurred in type III open injuries, but these type III fractures made up 80% of all the tibia fractures in this series.

External fixation is appropriate at Levels IIb to III (AII). Conversion to definitive fixation at Level IV remains controversial. At Level V, reamed, intramedullary nailing can be performed safely in selected patients with a lesser soft tissue injury. For type III open injuries, circular external fixation has been shown to have lower deep infection rates.

Open fractures of the humerus and forearm seem to be best managed with plate fixation. Immediate plate fixation of open humerus fractures has demonstrated safety and efficacy.[124] There is a subset of shotgun related and high-energy gunshot humerus fractures that have been successfully managed with external fixation.[125, 126] One series of soldiers with high-energy gunshot fractures to the humerus showed a very low infection rate when managed with external fixation.[74] Another war-related series supported the use of a functional brace over external fixation.[127] Low-energy gunshot fractures can also be effectively managed with a fracture brace.[128] For those humerus fractures in which surgical fixation is desired, there is some enthusiasm for nailing, but plating demonstrates an overall lower complication rate.[129-132]

Open forearm fractures in several series show safe and effective management with immediate plate fixation.[133-135] Some high-energy open fractures of the upper extremity have reasonable results when a staged protocol is used with initial temporary external fixation.[136, 137]

The current literature supports the use of temporary spanning external fixation or splint immobilization placed at Level I/II/III (BII) and transition to open plate and screw osteosynthesis for most open humerus and forearm fractures after soft tissue stabilization and closure (BII).

Antibiotic beads

The utility of antibiotic impregnated beads has not been adequately evaluated in combat casualties but are widely used as part of civilian care. Antibiotic agents used in impregnated beads need to be heat-stable and active against the pathogens associated with infections. Traditionally aminoglycosides and vancomycin have been used. However, due to concerns over the development of vancomycin resistance, one of the most active gram-positive agents available for systemic infection, this drug is typically not used. Antibiotic impregnated beads develop very high local drug levels but maintain low systemic concentrations.[138] Certain key antimicrobial agents, such as colistemethate, that might be useful in the multidrug-resistant pathogens seen among combat casualties do not appear to be heat stable.

Although civilian data supports the use of aminoglycoside impregnated beads in the treatment of open fractures, many of the studies are limited by their retrospective nature or small sample size. In a retrospective evaluation of tobramycin impregnated beads, those patients who received the beads had a lower infection rate (31 of 845 patients) in contrast to those without beads (twenty-nine of 240).[139] This was especially true for type IIIb and IIIc fractures. The patients with impregnated beads were closed earlier introducing a potential bias. A prospective randomized trial compared local administration of tobramycin eluting beads to systemic antimicrobial therapy with a 1st generation cephalosporin for type II, IIIa and IIIb fractures until wound clusure. There was no difference in infection rates between the two arms of the study (two infections in 24 treated with local therapy and two infections of 38 treated with systemic).[140] The use of antibiotic bead pouches has also been retrospectively assessed in combination with intramedullary nails for type II, IIIa and IIIb tibia fractures. Of 50 patients who received the antibiotic bead pouches in one study only two developed an infection in contrast to four infections in the twenty-five that did not receive the pouches.[141] The practical use of bead pouches during transport, with frequent serial debridements remains a difficult technical challenge.

There is inadequate data for a firm recommendation in military populations to use or not use antibiotic impregnated beads in the combat zone but if patients are not being evacuated or have delayed evacuation in the combat zone it should be considered (BII) (Table).

Additional management strategies

<u>Retained fragments</u>

The source of wounds commonly seen in ground combat and stability operations can vary from gunshot, grenades including rocket propelled, mortar, landmines, bombs, and motor vehicle crashes.[5] Many of these weaponry systems can result in numerous fragments lodged into the body. Often, the sheer numbers of fragments are not amenable to complete removal. An assessment of 63 casualties with 866 fragments managed nonoperatively with antibiotics and dressings found the majority of casualties arrived 24-48 hours after injury and had between two and twenty wounds, although some had more than 50 wounds.[142] There were only two complications among the 63 casualties managed in this manner. Criteria for nonoperative management included soft tissue injuries only (no fractures, no major vascular involvement and no break of pleura or peritoneum), wound entry/exit less than 2 cm in maximum dimension, wounds not frankly infected, and exclusion of mine wounds. Management included cleaning and dressing the wounds, administration of anti-tetanus immunoglobulin and toxoid, penicillin IM/IV for 1 day and then orally for the next 4 days. The two complications were superficial abscesses both patients recovered without further complications. One of the authors (CKM) treated approximately 100 patients in Iraq using similar criteria. They typically received a single dose of IV cefazolin and then four days of oral levofloxacin. Only one patient developed an abscess, likely due to the wounding location. In addition, the injury was likely heavily contaminated with fecal pathogens as the injury occurred in a portable latrine during a mortar attack. It is recommended that casualties with isolated retained metal fragments meeting the above criteria be treated with a single dose of intravenous first generation cephalosporin with clinical monitoring for evidence of infection (BII) (Table).

Overview

Open fractures are a challenge to manage especially in a combat environment with high energy explosive injuries, high contamination rate, challenging environmental constraints, different levels of medical care, and varying evacuation procedures and times. The management of these combat related wounds has not substantially changed over the last 50 years with early surgical debridement and stabilization, antibiotic administration, and delayed primary closures. While the civilian community has tried to advance the understanding of open fracture care during peace time, there are still many unanswered questions with regard to the optimal management of these casualties. Most of the recommendations for combat related infections are not supported by good cohort controlled studies much less randomized control trials and further efforts need to be made to answer many fundamental questions and establish best treatment strategies. This manuscript addresses the data and recommendations for management of combat casualties through the various levels of current military medical care.

Table. Evidence based recommendations of the management of combat-related infections of extremity injuries

	Level I/IIa	Level IIb/III	Level IV	Level V	Comments
Utility of pre- and post-debridement culture	EII	EII	EII	EII	Management should not be based upon surveillance cultures at Level IV, V
Antibiotic agent	AI 1st generation cephalosporin DIII Enhanced gram-negative activity	AI 1st generation cephalosporin DIII Enhanced gram-negative activity	AI 1st generation cephalosporin perioperatively	AI 1st generation cephalosporin perioperatively	Level I/IIa/IIb/III- wound preemptive therapy Level IV/IV- treat infected wounds Avoid use of vancomycin Avoid broad spectrum antibiotics Level IV and V- treat infections and use standard of care perioperative antibiotic recommendations
Antibiotic timing	AII Initiate therapy within 3 hours of injury	AII Initiate therapy within 3 hours of injury	AI Initiate therapy 0.5-1 hour prior to procedures	AI Initiate therapy 0.5-1 hour prior to procedures	At initial damage control surgery or if surgery is delayed
Antibiotic duration	BII Preemptive therapy for 3 days and reassess wound	BII Preemptive therapy for 3 days and reassess wound	AI Perioperative not to exceed 24 hours	AI Perioperative not to exceed 24 hours	No evidence to continue antibiotics during evacuation if that occurs after initial 72 hours and there is no evidence of infection No need to continue antibiotics awaiting wound closure
Irrigation- type of fluid	AI Irrigate wound with available fluid (NS, LR or potable water)	AI Irrigate wound with available fluid (NS, LR or potable water)	AI Irrigate wound with available fluid (NS or LR)	AI Irrigate wound with available fluid (NS or LR)	
Irrigation- volume of fluid	BIII Remove gross contamination	BIII 3L- type I 6L- type II 9L- type III	BIII 3L- type I 6L- type II 9L- type III	BIII 3L- type I 6L- type II 9L- type III	
Irrigation- delivery methods	BII Irrigate with bulb syringe or equivalent technique	BIII Low pressure irrigation DII Higher pressure irrigation	BIII Low pressure irrigation DII Higher pressure irrigation	BIII Low pressure irrigation DII Higher pressure irrigation	

Irrigation- additives	DII	DII	DII	DII	
Timing of evacuation	BII Evacuation to surgical evaluation within 6 hours	N/A	N/A	N/A	
Timing of operative procedure	N/A	CIII Surgery performed within 6 hours	N/A	N/A	
Immediate primary closure	N/A	EII	N/A	N/A	No primary closure during transport or evacuation
Wound VAC	N/A	BII (D, CNE) CIII (R, CE)	CIII	BII	VAC studies are underway to determine the safety and efficacy for air evacuation
Fixation	N/A	AII External fixation	See text	See text	
Antibiotic beads	N/A	B-II (D, CNE)	B-II	B-II	
Retained extremity metal fragment	BII One dose of 1st generation cephalosporin preemptive therapy	BII One dose of 1st generation cephalosporin preemptive therapy	N/A	N/A	Wound characteristics: Entrance/exit wound size (<2 cm) No high risk etiology such as mines No bone or joint involvement No breach of pleura or peritoneum No major vascular injury

LR- lactate ringers, NS- normal saline, N/A- not applicable, VAC- vacuum-assisted closure, Levels of care- see "Epidemiology of Infections Related to Combat-related Injuries in Iraq and Afghanistan" in this J Trauma supplement for definitions.

Evidence Grade:
Strength of Recommendation- A. good evidence to support a recommendation for use, B. moderate evidence to support a recommendation for use, C. poor evidence to support a recommendation for or against use, D. moderate evidence to support recommendation against use, E. good evidence to support a recommendation against use

Quality of Evidence- I. evidence from at least one properly randomized controlled trial (RCT), II. evidence from at least one well-designed clinical trail without randomization or from cohort or case-controlled studies, III. expert opinion

Other factors might influence recommendations and if the letter is included then it applies to those patient populations- R. applies during periods of rapid evacuation (stay less than 72 hours, D. applies during period of delayed evacuation (stay greater than 72 hours), CE. applies to casualty that will be evacuated from the combat zone, CNE. applies to casualty that will not be evacuated from the combat zone

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Abstract

Combat-related injuries to the central nervous system (CNS) are of critical importance because of potential catastrophic outcomes. Although the overall infection rate of combat-related CNS injuries is less than 5%, if an infection develops there is a very high associated morbidity and mortality. This review focuses on the management and prevention of infections related to injuries to the brain or the spinal cord. Management strategies emphasize the importance of expert evaluation and management by a neurosurgeon. This review provides evidence-based recommendations from military and civilian data to the management of combat-related CNS injuries. Areas of focus include bacteria cultures, antimicrobial therapy, irrigation and debridement, timing of surgical care, and wound coverage. Given these recommendations are not supported by randomized control trials or adequate cohorts studies in a military population, further efforts are needed to answer best treatment strategies.

Prevention and Management of Infections Associated with Combat-related Central Nervous System Injuries

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The prevention and management of infections associated with central nervous system (CNS) trauma are topics of critical importance, as CNS infections are usually catastrophic events. Battle wounds involving the head were reported in 6% of 14,000 injuries treated at US 5th Army hospitals in 1944, with one third of those classified as intracranial.[1] War-related penetrating spinal cord injury, which perhaps most famously claimed the life of Admiral Horatio Nelson at the Battle of Trafalgar, was reported in nearly 12% of WW II battlefield injuries.[2,3] War-related CNS trauma is often associated with high-velocity weapons (which create substantial tissue destruction and devitalization) and blast injuries (which are often associated with in driven foreign bodies).

Prior to the modern era, penetrating head injuries were considered uniformly fatal and were treated with expectant care. In a review of the historical treatment of head injuries, a mortality rate of 73.9% was reported in 898 cases of head wounds in the Crimean War and 71.7% in a series of 704 cases of penetrating head wounds from the American Civil War.[4] During World War I, Cushing found that more than 60% of deaths after dural penetration were due to sepsis. Although antimicrobial agents were not available, he was able to reduce the mortality associated with CNS injuries from 54% to 29% simply by expediting surgical debridement.[5] The introduction of penicillin during WW II further helped decrease the mortality associated with CNS trauma. Several reports from the 1940's report an infection rate of 21-31% with the use of local sulfa powder and/or parenteral sulfonamide therapy; this rate improved to 5.7-13% with the addition of penicillin.[1,6-9] Further medical advances saw mortality decrease to approximately 10% in the Korean and Vietnam wars and to 4.5% during Operation Desert Storm.[10-13] Similar to penetrating head injury, outcome from penetrating spinal cord injury experienced a marked improvement with the introduction of antibiotics.[14]

Epidemiology and Microbiology of Wound Colonization and Infection

There have been few studies reporting the bacteriologic culture of retained fragments or the identification of organisms associated with penetrating craniocerebral trauma. Ascroft et al. obtained systematic aerobic and anaerobic cultures from CNS traumatic injuries from the battle of El Alamein in 1942. Twenty-five cases of penetrating craniocerebral injury were studied, of which 6 cultures grew *Clostridium*, 22 grew *S. aureus* and 5 grew β-hemolytic streptococci in removed brain tissue; only two cases of sepsis resulted, both due to *S. aureus*.[15] Ecker, in a study of brain wounds due to shell fragments in the Normandy campaign, performed bacteriologic studies in patients wounded 3-86 days previously and who received sulfadiazine and penicillin. Seventy-six percent (32 of 42) of cultures grew organisms reported as *Staphylococcus aureus* (7 cases), *Staphylococcus albus* (17 cases), *Streptococcus viridans* (9 cases), non-hemolytic *Streptococcus* (9 cases), gram-negative bacilli (6 cases), *Micrococcus tetragenus* (4 cases) and *Clostridium* (2 cases).[16]

During the Vietnam War, Carey et al. performed cultures of skin wounds, brain and in driven bone fragments in 45 craniocerebral missile cases within 2-4 hours of occurrence.[17] Skin wounds were contaminated in 98% of cases, with 70% of the contaminating organisms being gram-positive cocci (predominantly *Staphylococcus*) and 28% being various gram-negative rods. Only 5 (11%) brain wounds showed bacterial contamination, suggesting that many missile tracks within the brain were initially sterile. In driven bone fragments were positive in 20-45% of samples (depending on the number of bone fragments cultured) and all grew *Staphylococcus*. Based on the predominance of gram-positive isolates recovered, the authors concluded that skin bacteria were the most important source of contamination for cranial wounds.

Hagan, in another study from the Vietnam War, reported that 56% (35/62) of patients operated on for retained intracranial bone fragments have positive microbial cultures of the fragment.[18] Most of these patients had undergone previous craniectomy and had been on antibiotics for an average of 2 weeks. *Staphylococcus epidermis* was the most common organism isolated, with a variety of gram-negative and gram-positive bacteria also reported.

Aarabi reported on 161 patients with missile head wounds injured in the Iran-Iraq war who underwent culture of wound edges and brain tracks as well as all in driven bone fragments[19] All patients in that study had received ampicillin and chloramphenicol or penicillin G and chloramphenicol after field evacuation, and prior to culture sampling. Wound cultures grew predominantly coagulase-negative *Staphylococcus*, while the brain tract cultures grew coagulase-negative *Staphylococcus*, *Acinetobacter* and *Staphylococcus aureus*. Cultures of bone fragments grew mostly coagulase-negative *Staphylococcus* and *S. aureus*. In this study, there were 6 cases of meningitis (secondary to *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Herellea vaginicola*, *Enterobacter*, alpha-streptococci and coagulase-negative staphylococcus) and two cases of brain abscess (Coagulase-negative staphylococcus and *E. coli*). Of interest, there was no relationship between the contaminating bacteria and post-debridement infective organisms. Furthermore, no patient with positive early wound, bone or brain culture, with or without bone or metal fragments retained, developed either meningitis or deep infection during follow-up.

Infection after penetrating brain injury is most commonly due to osteomyelitis of the skull, meningitis, and early or late abscess formation.[20] Several studies from the Vietnam War era included large numbers of patients in their analyses. Hammon published a series of 2,187 consecutive penetrating wounds of the brain and reported a meningitis rate of 0.63%, while Hagan reported 506 patients with penetrating brain injury, of whom culture-proven meningitis occurred in 3.56% of cases.[11,18] Brain abscess formation following penetrating injury has been reported in 2-3% of patients.[21,22] In one of these studies, 37 of 1221 patients developed a brain abscess after penetrating craniocerebral injuries in Vietnam, with culture of gram-positive cocci (predominantly *S. aureus* and *S. epidermis*) in 43% and gram-negative rods (a variety of organisms) in 56%.[21] Of note, anaerobic culture data was not routinely used.

In a publication on intracranial infections after missile brain wounds in the war in Croatia, Hecimovic et al. reported infectious complications occurring in 15 of 88 patients after missile brain injury (17%).[23] In 14 of 15 patients, infection developed within the first two months, and in one case, five months after wounding. Four cases of isolated bacterial meningitis, nine cases of brain abscess, one local cerebritis and one subdural empyema with concomitant meningitis were reported. The most commonly isolated organism was *Staphylococcus aureus*, and most patients developed a cerebrospinal fluid fistula and/or dehiscence in association with infection. Vrankovic et al. have reported their experience of 127 war-related missile brain injuries sustained in northeastern Croatia, and noted a 10% intracranial (meningitis, abscess) infection rate. In reporting complications of missile craniocerebral injuries during the Croation Homeland War, Tudor et al. found a 8.5% intracranial infection (meningitis, meningoencephalitis or ventriculitis) rate in 176 patients. [24,25] Splavski et al., also in Croatia, reported 3 cases of brain abscess and one bacterial meningitis among 21 patients with skull base missile injuries (19%).[26]

An intracranial infection rate of 4.7% (19/403) was reported as a result of missile injuries to the brain during the Lebanese Conflict by Taha et al.[27] Ninety percent of infections occurred within 6 weeks of injury, and the mortality rate was 43%. Gram-positive organisms were responsible for 36% of infections, gram-negative organisms accounted for 40%, mixed infections occurred in 7%, and 17% of cultures were negative. The relatively high rate of gram-negative infections was attributed to the use of antibiotics prior to surgery. In reporting the surgical outcome in 435 patients who sustained missile head wounds during the Iran-Iraq War, Aarabi found that 35 of 71 (49%) patients who died had an infection as a contributory factor (25 cases with meningitis and 10 with sepsis).[28] Levi et al. in their report on the wartime neurosurgical experience in Lebanon, reported a 4% intracranial infection rate in 116 patients, while Brandvold et al. reported that 8% of their patients, injured in the same conflict, developed meningitis.[29, 30] Although most studies report that intracranial infection occurs within 1 to 5 weeks after injury, delayed infection, sometime occurring years after the initial trauma, is well-reported.[31,32]

In summary, for penetrating brain injuries, study differences in culture techniques, prophylactic antibiotic use, and time of culture acquisition make definitive statements regarding the epidemiology of wound colonization after injury difficult to conclude with certainty. However, based on the available data, it appears that the most common organisms associated with wound colonization are of dermal origin (predominantly coagulase-negative *Staphylococcus*). For intra-cranial infections, most result from *S. aureus* or gram-negative facultative aerobic organisms, and, although most occur within several weeks of injury, delayed presentation must be considered.

Infectious complications occurring after spinal cord injury vary markedly from study to study. Meningitis is probably the most common infection, and a report from the US military experience in Vietnam reported this complication in 6 of 19 (32%) patients sustaining a spinal cord injury secondary to a transcolonic gunshot injury.[33] A similar high rate of infection was reported by Romanick et al. in a series of low-velocity missile wounds to the abdomen in a civilian institution.[34] In this study, while no patients without gastrointestinal tract perforation sustained infection, 7 of 8 patients with colonic perforation developed infectious complications. Despite receiving broad-spectrum antibiotics for a minimum of four days after the injury, there was one case of meningitis, three cases of abscesses and three cases of osteomyelitis. Cultures from three patients grew *E. coli*, *Enterococcus* and *Proteus mirabilis*, which would be consistent with a colonic source of infection. Heary et al. in a series of penetrating wounds to the spine at a civilian hospital, reported seven spinal infections occurring in five patients (2% of the entire cohort).[35] There were three occurrences of meningitis (two of these patients had bowel injuries), two paravertebral abscesses, one vertebral osteomyelitis, and one epidural abscess.

Other studies have reported contradictory results as to the risk of infection occurring after spinal injury. Waters and Adkins reported no cases of meningitis or spine infection in 19 cases of spine injury associated with bowel injury and Kihtir et al. reported no spinal or paraspinal infectious complications in five cases of spine injury with colonic injury.[36,37] Roffi et al. compiled a series of 42 patients with low-velocity gunshot wounds to the spine with an associated perforated viscus, and found that only three patients developed spinal or paraspinal infections.[38] One patient with a stomach perforation developed *E. coli* meningitis, and 2 of 14 patients with colonic perforations developed psoas abscesses. A more recent publication of 114 patients with low-velocity gunshot wounds to the spine demonstrated a significantly higher rate of spine infection and wound infection in patients with transgastrointestinal gunshot wounds to the spine, with 14.8% of GI-involved spinal gunshot wounds subsequently developing spinal infections.[39]

Prevention of Infection

Several recent, complete reviews have addressed the issue of preemptive antibiotics following penetrating brain injury and have concluded that, while available data are not sufficient to support a treatment standard, the use of preemptive antibiotics is recommended.[20,40] For craniocerebral injuries, prevention of infection requires the use of antibiotics which treat *S. aureus* and gram-negative bacilli. For penetrating brain injury, cefazolin 1 gram IV every 8 hours is recommended with consideration of extending coverage with the addition of gentamicin and penicillin if gross contamination is present (BIII) (grading outlined in this supplement of Journal of Trauma- Guidelines for the Prevention of Infection following Combat-related Injuries). Alternative therapy includes ceftriaxone 2 grams IV every 24 hours with consideration of extending coverage with the addition of gentamicin and penicillin if gross contamination is present. If the patient is allergic to penicillin then Vancomycin 1 gram IV every 12 hours and ciprofloxacin 400 milligrams IV every 8 to 12 hours is recommended.

The relationship between retained bone and metal fragments and subsequent infection is debated.[41] While extensive debridement has classically been recommended, some reports suggest less aggressive surgical intervention may be successful with preservation of brain function.[42-47] At this time, it is recommended to only remove easily accessible foreign bodies and grossly devitalized tissue (BII). Certain complications including cerebrospinal fluid leaks, air sinus wounds, or wound dehiscence have all be identified as risk factors for infection and necessitate more aggressive surgical interventions.[21, 48,49]

For penetrating injuries of the spine, one published review has suggested broad-spectrum antibiotic use for a minimum of 48 hours, with extension to a minimum of 7 days if the alimentary tract has been violated (BII).[35] Retained bullets are not thought to be a significant risk factor for the development of infectious complications from low-velocity civilian gunshot wounds, and that tenet presumably extends to shrapnel and high-velocity gunshot wounds.[35] Removal of foreign bodies in the spine should be immediately preformed for neurologic compromise but otherwise can remain in place until evaluation by a neurosurgeon (CIII). However if the casualty's injury is associated with gross contamination or associated with a tract from the peritoneal cavity into the spinal canal then exploration and irrigation is recommended. The optimum timing for spinal fracture fixation is debated. Although studies have shown that fixation within three days can reduce the incidence of pneumonia, length of stay, number of ventilator days and hospital charges, another study demonstrated poorer outcomes in some groups with early spine stabilization.[50] The timing of fixation should be individualized, especially in those patients with other catastrophic injuries (CIII).

There have been no studies assessing the ideal irrigation fluid for CNS combat related injuries. Typically room temperature normal saline is used. It is also important to close the injury site as quickly as possible, but there is often inadequate dura present for closure with penetrating trauma. Autologous tissue graft or a commercially available dural substitute may be needed in such cases. A high importance is placed on at least closing the skin. If it is not possible to close the skin and dura, and a watertight skin closure is emphasized (CIII). If paranasal sinuses are involved, dural closure or reconstruction becomes essential (BIII).

Diagnosis of Infection

The diagnosis of infection after penetrating brain injury can be difficult, as the patient usually has a depressed sensorium, and may have other wounds which complicate the clinical picture. Computed tomographic (CT) scanning of the head has been strongly recommended to evaluate the patient with penetrating brain injury,[51] and repeat imaging in the event of delayed clinical improvement (to assess for abscess) is recommended (BIII). MRI is usually not suggested, as there is a concern for retained ferromagnetic fragments which can cause artifact and image distortion, and potentially rotate and deflect in response to magnetic torque. A clinical concern for meningitis warrants sampling of the cerebrospinal fluid for cell count, protein, glucose, and culture.

As with penetrating brain injury, infection following penetrating spine injury can be subtle, a follow-up CT scanning of the spine and abdomen/pelvis to assess for abscess formation is recommended for patients who present with signs or symptoms consistent with an infection (BIII).

Treatment and Outcome of Infection

Specific treatment for post-traumatic CNS infections is beyond the scope of this review, and readers are directed to practice guidelines and current textbooks for the management of intracranial infections.[52-54] In general, antibiotic therapy in post-traumatic meningitis will be directed by the antibiotic susceptibilities determined from the culture of cerebrospinal fluid. Abscesses (intracranial, paravertebral, intraperitoneal, etc.) usually require drainage (either surgical or CT-guided aspiration). Again, antibiotic therapy will be guided by the results of microbiological culture, with some clinicians opting to add coverage for anaerobic bacteria, as these organisms can be difficult to isolate from clinical samples.

In general, the estimated mortality for posttraumatic meningitis appears to be approximately 10%, for epidural and subdural abscesses from 10 to 40%, and for brain abscess approximately 5%.[55, 56] Several studies have addressed the overall outcome of penetrating brain injuries in military injuries. Aarabi analyzed 435 patients injured in the Iran-Iraq War, and reported 71 dead, 0 vegetative, 22 severe disability, 203 moderate disability and 139 with good recovery.[27] Levi et al. and Brandvold et al. reporting on 229 patients injured in Lebanon, with 60 dead, 12 vegetative, 14 severe disability, 48 moderate disability, and 95 good recovery.[28,29] Military penetrating brain injury surviving to reach medical care is predominantly caused by shell and shrapnel injuries, which skews the surviving population toward lower velocity shrapnel wounds. Mortality rates from civilian penetrating brain injury tends to be much higher, as most wounds are due to gunshots and suicides.[56]

Data on the outcome of infection in wartime penetrating spine injuries is also scarce. A report of 96 patients with spine and spinal cord war injuries from the War in Croatia has been published, with a 4% in-hospital mortality and a 43% survival rate.[57]

Unresolved Issues and Potential Future Research Topics

Although the use of antibiotics following penetrating brain and spine injuries is has become standard-of-care, questions regarding the optimum choice of antibiotics and length of therapy are still unresolved. The impact of the rising incidence of bacteria (such as community-acquired methicillin-resistant *S. aureus* and multi-drug resistant *Acinetobacter baumannii*) needs to be tracked closely, and changes to the current recommendations may be needed if these bacteria emerge as common post-injury pathogens.

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Abstract

During wartime, abdominal and thoracic trauma constitutes approximately 20% of combat-related injuries. Rates of infection vary based upon organ of injury with the highest rates noted for trauma to the colon. This review focuses on the management and prevention of infections related to injuries of the thoracic and abdominal cavity. The evidence upon which these recommendations are based included military and civilian data from prior published guidelines, clinical trials, where available, reviews, and case reports. Areas of focus include antimicrobial therapy, irrigation and debridement, timing of surgical care, and wound closure. Overall, there are limited data available from the modern battlefield regarding the prevention or treatment of these infections and further efforts are needed to answer best treatment strategies.

Prevention and Management of Infections Associated with Combat-related Thoracic and Abdominal Cavity Injuries

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Abdominal injuries are seen in 7% of wartime trauma, and thoracic trauma in 9-15% of casualties, 90% of which are penetrating.[1] The nature of these wounds sustained during wartime can be quite different than those that present to civilian trauma centers. Several studies suggest that historically, thoracic trauma from combat injuries pose a higher risk for secondary infection. For example, studies on thoracic injuries from WWII showed an infection rate of 5 to 9%,[2, 3] while a comparable civilian study from the same time frame only had a 3% infection rate.[4] There are several distinct features of wartime trauma which must be considered, such as the impact from the blast component. It is also not uncommon for the modern wartime medic to see trauma patients with a combination of blunt and penetrating trauma, both high and low velocity, with significant blast effect and associated burns.[1, 5-7] In addition, injuries sustained during military conflicts may have a more significant delay before definitive surgical care.[8] Because of these reasons, trauma seen in civilian hospitals may not be comparable to injuries sustained in combat. These factors contribute to the complexity of abdominal and thoracic wartime trauma, and the difficulty in making treatment decisions in an effort to prevent and manage infections associated with them. Specific data from the modern battlefield regarding antimicrobial therapy following abdominal and thoracic trauma and treatment of subsequent infections have not been published. Therefore, we sought to perform a comprehensive review of the civilian trauma literature and combine those results with their clinical expertise in managing wartime injuries to present recommendations, evidence-based whenever possible, to ideally prevent and manage subsequent infections.

Infection following penetrating abdominal trauma has been a common complication during war, with the first detailed reports from WWI with mortality rates from colon injury ranged from 60 to 75%.[9, 10] During WWII, high rates of intra abdominal infection and mortality following abdominal trauma, specifically colonic trauma, resulted in the U.S. Surgeon General and others mandating colostomy in response to these injuries.[11, 12] More recent data from civilian trauma centers revealed the overall rate of postoperative infection following penetrating abdominal trauma to be approximately 30% if antibiotics were administered postoperative, and up to 70% for those with colon injury.[13, 14] Data from the current operations in Iraq and Afghanistan have recently been reported. From September 2003 to December 2004, 3,442 patients were treated at the 31st Combat Support Hospital, of which 175 (5.1%) had colorectal injuries.[15] Penetrating trauma accounted for 168 (96%) of these injuries, and 27 patients (16%) developed sepsis. Patients with colorectal injuries had a mortality of 18% , compared to 8% in those without ($p<0.001$). In a smaller series of 211 patients admitted to the USNS Comfort from March to May 2003, 56 patients (27%) were infected, and three (1.4%) died.[8] Of the 39 patients with abdominal wounds, 17 (43%) became infected. Similar to other reports,[16] the vast majority of bacteria were gram-negative organisms, with *Acinetobacter* spp. accounting for 33%.

Risk factors for secondary infection of the abdominal cavity following trauma depend on both the location of the injury and the condition of the host. Identified risk factors for trauma related postoperative infection include need for blood transfusion, higher penetrating abdominal trauma index score, and injury to the colon.[15, 17-20] While isolated colonic injury has long been associated with higher risk for secondary infection, a recent study showed that colonic injuries with concomitant gastric trauma are associated with even higher rates of infection.[21] In addition, for patients with pancreatic and/or duodenal trauma, the presence of the pancreatic injury was responsible for the increased risk of infection.[22] Lastly, one additional factor unique to modern, urban wartime trauma care which may impact upon the rate of infection is the potential delay from the time of injury until initial surgical and medical care.[7]

Bacteria responsible for colonization and subsequent infections from abdominal injuries depend on the particular injured organ or viscous structure disrupted.[23] Bacteria that colonize the stomach through the proximal small bowel (including the biliary system) include primarily gram-positive and some gram-negative aerobic and facultative organisms, while the distal small bowel has gram-negative aerobic and facultative organisms as well as some anaerobes such as *Bacteroides fragilis*. Colonic commensals include facultative and obligate anaerobes to include streptococci and enterococci. Overall, *Escherichia coli* is the most prominent pathogen in patients with complicated intra-abdominal infection (cIAI).[23, 24] In postoperative patients, the risk of colonization and subsequent peritonitis with nosocomial drug-resistant pathogens, such as *P. aeruginosa* increases over time.[23, 25] Therefore, the agents recommended for treatment of postoperative infections are broader spectrum, in general, compared with those used for perioperative prophylaxis.

Thoracic infection within the pleural space following thoracic trauma has been studied in previous conflicts similar to infection following abdominal trauma. As noted above, during WWII, with the advent of antibiotics, empyema was reported to occur in approximately 5-10%.[2, 3] During the Vietnam war approximately 2% of patients developed empyema following thoracic trauma.[26] More recently, data from Operation Iraqi Freedom (OIF) revealed that injuries to the thorax account for approximately 5-10% of wounds.[5, 6, 8] In the previously mentioned series of 211 patients admitted to the USNS Comfort, 30 patients (14%) suffered an injury to the chest, seven (23%) of which were associated with an infection, although the specific types of infection (i.e. empyema, pneumonia, bacteremia, extremity wound, etc.) were not reported.[8]

The greatest risk factor for infection of the thoracic space following trauma is retained hemothorax.[27, 28] Studies from the Korean war demonstrated up to 26% of undrained hemothoraces eventually became infected.[28] More recent data from civilian trauma centers show approximately 1-10% of patients requiring tube thoracostomy develop empyema.[27, 29-31] Other risk factors cited for empyema following chest tube placement include persistent pleural effusion, presence of pulmonary contusion, need for multiple chest tubes in the same hemithorax, higher thoracic acute injury score, and prolonged duration of chest tube use.[30, 32] Mechanism of injury is also an important risk factor, with penetrating injury, especially from a gunshot wound, associated with empyema, and blunt trauma and lung contusion associated with pneumonia.[29, 33, 34] Other studies describe patients in shock, unconscious on arrival, or injury sufficient to require splenectomy as risk factors for infection.[35] In general, the identified risk factors all point towards a direct relationship between increasing severity of thoracic injury and risk of empyema.

Various bacteria are responsible for infections following thoracic trauma, including gram-positive organisms, anaerobes, and gram-negative pathogens.[4, 29] In most reports, *S. aureus* is the most common bacteria found, isolated from 35-74% of patients.[29, 30, 32] In the case of empyema thoracis, if the infection originates from the initial entry point or local area, then skin organisms, primarily staphylococcal and streptococcal bacteria predominate. If the infection originates from the lungs, pulmonary pathogens, first community-acquired and later hospital-acquired or ventilator-associated organisms are seen. However, there is not always an obvious source of infection.[29] Additionally, the specific nosocomial pathogens may vary from one institution, or intensive care unit, to another. At times, infection may arise due to contamination of bacteria from an adjacent site, most notably the abdominal cavity due to concomitant penetrating abdominal trauma leading to enteric contamination of the thoracic space.[30] Flora associated with the hollow viscous that is damaged, as discussed above, should then be considered.

Prevention of infection following abdominal trauma

Antimicrobial Prophylaxis

The use of antimicrobials in preventing intra-abdominal infection (IAI) after operation for penetrating abdominal trauma has changed little in several decades. In 1972, Fullen provided the seminal argument for the use of preoperative antibiotics before surgical intervention for penetrating abdominal injury, demonstrating that patients whose antibiotics were delivered preoperatively had a much lower (7%) rate of secondary infection than those who received antibiotics intraoperatively (33%) or postooperatively (30%).[13] Subsequently, Thadepalli et al. showed that kanamycin paired with clindamycin was more effective than when paired with cephalothin, demonstrating the role for anaerobic coverage in preventing secondary infection.[14] Thus, from the early 1970's it was shown that antibiotics, particularly a regimen that includes anaerobic coverage as well as aerobic coverage decreases subsequent infection. No placebo-controlled trials have been done since, with most trials focusing on what is the most effective antimicrobial regimen.

Numerous studies in the subsequent years have evaluated different antibiotic agents and the optimal duration of therapy following abdominal trauma. Prospective, randomized trials have investigated penicillin, cephalosporins, clindamycin, aminoglycosides, doxycycline, and others, all in various combinations.[36-41] Study sample sizes have varied from approximately 50 to 300 patients, with postoperative infection rates ranging from 2-36%. No one antibiotic agent or combination has been consistently proven to have superior efficacy as long as the spectrum of activity of the drug or combination covers the bacterial flora of the gastrointestinal tract. No study has clearly demonstrated decreased rates of postoperative infection with courses of therapy extended beyond twenty four hours postoperation. In the largest prospective randomized trial evaluating the optimal duration of therapy, Fabian et. al showed no benefit to administering five days of cefoxitin or cefotetan compared with twenty four hours.[42] However, some argue that because this trial only included 111 patients with colon injuries the study was not able to definitively address the issue of prolonged antibiotic prophylaxis in those with the highest risk of infection. But other studies have also failed to demonstrate any benefit from prolonged therapy.[43-45]

More recent investigations have yielded similar results. Sims et al. randomized 291 patients to receive cefoperazone alone, ceftriaxone with metronidazole, or metronidazole with gentamicin and ampicillin for 1 to >5 days depending on the type of injury.[40] Overall, postoperative infections developed in 15 patients, only two of which developed in patients randomized to ceftriaxone with metronidazole. While there was no statistical difference between groups regarding the primary outcome, the study was underpowered, did not report differences in surgical management, and was confounded by varying lengths of therapy so conclusions from the study are limited. Tyburski et al. more recently compared metronidazole with either ciprofloxacin or gentamicin in 68 patients treated for 24 to 96 hours depending on the type of injury.[20] Again, no difference was found in the rate of postoperative trauma-related infections, but the study was underpowered.

At least three recent randomized, prospective studies have evaluated the impact of duration of prophylaxis on postoperative infection rates. Investigators have reported no difference in efficacy of ampicillin/sulbactam[18] or cefoxitin[17, 46] whether given for 24 hours or five days. In the trial comparing one versus five days of ampicillin/sulbactam, 317 patients were randomized, of which 162 had colon injuries.[18] Twenty-nine patients (9%) developed surgical site infections, which were equally distributed between groups, despite the fact that patients randomized to only one day of prophylaxis had significantly more patients with multiple hollow viscous injuries. Cornwell et al. studied cefoxitin for one versus five days in abdominal trauma patients at high risk of postoperative infection.[46] To be eligible, patients had to have full-thickness injuries to the colon with one of the following: penetrating abdominal trauma index >25, transfusion of 6 or more units of packed red blood cells, or be more than four hours from injury to operation. Similar to other studies, no reduction in risk of trauma-related postoperative infection was seen with prolonged prophylaxis. Unfortunately, due to the inclusion criteria, the study was small with only 63 patients and was underpowered by the authors' estimates.

Despite the EAST guidelines and the available evidence, which does not support the prolonged use of prophylactic antibiotics following abdominal trauma, clinicians continue to prescribe peri-operative antibiotics for more than 24 hours.[19] This is particularly true in patients with colon or other hollow viscous injuries.[17-19, 46] However, there is now some evidence that in addition to lacking benefit, prolonged presumptive antibiotic therapy may be associated with harm.[47, 48] In a retrospective study of 151 trauma patients with nosocomial pneumonia, Hoth et al. reported those with presumptive antibiotic therapy for more than 48 hours were more likely to have gram-negative organisms causing the first pneumonia, and more likely to have resistant organisms causing the first or second pneumonia.[48] Similarly, in a prospective, observational study of 250 patients, Velmahos et al. showed patients receiving prophylactic antibiotics for more than 24 hours were more likely to have a drug resistant infection.[47] These reports are concerning, but the data are not sufficient to support a definitive statement regarding the possible harm of prescribing a prolonged course of perioperative antibiotics for this guideline. However, clinicians should consider the potential risks and benefits of such a course of therapy prior to its administration.

It is difficult to form conclusions from the trials of perioperative antibiotic use following abdominal trauma due to the lack of uniformity in regard to mechanism and severity of injury, surgical intervention, antibiotic regimens, dosages, and duration. Furthermore, standard definitions of postoperative infections and degree of peritoneal contamination have not been used, and the majority of studies have been underpowered. A review in the late 1980's and another in 2000 concluded that while preoperative antibiotics are beneficial, there can be no definitive recommendation for a preferred prophylactic antimicrobial regimen for penetrating abdominal injuries.[36, 49] Our literature review found no evidence since 1996 that adds significantly to those conclusions. In the military trauma system, the initial site of surgical care (Level IIb or III facility) will likely perform the first laparotomy. In respect to antimicrobial therapy, we recommend the following for patients with penetrating abdominal trauma: presumptive antibiotic therapy preoperatively alone or peri-operatively started preoperatively and extended no more than 24 hours with sufficient gram-negative enteric and anaerobic coverage for patients with hollow viscous injury (AI) (grading outlined in this supplement of Journal of Trauma- Guidelines for the Prevention of Infection following Combat-related Injuries). Antibiotics should not be extended beyond this time as prolonged duration does not add benefit (BI). Recommendations for intra-theater antibiotics include cefoxitin (if available), or omoxifloxacin 400mg IV X 1 as a single agent, or levofloxacin in combination with metronidazole or ciprofloxacin in combination with metronidazole (AI). It is recommended that carbepenems not be used at this level as these drugs and/or their drug classes should be saved to treat potential future drug resistant organisms (CIII).

Surgical Management

The optimal surgical approach to the management of penetrating abdominal trauma is beyond the scope of this guideline. Many lessons have been learned by our surgeons performing surgery in level IIb/III facilities to stabilize patients for further and more definitive surgical care at a level IV or V facility. First, the standard of care should be followed, such as the appropriate debridement of all non-viable and heavily contaminated tissue, and the use of copious irrigation. At least 6 liters (L) of irrigation is recommended (BIII) as recent prophylactic antibiotic trials use following abdominal trauma have used 6 L or more of saline irrigation prior to closing the abdomen.[18, 46] In addition, early primary repair of complex or destructive colonic injuries is not recommended (BII), especially if associated with massive blood transfusion, on-going hypotension, hypoxia, reperfusion injury, multiple other injuries, high velocity injury, or extensive local tissue damage.[1] However, simple, isolated colon injuries may be repaired primarily (AI).[1, 15, 50, 51] In one series of 175 colorectal injuries from Operation Iraqi Freedom (OIF), primary repair was used for 55 patients (34%), and resection with anastamosis was used for 31 patients (19%). Of the 86 patients managed without stoma placement, 11 (13%) developed a leak, but on multivariate analysis this had no impact upon sepsis or mortality. Skin should not be closed if there is a colon injury or extensive devitalized tissue due to excessive infectious complications (BIII). Wound vacuums should be utilized in theater and place to closed suction; however, the safety of the use of suction devices in flight (CIII) is currently under investigation.

Immunization Following Splenectomy

Overwhelming sepsis is a well recognized risk for patients with splenectomy following abdominal trauma. While the lifetime incidence has been estimated to be <2%, the associated mortality is higher than 50%.[52, 53] Therefore, despite limited data regarding efficacy, surgeons have, in general, advocated immunization for these patients. Guidelines for vaccination following traumatic injury were recently published by the Surgical Infection Society.[54] Because of the risk of overwhelming infection all patients who have undergone splenectomy following traumatic injury should be immunized with 23-valent pneumococcal polysaccharide vaccine (CIII), meningococcal conjugate vaccine (CIII), and H. influenzae type b conjugate vaccine (CIII) all within two weeks of splenectomy. The optimal timing of vaccination is not clear and highly debated. One study reported improved opsonophagocytic antibody function in those immunized with pneumococcal vaccine at 14 days after surgery, compared with either one or seven days after surgery.[55] Unfortunately, nonspecific cross-reactive antibodies were not removed as part of the protocol, and in a follow-up study by the same group antibody responses were similar to healthy controls after removing cross-reactive antibodies regardless of whether the vaccine was administered at 14 or 28 days after surgery.[56]

Prevention of infection following thoracic trauma

Surgical management to prevent infection from thoracic trauma involves prompt lung expansion usually via tube thoracostomy as soon as safely possible. Because of risk of infection with retained hemothorax, prompt placement of a chest tube is recommended for any large or suspicious fluid collections. Tube thoracostomy is recommended for management of thoracic trauma for many indications other than just infection prevention.[1] Strict infection control techniques to include preparation of the site, and use of sterile gloves and equipment should be used for tube placement. One recent study looked at chest tubes placed in the field versus within the emergency department, with trained physicians performing thoracostomies at both sites; no statistical difference in subsequent infection was found.[57] This suggests that a chest tube placed in the field by a trained individual can be life-saving without significant additional infectious risk.

The use of antibiotics prior to, during or after tube thoracostomy following thoracic trauma is controversial, and has been addressed in guidelines[4] and a recent meta-analysis.[31] An older review from 1985 found a significant decrease in thoracic infections following tube thoracostomy when prophylactic antibiotics were used.[35] However, since that time, the majority of published studies have not found a protective effect. In addition, the studies have varied in antibiotics used, timing of dose, and duration of therapy. A total of six randomized, placebo-controlled trials have been published.[30, 58-62] None were able to show a statistically lower rate of empyema in those receiving antibiotics, compared to placebo. In the most recent of these trials, Maxwell et al. randomized 224 patients to cefazolin until removal of the chest tube, cefazolin for the first 24 hours after placement, or placebo.[30] Four patients (5.6%) developed empyema in the placebo group, 2 (2.5%) in those receiving cefazolin for one day, and none in those receiving cefazolin until the chest tube was removed. These differences were not statistically significant. Unfortunately, the study only enrolled 20% of the subjects needed per the power analysis due to difficulties with enrollment. Of the other infections seen during the study, the authors also observed more antibiotic resistance with increasing exposure to cefazolin. More recently, a meta-analysis of five of the randomized, prospective trials mentioned above was performed.[31] In that report, antibiotic administration for 24 hours or until removal of the chest tube was associated with a reduced risk of empyema, and the magnitude of reduction did not vary between a short or long duration of therapy.

Conflicting prospective randomized and observational studies lead us to conclude that a first generation cephalosporin may be used at chest tube insertion. As with prophylaxis following abdominal trauma, there is no evidence supporting a prolonged duration of therapy and some evidence that prolonging therapy only selects for more drug resistant bacteria should an infection occur. Therefore, we make the following recommendation: when performing tube thoracostomy consider preprocedure single dose of IV cefazolin (CII). The presence of a chest tube alone does not require use of antimicrobials.

Diagnosis of infection

Abdominal Trauma

Patients with fever, elevated white blood cell count, and systemic inflammatory response syndrome (SIRS) should be evaluated for infection from any source. Evidence pointing to cIAI includes peritonitis, changing abdominal exam or failure to regain normal gut function, or purulent exudates from inflamed tissue. Cultures should be taken intraoperatively or percutaneously if there is suspicion for infection. Infection can then be confirmed by findings of operative or percutaneous drainage to include presence of exudates, and positive gram stains and culture.

In general, blood cultures do not provide additional information to properly collected intra-abdominal specimens.[23, 25] An adequate intra-abdominal specimen is at least 0.5 ml of fluid or tissue, representative of the material associated with infection, that is expeditiously transported to the lab in anaerobic conditions (if anaerobic culture is available).[23] Swabs are not adequate. Gram stains of specimens may be helpful for nosocomial or postoperative cases when gram-positive pathogens, such as *S. aureus* or *Enterococcus* spp, may be seen which would alter empiric therapy. Yeasts are rarely seen on gram stain even if true pathogens.[25]

Thoracic Trauma

Likewise, patients post thoracic trauma should be evaluated for infection when they demonstrate evidence of a systemic inflammatory response to include fever, elevated WBC count, and hemodynamic instability. Empyema may present as localized pain, purulent drainage from existing wounds, or persistent, undrained fluid in the chest. In addition, patients may present with pneumonia, often ventilator-associated, with subsequent parapneumonic effusion or empyema. Suspicions for infection can also be confirmed by findings of operative or percutaneous drainage and gram stain and culture. Cell count, pH, lactase dehydrogenase, and serum to pleural albumin gradient can all help differentiate between empyema and simple parapneumonic effusion. If there is any question, prompt drainage with tube thoracostomy should be performed.

Treatment of infection

Abdominal Trauma

Guidelines endorsed by the Infectious Diseases Society of America, the Surgical Infection Society, the American Society for Microbiology, and the Society of Infectious Disease Pharmacists for the treatment of complicated intra-abdominal (cIAI) infection have been published recently.[23] Similar to the literature regarding perioperative antibiotics following abdominal trauma, there is lack of standardization in antibiotic treatment for cIAI regarding antibiotic agents, doses, and duration of therapy. Many studies have compared single agent to combination regimens using various drugs, such as flouroquinolones with or without metronidazole, beta-lactam/beta-lactamase inhibitors, cephalosporins, aminoglycosides, and carbapenems, all with comparable efficacy.[23] However, data regarding the optimal antibiotic regimen following postoperative intra-abdominal infection have not been published, and the trials investigating therapy for cIAI typically have enrolled few, if any, postoperative or trauma patients. Recent trials have even excluded patients with severe abdominal trauma.[63, 64] These differences in study populations, in addition to unique features of wartime trauma, make application of the currently published literature regarding cIAI treatment very difficult. With no particular regimen clearly superior to others in the literature, appropriate empiric therapy should be dictated by the local antibiogram.

In general, trauma patients who develop postoperative cIAI following appropriate prophylaxis should be empirically covered for nosocomial pathogens particular to that institution. Two studies have described increased risk of antimicrobial failure and recurrent infection in those with >48 hours of pre-operative antimicrobial therapy.[65, 66] While not explicitly described, this implies antibacterial resistance may be responsible, in part, for treatment failure. This hypothesis is supported by the largest study to date on postoperative cIAI, which showed that antibiotic resistance is common in patients following elective surgery and that inappropriate initial therapy adversely impacts outcome.[25] In their series of 100 patients with postoperative peritonitis following elective surgery, Montravers et al. reported that 70 had resistant pathogens isolated at the time of reoperation. Of these, 37 patients had multiply resistant bacteria, including *P. aeruginosa*, *K. pneumoniae, E. coli*, *S. marcescens,* and *A. baumannii*. In addition, *Candida* spp. were isolated from 23 patients. Anaerobes were only found in 14 patients. More troubling, empirical therapy was inadequate for 54 patients, and inadequate therapy was significantly associated with increased length of stay, increased number of subsequent reoperations, and higher mortality. Twenty seven (50%) of those treated with an inadequate regimen died within seven days of the initial reoperation for peritonitis.

In considering the above data, regimens used to treat cIAI should be selected after considering the likelihood of nosocomial pathogens and the clinical stability of the patient. Nosocomial organisms are more likely to be isolated from patients >48 hours after initial operation or in patients that have previously received >48 hours of antibiotics following penetrating abdominal trauma. Therefore, for cIAI in non-septic patients within 48 hours of initial surgery, who have not received more than 48 hours of antibiotics, we recommend empiric therapy to cover drug susceptible enteric and anaerobic bacteria to include *B. fragilis* (AII). Empiric choices may include fluoroquinolone (ciprofloxacin or levofloxacin) + metronidazole, third generation cephalosporin (cefotaxime or ceftriaxone) + metronidazole, ticarcillin/clavulanic acid, or moxifloxacin alone (AI). In all patients with sepsis or those that have received >48 hours of antibiotics or that are >48 hours after initial surgery, nosocomial organisms with drug resistance are more common, and the empiric regimen should target nosocomial pathogens particular to your institution (BII). Potential empiric regimens include piperacillin/tazobactam, imipenem/cilastatin, meropenem, third or fourth generation cephalosporin (ceftazidime or cefepime) + metronidazole, or aztreonam + metronidazole. Due to increasing antibacterial resistance of *B. fragilis*, and unavailability of anaerobic susceptibility testing, clindamycin and the cefamycins (cefoxitin and cefotetan) should not be used to treat cIAI in any setting (AIII).[23, 67, 68] Antibiotics should be appropriately narrowed after culture and sensitivity data become available (CIII).

The roles of antifungal and antienterococcal therapy in penetrating abdominal patients with cIAI are not clear. These organisms are typically isolated in polymicrobial infections in postoperative patients so their direct role in pathogenesis and outcome is not known.[25] However, fungal peritonitis was associated with increased mortality in one report,[25] and may play a role in patients with recurrent or postoperative intra-abdominal infection.[23, 25, 69] Therefore, if identified from culture, therapy for *Enterococcus* spp. and *Candida* spp. should be given to patients with cIAI occurring >48 hours after initial surgery (BIII). For *C. albicans*, fluconazole is the agent of choice, and for non-albicans *Candida* spp. treatment will be based upon local availability of antifungal agents.

Surgical management includes CT guided percutaneous or operative drainage. CT scans or other imaging modalities should be used when available to ensure adequate drainage if patients are not improving as expected. One recently published study reported that patients with intra-abdominal abscesses >6.5 cm in diameter or temperature >101.2^{o}F were more likely to fail conservative therapy with antibiotics alone and require percutaneous drainage.[70] There are no data regarding the appropriate duration of antimicrobial therapy. In recent clinical trials in patients with community-acquired cIAI, clinical response rates were approximately 80% with the duration of therapy ranging from 4-14 days.[24, 63, 64] Therefore, we recommend, in agreement with other experts,[23] continuing antibiotics until resolution of infection as evidenced by improvement in symptoms, normalization of temperature and white blood cell count, and resolution of SIRS (BIII).

Thoracic Trauma

As discussed above, the organisms causing empyema will change depending on the etiology of the infection, and so appropriate antibiotic therapy will as well. Therefore, one must ascertain the source of the empyema. For all empyemas, appropriate drainage of fluid is indicated (AI). For empyemas associated with either trauma itself or tube thoracostomy, appropriate antibiotics should target gram-positives and skin flora. We recommend a first generation cephalosporin such as cefazolin (BIII). Gram-negative coverage would only be necessary for a positive gram stain or if the infection was diagnosed > 48 hours into a hospital course. Empyemas due to enteric contamination should be covered with antibiotics appropriate for cIAI depending upon the duration of hospitalization and previous exposure to antimicrobial therapy (see above). Empyemas due to pneumonia, particularly ventilator-associated pneumonia, should be covered for nosocomial organisms. Similar to cIAI occurring after 48 hours of hospitalization, empiric therapy for empyema occurring >48 hours after hospitalization should be chosen based upon the institution's antibiogram (BIII). Appropriate antibiotics for VAP are beyond the scope of this paper but guidelines published by the American Thoracic Society/Infectious Disease Society of America are available..

There are no good studies delineating proper duration of therapy. Chest tubes placed to drain empyema can be removed once output has decreased to minimal levels, typically <100-200 mL/day, with improvement in local symptoms, temperature and white blood cell count and antibiotics can generally be stopped at that time (CIII).

Several studies in recent literature have validated the use of video-assisted thoracic surgery (VATS) as a less invasive alternative to open thoracotomy for persistent empyema.[71-73] If drainage proves difficult or impossible to drain via tube thoracostomy alone, VATS is a viable alternative to thoracotomy for patients presenting with a non-improving empyema post tube thoracostomy.

Summary

In most cases recommendations have been made by extrapolating data from the literature regarding civilian trauma. Because of this, these guidelines should be interpreted as such, and clinicians will need to continue considering the specific aspects of each patient prior to providing treatment. In general, decisions regarding the appropriate antibiotic prophylaxis or treatment are guided by knowledge of the most likely microorganisms to be encountered. Prolonged antibiotic prophylaxis following either penetrating abdominal or thoracic trauma has not been proven to improve outcomes. As wounding patterns change due to advances in protection and weaponry, surgical techniques will need to adapt as well.

While the care of combat casualties continues to improve, many issues involving abdominal and thoracic injury and infection to include incidence, bacteriology, appropriate therapy and outcomes, and prevention strategies are targets for future study. A description of the rates and pathogens associated with these infections from the current military conflict will be helpful in guiding physicians in future conflicts. In addition, the duration of antibiotic therapy with placement of a chest tube may be elucidated given the shear numbers of chest tubes that have been placed during OIF. However, the number of injuries at other sites and therefore need for antibiotics for other reasons may make this type of study difficult. In regards to treatment, ascertaining which antibiotic regimen leads to best clinical outcomes would be ideal and highly desirable, but may also prove elusive as it is difficult to standardize surgical practice. In addition, results may be specific to the pathogens at individual institutions and may not be generalized. Nevertheless, we owe it to those who will take care of wounded warriors after us to describe, to the best of our ability, through observation and research, the best way to prudently use antibiotics with surgical techniques to maximally prevent and optimally treat infections due to abdominal and thoracic trauma.

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Abstract

Maxillofacial injuries constitute 16% of all war related injuries. This review focuses on data available from military and civilian studies to provide evidence-based recommendations for the modification of infections associated with combat-related injuries to the head and neck. The major emphasis of this review is on the study of subsequent infection, perioperative antimicrobial prophylaxis, debridement of devitalized tissue, optimal time to wound closure to achieve a water tight seal, wound irrigation with removal of debris and gross contaminants, fracture fixation and removal of ocular foreign bodies with intravitreal antibiotics. Further studies are needed in combat-related injuries to the head and neck in military personnel to provide the highest evidence-based medicine recommendations.

Prevention and Management of Infections Associated with Combat-related Head and Neck Injuries

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Background

Modern battlefield injuries to the maxillofacial region have challenged surgeons because high-velocity, high-energy missile and fragmentation weapons inflict tremendous destruction and tissue loss. War associated traumatic injuries differ from civilian injuries in that combat firearm projectiles travel at higher velocities and cause more severe injuries. In addition, fragmentation ordinance such as shells, grenades, mines or explosive devices (EDs) are accompanied by a blast wave resulting in additional damage. Combat wounds often occur in a dirty environment. Studies have shown that animals wounded by these projectiles become colonized with bacteria from their immediate environment relatively quickly and casualty data show infections occur more frequently than in other forms of trauma.[1]

Maxillofacial, head and neck structures compose about 12% of total body surface area, but retrospective analysis of 26 recent conflicts showed disproportionately higher numbers of maxillofacial, head and neck injuries(about 16% of all war related injuries).[2] The proportion of maxillofacial injuries relative to other sites has increased in recent conflicts. Among injuries sustained in the Battle of Mogadishu, 36 % of the fatal wounds were to the head and neck, consistent with the Vietnam War experience.[3] In that study, Kevlar helmets did not offer protection from projectiles entering the cranium frontally through the face. It was postulated that the unprotected face of a Soldier wearing body armor is not only exposed but specifically targeted by the enemy in an urban environment.

Forty percent of facial injuries in World War II died after evacuation.[4] This high mortality rate was dramatically reduced to 1.3% during the Korean War through rapid evacuation and treatment of the wounded, to include the use of antibiotics.[5] Positioning an oral surgeon at forward operating facilities resulted in improved management of casualties during the Korean War.[6-8]

The maxillofacial region is anatomically complex with skin and mucosa lining structures that support the upper airway, deglutition apparatus and specialized sensory organs of sight, smell, hearing, taste, and touch. There are no large muscular masses in the face and neck, so the risk of late cavitary necrosis and subsequent possible infection is considerably lower than with other types of combat injures. Facial injuries can be extensive but are rarely life threatening; initial management priorities are airway management, particularly tracheotomy if required, hemostasis, and treatment of shock with fluid replacement.[9] The integrity of the oral cavity mucosal lining is a critical feature of the maxillofacial region. Battlefield injuries of the maxillofacial region often disrupt this mucosal lining leading to contamination of the deep structures of the face and neck with bacteria-laden saliva. However, due to the rich vascular supply, early primary closure of maxillofacial structures following conservative debridement is possible.

Combat-related infections of the maxillofacial region were first identified in the Vietnam conflict.[10] A comparison of in-theater infection rates of all war wounds (3.9 %) to maxillofacial injuries (7.1 %) revealed a higher prevalence of infections in maxillofacial wounds despite rapid evacuation, frequent use of "prophylactic" antibiotics and early wound care.

Ocular injuries are relatively uncommon in wartime but are increasing in numbers. In World War II they represented 2% of all injuries. In the 1967 Israeli war, they were 5.6% of injuries, and by the 1982 Israel-Lebanon War 6.8% of all injuries. Most distressing was in the 1982 conflict, when 28% of eye injuries were bilateral. Belkin attributes this rise in rates to increased urban warfare. The confined area of the urban battlefield concentrates airborne foreign bodies in the area of an explosion or projectile strike. There is also a pervasive non-adherence to ballistic goggle use.[11] During the current Iraq war, 10% of all hospital admissions to date had ocular injuries, 82% the result of blast injuries and 51% from EDs.[12] Of all the ocular injuries, 64% were open globe and 20% required enucleation. Non-use of ballistic eyewear are attributed for the current rise in these injuries. Penetrating eye injuries of the orbital fossa are unique in that they likely need neurosurgical involvement in addition to the ophthalmologist.[13]

The following factors have been useful in preventing infection of the traumatized maxillofacial region: early definitive treatment with debridement, irrigation, early repair of hard and soft tissues, and institution of broad spectrum antibiotics as soon as possible.[14,15] Current U.S. Army references indicate that maxillofacial war injuries not repaired ≤ 12 hours or without antibiotics ≥ 6 hours post-injury become infected and require antibiotics for 10-14 days.[16] While these recommendations are not evidence-based, they are nonetheless universal in current oral and maxillofacial surgery textbooks.[14,15] It is possible that antibiotics play a secondary role to early debridement, stabilization, closure, and drainage of maxillofacial war wounds for preventing infections. The purpose of this review is to analyze the current literature for evidence of treatment modalities useful in preventing and managing infections of the maxillofacial, head and neck region.

Epidemiology/microbiology of wound colonization and infection

Infection rates in maxillofacial injuries are well described. In one study of 17,690 trauma admissions to selected U.S. military hospitals during the Vietnam War, 1,958 (11.1%) casualties had maxillofacial injuries.[17] Within this group of injuries, there was a high incidence of comminuted fractures (75%) and avulsion defects (54%) of the mandible. Overall, maxillofacial infection wound rate was 7.1% in theater; further analysis of this group after evacuation from Vietnam was difficult because 68% of the casualties were lost to follow up. In a retrospective study of 162 patients with maxillofacial injuries from time of injury in Vietnam to treatment in higher level medical facilities, 68 (42%) developed infections during some point of treatment with 13% incidence at early-care facilities, 25% at intermediate facilities and 62% at late-care facilities.[18] Eighty-two patients with mandibular avulsion type injuries required bone grafts with infections later developing in 56.1% of those cases. Despite rapid evacuation and antibiotics, 42% of patients with severe maxillofacial injuries developed infection during the course of treatment.

In a retrospective analysis of 183 patients treated for weapon-related injuries in maxillofacial surgery clinics during the Balkans conflict (1988-2002) with special analysis of 91 patients injured during the period 1991-1995, 40% of the injuries were to the mandible and 6% had isolated maxillary fractures.[19] From 1991-1995 most injuries were caused by high-velocity projectiles with 56% from bullets and 44% by explosions. Perforating wounds occurred in 70% and penetrating wounds in 30% of patients. It was noted that most wounds were infected at presentation due to delays in admission to the clinic. The average time between injury and admission to the maxillofacial surgery clinic was 7 days during war and 5 days during peacetime. Wounds became infected postoperatively with *Escherichia coli* and *Streptococcus pyogenes* in 19% of war-wounded patients, compared with 10% in non-war wounds.

Among 210 combat casualties of the Iran-Iraq war with maxillofacial injuries, 94.3% were caused by missile and explosions, the rest resulting from motor vehicle accidents.[20] The mandible, especially the anterior, was the most prominent area injured. Twenty-four cases

(11%) were complicated by infection, including 9 cases of osteomyelitis. Significant contributors to infection rates were delay in evacuation and lack of suitable fixation devices.

Descriptions of actual pathogens in maxillofacial infections in combat associated trauma are rare. Providers should be aware of the pathogens involved and their potential for other system infections (e.g. pneumonia) as well as their capacity for complications (e.g. cervical osteomyelitis). In a study of 564 jaw fractures evacuated to an level IV hospital in the Philippines during the Vietnam war, 31 patients with postoperative infections were described.[6] Daily cultures were performed on all patients. *Pseudomonas* species (spp) and *Klebsiella* spp were cultured before the first surgery in 100% of patients. *Staphylococcus aureus, E. coli* and fungi (likely *Candida* spp) were also reported, but rates of infection for these pathogens are not included. The authors point out that infection rates for the mandible paralleled those for other non maxillofacial war wounds. Another study from Lebanon noted *Proteus mirabilis*, *Bacteroides fragilis*, *Peptococcus* and *Peptostreptococcus* in maxillofacial wound infections.[21] Based on these two studies, peri-operative and empiric antibiotics against these pathogens to prevent or initially treat infection might be warranted, but the evidence is very poor (CII) (grading outlined in this supplement of Journal of Trauma- Guidelines for the Prevention of Infection following Combat-related Injuries).

There are no other studies of maxillofacial combat wounds describing microbiology. Since trauma wounds are by definition contaminated or dirty, it is reasonable to examine data from military or civilian non-trauma microbiology studies of surgical cases classified as contaminated or dirty to better appreciate potential pathogens of interest. Table 2 summarizes all pathogens isolated from contaminated war or civilian surgical cases. One center reported microbiology of infection from 354 primarily oncologic patients enrolled in several peri-operative prophylactic antibiotic trials.[22] All patients were contaminated major head and neck surgical cases who received peri-operative antibiotics. Infection rates were 6.5%, which is equivalent to Tinder's reported rates of infection in Vietnam. Of the infections that occurred 1-23 days post-op, 96% were polymicrobial, 91% aerobic and 74% anaerobic. Fungi (100% C*andida* spp.) occurred in 45%, but were not treated and therefore felt to be colonizers. *Bacteroides* spp was the most common anaerobe (76%) followed by microaerophilic streptococci. *Streptococcus viridans* was the most common aerobe. Prophylactic peri-operative antibiotics did not select for resistance. Since most infections were late (> 10 days post-op) the authors concluded immediate post-operative antibiotics may not prevent infections.

Another summary of 400 primarily oncologic major surgery patients from a military center has similar findings.[23] More than 50% received peri-operative cefazolin and the infection rate was 3.2%. Of those infected, 88% were polymicrobial, 45% were aerobic and 54% anaerobic. *Streptococcus viridans* was again the most common aerobic pathogen followed by Lancefield group C and G streptococci and *S. aureus*. *Peptostreptococcus* spp., followed by *Bacteroides* spp. and *Fusobacterium* spp., were the most common anaerobes. Seventy-one percent of isolates were Beta-lactamase producers, which would theoretically render cefazolin ineffective.

Osteomyelitis of the cervical spine deserves mention as there are several case reports of this condition associated with war and low velocity civilian gunshot injuries to the neck.[24-26] These studies describe osteomyelitis in relation to penetrating trauma of the neck by bullets or shrapnel in 6 patients. Neurological symptoms are present in only 12-25% of patients with osteomyelitis in this setting. Erythrocyte sedimentation rate appears to be helpful in establishing the diagnosis. Common causes for osteomyelitis included failure to explore the neck, failure to debride cervical discs and bone, failure to remove foreign bodies and devitalized bony fragments, and failure to close the pharyngoesophageal injury. Antibiotics alone were insufficient to prevent osteomyelitis, emphasizing the need for good surgical exploration and debridement. Infections were polymicrobial and managed with intravenous Penicillin G plus aminoglycosides. A Halo Collar for cervical spine fixation was also critical in managing the infection.

There is some data on infection epidemiology and bacteriology in relation to war eye injuries. In one recent retrospective single-center study of 228 eyes in 212 patients with deadly-weapon related eye injuries, 9.5% of injuries developed endophthalmitis.[27] Factors associated with increased risk for infection included grade 4 injury and lens disruption, however a multivariate analysis was not performed and lens disruption and grade 4 injury were concurrent in 94% of cases. Intraocular foreign body was not associated with endophthalmitis as in previous studies. Vitrectomy was used in 11% and vitrectomy with intraocular antibiotics in 63%. There was no difference in outcomes between vitrectomy and vitrectomy with intraocular antibiotics. Cultures were positive in 21% of all endophthalmitis. *Staphylococcus epidermidis* was present in 42% of cultures, *S. aureus* in 21%, *Streptococcus* spp. in 11%, *Bacillus cereus* in 11% and *Acinetobacter* spp. in 11%. All pathogens except *S. epidermidis* were associated with poor visual outcomes. Time to first antibiotics and time to primary repair were not associated with worse outcome, suggesting some delay until primary care is acceptable without increased risk for infection. The authors felt the infection rates in their study were lower than previous studies due to empiric intravenous antibiotic use. One limitation possibly affecting outcomes was that infected but culture negative cases were excluded from this study.

Prevention of infection: surgical management

In an analysis of 31 Vietnam War casualties with mandibular comminuted fractures or avulsion defects evacuated 4 to 24 days after injury to the Philippines, all patients underwent repeated debridement, establishment of dependent drainage, and closed reduction of the fractures with indirect appliances.[8] Mandible fractures were definitively treated with open reduction using intra-osseous wire ligatures. A retrospective study of 1,357 war injuries in 1,021 patients from Beirut (1975-84) revealed 24% of injuries to the maxilla, 18% to the mandible, 10% to the nose, 8% to the oral cavity and 6% to the orbits.[18] Most of the maxillary injuries were compound, comminuted Lefort type fractures; treatment consisted of debridement, soft tissue coverage of bone and delayed definitive management. Twenty-five percent had complications of malunion, nonunion, fistula and infection. Most mandibular fractures were compound, comminuted with bone and soft tissue loss; 54% were treated with closed reduction and 46% with open reduction. Seventy-four percent healed after primary surgery, 26% requiring a second surgery for malunion, nonunion, graft extrusion or infection. Osteomyelitis developed in 6%, particularly when fractures had marked overlying soft tissue loss. Overall infection rate was 12%, with *S. aureus*, *P. aeruginosa* and *E. coli* isolated. This low infection rate was attributed to aggressive debridement, irrigation of wounds, meticulous removal of contaminates, minimal introduction of foreign synthetic material during initial surgery, coverage of bone with tension-free closure, and immediate institution of antibiotics in high risk wounds. Based on this large case series, using all of the aforementioned techniques might be helpful in minimizing infection (BII).

In a 10-year retrospective study of 44 patients with gunshot and war wounds to the face treated in a single medical center in Iran, soft tissue and underlying bone injuries were treated with primary reconstruction in 86.3% of the cases.[28] The mandible was the most frequently injured bone (72.7%), followed by the maxilla (34%). Closed reduction was used in 56.8%, and 22.6% had open reduction with internal fixation; the remainder required only debridement and closure of the wounds. Postoperative discharge was noted at the suture sites in 24.3% of the patients; all infections treated with daily irrigation resolved. Antibiotics were noted to play a major role in preventing infection after primary closure, but no details of type or regimen were described. The author concluded that early and conservative debridement, irrigation, fixation and immobilization, and primary closure with drainage were all important to prevent infection (BIII).

A large series of 1,135 patients injured in the face during the Iran-Iraq war revealed mixed bone and soft tissue injuries in 72.7% of the cases.[29] Lower facial injuries were the most common (72.6%), and compound mandible fractures occurred in 517 cases (45%). Most of the casualties with severe facial injuries were infected upon arrival at the hospitals. Following resuscitation, wounds were debrided of necrotic tissue margins, visible foreign bodies, dental fragments, and small bone fragments. The wounds were then irrigated with normal saline, hydrogen peroxide and povidone iodine. Soft tissue wounds were closed, with or without bony repair. Bone defects were packed with gauze impregnated with glycerin and povidone iodine. Bone injuries were later addressed with Kirschner wires, bone cement space maintainers and other temporary fixation devices (transosseous wires and arch bars). Late reconstruction involved bone grafting of defects. Peri-operative antibiotics were administered but no details on antibiotic regimens were offered. Despite a reported infection rate of 11% of patients presenting for treatment, the author experienced an overall 1.15% postoperative infection rate using a closed reduction and delayed reconstruction approach, suggesting this might be the preferred method of management to prevent infection (BII). Surgical techniques utilized are further detailed in a case report.[30]

Clark performed a retrospective study of 178 gunshot, 53 shotgun and 15 high-energy avulsion facial injuries.[31] Using a protocol of immediate bone stabilization, primary closure of existing soft tissue, serial debridement of devitalized tissue every 24-48 hours, and definitive early reconstruction of soft and hard tissue defects when no further necrosis was noted, 35% who underwent immediate reconstruction for comminuted mandible fractures developed localized sepsis, persistent fistula, or wound breakdown requiring further bone debridement. Furthermore, primary bone grafting was uniformly successful in the cranium and midface, but had higher failure rates when applied to the mandible. This supports our conclusion that avulsion defects of the mandible are best managed by stabilization of existing bone fragments, primary soft tissue closure, serial debridements and a delay of bone reconstruction for at least 8 weeks (BII). The loss of mucosal lining and difficulty of achieving a watertight intraoral soft tissue closure are reasons for a high failure rate of primary mandibular bone grafts. (BII)

Intraocular infections (endophthalmitis), although cited as occurring in 7-15% of penetrating ocular trauma, have not been seen in returning casualties from Iraq and Afghanistan. There is controversy as to the timing for removal of retained intraocular foreign bodies (IOFB), although the presence of a retained foreign body is an accepted risk factor for endophthalmitis. Management at level I and II should be protection of the eye from further injury with a fox shield and evacuation to definitive care at level III or higher by an ophthalmologist. Some measure of visual acuity as close as possible to the time of injury provides the best prognostic indicator of recoverable vision. Simple measurements including light perception, hand motion or finger counting provide useful information to the subsequent providers. Intraocular cultures should only be obtained by an ophthalmologist and are usually not required except in cases where endophthalmitis has already developed (BIII).

In a recent retrospective comparative interventional case series of 79 eyes in 70 patients with retained IOFB, 10% underwent enucleation due to severe injury and 84% had a vitrectomy at the time of IOFB removal.[32] Time to IOFB removal was 39 days mean and 21 days median. Fifty seven percent of IOFB were metallic, but compared to previous studies there were increasing numbers of stone or concrete IOFB noted. All patients received topical fluoroquinolones and some received IV/PO (not described in detail); only 3.7% received intravitreal antibiotics. No prophylactic intraocular injections were performed. Zero cases of endophthalmitis were described. This is in stark contrast to the previously cited studies.[47,48] This study provides good evidence that surgical extraction of retained IOFB may be delayed for weeks to months with no increased risk of endophthalmitis. Therefore, IOFB removal in forward levels is not recommended unless required to perform the initial repair (BII). It is preferentially performed at level IV. Furthermore, there is also evidence that intravitreal antibiotics are unnecessary when doing vitrectomy for retained IOFBs (BII).

Prevention of infection: prophylactic antibiotics

Antibiotic prophylaxis trials are summarized in Table 3. Several well constructed randomized trials exist, however they do not include any trauma or war injured patients. Among war literature, a previously cited study by Zaytoun routinely used cephalosporins and continued them for at least 3 days post-op.[18] In the Akhlaghi study, antibiotics described were either ampicillin or penicillin; patients undergoing bone grafting procedures received postoperative cephalotin and gentamicin.[17] Despite the use of antibiotics, Morgan showed infection remained a problem not only at initial repair but with later reconstructive procedures.[8] Therefore, these agents might have utility, but because the duration of therapy, definition of infection and organisms encountered is not defined, the evidence to support their use is poor (CII).

Perioperative antibiotics are clearly needed for traumatic war wounds of the maxillofacial region as they present contaminated with oral secretions and environmental debris. Studies show reductions in contaminated surgery infection rates from 28-87% down to 6-20% using perioperative antibiotics. A study of prophylactic antibiotics in the setting of facial fractures showed highly significant reductions in infection rates from 42% to 8.9% therefore based on this evidence peri-operative antibiotics are required when conducting repair of maxillofacial fracture, surgical debridement alone is inadequate (AI).[33]

One of the first studies to examine peri-operative prophylaxis for contaminated head and neck surgery was a placebo controlled trial of 1 or 5 days of either cefazolin or clindamycin/gentamicin.[34] Eighty-three patients were evaluated in 4 arms and the study later expanded to 107 patients.[35] Overall infection rates were 17%. Cefazolin had higher rates of infection than clindamycin/gentamicin (27% vs. 7%). All infections were polymicrobial with predominant isolates of *Klebsiella* spp., *Enterococcus faecalis* and *Serratia* spp. This trial showed that cefazolin at the 500 mg every 8 hours dose was inadequate perioperative prophylaxis for contaminated head and neck surgery, there is sufficient evidence to recommend it should not be used at this dosage when treating traumatic maxillofacial head and neck injuries (DI). It further demonstrated that 5 days was not superior to 1 day of post-operative antibiotic coverage; flap reconstruction however, tended to be more susceptible to infection and therefore there is evidence for extending antibiotic coverage during flap reconstructions of traumatic maxillofacial head and neck injury beyond 24 hours post-op (BI). A potential drawback of this study might be the small sample size in each arm.

Another randomized prospective study evaluated placebo vs. two 3rd generation cephalosporins: cefoperazone and cefotaxime, for peri-operative prophylaxis.[36] Doses were given pre-operatively and for 24 hours post-op. The placebo arm terminated after a 78% infection rate with several cases of bacteremia. This was highly significant and similar to earlier studies involving placebo prophylaxis for maxillofacial surgery (87% and 36% rates of infection).[37,38] Wound infections were similar following peri-operative antibiotics: 10% in the cefotaxime arm and 9.4% in the cefoperazone arm (equivalent to clindamycin/gentamicin despite poorer anaerobic activity and lack of beta-lactamase inhibition). This and 2 similar studies with highly significant rates of infection from placebo, give ample evidence that use of no peri-operative antibiotics (i.e. surgical debridement alone) is not warranted in combat related maxillofacial surgery (E1). This study provided good evidence that third generation cephalosporins are equivalent to clindamycin/gentamicin and can be used as peri-operative prophylaxis for surgical repair of contaminated head and neck injuries (BI).

While 500 mg of cefazolin every 8 hours failed to protect against infection, higher doses might still be adequate. This is encouraging as most combat trauma receiving institutions stock this antibiotic and it might be utilized as prophylaxis for other injuries. A prospective randomized trial of 118 patients receiving 24 hours of high dose cefazolin (2 grams every 8 hours) versus moxalactam showed wound infections in 8.5% of patients receiving cefazolin and 3.4% of moxalactam (not significant).[39] Wound infections were preceded by fluid collection under the flap. High dose cefazolin (6 gm/day) for 24 hrs was as good as 3rd generation cephalosporins at preventing post-op wound infections with no increased hematological or renal toxicities and because of the excellent evidence to support use, narrower spectrum of activity than 3rd generation cephalosporins and utility for other injury in multiply injured patients is therefore preferred for peri-operative prophylaxis of war related maxillofacial infections (BI).

Whether gram-negative coverage offered by 3rd generation cephalosporins is necessary is subject to debate. A prospective randomized double-blind trial of 104 patients examined 600 mg clindamycin vs. 600 mg clindamycin plus 1.7 mg/kg gentamicin every 8 hours, 1 dose pre-op and for 24 hours post-op.[40] Infection rates were the same in each arm of the study (3.8%). The authors felt that the gram-negatives often isolated in these wounds are likely colonizers and not pathogens, since addition of gram-negative coverage did not reduce infection rates. This is important in that gram-negative pathogens appear to be a significant portion of non-maxillofacial wound infections in the Iraq conflict.[41] In addition a smaller study of clindamycin alone had excellent peri-operative prophylaxis for contaminated head and neck surgery with infection rates <5%, therefore we feel there is excellent evidence that clindamycin alone is adequate prophylaxis for contaminated major head and neck surgery to the trauma setting (AI), addition of gram-negative antibiotics such as aminoglycosides or fluoroquinolones has no additional benefit and increases potential toxicity and potential for colonization with multi-drug resistant nososcomial pathogens and should be avoided (DI).

The optimum duration of peri-operative coverage for contaminated combat trauma wounds is not defined in the literature. Again we feel the data from contaminated major head and neck cancer surgery is the data most applicable to traumatic injuries. A prospective randomized placebo controlled multicenter trial (including military) of 1 vs. 5 days of cefoperazone enrolled 142 patients undergoing major contaminated head and neck surgery.[42] The outcome showed 19% of patients infected with 1 day of coverage vs. 25% with 5 days (not significant). The majority of infections were again polymicrobial. This study provides excellent evidence that extending peri-operative prophylaxis past 24 hours does not reduce infection rates and is unnecessary in contaminated head and neck surgery (AI).

Another prospective randomized placebo controlled trial enrolled 30 patients with uncomplicated open mandible fractures. Perioperative intravenous penicillin G was administered for 24 hours followed by oral penicillin VK or placebo for 5 days.[43] Rates of infection were not significant between oral penicillin and placebo (14.3% vs. 12.5%). In another prospective randomized trial of open mandibular fractures utilizing both intraoral and extraoral open reduction and fixation, patients received various pre-operative antibiotics and then switched to either 2 gm cefazolin peri-operatively plus 1 shot intra-muscular benzathine penicillin 2.4 million units as post-operative prophylaxis (900mg clindamycin intravenous and oral for 5-7 days if penicillin allergic) or no post-op antibiotics.[44] Follow up was to 8 weeks. Of 291 patients enrolled, 181 were studied; 81 received post-op antibiotics and 100 received none. There were no differences in infection rates between the two groups (8/81 vs. 14/100; $p = 0.399$). Based on these 2 studies, antibiotics in excess of those administered during the 24 hour peri-operative period for mandible fractures do not appear to reduce wound infection in otherwise uncontaminated wounds and should be discontinued at 24 hours post-op (AI).

The previously discussed cefoperazone trials, as well as the moxalactam and cefotaxime trials, give ample evidence that 3rd generation cephalosporins are adequate for peri-operative prophylaxis in maxillofacial, head and neck injury (BI). Rates of infection in the most recent cefoperazone trial were higher than clindamycin/gentamicin used in previous trials however, suggesting other cephalosporins might be preferred over this agent.[37] In addition to elective head and neck surgery, a prospective randomized controlled trial of ceftriaxone versus penicillin G for compound mandible fractures is described.[45] Intravenous antibiotics were given peri-operatively for 24 hours along with a dose of corticosteroid. Oral penicillin VK was then given to all patients for 1 week. Rates of infection for the 90 patients enrolled were not significantly different between penicillin and ceftriaxone and therefore there is moderate evidence that ceftriaxone can be used as prophylaxis for surgical repair of mandibular fractures (BI). Since 3rd generation cephalosporins are equivalent to narrower spectrum antibiotics, and broad spectrum antibiotics are thought to contribute to the current outbreak of multi-drug resistant *Acinetobacter baumannii* in military hospitals, providers are encouraged to use narrower spectrum antimicrobials such as high dose cefazolin and clindamycin when possible (BIII).[46]

The high rates of beta-lactamase producing anaerobes encountered in the described epidemiology, make it important to examine the use of beta-lactamase inhibitor combination antibiotics to see if they offer an advantage over previously utilized agents. A randomized trial of 242 patients analyzed ampicillin/sulbactam (AMP/S) vs. clindamycin pre-operatively and then for 24 hours post-op.[47] Wound infection rates were 12% and 13% in each arm and infection onset was again late (7 +/- 2 days post-op). Most infections (76%) were polymicrobial. This was the first trial to examine complications of antibiotics for surgical prophylaxis. Clindamycin patients had 7 times more *Clostridium difficile* enteritis complications than AMP/S. This study showed AMP/S is equivalent to clindamycin for peri-operative prophylaxis, furthermore, the addition of beta-lactamase inhibitor did not provide a prophylactic advantage over clindamycin when performing contaminated head and neck surgery (BI). However, there is evidence that *Clostridium difficile* enteritis is less prevalent with AMP/S than with clindamycin therapy (BI).

Another randomized prospective trial of beta-lactamase inhibitor antibiotics, 62 patients undergoing contaminated head and neck surgery were randomized to 48 hours of post-operative piperacillin/tazobactam (PIP/TAZ) or PIP/TAZ plus PIP/TAZ powder in 60 cc of 5% dextrose solution with a flavor packet as a gargle on call to the operating room and daily post-operatively.[48] Infection rates were 6.4% for intravenous alone and 9.7% with addition of the gargle (not significant). While this study showed some evidence that peri-operative PIP/TAZ has slightly lower rates of post-op wound infections than AMP/S or clindamycin in previous studies (BI), the lower rates of infection are likely a reflection of the smaller sample size and there was no direct comparison between the agents to suggest superiority. PIP/TAZ cannot be recommended as prophylaxis based on this study alone, but this does show efficacy and lends evidence for use of PIP/TAZ as empiric therapy should a wound develop subsequent infection (BIII). This study showed intravenous plus topical antibiotic prophylaxis was not superior to intravenous prophylaxis alone (BI), but topical agents require further mention.

In a retrospective descriptive study of 100 patients undergoing dental extraction and management of odontogenic abscess, 72 had surgical extractions plus 1% povidone iodine gargle with 10% povidone iodine applied to the drain site where it exited the skin, and were compared to 20 that received antibiotics alone.[49] Patients receiving iodine had a shorter duration of antibiotic therapy (8 vs. 12 days; $p < 0.05$), therefore topical agents might have conferred additional reduction in wound infections over intravenous therapy. However, because this study was not randomized, not controlled, and the arms were uneven favoring betadine the evidence favoring its use is poor (CII).

Clearly more study is necessary to see if topical agents such as these or chlorhexidine truly prevent infection or potentially impede wound healing. The war literature from Vietnam and Korea describes that oral irrigation with saline enhances wound healing. Evidence supports the authors' conclusion that early cleansing of wounds using irrigation and conservative debridement of devitalized tissue reduces foreign bodies and the bacterial load that contributes to post-operative infection (BIII). The most effective irrigation solution is not clear however.

Endophthalmitis has not occurred with any frequency in the current Iraq conflict. Broad spectrum antibiotic use at all levels of care and early primary globe repair may play a significant role in the prevention of this complication. (J. Blice personal communication). A recent multicenter randomized double-blind trail of intracameral (anterior chamber) or intravitreal injection of gentamicin and clindamycin vs. saline in penetrating eye injury at the time of primary repair sheds some light on methods to prevent endophthalmitis.[50] Post-operative gentamicin and steroid drops were also used in this study. Intravenous gentamicin (3-5 mg/kg) was administered upon admission and every 8 hours along with cefazolin (50 mg/kg) every 6 hours and continued for 5 days following primary repair. Outcome was the development of endophthalmitis at 14 days after injury. Of 346 patients enrolled, endophthalmitis developed in 2.6% of eyes overall and significantly more (2.3%) in controls than in patients receiving intraocular antibiotics (0.3%; $p = 0.04$ Odds Ratio 8.9). Thirty-four percent of cases were culture negative and the authors emphasized that high clinical suspicion was more important than obtaining cultures. IOFB was also associated with development of endophthalmitis in eyes not receiving intraocular antibiotics. Intravitreal injections trended towards better outcomes than intracameral ($p=.01$). Intraocular injections of clindamycin and gentamicin, particularly intravitreal, showed evidence of preventing endophthalmitis at the time of primary repair in this study (BI). Due to potential toxicities of intraocular injections (particularly gentamicin), routine prophylactic injections of intravitreal antibiotics in penetrating trauma is not recommended on the basis of this study alone.[51] However, it can be considered in some settings at the ophthalmologist’s discretion.

Diagnosis of infection

The hallmarks of an acute infection in the maxillofacial region are readily apparent within days of an injury manifested as pain, redness and swelling of the face or neck, trismus, dysphagia and drainage. Systemically, fever, lymphadenopathy, malaise, and an elevated white blood cell count are hallmarks of an infection. Diagnosis of deep neck space involvement is improved with CT scans or MRI to image deep soft tissues. The diagnosis of osteomyelitis is made histologically by the presence of bacteria in the marrow spaces, but bone scan studies are helpful in imaging occult bone infection.[14] In the literature reviewed, infection was noted as a common complication but there was scant information about infection severity (grade 1 to 5) or definition. Cultures of the affected deep wound bed, bone or pus collection if present are necessary to guide antimicrobial therapy. Based on the described epidemiology bacterial and anaerobic cultures should be obtained, fungal cultures are unnecessary, mycobacterial cultures can be considered, but mycobacterial infections were not described in the literature reviewed (BIII).[22]

Management of infection

The following factors have been identified in current oral and maxillofacial surgery textbooks as useful in the management of infection of the traumatized maxillofacial region: incision and drainage of accumulated pus, debridement of foreign bodies and necrotic tissue, stabilization of fractures and institution of antibiotics.[19,21] At several military facilities in the United States, the standard of care for a surgical wound infection is intravenous or intravenous and oral antibiotics for 10 to 14 days, or for 2 to 3 days after the wound is closed and no signs of infections are present. For osteomyelitis, especially of the mandible, 6 weeks of intravenous antibiotics are preferred. Review of literature on the management of infections in maxillofacial war wounds is consistent with these recommendations, but the length of antibiotic treatment was not studied or offered and therefore the evidence to support these recommendations is limited (CII). Empiric antibiotic treatment should be initiated at first signs of wound infection. Preferred agents should be broad in spectrum and take into account the possible pathogens described in the previous epidemiology. Since there are no described studies of particular antibiotics in these settings, agents should be selected with activity against the described pathogens, or that have been utilized in similar settings such as prophylaxis trials or human bite infection treatments. Based on its broad activity against *Streptococcus* spp as well as beta-lactamase producing anaerobic pathogens, and proven utility in contaminated head and neck prophylaxis trials, we recommend AMP/S 2 grams every 6 hours as the preferred initial agent for treating infection, and then tailoring therapy to organisms encountered from culture of the afflicted site once this information becomes available (BIII). For the beta-lactam allergic patient, we recommend clindamycin 600mg every 8 hours, plus moxifloxacin 400mg daily which should provide similar spectrum of activity (BIII). Alternatives to these 2 agents for intolerant patients or patients with specific allergy include PIP/TAZ 4.5 grams every 8 hours, which has proven efficacy in prophylaxis trials, but the additional pseudomonas coverage it provides over AMP/S is likely unnecessary; or Cefoxitin 2 grams every 8 hours, which is proven in human bite treatment (BIII).

Outcome of infection

The face and neck region is highly vascular and wound infections are usually contained regionally. Infections can however, result in delayed healing, deformity, fistula formation and scarring, any of which can greatly compromise resolution. Necrotizing cervical fasciitis, acute osteomyelitis and infected cavernous sinus thrombosis, although uncommon, are serious consequences of maxillofacial infections.[21] Osteomyelitis, non-union, fistula formation and scarring were described in several case series reviewed.[14,25-27, 31] However, no deaths as a consequence of maxillofacial infections were noted in any of the same case series.

Discussion

From the literature reviewed here, comminuted fracture or an avulsion defect of the mandible was identified as a high risk injury for infection. Except for one case series of delayed treatment with closed reduction fracture management, most used conservative debridement, early fracture stabilization, primary closure of soft tissue, drainage of wound, and administration of antibiotics. Maxillofacial war wounds were noted to become infected if there was a delay in treatment. Post-operative infection rates of 1.15% to 100% were noted in the case series reviewed, a total of 2,564 patients with maxillofacial injuries were treated, with 218 (8.5%) postoperative infections noted. Antibiotics were considered important and used in all of the case studies but the length of antibiotic coverage was not described. Two studies mentioned difficulty in obtaining stable fixation as a cause of complications. Lack of soft tissue for closing wounds was also noted to be a leading cause of complications.

When selecting a peri-operative agent, we conclude that both prophylactic and empiric antibiotics should cover *Streptococcus* spp. and anaerobes for contaminated maxillofacial, head and neck war surgeries (BII) and could reduce infection rates to 3-7%. This conclusion is based on 2 retrospective epidemiological studies of wound microbiology, one of which is a summary paper of several well designed prospective randomized trials and the second a military specific population.[23,24] Furthermore empiric antifungal coverage for yeast or molds is not required (EII).

The need for a beta-lactamase inhibitor is less clear as one paper showed low infection rates with cefazolin despite the presence of beta-lactamase in the majority of microbiologic isolates. Providers should consider a beta-lactamase inhibitor combination such as AMP/S in refractory cases of infection (BII). They should also be aware of the potential complication of cervical osteomyelitis, although today different antimicrobial agents might be employed to manage such an osteomyelitis rather than the penicillin and gentamicin reported in the literature.

Regarding surgical management, rapid evacuation from the battlefield to a medical facility with specialists to debride, irrigate, and stabilize the wounds is a major factor in preventing infections.[52] Care must be taken to conserve the inner mucosal lining during the debridement process. Antibiotics should be administered as soon as possible after injury. The highly vascularized tissues in the maxillofacial region allow for early or delayed-early primary reconstruction of the hard and soft tissues. Primary bone grafts to reconstruct defects appears successful in the upper and midface but not the lower face.[31] Bone grafting mandibular defects is best delayed until after the wound is infection-free and re-vascularized.[27-30] Rigid internal fixation of mandibular fractures was used in one case series of severe non-war facial injuries; the other case series used a combination of closed reduction techniques and open reduction with varying degrees of rigidity.[8,20-21,27-30] Taher's case series had the lowest infection rate which he attributed to avoidance of internal fixation devices.[29] Zaytoun also recommended minimal use of internal devices for fracture repair to avoid complications.[21]

In the Korean and Vietnam Wars, a team surgical approach using oral/maxillofacial surgery, neurosurgery, general/vascular surgery and ophthalmology worked well to manage complicated maxillofacial injures. This capability was augmented by the addition of otolaryngology during the Iraq war and remains of paramount importance.[53]

Our analyses of numerous previously mentioned maxillofacial, head and neck surgery studies determined that extending peri-operative antibiotics beyond 24 hours did not significantly reduce infection rates. One day of peri-operative treatment significantly reduced immediate peri-operative infections. Late infections still occur, and are not prevented by prolonged post-operative antibiotics. These late onset infections are related more to the nature of injury and adequacy of tissue for surgical repair. Peri-operative antibiotics should be terminated at 24 hours after primary repair of maxillofacial wounds (AI). Longer courses of antibiotics are indicated if there are signs of infection, compromise of blood supply to the affected area due to surgical approach, closure under tension due to inadequate tissue or requirement of flaps, or grafting for closure or coverage (CIII).

Overall infection rates are fairly comparable in all peri-operative studies performed with the exception of the 500 mg dosing of cefazolin which is significantly worse. Of all assessed medications currently available, moxalactam had the lowest rates of infection in head and neck surgical literature, and ceftriaxone or Penicillin G followed by 1 week of oral penicillin in the mandibular fracture literature. Moxalactam is not currently available in the United States however. Advantages of clindamycin include activity against beta-lactamase producers and no usage restrictions in beta-lactam allergy. Clindamycin might have higher rates of *C. difficile* infection however. Cefazolin high dose and cefotaxime are good alternatives. There is a putative concern with beta-lactamase production in oral anaerobes that has not proven to be true in clinical trials. Cefazolin and cefotaxime are given 3 times daily and are likely safe in penicillin allergy, but might have cross reactivity in 6-7% of cases.[54] We prefer ceftriaxone over cefotaxime, however due to its less frequent dosing schedule and similar spectrum of activity. Ampicillin/sulbactam and PIP/TAZ are effective against beta-lactamase producers, although in one study ampicillin/sulbactam was used 3 times daily, when they are traditionally given as 4 times daily drugs and are not useful in beta-lactam allergy. We would favor the use of cefazolin, clindamycin or ceftriaxone as peri-operative prophylaxis and to reserve beta-lactam/ß-lactamase inhibitor combinations for empiric treatment of infection.

Five days of peri-operative antibiotics do not appear to be superior to 1 day in both contaminated major head and neck surgery and mandible surgery, so providers should be advised to use the 1 day regimen. Topical oral or intraoperative irrigation antibiotics do not appear to have added value, but topical iodine might add a small value in preventing infections.

The incidence of combat-related maxillofacial infections in the current conflict, the relationship of antibiotic type and timing of administration with the incidence of infection, the outcomes of maxillofacial infections based on severity (grade 1 to 5), and the epidemiology of trauma and infections of the maxillofacial region are all areas that require further study. In addition, the relationship of infection to delays in definitive surgery has not been studied except in the Ophthalmology literature. The bacteriology of current maxillofacial war wounds deserves at least a retrospective, and preferably prospective, evaluation. Rigid internal fixation of mandible fractures is thought to reduce risk of infection and deformity by preventing micro-movements of the fragments.[19,21] The current conflicts in Iraq and Afghanistan are the first time rigid internal fixation is being applied to maxillofacial war wounds on a large scale. It is unknown whether rigid internal fixation on maxillofacial war wounds has an effect on infection incidence, especially in comminuted fractures and avulsion defects of the mandible. This is another area that requires thorough analysis. Finally, a longitudinal study of maxillofacial combat-injured patients throughout their course of treatment would be valuable in studying the incidence of complications. Better analysis in all of these areas will improve treatment outcomes and positively impact care for those brave warriors who have made a tremendous sacrifice, having suffered a severe maxillofacial war injury in the service of their country.

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Table 1. Summary of microorganisms encountered in contaminated head and neck surgical cases

Author	Year	War Related?	5 Most Common Organisms Isolated per category of pathogen	Percent of total isolates	Multiple organisms isolated? (% of infections polymicrobial)
Morgan HH	1968	Yes	*Pseudomonas* spp.	ND*	--
			Klebsiella spp.	ND	
			Staphylococcus aureus	ND	
			Escherichia coli	ND	
			"fungi"	ND	
Zaytoun GM	1986	Yes	**Aerobic**		--
			S. aureus	ND†	
			Pseudomonas aeruginosa	ND	
			E. coli	ND	
			Proteus mirabilis	ND	
			Anaerobic		
			Bacteriodes fragilis	ND	
			Peptococcus	ND	
			Peptostreptococcus	ND	
Rubin J	1988	No	**Aerobic**	**91%**	Yes (95%)
			Streptococcus spp.	76%	--
			Streptococcus viridans	71%	--
			Neisseria flava	--†	--
			Enterobacter cloacae	--	--
			Serratia marcescens	--	--
			Anaerobic	**74%**	Yes (71%)
			Bacteroides spp.	71%	--
			Microaerophilic *Streptococcus*	--†	--
			Gram-positive cocci	--	--
			Gram-positive rods	--	--
			Lactobacillus spp.	--	--
			Fungi‡	**48%**	No
			Candida tropicalis	45%	--
			Other Candida	55%	--
Brook I	1989	No	**Aerobic**	**45%**	Yes (88%)
			α-hemolytic *Streptococcus*.	20%§	--
			Non-group A β-hemolytic *Streptococcus*	9%	--
			S. aureus	8%	--
			Anaerobic	**54%**	Yes (88%)
			Bacteroides spp.	36%§	--
			Peptostreptococcus spp.	28%	--
			Fusobacterium spp.	15%	--

*ND=Not described †=In descending order of frequency, percentages not described ‡=thought to be colonizers, not infections§=percent of total aerobic or anaerobic organisms in descending order of frequency

Table 2. Summary of prophylactic perioperative antibiotic trials in contaminated head and neck surgery

Authors/year	Type of surgery	Drug	Dose	Days perioperative prophylaxis	No. of doses	Patients	Infections (%)
Johnson,Yu 1984	Contaminated H&N	Placebo	-	1	-	9	7 (78)
Johnson, Myers 1984	Contaminated H&N	Cefazolin	500mg q8h	1	4	21	7 (33)
Johnson, Myers 1984	Contaminated H&N	Cefazolin	500mg q8h	5	16	30	6 (20)
Johnson,Yu 1986	Contaminated H&N	Cefazolin	2g q4h	1	4	59	5 (8.5)
Johnson,Yu 1987	Contaminated H&N	Clindamycin	600mg q8h	1	4	52	2 (3.4)
Johnson, Kachman 1997	Contaminated H&N	Clindamycin	600mg q6h	1	5	88	12 (14)
Grandis, Vickers 1994	Contaminated H&N	Clindamycin	900mg q8h	1	4	5	0 (0)
Johnson,Yu 1987	Contaminated H&N	Clindamycin/Gentamicin	600mg/1.7mg/kg	1	4	52	2 (3.8)
Johnson, Myers 1984	Contaminated H&N	Clindamycin/Gentamicin	600mg/1.7mg/kg	1	4	29	2(7)
Johnson,Yu 1984	Contaminated H&N	Cefoperazone	2g	1	4	39	4 (10)
Johnson,Yu 1984	Contaminated H&N	Cefotaxime	2g	1	4	32	3 (9)
Johnson,Yu 1986	Contaminated H&N	Moxalactam	2g q4h	1	4	59	2 (3.4)
Johnson, Kachman 1997	Contaminated H&N	Ampicillin/sulbactam	1.5 g q6h	1	5	81	11 (14)
Simons, Johnson 2001	Contaminated H&N	Piperacillin/tazobactam	3.375g q6h	2	9	31	2(6.4)
Simons, Johnson 2001	Contaminated H&N	Pip/taz + pip/taz gargle	3.375g/3.375g	2	9/3	31	3 (9.7)
Grandis, Vickers 1994	Contaminated H&N	Clindamycin gargle	1.5g qday	1	2	5	0 (0)
Grandis, Vickers 1994	Contaminated H&N	Clindamycin gargle	1.5g qday	5	6	5	0 (0)
Grandis, Vickers 1994	Contaminated H&N	Amox/clav gargle +Ticar/clav irrigation	3.76g/3.1g	1	2/1	5	0 (0)
Miles, Potter 2006	Open Mandible fx repair	Cefazolin + Benzathine Pen G	2g+2.4mIU	1	1/1	81	8 (9.9)
Abubaker, Rollert 2001	Uncomplicated mandible fx repair	Pen G +Pen VK	2mIU q4h +500mg q6h	5	4/20	14	2(14.3)
Abubaker, Rollert 2001	Uncomplicated mandible fx repair	Pen G +placebo	2mIU q4h	1	4	16	2(12.5)
Heit, Stevens 1996	Compound mandible fx repair	Ceftriaxone + Pen VK	1g + 500mg q6h	7	2/28	45	2 (4.4)

Heit, Stevens 1996	Compound mandible fx repair	Pen G + Pen VK	2mIU + 500mg q6h	7	7/28	45	2 (4.4)

H&N-Head and Neck, fx-fracture, Amox/clav-amoxicillin/clavulanate, ticar/clav-ticarcillin/clavulanate, Pen G-Penicillin G, Pen VK-Penicillin VK, mg-milligrams, g-grams, mIU-million International Units, qxh- every x hours, qday- once daily

Table 3. Suggested antimicrobials and duration of administration for peri-operative use in maxillofacial war injuries

Agent	Dose and schedule	Duration of therapy	Evidence-based	Comments
Peri-operative prophylaxis- β-lactam tolerant				
Cefazolin	2 grams every 8 hours	Pre-operatively and then for 24 hours post-op	BI	The preferred agent for non-allergic patients. Presence of β-lactamase activity does not seem to influence outcomes.
Peri-operative prophylaxis- β-lactam allergic				
Clindamycin	600mg every 8 hours	Pre-operatively and then for 24 hours post-op	BI	Ideal for β-lactam allergic patients. Adding Additional gram negative coverage (i.e. a second antibiotic) does not improve outcomes (BI).
Peri-operative prophylaxis- alternate				
Ceftriaxone	1 gram every 12 hours	Pre-operatively and then for 24 hours post-op	BI	Based on studies using cefotaxime and cefoperazone. Should have similar activity (AIII). Not superior to cefazolin in head to head trials (AI), reserve for cefazolin or clindamycin intolerant. (AIII).

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Abstract

Burns complicate 5-10% of combat associated injuries with infections being the leading cause of mortality. Given the long term complications and rehabilitation needs after initially recovery from the acute burns, these patients are often cared for in dedicated burn units such as the Department of Defense referral burn center at the United States Army Institute of Surgical Research in San Antonio, TX. This review highlights the evidence-based recommendations using military and civilian data to provide the most comprehensive, up-to-date management strategies for burned casualties. Areas of emphasis include antimicrobial prophylaxis, debridement of devitalized tissue, topical antimicrobial therapy, and optimal time to wound coverage.

Prevention and management of infections associated with burns in the combat casualty

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Thermal injury is common to all military conflicts and burns have historically comprised approximately 5-10% of all combat casualties.[1] As a result of explosive devices being used against military personnel involved in Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF), burns are the primary cause of injury in approximately 5% of military personnel evacuated from these engagements.[2] The concept of the dedicated burn unit is relatively new, was a product of wartime and disaster experience, and was closely tied to developments in infectious disease treatment. Archibald McIndoe, civilian consultant to the Royal Air Force in plastic surgery, established a burns ward at the East Grinstead hospital in 1940. The focus of his work was on postburn reconstruction.[3] Following the Cocoanut Grove nightclub fire in Boston in 1942, Cope, Moore, and colleagues at the Massachusetts General Hospital established a temporary ward dedicated exclusively to the care of the surviving burn patients. The results of that experience were carefully documented;[4] the chapter on infections in that monograph was written by Dr. Champ Lyons, a surgeon and microbiologist who later became the first Director of the U.S. Army Surgical Research Unit (SRU).[5] The initial focus of the SRU was characterization and delivery to the battlefield of newly-discovered penicillin. The U.S. Army Burn Center was established at the SRU at Fort Sam Houston, TX in 1949, in response to the growing threat of nuclear war.[6] Because of the high rate of death from invasive gram-negative burn wound infection in the 1950s, development of effective prophylaxis against that problem was a major early priority.

The evacuation of burned personnel has also evolved with each new conflict to which the US military has responded. During the Vietnam conflict, burned personnel were evacuated to an Army General Hospital in Japan where they were treated for variable periods of time (days to weeks) before transfer to the United States.[1,7,8] In the current operations in Iraq and Afghanistan, injured Department of Defense healthcare beneficiaries, including Army, Navy, Air Force and Marine personnel, arrive in the United States for definitive care on average 4-6 days after injury. During the course of an evacuation from Iraq or Afghanistan, patients transition through several medical facilities before arriving at a major US medical center.

The military utilizes an level-based evacuation system, in which injured personnel initially receive basic resuscitation and hemorrhage control by organic military medics (level I). Some patients undergo initial medical therapy at facilities staffed by physicians or physician assistants (level IIa). Casualties who require further care are transported to a facility that can provide initial surgical stabilization such as a forward surgical team (level IIb) or more often a Combat Support Hospital (level III) that contains surgical subspecialists and intensive care capabilities. Personnel who require ongoing care are transported to Landstuhl Regional Medical Center in Germany (level IV) and from there are triaged to a major military medical center in the United States (level V). In the case of thermal injury, patients are transferred to the United States Army Institute of Surgical Research (USAISR, the U.S. Army Burn Center). The criteria for evacuation of burn patients from theater based on burn severity are listed in table 1. In the event of moderate or severe burns or any burns involving the hands, face or perineum, evacuation to the USAISR burn center is crucial. In addition to surgical and nursing expertise, the USAISR provides the intensive physical therapy, occupational therapy and psychological support necessary for these patients.

Historically, burn wound infection has been the most common cause of death in the thermally injured patient. Fortunately, advances in care have led to a decline in the occurrence of burn wound infection. Complications such as ventilator-associated pneumonia (VAP) and sepsis associated with long term intensive care and invasive procedures are now the primary infectious complications in these patients.[9] However, wound infection remains a concern, particularly in the setting of delays in definitive surgical care. In addition, variability in the level of care available across levels can be expected to have some effect on the risk of burn wound infection in these patients. The best method of caring for thermally injured patients as they transition from the battlefield setting has yet to be determined. Therefore, the prevention, diagnosis and treatment of infections in the burn patient as he or she transitions from the battlefield to definitive care at USAISR will be the focus of this review.

Microbiology and Epidemiology of Burn Wound Infections

The microbial epidemiology of burn wound infections has evolved over the past 20 years, as use of topical antimicrobials, early burn wound excision, and definitive coverage with autograft have become standard practice. There is evidence to suggest that the incidence of bacterial burn wound infection has declined due to the practice of early excision and grafting, but data are inconclusive in the setting of large burns.[10-13] A recent meta-analysis of all available randomized controlled studies found a reduction in mortality with early excision for all burn patients without an inhalation injury.[13]

Although data are inconclusive, early excision and grafting has become standard practice in most US burn centers. This level of care is typically not available for military personnel injured in forward operating areas until they arrive at the USAISR. The transit time for seriously injured burn patients from time of injury to the USAISR averages 4 days and often includes stops at 2-3 medical facilities depending on the origin of the patient (unpublished data, LTC Evan Renz, Oct 2007).[14] Therefore, knowledge of pre-excision burn wound flora is important to our understanding of the risks for burn wound infection in military personnel.

Most of the available data on the bacteriology of burn wound infections have been taken from studies performed prior to the practice of early excision and grafting. Although the incidence of infection has decreased, the list of offending micro-organisms has not changed significantly[15-19] In the absence of topical antimicrobials, the immediate post-burn period is characterized by rapid colonization of the injured tissue by resident microbial flora.[16-19] Gram-positive skin flora, such as *Streptococcus pyogenes* and *Staphylococcus aureus*, reside deep within skin appendages and colonize the wound within the first 24 to 48 hours after injury.[16,17] Endogenous gram-negative bacteria from the patients' respiratory and gastrointestinal tract, such as *Psuedomonas aeruginsoa, Klebsiella pneumoniae*, and *Escherichia coli*, colonize the wound within the first 48 to 72 hours after injury.[16,17] Micro-organisms may also be transferred to the burn wound from contaminated surfaces, equipment, or on the hands of health care workers (HCWs).[20-23] Of the many bacterial microorganisms that colonize the burn wound surface shortly after injury, *S. aureus* and *P. aeruginosa* are the most likely to result in an invasive infection.[15,18,24] This finding is due in part to the array of virulence factors possessed by these organisms. In addition to these pathogens, the US military health care system has experienced an increased rate of multidrug-resistant *Acinetobacter calcoaceticus-baumannii* complex (Acb) infections in military personnel injured in Iraq and Afghanistan. A recent retrospective cohort study by Albrecht et al. found multidrug-resistant Acb to be a frequent cause of infection in burn patients. However infection was not found to independently affect mortality in this population.[25]

Patients with burns are also subject to tetanus if inadequately immunized. Minor burn wounds have been associated with fatal tetanus in at least one case report.[26] Therefore, tetanus immunization status of all burn patients should be determined. Tetanus immunization should be administered if the last booster was over five years ago (AII) (grading outlined in this supplement of Journal of Trauma- Guidelines for the Prevention of Infection following Combat-related Injuries). Tetanus vaccination plus anti-tetanus immunoglobulin should be administered to patients who have no history of vaccination (AII). Booster vaccination should be administered at 4 weeks and 6 months for the later group.

Yeasts, such as *Candida* species, and filamentous fungi, such as *Aspergillus* species, have far outpaced bacterial pathogens as the most common cause of invasive burn wound infection since the introduction of topical antimicrobial agents.[15,19] Candidal colonization of burn wounds is more common then invasive disease and may arise from an endogenous or exogenous source.[27-29] The filamentous fungi are uniformly acquired from an exogenous environmental source and are much more likely to cause invasive disease then the *Candida* species.[27-31] The filamentous fungi commonly associated with burn wound sepsis include *Aspergillus* sp., *Fusarium* sp., and members of the Mucorales order of the Zygomycetes.[32] There have also been case reports of invasive wound infection due to a variety of dematiaceous fungi such as *Curvularia* sp.[33] Infections due to the filamentous fungi prove difficult to diagnose in the absence of a biopsy with interpretation by a skilled pathologist. A recent retrospective analysis of patients with thermal burns admitted to the USAISR found that fungal burn wound infection is an independent predictor of mortality in patients with TBSA 30-60%.[29] Fungal pathogens typically become a concern later in the treatment course after patients have undergone surgery and received broad spectrum anti-bacterials, and should not be a frequent cause of infection in the first few days following injury.[19,27]

Viral infection of burn wounds is rarely reported but does occur. Members of the herpes virus family, including herpes simplex virus (HSV) and varicella zoster virus (VZV), are the most common culprits.[31,34] Cutaneous disease typically occurs in healing partial thickness burns and donor sites.[35] Cutaneous infection follows a benign course if recognized and treated early with topical therapy. Fortunately, invasive disseminated HSV or VZV is a rare occurrence in the burn patient, but should be considered in the patient with cutaneous disease and findings of concomitant pneumonitis, hepatitis or meningitis as these patients will require systemic therapy.[31,34]

Prevention of Infection

The primary measures employed to prevent infection in the thermally injured patient are topical antimicrobials, early excision with coverage and good infection control measures. It should be noted that the availability of these measures will vary depending upon the location of the patient within the military level system.

Wound care, in the form of topical antibiotics and early excision with coverage, has been associated with a significant decline in the incidence of invasive burn wound infection.[13,36-38] The use of topical antimicrobials across all levels of care is feasible, while excision and coverage is typically available only at level III-V. First degree and superficial partial thickness burns may also be treated with topical antimicrobials and daily dressing changes (AII). [36-38] The use of temporary bio-synthetic materials such as Biobrane® is also an option for superficial partial thickness burns (BII).[39-41] Deep partial thickness and full thickness burns should be treated with topical antibiotics and twice daily dressing changes followed by excision and grafting (AII).[9-13,36-38] Ideally, excision and autografting should be performed at a burn center; however, if definitive surgical care must be accomplished in theater, it should be performed at an level III facility by experienced personnel (CIII). Management recommendations based on burn severity are summarized in Table 2.

The importance of wound care—both at the time of initial debridement and thereafter—cannot be overemphasized. Wound care should be directed at thoroughly removing devitalized tissue, debris, and previously placed antimicrobials. A broad-spectrum surgical detergent such as chlorhexidine gluconate should be used (CIII). Adequate analgesia (e.g. with frequent small doses of intravenous narcotics or ketamine), along with preemptive anxiolysis (e.g. with a pre-procedure oral benzodiazepine), are necessary in order to permit adequate wound care. Except when silver dressings or Biobrane® are used, wound care should be repeated twice daily (CIII). However, we recognize that in the deployed environment, it may be possible to do thorough wound care only once daily.

The most commonly employed topical antimicrobials for the prevention and treatment of burn wound infection are mafenide acetate, silver sulfadiazine, silver nitrate solution and silver-impregnated dressings.[36-38,42]

Mafenide Acetate

Mafenide acetate (Sulfamylon®) was first introduced in 1964.[36] A retrospective study comparing USAISR patients treated in the pre-mafenide era (1962-1963) with those treated after the introduction of mafenide found a decrease in overall burn mortality from 38-20%, and a reduction in the rate of invasive burn wound infection from 22% of admissions to 2%.[36] Mafenide acetate is available as an 11% water-soluble cream composed of α-amino-p-toluenesulfonamide monoacetate. Despite the name, it is functionally a non-sulfonamide antibiotic. It rapidly penetrates full thickness eschar and exerts a broad antibacterial effect.[43] In-vitro and animal studies have demonstrated mafenide acetate to have efficacy against *Staphylococcus* and *Pseudomonas* species.[44,45] Although resistant strains of *Providencia* and *Enterobacter* developed at the USAISR in the late 1960s, none of the nearly 8,500 strains of *P.*

aeruginosa isolated from USAISR burn patients during the period 1967-1992 were resistant to clinically relevant concentrations of the drug.[46]

There are some drawbacks to the use of mafenide acetate. It has no efficacy against filamentous fungi. It is painful on application, a consequence of its otherwise desirable ability to penetrate eschar and reach viable tissue. The drug and its primary metabolite (p-carboxybenzenesulfonamide) are inhibitors of carbonic anhydrase and metabolic acidosis has been reported in patients with extensive burns treated twice daily.[47] Patients with inhalation injury are at greater risk of this if their pulmonary dysfunction limits respiratory compensation.[47] This may pose a problem given that concentrations of the drug in eschar drop below therapeutic levels approximately 10 hours after application, necessitating twice daily dosing unless a second agent is also used.[43] One common practice at USAISR is to apply mafenide acetate in the morning and silver sulfadiazine 12 hours later in order to realize the benefits of both drugs while limiting the toxicities.[46]

Mafenide acetate is also available in powder form for reconstitution as a 5% aqueous solution. This solution is used to moisten gauze dressings and is indicated for topical treatment of wounds following skin grafting. In addition, we often use this solution, along with twice daily gauze dressing changes, for the topical treatment of deep partial thickness burns of limited extent. However, it was less effective than mafenide acetate cream in prevention of death in a murine model of *Pseudomonas* burn wound infection.[48]

<u>Silver Sulfadiazine</u>

Silver sulfadiazine (Silvadene®, Thermazine®, Flamazine®, SSD®, Burnazine®) is available as a 1% water soluble cream. It was developed in 1968 by complexing silver nitrate and sulfadiazine.[45,49] Previously, sulfadiazine alone had been used as a topical agent but the development of resistance became an issue. Complexing sulfadiazine with silver nitrate has largely overcome the resistance problem, and the agents appear to act synergistically. In essence, the complex acts as a slow-release formulation of silver cation.[50,51] Much like mafenide acetate, silver sulfadiazine exhibits activity against gram-negative and gram-positive organisms; however, unlike mafenide it has poor eschar penetration.[45,50,51] The advantages of silver sulfadiazine are that it is relatively painless on application and it has some activity against *Candida* species, but not against filamentous fungi. Rarely, a decrease in the neutrophil count has been observed with initiation of therapy, and has been attributed to depression of granulocyte-macrophage progenitor cells in the marrow.[49] This effect typically resolves even when the agent is continued and rarely necessitates discontinuation of therapy.[49]

Silver Nitrate Solution

Silver nitrate ($AgNO_3$) solution was first introduced in 1964 as topical prophylaxis against burn wound infection. It has been previously used as a 10% solution that was found to be tissue toxic.[51] It is now used as a 0.5% aqueous solution, a concentration at which it is not toxic to regenerating epithelium.[42,51] Burn wounds are dressed with multiple, thick layers of coarse mesh gauze, to which the silver nitrate solution is frequently reapplied in order to keep the gauze continuously moist.[46] Much like silver sulfadiazine, it exhibits activity against gram-positive bacteria, gram-negative bacteria and *Candida*. The major drawbacks to silver nitrate solution are that it has poor penetration of eschar, requires the use of occlusive dressings, and turns black upon contact with tissues.[51] Dressings must be changed twice daily in order to prevent buildup of exudate or of tissue-toxic levels of the silver nitrate. The need for continuously moist dressings means that patients with large wounds are at risk of hypothermia, particularly during transport or in general hospital rooms. Another drawback to this drug is the depletion of cations due to leeching across the open wound into the hypotonic solution. This phenomenon may result in hyponatremia, hypocalcemia, hypokalemia, and hypomagnesemia; therefore, close monitoring of electrolytes is necessary.[42]

Silver-Impregnated Dressings

A variety of dressings impregnated with elemental silver have been recently approved by the FDA as topical therapy for burns. Numerous formulations of these dressings are now available, but it is unknown if they are equivalent in silver delivery and antimicrobial efficacy. Some examples of available silver dressings include Silverlon® (Argentum LLC, Willowbrook, Il) and Acticoat® (Smith and Nephew, Hull, United Kingdom). Silverlon® is a knitted fabric composed of pure nylon-base fibers, covered uniformly and circumferentially with a thin coat of metallic silver. Alone and in combination with weak direct current, silver nylon has been shown to be effective in a lethal *Pseudomonas* murine model.[52] Acticoat® is a rayon/polyester core encased in a dense polyethylene mesh coated with nanocrystalline silver. Tredget *et al.* have reported Acticoat® to be more effective then silver nitrate solution with respect to preventing heavy burn wound colonization (10^5 organisms per gram of tissue).[53] Both Acticoat® and Silverlon® are approved for use in superficial and partial thickness burns and can be left in place for several days (at least 3, and possibly as many as 7 days) (BII). This offers significant advantages, particularly for the treatment of wounds sufficiently small that outpatient or ward care are reasonable option (AII).[54] The method of application for each of the topical agents is summarized in table 3.

Excision and grafting

Early excision of burned tissue and coverage with skin grafts or skin substitutes has been associated with a decrease in mortality in several studies.[12,13,17] The beneficial effect of this practice on mortality is likely multi-factorial, with a decreased incidence of wound infection[15] and with the removal of devitalized tissue as a stimulus for the inflammatory process both likely playing a role. The definition of “early” has not been definitively established. Studies have variably defined early excision as that performed either upon admission or up to 5 days after injury.[12,13,17,55]

Excision and grafting is indicated for deep partial thickness burns and for full thickness burns. The accurate assessment of burn depth is challenging, and it is often difficult to predict the ultimate fate of a burn within hours to days of injury. In fact, some burns may progress from partial to full thickness over a period of days.[56]

If excision is performed, the entire burn wound may be excised in a single procedure or in serial procedures performed over the course of several days.[39] Definitive coverage requires the application and successful integration of autograft. If sufficient autograft is not available, options for temporary wound coverage following excision include biological and synthetic coverings. Temporary biological dressings consist of allografts and xenografts. Allografts may be used to protect an excised wound, or as an overlay to protect an excised wound following application widely meshed (e.g. 3:1, 4:1) autograft. Fresh allograft may be available in the US, but more often is frozen. A shelf-stable allograft product, GammaGraft™, has been used in the combat zone during OIF.[57] Xenografts (such as pig skin) are typically used as temporary coverage of wounds expected to heal.[56] Temporary synthetic skin substitutes are also commonly used. There are several brands of synthetic coverings available, of which Biobrane® is appropriate for clean partial thickness burns. This, and similar products, act as a wound barrier and prevent evaporative losses but have no intrinsic antimicrobial properties.[39] Integra®, a bilaminar product (inner dermal analog of chrondoitin-6-sulfate and collagen; outer temporary epidermal analog of silicone) should only be used by experienced surgeons in a burn center.

As previously noted, surgical excision is normally not performed in the combat zone because it is labor and supply intensive, and because optimal outcomes require the multidisciplinary capabilities present only in a burn center. However, definitive surgical care for local nationals may be required in the combat zone. This should be done by qualified individuals at level III facilities,[58] recognizing that the situation is far from ideal.

Systemic antibiotic prophylaxis

Use of prophylactic systemic antibiotics is now well-accepted in a wide variety of settings, including the performance of many surgical procedures. But in the treatment of burns, use of systemic antibiotics for prophylaxis of subsequent burn wound infection has not been proved effective. Early use of antibiotics such as penicillin and erythromycin aimed at controlling outbreaks of *Streptococcus* have been anecdotally observed to be associated with an increase in infections caused by multiply-resistant *Staphylococci*,[59] though this has not been found uniformly.[60] However, no study has demonstrated a reduction in burn wound infections with the use of prophylactic antibiotics, and at least one has shown an increased incidence of infections from gram-negatives, including *Pseudomonas*.[61] The only exception to this might be found in the use of antibiotic prophylaxis against Staphylococcal toxic shock, which can be a problem in pediatric burn care,[62] although this remains controversial. Therefore, routine systemic antimicrobial prophylaxis in the burned patient is not indicated for rapid or delayed evacuation (EII) and there are insufficient data to recommend for or against its use in patients with concomitant inhalational injury (CII). In the event that a burn patient suffers from concomitant traumatic penetrating injury or fracture, antibiotic prophylaxis should be administered as recommended for that injury.

Antibiotic prophylaxis has also been examined in burn surgery. Few studies have supported the use of systemic antibiotics during acute burn surgery. Antibiotics appear to be of no value in the prophylaxis of wound infections accompanying surgery for small to moderate burns.[63] Early studies documented a significant incidence of transient bacteremia associated with wound manipulation,[64] but a more recent evaluation showed this incidence to be much reduced.[65] Antibiotic administration may reduce the incidence of this transient bacteremia,[66] but this did not affect outcomes. Antibiotic prophylaxis was of some benefit in one early study of reconstructive surgery,[67] but this has not been replicated. Despite fairly clear evidence on this topic, units continue to vary widely in their practices of providing peri-operative antibiotic prophylaxis, and a number of centers continue to administer antibiotics for every procedure which involves wound manipulation.[68,69] Given the lack of benefit, routine pre-debridement antibiotic prophylaxis of burns <40% TBSA is not recommended (DI). It is important to note that few data have been compiled on surgical prophylaxis of patients with massive (≥ 40% TBSA) burns. Therefore, pre-operative prophylaxis with a single dose of an intravenous antibiotic effective against resident flora can be considered pending further data (CIII).

It is crucial to note that, systemic antibiotic therapy is clearly indicated in the surgical treatment of infected burn wounds, and this may necessitate empiric treatment of many patients with large open wounds and evidence of infection. Many patients with large burns develop symptoms such as fever and elevated white blood cell count—as a consequence of the systemic response to injury, rather than infection--further complicating decisions regarding the use of antibiotics.[70]

Infection Control

Burn patients are highly susceptible to wound infection, pneumonia, and bacteremia due to the loss of the barrier function of skin, the immune dysregulation that accompanies severe burn injury, and the requirement for invasive procedures such as endotracheal intubation and central venous catheter placement.[71] Endogenous organisms account for early colonization of burn wounds but later colonization with drug-resistant bacteria is primarily the result of nosocomial transmission via contaminated equipment or on the hands of healthcare workers.[72]

As a means of detecting these organisms, some centers strongly advocate obtaining routine surveillance cultures of burn wounds, sputum, urine, and even stool as often as three times weekly.[73-75] These techniques are widely used in the US,[76] but little data exist to support this labor-intensive and expensive practice. The likelihood of obtaining positive cultures from biopsy is dependent on burn wound size,[77] but no burn size-specific criteria for surveillance cultures have been developed. An aggressive surveillance regimen may be indicated in cases of epidemics of specific infections, sometimes even including staff members, to detect "carriers" of such organisms as MRSA and drug-resistant gram-negatives.[78-81]

The environment surrounding the burn patient is an important factor in the risk for infection. Several studies in burn units have demonstrated that hand hygiene compliance, isolation rooms and environmental cleaning reduced outbreaks with drug-resistant organisms (AII).[78,82] A particular problem faced by the US military has been outbreaks of wound infections caused by drug resistant Acb in personnel injured in OIF/OEF. Data form OIF indicate that soldiers became colonized with the organism after entry into an level III facility and not at time of initial injury, thus suggesting that a breakdown of infection control measures played a significant role.[83] The Centers for Disease Control and Prevention (CDC) and the Society for

Health Care Epidemiology (SHEA) have released general infection-control guidelines for the hospital setting[84-87] however, there are currently no guidelines that specifically address infection control practices in the burn unit. Until further data are available we must rely on general infection-control guidelines.

Diagnosis of Infection

Although burn treatment methods have greatly reduced the incidence of invasive burn wound infections, these still occur, and can represent life-threatening problems for the burn patient. Clearly the most important method of detecting burn wound infection is the routine (at least daily) close inspection of all burn wounds by experienced personnel.[19,88] Several types of infection, including cellulitis, invasive infection, impetigo, and others, can be distinguished by routine examination, and used as an indication to obtain cultures and/or begin empiric antibiotic therapy.

On the other hand, major thermal injury epitomizes the systemic inflammatory response syndrome (SIRS). Consequently, systemic signs of infection such as fever and elevated white blood cell count are notoriously unreliable in burn patients.[89] In burn patients, occurrence of hyperglycemia, or worsening of previously-stable blood sugar control has been shown to correlate with increased incidence of severe infection, and may be considered an indication to search for an infectious source.[89,80]

<u>Culture Technique</u>

A variety of techniques for both surveillance and directed burn wound cultures have been advocated. Surface swab cultures frequently demonstrate bacterial growth, but this often reflects colonization without invasive infection,[91] and correlation with more definitive methods is poor.[92,93] For these reasons, surface swab cultures should not be performed for diagnosis of infection (DII). For many years, quantitative cultures of burn wound biopsies have been used to diagnosis burn wound infections, with cultures growing greater than or equal to 10^5 organisms/gram considered “positive”. Quantitative cultures of wound biopsies are somewhat more specific than swab cultures, but have a number of limitations. Among them is the finding that clinically septic patients often have far higher density of bacterial counts, sometimes as much as 10^{11} bacteria/gram.[91] In addition, quantitative cultures are costly and time-consuming, with low rates of positive cultures in many patients. Because such cultures represent a random “sample” from a single site, they may miss significant infection in adjacent wounds. Both false-positive and false-negative results are possible, further limiting their correlation with systemic infection.[94-96]

In addition, quantitative cultures have not been shown to correlate well with histopathologic examination of wounds,[19,75,96,97] nor do they predict outcome of grafting or other procedures.[98-100] As a result, quantitative cultures are advocated largely to detect and identify the sensitivities of predominant wound microflora.[97] Therefore, quantitative cultures can be considered for this purpose in level II and IV facilities with microbiology capabilities in an attempt to guide antibiotic therapy (CIII).

The use of burn wound histopathology to detect micro-organisms penetrating beneath burn eschar into viable tissue has long been considered the “gold standard” for diagnosis of invasive burn wound infection/sepsis.[19,75,80,88] This method differentiates colonization from invasion based upon the location of the microorganisms within the wound (table 4) and is the diagnostic modality of choice for burn centers (AI).[19,75,80,88] However, this technique requires technology and unique expertise and therefore, can not be recommended for use in theater (CIII).

Experimental techniques such as rapid polymerase chain reaction assays may be promising, but await clinical confirmation.[101]

There seems to be little disagreement that cultures are indicated in cases of specific infections. Indications for obtaining surveillance blood cultures seem to be less clear. Burns have been identified as a high-risk group for bacteremia.[102] Positive blood cultures have been detected during routine surveillance programs in burn patients following burn wound excision; in this circumstance, bacteremia is more commonly found in patients with large (> 40% TBSA injuries), and in procedures performed more than 10 days following injury.[103] However, routine blood culture surveillance in the absence of systemic signs of sepsis has had poor yield and is not recommended.[104,105] Routine wound surveillance cultures also appears to be of little utility. In one study, routine wound surveillance culture results did not predict occurrence of bacteremia. In addition, antibiotic prophylaxis to cover this transient bacteremia did not affect outcomes.[106]

Even in patients with positive wound cultures, indications for treatment are not entirely clear. For example, the recovery of *Candida* sp from burn wounds is specifically mentioned as an indication for systemic anti-fungal therapy by some.[107,108] Other authors state that invasive *Candida* infections are rare, while wound cultures showing filamentous fungi more frequently indicate invasive infection, and should be treated.[73] It should be noted that cultures alone are inadequate for diagnosis of wound infections due to filamentous fungi, as many of the causative organisms are more likely to be seen on histopathology and correlation between the two methods is inconsistent.[28] Recommendations for diagnosis of burn wound infection across the levels of care are summarized in table 5.

Treatment of Infection

Burn wound infection is highly lethal,[29] and urgent surgical excision of infected tissue, as soon as possible following resuscitation and institution of appropriate antimicrobials, is the most effective method of controlling burn wound infection. Such excision should be sufficiently radical to extirpate all involved tissue; thus, excision to fascia is frequently required. When infection is suspected, samples of the debrided tissue should be sent for histopathologic examination (if available) as well as for bacterial and fungal culture. Initial systemic antimicrobial therapy should be broad with tailoring of therapy based upon results of histology and culture of infected tissue and blood. Given that *S. aureus, P. aeruginosa* are the most common bacterial cause of burn wound infections,[16,18,19,24] empiric treatment regimens should cover these organisms. Level III-V facilities report antibiotic resistance profiles in quarterly antibiograms which enables the local resistance profiles, to include the presence of extended beta-lactamase (ESBL) producing isolates, to be taken into consideration when choosing empiric antibiotic therapy. Appropriate agents for empiric therapy include pipercillin-tazobactam or cefipime, +/- an aminoglycoside. If ESBL-producing organisms are a concern, imipenem or meropenem +/- an aminoglycoside is the treatment of choice. Antibiotic therapy should be narrowed once histology and culture results are available to avoid overuse of broad-spectrum agents.

Prompt excision of infected tissues, administration of systemic antimicrobials and topical antimicrobials are clearly the mainstay of therapy. In the event that surgical intervention is delayed, subeschar clysis with an antipsuedomonal penicillin can be considered, though data are limited (CIII).[109-111] The procedure described by McManus et al. consists of suspending one-half of the total daily dose of a semisynthetic penicillin (such as piperacillin) in a sufficient volume of crystalloid solution to treat the entire burn area. The solution is injected into the sub-eschar tissue using a No. 20 spinal needle. This procedure is repeated twice daily. Other authors have recommended sub-eschar injection of the full daily dose once a day.[112] There are no data to suggest superiority of one approach over another at this time. Recommendations for initial management of wound infections are summarized in table 6.

Fungal pathogens are also a concern, and therapy of fungal infections has become more interesting with the introduction over the past decade of several new anti-fungal agents, such as voriconazole, posaconazole and the echinocandins. Given that *Aspergillus* sp are the most common cause of invasive fungal burn wound infections, it is reasonable to direct anti-fungal therapy at this organism pending definitive identification.[19,27,30] It is important that aggressive attempts be made to identify the fungal pathogen to the species level as not all species of *Aspergillus* are sensitive to amphotericin formulations.[28] For example, *A. terreus* is inherently resistant to amphotericin. In addition, less common but potential pathogens such as the Zygomycetes are resistant to voriconazole.

Conclusions

The occurrence of invasive burn wound infection has decreased with the widespread use of early excision and grafting, topical antimicrobials, and the implementation of strict infection control measures in most centers. However, the unique and often austere environment encountered in the combat zone raises the issue of how best to prevent infection in injured military personnel. Wound care and the use of prophylactic, topical antimicrobials should occur as soon as possible in the evacuation process. The use of systemic antimicrobials should be avoided during the evacuation process in order to minimize selective pressure for resistant organisms. The recommendations offered by this article will certainly evolve, along with our knowledge of the unique risks posed to the burn patient receiving initial care in the combat environment.

Table 1. Recommendations for evacuation of burn patients from theater.[57]

Category	Burn Severity*	Evacuation Recommendation
1	Limited partial thickness burns not involving hands, joint, face, perineum	Air Evacuation to Landstuhl for wound care with expected return to duty
2	Limited, partial thickness involving hands, joint, face, perineum OR Any limited full-thickness burn	Air Evacuation to Institute of Surgical Research (ISR) burn center
3	Moderate partial or full-thickness burns, patient stable	Transfer to ISR via Critical Care Air Transport Team (CCATT)
4	Severe partial or full-thickness burns and/or inhalation injury requiring intubation, patient stable	Transfer to ISR using Burn special medical augmentation response team (SMART)
5	Severe partial or full-thickness burns, patient unstable for air evacuation to the US	Transfer to European burn center
6	Vesicant casualties	Air evacuation to ISR

*Burn severity definitions: Limited: <10% total body surface area (TBSA), Moderate: 10-30% TBSA, Severe: >30% TBSA

Table 2. Management of burn wounds based upon depth.[12,13,17,36-39,42,43]

Wound	Interventions
First Degree	Symptomatic care
Superficial Partial Thickness	Topical antibiotics with twice daily dressing change Silver-impregnated dressing changed every 3-7 days Biobrane
Deep Partial Thickness	Topical antibiotics with twice daily dressing change Silver-impregnated dressing changed every 3-7 days Excision and grafting
Full Thickness	Topical antibiotics with twice daily dressing change Excision and grafting

Table 3. Topical antimicrobial agents. [42-47,49-51,60,113-115]

Agent	Application	Penetration	Side Effects
Mafenide Acetate	Apply 1/16” layer twice daily**	Penetrates eschar	Painful on application Metabolic acidosis
Silver Sulfadiazine	Apply 1/16” layer twice daily**	Poor eschar penetration	Transient leukopenia
Silver Nitrate Solution	Dress wounds with multiple layers of coarse gauze and apply solution to keep gauze continuously moist	Poor eschar penetration	Discolors wound bed Electrolyte disorders
Acticoat* or Silverlon*	Moisten dressing with sterile water (not saline), cut to size, secure to wound with secondary dressing, change in 3-7 days	Poor eschar penetration	

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Acticoat* or Silverlon*	Moisten dressing with sterile water (not saline), cut to size, secure to wound with secondary dressing, change in 3-7 days	Poor eschar penetration	

*Application information obtained from package insert

**Commonly, alternate mafenide in the morning with silver sulfadiazine in the evening

Table 4. Histopathologic classification of burn wound infection.[41]

Stage	Grade
I: Colonization of nonviable tissue	A. Superficial colonization: Microbes present on burn wound surface
	B. Microbial penetration: Microbes present throughout eschar
	C. Subeschar proliferation: Microbes multiplying beneath eschar
II: Invasion of viable tissue	A. Microinvasion: Foci of microbes in viable tissue immediately beneath eschar
	B. Generalized invasion: Multifocal or diffuse penetration of microbes into viable tissue
	C. Microvascular invasion: microbes present in unburned blood vessels and lymphatics

Table 5. Diagnosis procedures of burn wound infection based upon evidence-based recommendations and level of medical care.

Diagnostic measure	Level I/IIA	Level IIb/III	Level IV	Level V
Daily wound inspection	AIII	AIII	AIII	AIII
Surface swab culture	N/A	DII	DII	DII
Biopsy and quantitative culture	N/A	CIII	CII	CII
Biopsy and histology	N/A	CIII	BII	BII

N/A- not applicable

Table 6: Treatment of burn wound infection by level of medical care.

Intervention	Level I/IIA	Level IIb/III	Level IV	Level V
Excision and grafting	N/A	DIII	AI	AI
Systemic antibiotics	AII	AII	AII	AII
Topical antibiotics	AII	AII	AII	AII
Sub-eschar clysis	N/A	CIII	CIII	CIII

N/A- not applicable

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CRR 110-434-385 Attachment:

Document No. 3

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON DC

27 February 2008

HQ USAF/SG
1780 Air Force Pentagon
Washington, DC 20330-1780

The Honorable Robert Byrd
Chairman
Committee on Appropriations
United States Senate
Washington, DC 20510

Dear Mr. Chairman

In response to the language of House Report 110-434, page 358, "Making Appropriations for the Department of Defense for the Fiscal Year Ending September 30, 2008," I am forwarding the enclosed report.

Infections from multi-drug resistant organisms have been identified in combat wounded service members who return to the United States for further treatment. This report provides information on current antibiotic regimens, the availability of new antibiotics, research initiatives, and continuing needs related to the ongoing surveillance of these infections.

A similar letter has been sent to the Ranking Minority Member of your committee, and to the Chairmen and Ranking Minority Members of the other congressional defense committees.

Sincerely

JAMES G. ROUDEBUSH
Lieutenant General, USAF, MC, CFS
Surgeon General

Attachment:
Report on Antibiotic Resistant Bacteria

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON DC

27 February 2008

HQ USAF/SG
1780 Air Force Pentagon
Washington, DC 20330-1780

The Honorable Thad Cochran
Ranking Minority Member
Committee on Appropriations
United States Senate
Washington, DC 20510

Dear Senator Cochran

In response to the language of House Report 110-434, page 358, "Making Appropriations for the Department of Defense for the Fiscal Year Ending September 30, 2008," I am forwarding the enclosed report.

Infections from multi-drug resistant organisms have been identified in combat wounded service members who return to the United States for further treatment. This report provides information on current antibiotic regimens, the availability of new antibiotics, research initiatives, and continuing needs related to the ongoing surveillance of these infections.

A similar letter has been sent to the Chairman of your committee, and to the Chairmen and Ranking Minority Members of the other congressional defense committees.

Sincerely

JAMES G. ROUDEBUSH
Lieutenant General, USAF, MC, CFS
Surgeon General

Attachment:
Report on Antibiotic Resistant Bacteria

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON DC

27 February 2008

HQ USAF/SG
1780 Air Force Pentagon
Washington, DC 20330-1780

The Honorable Daniel K. Inouye
Chairman
Subcommittee on Defense
Committee on Appropriations
United States Senate
Washington, DC 20510-6028

Dear Mr. Chairman

In response to the language of House Report 110-434, page 358, "Making Appropriations for the Department of Defense for the Fiscal Year Ending September 30, 2008," I am forwarding the enclosed report.

Infections from multi-drug resistant organisms have been identified in combat wounded service members who return to the United States for further treatment. This report provides information on current antibiotic regimens, the availability of new antibiotics, research initiatives, and continuing needs related to the ongoing surveillance of these infections.

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Lieutenant General, USAF, MC, CFS
Surgeon General

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DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON DC

27 February 2008

HQ USAF/SG
1780 Air Force Pentagon
Washington, DC 20330-1780

The Honorable Ted Stevens
Ranking Minority Member
Subcommittee on Defense
Committee on Appropriations
United States Senate
Washington, DC 20510-6028

Dear Senator Stevens

In response to the language of House Report 110-434, page 358, "Making Appropriations for the Department of Defense for the Fiscal Year Ending September 30, 2008," I am forwarding the enclosed report.

Infections from multi-drug resistant organisms have been identified in combat wounded service members who return to the United States for further treatment. This report provides information on current antibiotic regimens, the availability of new antibiotics, research initiatives, and continuing needs related to the ongoing surveillance of these infections.

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Sincerely

JAMES G. ROUDEBUSH
Lieutenant General, USAF, MC, CFS
Surgeon General

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Report on Antibiotic Resistant Bacteria

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON DC

27 February 2008

HQ USAF/SG
1780 Air Force Pentagon
Washington, DC 20330-1780

The Honorable David Obey
Chairman
Committee on Appropriations
United States House of Representatives
Washington, DC 20515-6015

Dear Mr. Chairman

In response to the language of House Report 110-434, page 358, "Making Appropriations for the Department of Defense for the Fiscal Year Ending September 30, 2008," I am forwarding the enclosed report.

Infections from multi-drug resistant organisms have been identified in combat wounded service members who return to the United States for further treatment. This report provides information on current antibiotic regimens, the availability of new antibiotics, research initiatives, and continuing needs related to the ongoing surveillance of these infections.

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Sincerely

JAMES G. ROUDEBUSH
Lieutenant General, USAF, MC, CFS
Surgeon General

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Report on Antibiotic Resistant Bacteria

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON DC

27 February 2008

HQ USAF/SG
1780 Air Force Pentagon
Washington, DC 20330-1780

The Honorable Kay Granger
Ranking Minority Member
Committee on Appropriations
United States House of Representatives
Washington, DC 20515-6015

Dear Ms. Granger

In response to the language of House Report 110-434, page 358, "Making Appropriations for the Department of Defense for the Fiscal Year Ending September 30, 2008," I am forwarding the enclosed report.

Infections from multi-drug resistant organisms have been identified in combat wounded service members who return to the United States for further treatment. This report provides information on current antibiotic regimens, the availability of new antibiotics, research initiatives, and continuing needs related to the ongoing surveillance of these infections.

A similar letter has been sent to the Chairman of your committee, and to the Chairmen and Ranking Minority Members of the other congressional defense committees.

Sincerely

James G. Roudebush

JAMES G. ROUDEBUSH
Lieutenant General, USAF, MC, CFS
Surgeon General

Attachment:
Report on Antibiotic Resistant Bacteria

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON DC

27 February 2008

HQ USAF/SG
1780 Air Force Pentagon
Washington, DC 20330-1780

The Honorable John P. Murtha
Chairman
Subcommittee on Defense
Committee on Appropriations
United States House of Representatives
Washington, DC 20515-6018

Dear Mr. Chairman

In response to the language of House Report 110-434, page 358, "Making Appropriations for the Department of Defense for the Fiscal Year Ending September 30, 2008," I am forwarding the enclosed report.

Infections from multi-drug resistant organisms have been identified in combat wounded service members who return to the United States for further treatment. This report provides information on current antibiotic regimens, the availability of new antibiotics, research initiatives, and continuing needs related to the ongoing surveillance of these infections.

A similar letter has been sent to the Ranking Minority Member of your committee, and to the Chairmen and Ranking Minority Members of the other congressional defense committees.

Sincerely

JAMES G. ROUDEBUSH
Lieutenant General, USAF, MC, CFS
Surgeon General

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Report on Antibiotic Resistant Bacteria

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON DC

27 February 2008

HQ USAF/SG
1780 Air Force Pentagon
Washington, DC 20330-1780

The Honorable C.W. Bill Young
Ranking Minority Member
Subcommittee on Defense
Committee on Appropriations
United States House of Representatives
Washington, DC 20515-6018

Dear Mr. Young

In response to the language of House Report 110-434, page 358, "Making Appropriations for the Department of Defense for the Fiscal Year Ending September 30, 2008," I am forwarding the enclosed report.

Infections from multi-drug resistant organisms have been identified in combat wounded service members who return to the United States for further treatment. This report provides information on current antibiotic regimens, the availability of new antibiotics, research initiatives, and continuing needs related to the ongoing surveillance of these infections.

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Lieutenant General, USAF, MC, CFS
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DEPARTMENT OF THE AIR FORCE
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27 February 2008

HQ USAF/SG
1780 Air Force Pentagon
Washington, DC 20330-1780

The Honorable Carl Levin
Chairman
Committee on Armed Services
United States Senate
Washington, DC 20510-6050

Dear Mr. Chairman

In response to the language of House Report 110-434, page 358, "Making Appropriations for the Department of Defense for the Fiscal Year Ending September 30, 2008," I am forwarding the enclosed report.

Infections from multi-drug resistant organisms have been identified in combat wounded service members who return to the United States for further treatment. This report provides information on current antibiotic regimens, the availability of new antibiotics, research initiatives, and continuing needs related to the ongoing surveillance of these infections.

A similar letter has been sent to the Ranking Minority Member of your committee, and to the Chairmen and Ranking Minority Members of the other congressional defense committees.

Sincerely

JAMES G. ROUDEBUSH
Lieutenant General, USAF, MC, CFS
Surgeon General

Attachment:
Report on Antibiotic Resistant Bacteria

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON DC

27 February 2008

HQ USAF/SG
1780 Air Force Pentagon
Washington, DC 20330-1780

The Honorable John McCain
Ranking Minority Member
Committee on Armed Services
United States Senate
Washington, DC 20510-6050

Dear Senator McCain

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James G. Roudebush

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Lieutenant General, USAF, MC, CFS
Surgeon General

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Report on Antibiotic Resistant Bacteria

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON DC

27 February 2008

HQ USAF/SG
1780 Air Force Pentagon
Washington, DC 20330-1780

The Honorable Ike Skelton
Chairman
Committee on Armed Services
United States House of Representatives
Washington, DC 20515-6035

Dear Mr. Chairman

In response to the language of House Report 110-434, page 358, "Making Appropriations for the Department of Defense for the Fiscal Year Ending September 30, 2008," I am forwarding the enclosed report.

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Surgeon General

Attachment:
Report on Antibiotic Resistant Bacteria

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON DC

27 February 2008

HQ USAF/SG
1780 Air Force Pentagon
Washington, DC 20330-1780

The Honorable Duncan Hunter
Ranking Minority Member
Committee on Armed Services
United States House of Representatives
Washington, DC 20515-6035

Dear Mr. Hunter

In response to the language of House Report 110-434, page 358, "Making Appropriations for the Department of Defense for the Fiscal Year Ending September 30, 2008," I am forwarding the enclosed report.

Infections from multi-drug resistant organisms have been identified in combat wounded service members who return to the United States for further treatment. This report provides information on current antibiotic regimens, the availability of new antibiotics, research initiatives, and continuing needs related to the ongoing surveillance of these infections.

A similar letter has been sent to the Chairman of your committee, and to the Chairmen and Ranking Minority Members of the other congressional defense committees.

Sincerely

JAMES G. ROUDEBUSH
Lieutenant General, USAF, MC, CFS
Surgeon General

Attachment:
Report on Antibiotic Resistant Bacteria

REPORT ON SAFETY MEASURES UTILIZED AT WARREN GROVE GUNNERY RANGE, NEW JERSEY

SECTION 359 REPORT TO CONGRESS

MARCH 1, 2008

TABLE OF CONTENTS

1.0 INTRODUCTION

This report is prepared pursuant to Section 359 of the National Defense Authorization Act for Fiscal Year 2008. See Appendix A for Section 359 reporting requirement language.

Warren Grove Range, located within restricted airspace designated as R-5002, is managed and operated by the 177th Fighter Wing. Entry into the airspace is restricted to provide approved users with a controlled environment in which to train for military and non-department of defense operations in support of military missions including Homeland Defense and the Global War on Terror. The range includes over 9,400 acres of federally owned/controlled land which is secured from public access to prevent inadvertent entry by unauthorized personnel.

Air National Guard (ANG) Ranges are national assets that directly support the ANG's primary mission of training for wartime operations. This training can not be conducted outside the confines of a dedicated training range. Warren Grove supports six primary ANG F-16 and A-10 units as well as other non-DOD users.

In continuous operation since 1942 when opened as a Naval Test Site, Warren Grove Range provides critical training opportunities for a variety of governmental agencies including the US Air Force, US Navy, US Army, the Air and Army National Guards, and other department of defense, federal, and state users. The use of Warren Grove Range and R-5002 is an important component for the training of federal forces in their mission of defending the US at home and overseas. The continued use of Warren Grove Range is contingent upon the ability to apply safety measures and risk management procedures to the existing range operations. The range's close proximity to civilian populations and the New Jersey Pinelands increases the need to insure safety considerations and minimize risk to civilians and their property adjacent to the range.

Additionally, Warren Grove Range is situated in a hurricane protected area with the infrastructure to perform Southern Jersey Emergency Operations Center duties. The co-located generators, water well, and runway make it an ideal location for this tasking. The range also supports the local community by providing local elementary schools with a Living Classroom to support Earth Sciences studies, hosting local university research projects, providing water to assist Forest Fire aircraft combating off range fires, and hosting over 1000 visitors per year.

On May 15, 2007, a fire occurred at Warren Grove Range, caused by the release of flares by a 177FW F-16. The fire burned 18,000 acres of land adjacent to the range and destroyed 4 homes, damaging several others. The range has been closed to operations since at that time. Until that closure, Warren Grove Range was the busiest of 14 ANG Ranges (3192 sorties in FY06) supporting numerous ANG and other service users.

This initial report focuses on the efforts made to ensure that Warren Grove Range provides the highest level of safety to its users and surrounding community. Future reports will detail the Master Plan being implemented at the range.

2.0 ASSESSMENT

Warren Grove Range remains closed pending complete final coordination of the Risk Mitigation Plan (RMP) with the New Jersey Governor's Office and New Jersey's Congressional Delegation. The objective of the RMP is to identify a comprehensive set of command and control procedures aimed at reducing the potential for mishaps at the range. These procedures will be strictly enforced by both the New Jersey Air National Guard and by all agencies engaged in training missions at the range.

2.1 THE FOUR PILLARS OF RISK MANAGEMENT

The development of the RMP is focused on four essential, interrelated pillars of risk management:

1. Reorganization and restructuring of the range Command and Leadership
2. Development and strict enforcement of operating procedures focused on approval processes, communications, and fire risk mitigation
3. Quality assurance procedures and oversight to ensure user compliance with range operating procedures
4. Extensive training at all levels aimed at fostering a culture of safe range operations

2.2 APPLICATION OF THE FOUR PILLARS AT WARREN GROVE

The application of the Four Pillars into the Warren Grove RMP is summarized below. The full details of each item will be published after all involved parties approve the plan.

2.2.1 REORGANIZE THE WARREN GROVE RANGE COMMAND STRUCTURE

Changes in leadership have been made to effect a change in unit culture focusing on range safety, compliance with governing directives, stewardship of critical assets, and risk mitigation. Additionally, the Warren Grove Range has been removed as a Detachment assigned directly to the Wing Commander supervised by the Vice Commander and has been placed under the supervision of the Operations Group Commander.

2.2.2 DEVELOPMENT AND STRICT ENFORCEMENT OF OPERATING PROCEDURES FOCUSED ON APPROVAL PROCESSES, COMMUNICATIONS, AND FIRE RISK MITIGATION

Changes to Warren Grove Range operating procedures have been made to mitigate risk of wildfire and other potential range mishaps. The culture of range operations has changed from one of "approved until prohibited" to one of "prohibited unless approved." Requirements for user coordination with range operations for events and expenditures have been clarified and delineated. The critical impact of this culture change is that there is a prohibitive response in the event of any communications failure. These changes include but are not limited to the following measures

1) Prohibit the use of aircraft flares
2) Prohibit the routine use without prior, written approval of rockets and surface-to-air simulator devices
3) Range control officers are prohibited from requesting aircrew to perform actions which have not been planned and coordinated unless those actions are necessary for safe range operation or range control operator training
4) Embed a Ground Safety Specialist at Warren Grove Range
5) Increased oversight and quality assurance procedures for daily range operations have been implemented
6) Institute mandatory Operational Risk Management procedures at the Warren Grove Range with a focus on wildfire potential
7) Incorporate the strictest possible safety standards on weapons employment into the Warren Grove Range procedures and regulations.
8) Develop detailed fire prevention and response plan to mitigate fire risk potential and standardize fire fighting response for incidental fires on Warren Grove Range

2.2.3 QUALITY ASSURANCE PROCEDURES AND OVERSIGHT TO ENSURE USER COMPLIANCE WITH RANGE OPERATING PROCEDURES

In order to implement risk mitigation strategies, users must be aware of range restrictions and operating requirements. To assure user compliance with the Warren Grove Range operating instructions, users must complete a range procedures lesson prior to utilizing the range. The training will be updated as operating procedures change. Each unit that wishes to utilize the range must maintain a list of users that have completed the course and passed the examination. Failure to comply with this requirement will result in denial of use of Warren Grove Range.

2.2.4 EXTENSIVE TRAINING AT ALL LEVELS AIMED AT FOSTERING A CULTURE OF SAFE RANGE OPERATIONS

The three preceding Pillars are applicable to all Warren Grove Range users and will mitigate risk for the range itself. This final Pillar of risk mitigation is directed towards mitigating risk for 177th Fighter Wing flight operations regardless of range or airspace being utilized for training. The Accident Investigation Board president concluded the cause of the mishap fire was pilot error – a failure of a 177th Fighter Wing pilot to comply with established range restrictions. This Pillar emphasizes that risk mitigation starts and ends with the pilot in command.

The draft RMP establishes new daily communications requirements for the Operations Supervisor and the range control officer. A new review of range operating procedures, instructions and training rules is to be implemented, with a focus on safety requirements and restrictions. In addition, the RMP directs the inclusion of the safety requirements into trainings, briefings and daily procedures.

3.0 PLANS

Warren Grove Range is an extremely important resource for aerial and ground training vital to the defense of the United States. Both the Air Force and the Air National Guard support the re-opening of the range. By implementing new safety, communication, and operational procedures, it is possible to minimize risks to the immediate and surrounding areas, while maintaining an essential training resource.

3.1 ACTION ITEMS FOR IMPLEMENTATION OF THE RISK MANAGEMENT PLAN

The RMP identifies eight primary actions necessary for the successful implementation of the mitigation plan:

1. Reorganize the Warren Grove Range Command Structure
2. Increase oversight and quality assurance procedures for daily range operations
3. Restrict the types of devices that may be used for training at the range
4. Implement an extensive education program for all units and agencies utilizing the range
5. Institute a two-way communications process to restrict range use to users who have been fully briefed concerning the hazards of operation for current day use of the range
6. Increase resources allocated for safe range operations including improved training of range monitor personnel
7. Embed a safety specialist at the Warren Grove Range
8. Increase the timeliness and size of the response force when fire is possible or probable

3.2 FINAL COORDINATON OF THE RISK MITIGATION PLAN

As the RMP receives final approval, the full details should be available for the subsequent Master Plan report, as required by Section 359. The draft RMP is undergoing review and will be coordinated by the following offices:

- Commander of the New Jersey Air National Guard
- The Adjutant General, New Jersey National Guard
- New Jersey Governor's office
- Director of the Air National Guard
- United States Air Force

The preceding summary of the Warren Grove Risk Mitigation Plan characterizes the draft version as of May 2008. Any changes made in the final version will be included with Master Plan Report.

APPENDIX A

SEC. 359. REPORTS ON SAFETY MEASURES AND ENCROACHMENT ISSUES AND MASTER PLAN FOR WARREN GROVE GUNNERY RANGE, NEW JERSEY.

(a) Annual Report on Safety Measures- Not later than March 1, 2008, and annually thereafter for 2 additional years, the Secretary of the Air Force shall submit to the congressional defense committees a report on efforts made by all of the military departments utilizing the Warren Grove Gunnery Range, New Jersey, to provide the highest level of safety.

(b) Master Plan for Warren Grove Gunnery Range-

(1) IN GENERAL- Not later than 180 days after the date of the enactment of this Act, the Secretary of the Air Force shall submit to the congressional defense committees a master plan for Warren Grove Gunnery Range.

(2) CONTENT- The master plan required under paragraph (1) shall include measures to mitigate encroachment of the Warren Grove Gunnery Range, taking into consideration military mission requirements, land use plans, the surrounding community, the economy of the region, and protection of the environment and public health, safety, and welfare.

(3) INPUT- In establishing the master plan required under paragraph (1), the Secretary shall seek input from relevant stakeholders at the Federal, State, and local level.

Congressional Report

Report on Search and Rescue Capabilities of the Air Force in the Northwestern United States

House Report 110-477, page 76

U.S. AIR FORCE

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Introduction

This report is being provided to the appropriate Congressional Committees as directed in House Report 110-477, page 76, dated December 06, 2007. This report addresses the Congressional request to submit a report on the Air Force's search and rescue capabilities in the northwestern United States. Specifically, the following areas are addressed in this report:

(1) An assessment of the search and rescue capabilities required to support Air Force operations and training
(2) A description of the compliance of the Air Force with the 2007 United States National Search and Rescue Plan (NSRP) for Washington, Oregon, Idaho, and Montana
(3) An inventory and description of the search and rescue assets of the Air Force that are available to meet the requirements of the NSRP
(4) A description of the use of such search and rescue assets during the three-year period preceding the date when the report is submitted
(5) The plans of the Air Force to meet current and future search and rescue requirements in the northwestern United States, including plans that take into consideration requirements related to support for both Air Force operations and training and compliance with the NSRP
(6) An inventory of other search and rescue capabilities equivalent to such capabilities provided by the Air Force that may be provided by other Federal, State, or local agencies in the northwestern United States

Executive Summary

Per the National Search and Rescue Plan, the Air Force is the recognized Search and Rescue Coordinator for the aeronautical Search and Rescue Region (SRR) encompassing the continental United States. The Air Force accomplishes Search and Rescue Coordinator duties via the established Air Force Rescue Coordination Center based at Tyndall Air Force Base, Florida which coordinates the use of Department of Defense and other federal assets in support of the National Search and Rescue Plan. In addition, the Air Force, along with other services and agencies, also provides aircraft and personnel to perform search and rescue missions, if requested, to local and state authorities on a case-by-case basis. Specifically for the northwestern United States, the Air Force has consistently provided significant contributions for both coordination of missions by the Air Force Rescue Coordination Center and actual accomplishment of missions with regionally based operational and training assets when requested.

Report

This report examines the search and rescue capabilities of the Air Force in the northwestern United States. For the purposes of this examination, the northwestern United States will be considered the four state region consisting of Idaho, Montana, Oregon, and Washington. Examined Air Force capabilities include helicopters, fixed-wing aircraft, or personnel specifically trained or equipped for search and rescue mission execution. Other Air Force assets, such as those equipped with surveillance capabilities, could also potentially assist in search and rescue missions but are not examined in this report.

(1) An assessment of the search and rescue capabilities required to support Air Force operations and training

In the northwestern region, the Air Force maintains two helicopter units with primary missions of supporting Air Force operations and training. These units consist of the 40th Helicopter Squadron at Malmstrom Air Force Base, Montana and the 36th Rescue Flight at Fairchild Air Force Base, Washington. Both of these units utilize the UH-1N Twin Huey helicopter equipped with hoist and Forward Looking Infrared (FLIR) systems. Also, an Air Force Reserve unit, the 304th Rescue Squadron, at Portland, Oregon provides a squadron of specially trained Pararescue (PJ) personnel able to augment rescue aircraft and perform and coordinate ground searches. These units may be available for civil search and rescue on a non-interference basis with their primary military missions. Specific descriptions of these three units are below:

36th Rescue Flight
Organized under the Air Education and Training Command, this unit consists of four UH-1N helicopters with the primary mission of supporting Survival, Evasion, Resistance, and Escape (SERE) student training at the Air Force SERE School and also providing evacuation capability of injured Department of Defense personnel from remote training areas.

40th Helicopter Squadron
Organized under the Air Force Space Command, this unit consists of eight UH-1N helicopters with the primary mission of providing a flexible, rapid response for intercontinental ballistic missile (ICBM) security. In addition, the helicopters provide surveillance and the rapid transport of personnel and components in support of ICBM operations.

304th Rescue Squadron
An Air Force Reserve unit, the 304th Rescue Squadron provides approximately forty-five Pararescue personnel to Air Combat Command. This unit provides capability for the Air Force's combat search and rescue (CSAR) mission and has been deployed in support of the Global War on Terror. Normally, these personnel are deployed with Air Force aircraft to perform the CSAR mission.

(2) A description of the compliance of the Air Force with the 2007 United States National Search and Rescue Plan (NSRP) for Washington, Oregon, Idaho, and Montana

The NSRP recognizes the Air Force as the Search and Rescue Coordinator for the aeronautical Search and Rescue Region corresponding to the continental United States (other than Alaska). Specifically, the NSRP states the Search and Rescue Coordinator has overall responsibility for establishing a Rescue Coordination Center (RCC) for their region and for providing or arranging for search and rescue services within their region.

The Air Force, as the recognized Search and Rescue Coordinator for the continental United States aeronautical region, has established the Air Force Rescue Coordination Center at Tyndall Air Force Base, Florida to coordinate and arrange search and rescue missions. Department of Defense components have facilities and other assets which may be utilized for civil search and rescue needs to the fullest extent practicable on a non-interference basis with primary military duties according to national directives, plans, guidelines, and agreements. The Air Force, through the Air Force Rescue Coordination Center, coordinates and provides efficient utilization of Department of Defense assets for civil search and rescue operations.

With the establishment of the Air Force Rescue Coordination Center, the Air Force is in compliance with the NSRP and recognized Search and Rescue Coordinator duties for the aeronautical region of the continental United States. In addition, on a non-interference basis with primary Air Force missions, aircraft and personnel may be provided to assist in civil search and rescue missions.

(3) An inventory and description of the search and rescue assets of the Air Force that are available to meet the requirements of the NSRP

The Air Force maintains a dedicated combat search and rescue force structure to enable recovery operations in denied enemy and hostile environments. Although these assets are heavily deployed in support of Global War on Terror operations, when available and on a non-interference basis with their primary military mission, they may assist in civil search and rescue operations such as disaster relief response. Also, other Air Force assets, such as those assigned to Air Force Space Command, Air Force Special Operations Command and Air Education and Training Command possess inherent capabilities to perform search and rescue mission execution if available and are included in this report.

HH-60G Pave Hawk helicopter
Specialized combat search and rescue helicopter equipped with weather radar, Forward Looking Infrared, and hoist extraction systems. Air Force Pararescue personnel normally fly as aircrew to extract and perform medical care on survivors.

HH-60G helicopters are based at the following locations in the continental United States and Alaska and are able to support NSRP requirements if available. Although not specifically based in the northwestern United States, assets could assist for major requirements in any region of the United States, such as occurred during the Hurricane Katrina response.

Location	Quantity	Command
Alaska – Kulis Air National Guard Base	6	Air National Guard
Arizona – Davis-Monthan Air Force Base	6	Air Force Reserve Command
Arizona – Davis-Monthan Air Force Base	8	Air Combat Command
California – Moffett Federal Air Field	6	Air National Guard
Florida – Patrick Air Force Base	9	Air Force Reserve Command
Georgia – Moody Air Force Base	15	Air Combat Command
New Mexico – Kirtland Air Force Base	12	Air Education and Training Command
New York – Gabreski Field	6	Air National Guard
Nevada – Nellis Air Force Base	15	Air Combat Command

HC-130 Combat King fixed-wing aircraft
Specialized combat search and rescue aircraft equipped with weather radar, Forward Looking Infrared, and airdrop capability of equipment and Pararescue personnel. In addition, HC-130s can perform air refueling of HH-60G helicopters extending range and response capabilities.

HC-130 aircraft are based at the following locations in the continental United States and Alaska and are able to support NSRP requirements if available. Although not specifically based in the northwestern United States, assets could assist for major requirements in any region of the United States, such as occurred during the Hurricane Katrina response.

Location	Quantity	Command
Alaska – Kulis Air National Guard Base	4	Air National Guard
Arizona – Davis-Monthan Air Force Base	4	Air Combat Command
California – Moffett Federal Air Field	4	Air National Guard
Florida – Patrick Air Force Base	5	Air Force Reserve Command
Georgia – Moody Air Force Base	10	Air Combat Command
New Mexico – Kirtland Air Force Base	4	Air Education and Training Command
New York – Gabreski Field	5	Air National Guard

Pararescue personnel

Specialized combat search and rescue trained personnel normally utilized in conjunction with HH-60G and HC-130 aircraft. Pararescue personnel provide medical treatment to survivors as well as perform ground search and rescue missions in demanding environments. Pararescue teams also provide high altitude, maritime, confined space, and vehicle extraction capabilities.

Location	Quantity of PJs	Command
Alaska – Kulis Air National Guard Base	29	Air National Guard
Arizona – Davis-Monthan Air Force Base	48	Air Combat Command
Arizona - Davis-Monthan Air Force Base	19	Air Force Reserve Command
California – Moffett Federal Air Field	32	Air National Guard
Florida – Hurlburt Air Force Base	36	Air Force Special Operations Command
Florida – Patrick Air Force Base	37	Air Force Reserve Command

Location	Quantity of PJs	Command
Georgia – Moody Air Force Base	59	Air Combat Command
Kentucky – Louisville International Airport	13	Air National Guard
New Mexico – Kirtland Air Force Base	23	Air Education and Training Command
Nevada – Nellis Air Force Base	30	Air Combat Command
New York – Gabreski Field	23	Air National Guard
North Carolina – Pope Air Force Base	36	Air Force Special Operations Command
Oregon – Portland International Airport	45	Air Force Reserve Command

UH-1N helicopter
Utility helicopter utilized for training and military support missions. Helicopters may be equipped with Forward Looking Infrared and hoist extraction systems at some locations. Medical technicians or Flight Surgeons are normally carried to perform medical care on survivors during search and rescue taskings.

Location	Quantity	Command
Florida – Eglin Air Force Base	2	Air Force Material Command
Florida – Hurlburt Air Force Base	2	Air Force Special Operations Command
Maryland – Andrews Air Force Base	19	Air Force District of Washington
Montana – Malmstrom Air Force Base	8	Air Force Space Command
New Mexico – Kirtland Air Force Base	6	Air Education and Training Command
North Dakota – Minot Air Force Base	8	Air Force Space Command

Location	Quantity	Command
Washington – Fairchild Air Force Base	4	Air Education and Training Command
Wyoming – F.E. Warren Air Force Base	9	Air Force Space Command

The Air Force Special Operations Command also has aircraft possessing an inherent capability to perform search and rescue missions. Normally, these assets are heavily deployed and tasked in support of Global War on Terror operations but, if available, may perform civil search and rescue support in the continental United States.

<u>MH-53 Pave Low helicopter</u>
Specialized helicopter optimized for special operations infiltration into deep, denied areas. Equipped with radar, Forward Looking Infrared, and hoist extraction systems. This aircraft will be permanently retired in October 2008.

<u>CV-22 Osprey tilt-rotor</u>
Tilt-rotor aircraft for special operations mission execution. Equipped with radar, Forward Looking Infrared, and hoist extraction systems. This aircraft is currently being fielded.

<u>MC-130E/H/P/W</u>
Fixed-wing aircraft equipped with radar, Forward Looking Infrared, and airdrop capability of equipment and personnel. In addition, MC-130s can perform air refueling of configured helicopters and CV-22s extending range and response capabilities.

Location	Quantity
Florida – Hurlburt Air Force Base	13 - MH-53 helicopter* 4 - CV-22 tilt-rotor 18 - MC-130
New Mexico – Kirtland** and Cannon Air Force Base	4 - CV-22 11- MC-130

* MH-53 will be retired by October 2008
** Assigned to Air Education and Training Command

(4) *A description of the use of such search and rescue assets during the three-year period preceding the date when the report is submitted*

During the period 2005 through 2007, the Air Force Rescue Coordination Center coordinated and arranged for 7,175 missions utilizing federal assets for search and rescue execution in the United States. In addition, the Air Force Rescue Coordination Center managed over 21,000 incidents during this timeframe resulting in the saving of 980 lives.

Air Force aircraft and personnel performed numerous search and rescue missions since 2005 including searches for overdue or missing aircraft and lost persons and rescues of injured civilians. Notably, during the aftermath of Hurricane Katrina, the Air Force amassed a large task force of rescue assets from the Active Duty, Air National Guard, and Air Force Reserve consisting of over 30 helicopters, 2 HC-130 aircraft, Pararescue, and Special Tactics Teams which were responsible for saving over 4,300 lives.

Specifically, for the northwestern United States, Air Force assets performed 70 search and rescue missions in this time period resulting in the saving of numerous lives. These missions were performed by the 36th Rescue Flight, 40th Helicopter Squadron, and 304th Rescue Squadron.

(5) *The plans of the Air Force to meet current and future search and rescue requirements in the northwestern United States, including plans that take into consideration requirements related to support for both Air Force operations and training and compliance with the NSRP*

The Air Force continues to examine and refine search and rescue capabilities ensuring compliance with the NSRP as well as the most efficient utilization and location of resources for operations and training in a fiscally constrained environment.

Recently, the Air Force relocated the Air Force Rescue Coordination Center from Langley Air Force Base, Virginia to Tyndall Air Force Base, Florida to maximize the ability to integrate with other Air Force command and control functions ensuring maximum support for search and rescue missions in Idaho, Montana, Oregon, and Washington.

In addition, Air Force Space Command recently increased the quantity of UH-1N helicopters at Malmstrom Air Force Base, Montana to enhance the support capabilities for ICBM operations. As noted earlier, these aircraft are able to perform search and rescue taskings on a case-by-case, non-interference basis with their primary mission of ICBM support.

The Air Force will continue to ensure, with consideration to the full spectrum of federal, state, and local assets in the northwestern United States, adequate search and rescue capabilities, including the Air Force Rescue Coordination Center, are available for mission coordination and execution.

(6) *An inventory of other search and rescue capabilities equivalent to such capabilities provided by the Air Force that may be provided by other Federal, State, or local agencies in the northwestern United States*

The following table highlights other assets in the northwestern United States capable of search and rescue mission taskings:

Location	Type	Organization	Remarks
Idaho - Boise	UH-60	Army National Guard	
Montana - Helena	UH-60 & CH-47	Army National Guard	
Oregon - North Bend	HH-65	Coast Guard	
Oregon - Astoria	HH-60	Coast Guard	
Oregon - Salem	UH-60	Army National Guard	

Location	Type	Organization	Remarks
Oregon - Pendleton	CH-47	Army National Guard	
Washington - Naval Air Station Whidbey Island	MH-60	Navy	
Washington - Port Angeles	HH-65	Coast Guard	
Washington - Fort Lewis	CH-47	Army Reserve	CH-47 - High Altitude Rescue Capability
Washington – Spokane & Gray Army Air Field	UH-60	Army National Guard	

Congressional Report

Report on Cheyenne Mountain Master Infrastructure Recapitalization Plan

Conference Report 110-477 to accompany H.R. 1585, Section 361
Page 78

U.S. AIR FORCE

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Introduction

This report is being provided to the Appropriations Committees as directed in House Report 110-477, page 78, dated December 6, 2007. This report addresses the Congressional request to submit a report on the Cheyenne Mountain Master Infrastructure Recapitalization Plan. The specific language follows:

"(1) IN GENERAL.-Not later than March 16, 2008, the Secretary of the Air Force shall submit to Congress a master infrastructure plan for Cheyenne Mountain Air Station. (2) CONTENT.-The plan required under paragraph (1) shall include—(A) a description of the projects that are needed to improve the infrastructure required supporting missions associated with Cheyenne Mountain Air Station; and (B) a funding plan explaining the expected timetable for the Air Force to support such projects."

Executive Summary

Cheyenne Mountain Air Force Station (CMAFS) is, and will continue to be, a vital component of national security. As such, CMAFS will continue to require infrastructure investment, and Air Force Space Command's intention is to continue providing this investment to support missions within CMAFS. The attached report shows the actual funding of projects in FY07 and planned (unfunded) future investments based on current mission requirements.

The following table outlines infrastructure project totals as of Feb 08 by FY:

Infrastructure Project List ($M)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Facility	10.91	5.08	5.38	3.15	3.38	1.24	3.24	4.23	1.31	37.92
Communication	1.37	3.44	0	6.07	.34	1.22	1.1	0	0	13.54
Total	12.28	8.52	5.38	9.22	3.72	2.46	4.34	4.23	1.31	51.46

Report

See following page.

Facility Infrastructure Project List

FY	DESCRIPTION	COST ($)
2007	CONSTRUCT STORAGE AREA - CHAMBER C	24,908
	CONSTRUCT WALL/DOOR (ROOM 3211)	12,321
	CONSTRUCT WALLS TSF ROOM 131	10,509
	EROSION CONTROL (NORAD & SOUTH PORTAL ROADS)	494,359
	HEATING, VENTILATING AND AIR CONDITIONING (HVAC) STUDY	90,647
	HVAC, FINISH, AND FIRE SUPPRESSION IMPROVEMENTS (11201)	199,073
	INSTALL CONDUIT/POWER FOR CAMERAS	47,597
	INSTALL ELECTRIC METERS	95,763
	INSTALL HVAC AND POWER (ROOM 2101)	449,505
	INSTALL POWER AND HVAC (ROOM 10102)	26,703
	INSTALL SPRINKLERS AND BACKFLOW PREVENTION DEVICES	147,675
	MAINTAIN CHEMICAL, BIOLOGICAL, RADIOLOGICAL FILTERS	44,862
	MAX FLOOR LOAD STUDY FOR 1111, 2102, 3310	25,000
	OVERLAY UPPER PARKING LOT	431,983
	REMOVE ABANDONED UNDERGROUND SEPTIC TANKS	20,158
	REPAIR RACQUETBALL COURT	85,558
	REPAIR AUXILIARY EXHAUST BLAST VALVE EQUIPMENT	233,878
	REPAIR AUXILIARY EXHAUST BLAST VALVES	850,610
	REPAIR MAIN WATER LINE TO CMAFS-PHASE 1	456,533
	REPAIR POWER CENTER 11	1,166,616
	REPAIR POWER CENTER 15	1,315,799
	REPAVE VEHICLE ENTRANCE (SALLY PORT) AREA	257,400
	REPLACE 4160V MARINE CABLE FEEDER	404,038
	REPLACE AIR HANDLER (MECH ROOM 102)	516,386
	REPLACE AIR HANDLER (MECH ROOM 22)	324,794
	REPLACE AIR HANDLER (MECH ROOM-31/33)	317,000
	REPLACE ANALOG EXCITERS - POWER PLANT	559,164
	REPLACE MAKE-UP AIR WAVEGUIDES	58,000
	REPLACE NORAD C/D UNINTERRUPTIBLE POWER SYSTEM	1,700,000
	REPLACE ROOF ON MOUNTAIN MAN PARK PAVILIONS	39,554
	RESURFACE WALKING/RUNNING TRACK	72,767
	TRACE & LABEL POWER PANEL CIRCUITS (PHASE IB)	269,000
	TRACE & LABEL POWER PANEL CIRCUITS (PHASE IA)	163,122
2007 Total		10,911,281
2008	INSTALL POWER AIR WARNING CENTER ROOM 2202	100,000
	MAINTAIN CHEMICAL, BIOLOGICAL, RADIOLOGICAL FILTERS	45,000
	RELOCATE DIESEL FUEL LINES IN BUILDING 12506	35,000
	RENOVATE RESTROOMS & LOCKER ROOMS IN 100 AND 101	80,000
	REPAIR EROSION AT ATV BRIDGE AND BOUNDARY FENCE	200,000
	REPLACE AIR HANDLER (MECH ROOM 34)	317,000
	REPLACE ELECTRICAL RELAYS (PHASE 1)	100,000
	REPLACE INDUSTRIAL COOLING WATER PUMPS (P-203 & P-204)	200,000
	REPLACE INTELLIGENCE AGENCY C/D UNINTERRUPTIBLE POWER SYSTEM	3,000,000
	REROOF BLDGS 103,104,106,200	150,000
	TRACE & LABEL POWER PANEL CIRCUITS (PHASE II)	500,000
	TRANSFER AUTO CADD AND MICROFICHE DATA TO CD'S	20,000
	UPDATE FACILITIES EXCELLENCE PLAN	30,000
2008 Total		5,077,000

Facility Infrastructure Project List (Continued)

FY	DESCRIPTION	COST ($)
2009	CRACK SEAL ALL PAVED AREAS OF CMAFS PHASE II	30,000
	CRACK SEAL ALL PAVED AREAS OF CMAFS PHASE III	30,000
	EXTEND ROOF HOIST (BLDG 1000)	543,000
	INSTALL FIRE SUPPRESSION SYSTEMS (300 AREA)	550,000
	INSTALL POWER AND HVAC ROOM 2204	250,000
	INSTALL POWER ROOM 8101B	60,000
	MAINTAIN CHEMICAL, BIOLOGICAL, RADIOLOGICAL FILTERS	80,000
	REFURBISH EXISTING ELEVATOR (BLDG 1000)	300,000
	REPAIR / REFURBISH SEWER MANHOLE #7	24,000
	REPAIR DOMESTIC WATER PIPE - BULK HEAD TO TANK #28	22,000
	REPAIR SNAP GLASS WINDOWS	50,000
	REPLACE A/C UNITS (AC-200 THRU AC-206)	280,000
	REPLACE CHILLED WATER VALVES	240,000
	REPLACE CHILLER BUILDING AIR HANDLER UNIT (AC-17)	200,000
	REPLACE ELECTRICAL RELAYS (PHASE 2)	450,000
	REPLACE SERVICE ADIT AIR HANDLER UNIT (AC-6)	100,000
	SEAL SOUTH PORTAL ROAD	50,000
	STABILIZE LAND SLIDE AREA	1,600,000
	TRACE & LABEL POWER PANEL CIRCUITS (PHASE III)	500,000
	UPGRADE ELECTRICAL - BLDG 100	25,000
2009 Total		5,384,000
2010	INSTALL AIR HANDLER UNIT VARIABLE FREQUENCY DRIVES	525,000
	INSTALL CHILLER VARIABLE FREQUENCY DRIVES	425,000
	INSTALL CONDENSATE HOT WATER PUMP	255,000
	INSTALL SECONDARY PUMP VARIABLE FREQUENCY DRIVES	315,000
	REPAVE SOUTH PORTAL ROAD	150,000
	REPLACE NORAD UTILITIES UNINTERRUPTIBLE POWER SYSTEM	1,000,000
	RETROFIT LIGHTING	475,000
2010 Total		3,145,000
2011	CONNECT NORAD E-BUS UPS TO BLDG 11	50,000
	CONSTRUCT WALL (BLDG 101, RM 203)	11,301
	CRITICAL INFRASTRUCTURE SURVEY	500,000
	EXPAND BLDG 309	745,000
	INSTALL CONTROLS (MECH ROOM 13W)	68,000
	INSTALL FUEL TANK (BLDG 517)	115,000
	PROVIDE GEOGRAPHICAL INFORMATION SYSTEM PHASE II	100,000
	REMOVE FIRE ALARM DEVICES	150,000
	RENOVATE HVAC (5300 AREA)	140,888
	REPAIR EROSION ALONG BOTH SIDES NORAD ROAD	200,000
	REPLACE CHEMICAL BIOLIGICAL RADIOLOGICAL DETECT SYSTEMS	1,284,558
	REPLACE DOMESTIC WATER PUMPS	20,000
2011 Total		3,384,747
2012	CONSTRUCT HANDICAP RAMP - 9201	40,000
	CRACK SEAL ALL PAVED AREAS OF CMAFS PHASE IV	30,000
	INSTALL BACK-UP GENERATOR FOR 300 AREA	150,000
	INSTALL BASE LIGHTING	100,000
	INSTALL SECTIONALIZER SWITCHES	120,000
	INSTALL STARTERS ON PUMPS	70,000
	MAINTAIN WATER PLATFORMS AND WALKWAYS	25,000
	REPLACE POWER MONITORING SYSTEM	75,000
2012 Total		1,240,000

Facility Infrastructure Project List (Continued)

FY	DESCRIPTION	COST ($)
2013	CONSTRUCT RUNNING TRACK	200,000
	CORROSION CONTROL (DOMESTIC RESERVOIR PLATFORM)	310,000
	CRACK SEAL ALL PAVED AREAS PHASE V	30,000
	ENCLOSE SPACE BETWEEN BUILDINGS 321 AND 320	50,000
	INSTALL BULK WATER FILL STATION PRE-FAB BUILDING	25,000
	INSTALL TEMPORARY OFFICES	300,000
	REBUILD / REPLACE BUS SWITCHES C&D - PH I	250,000
	REBUILD / REPLACE BUS TIE SWITCHES C&D - PH II	250,000
	RECONSTRUCT BRIDGE INTERSECTIONS	500,000
	REPLACE BATTERY BLAST SYSTEM AND CHARGER	150,000
	REPLACE ELECTRICAL FEEDERS (SUBSTATION - ELEC BAY)	500,000
	REPLACE VEHICLE WASHRACK - BLDG 302	357,000
	REPLACE VINYL COVERINGS (COMPLEX WIDE)	315,000
2013 Total		3,237,000
2014	CONSTRUCT VISUAL SCREEN FENCE	250,000
	INSTALL DUPLEX CHILLED WATER LINES UNDER BUILDINGS	1,200,000
	INSTALL HYDRANT SYSTEM	750,000
	INSTALL REFLECTIVE FILM (BLDG 101)	20,000
	INSTALL SUMP DRAINS - COMM MANHOLES	100,000
	RECONFIGURE FIRE DEPARTMENT ROOM 1108	10,000
	REPAIR CONCRETE SIDEWALK	75,000
	REPLACE 180 NICAD BATTERIES, BATTERY RACKS & CHARGERS	125,000
	REPLACE AIR HANDLER (MECH ROOM 61)	280,000
	REPLACE AIR HANDLER UNIT (BLDG 101)	635,000
	REPLACE AIR HANDLERS (MECH ROOMS 21E & 21W)	475,000
	REPLACE ALL HANDRAIL AND RAILINGS THROUGHOUT COMPLEX	200,000
	REPLACE CEILING TILES (BLDG 101)	10,000
	REPLACE ELECTRICAL TRANSFORMERS	100,000
2014 Total		4,230,000
2015	CONSTRUCT ENTRY CONTROL - BLDG 106	75,000
	CONSTRUCT STEEL LADDERS	45,000
	ENCLOSE ENTRY CONTROL FACILITY	30,000
	EXPAND OMCS ETHERNET TO INCLUDE BLDG 100	25,000
	EXTEND ATV TRAIL	100,000
	INSTALL CANOPY - BASE GAS STATION	50,000
	INSTALL DROP ARM BARRIERS	300,000
	RELOCATE CORE & TECH CONTROL DOUBLE DOORS	40,000
	RENOVATE ROOM 1111 TO ACCMODATE FIRE STORAGE VAULTS	40,000
	RENOVATE ROOMS 4309 & 4308 TO EXPAND 4309	27,000
	REPAVE ACCESS ROAD 300 BUILDING AREA	350,000
	REPLACE ELECTRICAL POWER PANELS	75,000
	REPLACE ELECTRICAL TRANSFORMERS	150,000
2015 Total		1,307,000
Grand Total		37,916,028

Communication Infrastructure Project List

FY	DESCRIPTION	COST ($)
2007	Replace Security Control System	740,000
	Upgrade Secure Telephone Switch Connectivity	150,000
	Upgrade Video Switch	480,000
2007 Total		1,370,000
2008	Capture Communications Geospatial mapping data	200,000
	Improve Communications Manhole Duct system	1,000,000
	Increase Secure Communications Access Nodes	250,000
	Install Wireless Data Network	420,000
	Replace Data network Systems	200,000
	Replace Remote Telephone Switch	566,300
	Replace Telephone Switch Voice Mail	200,000
	Upgrade Secure Telephone Switch Instruments	500,000
	Upgrade Telephone Switch Data Processors	103,500
2008 Total		3,439,800
2010	Replace Antenna Cable	435,000
	Replace Small Secure Telephone Switch	4,500,000
	Upgrade Communications Interior Wiring	300,000
	Upgrade Telephone Switch Operating Software	833,333
2010 Total		6,068,333
2011	Upgrade Network Equipment	336,000
2011 Total		336,000
2012	Replace Telephone Switch Batteries	120,000
	Upgrade Data Network Throughput Connectivity	100,000
	Upgrade Physical Boundary Security Devices	1,000,000
2012 Total		1,220,000
2013	Expand Host Telephone Switch Capabilities	1,000,000
	Install Security System Devices	100,000
2013 Total		1,100,000
Grand Total		13,534,133

Congressional Report

Report on Utilization of Tuition Assistance by Members of the Armed Forces

House Report 110-477, page 111

U.S. AIR FORCE

Integrity - Service - Excellence

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Introduction

This report is being provided to the Defense Committees as directed in House Report 110-477, page 111, dated December 6, 2007. This report addresses the Congressional request to submit a report on the utilization of tuition assistance by members of the Air Force. The specific language of Section 533(a) follows:

"The Secretary of each military department shall submit to the congressional defense committees a report on the utilization of tuition assistance by members of the Armed Forces, whether in the regular components of the Armed Forces, under the jurisdiction of such military department during the fiscal year 2007."

The specific language of Section 533(b) for the report with respect to a military department under subsection (a) shall include the following:

" 1) Information on the policies of such military department for fiscal year 2007 regarding utilization of, and limits on tuition assistance by members of the Armed Forces under the jurisdiction of such military department, including an estimate of the number of members of the reserve components of the Armed Forces under the jurisdiction of such military department whose requests for tuition assistance during that fiscal year were unfunded."

"2) Information on the policies of such military department for fiscal year 2007 regarding funding of tuition assistance for each of the regular components of the Armed Forces and each of the reserve components of the Armed Forces under the jurisdiction of such military department."

Executive Summary

Historically, the Air Force Military Tuition Assistance (Mil TA) Program has been successfully used as a recruitment and retention incentive wherein individuals are offered the opportunity to work towards both personal and professional higher educational goals, while serving our nation. In addition to enhancing Airmen's educational levels, the completed educational goals link well with Air Force institutional and occupational competencies. Policies encourage progressive educational completion. Limits are established to discourage repetitive education level pursuit. No reserve components were denied the Mil TA benefit due to lack of funds. Funding caps per credit hour and per year are set by the Department of Defense to ensure equity across the Services.

Background

Air Force (AF) has a history of providing strong education support for both officers and enlisted Airmen as part of the need to adapt its forces and capabilities to respond to a full range of strategic challenges. After the 1947 creation of the Air Force as a separate Service there was a great need for rated officers. During the "Space Race" of the 1960's it became obvious that all officers needed college education to deal with the emerging technologies. Accession programs that ensured bachelor degree completion were AF Reserve Officer Training Corps (AFROTC), Air Force Academy, and Officer Training School (OTS). Because of the fast growing need for pilots, two programs were created to allow entry without a bachelor's degree - Aviation Cadet Program (ACP) and Officer Candidate School (OCS). In 1962 the AF Voluntary Education (Vol Ed) Program began with a 75% Military Tuition Assistance (Mil TA) program, counseling services, Department of Defense funded academic testing, and a few on-base college programs. This ensured all active duty officers accessed through a nondegree-granting program acquired a bachelor's degree during their first tour of duty. By 1965 the Air Force changed accession policy and required all new accessions to hold a bachelor's degree upon entry. The ACP and OCS programs were terminated. The degree-requirement policy for entering officers allowed the AF to expand the Mil TA program in order to encourage officers to move upward with their education and pursue Advanced Academic Degrees (AAD). An officer's education level became part of the "total person" review at promotion boards. Because of this, today 90% of all officer Mil TA enrollments consist of Lieutenants and Captains who understand the value of an AAD for career advancement opportunities. Because the Vol Ed Program establishes on-base programs, each of these degree opportunities have been chosen in order to contribute to Air Force institutional and occupational skills.

Enlisted members also began to take advantage of the on-base Vol Ed services and the 75% Mil TA for tuition and fees at regionally accredited colleges. Because of frequent moves during a career and the need to transfer credits to a new school after each move, the AF developed an opportunity to assist enlisted Airmen with college accomplishment - Community College of the Air Force (CCAF). It was created in the 1970's to document credentialing of enlisted Airmen's training. Then AF went through the process to obtain regional accreditation from the Southern Association of Colleges and Schools (SACS) for Associate in Applied Science (AAS) degrees in enlisted career fields. The impact of this opportunity can be seen in the trends of participation and completion rates of enlisted members. Even though the enlisted force has been drawn down by approximately 100,000 since 1993, college participation has increased from 10% of the end strength to 33% of end strength. Current trends now show that one out of every three enlisted Airmen is enrolled in college courses each year. Award of CCAF AAS degrees in that same time frame rose from 12,318 in 1993 to 17,456 in 2007. Increased percentage of enlisted participation is translating into increased education goal completion in degrees that are career field related and contributing to Air Force institutional and occupational skills..

In the 1990's the Mil TA program expanded again to pay for Airmen to attend nationally accredited schools as well as regionally accredited schools. This opened up certificate and licensure programs that had been previously unavailable for Mil TA use. This expanded Airmen's capability to acquire other skills in addition to academic knowledge. By 2007, the ratio of expenditures in the Mil TA budget was 80% to enlisted and 20% to officers. A program that initially focused on officers was being well utilized by enlisted AF members. In a time of tightly controlled budgets, Mil TA has become the "go to" option for professional education. It has served the Air Force well by building a professional corps and enticing the best to make a career in the AF. Education is among the top reasons for individuals to join the AF – after "patriotism" and "securing a job." It is the number one benefit named in surveys over the last sixteen years for influencing Airmen to re-enlist.

Report

Air Force Military Tuition Assistance (Mil TA) Program Utilization and Limits

In 2007, utilization of Mil TA increased due to new AF policies and programs that encourage college attendance. Individual participation increased by six percent, enrollments increased by three percent, and Mil TA expenditures increased by ten percent. The unmasking of education level for officers meeting promotion boards, the requirement for a CCAF degree for enlisted to qualify for a senior rater (general officer level) endorsement on an annual appraisal, and the Air University Associate to Baccalaureate Cooperative (AU-ABC) impacted Mil TA activity causing an increase. Mil TA activity numbers for active duty were 94,786 individual participants, 277,697 course enrollments, and $164,241,100 expended in active duty Mil TA resources. Mil TA activity numbers for Reserve not on active duty were 2,979 individual participants, 10,111 course enrollments, and $5,571,993 expended in Reserve Mil TA resources.

In 2007, all active duty and reserve Airmen received Mil TA for courses requested that met AF policy. No one was turned away for lack of funds. There is a separate funding account for active duty and for reserve members. A statistical evaluation of Distance Learning (DL) courses , available through the Internet, were on average 33.7% more costly than the same courses delivered through the traditional in-the-classroom format. Approximately 50% of all course enrollments in the Air Force are now in DL courses. The DL option contributes to the flexibility of Airmen to continue pursuing their educational goals even though assigned temporarily or permanently to overseas locations. It has also resolved much of the transfer problems that Airmen encountered prior to establishment of the Internet when they had to attend all courses in-residence. DL course attendance is via the Internet.

Air Force Military Tuition Assistance (Mil TA) Program Policies and Funding

The Air Force Mil TA program supports long-range Air Force goals for maintaining a high-quality force and enhancing professional and personal development. It is an effective benefit that supports Air Force recruitment and retention. The policies regarding funding ensure that educational goals from high school completion, if needed, through certificate/licensure, associate, baccalaureate, and master's degrees are funded in accordance with the Department of Defense (DoD) policy for uniform funding among the Services. The DoD funding caps are $250 per semester hour, $166 per quarter hour, and $4,500 per fiscal year. Each Airman is required to set an education goal, provide an education plan such as a degree plan prior to authorization of Mil TA. This ensures each course enrollment fits into the education plan. Mil TA is authorized only for courses conducted by a school that has either regional or national accreditation from an agency recognized by the Department of Education. The AF provides funds for educational goals in a progressive manner and does not fund a second education goal at the same level. Mil TA covers reimbursable tuition and fees required by an institution as a condition of course enrollment. Students are required to complete courses with a satisfactory grade of "D" or above at the undergraduate level and "C" or above at the graduate level. Students are required to reimburse the government for nonsatisfactory results unless they have evidence that conditions beyond their control impeded them from satisfactory completion. Mil TA is paid to enlisted Airmen as long as the school's term dates fall within the dates of their active duty service and they have no active duty service commitment after the end of the term. Mil TA is paid in a similar manner to officer Airmen with one exception – in Title 10, Section 2007, officers have a service commitment of two years after course completion.

Funding is always a challenge as this program is a voluntary participation program rather than highly controlled through quotas. Each year funding need is based on prior year enrollments and expenditures. Statistics published in the Journal of Higher Education show tuition rate increases for 2-year and 4-year public schools as well as private schools have averaged over 5% per year. That inflation rate is included in annual yearly funding estimates for the Mil TA Program. The inflation rate included in the Program Objective Memorandum (POM) cycle traditionally is set as 2% for education and training. This does not allow the Air Force to fully fund in programming and planning across the future year defense program (FYDP). With the history of Mil TA expenditures back to 2000 loaded in AFAEMS, estimates of usage have become very accurate. New AF policy changes that impact the Mil TA budget within the same year can cause a shortfall required to be covered in year of execution until the budgeting process can accurately program funds in the next cycle. When DoD implemented the Uniform Mil TA Policy in fiscal year 2003, it took three years for the programming cycle to catch up with the unexpected high participation that it sparked among Airmen. In 2007, funding was provided to cover every Mil TA request from Airmen that met AF policy.

Recent Air Force Policies Impacting College Attendance and Mil TA Use by Airmen

In calendar year 2008, there is a lifting of a previous policy to mask (hide) officer education levels in files reviewed by officer promotion boards. With this, the emphasis on advanced academic degrees (AAD) returned to the forefront for officers. Education level updates in officer records to reflect AAD completion that previously averaged 1,500-2,000 per year, jumped to over 6,000 in calendar year 2006 to meet promotion board data cutoff dates. Officers who had previously stopped progress toward an AAD quickly completed any remaining course requirements and updated their record in military files.

In October of 2007, enlisted members were required to earn their CCAF degree before being considered for special endorsement by a senior rater of general officer level on their annual appraisal. The impact of this has been record CCAF graduation totals over the last three years, even though the enlisted force has been going through a down-sizing in order to better shape the AF and ensure critical military specialty fields are filled at needed capacity levels. In 2007, 17,456 CCAF AAS degrees were awarded.

In January 2007, the Air Force relaxed the policy on Mil TA for educational goals so that it could pay for individual foreign language courses that build the culture and language capabilities of Airmen sent to overseas locations and involved in the Global War on Terror. In 2007, the following college course enrollment activity in foreign languages was 1,940 individual participants, 2,077 course enrollments, and $1,107,649 Mil TA expended.

In June 2007, a new opportunity was unveiled for enlisted members wanting to continue their education after completing their career-related CCAF degree yet allow transfer of the maximum credits from that degree. The opportunity is called Air University Associate to Baccalaureate Cooperative (AU-ABC). It is a search engine loaded into the Air Force Virtual Education Center (AFVEC) obtainable on-line through the Air Force Portal (AF Portal). Partner schools throughout the United States were invited to register their bachelor degree programs that transfer all CCAF credits toward their bachelor's degrees and require only sixty more semester hours of credit for degree completion. In the past the CCAF degree, which is not equivalent to an associate of arts (AA) degree from a civilian college, was not well accepted because it contains only fifteen semester hours of general education courses. Most AA degrees contain 30 semester hours of general education courses. The AA degree is frequently equivalent to the first two years of a bachelor's degree. AF partner schools have for years been accepting many and sometimes all CCAF credits in transfer however the AU-ABC opportunity allowed them to register those transfer opportunities in the preferred search site for Airmen in the on-line AFVEC. This increased the capability of the AF to continue an enlisted member's education in career-related degree areas, building Air Force institutional and occupational skills. Since June 2007, thirty one schools have registered over eighty degrees in AU-ABC. Over two thousand Airmen made the decision in 2007 to continue on toward a bachelor's degree after recently completing their CCAF degree.

In April 2007, the Air National Guard was provided the opportunity to build content pages in the AFVEC for each of their education out-reach offices. The year before, 2006, the Air Force Reserve had built content pages for each of their units and built an on-line Mil TA option for their Reserve forces not on active duty. ANG does not have a Mil TA program like active duty or the Reserves. It is a grant-like opportunity with an agreement in most States between the ANG and the State schools to waive tuition payment. Each State has its own limit for the grant. The AF Reserve has policies similar to active duty in that it does not pay for degrees at the education level already attained and requires Airmen to progress upward in their educational goals. The funding limit for the Reserve is also $4,500 annually with a stipulation that Reserve members who move from Reserve to active duty status have a combined total of $4,500 annually. By using the same database for both active duty and Reserve in the Air Force Automated Education Management System (AFAEMS), the use of funds as a Reservist moves from "weekend warrior" status to full-time active duty is accurately tracked for wise use of resources of the Reserves and the Active Duty funds.

Congressional Report

Report on Feasibility of Establishing an Association Between 120^{th} Fighter Wing of the Montana National Guard and the Active Duty Stationed at Malmstrom AFB

House Report 110-477, page 197

U.S. AIR FORCE

Introduction

This report is being provided to the Congressional Defense Committees as directed in House Report 110-477, page 197, dated December 6, 2007. This report was developed pursuant to Section 2878 of the National Defense Authorization Act for Fiscal Year 2008, which provides as follows:

(1) An evaluation of the requirement of the Air Force for additional F–15 aircraft active or reserve component force structure.

(2) An evaluation of the airspace training opportunities in the immediate airspace around Great Falls International Airport Air Guard Station.

(3) An evaluation of the impact of civilian operations on military operations at Great Falls International Airport.

(4) An evaluation of the level of civilian encroachment on the facilities and airspace of the 120th Fighter Wing.

(5) An evaluation of the support structure available, including active military bases nearby.

(6) An evaluation of opportunities for additional association between the Montana National Guard and the 341st Space Wing.

(b) LIMITATION ON REMOVAL PENDING REPORT.—Not more than 40 missiles may be removed from the 564th Missile Squadron until 15 days after the report required in subsection (a) has been submitted.

Executive Summary

Section 2878 of the National Defense Authorization Act (NDAA) for Fiscal Year (FY) 2008 requires the Secretary of Defense to submit to the congressional defense committees a report on the feasibility of establishing an association between the 120th Fighter Wing at Great Falls International Airport, Montana and the active duty force at Malmstrom Air Force Base (AFB), Montana.

An evaluation of force structure and aircraft based on current and projected budgetary constraints determined that an association based on flying missions would not be feasible at this point. However, as demonstrated with the 219th RED HORSE Squadron (a MT ANG classic association with an active duty unit at Malmstrom AFB), the United States Air Force is committed to creating associations when we believe Reserve Components can provide cost-effective military capability.

The United States Air Force values the support received by the citizens and community in the Great Falls area. Malmstrom AFB and the Great Falls International Airport conduct critical missions in support of the defense of our nation through the 341st Space Wing and the Air National Guard's 120th Fighter Wing and 219th RED HORSE Squadron. In support of these missions, the Total Force Integration process continues to explore opportunities for additional associations with the 341st Space Wing.

Report

The United States Air Force realizes an integrated Total Force is the key to meeting the challenges and opportunities confronting the nation today and tomorrow. When implementing associations between Reserve Components and the active duty force, we are focused on providing combat capability to the nation in the most cost-effective way through a mix of active, Reserve Component, and civilian forces.

The Air Force is experiencing many challenges as we fly, fight, and win in the atmosphere, space, and the electromagnetic spectrum. The Air Force continues to examine its force structure to insure it provides superior combat capabilities to the warfighters.

(1) An evaluation of the requirement of the Air Force for additional F–15 aircraft active or reserve component force structure.

Air Combat Command (ACC) has been analyzing the entire F-15 fleet to include exploring opportunities for Total Force Integration (TFI) in the F-15. ACC is investigating a possible association at Jacksonville, utilizing manpower authorizations from a future reduction at the Formal Training Unit, but that option depends on overall F-15 force structure decisions. Currently, ACC does not have the available manpower authorizations to form an Active Association at any ANG F-15 base.

If Regular Air Force manpower becomes available due to future force structure decisions, ACC would explore options to stand-up additional Active Associations. If these actions do occur, the earliest opportunity for TFI in the F-15 would be after FY12. Additionally, proximity to Air Sovereignty Alert sites may be a factor in determining the priority of TFI associations.

(2) An evaluation of the airspace training opportunities in the immediate airspace around Great Falls International Airport Air Guard Station.

Currently, the F-16s from the 120th Fighter Wing use the Hayes Military Operations Area (MOA) for instrument training, air-to-air operations (defensive and offensive counterair) and air-to-ground operations (non-live munitions) to include close air support.

(3) An evaluation of the impact of civilian operations on military operations at Great Falls International Airport.

The impact of civilian operations on military operations was examined with the upcoming transition to a different weapon system (from the F-16 weapon system to the F-15 weapon system). The civilian operations at Great Falls International Airport do not have significant impact to current or future military operations.

(4) An evaluation of the level of civilian encroachment on the facilities and airspace of the 120th Fighter Wing.

During BRAC actions involving the 120th Fighter Wing, the Air Force in conjunction with the National Guard Bureau (NGB) submitted an Environmental Assessment (EA) that issued a Finding of No Significance (FONSI) for the F-16 to F-15 transition. The NGB also examined the potential for follow-on aircraft in the Great Falls area with respect to encroachment and noise considerations. The Great Falls airport has plans to add a parallel runway in the future that would reduce noise and encroachment issues, which currently surround operations with single runway operations.

(5) An evaluation of the support structure available, including active military bases nearby.

The support structure at Malmstrom AFB and Great Falls Airport is sufficient for both current and future operations based on force structure changes that are planned through the Future Year Defense Plan (FYDP).

(6) An evaluation of opportunities for additional association between the Montana National Guard and the 341st Space Wing.

Currently, there are no planned or programmed associations between the Montana National Guard and the 341st Space Wing. The classic association between the 219th RED HORSE Squadron (MT ANG) and the active duty 819th RED HORSE Squadron is a positive reflection of Montana's dedication to "total force" transformation. The Air Force will continue to investigate future opportunities based on the judicious use of equipment and personnel.

All transformation actions, including TFI associations, rely on evolving COCOM requirements and must align with the Air Force Roadmap, which is our template for transformation into AF 2025. As we pursue future opportunities, we must balance the desire to enhance capabilities force-wide against an increasingly constrained fiscal environment. The Air Force's ability to recapitalize its inventory to meet Required Force programming levels would likely result in an increased ability to associate at more locations. The Air Force must adhere to economies of scale within finite manpower and equipment resources, and must prioritize all missions to ensure that the 21st Century Air Force delivers Global Vigilance, Global Reach and Global Power.

REPORT IN RESPONSE TO DIRECTION IN THE NATIONAL DEFENSE AUTHORIZATION ACT FOR FISCAL YEAR 2008, REPORT 110-477, DECEMBER 6, 2007

COST AND FEASIBILITY OF INTEGRATING A SPACE BASED INFRARED SYSTEM HIGLY ELIPTICAL ORBIT SENSOR ONTO A GEO SATELLITE

1. Overview

The Conference Report on the 2008 National Defense Authorization Act directed the Air Force to study the cost and feasibility of integrating a SBIRS Highly Elliptical Orbit (HEO) payload (PL) onto a Geosynchronous Earth Orbit (GEO) space vehicle (SV). The Air Force deems this concept to be technically feasible but will not provide "DSP-like" performance without modifications to the sensor and satellite bus. The Air Force estimates a cost of approximately $2.08B for the development and fielding of this asset.

2. Concept Description

2.1. General Technical Overview

The feasibility of integrating a SBIRS HEO PL on a generic/commercial GEO bus and a SBIRS GEO bus were considered. Integration of a HEO PL on a generic/commercial GEO bus will result in significant Non-Recurring Engineering (NRE) to meet stringent pointing accuracy requirements, survivability (radiation hardening) and other SBIRS specific requirements. For a single unit gap filler mission, the resulting NRE cost would not only be cost prohibitive but also result in higher technical risks. Therefore, to minimize NRE cost and risk, the study utilized the concept of integrating a SBIRS HEO PL on a SBIRS GEO SV. This approach requires moderate re-engineering of both the PL and SV. The SBIRS HEO PL must be modified for re-hosting from its current classified space vehicle host to a SBIRS GEO SV. The GEO SV functions in a similar manner to its current state but requires modifications for hosting a SBIRS HEO PL.

2.2. PL and SV Modifications (Space Segment)

A proposed configuration of a HEO PL on a GEO SV is shown in Figure 1. This configuration was developed by the Aerospace Corporation and has been preliminarily engineered for most of the major aspects of intended use.

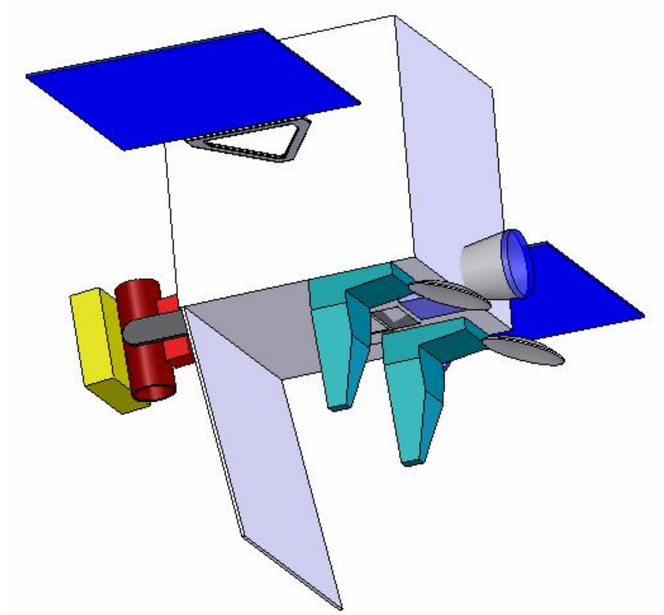

Figure 1. New Configuration for the Space Segment

The major PL and SV modifications in this configuration include:

- Repositioning of the PL and pallet components for attachment to SV
- New PL deployable sunshade due to a new geosynchronous orbit
- New PL reference bench due to a new geosynchronous orbit
- New Signal Processor Assembly (SPA) to incorporate new processor and associated SW due to a new SV host
- Modification of the PL and SV Thermal Control Systems (TCS) to accommodate new sun location due to a geosynchronous orbit and new heat loads of HEO PL
- Modified SV Pointing and Control Assembly due to gimbaled HEO PL
- Modified SV Flight Processor due to obsolescence of current processor and new flight software to accommodate the new processor
- Modified Command and Data Handling system to accommodate new PL

2.3. Supporting (SEIT) Products Modifications

The major systems engineering, integration, and testing modifications to incorporate this new space system (PL and SV) into the SBIRS system include:

- Modification to requirements verification and system test plans to include new simulation models for verifying and testing the new space system (PL and SV)
- Modification of the flight operations test plans and supporting software

2.4. Ground Products Modifications

The supporting ground products will have to go through minor modifications to incorporate a new space system (PL and SV) into the existing SBIRS system. The ground Tracking, Telemetry, and Control SW (TT&C) will have to be modified to insure proper functionality of a re-designed space system (PL and SV). The Mission Management software will also require modifications to incorporate a sensor in a geosynchronous orbit that does not have the same capability as the current SBIRS GEO sensors to insure proper tasking/constellation management.

3. Technical Feasibility

3.1. Overview

The feasibility of the study was performed in cooperation with the Aerospace Corporation. Based on the analysis performed, the concept is technically feasible. As stated in the concept description, the concept will require significant modification. In addition to the physical changes, the new configuration will also require new computational analysis to account for the new structural loads and thermal properties. The main issue with technical feasibility is associated with the gimbals on the PL.

3.1.1. Advantages/Pros

This configuration takes advantage of a proven space asset (although used differently) and a SV which by the time of major activity would also be proven. Major contributions in heritage can be expected to result in some risk reduction due to its level of maturity. The Ground Segment would have to replicate functions performed by the Classified Host SV but this design is owned by the government and arrangements probably could be made to transfer some of the functionality.

3.1.2. Challenges/Cons

The main challenge is producing an asset that does not violate non-degradation of the Mission Products. All four Mission Areas (Missile Warning (MW), Missile Defense (MD), Technical Intelligence (TI), and Battlespace Awareness (BSA) will have adverse impacts. The gimbals response and life are the main issues. With the current HEO design the gimbals can be expected to produce on the order of a 13.5 second revisit rate. The required revisit rate is on the order of 10 seconds. Given this revisit rate, initial report time, state vector accuracy, required number of hits on short duration theater missiles, would have unacceptable performance. A scan rate of 6 degrees per second is required to meet the required revisit rate. The gimbals were tested at 6.5 degrees per second in Azimuth and 4.8 degrees per second in Elevation with reduced moments of inertia. Actual moments of inertia are higher. Nominal scan rate operation is lower for High Sense and Fast revisit. Running the bearings at faster rates would have to be life tested and is an indeterminate risk at this point. Running the motors at higher currents and/or voltage to mitigate back electromotive force (EMF) limitations on the maximum gimbals velocity may have adverse thermal and life implications which are also indeterminate at this time. Removing equipment from the gimbaled mass to reduce moments of inertia would lead to other engineering challenges (e.g. noise, line of sight, etc.) A scan rate of 6 degrees per second would produce an acceptable Noise Equivalent Target (NET) when compared to DSP. The less sensitive NET would degrade TI and BSA to DSP levels of observation.

4. Production Schedule

4.1. Overview

In August 2006, a risk assessment was performed to determine the timelines for various Program Alternatives for the HEO Program. The schedule for accomplishing this re-engineering is between minimum and modest redesign. The range is shown in Table 1 and shows a schedule on the order of 8 to 9 years to get to mission operations (9 months pre-award and 12 months of on-orbit check-out time included).

Consistent with 17 August ,2006 Wormington Risk Assessment

	Govt Prep	Pre-EMD Competition Downselect	Development Non-recurring Engineering	Production	On-Orbit Checkout, Tuning, OT&E, ITW/AA Cert [1]	Months To Mission Ops
SBIRS Derivative, Same Team	9	0	69 Activities accomplished in parallel		6	9 + 75
Modest Block Upgrade [2] Same Team	9	0	24 (CDR)	69	12	9 + 105
New Development Competitive	15	24 (PDR)	18 (CDR)	69	12	15 +123

Notes:
1 – Timeframe shorter for proven design
2 – Upgrade processor & focal plane –existing telescope / optics

Table 1

5. Cost Estimate Rough Order of Magnitude (ROM)

5.1. General Overview

The cost estimate is based on the preceding concept definition and system description. It is important to note that the cost for modifying the HEO PL gimbals is not included in the cost estimate and, as described in the technical feasibility section of this document, limits the system's performance capability. The cost estimate assumes an 8-year development period producing one HEO PL on a GEO SV and incorporation into the SBIRS systems.

5.2. Cost estimating methodology

The estimate is based on an analogy to GEO 1-2 and HEO 1-2 non-recurring engineering (NRE) and recurring (REC) cost data. The HEO PL on GEO SV costs were derived by applying analogy factors to the GEO 1-2 and HEO 1-2 cost data. Analogy factors were derived based on an assessment by a joint SBIRS Wing cost/technical team.

5.3. Cost Estimate Summary

Total: $2.078B Then Year Dollars
NRE: $1.103B Then Year Dollars
REC: $0.975B Then Year Dollars

5.4. NRE

Major NRE cost elements include redesign of the GEO SV structures and mechanisms; new processor; new software language; modification of PCA software; modification of SPA software; and associated impacts to space vehicle integration, system design/test and Ground software.

5.5. REC

Recurring cost elements reflect cost similar to GEO 1-2 space vehicle integration and test, spacecraft, SEPM and Ground; and HEO P/L recurring costs. Additional recurring costs were added to the HEO SPA to increase performance to GEO SPA levels.

5.6. Ground Rules and Assumptions

- No HEO PCA Gimbal changes, resulting in less than "DSP like" performance
- Applied GEO 1-2 and HEO 1-2 non-recurring engineering (NRE) and recurring (REC) unit costs
- Used 15% of hardware recurring costs for spares
- GEO 1-2 and HEO 1-2 NRE and REC unit costs adjusted for new configuration complexity
- Applied 15% risk for NRE and REC
- Assumed 8 year development cycle
- Assumed no major parts obsolescence issues
- Assumes sole source to current EMD contractor (LM/NGC)
- Does not include Other Government Costs (i.e. Wing support, FFRDC, etc)

6. Conclusion

While technically feasible, the analyzed configuration will not meet the criteria of non-degradation of current MW and MD (“DSP-like”) without some level of re-engineering and re-design of the gimbals. While risks for the PL and SV have been burned down due to maturity level of the HEO and GEO operations/development, the proposed concept requires a new space configuration. There is a significant amount of engineering that must be done to integrate the PL and SV and incorporate this asset into the SBIRS system.

SECRETARY OF THE AIR FORCE
WASHINGTON

APR 7 2009

The Honorable Daniel K. Inouye
Chairman
Subcommittee on Defense
Committee on Appropriations
United States Senate
Washington, DC 20510-6028

Dear Mr. Chairman:

I am responding to House Report 110-652, page 408 from the Fiscal Year 2009 Defense Authorization Act, which directs the Secretary of the Air Force to report to the Congressional Defense Committees of the Senate and the House on the roles and responsibilities of Air Force Cyberspace Command. The committee asked for this report no later than 90 days after enactment of the National Defense Authorization Act.

In the months since the Air Force announced our intent and began action to formally establish a Cyberspace Command, we have examined a variety of alternatives to provide the desired capabilities at both the Department of Defense and national levels. We have determined the best solution for our Air Force and the nation is a cyberspace Numbered Air Force assigned to Air Force Space Command.

The Air Force remains fully committed to providing robust cyberspace capabilities. Over the past year, we defined the organization, training and equipping requirements and resources needed to ensure we have the capability to defend the Joint Force's use of the cyberspace domain into the future. We are now focused on developing a plan to activate the Numbered Air Force and realign program management of cyberspace capabilities into Air Force Space Command. We are also in the intermediate stages of a structured process to identify the permanent location for 24 AF, conducted in accordance with Air Force Instruction 10-503, *Base Unit Beddown Program*, with the goal of making the final site selection by June 2009, following compliance with the National Environmental Policy Act. By this summer, after we formally develop and document directives to establish the Numbered Air Force and assign roles and responsibilities, we will deliver Congress a more thorough report.

A similar letter has been sent to the Ranking Minority Member of your committee and to the Chairman and Ranking Minority Member of the other Congressional Defense Committees.

Sincerely,

Michael B. Donley

Michael B. Donley

SECRETARY OF THE AIR FORCE
WASHINGTON

APR 7 2009

The Honorable Thad Cochran
Ranking Minority Member
Subcommittee on Defense
Committee on Appropriations
United States Senate
Washington, DC 20510-6028

Dear Senator Cochran:

I am responding to House Report 110-652, page 408 from the Fiscal Year 2009 Defense Authorization Act, which directs the Secretary of the Air Force to report to the Congressional Defense Committees of the Senate and the House on the roles and responsibilities of Air Force Cyberspace Command. The committee asked for this report no later than 90 days after enactment of the National Defense Authorization Act.

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Sincerely,

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SECRETARY OF THE AIR FORCE
WASHINGTON

APR 7 2009

The Honorable David Obey
Chairman
Committee on Appropriations
U.S. House of Representatives
Washington, DC 20515-6015

Dear Mr. Chairman:

I am responding to House Report 110-652, page 408 from the Fiscal Year 2009 Defense Authorization Act, which directs the Secretary of the Air Force to report to the Congressional Defense Committees of the Senate and the House on the roles and responsibilities of Air Force Cyberspace Command. The committee asked for this report no later than 90 days after enactment of the National Defense Authorization Act.

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Sincerely,

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SECRETARY OF THE AIR FORCE
WASHINGTON

APR 7 2009

The Honorable Jerry Lewis
Ranking Minority Member
Committee on Appropriations
U.S. House of Representatives
Washington, DC 20515-6015

Dear Representative Lewis:

I am responding to House Report 110-652, page 408 from the Fiscal Year 2009 Defense Authorization Act, which directs the Secretary of the Air Force to report to the Congressional Defense Committees of the Senate and the House on the roles and responsibilities of Air Force Cyberspace Command. The committee asked for this report no later than 90 days after enactment of the National Defense Authorization Act.

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SECRETARY OF THE AIR FORCE
WASHINGTON

APR 7 2009

The Honorable John P. Murtha
Chairman
Subcommittee on Defense
Committee on Appropriations
U.S. House of Representatives
Washington, DC 20515-6018

Dear Mr. Chairman:

I am responding to House Report 110-652, page 408 from the Fiscal Year 2009 Defense Authorization Act, which directs the Secretary of the Air Force to report to the Congressional Defense Committees of the Senate and the House on the roles and responsibilities of Air Force Cyberspace Command. The committee asked for this report no later than 90 days after enactment of the National Defense Authorization Act.

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Sincerely,

Michael B. Donley

SECRETARY OF THE AIR FORCE
WASHINGTON

APR 7 2009

The Honorable C.W. Bill Young
Ranking Minority Member
Subcommittee on Defense
Committee on Appropriations
U.S. House of Representatives
Washington, DC 20515-6018

Dear Representative Young:

I am responding to House Report 110-652, page 408 from the Fiscal Year 2009 Defense Authorization Act, which directs the Secretary of the Air Force to report to the Congressional Defense Committees of the Senate and the House on the roles and responsibilities of Air Force Cyberspace Command. The committee asked for this report no later than 90 days after enactment of the National Defense Authorization Act.

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Sincerely,

Michael B. Donley

SECRETARY OF THE AIR FORCE
WASHINGTON

APR 7 2009

The Honorable Carl Levin
Chairman
Committee on Armed Services
United States Senate
Washington, DC 20510-6050

Dear Mr. Chairman:

I am responding to House Report 110-652, page 408 from the Fiscal Year 2009 Defense Authorization Act, which directs the Secretary of the Air Force to report to the Congressional Defense Committees of the Senate and the House on the roles and responsibilities of Air Force Cyberspace Command. The committee asked for this report no later than 90 days after enactment of the National Defense Authorization Act.

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SECRETARY OF THE AIR FORCE
WASHINGTON

APR 7 2009

The Honorable John McCain
Ranking Minority Member
Committee on Armed Services
United States Senate
Washington, DC 20510-6050

Dear Senator McCain:

I am responding to House Report 110-652, page 408 from the Fiscal Year 2009 Defense Authorization Act, which directs the Secretary of the Air Force to report to the Congressional Defense Committees of the Senate and the House on the roles and responsibilities of Air Force Cyberspace Command. The committee asked for this report no later than 90 days after enactment of the National Defense Authorization Act.

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SECRETARY OF THE AIR FORCE
WASHINGTON

APR 7 2009

The Honorable Ike Skelton
Chairman
Committee on Armed Services
U.S. House of Representatives
Washington, DC 20515-6035

Dear Mr. Chairman:

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Sincerely,

Michael B. Donley

SECRETARY OF THE AIR FORCE
WASHINGTON

APR 7 2009

The Honorable John McHugh
Ranking Minority Member
Committee on Armed Services
U.S. House of Representatives
Washington, DC 20515-6035

Dear Representative McHugh:

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Sincerely,

Michael B. Donley

Michael B. Donley

DEPARTMENT OF THE AIR FORCE
WASHINGTON, DC

Office of the Assistant Secretary

AUG 01 2008

SAF/FMB
1130 Air Force Pentagon
Washington, DC 20330-1130

The Honorable David R. Obey
Chairman
Committee on Appropriations
United States House of Representatives
Washington, DC 20510-6036

Dear Mr. Chairman

Enclosed is the "Air Force Family Housing Privatization Report: Status of Housing Privatization Projects at Hanscom, Patrick, Little Rock, and Moody Air Force Bases," consistent with the reporting requirement proposed in the Fiscal Year 2009 Military Construction and Veterans Affairs Appropriations Bill. Intense negotiations for the consensual sale of these projects by American Eagle to Hunt Pinnacle Group are ongoing. The parties are finalizing the definitive purchase and sale agreement and want to close the transaction later this fall.

The Air Force remains committed to a solution for the problems with the American Eagle projects that provide the required homes to our Airmen and their families, protects our Air Force investments, and resolves unpaid liens and claims of subcontractors which have performed work on the projects. As we have done in the past, we will continue to update members of Congress who have these projects in their states and districts on the status of the consensual sale process and stand ready to provide face to face briefings or meetings as desired.

A similar letter has been sent to the Ranking Minority Member of your Committee and to the Chairman and Ranking Minority Member of the House Appropriations Committee, Subcommittee on Military Construction and Veterans Affairs.

Sincerely

LARRY O. SPENCER, Maj Gen, USAF
Deputy Assistant Secretary (Budget)

Attachment:
Air Force Family Housing Privatization Report

DEPARTMENT OF THE AIR FORCE
WASHINGTON, DC

Office of the Assistant Secretary

AUG 01 2008

SAF/FMB
1130 Air Force Pentagon
Washington, DC 20330-1130

The Honorable Chet Edwards
Chairman
Subcommittee on Military Construction and Veterans Affairs
Committee on Appropriations
United States House of Representatives
Washington, DC 20515-6026

Dear Mr. Chairman

Enclosed is the "Air Force Family Housing Privatization Report: Status of Housing Privatization Projects at Hanscom, Patrick, Little Rock, and Moody Air Force Bases," consistent with the reporting requirement proposed in the Fiscal Year 2009 Military Construction and Veterans Affairs Appropriations Bill. Intense negotiations for the consensual sale of these projects by American Eagle to Hunt Pinnacle Group are ongoing. The parties are finalizing the definitive purchase and sale agreement and want to close the transaction later this fall.

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Attachment:
Air Force Family Housing Privatization Report

DEPARTMENT OF THE AIR FORCE
WASHINGTON, DC

AUG 0 1 2008

Office of the Assistant Secretary

SAF/FMB
1130 Air Force Pentagon
Washington, DC 20330-1130

The Honorable Jerry Lewis
Ranking Minority Member
Committee on Appropriations
United States House of Representatives
Washington, DC 20510-6036

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LARRY O. SPENCER, Maj Gen, USAF
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DEPARTMENT OF THE AIR FORCE
WASHINGTON, DC

AUG 01 2008

Office of the Assistant Secretary

SAF/FMB
1130 Air Force Pentagon
Washington, DC 20330-1130

The Honorable Zach Wamp
Ranking Minority Member
Subcommittee on Military Construction and Veterans Affairs
Committee on Appropriations
United States House of Representatives
Washington, DC 20515-6026

Dear Mr. Wamp

Enclosed is the "Air Force Family Housing Privatization Report: Status of Housing Privatization Projects at Hanscom, Patrick, Little Rock, and Moody Air Force Bases," consistent with the reporting requirement proposed in the Fiscal Year 2009 Military Construction and Veterans Affairs Appropriations Bill. Intense negotiations for the consensual sale of these projects by American Eagle to Hunt Pinnacle Group are ongoing. The parties are finalizing the definitive purchase and sale agreement and want to close the transaction later this fall.

The Air Force remains committed to a solution for the problems with the American Eagle projects that provide the required homes to our Airmen and their families, protects our Air Force investments, and resolves unpaid liens and claims of subcontractors which have performed work on the projects. As we have done in the past, we will continue to update members of Congress who have these projects in their states and districts on the status of the consensual sale process and stand ready to provide face to face briefings or meetings as desired.

A similar letter has been sent to the Chairman of this Subcommittee and to the Chairman and Ranking Minority Member of the House Appropriations Committee.

Sincerely

LARRY O. SPENCER, Maj Gen, USAF
Deputy Assistant Secretary (Budget)

Attachment:
Air Force Family Housing Privatization Report

Air Force Family Housing Privatization Report: Status of Housing Privatization Projects

at Hanscom, Patrick, Little Rock, and Moody Air Force Bases

Status: Project owners in default; bondholders stopped construction funding in 2007

- Hanscom – American Eagle scope 784 homes, 17 currently complete
- Patrick – American Eagle scope 552 homes, 163 currently complete
- Little Rock – American Eagle scope 1,200 homes, 28 currently complete
- Moody – American Eagle scope 606 homes, 0 complete

Information Hotline: Established July 1, 2008

- A toll-free telephone number was established on July 1, 2008, to answer questions related to the housing privatization projects at Hanscom, Patrick, Little Rock and Moody Air Force bases. The number is 1-877-527-2654.
- 12 calls have been received as of 25 Jul 08 date and responses to all calls were provided within 24 hours
- Most calls related to Moody project including calls from three subcontractors

Lien and Claim Status: Payment of subcontractor liens and claims progressing; As of 25 Jul 08:

- Majority of liens/claims have been resolved at Hanscom, Patrick and Little Rock
  - Hanscom: 38 claims, 35 validated, 31 paid to date ($6.1M)
  - Patrick: 26 claims, 25 validated, 22 paid to date ($2.4M)
  - Little Rock: 32 claims, 30 validated, 27 paid to date ($1.3M)
- Claims at Moody exceed $9M
  - Moody: 54 claims, 15 validated (to date), 15 paid ($1.7M)
  - Current project owner, prospective new owner, and surety are working with Georgia court and the receiver to refine/establish lien resolution process for Moody

Sale Negotiations Chronology: Hunt Pinnacle Group is prospective new project owner

- Hunt Pinnacle Group signed a letter of intent with the American Eagle project owners effective April 1, 2008 for acquisition of the projects
- Negotiations reached an impasse in May 2008
- Impasse resolved in June 2008 after meeting with SAF/IE on June 5, 2008 and a subsequent follow-on meeting on June 10-11, 2008 in San Antonio
- Parties currently working on a definitive purchase and sale agreement
- Sale closing projected for later this fall

United States Air Force

Report to Congressional Appropriations Committees

Report on Child Care Waiting List

September 2008

Introduction

This report is being provided to the congressional defense committees as directed in House Report 110-775, page 3.

"Report on Child Care Waiting Lists.—The Committee notes that the President has called for an increased commitment to providing child care and youth activity services to military families. The Committee fully supports this commitment and commends the Department of Defense for following the lead of Congress and increasing the number of child development and youth activity facilities from three in the fiscal year 2008 request to eleven in the fiscal year 2009 request. The Committee believes that more effort is needed, and to further this initiative, the committee directs that the Secretaries of the Army, Navy, and Air Force each provide a report to the Committees on Appropriations of both Houses of Congress on the current waiting list for child care services at each installation no later than August 1, 2008."

Executive Summary

This report provides the current Air Force Child Care Waiting List as of July 2008. Waiting list data changes daily based upon a variety of factors including the age of children, work status of parents and preference for child care. The list includes children who may already be using other child care options. The Department of Defense uses a population based formula to determine child care need, rather than a waiting list, due to fluctuations caused by these factors.

In FY05, the Air Force demand for child care, using the established AF and DoD formula, was 6,400 spaces.

From FY05-08, OSD funded $74M for 50 minor construction projects at 29 Air Force locations, reducing the shortage of child care spaces by 2,717 to a new demand of 3,683 spaces. For these projects, the Air Force funded $11.9M toward manpower (86 positions), supplies and equipment in FY08.

In FY08, three Child Development Centers with 866 spaces were approved in the military construction program. For these projects, the Air Force approved $4.758M in the FY10 POM for manpower (27 positions), supplies and equipment. These projects reduce the demand to 2,817 spaces.

Also, in FY08, three Child Development Centers with 724 spaces were approved with Supplemental funding. Two additional Child Development Centers with 433 spaces were submitted for FY09 PB and Supplemental funding and are very likely to be approved. For these projects, $21.5M will be submitted in the Air Force FY11 APOM for manpower (144 positions), supplies and equipment.

The preceding projects reduce the child care demand to 1,660 spaces by FY12.

Currently, there are six Child Development Centers (Vandenberg, CA; MacDill, FL; Moody, GA; Hill, UT; Hurlburt, FL; and Nellis, NV) on the Air Force Military Construction list for FY10-FY15. For these projects, a total of $15M would be needed for manpower (150 positions), supplies and equipment.

The Air Force has funded supplies, equipment and materials for new Child Development Centers and small minor construction projects at the following bases in Europe: Ramstein, Ramstein/Vogelweh, Geilenkirchen, Buchel, and Spangdahlem.

These Air Force efforts will decrease our overall child care waiting lists to approximately zero by 2016.

Report

AIR FORCE CHILD CARE WAITING LIST - JULY 2008
CHILDREN 6 WEEKS TO 12 YEARS

STATE	BASE	MAJOR COMMAND	WAITING LIST TOTAL
AK	Eielson **	PACAF	5
AK	Elmendorf **	PACAF	60
AL	Maxwell/Gunter	AETC	75
AR	Little Rock **	AETC	18
AZ	Luke	AETC	120
AZ	Davis-Monthan **	ACC	126
CA	Beale * **	ACC	175
CA	Edwards ** **	AFMC	14
CA	Los Angeles	AFSPC	53
CA	Vandenberg ***	AFSPC	53
CA	Travis **	AMC	209
CO	Buckley **	AFSPC	129
CO	Peterson	AFSPC	89
CO	Schriever	AFSPC	25
CO	Academy **	USAFA	32
DC	Bolling (includes DIA)	AFDW	69
DE	Dover	AMC	77
FL	Tyndall **	AETC	43
FL	Eglin * **	AFMC	309
FL	Hurlburt ** ***	AFSOC	160
FL	Patrick *	AFSPC	104
FL	MacDill ** ***	AMC	138
GA	Moody ** ***	ACC	142
GA	Robins	AFMC	55

STATE	BASE	MAJOR COMMAND	WAITING LIST TOTAL
HI	Hickam ** **	PACAF	291
ID	Mountain Home **	ACC	63
IL	Scott *	AMC	92
KA	McConnell	AMC	56
LA	Barksdale	ACC	77
MA	Hanscom **	AFMC	86
MD	Andrews	AFDW	85
MN	Minot	ACC	29
MO	Whiteman	ACC	10
MS	Columbus * **	AETC	24
MS	Keesler	AETC	70
MT	Malmstrom **	AFSPC	31
NC	Seymour-Johnson **	ACC	42
NC	Pope	AMC	98
ND	Grand Forks	AMC	10
NE	Offutt (CDC opens Sep 08) ** **	ACC	237
NJ	McGuire	AMC	80
NM	Cannon *	AFSOC	37
NM	Holloman ** **	ACC	30
NM	Kirtland **	AFMC	39
NV	Nellis ** ***	ACC	257
OH	Wright-Patterson	AFMC	92
OK	Altus	AETC	59
OK	Vance	AETC	6
OK	Tinker ** **	AFMC	176
SC	Shaw	ACC	25
SC	Charleston *	AMC	121
SD	Ellsworth	ACC	43
TX	Dyess	ACC	59
TX	Goodfellow	AETC	0
TX	Lackland	AETC	145
TX	Laughlin	AETC	6
TX	Randolph	AETC	154
TX	Sheppard	AETC	25
TX	Brooks (closing FY11)	AFMC	16
UT	Hill ***	AFMC	216
VA	Langley **	ACC	353
WA	Fairchild **	AMC	32
WA	McChord	AMC	87
WY	FE Warren ** **	AFSPC	50

STATE	BASE	MAJOR COMMAND	WAITING LIST TOTAL
GUAM	Andersen	PACAF	4
JAPAN	Kadena **	PACAF	67
JAPAN	Misawa	PACAF	8
KOREA	Osan ** **	PACAF	3
JAPAN	Yokota **	PACAF	17
AZORES	Lajes	USAFE	5
GERMANY	Geilenkirchen **	USAFE	46
GERMANY	Spangdahlem * **	USAFE	52
GERMANY	Bitburg *	USAFE	23
GERMANY	Ramstein **	USAFE	192
GERMANY	Vogelweh ** **	USAFE	57
GERMANY	Sembach	USAFE	0
ITALY	Aviano	USAFE	17
TURKEY	Incirlik	USAFE	10
UK	RAF Alconbury	USAFE	22
UK	RAF Croughton	USAFE	15
UK	RAF Fairford	USAFE	0
UK	RAF Lakenheath	USAFE	135
UK	RAF Menwith Hill	USAFE	6
UK	RAF Mildenhall	USAFE	106
SPAIN	Moron	USAFE	0
		Total	**6474**

* Military Construction Projects
** OSD-funded minor construction projects
*** Projected military construction projects

Distribution

The Honorable Robert Byrd
Chairman
Committee on Appropriations
United States Senate
Washington, DC 20510

The Honorable Thad Cochran
Ranking Minority Member
Committee on Appropriations
United States Senate
Washington, DC 20510

The Honorable Daniel K. Inouye
Chairman
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The Honorable Kay Bailey Hutchison
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The Honorable C.W. Bill Young
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The Honorable Chet Edwards
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Committee on Appropriations
United States House of Representatives
Washington, DC 20515-6026

The Honorable Zach Wamp
Ranking Minority Member
Subcommittee on Military Construction and Veterans Affairs
Committee on Appropriations
United States House of Representatives
Washington, DC 20515-6026

United States Air Force

Report to Congressional Appropriations Committees

Application of Inadequate Housing Definition

February 2009

Introduction

This report is being provided to the congressional defense committees as directed in the House Report 110-775 accompanying the Military Construction, Veterans Affairs, and Related Agencies Appropriations Bill, 2009.

> *Report on Government-Owned Family Housing.--The Committee understands that the Department of Defense defines an inadequate family housing unit as any unit requiring whole-house repair, improvement, or replacement exceeding a per unit cost of $50,000 adjusted by the area cost factor. The Committee further understands that the Services utilize condition assessments, based on private sector housing industry construction codes and sizing standards, as the basis for determining whether a unit meets the threshold of inadequacy. The Committee is concerned that this minimal definition of inadequacy will result in a remnant of Government-owned housing that does not keep pace with the rising expectations of service members and their families due to the success of privatization. The Committee therefore directs the Secretaries of the Army, Navy and Air Force to provide a report to the Committees on Appropriations of both Houses of Congress on the application of the DoD definition of inadequate housing no later than December 31, 2008. This report shall include at minimum: (1) a detailed description of the condition assessment method utilized, including the specific basis of sizing standards; (2) a breakdown of the total units currently assessed as `adequate' into quintiles according to the per unit cost of whole-house repair, improvement, or replacement; and (3) a breakdown of all government-owned units, both adequate and inadequate, by installation (along with an indication, where applicable, of those units for which a privatization, replacement, or improvement project is currently programmed in the Future Years Defense Program).*

Executive Summary

This report addresses the three areas of Congressional interest: (1) a detailed description of the condition assessment method utilized, including the specific basis of sizing standards; (2) a breakdown of the total units currently assessed as `adequate' into quintiles according to the per unit cost of whole-house repair, improvement, or replacement; and (3) a breakdown of all government-owned units, both adequate and inadequate, by installation.

The Air Force Housing Community Profile (HCP) process, used since 1989, is a mature, proven method for planning and programming of military family housing Operation & Maintenance, Military Construction and/or Privatization programs. The HCP methodology employs an impartial, uniform, and industry accepted approach that: assesses housing conditions, considers private sector housing construction codes, applies the Office of the Secretary of Defense (OSD) & Air Force sizing standards, uses commercial cost estimating systems, and considers input/comments from the commanders at every stage. This results in a Condition Assessment Matrix (CAM) score for housing neighbors/units on a scale from 0 to 5, with 5 being housing in best possible condition. Air Force size standards are based on private sector housing standards and are codified in the U.S. Air Force Family Housing Guide for Planning Programming, Design and Construction and OSD's Unified Facilities Criteria (UFC) 4-711-01 (available at www.wbdg.org). HCP reports are vetted, to review/resolve comments from every level, and finally approved multiple times at the installation, Major Command (MAJCOM) and Headquarters Air Force (HAF) levels. HCPs, in their present format, are baseline documents: used to develop privatization concepts and requests for proposals/qualifications; briefed to and accepted by the development industry and necessary to garner approvals from the Executive Steering Group (chaired by the Assistant Deputy Secretary of the Air Force for Installations) and the Office of the Secretary of Defense (OSD) Director of Housing & Competitive Sourcing.

In recent years, the Air Force has implemented a holistic strategy that can easily be described as the largest single quality of life enhancement in the history of our Service. Just five short years ago less than 40% of our homes were deemed adequate. Since then, our privatization initiative has ramped up and now over 80% of our houses in the Continental United States (CONUS) and outside the Continental U.S. have a funded solution to bring them up to par. Likewise, we are on glide slope to have 100% of our CONUS homes privatized by 2010. The Air Force privatization program has successfully closed 28 projects at 44 bases, will receive 37,221 houses (plus community amenities and operations/maintenance), worth $6.29 billion in development at a cost to the Air Force of $402 million – which means for each Air Force dollar the private sector invested more than sixteen dollars.

The breakdown of adequate family housing units needing repairs indicates 5,839 units need repairs within the range of $0 to $10,000 and 246 units need repairs within the range of $10,000 to $20,000.

Within the government-owned Air Force housing inventory, 28,447 units are adequate and 10,835 are inadequate as of 30 September 2008. Of the current inventory, 19,506 units are programmed for privatization and 19,776 government owned units will remain at overseas installations. Improvement or replacement is programmed for the government owned units at overseas installations at the end of the useful lives. Accordingly, 182 are programmed for replacement and 1,421 are programmed for improvement in the Future Years Defense Program.

Report

Air Force Housing Condition Assessment Methodology

The Air Force employs a rigorous and standardized methodology to assess family housing units. A uniform and consistent approach that assesses all housing units results in a Condition Assessment Matrix (CAM) score for housing neighborhoods/units on a scale from 0 to 5, with 5 being housing in best possible condition. This process uses private sector housing industrial construction codes and sizing standards as a basis. The reports are vetted, and approved multiple times at the installation, MAJCOM and Headquarters Air Force levels. The results of this assessment are captured in a Housing Community Profile (HCP) which articulates current conditions of family housing and describes actions and associated costs to bring family housing up to modern standards.

Air Force military family housing is assessed using a CAM scored on a scale from 0 to 5. Detailed field assessments of each unit type and its neighborhood are conducted usually on a four-year cycle. The total unit score is a combination of weighted scores which include condition (70%), functional (20%) and energy (10%). The neighborhood total score is a combination of weighted scores including condition (80%) and functional (20%). Inadequate units are those that require whole-house repair, improvement or replacement exceeding a per-unit cost of $50,000 adjusted by the area cost factor and as defined by CAM scores below 3.75. As an example of the unit CAM score, if the collective condition CAM score after assessing all rooms and components is 3.90; and the functional score after comparing the room sizes and other components to the standards is 2.8; and the energy score is 4.0; then the total CAM score for that unit type would be 3.69 and the unit type would be inadequate for its condition and intended use.

The condition score analysis considers the estimated sustainment costs for each component and sub component to correct deficiencies in each housing unit and neighborhood area today, plus expected system level replacement costs for the next five years based on industry life cycle standards. Cost estimates are developed to reflect each condition deficiency noted during the assessment and include a five-year renewal forecast of building components. A score is developed by comparing the remaining value of a component to its replacement cost, with a scale of 0 to 5. Each component has a weighted score which is calculated into the overall condition score.

A functional analysis of each unit type compares existing house and room size, configuration, and grade allowances to Air Force standards defined in the Air Force Family

Housing Guide. Functionality is scored on a scale of 1 to 5 and it is not a ratio of costs as is the condition score.

An energy score considers the overall energy efficiency of the housing unit including exterior enclosure, building systems and sustainable design principles. Energy is scored on a scale of 1 to 5 using an assessment comparison with the Air Force design guides.

Air Force size standards are based on private sector housing standards and are codified in the U.S. Air Force Family Housing Guide for Planning Programming, Design and Construction and OSD Unified Facilities Criteria 4-711-01.

Breakdown of Air Force Adequate Family Housing Units Needing Repairs

The breakdown of adequate family housing units needing repairs, in quintiles, according to per unit cost of repairs/improvements and replacement is provided in Table 1.

Table 1. Distribution of Air Force Adequate Units Needing Repairs Based on Per Unit Cost of Repairs/Improvements and Replacement

	$0 - $10,000	$10,001 - $20,000	$20,001 - $30,000	$30,001 - $40,000	Over $40,000	Total
Air Force	5,839	246	-	-	-	6,085

Reflects inventory as of 30 September 2008.
Represents costs adjusted for OSD geographic area cost factor.
No requirement for replacement or improvement for adequate housing.

Breakdown of Government-Owned Family Housing Units by Installation

The breakdown of Government-owned family housing by installation is provided in Table 2. Table data reflects Future Years Defense Program (FYDP) as of FY 2009 President's budget.

Table 2. Government-Owned Family Housing by Installation

				Units Programmed in Current FYDP			
Installation	Adequate	Inadequate	Total	Privatization	Replacement	Improvement	Total
Andersen, Guam	1,319		1,319	1,319			1,319
Arnold, TN		36	36	24			24
Beale, CA	307	1,246	1,553	798			798
Cannon, NM	497	634	1,131	1,221			1,221
Cavalier, ND	14		14	14			14
Charleston, SC	451	550	1,001	476			476
Dyess, TX	364	327	691	1,076			1,076
Edwards, CA	227		227	796			796
Eglin, FL	557	1,197	1,754	1,340			1,340
Eielson, AK	721	363	1,084	716			716
Ellsworth, SD		328	328	621			621
F.E. Warren, WY	210	621	831	823			823
Grand Forks, ND	715		715	274			274
Hurlburt, FL	311	69	380	594			594
Lackland, TX		564	564	463			463
Keesler, MS	1,067		1,067	1,028			1,028
Malmstrom, MT	1,294	111	1,405	1,224			1,224
McConnell, KS	493		493	441			441
Minot, ND	1,132	734	1,866	1,746			1,746
Mountain Home, ID	810	492	1,302	1,324			1,324
Seymour Johnson, NC	280	583	863	900			900
Shaw, SC		917	917	1,255			1,255
Whiteman, MO	878	91	969	932			932
Wright Patterson, OH	222	296	518	101			101
Incirlik, Turkey	780		780				-
Kaiserslautern, Germany	1,993		1,993				-
Spangdahlem, Germany	233		233				-
Learmonth, Australia	12		12				-
Alconbury, UK*	216	115	331			71	71
Croughton, UK	178		178				-
Fairford, UK	84		84				-
Lakenheath, UK	932	198	1,130		182	16	198
Menwith Hill, UK	101		101				-
Kadena, Japan	7,566	614	8,180			614	614
Misawa, Japan	1,872	370	2,242			370	370
Osan, Korea	351		351				-
Yokota, Japan*	2,260	379	2,639			350	350
Air Force Totals	**28,447**	**10,835**	**39,282**	**19,506**	**182**	**1,421**	**21,109**

*Current inventory includes surplus units that are programmed for divestiture in the FYDP

Distribution

The Honorable Robert Byrd
Chairman
Committee on Appropriations
United States Senate
Washington, DC 20510

The Honorable Thad Cochran
Ranking Minority Member
Committee on Appropriations
United States Senate
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The Honorable Daniel K. Inouye
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United States House of Representatives
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The Honorable Chet Edwards
Chairman
Subcommittee on Military Construction
and Veterans Affairs
Committee on Appropriations
United States House of Representatives
Washington DC 20515-6026

The Honorable Zach Wamp
Ranking Minority Member
Subcommittee on Military Construction
and Veterans Affairs
Committee on Appropriations
United States House of Representatives
Washington DC 20515-6026

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON DC

JUN 29 2007

HQ USAF/SG
1780 Air Force Pentagon
Washington, DC 20330-1780

The Honorable Daniel K. Inouye
Chairman
Subcommittee on Defense
Committee on Appropriations
United States Senate
Washington, DC 20510-6028

Dear Mr. Chairman

The following report is submitted as required by Senate Report 110-37, page 45.

As a result of the Fiscal Year 2007 Supplemental Appropriations Act, the Air Force Medical Service received $75 million in operations and maintenance funding and $38 million in procurement funding. With these funds restored, we have invested in areas where we assumed the original risk. Specifically, we have restored and are executing the O&M funds in contracts ($17.4 million), sustainment, restoration and maintenance ($24.1 million), information management and information technology ($2.2 million), and medical equipment ($31.3 million).

Through the Air Force Medical Service corporate review process, we prioritized the reinvestment of these funds within each category. This process allowed us to compare competing unfunded requirements to determine where the funds would be most efficiently utilized.

The specific spend plan for the $38 million in procurement funds has not been determined. However, we have an existing unfunded requirement of $101.6 million, and we will compete, review, and adjudicate the optimal investment prior to distribution of these funds as well.

A similar response has been sent to the Ranking Minority Member of your subcommittee.

Sincerely

James G. Roudebush

JAMES G. ROUDEBUSH
Lieutenant General, USAF, MC, CFS
Surgeon General

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON DC

JUN 29 2007

HQ USAF/SG
1780 Air Force Pentagon
Washington, DC 20330-1780

The Honorable Ted Stevens
Ranking Minority Member
Subcommittee on Defense
Committee on Appropriations
United States Senate
Washington, DC 20510-6028

Dear Senator Stevens

The following report is submitted as required by Senate Report 110-37, page 45.

As a result of the Fiscal Year 2007 Supplemental Appropriations Act, the Air Force Medical Service received $75 million in operations and maintenance funding and $38 in procurement funding. With these funds restored, we have invested in areas where we assumed the original risk. Specifically, we have restored and are executing the funds in contracts ($17.4 million dollars), sustainment, restoration and maintenance ($24.1 million), information management and information technology ($2.2 million), and medical Equipment ($31.3 million).

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Sincerely

James G. Roudebush

JAMES G. ROUDEBUSH
Lieutenant General, USAF, MC, CFS
Surgeon General

United States Air Force

Report to Congressional Committees

Report in ICBM Industrial Base Capabilities to Maintain, Modernize, and Sustain Minuteman III Through 2030 and Provide a Replacement Land Based Strategic Deterent System after 2030

October 2008

Introduction

This report is being provided to the Appropriations Committees as directed in Senate Report 110-155, page 166, dated September 14, 2007, as follows:

"ICBM Modernization.—The Committee is aware that the Air Force is implementing a modernization program for the Minuteman III, as directed in section 139 of Public Law 109–364, in order to sustain the deployed force of such missiles through 2030. The Committee is concerned that following the completion of this modernization program, the capability of the defense industrial base to modernize or replace these ICBMs will be severely diminished. The Committee directs the Department of the Air Force to conduct a study on the capability of the defense industrial base to maintain, modernize, and sustain the Minuteman III system until 2030, and on the industrial base's capability to replace the Minuteman III with a follow-on land-based strategic deterrent system after 2030. The report shall be provided to the congressional defense committees not later than March 1, 2008. The study shall include an analysis of the risks associated with not maintaining the defense industrial base capability after completion of the Minuteman III modernization program, and the benefits associated with developing a life extension program for the Minuteman III system similar to the Trident II D5 Service Life Extension Program."

This report addresses the capability of the ICBM defense industrial base to support the Air Force Minuteman III weapon system until and beyond 2030. As the Committee notes, the Air Force's major Minuteman III modernization programs will be complete by FY2009. That modernization effort is defined as the replacement of components with a form, fit, and function replacement as required based on the need to address age out and asset depletion issues. The Propulsion Replacement Program contract closeout occurs in FY2009. The Guidance Replacement Program completes transition to sustainment in FY2009. Additional smaller modernization programs are programmed through 2015. The 2007 National Defense Authorization Act (NDAA) directs the Department of Defense to, "modernize Minuteman III intercontinental ballistic missiles in the United States inventory as required to maintain a sufficient supply of launch test assets and spares to sustain the deployed force of such missiles through 2030." Accordingly, the Air Force is in the process of evaluating the needs of the weapon system to ensure viability through 2030. This report responds to the Committee direction on the basis of both currently understood facts and uncertainties about the state of the Minuteman III system and its viability through 2030.

Executive Summary

The Air Force is focused on sustaining a safe, reliable Minuteman III force through 2030 while protecting the ability to field follow-on land based strategic deterrent capabilities. Recent analyses of the strategic ballistic missile industrial base (2005-present) have identified increased challenges associated with the Air Force's ability to maintain a viable deterrent.

The 2006 ICBM Industrial Base Study conducted by the ICBM Long-range Requirements Planning Steering Group forecast a decline in development, production, and sustainment skills as current life extension efforts conclude. The findings of the study were threefold: First, at the completion of the current ICBM modernization efforts, the first of which concludes in 2009, large portions of the workforce will retire, be moved to other work within companies, or go to new jobs elsewhere resulting in a risk that those skills will not be recoverable. Second, to maintain, sustain, and modernize the ICBM system to 2030, sufficient resources are required to preserve the production and development capabilities for ICBM unique capabilities. Furthermore, significant risk exists, which is quantifiable in terms of cost, schedule, and capability, relative to having capabilities available to develop and produce a follow-on land based strategic deterrent unless the skills and capabilities are preserved during the period between the current production efforts coming to a close and the development of a new system. Lastly, a risk exists that companies with specific skill sets may choose to exit the ICBM industry due to lack of business.

A 2006 study by the Defense Science Board Task Force on Future Strategic Strike Skills noted that critical skills and domain knowledge needed to design, develop, produce, and maintain strategic systems cannot be hired from the mainstream work force and such skills are unique and diminishing. The Task Force recommended that steps must be taken to preserve critical knowledge and capabilities as the current strategic workforce ages and retires. The Task Force stated, "The strategic strike area most at risk today is ballistic missiles" and absent intervention, a serious decline in design capabilities would occur within five years and within ten years for sustainment efforts.

Based on the conclusions of both of the aforementioned efforts, it is clear that the ICBM industrial base is a major concern when current Minuteman III ICBM Modernization efforts conclude. The Air Force remains committed to working with DoD and industry partners to preserve a national industrial capacity to develop, produce, and deploy strategic missile capabilities. However, in the absence of weapon system development activities such as major modernization programs or a follow-on ICBM program, sustainment funding alone is insufficient and other methods are required to preserve and exercise the industrial base. The Office of the Secretary of Defense (OSD) has recommended that the Air Force fund ICBM Demonstration/Validation Program to retain certain industrial strategic skills. The ICBM Demonstration/Validation Program, is actively exercising these critical strategic skills through technology development. Close cooperation with the Navy Strategic Systems Program (SSP) applications programs ensures a joint, synergistic approach. Air Force Research Laboratory (AFRL) also continues to be a critical partner in the execution of the application programs with core science and technology expertise. Additionally, other DoD efforts such as Conventional Prompt Global Strike (CPGS) and Missile Defense provide opportunities to leverage common technologies across the strategic missile enterprise. While continuing to recognize and maintain the "bright line" between nuclear and conventional weapons and methods, common technology development is a cost effective method of supporting multiple missions that can be used to exercise the underlying industrial base.

While the ICBM Demonstration and Validation Program exercises engineering skills associated with technology development and maturation efforts, production and manufacturing skills are critical for executing life extension and modernization programs. An effective combination of focused research and development, responsive sustainment, and continuous production capability is required to preserve the industrial base necessary for long-term viability of the ICBM weapon system.

Report

Capability of the Defense Industrial Base to Maintain, Modernize, and Sustain the Minuteman III system until 2030

Modernization programs currently in production were designed to extend Minuteman III missile and ground support infrastructure operational life through 2020 while maintaining performance and reliability standards required by United States Strategic Command (USSTRATCOM). Recent direction requires the Air Force to sustain the Minuteman III weapon system through 2030.

Figure 1 outlines current modernization efforts for the Minuteman III ICBM.

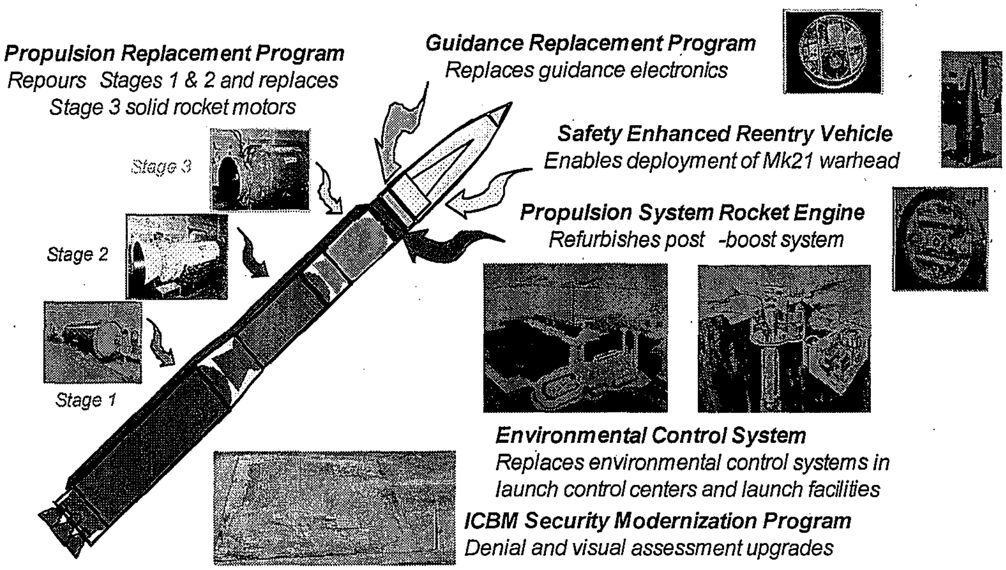

Figure 1. **Modernizes Minuteman III ICBMs and infrastructure to ensure reliability, maintainability, and supportability**

As shown in Figure 2 on the following page, the Guidance Replacement Program (GRP) completes transition from production to long-term sustainment in FY2009. The Propulsion Replacement Program (PRP) completes production in FY2008 and commences with closeout activities in FY2009.

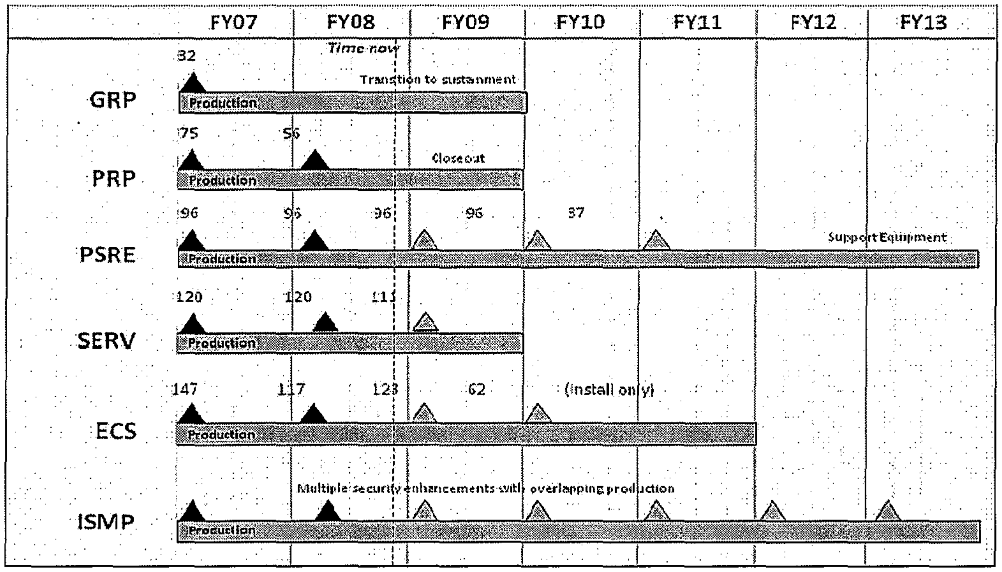

Figure 2. **Minuteman III modernization efforts through 2013**

The ICBM industrial base will experience a significant decrease in size as the GRP and PRP programs and other smaller Minuteman modernization programs conclude. Figure 3 graphically depicts the reduction in funding as the major ICBM modernization programs are completed.

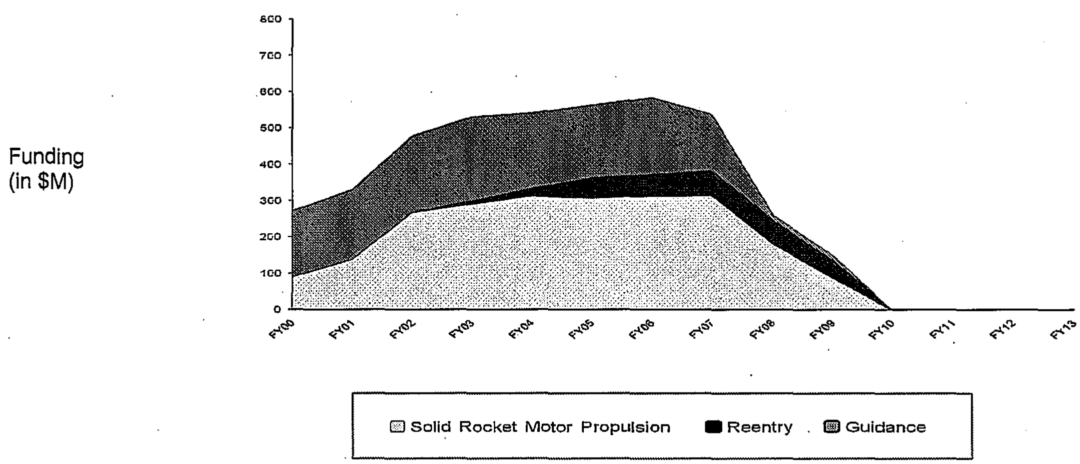

Figure 3. **Post ICBM Modernization Funding Drop-off begins Industrial Base Gap**

Modernization and sustainment of the Minuteman III weapon system is accomplished by the 526th ICBM System Group (526 ICBMSG).

A comprehensive surveillance, sustainment, and modernization effort will be necessary to maintain weapon system viability as systems age beyond their planned operational life. In response to the 2007 NDAA, Air Force Space Command is building a Strategic Deterrence Plan of potential missile, infrastructure, and support equipment investments required to extend the Minuteman III weapon system through 2030. The Air Force FY2009 Unfunded Requirements List (URL) quantifies near-term sustainability issues. The current, planned

ICBM funding is insufficient to sustain the Minuteman III to 2030 and to sustain an industrial base qualified to develop a follow-on system.

Within the FYDP the Guidance, Propulsion, and Safety Enhanced Re-entry Vehicle production programs will end, resulting in the loss of production skills. This production skill base will either be downsized or reallocated to other corporate efforts. An increased production capability risk will be assumed for future modernization or for addressing sustainment issues when they arise. Therefore, confidence is low to medium that these capabilities will be available.

Industrial Base's Capability to Replace the Minuteman III with a Follow-on Land-based Strategic Deterrent System after 2030

The Land Based Strategic Deterrent (LBSD) Initial Capabilities Document (ICD), signed in 2006, codified warfighter requirements and critical attributes for a follow-on ICBM originally intended to replace Minuteman III in the early-2020's timeframe. Postponing the replacement ICBM program to 2030 drives the need for alternative methods to retain necessary skills. The industrial base is operating across a broad spectrum of programs to help maintain a viable strategic missile workforce including technology development, sustainment engineering, and other strategic missions. While the ICBM Demonstration/ Validation program ensures a responsive design and development engineering infrastructure to address issues within ICBM force and other common mission areas, and to develop enhanced multi-use capabilities for technology insertion, it cannot provide complete industrial base coverage in all areas of the MM III weapon system. Efforts identify methods to reduce life cycle costs, improve nuclear safety and surety, and ensure strategic missile viability.

By exercising unique strategic missile skills, the ICBM Demonstration/Validation program is one of the several avenues which will help bridge the gap between the completion of the ICBM Modernization programs and the beginning of a follow-on ICBM or Minuteman III life extension program. Primary ICBM Demonstration/Validation projects are listed below:

- The Guidance Applications Program (GAP) evaluates and develops modern and advanced guidance system concepts, advanced instrument technologies, radiation hardening, and test options;
- The Propulsion Applications Program (PAP) develops and tests advanced common boost and post-boost propulsion concepts;
- Reentry Vehicle Applications Program (RVAP) evaluates improvements in common material replacements and develops/tests potential replacement options for critical RV components;
- Long Range Planning conducts future strategic missile technology insertion feasibility studies and monitors/guides application program investments.

ICBM Dem/Val is not a substitute for a follow-on ICBM development program and cannot provide industrial base coverage in all areas of the Minuteman III weapon system. However, minimizing single-mission solutions and emphasizing common technology development will enable the ICBM program to better leverage efforts across the strategic missile enterprise including the Navy Trident Life Extension program, Conventional Prompt Global Strike (CPGS) research and development, Operational Responsive Spacelift, and Missile Defense Agency interceptor development. Areas requiring ICBM-unique skills, expertise, and facilities, such as reentry vehicle component/subsystem evaluation, and radiation harden components will remain a high priority in the ICBM Dem/Val Program. The Air Force Research Laboratory (AFRL) complements the efforts in ICBM Dem/Val, by identifying the most promising core technologies for further development. By participating in technical interchanges and long-range planning meetings, AFRL remains closely aligned to the needs of designers/developers.

In addition to the development skills exercised by the ICBM Demonstration Validation program and the work being done by AFRL, the Air Force recognizes the need to ensure that production, manufacturing, and facility capabilities are also exercised to retain those critical skill sets. The Air Force identified the need for a low-rate solid rocket motor life extension program and included it on the FY09 Unfunded Requirements List.

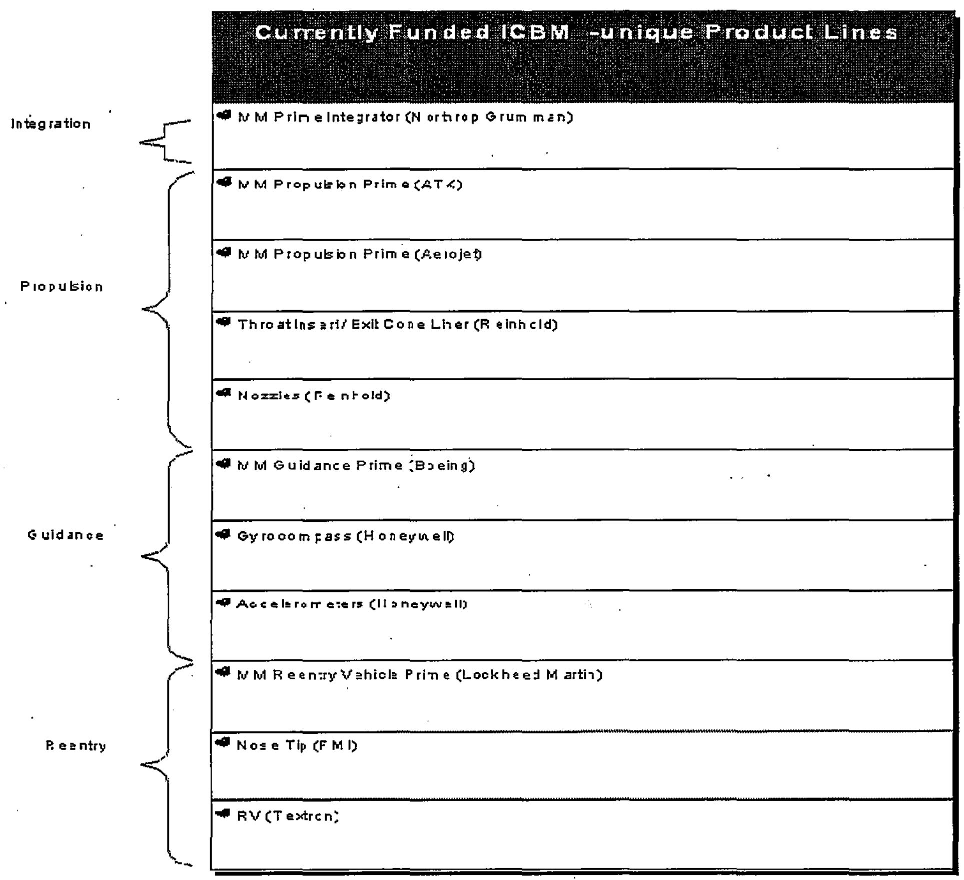

Figure 4. **Currently funded ICBM unique industrial base and major contractors**

ICBM Industrial Base Capability Risk Analyis After Completion of the Minuteman III Modernization Program

Analysis of the risks to the Minuteman III weapon system and its associated industrial base is an ongoing process. Air Force Space Command's ICBM Long-Range Requirements Steering Group and the ICBM Sustainment Conference both meet every six months to assess the operational system, associated infrastructure, and test equipment as well as future technology requirements. Additionally, the Commander of Air Force Space Command has initiated development of a Strategic Deterrence Plan intended to identify/prioritize long-term sustainment and modernization efforts to maintain Minuteman III viability while reducing overall life-cycle costs. These efforts include an industrial base element to their analysis with industry partners as active participants. An analysis of the industrial base was completed for the 2006 study by the Defense Science Board Task Force on Future Strategic Strike Skills. Of particular note is that critical skills and domain knowledge needed to design, develop, produce, and maintain strategic systems cannot be hired from the mainstream work force and such skills are unique and diminishing. In general, the findings indicate that the depth and breadth of Minuteman III skills are expected to decline dramatically as focus shifts from modernization to long-term sustainment.

The reported data from the 2006 Defense Science Board Task Force is still valid today. The report was focused on the overall skill sets required for the life cycle of the system including: development, production, sustainment, materials, component suppliers, and facilities. It is particularly important to consider holistically all of the skills sets associated with the industrial base and their respective critical mass (defined by retention of at least 75% of the critical skill areas covered with at least 2 area experts to be low risk; 45% to 75% of skills covered with 1 expert and 1 apprentice to be moderate risk; and less than 45% coverage with no expert or apprentice is high risk). The propulsion, guidance, and reentry vehicle areas are discussed in greater detail below.

Propulsion

Broad solid rocket motor production skills will continue to be exercised through a diverse set of programs including the Trident D-5 Submarine-Launched Ballistic Missile (SLBM), Missile Defense Agency interceptors, Air Force/NASA launch vehicles, and potential rocket motor development and production in the interest of a conventional prompt global strike system. All share fundamental similarities with the Minuteman III booster, however these programs do not specifically address Minuteman III unique materials, processes, facilities, hardening, and supplier availability. Furthermore, the schedules of the above programs do not always match up with the capability needs associated with the ICBM industrial base. Unlike guidance sets, solid rocket motors cannot be repaired and must be remanufactured or replaced to correct age-related discrepancies. Statistically significant aging data will not be available on Propulsion Replacement Program (PRP) boosters before 2014, five years after PRP close-out. Should the need arise to remanufacture or produce a MM III system due to pre-mature age out or unforeseen issues, the time and costs will be significant depending on the risk mitigation approach. The costs associated with fully funding the ICBM Dem/Val program and maintaining a continuous production line can provide cost effective risk mitigation. Application of propulsion technology currently under development in ICBM

Dem/Val will benefit a long-term booster replacement, but an extensive production, manufacturing and test program would be required before such an alternative could be operationally deployed.

The overall risk based on data collected from ICBM community indicates a significantly growing reconstitution concern in the next 3 to 5 years (post-PRP production). In an effort to mitigate reconstitution concerns, the Air Force included a FY2009 Unfunded Requirements List initiative to begin a low-rate solid rocket motor life extension program immediately following the completion of PRP. With the initiation of a low-rate solid rocket motor life extension program immediately following the completion of PRP and consistently strong investment in the ICBM Dem/Val Program's development of future technologies, the overall risk would be assessed as low to moderate.

Guidance

The Guidance Replacement Program (GRP) was initially conceived as a two phase program due to funding constraints in the early 1990's. GRP Phase I (1993-2008) modernized the Minuteman III Missile Guidance System (MGS) electronics including the Missile Guidance Computer (MGC) and Missile Guidance Set Control (MGSC), but stopped short of modernizing the Gyro Stabilized Platform (GSP) which continues to use 1960s era components (accelerometer and gyroscope). There was no requirement for improved accuracy in the GRP Phase I program. As GRP Phase I completes transition from production to sustainment in FY2009, the industrial base supporting legacy guidance technologies will be retained to accomplish aging surveillance and repairs. In parallel, ICBM Dem/Val is investigating advanced guidance concepts for future technology insertion. Some common guidance technologies in development at AFRL and for the Navy Trident Life Extension program are being leveraged. Based on a continued capability to repair deployed guidance sets and development of future technologies, the overall risk to Minuteman III guidance is low to moderate. However, with the completion of the GRP production program in 2009 the skill sets and associated risk in production, materials component suppliers, and production facilities is assessed as moderate to high.

Reentry Vehicles (RVs)

The Safety Enhanced Reentry Vehicle (SERV) program performs hardware and software modifications to the Minuteman III missile to allow deployment of the Mk21 warhead originally deployed on the now retired Peacekeeper ICBM. Use of the Mk21 on Minuteman III permits retirement of the Mk12 warhead avoiding a projected one billion dollar life extension effort for that warhead. The current stockpile of Mk12A and Mk21 warheads is numerically sufficient to sustain the deployed force through 2030. Absent replacement with a next generation warhead, a costly life extension program will certainly be required for the MK-12A RV before 2030. In addition, the ICBM Demonstration/Validation Program continues to evaluate and advance the technology readiness of replacement components including mission-unique cables and fuses. Several programs including the ICBM Demonstration/Validation Program, Navy Reentry System Applications Program, and Conventional Prompt Global Strike efforts in the Army, Navy, and Air Force are investigating thermal materials necessary for future RV nosetip and aeroshell construction. However, no program is developing and producing a complete ballistic reentry vehicle or contributing substantially to the domestic industrial base. Furthermore, domestic static testing capability of the extreme operating environments experienced by RVs is limited. While numerically sufficient, the current inventory of RVs will require some sustainment activity and development of technologies limited primarily to materials to support through 2030, therefore the overall risk is assessed as moderate to high.

Benefits Associated with Developing a Life Extension Program for the Minuteman III System Similar to the Trident II D-5 Service Life Extension Program

The Navy's D-5 Life Extension requirement was initiated to extend service life to 2042. The Navy opted to do a complete redesign and retrofit of missile electronics and guidance system as well as procure new boosters to keep their fleet postured to meet all new development and operational test requirements. Additionally, the Navy retains a low-rate booster program (12/year) to retain specialized production skills.

On the other hand, Minuteman III has undergone modernization/life extension efforts since deployment in the early 1970's. The latest ICBM Modernization program (PRP) was initiated to extend Minuteman III to 2020, at which time a follow-on ICBM was expected to replace it. As such, the Air Force opted to specially target known Minuteman III reliability issues using an incremental modernization effort while minimizing new technology insertion that would have driven extensive flight testing. To comply with 2007 NDAA direction extending Minuteman III through 2030, the Air Force will continue surveillance/sustainment efforts to identify/address emerging issues as systems age past their planned operational life while attempting to reduce total cost of ownership. A continuous ICBM solid rocket motor production line will provide the basis for sustaining and maintain key manufacturing, facility, and material skill sets. It will provide an available and experienced workforce to address propulsion issues that arise in the current weapon system. This approach combined with an adequate design and engineering program, will provide the fundamentals to retain and sustain necessary skill sets.

Summary

The Committee directed the Air Force to answer three fundamental questions:

1. **"The capability of the defense industrial base to maintain, modernize, and sustain the Minuteman III system until 2030, and on the industrial base's capability to replace the Minuteman III with a follow-on land-based strategic deterrent system after 2030."** Since original deployment in 1970, life extension efforts have relied on both the commercial launch vehicle programs and the specific ballistic missile programs which have kept the Minuteman III weapon system operating 30 years beyond its original planned life as well as sustained the industrial base. A comprehensive program of aging surveillance, stable sustainment efforts, timely modernization activities and a robust ICBM Dem/Val Program will be required to maintain Minuteman III through 2030. The Air Force recognizes a responsive and available strategic missile industrial base will be necessary to implement Congressional guidance and encourages continued support of this unique national competence through investments of sufficient size and focus.

2. **"An analysis of the risks associated with not maintaining the defense industrial base capability after completion of the Minuteman III modernization program."** The risk of retaining the skills base for development, production, materials, component suppliers, and facilities is moderate to high. This risk can be mitigated with investment in application of technology through the ICBM Demonstration / Validation program, on-going R&D investment and a low-rate solid rocket motor life extension program production line.

3. **"The benefits associated with developing a life extension program for the Minuteman III system similar to the Trident II D5 Service Life Extension Program."** A low-rate solid rocket motor life extension program production line would provide the foundation for sustaining and maintain key manufacturing, facility, material and supplier skill sets that would otherwise deteriorate and be lost. This approach also provides an available and experienced workforce to address issues that arise in the current weapon system.

Joint Air-to-Surface Standoff Missile [JASSM].—The fiscal year 2008 budget request includes $201,125,000 for the procurement of JASSMs. The program breached the Nunn-McCurdy limits earlier this year and has not yet been re-certified by the Department of Defense. Additionally, the JASSM failed four successive flight tests this spring due to failures of the navigation system and problems with the fuze, calling into question the effectiveness of previously funded reliability enhancement efforts. In July, the Air Force received permission from the Under Secretary of Defense for Acquisition, Technology and Logistics to proceed with a $68,000,000 8-month reliability enhancement program, with the costs to be shared between the Air Force and the contractor. The Committee has reviewed the proposed reliability enhancement program and provides full funding for the Air Force's $30,000,000 share of this program. Additional funding is provided to support a potential June 2008 production award following a successful Nunn-McCurdy recertification. The Committee reduces the remaining requested procurement funding by $67,700,000 for missiles funded ahead of need. The funding provided will allow production to continue without a production break until a fiscal year 2009 contract award. The Committee directs that none of the funds provided in this bill may be obligated for the procurement of missiles in fiscal year 2008 until 10 days after the Committee has been notified by the Under Secretary of Defense for Acquisition, Technology and Logistics of the results of the Phase I reliability enhancement program and the Nunn-McCurdy recertification. Further, the Committee designates this program as a congressional special interest item for the purpose of reprogramming.

Advanced Medium Range Medium Air-to-Air Missile [AMRAAM].—The fiscal year 2008 budget request includes $224,577,000 in Missile Procurement, Air Force and $87,460,000 in Weapons Procurement, Navy for the procurement of Phase 4 AIM–120D AMRAAMs. This is an increase of $108,333,000, or 53.2 percent, over amounts provided in fiscal year 2007 for a program that is still in its System Development and Demonstration phase. The budget request requires a three-fold increase in monthly production rates. Given past production problems, the Committee questions the wisdom of this drastic increase and recommends funding for a more gradual production ramp increase. The Committee provides $258,137,000 for the procurement of AMRAAMs, an increase of $54,433,000 over amounts provided in fiscal year 2007.

ICBM Modernization.—The Committee is aware that the Air Force is implementing a modernization program for the Minuteman III, as directed in section 139 of Public Law 109–364, in order to sustain the deployed force of such missiles through 2030. The Committee is concerned that following the completion of this modernization program, the capability of the defense industrial base to modernize or replace these ICBMs will be severely diminished. The Committee directs the Department of the Air Force to conduct a study on the capability of the defense industrial base to maintain, modernize, and sustain the Minuteman III system until 2030, and on the industrial base's capability to replace the Minuteman III with a follow-on land-based strategic deterrent system after 2030. The report shall be provided to the congressional defense committees not later than March 1, 2008. The study shall include an analysis of the risks associated with not maintaining the defense industrial base capability after completion of the Minuteman III modernization program, and the benefits associated with developing a life extension program for the Minuteman III system similar to the Trident II D5 Service Life Extension Program.

Advanced Extremely High Frequency Satellite-4 [AEHF–4].—The Committee recommends an additional $125,000,000 for the advance procurement of the fourth AEHF satellite and directs the Air Force to fully fund the satellite in the fiscal year 2009 budget request.

Space-Based Infrared System [SBIRS] Highly Elliptical Orbit-4 [HEO–4] Advance Procurement.—The Committee strongly supports the Air Force's procurement of the SBIRS HEO payloads three and four. However, based on the current launch schedule, the request for advance procurement of HEO–4 is premature. Therefore, the Committee reduces the fiscal year 2008 budget by $81,000,000 and directs the Air Force to include advance procurement for HEO–4 in the fiscal year 2009 budget request.

PROCUREMENT OF AMMUNITION, AIR FORCE

Appropriations, 2007	$1,054,302,000
Budget estimate, 2008	868,917,000
House allowance	342,494,000
Committee recommendation	854,167,000

The Committee recommends an appropriation of $854,167,000. This is $14,750,000 below the budget estimate.

COMMITTEE RECOMMENDED PROGRAM

The following table summarizes the budget estimate for this appropriation, the Committee recommendation, and the Committee recommended adjustments to the budget estimate:

STAFF SUMMARY SHEET

	TO	ACTION	SIGNATURE (*Surname*), GRADE AND DATE		TO	ACTION	SIGNATURE (*Surname*), GRADE AND DATE
1	PEO/SP	COORD	Coord/no comments/15 Sep 08	5	AF/A3/5	COORD	Coord/no comments/20 Aug 08
2	AFSPC/CV	COORD	Coord/no comments/21 Aug 08	6	SAF/LLW	COORD	Coord/no comments/22 Aug 08
3	AFMC/CV	COORD	Concur w/comments/27 Aug 08	7	SAF/FML	COORD	Coord/no comments/19 Aug 08
4	AF/A4	COORD	Coord/no comments/26 Aug 08	8	SAF/AQR	COORD	Concur w/comments/ 25 Aug 08

SURNAME OF ACTION OFFICER AND GRADE	SYMBOL	PHONE	TYPISTS INITIALS	SUSPENSE DATE
Lt Col Diezman	SAF/USAL	703-588-7372	shd	

SUBJECT	DATE
AF ICBM Industrial Base Report to Congress	

SUMMARY

1. Purpose. Obtain coordination on AF Industrial Base Report to Congress (Tab 1) directed in Senate Report 110-155 (Tab 2).

2. Background. Senate Report, 110-155, Department of Defense Appropriations Bill, 2008, directed the Department of the Air Force submit a report on ICBM industrial base capabilities to maintain, modernize, and sustain MM III through 2030 and provide a replacement land-based strategic deterrent system after 2030. Report was due 1 Mar 08. An interim message was sent informing the defense committees of a planned Aug 08 submission to more closely tie with OSD's Solid Rocket Motor Industrial Base Report to Congress (also due in Aug 08). The two reports will be submitted separately.

3. Discussion. Numerous studies have documented the challenges facing the strategic missile industrial base. The attached report acknowledges those studies while emphasizing Air Force commitment to maintaining a viable ICBM force through 2030. In the absence of an ICBM follow-on program, the Air Force is leveraging efforts in technology development areas such as Conventional Prompt Global Strike (CPGS), ICBM Demonstration and Validation, and submarine-launched ballistic missiles to ensure necessary skills are retained to address emerging issues and future ICBM requirements.

Following GO-level coordination, SAF/FML will enter report into Top-4 coordination.

4. Recommendation. Review report and provide comments using the attached Comment Resolution Matrix (Tab 3).

//SIGNED//

WILLIAM N. MCCASLAND, Major General, USAF
Director, Space Acquisition
Office of the Under Secretary of the Air Force

Tabs
1. AF Industrial Base Report to Congress
2. Excerpt from Senate Report 110-155
3. Comment Resolution Matrix Template
4. 0-6 level Comment Resolution Matrix
5. 0-6 level Coordination SSS

SECRETARY OF THE AIR FORCE
WASHINGTON

FEB 25 2010

The Honorable Daniel K. Inouye
Chairman
Committee on Appropriations
United States Senate
Washington, DC 20510-6028

Dear Mr. Chairman:

I am pleased to provide the enclosed information responding to House Report 111-330, page 190 regarding Undefinitized Contract Actions (UCAs). The attachments include all Air Force Major Commands with UCAs in excess of $50 million as of January 31, 2010, and a policy memorandum rescinding the 2001 waiver.

A similar letter has been sent to the Vice Chairman of your Committee and to the Chairmen and Ranking Minority Members of the other Congressional Defense Committees.

Sincerely,

Michael B. Donley

Michael B. Donley

Attachments:
1. Air Force UCAs in excess of $50 million
2. SAF/AQC Policy Memo 09-C-01, w/atchs

SECRETARY OF THE AIR FORCE
WASHINGTON

FEB 2 5 2010

The Honorable Thad Cochran
Vice Chairman
Committee on Appropriations
United States Senate
Washington, DC 20510-6028

Dear Mr. Vice Chairman:

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SECRETARY OF THE AIR FORCE
WASHINGTON

FEB 25 2010

The Honorable David Obey
Chairman
Committee on Appropriations
U.S. House of Representatives
Washington, DC 20515-6015

Dear Mr. Chairman:

I am pleased to provide the enclosed information responding to House Report 111-330, page 190 regarding Undefinitized Contract Actions (UCAs). The attachments include all Air Force Major Commands with UCAs in excess of $50 million as of January 31, 2010, and a policy memorandum rescinding the 2001 waiver.

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SECRETARY OF THE AIR FORCE
WASHINGTON

FEB 25 2010

The Honorable Jerry Lewis
Ranking Minority Member
Committee on Appropriations
U.S. House of Representatives
Washington, DC 20515-6015

Dear Representative Lewis:

I am pleased to provide the enclosed information responding to House Report 111-330, page 190 regarding Undefinitized Contract Actions (UCAs). The attachments include all Air Force Major Commands with UCAs in excess of $50 million as of January 31, 2010, and a policy memorandum rescinding the 2001 waiver.

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SECRETARY OF THE AIR FORCE
WASHINGTON

FEB 25 2010

The Honorable Norman D. Dicks
Acting Chairman
Subcommittee on Defense
Committee on Appropriations
U.S. House of Representatives
Washington, DC 20515-6018

Dear Mr. Chairman:

I am pleased to provide the enclosed information responding to House Report 111-330, page 190 regarding Undefinitized Contract Actions (UCAs). The attachments include all Air Force Major Commands with UCAs in excess of $50 million as of January 31, 2010, and a policy memorandum rescinding the 2001 waiver.

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SECRETARY OF THE AIR FORCE
WASHINGTON

FEB 25 2010

The Honorable C.W. Bill Young
Ranking Minority Member
Subcommittee on Defense
Committee on Appropriations
U.S. House of Representatives
Washington, DC 20515-6018

Dear Representative Young:

I am pleased to provide the enclosed information responding to House Report 111-330, page 190 regarding Undefinitized Contract Actions (UCAs). The attachments include all Air Force Major Commands with UCAs in excess of $50 million as of January 31, 2010, and a policy memorandum rescinding the 2001 waiver.

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Sincerely,

Michael B. Donley

Michael B. Donley

Attachments:
1. Air Force UCAs in excess of $50 million
2. SAF/AQC Policy Memo 09-C-01, w/atchs

SECRETARY OF THE AIR FORCE
WASHINGTON

FEB 25 2010

The Honorable Carl Levin
Chairman
Committee on Armed Services
United States Senate
Washington, DC 20510-6050

Dear Mr. Chairman:

I am pleased to provide the enclosed information responding to House Report 111-330, page 190 regarding Undefinitized Contract Actions (UCAs). The attachments include all Air Force Major Commands with UCAs in excess of $50 million as of January 31, 2010, and a policy memorandum rescinding the 2001 waiver.

A similar letter has been sent to the Ranking Minority Member of your Committee and to the Chairman and Ranking Minority Member of the House Armed Services Committee.

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Michael B. Donley

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Attachments:
1. Air Force UCAs in excess of $50 million
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SECRETARY OF THE AIR FORCE
WASHINGTON

FEB 25 2010

The Honorable John McCain
Ranking Minority Member
Committee on Armed Services
United States Senate
Washington, DC 20510-6050

Dear Senator McCain:

I am pleased to provide the enclosed information responding to House Report 111-330, page 190 regarding Undefinitized Contract Actions (UCAs). The attachments include all Air Force Major Commands with UCAs in excess of $50 million as of January 31, 2010, and a policy memorandum rescinding the 2001 waiver.

A similar letter has been sent to the Chairman of your Committee and to the Chairman and Ranking Minority Member of the House Armed Services Committee.

Sincerely,

Michael B. Donley

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Attachments:
1. Air Force UCAs in excess of $50 million
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SECRETARY OF THE AIR FORCE
WASHINGTON

FEB 25 2010

The Honorable Ike Skelton
Chairman
Committee on Armed Services
U.S. House of Representatives
Washington, DC 20515-6035

Dear Mr. Chairman:

I am pleased to provide the enclosed information responding to House Report 111-330, page 190 regarding Undefinitized Contract Actions (UCAs). The attachments include all Air Force Major Commands with UCAs in excess of $50 million as of January 31, 2010, and a policy memorandum rescinding the 2001 waiver.

A similar letter has been sent to the Ranking Minority Member of your Committee and to the Chairman and Ranking Minority Member of the Senate Armed Services Committee.

Sincerely,

Michael B Donley

Michael B. Donley

Attachments:
1. Air Force UCAs in excess of $50 million
2. SAF/AQC Policy Memo 09-C-01, w/atchs

SECRETARY OF THE AIR FORCE
WASHINGTON

FEB 25 2010

The Honorable Howard P. McKeon
Ranking Minority Member
Committee on Armed Services
U.S. House of Representatives
Washington, DC 20515-6035

Dear Representative McKeon:

I am pleased to provide the enclosed information responding to House Report 111-330, page 190 regarding Undefinitized Contract Actions (UCAs). The attachments include all Air Force Major Commands with UCAs in excess of $50 million as of January 31, 2010, and a policy memorandum rescinding the 2001 waiver.

A similar letter has been sent to the Chairman of your Committee and to the Chairman and Ranking Minority Member of the Senate Armed Services Committee.

Sincerely,

Michael B. Donley

Michael B. Donley

Attachments:
1. Air Force UCAs in excess of $50 million
2. SAF/AQC Policy Memo 09-C-01, w/atchs

DEPARTMENT OF THE AIR FORCE
WASHINGTON, DC

JUL 23 2009

OFFICE OF THE ASSISTANT SECRETARY **Policy Memo 09-C-01**

MEMORANDUM FOR ALMAJCOM/FOA/DRU (CONTRACTING)

FROM: SAF/AQC
1060 Air Force Pentagon
Washington, DC 20330-1060

SUBJECT: Undefinitized Contract Action Waivers Pursuant to DFARS 217.7404-5

Defense Federal Acquisition Regulation Supplement (DFARS) Subpart 217.74, Undefinitized Contract Actions (UCAs), implements 10 U.S.C. 2326 by imposing specific limitations on UCA obligations and definitization schedules. The Subpart also provides that agencies may waive these limitations upon determining that a waiver is necessary to support a "contingency operation or humanitarian or peacekeeping operation." Consistent with this requirement, SAF/AQC previously issued blanket waivers of these limitations as applied to Operations Enduring Freedom and Iraqi Freedom.

Effective immediately, I am rescinding the waivers to the limitations described in DFARS 217.74 that were previously granted under Enduring Freedom Memo EF-01-03, dated November 28, 2001, and Contract Policy Memo 03-C-13, dated September 26, 2003. Therefore, the authority to grant new waivers to the limitations set out in DFARS 217.7402-2, 217.7402-3, and 217.7402-4 pursuant to DFARS 217.7404-5 is now wholly retained by the Deputy Assistant Secretary (Contracting) or Associate Deputy Assistant Secretary (Contracting). Requests for waivers of these limitations shall be submitted to SAF/AQCK with appropriate justification for consideration.

If you have any questions, please contact (b) (6) [redacted]

ROGER S. CORRELL
Deputy Assistant Secretary (Contracting)
Assistant Secretary (Acquisition)

Attachments:
1. Memo EF-01-03 dtd Nov 28, 2001
2. Contract Policy Memo 03-C-13 dtd Sep 26, 2003

DEPARTMENT OF THE AIR FORCE
WASHINGTON DC

2 8 NOV 2001

Office Of The Assistant Secretary

ENDURING FREEDOM MEMO EF-01-03

MEMORANDUM FOR ALMAJCOM/FOA/DRU (CONTRACTING)

FROM: SAF/AQC
1060 Air Force Pentagon
Washington, DC 20330-1060

SUBJECT: Undefinitized Contract Actions and Contingency Operations in Support of Operations ENDURING FREEDOM and NOBLE EAGLE

The Defense Federal Acquisition Regulation Supplement (DFARS) 217.74, Undefinitized Contract Actions (UCA), implements 10 U.S.C. 2326 that imposes limitations on obligations and definitization schedule. It also provides for waiving these limitations if it is determined that a waiver is necessary to support "(1) A contingency operation as defined in 10 U.S.C. 101(a)(13)."

Operation ENDURING FREEDOM is the name associated with the war on terrorism outside the United States. Operation NOBLE EAGLE refers to United States military operations in homeland defense and civil support to federal, state, and local agencies in the United States. Operation ENDURING FREEDOM was officially declared a contingency operation by USD (A&T) memo, Oct 9, 2001. Using the same rationale, Operation NOBLE EAGLE also meets the statutory definition of a contingency operation. However, the "Simplified Acquisition Threshold" for Operation NOBLE EAGLE remains at $100,000 as it only applies to military operations inside the United States.

I, therefore, determine to waive, as described below, the limitations in DFARS 217.7404-3, Definitization schedule, and 217.7404-4, Limitations on obligations, for undefinitized contract actions that support Operations ENDURING FREEDOM or NOBLE EAGLE. Additionally, I grant a class deviation to exempt such contract actions from AFFARS 5317.7404-4, Limitations on obligations.

Contracting officers will use the following limitations when supporting Operations ENDURING FREEDOM or NOBLE EAGLE. In DFARS 217.7404-4, replace "50 percent" with "75 percent", and "75 percent" with "90 percent." Also, under exceptional circumstances the UCA approval official may permit obligation up to 100 percent. In addition, the UCA approving official may extend the definitization schedule requirements in 217.7404-3. Contracting officers must reference this memo when preparing approval documentation.

This DFARS waiver and AF class deviation only apply to actions that support Operations ENDURING FREEDOM or NOBLE EAGLE. All other undefinitized contract actions must comply with DFARS 217.74 and AFFARS 5317.7404-4.

Attachment 1

I am granting this waiver to help support Operations ENDURING FREEDOM and NOBLE EAGLE, but everyone needs to remember that UCA's are not our normal means of conducting business and we should only use them when the negotiation of a definitive contract action is not feasible to meet our requirements.

If you have any questions, please contact [redacted]

DARRYL A. SCOTT, Brig Gen, USAF
Deputy Assistant Secretary (Contracting)
Assistant Secretary (Acquisition)

DEPARTMENT OF THE AIR FORCE
WASHINGTON DC

Office Of The Assistant Secretary

2 6 SEP 2003

Contract Policy Memo 03-C-13

MEMORANDUM FOR ALMAJCOM/FOA/DRU (CONTRACTING)

FROM: SAF/AQC
1060 Air Force Pentagon
Washington, DC 20330-1060

SUBJECT: Undefinitized Contract Actions and Contingency Operations in Support of Operation Iraqi Freedom

The Defense Federal Acquisition Regulation Supplement (DFARS) 217.74, Undefinitized Contract Actions (UCA), implements 10 U.S.C. 2326 that imposes limitations on obligations and definitization schedule. It also provides for waiving these limitations if it is determined that a waiver is necessary to support "(1) A contingency operation as defined in 10 U.S.C. 101(a)(13)."

Operation Iraqi Freedom is the name associated with the war in Iraq. SAF/AQC memo 03-C-06, dated 21 March 2003, determined that Operation Iraqi Freedom is a contingency operation.

I, therefore, determine to waive, as described below, the limitations in DFARS 217.7404-3, Definitization schedule, and 217.7404-4, Limitations on obligations, for undefinitized contract actions that support Operation Iraqi Freedom.

Contracting officers will use the following limitations when supporting Operation Iraqi Freedom. In DFARS 217.7404-4, replace "50 percent" with "75 percent", and "75 percent" with "90 percent." Also, under exceptional circumstances the UCA approval official may permit obligation up to 100 percent. In addition, the UCA approving official may extend the definitization schedule requirements in 217.7404-3. Contracting officers must reference this memo when preparing approval documentation.

This DFARS waiver applies to actions that support Operation Iraqi Freedom. The DFARS waiver in SAF/AQC memo EF-01-03, dated 28 Nov 01, is still valid for Operations Enduring Freedom and Noble Eagle. All other undefinitized contract actions must comply with DFARS 217.74.

I am granting this waiver to help support Operation Iraqi Freedom, but everyone needs to remember that UCA's are not our normal means of conducting business and we should only use them when the negotiation of a definitive contract action is not feasible to meet our requirements.

Attachment 2

If you have any questions, please contact [redacted]

Maureen M. Clay

MAUREEN M. CLAY, Col, USAF
Associate Deputy Assistant
Secretary (Contracting)
Assistant Secretary (Acquisition)

Sub Agency (1)	Sub Agency (2)	Contract #	TO/DO # (if applicable)	Program Description/Reason for Award	Date UCA Awarded	Anticipated Date for Definitization	NTE Amount ($)	Amount Obligated ($)
AFSPC	SMC	FA8816-06-C-0004, P00012		AFSPC-2 Launch Order, EELV Lockheed-Martin Buy 3; urgent requirement	6-Nov-2008	31-Mar-2010	$ 145,200,000.00	$ 72,600,000.00
AFSPC	SMC	FA8819-08-C-0006, P00002		Space Based Space Surveillance (SBSS) Maint/Ops (MOR). Enable pre-planning ops, and logistics support post-launch post-2009; urgent requirement	22-Dec-2008	14-Jan-2010	$ 55,600,000.00	$ 41,716,701.00
AFSPC	SMC	FA8810-08-C-0002, P00002		SBIRS SFP HEO/GEO 3 Prod & Ground Sys; preserve delivery dates, accommodate 3rd HEO	29-May-2009	31-Mar-2010	$ 1,487,400,000.00	$ 1,115,550,000.00
AFSPC	SMC	FA8810-08-C-0002, P00007		SBIRS SFP HEO/GEO 4 Long Lead Effort; UCA needed to preserve delivery schedule	10-Jul-2009	31-Mar-2010	$ 262,000,000.00	$ 137,125,000.00
AFSPC	SMC	FA8818-09-C-0050, P00008		SDTW Operationally Responsive Space-1 (ORS-1); procure Space Vehicle in support of JFC Urgent Need #3	6-Aug-2009	21-Jan-2010	$ 85,899,999.00	$ 44,000,000.00
AFSPC	SMC	FA8808-10-C-0002		Milstar/DSCS Orbital Operations & Logistics Sustainment Support (MOO&LSS); UCA required due to delayed Acq Plan approval	1-Dec-2009	31-May-2009	$ 57,300,000.00	$ 9,811,000.00
AFMC	AAC	FA8681-09-C-0280 P00002		Massive Ordnance Penetrator	30-Sep-09	13-Feb-10	$ 51,900,000	$ 25,900,000
AFMC	ASC	FA862006G40260124		Gorgon Stare	24-Feb-09	30-Sep-09	$ 70,400,000	$ 46,464,000
AFMC	ASC	FA862007C4015, P1, P2, P7, P8, P10, & P12		Global Hawk	22-Feb-07	31-Oct-08	$ 305,900,000	$ 207,618,109
AFMC	ASC	FA862008G30050003		Global Hawk Depot Activation UCA	1-Apr-08	15-Oct-08	$ 59,023,729	$ 43,420,753
AFMC	ASC	FA861508C6050 (Basic and P00004)		F-16 Morocco Production Program	5-Jun-08	30-Nov-09	$ 332,475,742	$ 169,295,741
AFMC	ASC	FA861404C2004P00110, P00129, P00139, P00211, P00252, P00269		C-17 Australian GSP Support	27-Jul-06	31-Mar-10	$ 128,688,689	$ 82,251,000
AFMC	ASC	FA861507C6032		F-16 Peace Drive II (Pakistan Mod Program)	14-Dec-06	16-Apr-10	$ 272,542,931	$ 204,276,551
AFMC	ASC	F3365701D20500049, 004901, 004902, 004904, 004905, 004906, 004912, 004917, 004918, 004919, 004920, 004921, 004922, 004923, 004924, 004925, 004926, 004927, 004928		B-1 Pylon, Hardpoint, DDR & LCTP	9-Mar-07	26-Feb-10	$ 84,428,631	$ 61,660,899
AFMC	ASC	FA861404C2004P00180, P00193, P00206, P00220, P00242, P00255		C-17 Canadian GSP Support	6-Jun-07	31-Mar-10	$ 104,159,522	$ 52,079,628
AFMC	ASC	FA861706D61500002, 000218,and 000234.		JPATS COMBS Services (FY08,FY09 and FY10)	31-Oct-07	26-Feb-10	$ 174,080,255	$ 104,846,924
AFMC	ASC	F3365703G43060046		Global Hawk Block 20 Initial Spares	20-Dec-07	24-Dec-09	$ 76,000,000	$ 57,000,000

Sub Agency (1)	Sub Agency (2)	Contract #	TO/DO # (if applicable)	Program Description/Reason for Award	Date UCA Awarded	Anticipated Date for Definitization	NTE Amount ($)	Amount Obligated ($)
AFMC	ASC	FA862005G30270017 & Mod 01		PPSL Conversion /SATCOM Upgrade	5-Mar-08	22-Jan-10	$ 40,468,992.00	$ 24,285,058.00
AFMC	ASC	FA862007C4015P00004		Global Hawk Lot 7 MP-RTIP Production	7-Mar-08	26-Feb-10	$ 79,400,000	$ 53,889,761
AFMC	ASC	FA862506C6456P00044		C-130J Production and support for India	28-Mar-08	15-May-10	$ 595,800,000	$ 297,900,000
AFMC	ASC	FA862008C3001, P1, P2, P3, P4, P5, P7, P8 & P10		Global Hawk Lot 8 Long Lead and Full production	2-Apr-08	7-Apr-10	$ 732,050,447	$ 258,427,255
AFMC	ASC	FA862008C3013		MOROCCO DB-110 Pods	28-Aug-08	**30-Jan-10**	$ 87,940,000	**$48,419,052**
AFMC	ASC	FA862006G40410008, 000801(17 Sep 08), 000802(24 Sep 08)), 000803(17 Nov 08)		Predator/Reaper Multi-spectral Targeting System (MTS) FY08 Production Requirements	17-Sep-08	29-Jan-10	$ 120,174,000.00	$ 49,165,062.00
AFMC	ASC	FA862506C6456P00060, P00075		C-130J FY08 GWOT Buy	3-Oct-08	15-May-10	$ 1,896,600,000	$ 236,636,592
AFMC	ASC	FA862005G30280050		MQ-9 A/Vs	26-Nov-08	30-Dec-09	$ 115,158,656.00	$ 86,368,992.00
AFMC	ASC	FA862005G30280058		MQ-9 Italian FMS	5-Feb-09	12-Apr-10	$ 81,273,117.00	$ 40,049,760.00
AFMC	ASC	FA861406D20060003 & 000303		C-17 +15 Buy	6-Feb-09	31-Mar-10	$ 2,950,000,000	$ 2,203,135,820
AFMC	ASC	FA861404C2004P00278		C-17 SAC Sustainment Effort	9-Feb-09	10-May-10	$ 114,400,000	$ 56,056,000
AFMC	ASC	F3365702D00090064		F-22 Shutdown Planning	3-Apr-09	30-Sep-10	$ 74,800,000	$ 17,500,000
AFMC	ASC	FA862009C4001 & P1		Global Hawk Lot 9	22-Apr-09	15-Sep-10	$ 75,209,000	$ 75,209,000
AFMC	ASC	FA862009D30330001		Big Safari - Project Liberty	24-Apr-09	19-Mar-10	$ 93,312,000	$ 47,137,589
AFMC	ASC	FA862506C6456P00080		C-130J Iraq (4 aircraft)	30-Apr-09	15-May-10	$ 292,800,000	$ 6,920,907
AFMC	ASC	FA861406D20060004		C-17 NATO Aircraft	5-May-09	30-Jun-10	$ 400,000,000	$ 318,873,120
AFMC	ASC	FA862006G40020942		Big Safari - Project Liberty	5-May-09	15-Feb-10	$ 55,665,245	$ 41,748,934
AFMC	ASC	FA861709C6166		T-6A Israeli FMS Case	18-May-09	15-Feb-10	$ 123,794,733	$ 84,810,375
AFMC	ASC	FA861404C2004P00298		C-17 CY09 GRIP	19-May-09	5-Mar-10	$ 144,527,500	$ 65,037,375
AFMC	ASC	FA862009D30330003		Big Safari - Project Liberty	15-Jul-09	31-Mar-10	$ 119,744,999	$ 61,069,949
AFMC	ASC	FA862006G40410010		Predator/Reaper Multi-spectral Targeting System (MTS)	24-Jul-09	22-Apr-10	$ 119,724,061.00	$ 19,323,645.00
AFMC	ASC	FA862009C3046		Big Safari - Java Man	4-Aug-09	27-Jan-10	$ 86,802,798	$ 86,802,798
AFMC	ASC	FA862506C6456P00098		C-130J Iraq (2 addt'l aircraft)	11-Aug-09	15-May-10	$ 140,300,000	$ -
AFMC	ASC	FA861709C6175		T-6A Iraq FMS Case	14-Aug-09	19-Mar-10	$ 170,848,937	$ 146,192,091
AFMC	ASC	FA861709C6170 and P1		T-6C Morocco FMS Case	18-Sep-09	18-Feb-10	$ 185,267,002	$ 91,055,341
AFMC	ASC	FA862006G40020946		Big Safari - Project Liberty	6-Oct-09	31-Mar-10	$ 68,528,170	$ 29,330,000
AFMC	ASC	FA862506C6456P00087		C-130J FY10 USAF Buy (12 a/c)	16-Oct-09	15-May-10	$ 827,400,000	$ 8,274,000
AFMC	ASC	FA861109C2900 and P7		F-22	29-Oct-09	7-Oct-10	$ 652,200,000	$ 205,400,000
AFMC	ASC	FA862006G40020945		Big Safari - Project Liberty	2-Dec-09	13-Apr-10	$ 126,532,976	$ 52,677,984
AFMC	ASC	FA861108C2896P00020		F119 Engines	11-Dec-09	13-Apr-10	$ 147,958,008	$ 59,930,313
AFMC	ASC	FA861108C2897P00036		F-22 FASTeR	15-Dec-09	13-Apr-10	$ 550,432,272	$ 312,067,896
AFMC	ASC	FA862510C6505		**C-40C Aircraft Buy**	18-Dec-09	30-Apr-10	$ 89,672,271	$ 26,890,000
AFMC	ESC	FA870609C0001		Royal Saudi Air Force (RSAF) AN/FPS-117 Radar Upgrade	30-Jun-09	2-Mar-10	$ 76,229,449	$ 19,474,319
AFMC	ESC	F1962803D00150071		INDIANA/KANSAS/MA ANG DCGS SITES	13-Mar-09	16-Oct-09	$ 60,007,695	$ 45,005,772
AFMC	ESC	FA870806D0001001011		JSTARS Propulsion Pod System Production	9-May-08	26-Jun-09	$ 268,400,000	$ 129,221,942

Sub Agency (1)	Sub Agency (2)	Contract #	TO/DO # (if applicable)	Program Description/Reason for Award	Date UCA Awarded	Anticipated Date for Definitization	NTE Amount ($)	Amount Obligated ($)
AFMC	ESC	FA872609C0010		Battlefield Airborne Communications Node (BACN) Rapid Fielding	24-Jun-09	20-Jan-10	$ 276,281,235	$ 97,802,680
AFMC	OO-ALC	FA821308C0028		Enhanced Paveway II and Enhanced Paveway III	14-Dec-07	31/3/2010	$ 161,278,400	$ 113,374,851

Congressional Report

Report On Air Force, Air Force Reserve, and Air National Guard Bases Affected by 2005 Round of Defense Base Closure and Realignment

Section 2832 of the National Defense Authorization Act for Fiscal Year 2007

U.S. AIR FORCE

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Table of Contents

Introduction

The purpose of this report is to meet the Congressional direction in Section 2832 of the National Defense Authorization Act for Fiscal Year 2007. The exact language is repeated below:

SEC. 2832. REPORT ON AIR FORCE AND AIR NATIONAL GUARD BASES AFFECTED BY 2005 ROUND OF DEFENSE BASE CLOSURE AND REALIGNMENT.

(a) REPORT. – Not later than January 1, 2007, the Secretary of the Air Force shall submit to Congress a report on planning by the Department of the Air Force for future roles and missions for each Air Force and Air National Guard installation that –

(1) will have the number of aircraft, weapon systems, or functions assigned to the installation reduced or eliminated as a result of decisions made as part of the 2005 round of defense base closure and realignment under the Defense Base Closure and Realignment Act of 1990 (Part A of title XXIX of Public Law 101-510; 10 U.S.C. 2687 note); or

(2) will serve as a receiving location for the realignment of aircraft, weapons systems, or functions as a result of such decisions.

(b) ELEMENTS OF REPORT. – The report required under subsection (a) shall include the following:

(1) An assessment of the capabilities, characteristics, and capacity of the facilities, other infrastructure, and personnel at each installation described in subsection (a).

(2) A description of the planning process used by the Department of the Air Force to determine future roles and missions at each installation described in subsection (a), including an analysis of alternatives for installations to support each future role or mission.

(3) A description of the future roles and missions under consideration for each Air Force and Air National Guard installation, including installations described in subsection (a), and an explanation of the criteria and decision-making process to make final decisions about future roles and missions for each installation.

(4) A timeline for decisions on the final determination of future roles and missions for each installation described in subsection (a).

Executive Summary

The primary focus of this report is to describe the process the Air Force used in collaboratively assigning future roles and missions to Air Force, Air Force Reserve, and Air National Guard (ANG) BRAC 2005 affected locations.

The Air Force conducted a comprehensive analysis of its installations during the congressionally mandated BRAC process and submitted this analysis to DoD for the Secretary's use in making his recommendations to the BRAC Commission. The Commission conducted its own analysis and made significant changes to the Secretary's recommendations. The BRAC Commission analysis and its recommendations are a matter of public record and the Air Force is now required by law to implement the Commission's recommendations. The BRAC Commission's recommendations were used as the primary reference when addressing the assignment of future roles and missions at affected, or in some cases, unaffected installations. This report will only focus on those installations affected by the BRAC Commission itself and will not focus on any analysis conducted outside the scope of the Commission's recommendations.

In May 2005, the Deputy Chief of Staff for Plans and Programs stood up the Future Total Force Directorate (now Total Force Integration (TFI)) to lead the effort in integrating Active Duty, Air National Guard, and Reserve forces to more efficiently and effectively meet Combatant Commanders (COCOM) requirements at home and abroad. This integration effort laid the foundation and processes that would be used in transparent, collaborative, and inclusive ways to assign post-BRAC new missions and employ new organizational constructs. Integration would occur where recommended by the Commission and where opportunity for new mission placement at enclaves could be facilitated. Through a comprehensive process of Working Groups, Integrated Process Teams (IPTs), and General Officer Steering Committees (GOSCs), the Air Force employed a transparent and inclusive process that included all stakeholders. The Deputy Chief of Staff for Strategic Plans and Programs partnered with the National Guard Bureau (NGB) who worked closely with each state to ensure they captured their inputs and interests. This interaction between the NGB and The Adjutants General (TAGs) culminated with a Senior Leaders Conference where the individual state plans were presented in total. With all stakeholders included, TFI facilitated the development of new future missions and associations using a "design together" effort in a bottom-up approach. The results of this approach were "phase lists", which were listings of TFI initiatives at certain points in development—essentially a tool used to manage and communicate the new missions. These phase lists were vetted through the TFI structure as well as coordinated through normal staffing processes to the Major Commands (MAJCOMs), Air Staff, NGB, Air Force Reserve Command (AFRC) and the TAGs.

The development and matching of future missions relied on the current and future COCOM (including NORTHCOM) requirements as described in DoD strategic planning efforts as well as a concerted effort to build regional capability as described by the Chief, National Guard Bureau's 10 essential capabilities across the states. In addition, strong consideration was given to The Adjutants General list of imperatives. Finally, prioritization for this matching was given to states/units that lost missions as a result of BRAC law but retained manpower needing new missions. The BRAC commission recommended that the Air Force identify missions for these units relevant to the state's security interests and consistent with Total Force Integration (then called Future Total Force). These units were at the forefront when future missions were addressed in the Phase II and Phase III lists. Appendix B shows the currently identified and in coordination future missions at these affected installations.

There are currently 138 TFI initiatives on the Phase IV list currently being staffed for signatures. Of these 138 initiatives, 124 are applicable to Air Force, Air Force Reserve, and ANG installations affected by the 2005 BRAC, and are listed in Appendix B. The timeline for decisions on the final determination of future roles and missions for 90 of these 124 initiatives is the FY08 Program Objective Memorandum (POM). There are 34 remaining initiatives that require further investigation, but the goal is to have them included in the FY10 POM, or by other funding mechanisms if appropriate. The timeline of the BRAC mission losses is a driver for the final decision timing on the 34 remaining initiatives.

Background

As we move into the 21st century, we face greater than ever modernization and recapitalization challenges, adversaries that are increasingly hard to define, and constrained fiscal realities. While we possess weapon systems to meet today's challenges, we must make transformational changes to maximize our future capabilities. To do so, we are investing in cutting edge technology and highly capable and motivated personnel. The future picture of our Total Aircraft Inventory will undoubtedly look much different than what is on our flight lines today, as we expect the historical platform decreases seen in our Air Force over the last several decades to continue, especially as capabilities per platform increase. The trend of increased technology employed by fewer platforms will continue over the next 20 years, as will the need to grow additional capability in missions vital to successful operations in the changing threat environment. Unmanned aerial systems, space, intelligence, information operations, civil engineering, rapid base establishment and cyber capabilities are examples of these critical missions.

In addition to new missions, the Air Force must explore new organizational constructs that can best exploit these new capabilities. In the mid-1990s, the Air Force began developing a vision to gain efficiencies and capabilities by integrating Active, Guard, and Reserve forces. This vision became known as the Future Total Force, and eventually led the Air Force to establish Total Force Integration (TFI), the transformational concept which embodies the Air Force's strategy for maximizing our air, space and cyber dominance for tomorrow's challenges. To champion this integration effort, the Chief of Staff of the Air Force (CSAF) stood up the Future Total Force Directorate under the Deputy Chief of Staff for Strategic Plans and Programs for a 2-year period to focus exclusively on "jump starting" this next step in the integration effort.

Through a process that was inclusive and transparent to all stakeholders, the Air Force used Working Groups, Integrated Process Teams (IPTs) and General Officer Steering Committees (GOSCs) consisting of Active Duty, Guard, and Reserve members as its planning and decision making bodies. Standing membership in the GOSC included three State Adjutants General (TAGs) who were selected by the president of the Adjutants General Association of the United States (AGAUS). These TAGs also served as members of the Air National Guard Force Structure Committee. By 2006, the president of the AGAUS was added to the GOSC as a fourth TAG member.

Report

AIR FORCE BRAC ANALYSIS

The Air Force conducted a comprehensive analysis of its installations during the congressionally mandated BRAC process and submitted this analysis to DoD for the Secretary's use in making his recommendations to the BRAC Commission. The Commission conducted its own analysis and made significant changes to the Secretary's recommendations. The BRAC Commission analysis and its recommendations are a matter of public record and the Air Force is now required by law to implement the BRAC Commission's recommendations. The BRAC Commission's recommendations were used as the primary reference when addressing the assignment of future roles and missions at affected, or in some cases, unaffected installations. This report will only focus on those installations affected by the BRAC Commission itself and will not focus on any analysis conducted outside the scope of the Commission's recommendations.

TFI was a distinct effort intentionally segregated from work done for and recommendations made by the BRAC commission. Total Force "concepts" were available to BRAC planners as evidenced by the inclusion of associate units in the BRAC Commission's recommendations. However, BRAC planning and deliberating was not known or used by total force planners. It was not until after the Department of Defense (DoD) BRAC recommendations were released to the Commission was the team apprised of the results and began its assessment of opportunities. It was not until after the BRAC commission publicly released its recommendations in September 2005 that TFI initiatives began to be applied to specific installations affected by BRAC.

The DoD maintains the database information for the collective decisions and business cases and therefore is the source of input to question (b)1 of Section 2832. The remainder of this report will focus on the Air Force processes that relate to questions (b) 2, 3, 4, of Section 2832, specifically those processes that relate to TFI initiatives.

THE PLANNING AND DECISION-MAKING PROCESSES

This section outlines the Air Force's planning and decision–making processes and the criteria used to determine future roles for the Air Force, Air Force Reserve, and Air National Guard installations affected by the 2005 BRAC.

The Beginning

In the mid 1990s Air Force strategic planners identified a growing Total Force recapitalization and modernization dilemma as we approached the year 2010 and beyond. To address this growing concern in a way that leveraged proven capabilities and benefits of our 3-component force, Total Force planners developed a vision to further integrate Active, Guard, and Reserve forces in order to gain efficiencies and capabilities as well as identify new and emerging missions that would benefit all by the greater inclusion of the Guard and Reserve. The term Future Total Force was born, and Air Force planners began to look at force structure through a different "Total Force" lens. In the fall of 2004, under the oversight of the Deputy Chief of Staff for Plans and Programs (AF/XP), the MAJCOMs, Air Force Reserve and Air National Guard were tasked with identifying mission sets in which the Air National Guard and Air Force Reserves could grow in mission share. Responses from all MAJCOMs, AFRC and NGB contained thousands of possible positions. This list was filtered through a Total Force IPT and GOSC including ANG and TAGs and was reduced to a relevant number of possible mission sets (over 300). While the larger list was being filtered and reduced, the Secretary of the Air Force (SECAF) and CSAF independently selected six inititives and directed they be accomplished as tests of total force concepts.

Six Test Initiatives—Phase 1

The XPX-FTF Division initially led implementation efforts on these six test initiatives directed by the CSAF in November 2004. These were intended to start the Air Force's transformational efforts in the area of TFI and were termed "Phase I" a year later in the process. The activities included working with the MAJCOMs and components to secure manpower and funding as well as develop Concept of Operations (CONOPS), Memorandums of Understanding (MOUs) and other necessary tasks to implement the six initiatives below.

- Community Basing at Burlington Vermont
- Air National Guard Predator missions in Arizona and Texas
- AFRC Classic Associate F-16 squadrons at Hill AFB
- AFRC integration into the Air Warfare Center at Nellis AFB
- Air National Guard Distributed Ground Station in Western New York (this initiative was later changed to a Predator Ground Control Station)
- Classic Associate F-22 squadrons at Langley AFB

These initiatives are no longer considered "tests" but part of the 137 TFI missions.

As the importance of a Future Total Force began to grow and the need for a lead agency to develop its concepts became apparent, the CSAF stood up a new directorate in March 2005 called Future Total Force - AF/XPF, under the Deputy Chief of Staff for Plans and Programs, AF/XP. When the Air Force headquarters was realigned, the directorate, led by a Brigadier General, was restructured as the Total Force Integration Directorate – AF/A8F, under the Deputy Chief of Staff for Strategic Plans and Programs, AF/A8. Subsequent to the stand-up of the TFI Directorate, the responsibility for this oversight moved from A8X-FTF (which stood down as the new Directorate stood-up). Although the name change was commensurate with the Air Force staff restructuring, it also marked a shift in Air Force philosophy—Secretary Michael Wynne stated, "The future is now." This shift in philosophy was reflected in the TFI Directorate's new name – Total Force Integration. The Directorate's objectives are reflected in its mission statement and goals:

To produce a smaller, more capable, more affordable Air Force composed of Active, Guard, and Reserve Airmen by recapitalizing our force and changing our organizational constructs in a way that defends against, deters, and defeats every adversary in any future challenge to the American way of life

Six overarching TFI Directorate goals address high priority organizational issues and themes to include Homeland Security and Homeland Defense strategy as it applies to the Air Force, Air National Guard and Air Force Reserve. Each goal is intended to significantly improve the Air Force's ability to field needed future capabilities not only in the near term through the FYDP (FY06-FY11), but also longer range (FY 12-FY25).

- Goal 1: Develop missions and initiatives for the Total Force Integration (TFI) utilizing the results of BRAC proceedings, Quadrennial Defense Review (QDR) recommendations, and self initiated actions to enhance support to the joint warfighter at home and abroad.

- Goal 2: Advocate for and lead the implementation of Total Force Integration concepts, initiatives, and policies for the Air Force.

- Goal 3: Work with Air Staff, MAJCOMs, Air National Guard and Air Force Reserve to develop the optimal force mix for various locations.

- Goal 4: Monitor current and emerging mission areas to ensure an appropriate fit of role to component in the Air Force
- Goal 5: Ensure new requirements and initiatives are presented to and supported in the corporate structure for resources, equipment and manpower.
- Goal 6: Communicate the TFI message to the DoD, Air Force, Congress and the Public.

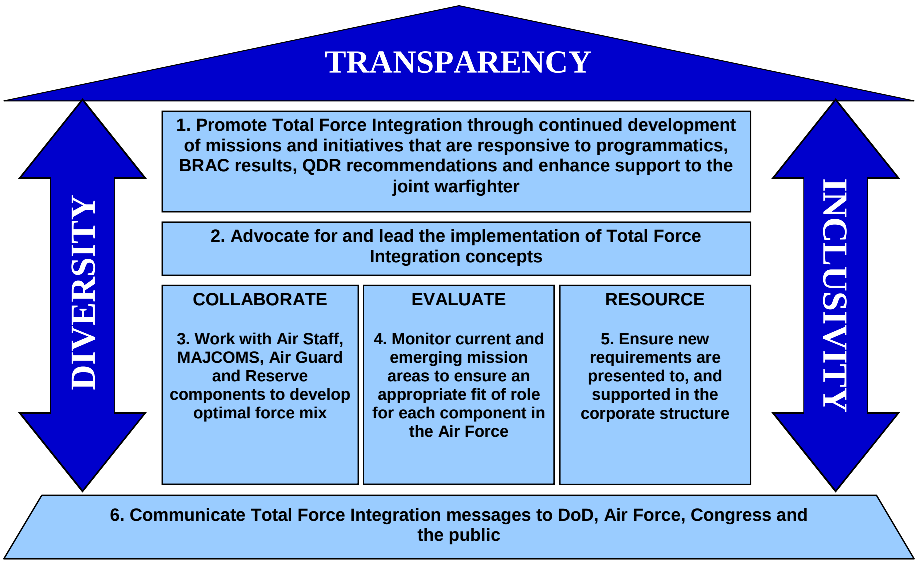


Figure 1: AF/A8F Directorate Organizational Goals

During the Directorate's organizational buildup, the key Total Force tenet—integration of Active, Guard and Reserves—was clearly evident: the organization is staffed by members of the Air Force Reserve, the Air National Guard as well as Active Duty and includes two action officer representatives of the TAGs who sit on the TFI GOSC. It has also included over time, representatives or liaisons of the National Guard Bureau's Air Directorate. Roughly one-third of the military members come from each of those components. This is a design criterion that is further exemplified in the processes and methods by which future missions are considered. These processes are built to be fully inclusive and transparent, taking into consideration the points of view of its own members and the organizations they represent.

Key Criteria in the Matching Process

While the BRAC's focus was maximizing warfighting capability; realigning Air Force infrastructure; eliminating excess physical capacity; and capitalizing on opportunities for joint activity, the TFI Directorate focused on a broad range of factors, many of which were results of the BRAC Commission's decisions. The primary TFI criteria were:

Future mission requirements: Based on multiple documents such as Vision 2025, The USAF Transformational Flight Plan, Strategic Planning Guidance, the QDR, CNGB Vision, Adjutants General Association of the United States Principles, and AFRC Vision, the Air Force laid out a consistent vision of future mission requirements. One of the Total Force Integration challenges was to see how each component could best support these emerging missions.

Enclaves and available manpower: In a number of instances, the BRAC Commission relocated aircraft without closing bases and gave the Air Force and the ANG the opportunity to re-mission the remaining unit or units. The manpower left at the bases whose aircraft had been relocated was termed "enclaves". The BRAC Commission provided for the manpower at these locations to be temporarily frozen in place until new missions were determined. While the Air National Guard is working with the Air Force to match new missions at these locations, there is no BRAC requirement that there be an exact match. Once new missions have been implemented, normal manpower management practices will be used.

Aircraft and mission flow: While the BRAC law directed that all actions must be complete by the end of FY11, the timing of aircraft realignments had to meet the constraints defined by force structure reductions and proper fleet management within each Mission Design Series (MDS). In cases where aircraft retirements or realignments occur prior to the arrival of a follow-on mission, TFI was sensitive to "bridge" issues. In some cases, realignment of aircraft was adjusted to shorten the gap between loss of flying mission and arrival of follow-on mission.

Developing the Processes

Another key focus of the Directorate was to expand and formalize the foundational process. The backbone of this process was a series of meeting fora – the Working Group, IPT, and GOSC that together accomplished several aims:

- Discuss TFI topics at the lowest possible level
- Refine topics and gain concurrence at successively higher leadership levels
- Embrace the transparency concept with wide membership and open forum discussions

Together, the Working Group, IPT and GOSC formed a backbone for communications and decision-making to shape the outcomes of TFI initiatives, including making recommendations to the SECAF and CSAF on new missions. Figure 2 graphically shows the inputs and outputs of the IPT and GOSC process.

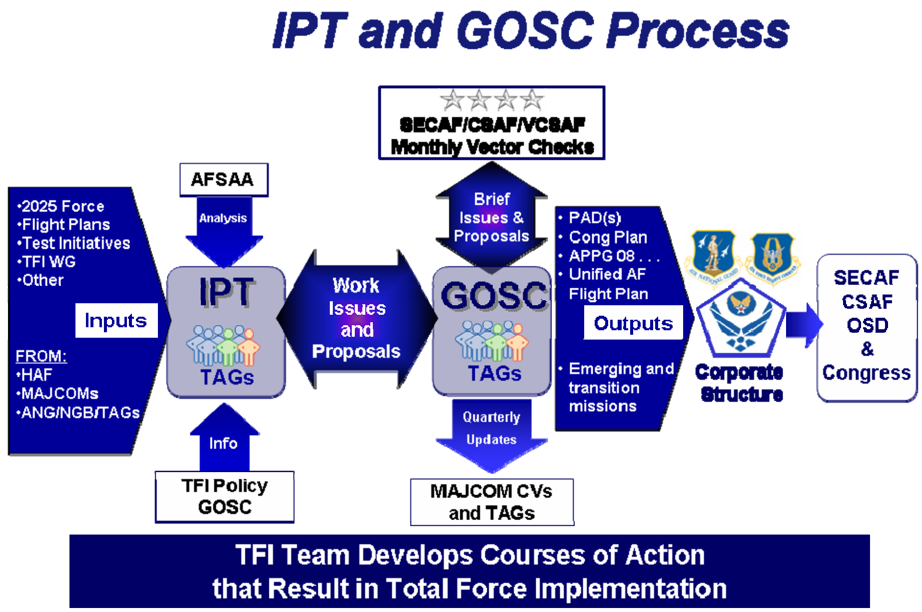


Figure 2: The Process Flow

In order of rank structure, the Working Group is the lowest body, comprised of action officers from the stakeholder organizations and chaired by a Colonel. Representatives in the Working Group included all MAJCOMS, the Air Force Reserve and Air National Guard – both from the National Guard Bureau as well as TAG reps. Agenda items were solicited from all parties. The body's tasks included vetting ideas, reaching consensus where possible, and raising issues for higher-level consideration and decision.

The Director of Total Force Integration, a Brigadier General, chaired the IPT. The membership of the IPT mirrored the Working Group structure, representing all stakeholders from the MAJCOMs, the National Guard Bureau, the Air Force Reserve and the Air Staff. Again, the focus of the IPT was to provide a forum for discussion on important issues, reach consensus, make recommendations to the next higher body, and provide increasingly higher levels of oversight as ideas and concepts matured.

The GOSC was chartered to act as a senior level oversight body for Total Force issues. It was chaired by the Air Force Deputy Chief of Staff (DCS) for Strategic Plans and Programs, who delegated routine authority to the deputy – first an Air National Guard two-star general and presently an Air Force Reserve two-star general. Its members include key Air Force leaders from each component, the major commands and the Air Staff.

The goals from the GOSC charter are to:

- Develop Total Force Integration missions and initiatives utilizing the results of BRAC proceedings and QDR recommendations, and Air Force-initiated actions to support the joint warfighter at home and abroad.
- Advocate for and lead the implementation of Total Force Integration concepts, initiatives, and policies for the Air Force.

- Work with Air Staff, MAJCOMs, the Air National Guard and Air Force Reserve to develop the optimal force mix for various locations.
- Monitor current and emerging mission areas to ensure an appropriate fit of role to components in the Air Force.
- Ensure new requirements and initiatives are presented to and supported in the corporate structure for resources, equipment and manpower.
- Communicate the TFI message to the Air Force, Department of Defense, Congress, the media and public.

The GOSC met multiple times prior to BRAC, and has met seven times since early 2005 in order to address BRAC impacts.

Standing membership in the GOSC included three TAGs who were selected by the president of the AGAUS. These TAGs also served as members of the Air National Guard Force Structure Committee. By 2006, the president of the AGAUS was added to the GOSC as a fourth TAG member.

In addition, knowing the concerns of the 54 TAGs and their importance to matching future missions and resources for the ANG as well as Active Duty, the Deputy Chief of Staff for Plans and Programs, through the NGB, ensured all the TAGs were kept informed and engaged as work progressed in addressing BRAC-impacted installations and TFI initiatives. Figure 3 shows the many occasions over the last two years that the AF/A8 reached out to the TAGs to ensure open communication about Total Force issues, often with a focus on BRAC effects.

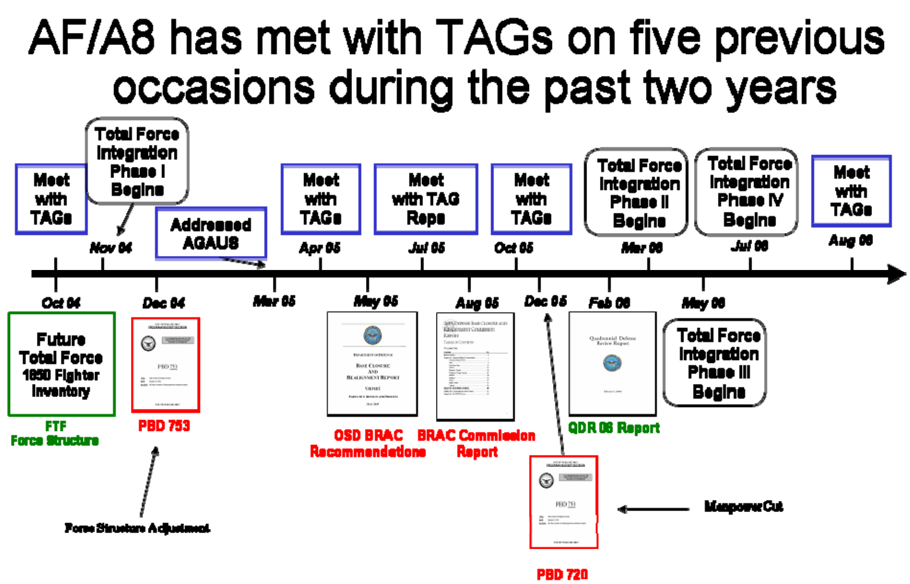


Figure 3: A8 Transparent Communication with the Adjutants General

The TFI Directorate also developed a Total Force Integration Tracking Tool (TFITT), which provides daily updates on each initiative, and includes specific implementation metrics to guide the focus. All members of the TFI process—to include TAGs--have unlimited access to this database. Data was exchanged and validated with the NGB Air Directorate organization responsible for TFI.

Banded List Provides Prioritized Starting Point
One of the principle products developed early in the process after several meetings of the TFI Working Groups and IPTs was a list of over 300 possible TFI missions. This list of unconstrained and unresourced initiatives was termed the “banded” list (see Figure 4). The name reflected the Working Group’s approach to prioritize the larger list into bands based on mission criticality to the COCOMs, Air Force, MAJCOMs, ANG and AFRC as represented by the stakeholders. The participants in these groups were instructed to bring in any and all initiatives and the initiatives were banded as a result of negotiations among the stakeholders. The TAGs point of entry to this process was through the NGB who collectively submitted these to the Working Group. In addition to the banded-list, stakeholders added new missions as concepts developed and matured (example: JCA). This list would be further refined into phase lists, which were subsequently used to manage TFI initiatives.

- **Unconstrained by money, implementation timing, training, or manpower**
- **Pre-BRAC, Pre-Program Budget Decision 720**
- **A wish list …**
- **Over 300 initiatives were identified**
- **FTF Working Group “graded” initiatives into four bands/categories (1-4)**

Definition Criteria Issues / Potential Problems / Results if not completed
Band 1 - Must Do **Legislative Promises, Legal Issues, Critical Mission Need Statement, CSAF/OSD documented direction.**
Band 2 - Mission Critical **Mission Essential, Meets Priorities, Support of a Must Do, Somebody is going to do it!**
Band 3 - Mission Significant **If not completed…negative impact to mission.**
Band 4 - Mission Enhancing **Emerging Mission / Not Validated… low likelihood of manpower**

Figure 4: The Banded List

Phased Progression – Phase II
In late 2005, following the release of the BRAC Commission’s report, the TFI Directorate had enough information on important mission elements – BRAC enclaves and future missions – to begin development and matching of the next set of initiatives. This effort was briefed to the DCS for Strategic Plans and Programs, who in turn forwarded the initiatives to the CSAF and Secretary for approval. The Secretary directed development of a clear path toward accomplishing <u>all</u> TFI initiatives expeditiously. Faced with the task of broadening and accelerating development of the initiatives, the SECAF dictated that a phased approach be used. Taking inputs from Senior Active Duty, Air Force Reserve and Air National Guard leadership, the Working Group, IPT, and GOSC developed a list of Phase II proposed initiatives. Although this list was primarily focused on the BRAC-directed actions and “enclaved” manpower, there were some additional initiatives added by stakeholders. This list, which included over 70 initiatives, was then staffed to the Air Staff, National Guard Bureau and Air Force Reserve Command. This list, known as “Phase II,” was provided to the CSAF and SECAF. They, along with the Chief of the National Guard Bureau and the Commander, AFRC, signed a letter on 27 February 2006 outlining the potential Phase II initiatives for consideration. This letter was released to

the MAJCOM commanders, the NGB, and to the State Adjutants General who were asked to provide their input and feedback to the proposed initiatives. After gathering the input and adjusting the plan, the Phase II list was complete. The 27 Feb 06 letter also informed all stakeholders that Phase III would be developed and released by mid-May 2006.

Phase III

By third quarter FY06, the process for developing, vetting and deciding on initiatives was now mature and work on developing initiative proposals advanced quickly. The stakeholders were fully engaged in the planning and coordination process, which proved its validity during Phase II. By developing over 110 initiatives for the Phase III list, this accelerated process also guaranteed the bulk of proposals could be addressed in the FY08 POM. This was critical to the Active Duty, Air National Guard and Air Force Reserve in order to limit incidents of negative mission impact from BRAC.

Most new missions came from either the reserve components – the ANG or AFRC – or the MAJCOMs. Each component and MAJCOM internally matched requirements and resources within their control, and then brought the initiatives forward to be considered by the process. To reiterate, as was the case with all previous Total Force initiatives, these ideas received scrutiny at each level – the Working Groups, the IPTs and the GOSCs. These fora were supplemented by normal staffing procedures. All signed phase letters are contained in Appendix A. Subsequent to the receipt of the Phase III list, a new Director of the ANG was appointed. The Director requested a delay of further mission assignment while a comprehensive manpower review was done of the entire ANG. The SECAF and CSAF readily agreed.

The FY08 Program Objective Memorandum

As was noted above, the Total Force Integration Directorate undertook efforts to advocate for the allocation of Air Force resources for TFI initiatives. As a starting point, two new seats were added to the Air Force Corporate Structure, one on the Air Force Group (a colonel position) and the other on the Air Force Board (a general officer position). These two members held the roles of advocate and advisor for TFI initiatives.

Two important facts influenced the development of TFI initiatives. First, BRAC funds could not be used to establish new missions, including locations where the unit's mission was moved by BRAC but the personnel remained. This meant that the Air Force was required to find resources through its Corporate Structure to establish new missions at those locations and provide the resources to sustain them. Second, any new TFI initiative had to compete with other Air Force programs for resources in the larger Air Force budget process but in large part they did well.

Additionally, during preparations for the FY08 Program Objective Memorandum (POM), members of the TFI Directorate staff worked with the officers in the Air Force Programs Directorate to develop a framework through the Annual Planning and Programming Guidance (APPG) document, which guides MAJCOMs as they prepare their budget submissions. For the first time, TFI initiatives were included in this document and became a major accountability factor in the development of TFI.

Phase IV – to Present Day

As with the previous phases, the effort to develop the Phase IV list followed the established process model through the Working Group, IPT and GOSC bodies, and was supplemented by normal staffing procedures. Phase IV differed in one significant aspect from the three previous phase lists; it was developed with the goal of encapsulating initiatives from all the previous phase lists and becoming the single-source document for initiatives. The phase IV list ties together 22 new initiatives (not just BRAC affected) with initiatives from all the previous phases. It is intended to render the previous phase lists as historical documents and be comprehensive in nature.

TFI, Associate Units, and Emerging Missions

Through the TFI initiatives, the Air Force is shifting investment from "traditional" combat forces with single-mission capabilities, to multi-role forces by aggressively divesting itself of older systems and investing in emerging missions. The result will be a force structure with expanded capability to combat conventional threats while continuing to wage the Global War on Terror (GWOT). The Air Force will become a smaller, yet more capable force through modernization and recapitalization of selected weapon systems with a commitment to networked and integrated joint systems.

TFI initiatives will maximize efficiencies and enhance combat capability through innovative organizational constructs. The Air Force has developed a construct based on the success of the Associate Model in use by the Regular Air Force and the Air Force Reserve since 1968. Associate units are comprised of two or more components that are operationally integrated. This model capitalizes on inherent strengths of the Air Force's three components – Active Duty, Air National Guard, and Air Force Reserve – ensuring partnership in virtually every facet of Air Force operations, while preserving each component's unique heraldry and history. Increased integration allows Active Duty personnel to capitalize on experience levels of the Guard and Reserve, while building vital relationships necessary to sustain successful combat operations.

There are four associate models being used for TFI implementation:

<u>Classic Associate</u>: An integration model where a Regular Air Force component unit retains principal responsibility for weapon system or systems, which it shares with one or more reserve component units. Regular and reserve component units retain separate organizational structures and chains of command. Varying degrees of functional integration based on MOUs.

<u>Active Associate</u>: An integration model where a reserve component unit has principal responsibility for weapon system or systems, which it shares with one or more regular units. Reserve and regular component units retain separate organizational structures and chains of command. Varying degrees of functional integration based on MOUs.

<u>ARC Associate</u>: An integration model where two or more Air Reserve Components (ARC)--Guard or Reserve--units integrate with one retaining principal responsibility for weapon system or systems, which are shared by all. Each unit retains separate organizational structures and chains of commands. Varying degrees of functional integration based on MOUs.

<u>Integrated Associate</u>: An integration model similar to the classic associate model; however, members of all components contribute to one unit mission with administrative control and support provided by the respective component via detachments.

Moving all components into emerging missions is a critical component of TFI.
The following is a list of missions considered for implementation at locations affected by the 2005 BRAC:

<u>Predator Unmanned Aerial System:</u> Function as a dynamic weapon system able to combine all elements of the targeting cycle (find, fix, target, track, engage, and assess) in a single system.

<u>Distributed Ground System:</u> Reachback intelligence processing, exploitation and dissemination complex designed to provide actionable intelligence in near real-time data

via imagery, electronic, and human intelligence analysis to combatant commanders and users.

Contingency Response Group: Secure and protect airfields, rapidly assess and open airbases, and perform initial airfield/airbase operations to ensure a smooth transition to subsequent operations.

Information Operations (IO): Designed to improve IO capabilities. These units range in size from several personnel to several hundred personnel. They may be formed as stand alone units or detachments, based on size and mission scope.

Combat Support Units: Manpower package designed to support wartime personnel requirements at all levels of command. Manpower requirements vary based upon the unit being supported.

Component MAJCOMs and Component Numbered Air Forces (NAFs): Operational-level organization that provides the command, control and support for forces in support of the unified combatant commander. The mission is to plan, command, control, and execute air, space and information capabilities across the full-range of military operations.

RED HORSE: Consists of self-sufficient mobile heavy construction squadrons capable of rapid response and independent operations in remote, high-threat environments; provides damage/requirements assessment, heavy damage repair, bare-base development, and heavy construction operations, such as aircraft parking ramps and munitions pads.

Battlefield Airmen: Consists of following mission/career fields: Air Support Operations Centers (ASOC)/Tactical Air Control Party (TACP) that provide USAF advice and direct field support for US Army, USAR and ARNG; Battlefield Weather Teams (BWT) support for US Army and Special Operations Forces (SOF); Combat Control Teams (CCT) and Special Tactics Teams (STT) directly supporting SOF; and Combat Rescue including Combat Search and Rescue (CSAR) and SOF support.

Space Operations Squadrons: Provide missile launch, space launch and nuclear detonation warnings to senior leadership, including the President and Secretary of Defense.

Emerging Medical Missions: Expeditionary Medical Support (EMEDS) is the Medical component to CBRNE Enhanced Response Force Package (CERFP). No Air Force defined requirement at this time.

Overseas and Homeland Defense Bases Expeditionary Combat Support: Deploys personnel and equipment into cold bases, stands them up for operations, and operates them for the length of the contingency.

Centralized Intermediate Repair Facility: Provide regional intermediate level repair for both Class VII and IX type reparables to include avionics, Electronic Counter Measure pods, Low Altitude Navigation and Targeting Infrared for Night (LANTIRN) Navigation and Targeting pods, and the F100, F110, and TF34 engines.

Joint Cargo Aircraft (JCA)/C-21: The JCA is a future acquisition that will provide intra-theatre airlift for combatant commanders as well as regional support function within the United States. The C-21 mission is envisioned as a potential Operational Support Airlift flying mission primarily within the continental United States.

Appendix B lists BRAC affected Air Force, Air Force Reserve and Air National Guard installations and the planned future roles and missions.

DECISIONAL TIMELINE AND FINAL DETERMINATION

The Air Force worked closely with the Air Force Reserve and the National Guard Bureau (who worked with the TAGs) to resolve issues regarding TFI timelines, manpower and resources, potential locations for emerging missions and new organizational constructs. Although the introduction of PBD 720 with its significant manpower reductions slowed the effort and required us to take another look at our approach, through the Air Force corporate process, our IPTs and GOSCs, and close coordination with our Total Force stakeholders, we were able to address the BRAC directed actions. There are currently 138 TFI initiatives on the Phase IV list currently being staffed for signatures. Of these 138 initiatives, 124 are applicable to Air Force, Air Force Reserve, and ANG installations affected by the 2005 BRAC. The timeline for decisions on the final determination of future roles and missions for 90 of these 124 initiatives is the FY08 POM. There are 34 remaining initiatives that require further investigation, but the goal is to have them included in the FY10 POM, or by other funding mechanisms if appropriate. The timeline of the BRAC mission losses is a driver for the final decision timing on the 34 remaining initiatives.

Appendices

A: Phase Letters

B: Affected Installations and Planned Future Missions

THE SECRETARY OF THE AIR FORCE
CHIEF OF STAFF, UNITED STATES AIR FORCE
WASHINGTON DC

NOV 24 2004

MEMORANDUM FOR ALMAJCOM/CC

SUBJECT: Future Total Force Implementation Plan

For nearly two years, we've been working Future Total Force initiatives that will enable us to meet the challenges of the 21st century with a smaller but more capable Air Force. The time has come to act! We want to move on all Future Total Force test initiatives that were briefed at Corona, within the next calendar quarter, to meet the immediate challenges before us. Accordingly, we want the MAJCOMS to provide plans ready for immediate execution NLT 17 January 2005 on the following:

1. Identify, by name, two Virginia Air National Guard maintenance NCOs and one Virginia Air National Guard pilot to begin training for the F/A-22 at a time mutually agreed upon by the MAJCOM Commander and the Adjutant General of Virginia. These Guardsmen will be part of the initial cadre for our Total Force efforts at Langley AFB, Virginia.

2. Identify, by name, NLT 31 Jan 05, at least 10 Active Duty F-16 maintainers for PCS in the normal FY-05 cycle, to Burlington, Vermont, to begin the Community Basing concept with the Vermont ANG. The purpose of this move is to capture the experience vested in ANG senior maintainers and help season our inexperienced active duty personnel. We must begin testing other Community Basing concepts ASAP.

3. Continue the completion of the concept of operations and organizational plan to create our first integrated fighter associate unit by combining the 419th Fighter Wing (AFR) and the 388th Fighter Wing (AD) at Hill AFB, Utah. This unit should be established NLT end of FY-05.

4. Complete a concept of operation, draft appropriate MOUs, and stand up a SATAF to define the partnership with the Air National Guard in Texas and Arizona operating the Predator weapon system as appropriate. The goal should be to have these units IOC on or before June 2006, if at all possible.

5. Complete a concept of operation, draft appropriate MOUs, and stand up a SATAF to establish a Distributive Ground Station with the Air National Guard in western New York state. Our goal is to develop, in partnership with the Army National Guard and Air National Guard of New York, a plan to operationalize this unit by the summer of 2006.

6. Integrate Air Force Reserve personnel into all appropriate missions within the Air Warfare Center at Nellis AFB. Develop a plan to identify sections of the Air Warfare Center that may be appropriate for ANG involvement, if such sections are unit centric. Integrate ANG and AFR into Predator ops with a target IOC of May 2005.

7. The HAF/XP FTF Office shall track these efforts and report back through HAF/XP and the FTF implementation IPT and GOSC. We look forward to reviewing your plans and actions that you develop for our Future Air Force.

John P. Jumper
General, USAF
Chief of Staff

James G. Roche
Secretary of the Air Force

cc:
AF/DP
AF/FM
AF/IL
AF/RE
AF/XO
AF/XP
NGB/ZA
NGB/CF
THE ADJUTANTS GENERAL OF ALL STATES, PUERTO RICO, THE U.S. VIRGIN ISLANDS, GUAM, AND THE COMMANDING GENERAL OF THE DISTRICT OF COLUMBIA

THE SECRETARY OF THE AIR FORCE
CHIEF OF STAFF, UNITED STATES AIR FORCE
WASHINGTON DC

MEMORANDUM FOR ALL MAJCOM/CC FEB 27 2006

SUBJECT: Initial Total Force Integration Plan - Phase II

The Air Force is the undisputed leader in Total Force integration, yet vast potential remains. Tapping that reservoir of talent and capability is more important than ever given the need to recapitalize the force, growing budget pressures, the results of BRAC and QDR, and the continuing operational demands on our Airmen, their families, and civilian employers.

During the past two years, through extensive discussion and collaboration with all stakeholders, we have worked hard to develop the next phase of Total Force integration. Now, it is time to move beyond discussion to decision and implementation. Attached is our plan, subject to required environmental reviews, for the Total Force Integration – Phase II.

The plan meets many of our important challenges:

- We increase the Total Air Force's ability to respond to homeland emergencies in all regions of the country
- We maintain our ability to tap capabilities in all components to meet AEF rotation requirements
- We ensure a Total Force capabilities approach to meeting new missions

We will announce this publicly through our Director of Communications and Legislative Liaison, but want your feedback first. Please review this plan and report any absolute showstoppers to AF/A8 by 1200 EST, 3 March.

Once final, this plan will guide our decisions. We will begin to work execution of this plan in FY06/07 and will carry forward these efforts into the FY08 POM build. We will review this plan quarterly to ensure its success and to accommodate fact-of-life changes. This is not an all-inclusive list, but a "living document." We recognize that there are other initiatives like Warfighting Headquarters and Distributive Ground Stations whose definition or requirements have not matured to the point we can assign missions. We intend to address these initiatives as they mature and add them to our plan.

You are key to this effort. We know that you will continue to work these missions as a Total Force team. We appreciate your Phase II comments by 1200 EST, 3 March and will begin to work Phase III missions with you for a mid-May release.

Michael W. Wynne
Secretary of the Air Force

T. Michael Moseley
General, USAF
Chief of Staff

ATTACHMENT:
Initial Total Force Integration Plan – Phase II

cc:
SAF/US
AF/CV
AF/CVA
AF/A1
AF/FM
AF/A4
AF/RE
AF/A5
AF/A8
SAF/MR

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON DC

MEMORANDUM FOR NATIONAL GUARD ADJUTANTS GENERAL
AFRC/CV

FEB 27 2006

SUBJECT: Initial Total Force Integration – Phase II

The Air Force is the undisputed leader in Total Force integration, yet vast potential remains. Tapping that reservoir of talent and capability is more important than ever given the need to recapitalize the force, growing budget pressures, the results of BRAC and QDR, and the continuing operational demands on our Airmen, their families, and civilian employers.

During the past two years, through extensive discussion and collaboration with all stakeholders, we have worked hard to develop the next phase of Total Force integration. Now, it is time to move beyond discussion to decision and implementation. Attached is, subject to required environmental reviews, our initial plan for the Total Force Integration – Phase II.

The plan meets many of our important goals:

- To the maximum extent possible, the Air National Guard in every state will have a flying mission.

  Most personnel left "uncovered" in terms of missions by BRAC are covered and we are committed to rapidly identifying missions for the rest.

  The Air National Guard and Air Force Reserve will continue to build capability in mission areas in which it already has a strong footing and record of success.

- We will increase the Total Air Force's ability to respond to homeland emergencies in all regions of the country.

- We will maintain our ability to tap capabilities in all components to meet AEF rotation requirements.

We will announce this publicly through our Director of Communications and Legislative Liaison , in close coordination with their Guard and Reserve counterparts, but want your feedback first. Review this plan and report any absolute showstoppers concurrently to AF/A8 and your respective Air National Guard or Air Force Reserve leadership who will finalize communication to us by 1200 EST, 3 March.

Once final, this plan will guide our decisions. We will begin to work execution of this plan in FY06/07 and will carry forward these efforts into the FY08 POM build. We will review this plan quarterly to ensure its success and to accommodate fact-of-life changes. This is not an all-inclusive list, but a "living document." We recognize that there are other initiatives like Warfighting Headquarters and Distributive Ground Stations whose definition or requirements have not matured to the point we can assign missions. We intend to address these initiatives as they mature and add them to our plan. To those states not directly addressed in this initial rollout, we will work together--Air Staff, NGB and AFRC--as we further develop other Total Force integration opportunities. We will stay engaged as a team to fully exploit future missions that benefit our Air Force and the Nation.

You are key to this effort. We know that you will continue to work these missions as a Total Force team. We appreciate your Phase II comments by 1200 EST, 3 March and will begin to work Phase III missions with you for a mid-May release.

Michael W. Wynne
Secretary of the Air Force

T. Michael Moseley
General, USAF
Chief of Staff

H Steven Blum
Lieutenant General, USA
Chief, National Guard Bureau

John A. Bradley
Lieutenant General, USAF
Commander, Air Force Reserve Command

ATTACHMENT:
Initial Total Force Integration Plan – Phase II

cc:
SAF/US
AF/CV
AF/CVA
AF/A1
AF/FM
AF/A4
AF/RE
AF/A5
AF/A8
SAF/MR

THE SECRETARY OF THE AIR FORCE
CHIEF OF STAFF, UNITED STATES AIR FORCE
WASHINGTON DC

JUN 7 2006

MEMORANDUM FOR ALL MAJCOM/CC

SUBJECT: Total Force Integration - Phase III

In February, we asked you to embrace Phase II of our efforts to tap the existing reservoir of talent and capability within all components by moving forward with Total Force initiatives, converting discussion into implementation. Our expectations were to reach consensus and begin to work execution of these initiatives in FY06/07 as we worked the FY08 POM build. We have made satisfactory progress with the Phase II initiatives and congratulate you for your successes. Still, much remains to be accomplished. Today, we provide you with the next step, a Phase III list of initiatives.

Since early March, your staffs worked diligently to develop and refine the Phase III initiatives. This list has been vetted extensively through the Total Force Working Group, Integrated Process Team and General Officer Steering Committee. It contains a dozen matured initiatives ready for implementation and slightly more than two dozen initiatives that require further investigation and effort. Also included in this list are revisions you proposed for several Phase II initiatives that will keep it a "living document" as we outlined in February.

Like our previous plan, Phase III meets many of our important Total Force goals:

- To the maximum extent possible, the Air National Guard in every state will have a flying mission.
- We will continue to bring the Guard and Reserve into new and relevant future missions (F-22, DGS, Predator, etc.)
- Most personnel left "uncovered" in terms of missions by BRAC are covered and we are committed to rapidly identifying missions for the rest.
- The Air National Guard and Air Force Reserve will continue to build capability in mission areas where they already have a strong footing and record of success.
- We will increase the Total Force's ability to respond to homeland emergencies in all regions of the country.
- We will maintain our ability to tap capabilities in all components to meet AEF rotation requirements.

Like Phase II, we will review this plan quarterly to ensure its success and to accommodate fact-of-life changes, and will make adjustments, as needed. We encourage you to continue collaborative efforts with all stakeholders so we can maintain forward progress toward our goals.

You remain key to this effort. We know that you will continue to work these missions as a Total Force team. We appreciate your leadership and support. As a "heads-up," we will begin to formulate Phase IV initiatives with you for a mid-September release.

Michael W. Wynne
Secretary of the Air Force

T. Michael Moseley
General, USAF
Chief of Staff

Attachment:
Total Force Integration Plan - Phase III

cc:
SAF/US
AF/CV
AF/CVA
SAF/FM
SAF/MR
AF/A1
AF/A4/7
AF/RE
AF/A3/5
AF/A8
ANG/CF

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON DC

JUN 7 2006

MEMORANDUM FOR THE ADJUTANTS GENERAL
AFRC/CV

SUBJECT: Total Force Integration – Phase III

In February, we asked you to embrace our efforts to tap the existing reservoir of talent and capability within all components by moving forward with Total Force initiatives, converting discussion into implementation. We provided you with a Phase II list of initiatives that had been extensively discussed and collaborated through the Total Force Working Group Integrated Process Team and General Officer Steering Committee. Our expectations were to reach consensus and begin to work execution of these initiatives in FY06/07 as we worked the FY08 POM build. We have made satisfactory progress with the Phase II initiatives and congratulate you for your successes. Still, much remains to be accomplished.

Since early March, your staffs have diligently worked to develop and refine the next phase of Total Force initiatives – Phase III. This list has been vetted extensively. It contains a dozen matured initiatives ready for implementation and slightly more than two dozen initiatives that require further investigation and effort. Also included in this list are revisions you proposed for several Phase II initiatives.

Like our previous plan, Phase III meets many of our important goals:

- To the maximum extent possible, the Air National Guard in every state will have a flying mission.
- We will continue to bring the Guard and Reserve into new and relevant future missions (F-22, DGS, Predator, etc.)
- Most personnel left "uncovered" in terms of missions by BRAC are covered and we are committed to rapidly identifying missions for the rest.
- The Air National Guard and Air Force Reserve will continue to build capability in mission areas where they already have a strong footing and record of success.
- We will increase the Total Force's ability to respond to homeland emergencies in all regions of the country.
- We will maintain our ability to tap capabilities in all components to meet AEF rotation requirements.

Please review this plan and report any absolute showstoppers concurrently to AF/A8 and your respective Air National Guard or Air Force Reserve leadership who will finalize communication to us by 1200 EDT, 23 June.

Like Phase II, we will review this plan quarterly to ensure its success and to accommodate fact-of-life changes, and will make adjustments, as needed. We encourage you to continue collaborative efforts with all stakeholders so we can maintain forward progress toward our goals.

You remain key to this effort. We know that you will continue to work these missions as a Total Force team. We appreciate your Phase III comments by 1200 EDT, 23 June. As a "heads-up," we will begin to formulate Phase IV initiatives with you for a mid-September release.

T. Michael Moseley
General, USAF
Chief of Staff

Michael W. Wynne
Secretary of the Air Force

H Steven Blum
Lieutenant General, USA
Chief, National Guard Bureau

John A. Bradley
Lieutenant General, USAF
Chief of Air Force Reserve

ATTACHMENT:
Total Force Integration Plan – Phase III

cc:
SAF / US
AF / CV
AF / CVA
SAF / FM
SAF / MR
AF / A1
AF / A4/7
AF / RE
AF / A3/5
AF / A8
ANG / CF

Table of BRAC-Affected
Air Force, Air Force Reserve, and Air National Guard Installations
and planned Future Missions

State / Installation	BRAC Gain (+) / Loss (-)	Future Missions
Alabama		
Birmingham IAP AGS	+ Armed Forces Reserve Center	• Investigate robusting ANG Distributed Ground System (DGS) unit at Birmingham AL
Dannelly Field AGS	+3 ANG F-16s	
Maxwell AFB	- Religious training and education	
Alaska		
Elmendorf AFB	Kulis assets to Elmendorf + 8 ANG C-130s + 3 ANG HC-130s + 5 ANG HH-60s + 4 ANG C-130s + Active Associate Unit on 12 C-130s - 24 AD F-15Cs - 18 AD F-15Es + Joint Base Elmendorf / Fort Richardson	• Establish an AFRC Classic Associate unit on two F-22A squadrons at Elmendorf AFB • Establish a BRAC-directed Active Associate unit on 12 ANG C-130s at Elmendorf AFB, if adequate MILCON funds for facilities at Elmendorf are available • Establish an ANG Classic Associate unit on C-17s at Elmendorf AFB
Kulis ANGB	Kulis assets to Elmendorf - 8 ANG C-130s - 3 ANG HC-130s - 5 ANG HH-60s **Closes – (Contingent on the availability of adequate military construction funds)**	
Eielson AFB	-18 AD A-10s AD Alert Mission from Galena (Elmendorf F-15s)	
Galena AS (FOL)	AD Alert Mission to Eielson **Closes**	

State / Installation	BRAC Gain (+) / Loss (-)	Future Missions
Arizona		
Luke AFB	- 27 AD F-16s - 15 AFRC F-16s - AD LRS Positions to CAF LSC - AD LANTIRN Repair - Initial JSF Training to Eglin AFB FL	• Pending Operational Mission development, Investigate a High Altitude Operations mission in AZ
Mesa City	- Most AD Functions transfer to WPAFB - AD A-10 Training Systems Support Center **Closes**	
Davis Monthan AFB	+12 AD A-10s (Non-BRAC Programmatic) + AD A-10 Training Systems Support Center	• Establish an AFRC Classic Associate unit on A-10 FTU at Davis-Monthan AFB • Establish an ANG Predator unit in AZ
Arkansas		
Ft Smith	- ANG 15 F-16s + ANG 18 A-10s - ANG Moves Home Station Training Site to Savannah GA	
Little Rock AFB	+1 ANG C-130 - AD LRS positions	• Investigate robusting ANG Distributed Ground System (DGS) at Little Rock AFB • Investigate an ANG Classic Associate JCA FTU at Little Rock AFB
California		
Edwards AFB	- AD LANTIRN MX - AD Correctional Facilities Aircraft Modernization (Non-BRAC Programmatic)	
Beale AFB	- 8 AFRC KC-135s	• Robust ANG Classic Associate unit on DGS-2 at Beale AFB • Establish an AFRC Classic Associate Unit on DGS-2 Operations at Beale AFB • Establish an AFRC Classic Associate unit on Global Hawk Maintenance and Operations unit at Beale AFB • Establish an ANG Classic Associate unit on Global Hawk Comm Maintenance unit at Beale AFB • Establish an AFRC AOC (Component NAF) augmentation unit in support of PACAF at Beale AFB

State / Installation	BRAC Gain (+) / Loss (-)	Future Missions
California (continued)		
Channel Islands AGS	+ Aircrew and maintenance personnel required to meet increased crew ratio from 163rd ARW, March ARB	
Fresno-Yosemite AGS	+3 F-16s	
March ARB	-9 ANG KC-135s - Aircrew and maintenance personnel required to meet increased crew ratio at Channel Islands AGS +4 AFRC KC-135s **Enclaved ANG Manpower**	• Establish an ANG Predator unit at March ARB • Establish an ANG Predator Formal Training Unit (FTU) at March ARB • Establish an ANG Predator Field Training Detachment (FTD) at March ARB
Onizuka AFS	- AD AFSCN, DISA, DSCS **Closes**	
Vandenberg AFB	+ AD AFSCN, DISA, DSCS + AFRC ECS	• Robust an AFRC Classic Associate Unit for Space Group/Wing at Vandenberg AFB - supporting the Joint Space Operations Center (JSPOC) • Establish an ANG Classic Associate Unit for Space Group/Wing at Vandenberg AFB - supporting the Joint Space Operations Center (JSPOC)
Colorado		
		• Establish an AFRC Classic Associate unit for Space-based Infrared System Mission Control Station - Backup (SBIRS MCS-B) in CO • Establish an AFRC Classic Associate unit for Rapid Attack, identification, Detection and Reporting System (RAIDRS) in CO
USAFA	AD Hospital to Clinics and Ambulatory Surgery Center	
Buckley AFB	+ 3 ANG F-16s + AFRC ECS + Air Reserve Personnel Center	

State / Installation	BRAC Gain (+) / Loss (-)	Future Missions
Colorado (continued)		
Buckley Annex	- Air Reserve Personnel Center - DFAS facility - IMA operational management functions **Facility Closes**	
Peterson AFB	- 1 AFRC C-130 + CIFA Components	• Investigate an Active Associate unit on AFRC C-130s at Peterson AFB • Investigate an Active Associate unit on ANG UE C-21s at Peterson AFB • Investigate an ANG Classic Associate Cryptologic unit in CO
Connecticut		
Bradley IAP AGS	- ANG 15 A-10s + ANG TF-34 CIRF with Active Associate **Enclaved ANG Manpower**	• Establish an Active Associate unit on a BRAC-directed ANG TF-34 (A-10) engine Centralized Intermediate Repair Facility (CIRF) at Bradley IAP • Establish an ANG JCA unit at Bradley IAP • Investigate an ANG AOC (Component NAF) augmentation unit at Bradley IAP • Establish an ANG C-21 UE (bridge) unit at Bradley IAP
Delaware		
Dover AFB	+ Armed Forces Medical Examiner, DNA Registry, and Accident Investigation	
District of Columbia		
Bolling AFB	- Joint Base Anacostia / Bolling - Civilian Personnel - AF & DIA Central Adjudication Facility	
Andrews AFB	***See Maryland***	

State / Installation	BRAC Gain (+) / Loss (-)	Future Missions
Florida		
Eglin AFB	- AD 48 F-15Cs (Non-BRAC programmatic) + AD Weapon and Armaments DAT&E + AD DTRA Conventional Armaments + JSF Initial Training Site Ops and MX + AD Army 7th SFG	• Establish an AFRC Classic Associate with ACC units at Eglin AFB
Hurlburt AFB	- AD RSS Positions for MAF LSC	• Establish an AFRC AOC (Component NAF) augmentation unit in support of SOCOM (AFSOC) at Hurlburt Field • Investigate an AFRC Classic Associate Wing supporting AFSOC at Hurlburt Field • Investigate an AFRC Classic Associate unit with the RED HORSE unit at Hurlburt Field • Investigate an ANG Classic Associate Unit with AFSOC on DGS at Hurlburt Field
MacDill AFB	+4 AD KC-135s - AD Hospital to Clinics and Ambulatory Surgery Center	• Establish a BRAC-directed AFRC Classic Associate unit on KC-135s at MacDill AFB
Tyndall AFB	+2 F-22A (Non-BRAC programmatic) - 20 AD F-15Cs - AD F-100 Engine MX + AD F-15 Avionics MX CIRF	• Establish a BRAC-directed USAF F-15 Avionics CIRF at Tyndall AFB • Establish a fully integrated Total Force F-22A Flying Training Unit (FTU) (AD/ANG/AFRC) at Tyndall AFB
Jacksonville ANGB	+3 ANG F-15s - ANG F-100 Engine MX	
Homestead ARB		• Investigate an Active Associate unit on AFRC F-16s at Homestead ARB
Georgia		
Dobbins ARB	+ Naval Air Reserve and Marine Corps Reserve Center	

State / Installation	BRAC Gain (+) / Loss (-)	Future Missions
Georgia (continued)		
Robins AFB	-12 AD KC-135s - Civilian Personnel - AD Rotary Wing Development - AD Fixed Wing Development - AD Logistics Consolidations / losses + Aircraft & personnel from NAS Atlanta + 202d EIS + IMA operational management function	
Moody AFB	-49 AD T-38s -38 AD T-6s - Primary Pilot Training - IFF, IFF for weapons, IFF for instructors - AD Pilot WSO Training + AD TF-34 Engine CIRF +48 AD A10s	• Establish a BRAC-directed USAF T-34 (A-10) engine CIRF at Moody AFB • Establish an AFRC Classic Associate unit on A-10s at Moody AFB
Savannah IAP AGS	+ Home Station Training Site for Ft Smith AR	
Hawaii		
Hickam AFB	- AD RSS Positions to CAF LSC - Joint Base w/ Pearl Harbor + 4 ANG KC-135s + Active Association on 12 KC-135s	• Establish an ANG AOC (Component NAF) augmentation unit in support of PACAF at Hickam AFB • Establish an Active Associate unit on ANG F-22s at Hickam AFB • Investigate an ANG Classic Associate unit on DGS/CSS in HI • Establish an ANG Classic Associate on C-17s at Hickam AFB • Establish a BRAC-directed Active Associate on ANG KC-135s at Hickam AFB
Idaho		
Boise Air Terminal AGS	+ 3 ANG A-10s - 4 ANG C-130s	• Investigate an ANG A-10/ASOC Intelligence Training Unit at Boise, ID
Mountain Home AFB	- 18 AD F-15Cs - 18 AD F-16s + 18 AD F-15Es - AD LANTIRN MX	

State / Installation	BRAC Gain (+) / Loss (-)	Future Missions
Illinois		
Scott AFB	- 8 ANG KC-135Es +8 ANG KC-135Rs + AD MAF LSC + Additional TRANSCOM functions - AD Hospital to Clinics and Ambulatory Surgery Center	• Establish ANG manpower support to the BRAC-directed Logistics Support center at Scott AFB • Establish an Active Associate unit on AFRC C-40s at Scott AFB • Investigate an Active Associate unit on ANG UE C-21s at Scott AFB • Investigate an ANG Intelligence Squadron is support of AMC in IL
Capital ANGB	- 15 ANG F-16s + ANG F-110 Engine CIRF **Enclaved ANG Manpower**	• Establish a BRAC-directed ANG F-110 (F-16) engine CIRF at Capital MAP, IL • Robust ANG Air Support Operations Group (ASOG) in IL • Establish an ANG AOC (Component NAF) augmentation unit in IL
Indiana		
Hulman Regional APT AGS	- 15 ANG F-16s **Enclaved ANG Manpower**	• Establish an ANG Air Support Operations Squadron (ASOS) at Hulman Regional APT, IN • Establish an ANG Distributed Ground System (DGS) at Hulman Regional APT, IN
Ft Wayne IAP AGS	+ 3 ANG F-16s - ANG F110 Engine MX	
Iowa		
Des Moines IAP AGS	+3 ANG F-16s - ANG F110 Engine CIRF	
Sioux Gateway AGS	- 8 KC-135Es + 8 KC-135Rs	
Kansas		
McConnell AFB	-9 ANG KC-135s +18 AD KC-135s + STAMP/STRAPP **Enclaved ANG Manpower**	• Robust ANG Distributed Ground System (DGS) at McConnell AFB • Establish an ANG Air Support Operations Squadron (ASOS) in KS
Forbes Field AGS	-8 ANG KC-135Es +12 ANG KC-135Rs	

State / Installation	BRAC Gain (+) / Loss (-)	Future Missions
Louisiana		
Barksdale AFB	+9 AFRC A-10s	• Investigate an Active Associate unit on AFRC A-10s at Barksdale AFB
NAS New Orleans	+ 3 ANG F-15s - 15 AFRC A-10s - 926th HQ & ECS **AFRC Closes** + ANG F-100 Engine CIRF + 214th EIS	• Establish an Active Associate unit on a BRAC-directed ANG F-15 Engine CIRF at NAS New Orleans JRB
Maine		
Bangor IAP AGS	-8 KC-135Es +10 KC-135Rs	
Maryland		
Andrews AFB	+ 3 DCANG F-16s - 2 AD C-21s & AFFSA Functions + ANG Aerial Port Squadron - 89 MG to Clinics and Ambulatory Surgery Center - AD OSI + Joint Base Andrews/NAF Washington + Personnel from leased space in NCR	• Investigate a MD ANG - DC ANG fighter unit Initiative at Andrews AFB • Investigate an Active Associate unit on ANG UE C-21s at Andrews AFB • Establish a Cooperative Effort MOU in VIP Airlift Operations at Andrews AFB
Martin State APT AGS	+ 3 ANG A-10s - 8 ANG C-130s - ANG TF-34 Engine MX - ANG Aerial Port Squadron	• Establish an ANG JCA unit at Martin State APT, MD
Massachusetts		
Barnes ANGB	-15 ANG A-10s +18 ANG F-15Cs + ANG ASA Facility - ANG TF-34 Engine MX + ANG Firefighters	
Hanscom AFB	- Space Vehicles Directorate - Sensors Directorate	
Otis ANGB	- 15 ANG F-15s - ANG Firefighters **Enclaved ANG Manpower**	• Investigate an ANG AOC (Component NAF) augmentation unit in MA • Establish an ANG Distributed Ground System (DGS) in MA
Westover ARB	+ Armed Forces Reserve Center	

State / Installation	BRAC Gain (+) / Loss (-)	Future Missions
Michigan		
W.K.Kellogg Field AGS	-15 ANG A-10s **Enclaved ANG Manpower**	• Establish an ANG AOC and AFFOR (Component NAF) augmentation unit in MI • Investigate an ANG JCA unit at W.K. Kellogg Field AGS
Selfridge ANGB	-8 ANG C-130s +8 ANG KC-135s -15 ANG F-16s +24 ANG A-10s - ANG TF-34 Engine MX -8 AFRC KC-135s **AFRC Closes**	
Mississippi		
Columbus AFB	+ Training Aircraft + IFF for Pilots and WSOs	
Keesler AFB	- Medical Center to Community Hospital	
Key Field ANG	-9 ANG KC-135s **Enclaved ANG Manpower**	• Establish an ANG AOC and AFFOR (Component NAF) augmentation unit in MS
Missouri		
Lambert Field AGS	-15 ANG F-15s + 157th AOG + 218th EIG **Enclaved ANG Manpower**	• Investigate robusting ANG AOC (Component NAF) augmentation unit at Lambert Field, MO
Rosecrans Memorial AGS	+ 2 ANG C-130s	
Whiteman AFB	+9 AFRC A-10s	• Investigate an Active Associate unit on AFRC A-10s at Whiteman AFB • Establish an ANG Classic Associate unit on B-2s at Whiteman AFB
Montana		
Great Falls IAP AGS	-15 ANG F-16s +15 ANG F-15s	
Malmstrom AFB	+ Armed Forces Reserve Center	

State / Installation	BRAC Gain (+) / Loss (-)	Future Missions
New Hampshire		
Pease ANGB	-1 ANG KC-135	
Nebraska		
Offutt AFB	- DFAS	• Investigate an ANG Electronic Warfare coordination Cell (EWCC) augmentation unit at Offutt AFB • Investigate robusting ANG Integrated Associate unit with 55th WG to support RC-135 Airborne Cryptologic Linguist Training at Offutt AFB
Nevada		
Nellis AFB	+ AFRC HQ function +18 AD F-15s +25 AD F-16s	• Robust ANG/AFRC Associations throughout missions at the United States Air Force Warfare Center, Nellis AFB • Investigate an AFRC Classic Associate unit with the REDHORSE unit at Nellis AFB
New Jersey		
McGuire AFB	+ Joint Base McGuire/ Ft Dix/ Lakehurst - 8 ANG KC-135s ANG Tanker Modernization + USN aircraft, personnel, & equipment + USMC Light Attack Helicopter Squadron	• Establish an ANG Classic Associate unit in the Contingency Response Group (CRG) at McGuire AFB • Investigate an Active Associate unit with ANG Mobility Intelligence Formal Training Unit (FTU) at Ft Dix
Atlantic City ANGB	+ 3 ANG F-16s	• Establish an ANG Air Support Operations Squadron (ASOS) unit in NJ
New Mexico		
Cannon AFB	-60 AD F-16s Installation Transition Plan **Enclaved AD Manpower**	**Note: Cannon AFB will convert to support Air Force Special Operations Command (AFSOC) with appropriate missions, personnel, and support.**
Holloman AFB	- Centrifuge and physiological training units	• Establish a Classic Associate unit on F-22A at Holloman AFB
Kirtland AFB	+ AD Space Vehicle Directorate - AD Correctional Functions + 3 ANG F-16s + Joint Armed Forces Reserve Center	

State / Installation	BRAC Gain (+) / Loss (-)	Future Missions
New York		
Rome Labs	- AD Sensor Directorate + AD Info Systems Directorate	• Establish an ANG NRO support unit in NY
Niagara IAP ARS	-8 KC-135s ARC Assoc on AFRC Wing **Enclaved ANG Manpower**	• Establish a BRAC-directed ARC Associate Unit with AFRC as lead on 8 C-130s at Niagara IAP. A minimum of 4 additional C-130 A/C required
North Carolina		
Charlotte/Douglas IAP AGS	+2 ANG C-130s	
Pope AFB	-42 AD A-10s -28 AD C-130s +16 AFRC C-130s - AD ALQ-184 MX + 440th AW AFRC Ops, Mx, & ECS - 43d Medical Group to Medical Squadron **Facility converts to US Army (Pope Field)**	• Establish a BRAC-directed Active Associate unit on AFRC C-130s at Pope AFB
Seymour Johnson AFB	+ 8 AFRC KC-135s + F-100 Engine CIRF	• Investigate an Active Associate on AFRC RED HORSE Squadron at Seymour Johnson AFB • Establish a BRAC-directed Active Associate on AFRC KC-135s at Seymour Johnson AFB • Establish an AFRC Classic Associate unit on F-15Es at Seymour Johnson AFB • Establish a BRAC-directed F-100 engine CIRF at Seymour Johnson AFB
North Dakota		
Grand Forks AFB	-36 AD KC-135s + Accommodate emerging UAV missions	• Develop a BRAC-directed bed-down and operational plan to support family of UAV missions at Grand Forks AFB
Hector IAP AGS	-15 ANG F-16s + Predator GCS + Regional Readiness Command Center **Enclaved ANG Manpower**	• Establish an ANG Predator unit at Hector IAP, ND • Establish an ANG JCA unit at Hector IAP, ND • Establish an ANG C-21 UE (bridge) unit at Hector IAP, ND

State / Installation	BRAC Gain (+) / Loss (-)	Future Missions
Ohio		
Mansfield Lahm AGS	-8 ANG C-130s + Armed Forces Reserve Center **Enclaved ANG Manpower**	• Establish an ANG JCA unit at Mansfield Lahm APT, OH
Springfield-Beckley AGS	-18 ANG F-16s + Armed Forces Reserve Center **Enclaved ANG Manpower**	• Establish an ANG Foreign Military Sales (FMS) F-16 FTU at Springfield-Beckley MAP, OH • Robust ANG RED HORSE Unit in OH
Toledo Express Airport AGS	+3 ANG F-16s	
Wright Patterson AFB	- AD Logistics Oversight Functions - AD Information Systems Directorate + AD Sensors Directorate + AD High-onset Gravitational Force Centrifuge + SAM + Air Platform Develop and Acquisition - Fixed Wing Live T&E - V-22 D&A + Naval Aeromedical Research Lab + AFRL functions from Mesa City - Transactional functions of Civilian Personnel	• Establish an ANG Classic Associate unit for Measurement and Signature Intelligence (MASINT) supporting NAISC at Wright-Patterson AFB
Oklahoma		
Altus AFB	- AD LRS positions	
Will Rogers APT AGS	- 8 ANG C-130s + 2 AD C-21s & AFFSA Functions + AD USAF Advanced Instrument School + AD Global Air Traffic Operations Program Office (GATOPO) **Enclaved ANG Manpower**	• Establish an ANG Air Support Operations Squadron (ASOS) unit in OK
Tinker AFB	+ 4 AFRC KC-135s ARC Association on 12 AFRC KC-135s - AD Logistics Oversight Functions - AD GATOPO - AD Wholesale Storage and Dist/ Consolidate S&S - AD Fixed Wing D&A - Civilian Personnel	• Establish a BRAC-directed ARC Associate Unit on AFRC KC-135s at Tinker AFB

State / Installation	BRAC Gain (+) / Loss (-)	Future Missions
Oklahoma (continued)		
Tulsa IAOP AGS	+6 ANG F-16s	
Vance AFB	+ Training Aircraft + IFF for Pilots and WSOs + Armed Forces Reserve Center	
Oregon		
Portland IAP	+ 3 ANG F-15s - 8 AFRC KC-135s - AFRC OPS, MX & ECS	• Investigate an ANG Combat Support Wing in OR (Manpower neutral)
Pennsylvania		
NAS Willow Grove JRB	-15 ANG A-10s **Enclaved ANG Manpower**	• Establish an ANG Air Support Operations Squadron (ASOS) unit in PA • Establish an ANG AOC (Component NAF) augmentation unit in PA • Robust ANG RED HORSE unit in PA
Pittsburgh IAP ARS	+ Regional Joint Readiness Center	
South Carolina		
Charleston AFB	+ Joint Base Charleston AFB/Navel Weapons Station Charleston	• Investigate an ANG Combat Support Wing in OR (Manpower neutral)
Shaw AFB	- AD TF-34 Engine MX + AD ALQ-184 POD CIRF + HQ 3rd Army	• Establish a BRAC-directed ECM pod CIRF at Shaw AFB • Robust AFRC Classic Associate unit on F-16s at Shaw AFB
McEntire AGS	+ 9 ANG F-16s	• Establish an Active Associate unit on ANG F-16s at McEntire ANGB
South Dakota		
Joe Foss Field AGS	+3 ANG F-16s - ANG F-110 Engine MX	

State / Installation	BRAC Gain (+) / Loss (-)	Future Missions
Tennessee		
McGhee-Tyson Airport AGS	- 8 ANG KC-135Es +12 ANG KC-135Rs	• Robust ANG Command and Control Squadron in support of space operations at McGhee-Tyson APT
Nashville IAP AGS	-8 ANG C-130s **Enclaved ANG Manpower**	• Establish an ANG Intel production squadron in support of ACC at Nashville Metro APT • Investigate an ANG JCA unit at Nashville Metro APT
Texas		
Brooks City-Base	- AD AFNEWS - Other Human Effects Directorate - Directed Energy portion, Human Effects Directorate - AF Audit Agency - AD 341st Recruiting Squadron - AF Medical Support Agency, - Aft Medical Operations Agency, - AF Element Medical Defense Agency and DoD - AF Center for Environmental Excellence, AF Support Element, - 710th Information Operations Flight, - 68th Information Operation Flight - Aerospace Medicine, Institute of Operation Health, HSD&A - Human Effectiveness Directorate - Non-Medical Chemical Biological DD&A **Facility Closes**	
NAS JRB Ft Worth (Carswell)	+9 AFRC F-16s - AFRC F-110 Engine MX	• Investigate an Active associate unit on AFRC F-16s at NAS Ft Worth (Carswell)
Dyess AFB	+ Armed Forces Reserve Center	
Ellington Field AGS	-15 ANG F-16s + 272nd EIS **Enclaved ANG Manpower**	• Establish an ANG ASOS unit in TX • Establish an ANG Predator unit at Ellington Field
Laughlin AFB	+ Training Aircraft + IFF for Pilots and WSOs	

State / Installation	BRAC Gain (+) / Loss (-)	Future Missions
Texas (Continued)		
Lackland AFB	+ Joint Base Lackland / Ft Sam / Randolph + Air Force Real Property Agency (Rosslyn) + AF Medical Support Agency, Aft Medical Operations Agency, AF Element Medical Defense Agency and DoD + AF Center for Environmental Excellence, AF Support Element, 710th Information Operations Flight, 68th Information Operation Flight - F-110 Engine CIRF - STAMP/STRAPP - Transportation Management Training - Culinary Training - Correctional Function + AETC Training Aircraft - 59 MG Wilford Hall to Ambulatory Care, Inpatient	• Establish an AFRC C-5 FTU at Lackland AFB • Continue an ANG Classic Associate unit (273rd IOS) in support of IO missions at Lackland AFB • Investigate a fully integrated Total Force Enlisted Aircrew Center of Excellence (AD/ANG/AFRC) at Lackland AFB
Randolph AFB	- Joint Base Lackland / Ft Sam / Randolph + AD AF Audit Agency, + AD 341st Recruiting Squadron + AIS + IFF for Pilots and Instructor Pilots - Undergraduate Navigator Training + Civilian Personnel Consolidation	
Sheppard AFB	+ AETC Training Aircraft + IFF for Pilots and WSOs - Enlisted Medical Training - JSF Mx Instruction	
Utah		
Hill AFB	- 15 AFRC F-16s + 6 AD F-16s + AD F-110 Engine CIRF + AD LANTIRN CIRF - Misc Logistics - Wholesale Storage/Distribution - Contracting/Logistics (Tires) - Civilian Personnel - Weapons & Armaments RDAT&E - Fixed Wing RDAT&E	• Establish an AFRC Classic Associate unit on F-16s at Hill AFB UT • Establish a BRAC-directed Targeting Pod CIRF at Hill AFB • Establish a BRAC-directed F-110 engine CIRF at Hill AFB

State / Installation	BRAC Gain (+) / Loss (-)	Future Missions
Vermont		
Burlington IAP AGS	+3 F-16s	• Continue CSAF-directed community basing initiative at Burlington
Virginia		
Langley AFB	+ 18 F-15s (Non BRAC programmatic) + Joint Base Langley / Ft Eustis - AD F-15 Avionics Mx + CAF Logistics Support Center (LSC) + ANG Association with 1FW - AD F-100 Engine Mx	• Establish an ANG Classic Associate unit in F-22A at Langley AFB • Continue AFRC Classic Associate unit on F-15s at Langley AFB • Investigate robusting ANG Classic Associate on the Distributed Ground System (DGS-1) at Langley AFB • Establish ANG manpower support to the BRAC-directed Logistics Support center at Langley AFB
Richmond IAP AGS	-15 ANG F-16s **ANG Facility closes**	
Wisconsin		
Gen Mitchell Field	-8 AFRC C-130s - 440th AW AFRC Ops, Mx, & ECS **AFRC Closes** +3 ANG KC-135s	
Traux Field AGS	+3 ANG F-16s - ANG F-110 Engine MX	
Washington		
Fairchild AFB	- 8 ANG KC-135s + Armed Forces Reserve Center + 242nd Combat Comm + 256th Combat Comm ANG Classic Association in Wing	• Establish a BRAC-directed ANG Classic Associate wing at Fairchild
McChord AFB	- Installation Management & Medical functions	• Continue an ANG Combat Support Wing in WA • Establish an ANG ASOG unit in WA

State / Installation	BRAC Gain (+) / Loss (-)	Future Missions
Wyoming		
Cheyenne MAP	+ 4 ANG C-130s + Active Association on ANG C-130s	• Establish a BRAC-directed Active Associate unit on ANG C-130s at Cheyenne MAP
F.E. Warren AFB	+ Army National Guard units and aviation functions + WYARNG AASF, Readiness Center, and Field Maintenance Shop	
Guam		
Andersen AFB	- Joint Base US Naval forces Marianas Islands/Guam AFB	• Establish an ANG Red Horse Classic Associate Squadron in Guam

United States Air Force

Report to Congressional Appropriations Committees

Grand Forks Air Force Base, North Dakota Infrastructure

December 2008

FY09 Defense Appropriations Act, Joint Explanatory Statement, page 105

Introduction

This report is being provided to the Congressional Appropriations Committees as directed in HR 2638 Consolidated Security, Disaster Relief, and Continuing Resolution 2009, page 105.

> *GRAND FORKS AIR FORCE BASE, NORTH DAKOTA, INFRASTRUCTURE*
>
> *The January 2008 United States Air Force Weapons Systems Roadmap anticipates a future KC-X tanker mission at Grand Forks Air Force Base after the departure of the base's current fleet of KC-135R tankers. Thus, the Air Force is directed to prepare a report which recommends the best way to keep the base and its associated infrastructure viable until the potential arrival of KC-X tanker aircraft so it does not have to rebuild or recreate facilities that now exist. This report shall be provided to the House and Senate Committees on Appropriations within 90 days of Enactment of this Act.*

Executive Summary

Despite the termination of the competition for a U.S. Air Force airborne tanker replacement, the challenges since the 2005 BRAC announcement continue. However, as a result of events at the national, state, and local levels, new opportunities have emerged that may leverage the unused capacity resident at Grand Forks Air Force Base (GFAFB).

Annual fixed costs to maintain the viability of GFAFB with assigned workforce, infrastructure and associate mission support requirements are approximately $45.2 million per year. The four areas that drive the annual costs include: airfield maintenance for the Unmanned Aerial System (UAS) mission; civilian pay, base support, and utilities.

A programmatic drawdown of the Grand Forks Air Force Base tanker mission will complete in December 2010 when the final KC-135 aircraft departs. Keeping GFAFB viable for future mission sets is dependent on two strategies: embracing the current and future UAS mission and preserving infrastructure within Air Force fiscal constraints.

GFAFB has a robust infrastructure with excess capacity for new missions and a team of Air Force experts is developing an action plan that details a number of pro-active options to defray base operating costs during the "bathtub" period. These actions include demolition of unusable space, placement of under-utilized space in caretaker status, and promote short-term leases to provide a potential revenue stream to offset base operating costs.

Report

Mission Environment.

In May 2005, the Department of Defense (DoD) recommended to the Base Realignment and Closure (BRAC) Commission that GFAFB be realigned. While this decision effectively prevents the base from being closed, it does result in a loss in personnel and the installation's current tanker mission. To offset some of these losses, the Air Force is planning on expanding the BRAC directed bed down of UAS aircraft at GFAFB, to include the Predator A (MQ-1) to be operated by the Air National Guard (the 119th Air Wing in Fargo, ND) and the Global Hawk (RQ-4) operated by Air Combat Command (ACC). A depiction of the proposed UAS bed down plan is included at Tab 1.

GFAFB is shaping up to be a unique wing, with partners from DoD, Department of Homeland Security Customs and Border Protection (DHS/CBP) Air and Marine Division (AMO) and the National Guard slated to conduct UAS Operations side-by-side in the very near future. GFAFB finds itself facing a series of significant challenges as it transitions from a super tanker wing to a UAS wing.

Challenges

Tanker mission "bathtub" and fixed cost. During the tanker "bathtub" period – the timeframe between the departure of the aged KC-135R fleet and the potential beddown of a new Air Force tanker -- mission support and base support Airmen will continue to operate the base. Additionally, the facilities and infrastructure will remain with considerable spare capacity. People and infrastructure drive the "fixed cost" portion of operating an installation representing the cost of keeping the gates open. Much like the fixed cost associated with a manufacturing plant, the base's fixed cost varies only slightly with flying mission changes. The fixed cost is more dependent upon base capacity (land, number of facilities, ramp/hangar space, number of support functions, etc). Mission operations tempo (aircraft maintenance cost, jet fuel cost, operator personnel costs, etc.) drives the variable costs of the base. Variable cost has little impact on the fixed cost as long as the operations tempo requirements do not exceed the capacity of the base driving additional infrastructure and support personnel to expand.

To keep GFAFB viable, we need to preserve the support machine and infrastructure, which includes funding the associated annual fixed-cost bill. No mission set on the immediate horizon will bring instant growth. Therefore, the "bathtub" period is a significant challenge for cost and efficiency. Temporary solutions to offset fixed operating cost will require non-standard solutions and innovation.

Summary of annual funding requirements. $45.2 million per year is required in fixed costs to maintain the viability of GFAFB with assigned workforce, infrastructure and associate mission support requirements. Costs are outlined in the projected operating cost point paper in Tab 4. Costs are driven by the following areas:

- **Airfield maintenance.** $2.3 million per year in maintenance costs is required to preserve airfield pavement and lighting alone for the UAS and other potential new missions
- **Civilian pay.** $20.4 million is required for Fiscal Year 2012 civilian payroll funding (doesn't include pay raises, performance awards, retirements, and, lump sum leave)
- **Base support.** $15.3 million is required for Fiscal Year 2012 base support funding
- **Utilities.** $7.2 million is required for Fiscal Year 2012 utility funding

Infrastructure available for new missions. GFAFB will have excess capacity for new missions. In the last decade, this base has benefited from $438 million in infrastructure project investment. GFAFB has a new runway, quality housing, one of the Air Force's finest fitness complexes (at 135,000 sq ft), and a host of buildings less than four years new. Additionally, the base is preparing to break ground on a $13 million state-of-the-art control tower and RAPCON facility and anticipate construction of a $13 million fire station in the very near future. Finally, GFAFB is launching a 2+ year upgrade of the communication systems (fiber backbone, key equipment nodes, and pipelines off-base) which is estimated to be scoped at several million dollars. There is 225,000 square feet of administrative, warehouse and hangar space available (Tab 3) in addition to 1,200 acres of real estate for potential development (Tab 2). GFAFB will have 224 adequate surplus dorm rooms and 273 surplus new military family housing units.

Action Plan for viability. The Air Force can grow the UAS mission assigned to GFAFB and concurrently preserve capacity for any future potential tanker mission. GFAFB may have sufficient space to assign additional mission sets without jeopardizing the base as a potential bed down site for a new tanker mission.

Objective 1: Preserve Capacity for potential future tanker mission and other emerging mission sets.

> **Demolition.** There is space on GFAFB that is beyond its useful life and unsuitable for any re-use, which will be prioritized for demolition. However, none of that demolition will hamper the Air Force's ability to develop the UAS mission, house a potential tanker mission, or host an emerging mission set. In fact, demolishing facilities past their useful life-cycle prepares land for future redevelopment.
>
> **Care-taker maintenance.** While the preference is to find temporary or long-term use for buildings, some space will likely remain vacant. The Air Force will maintain those buildings with a care-taker maintenance plan. The plan will divert infrastructure craftsman labor to a periodic inspection and maintenance cycle for vacant facilities. The Air Force will maintain the facility shells and the mechanical equipment in order to preserve integrity of the building and maintain moisture control inside. The temperatures will be controlled to maintain humidity but set at seasonal extremes to save energy costs. All repairs beyond what is necessary to keep the buildings ready for re-use will be shelved for the foreseeable future.

Housing/dorm capacity. During the bathtub period, the Air Force projects that it will have 224 surplus dorm rooms and 273 surplus adequate military family housing units. GFAFB is aggressively working to privatize the military family housing units and divest the infrastructure from Air Force real property records by late 2009 to early 2010. Unoccupied dorms will be kept in care-taker status. The Air Force will continue to explore opportunities to use unoccupied dormitories until tanker mission beddown plans are solidified.

Objective 2: Explore opportunities to increase defense value and efficiency for the tax-payer investment.

Direct reimbursement lease provisions: Lease authority to temporarily lease unused facility space is covered by provisions of 10 USC 2667, which contains provisions to displace the tenant for an emergent high-priority Air Force mission (i.e., KC-X or some other large-scale platform). This lease authority provides the flexibility to structure the lease to accept payment in-kind or money.

The sum square footage available for leases across the wing (after fully accounting for the current bed down of Department of Homeland Security (DHS, North Dakota Air National Guard, and active duty UAS platforms) could provide a revenue stream to help offset base operating costs.

Leases in response to unsolicited proposals. Any unsolicited proposals to lease facilities and land at GFAFB may provide the opportunity for funding to maintain GFAFB viability for short and long term leasing. Long term lease commitments are more appropriate for land available for development or for facilities earmarked for long-term exclusive use.

Objective 3: Acquire new missions to defray base operating costs.

On-Going Airspace Initiative. Air Mobility Command and Air Combat Command are working to obtain funding and be inserted into the Air Force Laser Lab schedule to investigate and certify Camp Grafton South, restricted area (R-5401) for non-eye safe laser UAS air operations. The Environmental Impact Statement is on-going with the current completion date being slipped from October 2009 to January 2010.

Emerging UAS technologies and programs. The demand for UAS technologies continues to rapidly proliferate. GFAFB is uniquely positioned to support these emerging UAS needs and initiatives by providing synergistic opportunities that could net significant economies of scale for all stakeholders by combining them.

Department of Homeland Security (DHS) UAS missions. The DHS mission, as currently described, is slated to grow to approximately 103 personnel operating up to six Predator B's. There is potential for further DHS expansion as a training hub.

University of North Dakota UAS programs. The University of North Dakota has been working to establish a UAS Center of Excellence in the greater Grand Forks region to conduct research projects for the FAA, DOD, and private companies. The Center will use the core competencies of the university to strengthen the defense of the U.S. and further the civil development and implementation of unmanned aircraft.

In addition, the University of North Dakota is currently partnering with the Joint UAS Center of Excellence at Creech AFB, NV, conducting analysis into UAS payloads and evaluating the use of ground based radar for traffic de-confliction purposes. Recently, the University of North Dakota has teamed with Crew Training International (CTI) as a part of a $50 million contract to conduct all ground training for the Air Force Reaper (MQ-9). As a result of its broad based UAS partnerships and long-standing reputation for civilian pilot training, University of North Dakota now finds itself uniquely positioned to offer initial pilot and UAS training.

Air National Guard. Consistent with the BRAC law, the North Dakota Air National Guard will begin flying UAS at GFAFB no later than the first quarter of the 2011 fiscal year. The North Dakota Guard units are slated to be co-located in the same facility as DHS. Potential exists to establish a UAS Center of Excellence for the National Guard in the region.

Air Force Research Labs (AFRL). GFAFB has been approved for base level security testing of "riding lawnmower sized" helicopter UAS systems that both enhance force protection efforts and enhance our security forces ability to respond quicker at greater stand-off distances. AFRL has an approved test plan and an air vehicle that will arrive at the base in the near future for commencement of integration and human factors testing.

The United States Air Force Academy (USAFA). USAFA personnel are interested in partnering with UND on a recently awarded $3.76 million USAF Battle Lab funded contract to research the potential of using gang phased array radar to measure the issues associated with UAS sense and avoid challenges.

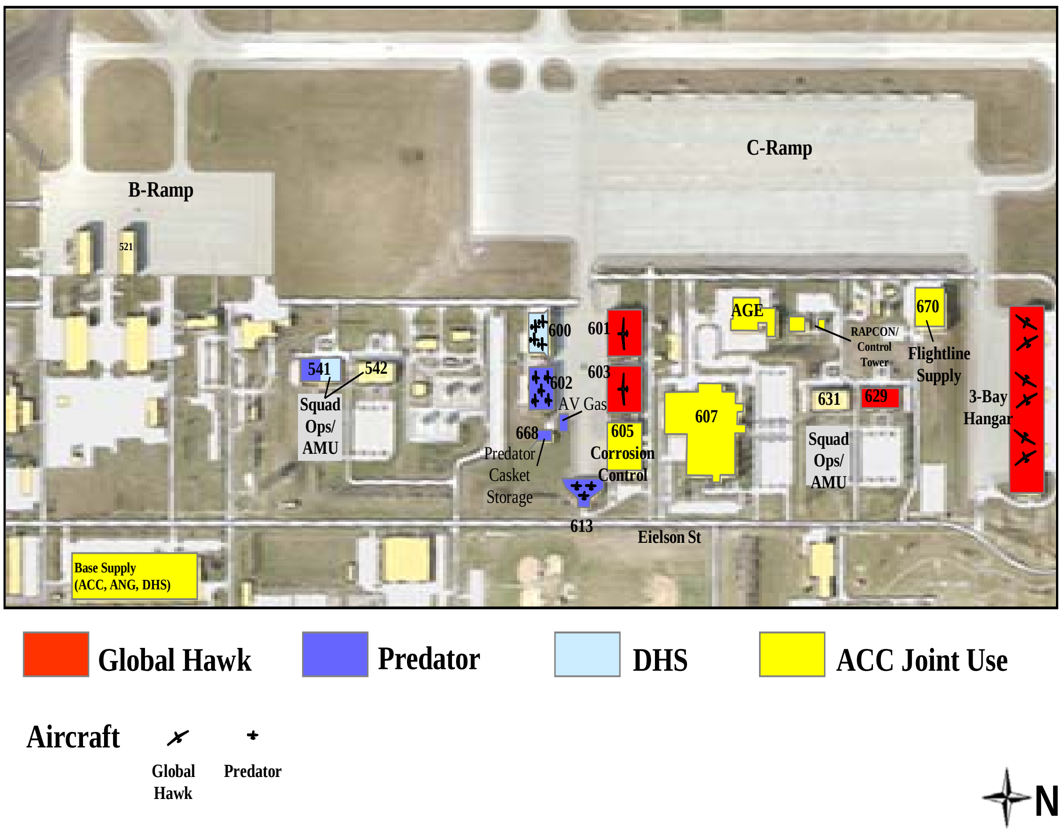
Private entities. Private corporations involved in the development of UAS technologies have approached GFAFB requesting the opportunity to enter into some form of lease arrangement. Among those companies, Laserlith Corporation is a rapidly growing technology company that is currently developing a family of nanotechnology-based products that deliver reliable and high performance UAS-related communications equipment to the war fighter.

The integration of UAS-centric private businesses into available base facilities provides a tremendous opportunity to not only offset base operating costs addressed earlier during this period of transition, but also keeps the focus on integrating only synergistic entities. This is an opportunity to open unused space to commercial interests that are involved in the development, training, or manufacturing of UAS-centric endeavors.

Bottom line: The USAF is projected to require $45.2 million annually starting in Fiscal Year 2012 to maintain the viability of GFAFB with assigned workforce, infrastructure and associate mission support requirements. A responsible action plan is being developed to mitigate the tanker "bathtub". GFAFB and the Air Force are moving forward to beddown UAS aircraft with the North Dakota Air National Guard operating the Predator A (MQ-1) and Air Combat Command (ACC) operating the Global Hawk (RQ-4). Air Mobility Command and the 319 Air Reserve Wing have developed strong partnerships with federal, state, and local government agencies, the Grand Forks community, and the private sector to utilize leasing opportunities to open up the base to potential UAS related industry and academic initiatives.

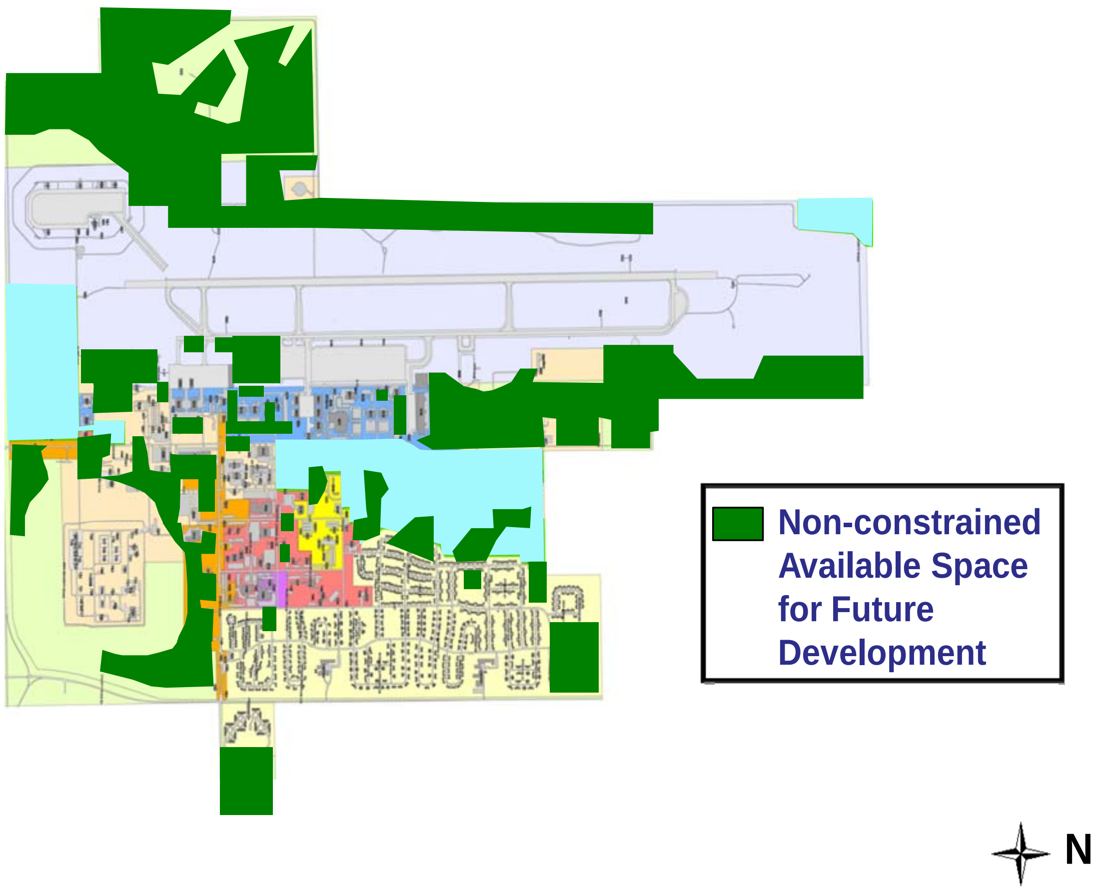
Tab 1

Future with UAV's Only



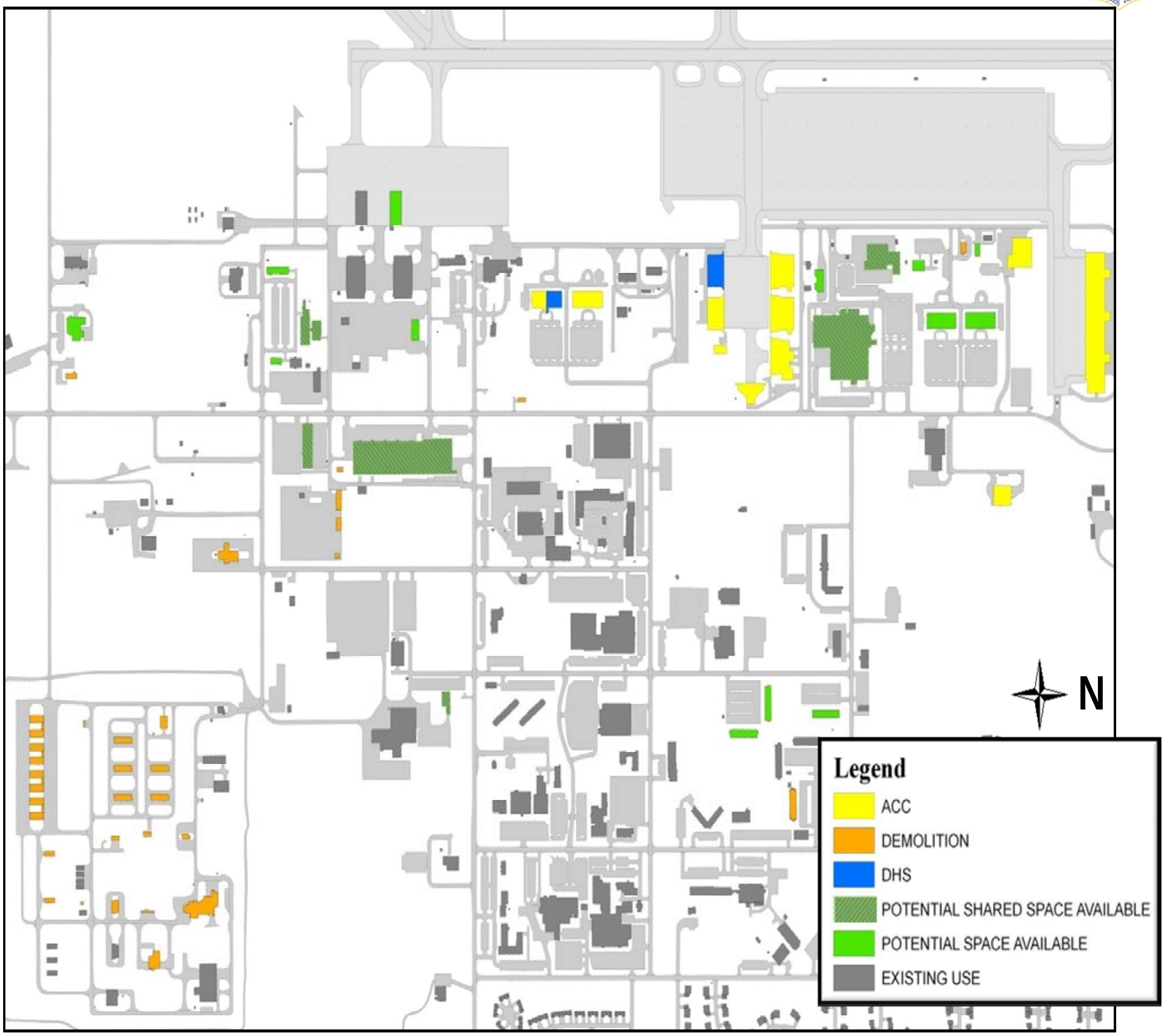
Tab 2

Grand Forks AFB
Non-constrained Available Space



Tab 3

Grand Forks AFB
Future Space Potential



Tab 4

GFAFB Aggregated Base Operating Support Summary

	FY08 Requirements ($K)	FY12 Requirements ($K)	
Airfield Maintenance	$2,100	$2,272	Cost to maintain airfield during "bathtub" period
Civilian Pay	$20,600	$20,443	Reduction due to loss of 39 civilian positions plus an additional 8 positions retained for KC-X missions--are expected to be lost in FY11 if the timeline slips further to the right
Utilities	$7,140	$7,228	Reduced number of base personnel will reduce utility requirements; and completion of energy savings projects and measures will reduce consumption
Base Support	$14,100	$15,256	Reduced number of active duty personnel will allow re-negotiation of service contracts
		$45,199	Total required to maintain GFAFB during the “bathtub” period

Note: Inflation is accounted for in these projections

Distribution

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Chairman
Committee on Appropriations
United States Senate
Washington, DC 20510-6025

The Honorable Thad Cochran
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October 8, 2008

HAF/A4/7
1030 Air Force Pentagon
Room 4E260
Washington, DC 20330-1030

Dear HAF/A4/7:

Per your request, please find attached a summary of the analytic approach used in the RAND Logistics Enterprise Analysis for the F-16 and KC-135 fleets as well as a list of the key assumptions in this analysis.

Sincerely,

Laura H. Baldwin

In 2007, senior Air Force logisticians asked RAND to undertake a strategic reassessment of the Air Force's logistics enterprise to identify alternatives for appropriately rebalancing logistics resources and capabilities between operating units and support network nodes, based on projections for the future operating environment derived from Department of Defense planning guidance. This analysis first determined the maintenance capabilities necessary to support the F-16 and KC-135 across both steady-state deployments and the requirements of major combat operations, as outlined in Department of Defense guidance. For the operational units, the mission-generation manpower necessary to accomplish each squadron's flying mission was determined. For combat-coded and combat-direct-support squadrons, the analysis determined the requirement for both (1) the deployment of the entire squadron and (2) support of a "split-operations" concept, in which the squadron deploys a portion of its aircraft while continuing operations at home station with its nondeployed aircraft. A mathematical optimization procedure was then used to determine the location and size of a set of centralized repair facilities (CRFs). This optimization used an objective function that minimized the total system cost of meeting all requirements, with the total comprised of manpower cost, an amortized facility construction cost, and a transportation cost associated with shuttling aircraft between their operating locations and CRFs. The extent of centralization was not predetermined; rather, the optimization model was allowed to choose the minimum-cost alternative from a broad set of options that ranged from complete decentralization, with CRF maintenance capability remaining at each home-station operating location, to complete centralization, with all CRF maintenance capabilities at a single site. This optimization technique was also used to determine how the costs would vary if alternative CRF locations were selected for other reasons.

The key assumptions included in this analysis were:

- Current wing-level maintenance manpower levels were determined using Manpower Programming and Execution System (MPES) data, taking a data snapshot from September 30, 2007.

- Future manpower requirements were determined using the Logistics Composite Model (LCOM) simulation, the Air Force's standard approach for developing aircraft maintenance manpower requirements.
- All manpower in the analysis was assumed to have standard Air Force availability and productivity factors.
- The mission-generation manpower for Reserve Component units assumed that the current ratio of Aircraft Maintenance Squadron full-time (technician) to part-time (drill position) manpower would be maintained. Note that no such assumption was made regarding Reserve Component support to CRF manpower requirements; the distribution of CRF manpower across the Active Duty and Reserve Components is presented as a policy option for the consideration of decisionmakers.
- This analysis assumed an annual manpower cost of $65,000 per full-time position, based on Air Force Instruction 65-503 Annex 19-2, US Air Force Cost and Planning Factors, FY2008 Standard Composite Rates by Grade. A Reserve Component drill position was assumed to cost 25 percent of the equivalent Active Duty cost of $65,000.
- The set of potential CRF sites considered included all current home-station operating locations, along with the Air Logistics Centers at Warner-Robins, Ogden, and Oklahoma City.
- It was assumed that the facilities used by any CRF would require new construction at each site, with no allowance for the use of existing facilities at any potential CRF site. Further, all CRF sites were assumed to have sufficient space to accommodate the growth associated with CRF operations.
- The only facility cost included in this analysis was that associated with constructing new aircraft hangars at the CRF sites, with cost data drawn from the *Historical Air Force Construction Cost Handbook*, Directorate of Technical Support, Air Force Civil Engineer Support Agency, February 2004. This facility cost was assumed to be constant across all potential facilities.

- The transportation costs were based on FY08 Cost Per Flying Hour data for each aircraft. It was assumed that these flight hours were a purely additive cost, with no credit for pilot training being accomplished during flights to and from CRFs.
- The flying requirements for home-station training were based on the FY08 Flying Hour Program, as obtained from Air Force Total Ownership Cost-Cost Analysis Improvement Group (AFTOC-CAIG).
- CRFs were assumed to operate 24 hours per day, 7 days per week. If this assumption were modified such that CRFs operated fewer hours per week, each aircraft induction would remain at the CRF longer, increasing the number of unavailable aircraft and increasing the facility requirements. Note, however, that such a reduction in weekly operating hours would have little effect on CRF manpower requirements.

United States Air Force

Report to Congressional Defense Committees

Report on Reduction in Number of Firefighters in Air Force Bases

January 2009

2009 National Defense Authorization Act (Section 326, page 144-145)

Introduction

This report is being provided to the congressional defense committees as directed in Public Law 110-181, Section 1636, the National Defense Authorization Act Fiscal Year 2009.

2009 National Defense Authorization Act, Section 326, *Report on Reduction in Number of Firefighters on Air Force Bases*:

> *To ensure that the Air Force is meeting the minimum safety standards for staffing, equipment, and training, as required by Department of Defense Installation and Environment Instruction 6055.6, the Secretary of the Air Force shall submit to Congress, by not later than 90 days after the date of the enactment of this Act, a report on the effects of the reduction in the number of firefighters on Air Force bases during the three fiscal years preceding the fiscal year in which the report is submitted. Such report shall include each of the following:*
>
> *(1) An evaluation of current fire fighting capability of the Air Force and whether the reduction in the number of firefighters on Air Force bases has increased the risk of harm to either firefighters or those they may serve in response to an emergency.*
>
> *(2) An evaluation of whether adequate capability exists in the municipal communities surrounding the Air Force bases covered by the report to support a base aircraft rescue or to respond to a fire involving a combat aircraft, cargo aircraft, or weapon system.*
>
> *(3) An evaluation of the effects that the reductions in fire fighting personnel or functions have had on the certifications of Air Force base fire departments.*
>
> *(4) If the Secretary determines that reductions in the number of fire fighting personnel during the fiscal years covered by the report have negatively affected the ability of fire fighters on Air Forces bases to perform their missions, a plan to restore the fire fighting personnel needed to adequately support such missions.*

Executive Summary

This report is being provided to the congressional defense committees as directed in Public Law 110-181, Section 1636, the National Defense Authorization Act Fiscal Year 2009.

We appreciate the opportunity to explain recent changes to Air Force firefighter manning implemented as part of our Fire Emergency Services transformation. In 2006, we initiated a comprehensive review and risk-based analysis of our fire departments. This analysis revealed that we possessed the capability to respond to multiple emergency events simultaneously, exceeding the DoD requirement. After a thorough review of emergency response data, we could not validate the need to maintain this increased capability. We adjusted our manpower accordingly eliminating 901 firefighter positions, resulting in a 14 percent reduction in firefighter end strength. Our revised manning balances fire department capability with the risks that confront our firefighters and mission while fully complying with the requirements set forth in Department of Defense Instruction 6055.06, *Department of Defense Fire and Emergency Services Program*.

For this report, we reviewed emergency response data and major accidents since implementing our Fire Emergency Services transformation and concluded that manpower reductions have not had any detrimental impact. In fact, our continued focus on fire prevention and firefighter safety has decreased the number/severity of fire responses and firefighter injuries. Air Force Fire Emergency Services found no historical data indicating additional firefighter manning would have changed the outcome of large scale incidents. Our conclusion is that increasing firefighter manning in the Air Force is not warranted at this time.

Background

In 2006, the Air Force conducted a comprehensive risk analysis of its Fire Emergency Services programs. This analysis included a thorough review of 4.5 years of emergency response data covering the period 1 Apr 02 to 30 Sep 06, and the professional judgment and experience of our senior fire officials. The data revealed that an aircraft fire had occurred every 611 days on average at each Air Force base and a building fire had occurred every 108 days. A hazardous materials (HazMat) incident had occurred every 4.5 days and an emergency medical services (EMS) response every 2.7 days. Aircraft and structural fire fighting are our most resource-demanding missions and form the basis for manpower, vehicles and equipment in our fire departments. HazMat and EMS calls, although more frequent, are performed by firefighters authorized for firefighting using a common cross-staffing (multi-tasking) concept. This concept is consistent with the assumption that only one major event will occur at the same time contained in Department of Defense Instruction 6055.06, *Department of Defense Fire and Emergency Services Program*.

We concluded that the low frequency of fires in the Air Force was attributable to our historically successful fire prevention programs and our capability to intervene early at small fires, preventing large fires from developing. The Air Force's investments in fire safety engineering, inspection and enforcement of fire safety requirements, and public education had yielded the desired results - the prevention of most fires and early intervention when fires occur. Fires had been detected early by automatic fire protection systems or occupants and had been extinguished by occupants or initially responding firefighting crews. Consequently, fires that had occurred had not been able to progress to large fires that would have required large numbers of firefighters to extinguish.

Very few large fires had occurred on Air Force installations but no large fire had developed after the arrival of the initially responding firefighters. As a result, we concluded that when fires are not prevented, early intervention is the key to avoiding or minimizing fire damage. Rather than maintaining large numbers of firefighters to fight large fires, the focus must be on effective fire prevention programs and early intervention to prevent large fires from developing.

The review concluded that firefighters encountering a large fire upon initial arrival could have little or no impact on the outcome of the event. The opportunity to avoid damage had passed before they arrived. In large fires, regardless of the number of firefighters available, the objective is to protect exposures and contain the large fire rather than directly attacking the fire. This strategy is common practice worldwide and is necessary to ensure firefighter safety.

The analysis credited the Air Force's change to JP-8 fuel in its weapons systems as a major factor in the low rate of aircraft fires. Unlike previous volatile and unstable fuels such as JP-4, JP-8 does not ignite easily or spread rapidly. The result is fewer fires and a reduced probability that large fires will develop. Although large fires are still possible during aircraft crashes and similar catastrophic events, firefighters cannot prevent the damage from such events regardless of the number available.

As the analysis progressed, it became apparent that the core missions and operational objectives for Air Force fire departments had not been clearly articulated in Air Force policy. Firefighter manpower requirements had been subjectively determined based on perceived worse case scenarios that had not occurred. The typical scenario included the largest aircraft or building on the installation totally enveloped in fire, inside and out, with rescue required. Furthermore, objectives for such situations were not established leaving managers without an understanding of what they were expected to do should they encounter such a situation. Managers had advocated, often successfully, for enough firefighters to accomplish what they perceived as the objective for the unrealistic scenario. We concluded that it is not possible to provide enough manpower to prevent the loss of property after a large fire had already developed. It is possible however, to provide enough manpower to intervene early at fires and prevent them from progressing to a large fire; this became the genesis for transforming our fire departments.

Core missions were then established for Air Force fire departments. Likewise, objectives were established that defined the expectations from fire departments. This enabled firefighter requirements to be objectively determined for the first time in the Air Force.

We also reviewed emergency response data to determine the size and complexity of fire fighting operations that had occurred. The 4.5 year study period revealed that most fires could be managed by one fire company (one fire fighting vehicle with 4 to 7 firefighters). In rare cases where firefighters had encountered a large fire upon arrival, the number of firefighters available had not made a significant difference in the outcome of the event because the damage had occurred before the arrival of the firefighters.

Finally, we determined the most probable time of day and day of the week that fire incidents will occur. The review revealed that over 70 percent of all activity occurred during normal duty hours (Figure 1); 18 percent occurred on weekends (Figure 2); and just over 1 percent of all activity occurred on holidays. These risk factors indicated it was reasonable for the level of fire services to vary according to the probability of a fire incident.

Figure 1. Activity by Hour of the Day

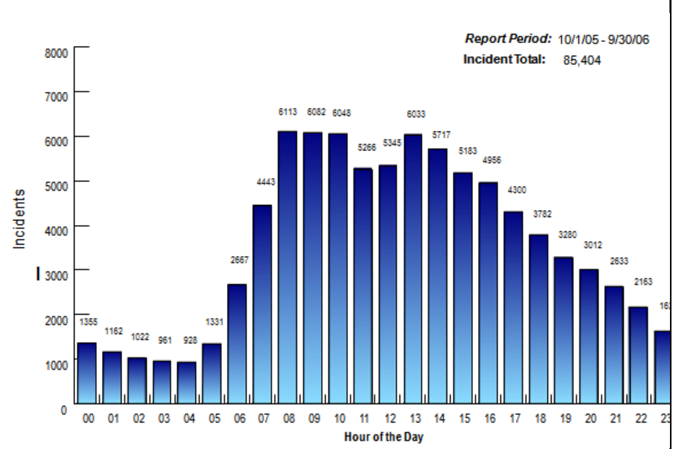
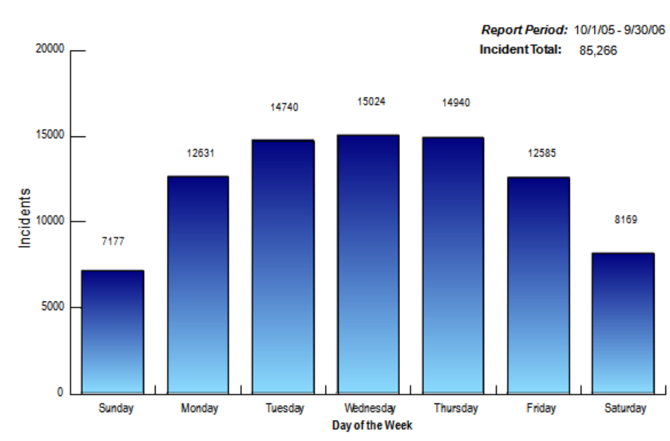


Figure 2. Activity by Day of the Week



As a result of the risk analysis, Air Force senior leaders accepted the risk associated with reducing 901 firefighters across the Air Force affecting 71 installations. This was an overall 14 percent reduction from 6,416 firefighters, leaving 5,515 active duty military and civilian firefighters. This effort did not affect the number of Air Force Reserve or Air National Guard firefighters. While we did not reduce firefighters to the minimum capability indicated by the risk assessment, we did eliminate firefighters that were clearly in excess to Air Force needs.

Response Findings

The Fiscal Year 2009 National Defense Authorization Act required a report to Congress reporting the affects of the reduction of firefighters for the fiscal years 2006, 2007, and 2008 timeframe. Specifically it required we evaluate current capability, determine if any increased risk has occurred to firefighters or those the serve, determine the adequacy of municipal communities to support aircraft fires, evaluate the effects on fire department certifications, and the plan, if any, to restore firefighter authorizations.

1. a Evaluation of Current Fire Fighting Capability

In October 2008, the emergency response data for fiscal years 2006 through 2008 was analyzed to determine if risk to Air Force people, property, or missions had increased since the 2006 manpower reduction. The analysis revealed that the frequency for fire incidents had actually decreased, further reducing risk. The table below summarizes the average frequency for emergency incidents at each Air Force installation.

Table 1. ***Frequency of Emergency Incidents***

	1 Apr 02 to 30 Sep 06	**1 Oct 05 to 30 Sep 08**
Aircraft Fire:	**611 days**	**939 days**
Structure Fire:	**108 days**	**765 days**
Hazardous Materials Mitigation	**4.5 days**	**16.5 days**
Emergency Medical Services Support	**2.7 days**	**4.8 days**

We also reviewed significant fire incidents that had occurred during the period. As with the 2006 risk assessment, no fires could be identified where a larger number of available firefighters would have made a difference in the outcome of the event. No large fire had developed after firefighters arrived. Large fire incidents included two T-38 aircraft crashes at Sheppard AFB, Texas and Columbus AFB, Mississippi, respectively, and a B-2 aircraft crash at Andersen AFB, Guam. The outcome of these events would not have improved with additional firefighters.

We concluded that our fire departments have the desired capability and the reduction of firefighters has not resulted in increased risk to our people, property or mission.

1.b Evaluation to Determine if the Reduction in the Number of Fire Fighters on Air Force Bases has Increased the Risk of Harm to Fire Fighters or those that may be served by firefighters

The reduction of firefighters did not impact the safety of firefighters. The Air Force uses National Fire Protection Association Standard 1500, *Fire Department Occupational Safety and Health Program*, to ensure the safety of firefighters. This standard establishes requirements for personal protective equipment and establishes safety requirements during emergency operations. Additionally, the Air Force strictly enforces the Occupational Safety and Health Administration's 2-in/2-out rules (29 CFR 1910.134), which requires a rapid intervention team of two or more firefighters to be on standby to come to the aid of firefighters operating in atmospheres that are immediately dangerous to health or life, such as inside a burning building or aircraft. These two directives serve as the foundation for our firefighter safety program and are integral components to firefighter training programs and standard operating procedures.

We reviewed the emergency response data reported to the National Fire Incident Reporting System by our fire chiefs for all emergency responses (fires, emergency medical support, industrial accidents, support to community fire departments, etc.). Table 2 summarizes the data and indicates a steady decrease in Air Force firefighter injuries between fiscal years 2003 and 2008, covering the time periods prior to, during and after the reduction of firefighters. We attribute this decrease to our continuous emphasis on firefighter safety and abiding by our mantra "if it can't be done safely, it shall not be done."

Table 2. ***Number of deaths and injuries at emergency incidents***

	FY03-04		**FY05-06**		**FY07-08**	
	Deaths	**Injuries**	**Deaths**	**Injuries**	**Deaths**	**Injuries**
Firefighters	**0**	**89**	**0**	**54**	**0**	**31**
Casualty	**26**	**197**	**24**	**78**	**10**	**25**

The reduction of firefighters did not increase the risk of harm to Air Force personnel served by our firefighters. Air Force fire departments continuously maintain the capability to perform initial rescue and fire fighting within the response time standard contained in Department of Defense Instruction 6055.06, *Department of Defense Fire and Emergency Services Program*. This level of service includes the capability to perform rescue and fight fire while providing for the safety of firefighter rescuers.

Emergency response data from the National Fire Incident Reporting System for fiscal years 2003 through 2008 was analyzed to determine the impact of the firefighter reduction on civilian deaths and injuries. As indicated in Table 2, civilian deaths and injuries declined dramatically. We attribute the decrease in deaths and injuries to the overall reduction in fire occurrence reflected in Table 1; less exposure to fires equals fewer deaths and injuries.

II. An Evaluation of Whether Adequate Capability Exists in the Municipal Communities Surrounding Air Force Bases to Support an Aircraft Rescue or to Respond to a Fire Involving Combat Aircraft, Cargo Aircraft, or Weapon System

Most municipal fire departments do not have the capability to support an aircraft rescue or to respond to a fire involving a combat aircraft, cargo aircraft, or weapon system. First, most municipal fire departments do not have an aircraft mission and do not maintain aircraft fire fighting and rescue capability. Second, they normally cannot meet the Department of Defense's 5-minute response time standard to aircraft incidents. Therefore, the Air Force provides in-house capability to manage aircraft-related emergency emergencies and initial response to all other responses within the scope of services. This capability includes the delivery of the quantity of fire fighting agents prescribed in National Fire Protection Association (NFPA) Standard 403, *Standard for Aircraft Rescue and Fire Fighting Services at Airports*, which we typically exceed. For example, NFPA requires 1,125 gallons of agent for an F-15 aircraft; the Air Force provides 2,500 gallons. For the B-52 aircraft, NFPA requires 4,682 gallons of agent but the Air Force provides 8,000 gallons.

Most Air Force bases maintain mutual aid agreements with surrounding communities. Although most of these community fire departments have little or no capability for initial response to aircraft fires, they provide valuable support services such as delivering additional agent to the fire scene, resupplying fire fighting vehicles, resupplying breathing air cylinders, or responding to other emergencies that may occur.

III. An Evaluation of the Effects the Reductions in Fire Fighting Personnel or Functions have had on the Certifications of Air Force Base Fire Departments

Air Force fire departments are assessed annually by the fire chief using a standard Fire Emergency Services Assessment Program. Then, this self-assessment is externally validated every three years by our Inspector General. There is no indication that the firefighter reduction had any impact on our fire departments' ratings.

IV. Restoration of Firefighter Manpower

There are currently no plans to restore firefighter manpower authorizations resulting from the 2006 assessment. However, a revised firefighter manpower standard is underway that will better allocate manpower across the Air Force based on objective criteria and we expect minor adjustments at our fire departments. We will continue to monitor the capability of our fire departments and maintain capability to protect Air Force people, property, and missions consisted with DoD policy.

Thank you for the opportunity to explain in greater detail how our fire departments operate. We are very proud of our firefighters and the tremendous value they add to our Air Force. We will continue to provide for their safety as they protect those who protect our great country.

Distribution

The Honorable Robert Byrd
Chairman
Committee on Appropriations
United States Senate
Washington, DC 20510

The Honorable Thad Cochran
Ranking Minority Member
Committee on Appropriations
United States Senate
Washington, DC 20510

The Honorable Daniel K. Inouye
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United States Air Force

Report to Congressional Defense Committees

Report on Plan to Enhance Combat Skills of Air Force Personnel

January 2009

Introduction

This report is being provided to the congressional defense committees as directed in House Report 110-652, page 346, National Defense Authorization Act Fiscal Year 2009. The following issues are addressed in this report:

1. The criteria that the Secretary of the Air Force used to select permanent sites for their Common Battlefield Airmen Training course.

2. An identification of the extent to which the Secretary of the Navy and Secretary of the Air Force coordinated with each other and with the Secretary of the Army and the Commandant of the Marine Corps with respect to their plans to expand combat skills training for members of the Navy and Air Force, respectively, together with a complete list of bases or locations that were considered as possible sites for the coordinated training.

3. The estimated implementation and sustainment costs for the Air Force Common Battlefield Airmen Training and Navy Expeditionary Combat Skills Courses.

4. The estimated cost savings, if any, which could result by carrying out such combat skills training at existing Department of Defense facilities or by using existing ground combat training resources.

Executive Summary

Common Battlefield Airman Training (CBAT), a $290M initiative championed by AF leadership prior to August 2008, has been cancelled in favor of enhancing existing, proven expeditionary programs and venues. The Air Force is currently conducting an internal review of all pre-deployment training programs to identify areas for improvement in meeting Combatant Commander training requirements, and will submit requests for funding, as needed, to fulfill any unmet readiness requirements.

Report

Since 2001, the Air Force has made great strides in improving the expeditionary combat readiness of Airmen tasked to deploy in support of the Global War on Terrorism. Common Battlefield Airman Training (CBAT) was one new expeditionary skills training initiative intended to provide basic expeditionary skills training for approximately 16,000 new Enlisted airmen per year.

In August 2008, after an in-depth review by Air Force leadership, the CBAT initiative was cancelled, with a new directive to utilize existing courses and facilities with a focus on meeting specific Combatant Commander theater-entry training requirements. CBAT would have provided a foundational level of exposure to expeditionary skills (weapons, movement, concealment, etc.) within the first two years of accession for selected Enlisted personnel, but was not conceived to provide the specific skills (and associated periodic recurrency training) of immediate need in the ongoing Global War on Terrorism. Current AF leadership believes there is greater immediate value in focusing on real-world training demands in-lieu of bolstering the foundational "warrior ethos" through the training that would have been offered by a new CBAT course and venue.

Accordingly, the Air Force is currently conducting an internal holistic review of all expeditionary skills and pre-deployment training offered by existing programs and venues. When complete, this review will identify any existing deficiencies (and associated resource shortfalls) in training required for theater entry.

The following comments are offered in-response to the specific questions raised in House Report 110-652 regarding the AF's previously planned implementation of the CBAT initiative:

1. *The criteria that the Secretary of the Air Force used to select permanent sites for their Common Battlefield Airmen Training course.*

Prior to program cancellation, the AF utilized an Environmental Impact Analysis Process (EIAP), as required by public law (Public Law 91-190, 42 USC 4321-4347, as amended), along with business-case, training, and operational analysis to identify three final CBAT location candidates from an initial pool of 64 CONUS AF installations. When cancelled in

Aug 08, the final CBAT location had yet to be named from these three permanent beddown alternatives.

2. ***An identification of the extent to which the Secretary of the Navy and Secretary of the Air Force coordinated with each other and with the Secretary of the Army and the Commandant of the Marine Corps with respect to their plans to expand combat skills training for members of the Navy and Air Force, respectively, together with a complete list of bases or locations that were considered as possible sites for the coordinated training.***

Initially, CBAT was conceived as an expeditionary skills training and awareness program; taught by Airmen for Airmen. As such, extensive inter-service coordination was deemed unnecessary to achieve the stated program objectives. However, when cancelled, senior AF and Army officials had initiated formal dialogue on potential areas for leverage of inter-service mission & training expertise.

3. ***The estimated implementation and sustainment costs for the Air Force Common Battlefield Airmen Training and Navy Expeditionary Combat Skills Courses.***

Prior to cancellation, the estimated cost for implementation and sustainment of CBAT across the FYDP was between $175M-$290M, dependent on location.

4. ***The estimated cost savings, if any, which could result by carrying out such combat skills training at existing Department of Defense facilities or by using existing ground combat training resources.***

CBAT is no longer planned for implementation; therefore further cost analysis is not applicable.

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United States Air Force

Report to Office of the Secretary of Defense
Acquisition, Technology & Logistics

Career Path and Other Requirements for Military Personnel in the Acquisition Field (Sec. 813/834)

December 2008

MEMORANDUM FOR OSD(AT&L)

FROM: SAF/AQ

Subject: Report for Sections 813/834 of the 2009 National Defense Authorization Act

The Air Force is pleased to provide the attached report on *Career Path and Other Requirements for Military Personnel in the Acquisition Field* as requested in Public Law 110-329, Sections 813 and 834.

My point of contact for the report is [redacted] (b)(6)

(b)(2)

SUE C. PAYTON
Assistant Secretary of the Air Force
(Acquisition)

Introduction

This report is being provided to the Office of the Secretary of Defense, Acquisition, Technology & Logistics as directed in Public Law 110-329, Section 813/834, National Defense Authorization Act Fiscal Year 2009.

SEC. 813. CAREER PATH AND OTHER REQUIREMENTS FOR MILITARY PERSONNEL IN THE ACQUISITION FIELD.

(a) ACQUISITION PERSONNEL REQUIREMENTS.—
(1) IN GENERAL.—Chapter 87 of title 10, United States Code, is amended by inserting after section 1722 the following new section:

''§ 1722a. Special requirements for military personnel in the acquisition field
''(a) REQUIREMENT FOR POLICY AND GUIDANCE REGARDING MILITARY PERSONNEL IN ACQUISITION.—The Secretary of Defense shall require the Secretary of each military department (with respect to the military departments) and the Under Secretary of Defense for Acquisition, Technology, and Logistics (with respect to the Office of the Secretary of Defense, the unified combatant commands, the Defense Agencies, and Defense Field Activities), to establish policies and issue guidance to ensure the proper development, assignment, and employment of members of the armed forces in the acquisition field to achieve the objectives of this section as specified in subsection (b).
''(b) OBJECTIVES.—Policies established and guidance issued pursuant to subsection (a) shall ensure,at a minimum, the following:
''(1) A career path in the acquisition field that attracts the highest quality officers and enlisted personnel.
'' (2) A number of command positions and senior non-commissioned officer positions, including acquisition billets reserved for general officers and flag officers under subsection (c), sufficient to ensure that members of the armed forces have opportunities for promotion and advancement in the acquisition field.
''(3) A number of qualified, trained members of the armed forces eligible for and active in the acquisition field sufficient to ensure the appropriate use of military personnel in contingency contracting.

''(c) RESERVATION OF ACQUISITION BILLETS FOR GENERAL OFFICERS AND FLAG OFFICERS.—
(1) The Secretary of Defense shall establish for each military department a minimum number of billets coded or classified for acquisition personnel that are reserved for general officers and flag officers and shall ensure that the policies established and guidance issued pursuant to subsection (a) by the Secretary of that military department reserve at least that minimum number of billets and fill the billets with qualified and trained general officers and flag officers.
''(2) The Secretary of Defense shall ensure that a sufficient number of billets for acquisition personnel who are general officers or flag officers exist within the Office of the Secretary of Defense, the unified combatant commands, the Defense Agencies, and the Defense Field Activities.
''(3) The Secretary of Defense shall ensure that a portion of the billets referred to in paragraphs (1) and (2) involve command of organizations primarily focused on contracting.
''(d) RELATIONSHIP TO LIMITATION ON PREFERENCE FOR MILITARY PERSONNEL.—Any designation or reservation of a position for a member of the armed forces as a result of a policy

established or guidance issued pursuant to this section shall be deemed to meet the requirements for an exception under paragraph (2) of section 1722(b) of this title from the limitation in paragraph (1) of such section.

‘‘(e) REPORT.—Not later than January 1 of each year, the Secretary of each military department shall submit to the Under Secretary of Defense for Acquisition, Technology, and Logistics a report describing how the Secretary fulfilled the objectives of this section in the preceding calendar year. The report shall include information on the reservation of acquisition billets for general officers and flag officers within the department.’’.

(2) CLERICAL AMENDMENT.—The table of sections at the beginning of such chapter is amended by inserting after the item relating to section 1722 the following new item:

‘‘1722a. Special requirements for military personnel in the acquisition field.’’.

(b) ADDITIONAL ITEM FOR INCLUSION IN STRATEGIC PLAN.—Section 543(f)(3)(E) of the National Defense Authorization Act for Fiscal Year 2008 (Public Law 110–181; 122 Stat 116) is amended by inserting after ‘‘officer assignments and grade requirements’’ the following: ‘‘, including requirements relating to the reservation of billets in the acquisition field for general and flag officers,’’.

Executive Summary

As required by Sections 813 and 834 of the National Defense Authorization Act Fiscal Year 2009, this report addresses the US Air Force's designated career paths for military acquisition professionals to ensure the highest caliber officers and enlisted Airman enter and remain in the acquisition workforce. This report will further address the command opportunities for acquisition and contracting officers (to include General officer opportunities); and the development of qualified contingency contracting personnel. For the purpose of this report, the Acquisition career field is made up of five acquisition specialties: Scientists, Engineers, Program Managers, Contracting, and Financial Management professionals. As development dictates, officers are interchangeable across the five specialties at the senior ranks.

The Air Force has made significant progress on the deliberate development of military personnel in the Acquisition career fields, to include contracting officers. The use of Developmental Teams to guide the deliberate development process has paid great dividends in the development and upward progression of military personnel in the acquisition workforce. Additionally, the increased command opportunities generated by re-structuring the AFMC and AFSPC Centers into a Wing-Group-Squadron structure has paved the way for acquisition personnel to have the same command opportunities as their fellow Airmen in other career fields.

The Air Force maintains the largest and most versatile contingency contracting corps in the Department of Defense. Air Force contracting professionals have filled; and will continue to fill, the majority of the contracting positions in Iraq and Afghanistan. Increased operations tempo of the contracting workforce requires proactive measures to ensure adequate retention of our highly-trained and battle-tested contracting workforce. Some of these measures include efforts to re-instate a Critical Skills Retention Bonus (CSRB) and preferential assignment treatment for personnel that return from extended deployments.

In aggregate, Air Force acquisition leadership has a deliberate and well defined strategy for addressing the objectives outlined in Sections 813 and 834; and for paving the way forward for the acquisition workforce of today and the foreseeable future.

Objective 1: A career path in the acquisition field that attracts the highest quality officers and enlisted personnel.

The Air Force deliberately develops acquisition and contracting professionals according to well defined career path models. *Figures 1-1 and 1-2* present the career path models for military acquisition professionals and serve as a guide for developing military professionals within the acquisition workforce through assignments, education, and training. These career models provide ample opportunity and experience for acquisition professionals at all ranks; and provides a defined path to greater rank and responsibility within the acquisition workforce.

As defined by Air Force Instruction 36-2640; *Executing Total Force Development*, the development of acquisition workforce members is enhanced by the use of Career Field Development Teams. Development Teams, consisting of senior leadership from within a Career Field, meet throughout the year at the Air Force Personnel Center to aid in the development of both civilian and officer personnel for that career field. The Acquisition Development Teams (DT) meet to provide officers career path vectors, select officers and civilians for service schools (developmental education), and identify military and civilian candidates for command leadership positions within the acquisition workforce. Using the published acquisition career path models as a guide, the DTs also provide each officer individual developmental guidance placing them on a specific path or vector to greater progression and opportunity in the acquisition workforce. The Acquisition DTs also address the major challenges within the workforce, and ensure that officers that comprise the workforce are appropriately developed in accordance with Air Force requirements.

The Air Force has also established career field management and force development teams at the HQ Air Staff level that provide strategic direction and daily oversight of the career fields, as well as manage the Developmental Team process. Under this Air Force construct, all acquisition career fields except Financial Management are under the functional management and oversight of the Military Deputy to the Assistant Secretary of the Air Force for Acquisition. Financial Managers are managed by the Assistant Secretary of the Air Force for Financial Management. The Air Force Director of Acquisition Career Management (DACM) serves as the integrating function across all of the career fields as to ensure appropriate policy, direction and oversight of acquisition professionals covered under the Defense Acquisition Workforce Improvement Act (DAWIA). The Air Force DACM also serves as the Acquisition Career Field Manager for the Air Force.

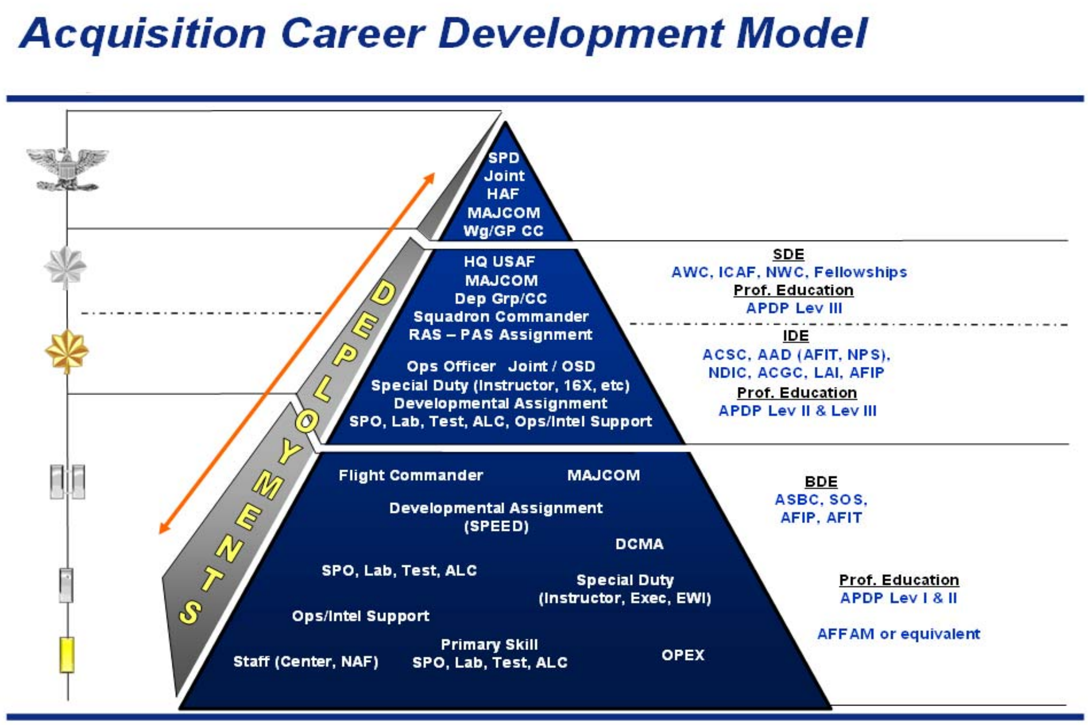

Figure 1-1

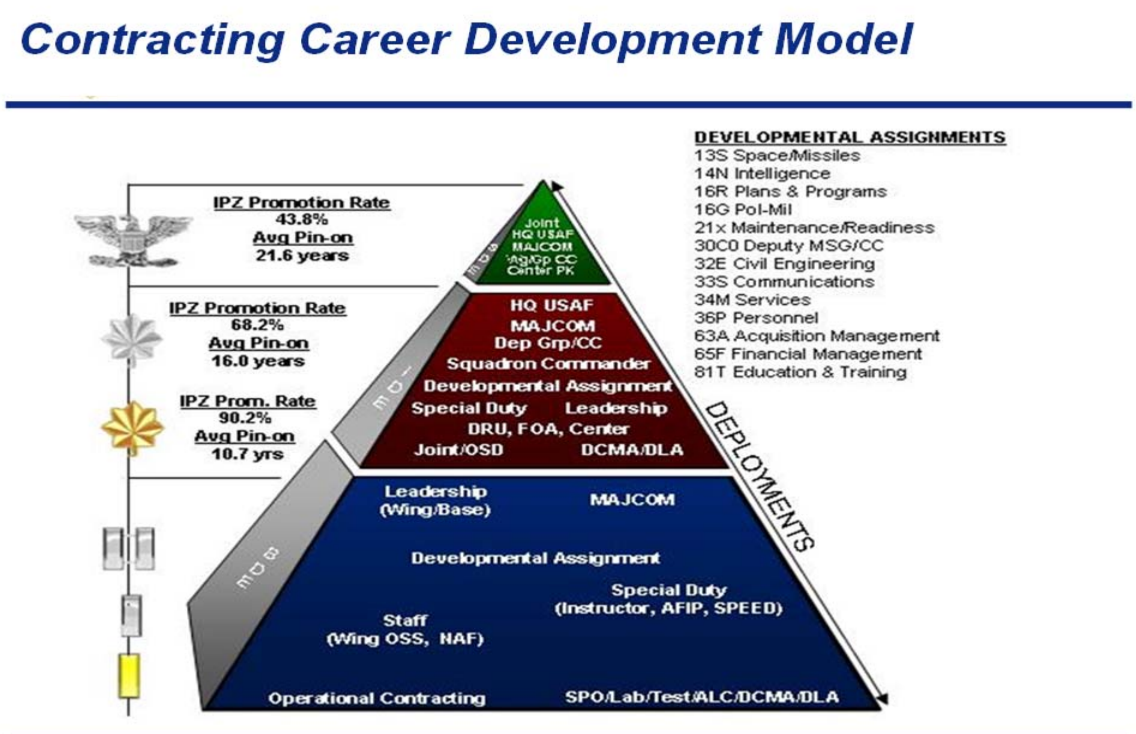

Figure 1-2

Objective 2: A number of command positions and senior non-commissioned officer positions, including acquisition billets reserved for general officers and flag officers under subsection (c), sufficient to ensure that members of the armed forces have opportunities for promotion and advancement in the acquisition field.

Air Force acquisition leaders recognize the need for leadership and command opportunities for the acquisition workforce. Command is an essential part of every officer's career and the acquisition community has made great strides in providing opportunities for acquisition and contracting officers.

In the 2002-03 timeframe, the Air Force initiated an unprecedented change in the acquisition organizational structure within the Acquisition and Logistics centers. The centers were reorganized into a Wing-Group-Squadron structure that aligns similarly with the organizational constructs employed by Air Force operational units. The result of this re-structuring has provided command opportunities that were not previously available to the acquisition workforce. These command opportunities are for officers of all specialties meeting the acquisition prerequisites, and ensure a cross-functional mix of the different acquisition specialties serving in acquisition leadership positions.

The Air Force acquisition workforce also has a contingent of enlisted personnel within the contracting career field. These Airmen serve in key positions throughout the Air Force in the operational and contingency contracting communities and are also developed in concert with the needs of the Air Force. These Airmen have career opportunities at the HQ USAF, MAJCOM, Wing, Group, and Squadron level. The development of this invaluable resource is addressed both within the enlisted force and within the contracting community to ensure the right quality and number of contracting NCOs are retained for the Air Force contracting mission.

The Air Force codes and tracks all GO and SES billets in the acquisition workforce for use in development and succession planning, and to ensure the best qualified leaders are identified to fill these key leadership positions. The DACM Office (SAF/AQX) and the Air Force General Officers Matters Office (HQ AF/DPG) continue to work closely to ensure acquisition leaders meet position requirements as defined by DAWIA statutes. Figures 2-1 and 2-2 identify the General Officer opportunities that reside within the acquisition program management specialty. Figures 2-3 and 2-4 identify the General Officer and SES opportunities that reside within the acquisition contracting specialty. These visual representations outline the significant opportunity for upward progression in the acquisition program management and contracting specialties. One should also note that while these positions are labeled as SES or General Officer billets, the Air Force has converted the billets between military and civilian depending on the needs of the service at a given point in time (and in accordance with DAWIA shared leadership provisions).

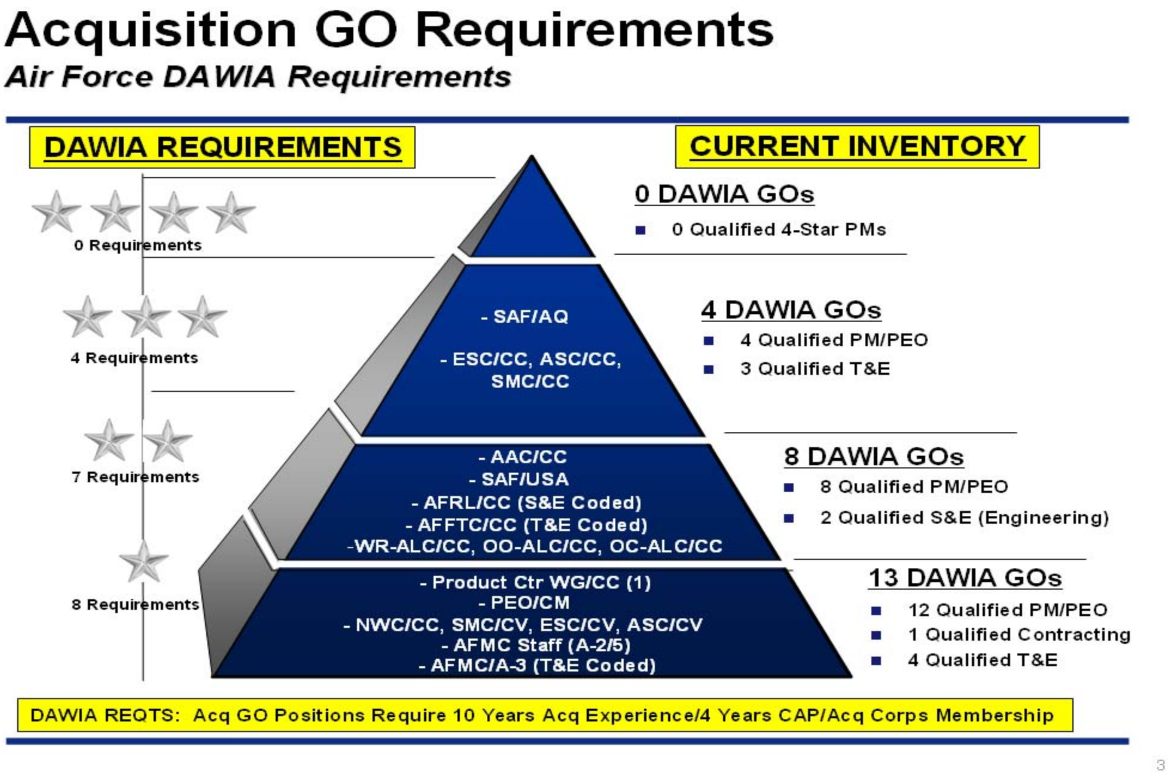
Acquisition GO Requirements
Air Force DAWIA Requirements
DAWIA REQUIREMENTS
CURRENT INVENTORY
0 Requirements
4 Requirements
7 Requirements
8 Requirements
- SAF/AQ
- ESC/CC, ASC/CC, SMC/CC
- AAC/CC
- SAF/USA
- AFRL/CC (S&E Coded)
- AFFTC/CC (T&E Coded)
-WR-ALC/CC, OO-ALC/CC, OC-ALC/CC
- Product Ctr WG/CC (1)
- PEO/CM
- NWC/CC, SMC/CV, ESC/CV, ASC/CV
- AFMC Staff (A-2/5)
- AFMC/A-3 (T&E Coded)
0 DAWIA GOs
0 Qualified 4-Star PMs
4 DAWIA GOs
4 Qualified PM/PEO
3 Qualified T&E
8 DAWIA GOs
8 Qualified PM/PEO
2 Qualified S&E (Engineering)
13 DAWIA GOs
12 Qualified PM/PEO
1 Qualified Contracting
4 Qualified T&E
DAWIA REQTS: Acq GO Positions Require 10 Years Acq Experience/4 Years CAP/Acq Corps Membership
3

Figure 2-1

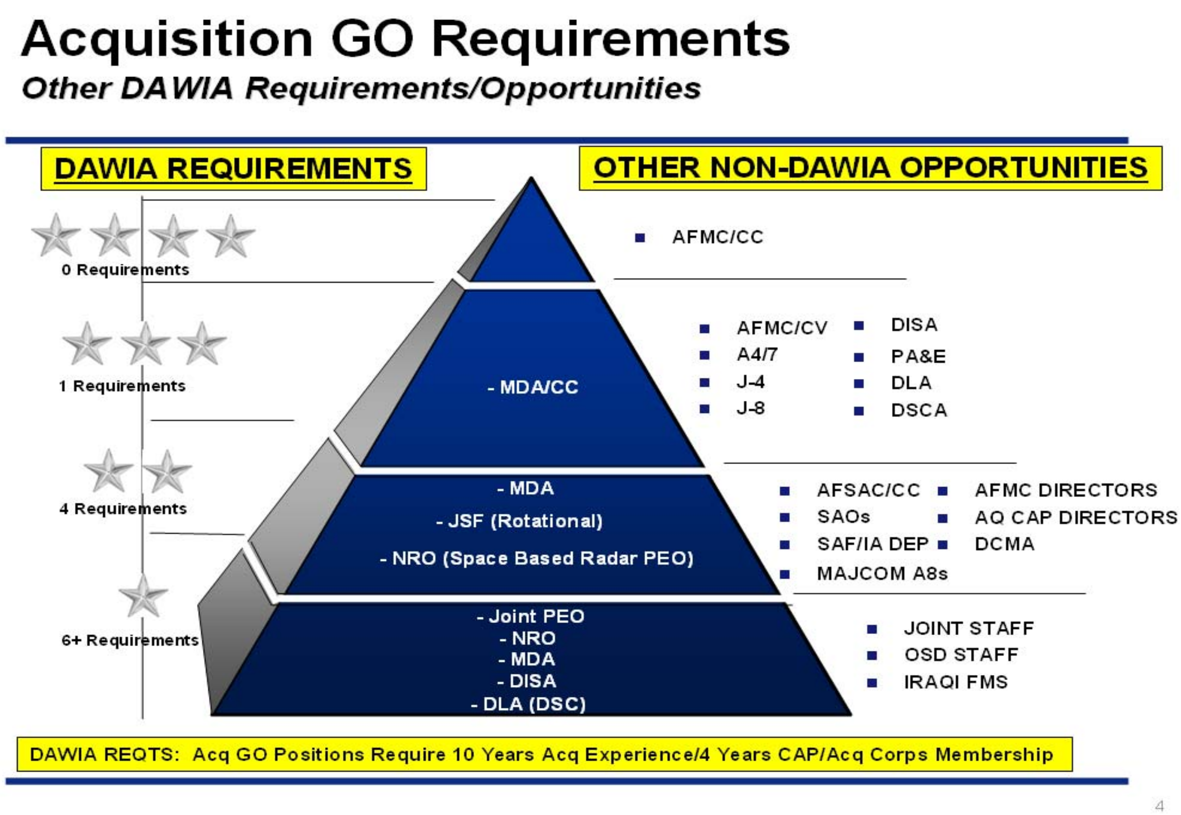
Acquisition GO Requirements
Other DAWIA Requirements/Opportunities
DAWIA REQUIREMENTS
OTHER NON-DAWIA OPPORTUNITIES
0 Requirements
1 Requirements
4 Requirements
6+ Requirements
- MDA/CC
- MDA
- JSF (Rotational)
- NRO (Space Based Radar PEO)
- Joint PEO
- NRO
- MDA
- DISA
- DLA (DSC)
AFMC/CC
AFMC/CV
A4/7
J-4
J-8
DISA
PA&E
DLA
DSCA
AFSAC/CC
SAOs
SAF/IA DEP
MAJCOM A8s
AFMC DIRECTORS
AQ CAP DIRECTORS
DCMA
JOINT STAFF
OSD STAFF
IRAQI FMS
DAWIA REQTS: Acq GO Positions Require 10 Years Acq Experience/4 Years CAP/Acq Corps Membership
4

Figure 2-2

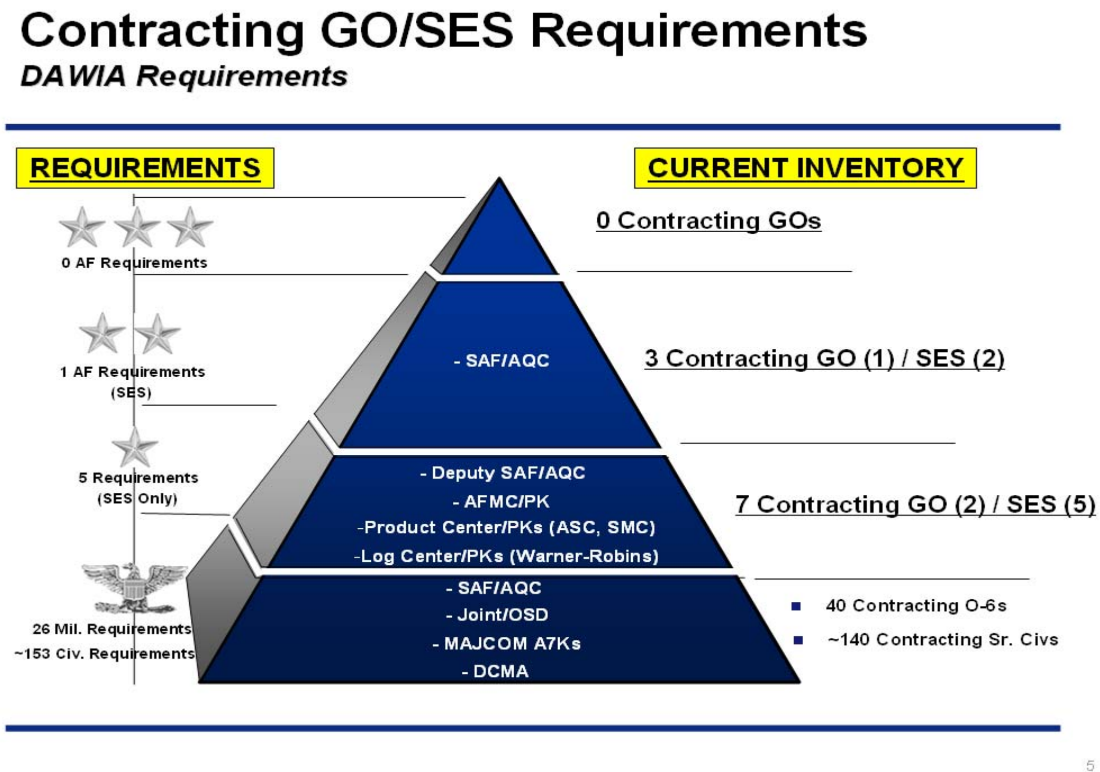

Figure 2-3

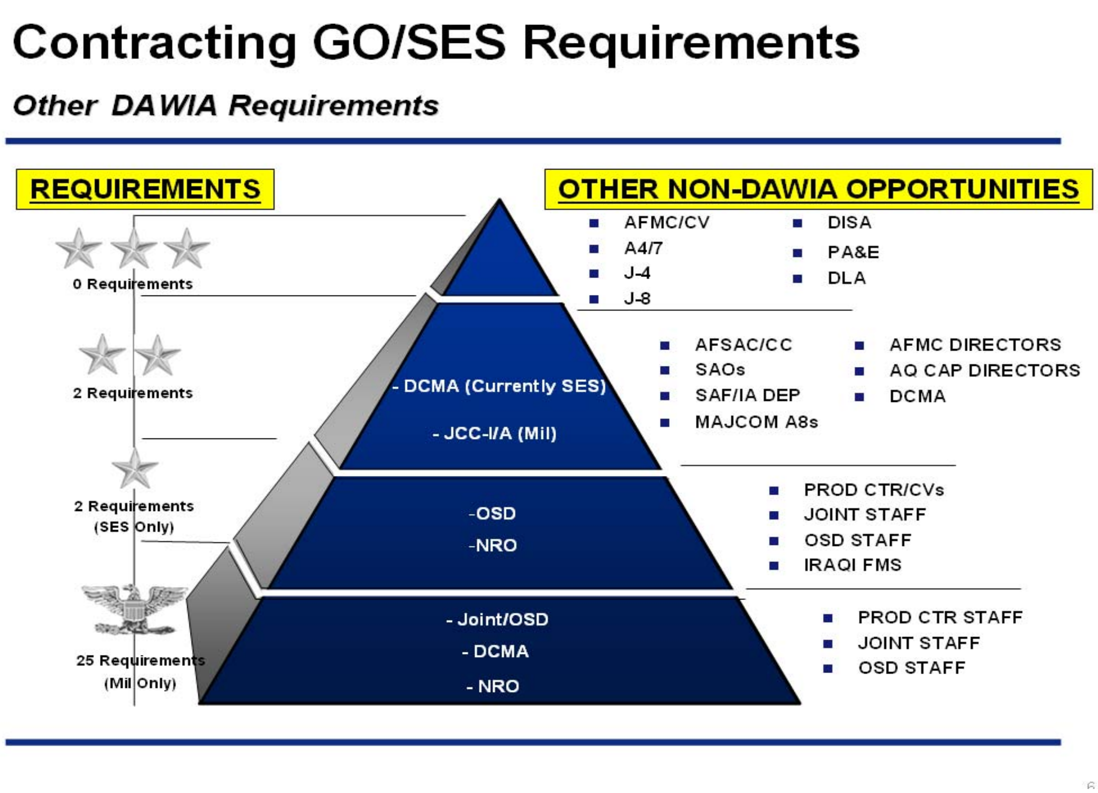

Figure 2-4

Objective 3: A number of qualified, trained members of the armed forces eligible for and active in the acquisition field sufficient to ensure the appropriate use of military personnel in contingency contracting

The Air Force has retained a large pool of military contracting officers in order to meet Air Force and, a fair share of joint, contingency contracting deployments. Today the Air Force maintains the Department of Defenses largest deployable contracting force and is filling the bulk of the contingency contracting and contract administration deployment requirements in Iraq and Afghanistan. We continue to work with the other Services and OSD AT&L in the evaluation of future resource and training requirements and on doctrine related to contingency contracting.

At a given time, approximately 95% of the contracting workforce is world-wide deployable. However, the current operations tempo generated by the wars in Iraq and Afghanistan has put great strain on the contingency contracting corps in the Air Force. This strain has made the contracting career field one of the most deployed career fields in the Air Force. Air Force leadership recognizes the threat the current ops tempo poses to the retention of the contracting force and has initiated numerous efforts to ensure the workforce remains the backbone of the contingency contracting mission. One of the recent efforts is to evaluate the need for a Critical Skills Retention Bonus for contracting officers in targeted year groups and ranks/grades. This effort has been underway for some time and is expected to formally roll out in the 2009 fiscal year. The contracting career field manager has also instituted an effort to allow for a follow-on assignment to a base of preference, consistent with AF requirements, for those officers who deploy to the theater for at least 365 days. This program would provide increased stability for officers and their families as they continue to serve their country.

The Air Force has recently initiated efforts to allow non-contracting acquisition personnel to fill contingency positions in theater that do not require a warranted contracting officer. These contingency positions; largely contractor oversight and administrative positions, increase the pool of eligible officers available to serve in contingency contracting positions and relieve some of the strain on the contracting workforce. While initiated as a pilot program with the Defense Contract Management Agency (DCMA), the Air Force is already seeing great returns on this effort.

American Eagle Communities
Analysis of Alternatives

United States Air Force

Contents

1 Purpose

Earlier this year, the Air Force agreed to provide to the congressional defense committees and congressional delegations an analysis of the alternatives considered by the Air Force to resolve problems with the American Eagle Communities ("AEC") housing privatization projects at Hanscom, Little Rock, Moody and Patrick Air Force Bases before concluding that a consensual sale by AEC of the assets of the projects to a new, experienced, project owner was the resolution most likely to satisfy the Air Force objectives identified in this analysis. It was agreed the analysis of alternatives, in lieu of a cost-benefit analysis, would meet the intent of Section 2807 of the Duncan Hunter National Defense Authorization Act for Fiscal Year 2009, which requires the Air Force to provide by 13 Nov 08 a cost-benefit analysis of dissolving the Patrick Family Housing, LLC without exercising the full range of rights available to recover damages against such project owner.

2 Background

The Air Force closed four separate privatization projects with AEC between October 2003 and October 2004. AEC is a trade name used by the private sector project owners of military housing privatization projects owned in whole or in part by C.E. I. Investment Corp. ("CEI") located in Meriden, Connecticut and controlled by the Carabetta family and Shaw Infrastructure, Inc. ("Shaw"), a Fortune 500 company, located in Baton Rouge, Louisiana.

Project schedules immediately suffered due to AEC failures in a number of areas including timely submittal of design and construction plans, obtaining required payment and performance bonds, executing best practices in production home building, and implementing an effective cost tracking and forecasting system. Additionally, the Patrick Air Force Base project schedule was negatively affected by two hurricanes that damaged work-in-progress in 2004. Due to the continued construction delays and lower than expected demand, occupancy at all projects was lower than forecasted. The resulting shortfalls in revenue combined with substantial construction cost overruns contributed to a significant shortfall in funds required to complete the work proposed by AEC. As a result of the imbalance between construction sources and uses, the bondholders for the Moody, Hanscom and Patrick Air Force Base projects stopped funding construction. At the same time, the bondholders for the Little Rock Air Force Base project accelerated their bonds and applied funds on deposit within the project lockbox accounts to repay them. Although construction has stopped, daily operations and maintenance has continued at an acceptable level at all installations. Since prerequisites to the funding of government direct loans ("GDLs") for the Moody Air Force Base and Little Rock Air Force Base projects have not been satisfied, no GDL proceeds have been disbursed at either of the two projects.

The Air Force engaged AEC about performance issues within months after the financial closing of each project. Throughout 2004 and 2005, the Air Force met with the AEC to discuss project requirements and provide recommendations for performance improvement. In mid-2006, following the repeated failure by AEC to improve performance, the Air Force began communicating directly with the bondholder representatives encouraging the bondholders to conduct independent assessments of performance failures and corrective action. Since late 2006, the Air Force has worked with AEC, the bondholders and interested firms to facilitate a consensual sale of the assets of the four projects to a new owner, preserve each project's asset value and to minimize any adverse impact to the local communities. Additionally, in order to ensure that all rights available under the transaction documents can be pursued expeditiously, the Air Force sent formal notices of default to AEC demanding correction of the project deficiencies.

In late 2007, the Air Force facilitated meetings with AEC, the bondholders and interested firms to develop the consensual sale framework. Proposals were requested from four development teams (Hunt Pinnacle, Forest City Military Communities, GMH and Bay Company) looking at both three and four base groups. The Bay Company, a Valdosta, Georgia developer, submitted a single base proposal for Moody only. Hunt Pinnacle was selected by AEC as the preferred developer to proceed in the consensual sale process. The bondholders and the Air Force approved the AEC selection. The Air Force continues to negotiate with AEC, the prospective buyers and the bondholders to facilitate a transaction that meets the requirements of all parties.

Earlier this year, the Army and Navy AEC housing privatization projects were sold to new project owners using a consensual sale process. In both cases, construction work at the projects has been restarted.

3 Analysis of Alternatives

3.1 Air Force Objectives

The following Air Force objectives were considered in the evaluation of alternatives for resolving the issues at the AEC projects:

- Eliminate inadequate housing and provide quality housing at each installation
- Deliver end state scope that satisfies Air Force housing requirements within an acceptable time frame at each installation
- Provide financially viable projects for the fifty-year project term at each installation
- Resolve all subcontractor liens against AEC projects
- Minimize potential adverse impacts of AEC project issues on Air Force programs
- Achieve the most favorable balance of benefits and costs using available resources
- Restructure the four AEC projects into one grouped project.

3.2 Alternatives Reviewed

The following alternative courses of action, some of which the Air Force can initiate or directly influence and others which either the Air Force cannot initiate or directly influence or that require collaboration with other stakeholders, were evaluated:

- Air Force cash contributions
- Consensual sale – individual projects
- Litigation to enforce existing Air Force rights
- Consensual sale – group project
- Lease and use agreement terminations
- Bankruptcy
- Bondholder foreclosures.

3.2.1 Alternatives Inconsistent with Air Force Objectives

The following alternative courses of action were determined to be inconsistent with the Air Force objectives and therefore not viable. As a result, these have not been pursued.

Air Force Cash Contributions

Infusion of cash through Air Force investment in the owners of the AEC projects to address funding shortfalls would result in government subsidized solutions to private sector project problems. The primary beneficiaries of such investment would be the current owners. Additionally, such investment could set a negative precedent and have adverse impacts on existing or future Air Force public-private sector venture programs.

Consensual Sale – Individual Projects

Given the varying scope required and cash flow available at each AEC project, AF analysis indicated neither the Moody nor the Little Rock project could be restructured and executed on terms consistent with current Air Force requirements unless grouped with other MHPI projects because they singularly would not be financially viable. This outcome is inconsistent with the Air Force objective of having financially viable projects at each of the four installations.

Litigation to Enforce Existing Contract Rights

A court is unlikely to order specific performance by the owners of the AEC projects of their respective contractual obligations to complete the projects because losses suffered by the Air Force as a result of their nonperformance are quantifiable as monetary damages. Judgments for monetary damages against the owners of the AEC projects are not likely to be paid because the only assets that the current owners have to satisfy the judgments are the project assets which are encumbered by liens securing repayment of the bonds. In each instance, the value of the project assets is less than the amount owed on the bonds rendering the current owner insolvent.

3.2.2 Alternatives Requiring Air Force Action

The alternatives outlined in this section, group consensual sale and termination of ground leases and use agreements, require Air Force action. For a simultaneous group consensual sale to occur, Air Force action is required in conjunction with action by all other stakeholders. In contrast, the ground leases and use agreements may be terminated unilaterally by the Air Force.

3.2.2.1 Consensual Sale – Group Project

A simultaneous sale of the assets of the four projects to a single new owner enables all stakeholders to resolve existing disputes, provides sources for payment of existing lien claimants and allows construction and renovation of housing on the bases to restart. This option requires the following: (a) the agreement of the current owners and the new project owner to terms for a sale of the project assets; (b) the agreement of the Air Force, bondholders and new owner to a revised scope of housing construction and renovation on the bases that is supported by a pro forma that considers housing construction requirements, revenue, expense and cash flow projections and market conditions; (c) the amendment and restatement of existing project documents and creation of new documents for the group project; (d) the amendment and restatement of the existing bond documents to provide financing for the group project (this step requires unanimous bondholder approval); (e) amendment and restatement of the two existing forward commitments for GDLs for Little Rock and Moody projects into one forward commitment for one GDL for the group project; (f) resolution of all subcontractor liens; and (g) agreement to terms for mutual releases among various stakeholders.

Negotiations for a consensual sale are ongoing. The projected date of the sale is November 4, 2008. The scope and end state of the group project are consistent with information previously provided to the congressional defense committees and congressional delegations for each of the installations.

Inclusion of North and Central Housing

The inclusion of north and central housing ("North and Central") at Patrick Air Force Base into the group project will increase the funds available to provide scope and improve the financial viability of the group project. Without the addition of North and Central, the bondholders will not restructure the existing bonds or provide the additional bonds required to fund scope. The inclusion of North and Central enables the project to generate additional net operating income by capitalizing on historic demand for military housing in excess of the Housing Requirement and Market Analysis ("HRMA") for Patrick Air Force Base. This alternative also contributes to achievement of the Air Force goal of privatizing 100% of the military family housing in the continental United States and territories consistent with the MHPI authorities. This is an opportune time to privatize North and Central.

Excess Patrick Project South Housing Land

An Air Force requirement of the group consensual sale is demolition of the heritage homes in phases II and III of the south housing area that is part of the Patrick project ("South Housing"). This demolition will leave approximately 101 acres of vacant land in the group project. The bondholders insist the land remain in the deal as collateral in the restructured group project. The land's use is restricted by the Amended and Restated Declaration of Restrictive Covenants and Use Agreement for the Military Housing Project by and between the Department of the Air Force and Patrick Family Housing, LLC signed April 1, 2005 ("Patrick Use Agreement"), which states "the sole purpose for which the Owned Project Site and the improvements that are now and will be erected thereon may be used, in the absence of the prior written approval of the Government for any other use, is for the design, construction, renovation, operation and maintenance of an owned rental housing development in accordance with the Project Documents." The project documents state the housing development is primarily for Air Force families authorized to live on Patrick Air Force Base. The Patrick Use Agreement states that "in no event shall the Owned Project Site be used by the Project Owner for the development of any resale merchandise, services and commercial recreational operations or activities." These land use restrictions will continue to apply to phases II and III of South Housing when the consensual sale is closed. Phases II and III also are subject to a City of Satellite Beach Planned Unit Development ("PUD") which restricts the land use to housing. Any deviation from the land use for phases II and III of South Housing would require Air Force approval and an amendment of the PUD.

Group Consensual Sale Advantages:

- Quickest way to resolve project issues and restart construction and renovation
- Required project scope funded with existing bond proceeds and proceeds from additional bonds at a time when no market funding options exist
- Significantly reduces the likelihood of litigation and associated risks and delays because all stakeholders must agree on terms for the consensual group sale
- No requirement for Air Force funding of MILCON or funding of operations and maintenance, property management, utility bills, etc
- Smooth transition to new owner with minimal disruption to tenants
- Includes resolution of subcontractor liens
- AEC owned parcel (Magnolia Grove) at Moody Air Force Base stays in group project.

Group Consensual Sale Disadvantages:

- Project exceeds HRMA requirement; if occupancy drops below 95% for three consecutive months the project owner may rent units to non-target tenants, including civilians who satisfy installation security forces requirements for unrestricted access to the installations.

3.2.2.2 Lease and Use Agreement Termination

The principal alternative course of action to a consensual sale is the termination of each of the existing ground leases and the Patrick Use Agreement by reason of the existing defaults of the current owners under those documents. The terminations cannot occur until: (a) disputes between the current owners and the Air Force about the defaults are resolved either by agreement or issuance of final decisions on the disputes by the appropriate contracting officer; (b) notices of termination to the current owners and bondholders by the Air Force become effective, which by agreement of the parties must be at least five days after the date notice is given. Litigation over the terminations also may delay the terminations.

Advantages:

- Air Force attains title to all project assets other than the Magnolia Grove land that is part of the Moody project
- Air Force has unilateral control on future decisions regarding the projects other than decisions about Magnolia Grove
- The current owners will have no interest in the projects other than in Magnolia Grove.

Disadvantages:

- Uncertain timeline for resolution of disputes raised by the current owners
- Increased potential for litigation that would delay termination which, if successful, effectively allows bondholders to use project resources (including rent proceeds derived

from the basic allowance for housing ("BAH") paid to Air Force members) to fund such litigation and further delays restart of the project

- Air Force bears risks and costs of litigation over disputes with the current owners and issues arising in connection with litigation
- Air Force bears cost of property management (includes maintenance, repairs, utility bills, etc.) and unfinished site work (streets, community center, etc.) between termination and re-privatization
- The scope of the re-privatized projects may not be better than the scope proposed under the consensual sale
- Air Force bears risk of substantial delay in the delivery of improved units for Air Force members. Loss of ability to utilize Magnolia Grove as part of the Moody project
- No resolution of outstanding subcontractor liens.

3.2.3 Other Available Legal Remedies

Other legal remedies not requiring Air Force action which stakeholders may seek to implement include bankruptcy and foreclosure. These actions alone, without additional agreements or termination, would not resolve the current issues at the AEC projects.

3.2.3.1 Bankruptcy

Reorganization or liquidation under the provisions of federal bankruptcy law may be sought by the current owners or the creditors of a project. In a reorganization under Chapter 11 of the Bankruptcy Code, an ongoing business may restructure its business and obligations to creditors to allow the business to continue or to structure the business for a sale to a third party as a going concern free and clear of liens and encumbrances. In a Chapter 7 liquidation, a business is simply liquidated. In both proceedings, creditors are classified and prioritized based on whether they are secured or unsecured and their rights to collateral and financial recovery are administered by a bankruptcy court. Absent agreement by the Air Force to restructure the obligations of the current owners, which would only be provided in a context that resolves disputes and assures the creation of a financially viable project or projects, the Air Force does not believe that the projects would be successfully reorganized through bankruptcies or that the scope of the projects would increase. Additionally, the Air Force does not believe that the current owners have an incentive to commence a voluntary reorganization proceeding. Nevertheless, it is possible that the current owners or creditors may seek bankruptcy protection for one or more of the projects. If that occurs, the Air Force would be precluded from exercising its termination rights under the ground leases and Patrick Use Agreement without court authorization.

Advantages:

- The current owners ultimately would be removed.

Disadvantages:

- Interjects bankruptcy courts and possibly court - appointed trustees into project management; any action related to the project assets would require court action and/or approval
- Project revenue from BAH payments would continue during the bankruptcy proceedings and would be utilized to fund legal fees and debt service payments
- Departure of the current owners could create a significant disruption of service to current occupants until new management is installed
- The reorganization proceedings would create delays and a level of uncertainty about the scope and timing of completion of each project
- Outstanding subcontractor liens would not be satisfied
- Creation of a financially viable group project may not be possible.

3.2.3.2 Bondholder Foreclosure

Under the laws of each state where the individual projects are located, the bondholders are allowed to foreclose their liens and security interests against project assets. While the exercise of such rights by the bondholders will terminate any interests that the current owners have in project assets, it may not result in completion of the projects. The Air Force does not believe it is likely that the bondholders will foreclose to gain control of the projects because the bondholders do not intend and do not have the financial capability to fulfill the obligations of the current owners under the Air Force documents unless the obligations are restructured by the Air Force. The Air Force will not amend and restate the Air Force documents unless the restructure will provide a financially viable project or projects.

Advantages:

- Terminates the interests of the current owners in the projects.

Disadvantages:

- No resolution of outstanding subcontractor liens
- Departure of the current owners could create a significant disruption of service to current occupants until new management is installed
- Bondholders may not act to preserve project assets, which could lead to ground lease termination by the Air Force if defaults exist under the ground lease
- Project proceeds would be used to pay bondholder costs and expenses associated with a sale of the project.

4 Description of Releases

The consensual sale process (and likely any other consensual transaction with the current owners that involves obtaining control of the projects) will involve the granting of mutual releases between the Air Force, for itself and on behalf of others involved on its behalf, and the current owners and their affiliates (a "current owner party") for claims, liabilities and causes of action arising under the documents for each project. The release the Air Force would receive from the current owners and their affiliates would fully release the Air Force from all such claims, liabilities and causes of actions except reserving the ability of a current owner party to bring a counterclaim against the Air Force in defense of a fraud claim brought initially by the Air Force. The party bringing the counterclaim against the Air Force would not be entitled to receive a net recovery against the Air Force but would be entitled to offset any damages and attorneys fees awarded in connection with such counterclaim against any recoveries or damages and attorneys fees recovered by the Air Force. On the other hand, the Air Force releases in favor of the current owner party would contain key limitations and carve-outs to protect the interests of the Government. The exclusions from the Air Force release will preserve the right of the Government to pursue certain key claims, liabilities and causes of action against the current owner parties including the following: Government rights with respect to crimes, Government administrative rights with respect to suspension and debarment, Government rights arising by reason of fraud and Government environmental claims against the current owners that arose during the terms of the ground leases. Many of these reserved claims for damages would be asserted against the current owners which are all likely insolvent and therefore are not likely to create recoveries.

5 Description of Air Force Rights

5.1 Air Force Rights Prior to Privatization

Prior to MHPI, housing for Air Force members and their families was built by private contractors pursuant to contracts awarded under the Federal Acquisition Regulations ("FAR") and paid for with MILCON funding. Any disputes that arose between the Air Force and the contractor were resolved in accordance with the Contract Disputes Act. Air Force rights and remedies upon a default by a contractor were governed by the FAR and included the right to terminate the contract.

5.2 Air Force Rights in Privatization

In order to provide a structure for private investment in and private financing of military housing, the Air Force housing privatization program utilizes 50 year ground leases that run in favor of project owners. All existing housing and other real property improvements relating to housing are conveyed to the project owner in consideration for the obligations of the project owner to construct and/or renovate an approved scope of housing and manage and maintain the housing during the 50 year ground lease term. Project owner contributed equity, private loan proceeds and rents received from Air Force members are used to fund construction and renovation during the initial development period. In some cases, as the Little Rock and Moody projects, the Government also provides GDLs to refinance private construction loan debt or pay for discrete phases of work upon completion. The Government also may infuse equity into a project as a member of partner in the project owner. The project documents include standards for the construction, operation, management, leasing, maintenance, repair, and renovation of the housing units and related improvements over the 50 year term of the ground lease. In a typical transaction, a portion of post completion cash flow is directed into a reinvestment account that may be used for the preservation and renovation of housing and other project enhancements over the term of the ground lease. The documents governing Air Force housing privatization transactions provide the traditional rights and remedies for defaults found in documentation for private sector real estate development and management transactions, including termination.

5.3 Air Force Rights After Consensual Sale

After the group consensual sale closes, the AEC projects will be a single, four-base project. The obligations relating to management of the project and rights and remedies included in the amended and restated project documents will be materially the same as those found in existing project documents. The scope and end state requirements will be those negotiated for the restructure of the projects and consistent with the scope and end state previously communicated to the congressional defense committees and congressional delegations.

The Air Force will have no rights against the current owners except those preserved in the mutual releases relating to crimes, suspension and debarment, fraud and environmental claims.

5.4 Comparison to Rights of Other Services

The National Defense Authorization Act for Fiscal Year 1996 provides alternative authorities for long-term business agreements between the Services and private industry for housing privatization projects. Under these authorities the Services may, among other things, make direct loans, invest in joint ventures, or convey or lease government-owned land. As reported by the Army's Residential Communities Initiatives, the Army typically is a non-managing, minority member of the limited liability companies that own and operate Army housing privatization projects. As such, the Army does not have authority over the day-to-day operations of its projects. However, certain actions relative to Army projects cannot be undertaken without the Army's consent as the non-managing, minority member. The Army, in a separate and distinct legal capacity, also leases land to the project owner. The Army's rights as the lessor under its ground leases are comparable to those running in favor of the Air Force under its ground leases. We understand the Navy's structure for its housing transactions typically is similar to that of the Army's.

6 Conclusion

The following chart summarizes the evaluation and risk factors considered by the Air Force in its analysis of the alternatives discussed above:

U.S. AIR FORCE

Action	Evaluation and Risk Factors: MILCON	O&M	Time	Scope	Litigation	Liens
Bankruptcies	N/A	N/A	R	R	Y	R
Bondholder Foreclosures	N/A	N/A	R	R	R	R
Project Terminations	R	Y	R	Y	R	R
Consensual Sale: 4 projects	N/A	N/A	G	Y	G	G

Red – High Risk or Cost; Lowest Chance of Meeting Expectations
Green – Lowest Risk or Cost; Likely to Meet Expectations

Integrity - Service - Excellence

Based on the analysis it is the conclusion of the Air Force that a simultaneous consensual sale of the assets of the four AEC projects to a new owner will provide the most effective and lowest risk solution for resuming construction activities, eliminating inadequate housing and addressing outstanding subcontractor liens. The Air Force will consent to the consensual sale and proceed with the restructure of the projects scheduled for November 4, 2008 upon the terms previously briefed to the congressional defense committees and congressional delegations.

SECRETARY OF THE AIR FORCE
WASHINGTON

MAR 27 2009

The Honorable Carl Levin
Chairman
Committee on Armed Services
United States Senate
Washington, DC 20510-6050

Dear Mr Chairman:

I am pleased to enclose an updated transportation rule reflecting the requested change as noted in the Joint Explanatory Statement, Sec 355, from the National Defense Authorization Act for Fiscal Year 2009.

Section 355 required Air Freight Traffic Rules Publication Number 5, dated January 15, 1999, be revised to ensure cargo is carried in accordance with commercial best practices that are based on a mode neutral approach. A revised rules publication with language that allows movement by any mode that meets time definite delivery requirements was posted on December 18, 2008 to the public portion of Surface Deployment and Distribution Command web site (www.sddc.army.mil/Public/Home). This site provides carriers a single source for all rules publications governing the movement of freight within the continental United States. The requested change is attached for your convenience and can be found in bold type at pages 1-2, section 1, paragraph 1.

A similar letter has been sent to the Ranking Minority Member of your Committee and to the Chairman and Ranking Minority Member of the other Armed Services Committee.

Sincerely,

Michael B. Donley

Michael B. Donley

Attachment:
Updated Rules Publication

SECRETARY OF THE AIR FORCE
WASHINGTON

MAR 27 2009

The Honorable John McCain
Ranking Minority Member
Committee on Armed Services
United States Senate
Washington, DC 20510-6050

Dear Senator McCain:

I am pleased to enclose an updated transportation rule reflecting the requested change as noted in the Joint Explanatory Statement, Sec 355, from the National Defense Authorization Act for Fiscal Year 2009.

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Sincerely,

Michael B. Donley

Michael B. Donley

Attachment:
Updated Rules Publication

SECRETARY OF THE AIR FORCE
WASHINGTON

MAR 27 2009

The Honorable Ike Skelton
Chairman
Committee on Armed Services
United States House of Representatives
Washington, DC 20510-6035

Dear Mr Chairman:

I am pleased to enclose an updated transportation rule reflecting the requested change as noted in the Joint Explanatory Statement, Sec 355, from the National Defense Authorization Act for Fiscal Year 2009.

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Sincerely,

Michael B. Donley

Michael B. Donley

Attachment:
Updated Rules Publication

SECRETARY OF THE AIR FORCE
WASHINGTON

MAR 27 2009

The Honorable John McHugh
Ranking Minority Member
Committee on Armed Services
United States House of Representatives
Washington, DC 20510-6035

Dear Representative McHugh:

I am pleased to enclose an updated transportation rule reflecting the requested change as noted in the Joint Explanatory Statement, Sec 355, from the National Defense Authorization Act for Fiscal Year 2009.

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A similar letter has been sent to the Chairman of your Committee and to the Chairman and Ranking Minority Member of the other Armed Services Committee.

Sincerely,

Michael B. Donley

Michael B. Donley

Attachment:
Updated Rules Publication

AIR FREIGHT TRAFFIC RULES PUBLICATION NO. 5 (AFTRP NO. 5)

RULES AND ACCESSORIAL SERVICES GOVERNING THE MOVEMENT OF DEPARTMENT OF DEFENSE FREIGHT TRAFFIC WITHIN THE CONTIGUOUS UNITED STATES BY AIR CARRIER, AIR FORWARDER, AIR TAXI

Headquarters
Air Mobility Command
Directorate for Logistics - Air Transportation Division
Scott AFB, IL 62225

ISSUED: 18 December, 2008 **EFFECTIVE: 18 December, 2008**

This document supersedes AFTRP No. 5 issued by AMC on January 15, 1999 and effective January 20, 1999

AIR FREIGHT TRAFFIC
RULES PUBLICATION NO. 5
(AFTRP NO. 5)

RULES AND ACCESSORIAL SERVICES GOVERNING THE MOVEMENT
OF
DEPARTMENT OF DEFENSE FREIGHT TRAFFIC
WITHIN
THE CONTIGUOUS UNITED STATES
BY
AIR CARRIER, AIR FORWARDER, AIR TAXI

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Headquarters
Air Mobility Command
Directorate for Logistics—Air Transportation Division
Scott AFB, IL 62225

SECTION 1

GENERAL APPLICATION AND INSTRUCTIONS

For Explanation of Abbreviations, Codes, Definitions, and Reference Marks

See SECTION 5.

Headquarters
Air Mobility Command
Directorate for Logistics—Air Transportation Division
Scott AFB, IL 62225

ITEM 5 **PURPOSE AND APPLICATION**

1. The purpose of this publication is to articulate the air transportation service needs of the Department of Defense (DOD) for the movement of its freight traffic; to ensure that air freight carriers providing that transportation have both the willingness and the capability to meet those needs; and to provide the standardization necessary for achieving a fully automated system for routing DOD freight traffic. These Rules are a governing publication to carriers' tenders which are intended to apply when either air service, or air with incidental motor service, is performed. Further, these Rules are a governing publication to carriers' tenders which are intended to apply when, during a national emergency or general mobilization, the carrier substitutes motor for air service. Commercial air service will not be used for transportation of shipments to be delivered within 500 surface miles from the shipping point except when commercial air is the low cost mode or is the only mode that can meet shipment requirements. Shipments tendered to carriers for air service must move, all or in part, via air transportation unless extreme conditions (e.g., severe weather, strikes, etc.) warrant diversion to motor service. **Notwithstanding the forgoing, shipments tendered to carriers for air service and subject to a time definite delivery condition may move in any mode of conveyance that the carrier reasonably expects to ensure the time definite delivery.** Participation in the Civil Reserve Air Fleet (CRAF) program is highly encouraged and Transportation Officers are advised to use participating carriers to the maximum extent feasible. As a prerequisite to submitting tenders to the DOD, air carriers must be approved by Air Mobility Command's Survey and Analysis Office, HQ AMC/A3B, and air freight forwarders must be qualified under the SDDC Qualification Program.

2. The rules and accessorial charges contained in this publication will govern the freight services of all air freight carriers doing business with DOD. The rules and accessorial charges shall apply from, to, or between those points in the contiguous United States specified in the individual DOD Standard Tender of Freight Services (tender), MT Form 364-R, filed with HQ, USTRANSCOM, ATTN: TCAQ-I/A, 402 Scott Drive, Unit 3A1, Scott Air Force Base, IL, 62225-5302. This publication (AFTRP NO. 5) must be shown as a governing publication in Section B of the tender in order for the tender to be considered for DOD routing. Tenders may not be made subject to any carrier service guide or other publications for application of the rates and charges therein. The publications (and successive reissues thereof) listed below shall be considered as part of this rules publication and will not be listed in Section B of the tender form:

a. National Motor Freight Classification (NMFC), Tariff ICC NMF 100-series, published by the National Motor Freight Traffic Association, Inc., Agent, 1001 North Fairfax St, Ste 600, Alexandria, VA 22314 (Commodity item numbers and descriptions only).

b. Continental Directory of Standard Point Location Codes (SPLC), ICC NMF 102-series, published by the National Motor Freight Traffic Association, Inc., Agent.

c. Directory of Standard Multi-Modal Carrier and Tariff Agents Codes (SCAC/STAC), ICC NMF 101-series, published by the National Motor Freight Traffic Association, Inc., Agent.

d. Defense Table of Official Distances (DTOD), commercially known as PC*Miler. DTOD is the official mileage guide for DOD freight shipments. Mileage will be calculated based on the DTOD version in effect on the date of shipment pickup. DTOD mileages shall apply to all DOD freight shipments made on or after April 1, 1999.

e. Code of Federal Regulations, Title 49.

f. SDDC Standard Tender Instruction Publication No. 364-B.

g. International Civil Aviation Organization Technical Instructions (ICAO).

h. International Air Transport Association (IATA).

ITEM 5 (Continued)

3. When rules, regulations, charges, or other provisions provided by SDDC in specific publications differ from or conflict with the provisions of this publication, the provisions contained in the specific publications or solicitations will apply, but only to specific movements named therein.

4. Carriers must independently establish their own level of security or accessorial charges for each service, by inserting in Items 1 and 2, Section F, of their tenders, the charges which will apply to the movements covered by each tender. (See ITEM 10, HOW TO USE THIS PUBLICATION.)

5. Rates and charges will include all taxes, including Federal Excise Tax.

ITEM 10 **HOW TO USE THIS PUBLICATION**

1. The rules contained in this publication are divided into five sections. **SECTION 1** contains the general application and instructions. **SECTION 2** contains those security service rules applicable to the movement of DOD sensitive and classified shipments. **SECTION 3** contains general operational and accessorial service rules applicable for all air carriers subject to this publication. **SECTION 4** contains special operational rules which apply movement of hazardous, classified, and protected (sensitive) materials. **SECTION 5** contains abbreviations, codes, definition of terms used in this publication, and explanation of reference marks.

2. Except as otherwise provided, this publication is to be used solely in conjunction with the DOD Standard Tender of Freight Services (tender), MT Form 364-R. The optional rules for transportation protective and accessorial services in this publication identify the application of the charges, minimum charges, etc., as applying per mile, per shipment, etc. This application cannot be changed.

3. Carriers must specify **all** of the protective security and accessorial services which they are willing, qualified, and able to provide.

a. The three-character code (following the title of each optional rule) for each service must be entered in Items 1 and 2 of Section F of the tender under the "Service" column. The charge for that service will be entered under the "Charge" column opposite each service code and stated as indicated in the optional service rule; e.g., dollars and/or cents.

b. When a rule provides for more than one charge, a separate charge figure must be given for each sub-item charge number in the rule. For example, if a carrier wishes to provide Dual Driver Protective Service with National Agency Check (DDN) and Dual Driver Protective Service (DDP), the following information would be shown in Item 1, Section F, of the tender:

SERVICE	CHARGE
DDN1	$050.00
DDP1	$050.00

c. When the individual optional service rules indicate a minimum or maximum charge, it will be shown in the "Minimum Charge" or "Minimum Charge/Wt." column.

4. Carriers have the option to offer any accessorial service in these sections without charge. To implement this action, the carriers will enter the standard three-character code for that accessorial service in the "Service" field. All spaces to the immediate right under the "Charge" and "Minimum Charge/Wt." columns will be filled with zeros.

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ITEM 10 (Continued)

5. Rules whose titles are not followed by a three-character code do not contain baseline accessorial charges. These rules are not optional but are binding on all carriers subject to this publication.

ITEM 15 **AMENDING THIS PUBLICATION**

1. This publication will be amended by new or revised items on an as-needed basis.

2. Items in which text has been changed will be designated with "(C)" followed by the applicable change number; e.g., "(C2)." The Table of Contents shows the current change of each item.

3. New items will be designated with "(N)" followed by the applicable change number; e.g., "(N/C2)."

ITEM 20 **ELECTRONIC DATA INTERCHANGE**

1. Electronic Commerce (EC) is the electronic exchange of routine business documents between trading partners. Electronic Data Interchange (EDI) is a type of EC. EDI is the computer-to-computer exchange of routine business documents in machine readable form. EDI utilizes publicly-defined standards of the American National Standards Institute (ANSI).

2. To participate in the DOD EC/EDI program, all commercial trading partners (e.g. carriers, vendors) must execute an EC/EDI Trading Partner Agreement (TPA) and comply with applicable instructions, standards, and conventions. The EC/EDI Trading Partner Guide for Defense Transportation is available on SDDC's website at:

http://www.sddc.army.mil

DOD EDI implementation conventions are available at:

http://www.sddc.army.mil

3. Participation in the EDI program requires compliance with published ANSI Accredited Standards Committee X12 standards and DOD EDI implementation conventions when electronically exchanging transportation or transportation-related data with DOD transportation components or their agents. The commercial EDI trading partner must be capable of:

a. Electronically exchanging shipment, rate, and award information;

b. Securing freight payment services for the DOD using the value-added US Bank PowerTrack service;

c. Receiving Electronic Funds Transfer (EFT); and

d. Providing delivery and/or shipment status reports to PowerTrack and/or US TRANSCOM (or its component commands) through DOD's EC Infrastructure.

4. Commercial vendors/carriers who exchange EDI transactions with DOD transportation components or their agents may exchange business data through third-party value-added-networks (VANs) which must be compatible with the DOD system or DOD's ECI.

ITEM 20 (Continued)

5. In compliance with the National Debt Reduction Act, all vendors wishing to do business with the DOD or receive payments for goods or services must be registered in the Central Contractor Register (CCR). Further information on CCR registration is available at:

http://www.ccr.gov

6. Point of contact for information pertaining to CCR/TPA, call 1-703-428-2915, or write:

HQ SDDC
Attn: Automated Transportation Systems Division
709 Ward Drive, Building 1990
Scott Air Force Base, IL.62225
Telephone: (618) 220-5673

ITEM 25 **FRACTIONS**

1. Fractions of a cent resulting from the application of a carrier's independently established rates and accessorial charges, shown in Sections D, E, and F of its tender, shall be disposed of as follows:

a. Fractions of less than one-half of one cent shall be omitted.

b. Fractions equal to or greater than one-half of one cent shall be increased to the next whole cent.

2. Fractions of a pound resulting from the application of a carrier's independently-established rates and accessorial charges shall be rounded to the next higher pound.

ITEM 30 **MILEAGES**

Mileage rates will be based on the shortest highway distance. See ITEM 5, PURPOSE AND APPLICATION, paragraph 2d for the applicable governing mileage publication.

ITEM 35 **SERVICES NOT OTHERWISE SPECIFIED**

When carriers perform services that are required for normal movement of freight shipments and such services are not identified in this rules publication, the charges for those services will be negotiated by Headquarters TCAQ-I/A and the carriers.

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SECTION 2

SECURITY SERVICES RULES

For Explanation of Abbreviations, Codes, Definitions, and Reference Marks

See SECTION 5.

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ITEM 100 APPLICATION OF TRANSPORTATION PROTECTIVE SERVICES

1. Security services CIS, DDN, DDP, PSS, and SEV described in this section may be offered by air carriers which Headquarters, SDDC has approved for these services.

2. If a DOD consignor annotates the bill of lading requesting that carrier provide more than one transportation service and the requirements of one service duplicate the requirements of another requested service, carrier will assess charges only for the higher protective service. For example: If consignor annotates the bill of lading requesting the carrier to provide both DDP and CIS, then the carrier will assess charges only for DDP because DDP also includes the requirements for DDP and CIS.

ITEM 105 DOD CONSTANT SURVEILLANCE SERVICE (CIS) ***(See NOTE)***

1. DOD Constant Surveillance Service (CIS) is a transportation protective service which provides for constant surveillance over a shipment during movement and includes use of a Signature and Tally Record (DD Form 1907).

2. A qualified carrier representative, as used herein, is a person employed by a carrier or terminal and who is:

a. Designated by carrier or terminal management to attend a transportation conveyance.

b. Authorized to move a ground transportation conveyance and has the means and ability to do so.

c. Aware of the sensitivity of the material moving under CIS.

d. Knows the safety, security, and emergency procedures that must be followed.

3. When providing consignor requested CIS, the carrier will:

a. Use only qualified carrier representatives for shipment handling.

b. Use a Signature and Tally Record (DD Form 1907) (see 120, ELECTRONIC SIGNATURE SERVICE and 145, SIGNATURE AND TALLY RECORD SERVICE) or equivalent carrier-furnished signature and tally record.

c. For parked aircraft which contains material requiring CIS, ensure aircraft is parked within the confines of a commercial airport that has access control under Federal Aviation Agency rules and guidelines or on a military installation or DOD - contractor location. If the aircraft is parked anywhere else, or if the classified/sensitive cargo is removed from the aircraft or awaiting loading or unloading, the shipment must be under required degree of observation by employees of the airline transporting it as required by the terminal standards for CIS. As an alternative to observation, the shipment may be placed in an appropriate security cage (*see NOTE.)*

d. Observation of the shipment is not required during the period it is stored in an aircraft in connection with flight transit provided the shipment is loaded into an appropriately secured, approved container. Observation is required during loading and unloading operation and at any intermediate stops along the flight route.

e. Route shipments accepted for transport under CIS only via carriers which can provide CIS.

f. Be able to trace a shipment in less than 24 hours.

g. Provide immediate telephonic notification to consignee if shipment cannot reach consignee within 24 hours of agreed upon time of arrival.

ITEM 105 (Continued)

4. In addition to requirements specified in paragraph 3 above, air carriers providing associated motor transport to/from aircraft loading/unloading points will maintain CIS during the motor portion of a movement by providing the following:

a. Preparation and use of a Signature and Tally Record (DD Form 1907). (See ITEM 120, ELECTRONIC SIGNATURE SERVICE.)

b. Ensure conveyance containing the shipment is constantly attended by a qualified carrier representative. A vehicle is "attended" when the person responsible for the shipment is in the vehicle, awake, not in a sleeper berth, or within 100 feet of the vehicle and has the vehicle within constant, unobstructed view.

c. Ensure conveyance containing the shipment is parked only at a carrier terminal, a state or local safe haven established under Department of Transportation regulations (49 CFR Part 397.5(a)), a fuel stop within the guidelines of paragraph b above, or in an emergency at a Department of Defense safe haven or refuge location.

(1) When a shipment is parked within a carrier terminal area or at a safe haven, it must be under constant direct visual observation of a qualified carrier representative who is within 100 feet of the shipment or shipment must be secured in a fenced and lighted area; and it must be under the constant, general observation of a qualified carrier representative.

(2) As an alternative, a shipment may be placed in a security cage which meets specifications contained in NOTE.

d. Instruct drivers on actions to take in event of attempted hijacking or terrorist attack. Instructions will include how to obtain DOD safe haven or refuge, state and local law enforcement assistance, and evasive driving techniques.

e. Obtain prior approval on a case-by-case basis for any deviation from the requirements specified in paragraphs b or c above, from HQ, Surface Deployment & Distribution Command Operations Center, ATTN: Freight Carrier Registration Program (FCRP), 661 Sheppard Place, Fort Eustis, VA 23604-5050; telephone 757-878-8742.

f. The tractor moving a CIS shipment must be equipped with a working mobile telephone unit, capable of contacting state/local law enforcement personnel for the purpose of seeking assistance. Drivers must be capable of using the unit to make the contact.

5. Each bill of lading will contain the following annotations for carrier compliance:

a. "DOD Constant Surveillance Service Requested. Signature and Tally Record (DD Form 1907) furnished to carrier."

b. "Carrier to notify (Consignor and consignee) (duty/24-hour non-duty numbers) immediately if shipment is delayed because of an accident or incident. If neither can be reached, contact SDDC HOTLINE: 1-800-524-0331. Also, use HOTLINE number to obtain safe haven or refuge instructions in the event of a civil disorder, natural disaster, carrier strike, or other emergency."

6. In addition to all rates and charges for transportation, shipments on which DOD CIS is provided at consignor's request will be subject to a charge of CIS(1) $_______ per shipment. Carrier will enter CIS(1) in Section F, Item 1 of the DOD tender.

ITEM 105 (Continued)

7. Carriers providing Constant Surveillance Service are also subject to the provisions of ITEM 110, DOD DRIVER IDENTIFICATION REQUIREMENTS; ITEM 115, DUAL DRIVER PROTECTIVE SERVICE and DUAL DRIVER PROTECTIVE SERVICE WITH NATIONAL AGENCY CHECK; ITEM 120, ELECTRONIC SIGNATURE SERVICE; ITEM 130, LEASED EQUIPMENT RESTRICTIONS; ITEM 135, PROTECTIVE SECURITY SERVICE; ITEM 140, SECURITY ESCORT VEHICLE SERVICE; and ITEM 145, SIGNATURE AND TALLY RECORD SERVICE in this publication.

NOTE: SECURITY CAGE STANDARDS

GENERAL: Security cages will be fabricated from commercial steel grating panels. Walls, doors, floors, and ceiling must provide protection equivalent to the steel grating to preclude forced entry. Doors must have DOD-approved padlocks (equivalent to American 200 series) and hasp systems, and connecting hardware must be welded or otherwise secured to deter unauthorized entry.

CEILING: Same material as wall or floor. Minimum height - 8 feet. Frame - metal.
Hinges - welded hinge pins. Locks-DOD approved (equivalent to American 200 series) security locks and hasps.

CONNECTING DEVICES: Welded, peened or otherwise installed so as to deter unauthorized entry.

FLOORS: Made of asphalt or reinforced concrete or wood if reinforced with steel floor plating.

HINGES: Welded hinge pins

LOCKS: DOD-approved (equivalent to American 200-series) security locks and hasps.

WALLS: Constructed of structural steel angle and expanded steel grating. Building walls also may be used which provide equivalent security to form sides(s). (Examples: Double-course reinforced or filled concrete block.)

WINDOWS/OPENINGS: - Expanded steel grating, anchored in metal frame, secured in same manner as door.

ALTERNATIVE: As an alternative to a security cage, dromedary, or similar heavy container which is sealed and locked with a DOD-approved (equivalent to American 200 series) lock may be used in buildings which are locked, guarded, or alarmed. In lieu of locking the containers, they may be placed with doors against each other or against a substantive building wall.

ITEM 110 **DOD DRIVER IDENTIFICATION REQUIREMENTS**
(Applicable only to Motor Portion of Air Freight Shipments)

1. All commercial drivers employed to handle shipments accorded either DOD Constant Surveillance (CIS), Dual Driver Protective Service (DDP), Dual Driver Protective Service with National Agency Check (DDN), Protective Security Service (PSS), or Security Escort Vehicle Service (SEV) are required to carry adequate identification which verifies their affiliation with the carrier(s) named on the bill of lading. From the documents provided, consignors must be able to verify the driver's affiliation with the origin carrier named on the bill of lading.

2. Carriers must ensure that drivers handling such shipments carry a valid driver's license and medical qualification card, employee record card, or similar documents, one of which must contain the driver's photograph. All documents must be in English and employ tamper proof technology to be considered adequate.

3. For carriers cleared to handle SECRET shipments, the identification requirements are in accordance with the Industrial Security Manual (paragraph 8, DOD 5220.22-M) and Carrier Supplement to Industrial Security Manual (paragraph 11.A(10), Section 111, DOD 5220.22-C).

ITEM 115 **DUAL DRIVER PROTECTIVE SERVICE (DDP)**
DUAL DRIVER PROTECTIVE SERVICE WITH NATIONAL AGENCY CHECK (DDN)
(Applicable only to Motor Portion of Air Freight Shipments)
(See NOTE)

1. Dual Driver Protective Service (DDP) or Dual Driver Protective Service with National Agency Check (DDN) will be provided by the carrier upon request of the consignor, subject to the following:

a. Continuous responsibility, attendance, and surveillance of shipment through the use of two (dual) qualified drivers in the same line-haul vehicle and includes the maintenance of a Signature and Tally Record (DD Form 1907). Such attendance and surveillance shall prevent all inspections (except those performed by government enforcement agencies in their line of duty), tampering, pilfering, or sabotage, including, insofar as humanly possible, all manner of unusual circumstances, such as wreck, delay, flood, or violent disturbances.

b. For the purposes of DDP and DDN, unless otherwise stated herein, when not being driven a vehicle must be attended at all times by a qualified representative of the carrier. A vehicle is "attended" when the person responsible for the shipment is in the vehicle, awake, not in a sleeper berth or is within 25 feet of the vehicle and has the vehicle within his/her constant, unobstructed view. A qualified representative is a person who is employed by the carrier or the terminal involved in handling of shipments, designated by the carrier/terminal to attend the conveyance, aware of the sensitivity of material moving under DDP and DDN, knowledgeable of the safety, security, and emergency procedures that must be followed, is authorized, and has the means and capability to move the transportation conveyance.

c. For brief stops en route, carrier will ensure that the vehicle or shipment is attended.

d. When circumstances require lengthy stops en route, carrier will insure that the vehicle is parked only at a carrier terminal, a state or local approved safe haven under 49 CFR, or during emergencies, in a DOD safe haven or refuge location. When a vehicle is parked in a carrier terminal or at a state or local safe haven, a qualified carrier or terminal representative must keep the shipment in view and stay within 25 feet of the vehicle or shipment at all times, or the shipment must be secured in a adequately lighted area that is surrounded by at least a 6-foot chain link fence and is continuously patrolled by a representative of the carrier or terminal employee at all times. Shipments under DDN must be checked at least once every 30 minutes. As an alternative, a shipment may be placed in a security cage (See ITEM 105, NOTE).

ITEM 115 (Continued)

e. The maintenance of a Signature and Tally Record (DD Form 1907) by the carrier is an integral part of DDP and DDN. Both the consignor and the carrier shall comply with the requirements of SIGNATURE AND TALLY RECORD SERVICE on all shipments for which DDP or DDN are requested and provided. **Both drivers are required to sign the Signature and Tally Record (DD Form 1907) when they assume initial responsibility for the shipment.**

f. For single line-haul, not more than one motor carrier may furnish Pickup or Delivery Service for each shipment.

g. No trip lease authorized. *(See ITEM 130, LEASED EQUIPMENT RESTRICTIONS).*

h. The vehicle conveying the shipment upon which DDP or DDN is requested must remain connected with the power unit (tractor) during shipment except when stopped at a DOD activity/contractor for loading/unloading; at a carrier terminal for servicing; at a carrier-designated point where the driver(s) maintains continuous attendance and surveillance over the shipment while disconnected; at a state or local safe haven location which meets the terminal security standards of paragraph (d); or, in emergencies, at a DOD safe haven or refuge location.

i. The tractor moving a DDP or DDN shipment must be equipped with a working mobile communications unit, such as a Citizens Band (CB) radio unit or a mobile telephone unit, capable of contacting state/local law enforcement personnel for the purpose of seeking assistance. Both drivers must be capable of using the unit to make the contact.

j. Carrier must be able to trace a shipment in less than 24 hours.

k. Carrier or its agent will notify the consignee by telephone if shipment cannot reach consignee within 24 hours of the agreed upon desired delivery date.

l. Drivers moving shipments on which DDP or DDN is requested will be instructed by the carrier on how to obtain DOD safe haven/refuge, state and local law enforcement assistance, and actions to take to comply with the requirements listed in paragraphs 1.a. through 1.1. above.

2. When DDP or DDN is required for a shipment, the consignor shall notify the carrier in advance of the requirement, and annotate on the bill of lading:

"Dual Driver Protective Service Requested.
Signature and Tally Record (DD Form 1907) furnished to carrier."
or
"Dual Driver Protective Service with National Agency Check Requested.
Signature and Tally Record (DD Form 1907) furnished to carrier."

3. Carriers providing DDN agree to permit a National Agency Check on all management and operational personnel involved. Management Personnel include: owners (including partnership where applicable), principal deputies, board members (where applicable), and company managers responsible for liaison with DOD operations. Operational personnel include: drivers, handlers, and terminal and security personnel hired permanently or temporarily by the company to protect the DOD cargo.

ITEM 115 (Continued)

4. Charges.

a. In addition to all rates and charges for transportation, shipments for which DDP or DDN is provided by carrier at consignor's request will be subject to the following charges which will apply from point of pickup to origin airport and/or from destination airport to point of delivery:

Dual Driver Protective Service (DDP) DDP(1) $_________ per shipment.
Dual Driver Protective Service with NAC (DDN) DDN(1) $____________ per shipment.

b. These charges include expedited service, the maintenance of a Signature and Tally Record (DD Form 1907), Exclusive Use of Vehicle for DDN, furnishing of dual drivers, and a working mobile communication unit in the tractor, and all other provisions/requirements shown in paragraphs 1.a. through 1.l above. Carriers cannot assess Exclusive Use of Vehicle Charges for DDP unless Exclusive Use of Vehicle is requested on the bill of lading by the consignor.

c. In Section F(1) of the DOD tender, carriers will enter DDP(1) or DDN(1).

5. Carriers providing DDP or DDN are also subject to the provisions of ITEM 110, DOD DRIVER IDENTIFICATION REQUIREMENTS, and ITEM 130, LEASED EQUIPMENT RESTRICTIONS, in this publication.

NOTE: Subject to ITEM 120, ELECTRONIC SIGNATURE SERVICE.

ITEM 120 **ELECTRONIC SIGNATURE SERVICE (see NOTE)**

1. In lieu of the Signature and Tally hard copy record (DD Form 1907), upon approval, carriers may offer an Electronic Signature Service that shows the movement of shipments through the carrier's system as recorded by various electronic scans. When electronic scans are used, neither actual signatures of persons handling the shipment nor a manually prepared signature/tally record is required. However, a hard copy of the printout must be presented by the carrier to the consignee within three business days of the shipment receipt. In addition, upon request from the consignor or consignee, carrier must provide the identity of each person responsible for scans, as reflected in the electronic records.

2. Approval must be obtained through Surface Deployment & Distribution Command Operations Center, ATTN: Freight Carrier Registration Program (FCRP), 661 Sheppard Place, Fort Eustis, VA 23604-5050; telephone 1-757-878-8742.

NOTE: Subject to ITEM 145, SIGNATURE AND TALLY RECORD SERVICE.

ITEM 125 **EXPRESS CARRIERS**

Classified and sensitive materials designated for transportation as air express shipments are limited to the U.S. Postal Service, GSA small package contract air carrier, or carriers approved to provide Transportation Protective Services as detailed in this publication. Use of other, non-approved carriers is strictly prohibited.

ITEM 130 **LEASED EQUIPMENT RESTRICTIONS**
(Applicable only to Motor Portion of Air Freight Shipments)

1. Trip-leased commercial vehicles will **not** be used to transport the following:

Ammunition and explosives (Class 1)
Inhalation hazard poisons
Radioactive yellow-III label material
DOD shipments for which any the following services are required:
DOD Constant Surveillance Service
Dual Driver Protective Service
Dual Driver Protective Service with National Agency Checks
Protective Security Service
Security Escort Vehicle Service

2. The vehicles used must be owned or leased under a valid agreement (see paragraph 3 below) by the company transporting the shipment, and the vehicle drivers must be full-time employees or under the direct control and responsibility of that company. This is not to be construed, however, as precluding the interchange of equipment in furtherance of a through movement of traffic at a point or points which such carriers are authorized to serve.

3. The contract of lease must be in writing, signed by the parties thereto, and must not be canceled by either party with less than 30 days' notice. In addition, the contract of lease must provide for the exclusive possession, control, and use of the equipment, and for the complete assumption of liability in respect thereto by the lessee. The leased equipment may not be further leased or subject to any other carrier for the duration of the lease. The consignor will ensure that a copy of the appropriate contract of lease is carried in all leased vehicles and is available for inspection.

ITEM 135 **PROTECTIVE SECURITY SERVICE (PSS)** ***(See NOTE)***
(Applicable only to Motor Portion of Air Freight Shipments)

1. Carriers that have been cleared by the Defense Investigative Service and qualified by SDDC to transport SECRET shipments shall provide Protective Security Service (PSS) upon request of consignor, subject to the following:

a. PSS is a transportation protective service used for SECRET shipments which includes continuous attendance and surveillance of the shipment by qualified employees, the maintenance of a signature and tally record, and the use of two (dual) carrier drivers in the cab of the same vehicle who are cleared under the DOD Industrial Security Program. Such attendance and surveillance shall prevent all inspections (except those performed by governmental enforcement agencies in their line of duty), tampering, pilfering, or sabotage, including, insofar as humanly possible, all manner of unusual circumstances, such as wreck, delay, flood, or violent disturbances.

ITEM 135 (Continued)

b. Requirements.

(1) When PSS is required for a DOD shipment, the consignor shall notify the carrier in advance and annotate "Protective Security Service Requested. Signature and Tally Record (DD Form 1907) Furnished to Carrier" on the bill of lading.

(2) Exclusive use of the vehicle.

(3) The trailer or conveyance containing the material upon which PSS is requested must always be connected with the power unit (tractor) during shipment except when stopped at a DOD activity for loading/unloading; at a carrier terminal for servicing; or at a carrier designated point where the driver(s) maintains continuous attendance and surveillance over the shipment while disconnected.

(4) The tractor/truck moving a PSS shipment must contain a working mobile communications unit, such as a Citizen Band (CB) radio or a mobile communications unit, capable of contacting state/local law enforcement personnel for the purpose of seeking assistance, and both drivers must be capable of using the unit to make the contact.

(5) The maintenance of a Signature and Tally Record (DD Form 1907) by the carrier is an integral part of PSS. Both the consignor and the carrier shall comply with the requirements of ITEM 145, SIGNATURE AND TALLY RECORD SERVICE, on all DOD shipments for which PSS is requested and provided.

(6) Stops en route.

(a) For brief stops en route, carriers will ensure that at least one of the drivers remains in the cab of the vehicle, or remains within 10 feet of the vehicle, provided the vehicle is within the driver's unobstructed view.

(b) When circumstances require more lengthy stops en route, carriers shall ensure that the vehicle is parked only at a carrier terminal, a state or local approved safe haven or, during emergencies, in a DOD safe haven or refuge location. When a vehicle is parked in a carrier terminal or at a state or local safe haven, a qualified carrier or terminal employee must keep the shipment in view and stay within 25 feet of the vehicle or shipment at all times, or the shipment must be secured in a fenced and lighted area under the general observation of a qualified carrier or terminal employee at all times. As an alternative, the material may be placed in a security cage. (See NOTE, ITEM 105, DOD CONSTANT SURVEILLANCE SERVICE.)

(7) Special procedures. If time or distance does not permit delivery during the same day of pickup, the special procedures outlined below will be followed by the carrier:

(a) If the shipment remains in the transportation conveyance, at least one qualified carrier employee will maintain continuous attendance and surveillance of the shipment to prevent access by unauthorized persons.

(b) When a SECRET shipment is unloaded from the vehicle during stopovers en route, it shall be under the constant surveillance of a cleared carrier representative or shall be placed in storage in a closed area, vault, or strong room as prescribed in the Defense Industrial Security Manual. In those cases in which SECRET shipments, such as a missile, may require outside storage, special protective measures shall be taken to include constant and continuous surveillance by at least one or more cleared carrier representatives. As an alternative, the material may be stored in a vault type structure approved by the Defense Investigative Service.

ITEM 135 (Continued)

c. Charges.

(1) In addition to all rates and charges for transportation, shipments for which PSS is provided by carrier at consignor's request will be subject to a charge of PSS(1) $_______ per shipment which will apply from point of pickup to origin airport and/or from destination airport to point of delivery. Enter PSS(1) in Section F(1) of the DOD Standard Tender of Freight Services (MT Form 364-R).

(2) These charges will include dual drivers, Exclusive Use of Vehicle, constant attendance and surveillance, and the maintenance of a Signature and Tally Record (DD Form 1907).

2. Carriers providing Protective Security Service are also subject to the provisions of ITEM 110, DOD DRIVER IDENTIFICATION REQUIREMENTS, and ITEM 130, LEASED EQUIPMENT RESTRICTIONS, in this publication.

NOTE: Subject to ITEM 120, ELECTRONIC SIGNATURE SERVICE.

ITEM 140 **SECURITY ESCORT VEHICLE SERVICE (SEV)**
(Applicable only to Motor Portion of Air Freight Shipments)

1. Security Escort Vehicle Service (SEV) is defined as a trail vehicle service designed to maintain discreet constant and specific surveillance of the cargo vehicle transporting sensitive DOD cargo and to provide emergency assistance when required, primarily by contacting appropriate state or local law enforcement agencies. SEV will be provided by the carrier upon request of the consignor, subject to the following requirements and charges:

a. Carrier will provide an escort vehicle--an inconspicuous, unmarked automobile or van, or a freight vehicle, such as tractor, tractor-trailer (flatbed or van) combination or straight bed truck with two unarmed licensed drivers in the escort vehicle--to maintain constant and specific surveillance of the cargo vehicle for which the service is requested. Under no circumstances will the escort vehicle be under load while in escort service; i.e., the trailer or straight truck must be empty and doors sealed by the origin consignor and verified by the consignee. Where SEV accompanies a movement which requires Protective Security Service, the drivers will be cleared for SECRET under the DOD Industrial Security Program, per DOD 5220.22-M. Constant and specific surveillance of the cargo vehicle is defined as occupying a position behind the cargo laden vehicle while maintaining a continuous view of that same vehicle. During en route stops, at least one of the escort vehicle drivers must remain in the escort vehicle or must be within approximately 25 feet of such vehicle and maintain a constant, unobstructed view of the cargo vehicle.

b. In an on-road emergency, where feasible, the SEV vehicle/driver may be used to move the freight or freight trailer as authorized by a state or local law enforcement or rescue service official, a DOD transportation officer, or SDDC official.

c. Carrier will instruct drivers of the escort vehicle to remain clear of a cargo vehicle should it come under attack. In such instances, drivers will immediately contact the nearest state or local law enforcement agency and record details about the attack. In the event of an accident, breakdown, natural disaster, or civil disturbance involving or affecting either vehicle, drivers will contact the nearest state or local law enforcement agency for emergency assistance or, as appropriate, escort the cargo vehicle to a DOD refuge/safe haven.

ITEM 140 (Continued)

d. The security escort vehicle must contain a working Citizens Band radio or mobile communications unit capable of obtaining emergency assistance and assuring two-way communication between the cargo vehicle and the security escort vehicle.

Two-way communications will be kept to a minimum. The drivers of the security escort vehicle will neither discuss the nature of the shipment nor reveal its origin and destination. Both security escort vehicle drivers must be trained in the operation and use of the mobile communications unit or Citizens Band radio and be responsible for its proper maintenance and serviceability throughout the movement.

2. Provisions apply when the bill of lading is annotated:

"Security Escort Vehicle Service Requested"

3. In addition to all rates and charges for transportation, shipments for which Security Escort Vehicle Service is provided by carrier at consignor's request, carriers will provide an escort vehicle and two drivers from point of pickup to origin airport and/or from destination airport to point of delivery and will assess charge of SEV(1) $_______ per shipment. Carrier will enter SEV(1) in Section F(1) of the DOD tender.

4. Carriers providing Security Escort Vehicle Service are also subject to the provisions of ITEM 110, DOD DRIVER IDENTIFICATION REQUIREMENTS, AND ITEM 130, LEASED EQUIPMENT RESTRICTIONS.

ITEM 145 **SIGNATURE AND TALLY RECORD SERVICE (675)** ***(See NOTE)***

Carriers shall provide Signature and Tally Record Service (675) upon request of the consignor, subject to the following:

a. "675" is a service designed to provide continuous responsibility for the custody of DOD shipments in transit. It requires a Signature and Tally Record (DD Form 1907) from each person responsible for the proper handling of the shipment at specified stages of its transit from origin to destination.

b. Consignor or his agent must place and sign the following annotation on the bill of lading:

"Signature and Tally Record requested. DD Form 1907 furnished to carrier.

DATE_____________SIGNATURE______________________TITLE__________________"

c. Air carriers performing "675" service for the DOD may use either a DD Form 1907, their own commercial signature form, or an electronic signature service to provide the record of continuous accountability and custody required for "675" shipments. The options are further explained below:

(1) Carrier-supplied form will provide a complete record of the chain of custody of the shipment and will have a standardized block of data pertinent to the government shipment, including all data elements contained in Section A of the DD Form 1907. It will provide a chain of custody for the shipment through each terminal handling point at origin, hub or other interline point(s) and at destination. The carrier form will be supplied to consignors by the air carrier in advance to allow for preparation of the shipment. Form will be assembled in sufficient copies to cover all handling points and provide a signed copy to the consignee.

ITEM 145 (Continued)

(2) Carriers may also offer an Electronic Signature Service that shows the movement of the shipment through the carrier system as recorded by certain electronic scans. When electronic tracking scans are used, neither actual signatures of persons handling the shipment nor a manually prepared Signature and Tally Record is required. However, a hard copy printout must be presented by the carrier to the consignee within three business days of shipment receipt. This printout will show scans at pickup and delivery and will also show movement as applicable into and out of terminals, stations, and/or hub locations. Upon request from the consignor or consignee, a carrier must be able to provide the identity of each person responsible for the scans, as reflected in the electronic records.

(3) Carriers wishing to use a commercial signature form or an electronic signature service must have their forms and procedures approved by SDDC prior to use. Inquiries will be directed to:

Headquarters
Surface Deployment & Distribution Command
Operations Center
ATTN: Freight Carrier Registration Program (FCRP)
661 Sheppard Place
Fort Eustis, VA 23604-5050
Telephone: (757)-878-8742

d. In addition to all rates and charges for transportation, shipments on which "675" is provided at consignor's request will be subject to a charge of 675(1) $_______ per shipment. In Section F(1) of the DOD Standard Tender of Freight Services, carrier will enter 675(1).

NOTE: For alternative method, see ITEM 120, ELECTRONIC SIGNATURE SERVICE.

SECTION 3

RULES: GENERAL

For Explanation of Abbreviations, Codes, Definitions, and Reference Marks

See SECTION 5.

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ITEM 200 **ADVANCING CHARGES (045)**

1. Carriers shall advance, for subsequent collection from the Government, the lawful charges incurred for custom house and in bond service, and for special bonds or tolls required by state or other governmental authority for transportation of a shipment; which because of its hazardous nature, requires the securing of such for movement over streets or highways.

2. The charge of the carrier for advancing monies, as described above, shall be 045(1) $_______ for each advancement.

3. Lawful charges for services listed in paragraph 1 that the carrier incurred and advanced will be identified on the BL or EDI transaction submitted to the Defense Finance and Accounting Service for payment. Carrier will maintain for audit purposes documentary evidence that it actually incurred and advanced the charges claimed.

ITEM 205 **AGGREGATE WEIGHT**

1. The carrier agrees that it will aggregate all shipments from the same origin point to the same destination consignee, for the same level of service tendered at the same time on the same day. Weight will be adjusted and billed at the applicable rate for the total weight of these shipments.

2. All succeeding Bills of Lading (BL) issued after the first BL for the given destination will be annotated "Aggregate Weight Rule applies, Reference: BL Number:_________" by the consignor.

3. Hazardous or dangerous commodities may be consolidated, as described above, only with other compatible hazardous or dangerous commodities (see Item 430).

Note: Consignors must tender shipments in whole pounds; fractions of pounds shall be increased to the next higher pound.

ITEM 210 **AIRCRAFT ORDERED BUT NOT USED (AFN) *(See NOTE)***
(Applicable only to Air Taxi)

1. When a carrier, upon consignor's request, furnishes an aircraft for loading of a shipment and through no fault of the carrier the consignor cancels loading of the aircraft, the carrier will be entitled to a charge of AFN(1)$________ per highway mile for each aircraft furnished and not used, from point of dispatch to the scheduled loading point, and return to original dispatch point, subject to a minimum charge of AFN(2)$________.

2. In lieu of the charges in paragraph 1, carrier may establish a flat charge of AFN(3)$________ for each aircraft furnished and not used. If a flat charge is elected by carrier, the minimum surcharge AFN(2) is not applicable.

3. The charges will not apply when notice of cancellation is received by the carrier prior to actual dispatch of aircraft from the carrier terminal.

4. Claim for collection of charges under this item shall be supported by consignor's certification of cancellation.

5. When pickup carrier is inbound with a loaded aircraft which is scheduled for outbound loading from the same airport and the consignor cancels loading of the aircraft, no charge will be assessed under paragraphs 1, 2, or 3 above.

6. When service is requested from a carrier, the carrier must identify the airport from which the aircraft will be dispatched.

NOTE: See ITEM 5, PURPOSE AND APPLICATION, Paragraph 2d for applicable governing publication on highway mileage and ITEM 315, SUBMISSION OF CHARGES FOR ACCESSORIAL SERVICES.

ITEM 215 **ALTERNATION OF RATES - DOD TENDERS**
(Not Applicable to Guaranteed Traffic Tenders)

1. Point-to-point rates will take precedence over territorial rates.

2. Specific commodity rates will take precedence over Freight All Kinds rates only when the shipment consists of a single commodity.

3. Except as provided in paragraphs 1 and 2, where different rates, between the same points of origin and destination, on the same commodity or commodities, based on different minimum weights, or where a different charge on the same commodity or commodities are published in another section of the same tender or in different DOD tenders filed by the same carrier, the lowest charge obtainable under the minimum weight or different charges applicable thereto will apply.

4. In no case shall the charge for any shipment from and to the same point, via the same route of movement, be greater than the charge for a greater quantity of the same commodity in the same shipping form and subject to the same packing provisions at the rate or rates and weight applicable to such greater quantity of freight.

ITEM 220 **ASTRAY FREIGHT & EMERGENCY NOTIFICATION**

1. The following toll-free (800) Astray Freight and HOTLINE telephone numbers are for commercial transportation notification only. These numbers are to be used for reporting:

a. The holding of DOD shipments which cannot be delivered because the consignor or consignee cannot be adequately identified (astray freight).

b. Intransit accidents, incidents, delays, or other emergencies involving DOD shipments.

2. Carriers shall telephone SDDC Deployment Support Command at the following toll-free numbers to report:

a. Astray freight: 1-800-631-0434

b. Accidents, incidents, delays, or other emergencies: 1-800-524-0331

3. For emergency situations only:

a. Involving incidents involving explosives and ammunitions: 1-703-697-0218 (call collect) U.S. Army Operations Center.

b. Involving HAZMAT other than explosives and ammunition: 1-800-851-8061 (Defense Logistics Agency)

4. Carriers unable to obtain forwarding instructions from the source listed above shall notify the transportation officer at the military installation nearest the carrier terminal where the astray freight is being held.

a. The transportation officer will, if possible, develop and furnish the carrier with proper forwarding instructions.

b. Containers without identifying marks or those bearing conflicting marks shall be opened by the transportation officer with the prior approval of the carrier and in the presence of the carrier authorized representative.

5. Pending the determination of final disposition, carrier may give possession of astray freight, identified as Government property, to the local transportation officer. A receipt will be given the carrier and the Transportation Discrepancy Report (TDR) system (SF 361) will be implemented. If the freight is subsequently returned to the carrier for forwarding to the correct destination, the receipt given the carrier shall be canceled.

ITEM 225 **CARRIER-PROVIDED SERVICES**

1. When a carrier publishes different levels of service at varying rates, carrier will bill the Government at the rate applicable to the actual service performed and not to exceed the rate applicable to the service requested. Carrier must select the level of service to be used in the Standard Tender (Sections G, H, and I) as follows:

a. Priority Service (SG) Next available flight; shipment may be required anytime during a 24 hour period, no specific time for pickup or delivery stated (consignor may insert time requirements on BL IAW carrier quote). Special pick up and/or delivery service may also be required (see ITEM 295, PICKUP AND DELIVERY).

b. Overnight Service (D1): Shipment to be delivered by 5:00 p.m. of the following business day after pickup of shipment.

c. Second Day Service (D2): Shipment to be delivered by 5:00 p.m. of the second business day after pickup of shipment.

d. Deferred Service (D3): Shipment to be delivered NLT 5:00 p.m. of the fifth business day after pickup of shipment.

2. When the consignor requests Overnight (D1) service with a before 12:00 p.m. delivery, the carrier is entitled to a charge of DEL(1)$______ per CWT subject to a minimum charge of DEL(2) $_______.

3. Carriers must also select the type of service to be used as follows:

a. Airport-to-Airport Service (AA): Origin city airport to destination city airport.

b. Door-to-Door Service (DD) - Shipper's origin to consignee's receiving point.

4. Consignor must annotate on the bill of lading clearly and specifically a request for Priority, Overnight, Second Day Service, or Deferred Service. Where level of service is not requested, carrier will bill for the lowest published charge in his tender. In no case will the carrier bill for a higher level of service than that actually provided. In no event will the carrier bill for any service not provided.

ITEM 230 **CHARGES FOR WEIGHT** ***(See NOTES)***

Transportation charges for a shipment will be based on the greater of:

1. Actual gross weight (including packing material)

Or

2. Dimensional weight. Dimensional weight for a shipment will be calculated on the basis of one pound for each 194 cubic inches as follows:

a. Length (inches) x Width (inches) x Height (inches) = Total Cubic Inches.

b. Total Cubic Inches divided by 194 = Dimensional weight.

NOTE 1: See ITEM 240, DESCRIPTION OF SHIPMENTS; ITEM 285, OVERSIZED FREIGHT; and ITEM 290, PACKAGING AND MARKING REQUIREMENTS.

NOTE 2: : Consignors must tender shipments in whole pounds; fractions of pounds shall be increased to the next higher pound.

ITEM 235 **CLAIMS**

Carriers will process U.S. Government claims for loss, damage, overcharge, and duplicate payment in accordance with the following regulations: Parts 1005 and 1008, Title 49, of the Code of Federal Regulations, and, as applicable to U.S. Government property as published in Parts 101-40 and 101-41, Title 41 of the Code of Federal Regulations.

ITEM 240 **DESCRIPTION OF SHIPMENTS**

The airbill description of shipments forwarded by air freight carrier or air freight forwarder must be indicated on the BL showing the aggregate cubic measurement, and in addition, the number of pieces, weight, and cubic measurement of each piece or package separately in block 18, Description of Commodities. For the purpose of determining cubic measurements, the greatest dimension of length, width, and height will be used.

ITEM 245 **DISTRIBUTION OF TENDERS**

1. The manual submission and distribution of Department of Defense Standard Tender of Freight Services, MT Form 364-R (including supplements) for the movement of DOD air freight shipments will be accomplished in accordance with the following procedures:

a. The carrier will mail or deliver three signed copies and seven unsigned copies of the tender to:

Headquarters
USTRANSCOM
ATTN: TCAQ-I/A
402 Scott Drive, Unit 3A1
Scott AFB, IL 62225-5302

b. Advance or informational copies of tenders will **not** be sent to any DOD consignor, DOD agency or service, or to SDDC.

2. After TCAQ-I/A approves the tender, the CONUS Freight Management (CFM) system will assign it a distribution number and date and return one copy to the carrier. Air freight tenders for Class 1, Divisions 1.1, 1.2, and 1.3 ammunition and explosives will not be distributed to DOD consignors.

ITEM 250 **ESCORTS/COURIERS (ECR)**

Escorts and/or couriers may accompany shipments aboard aircraft at the request of the Government. Each escort and/or courier will be subject to a charge of ECR(1) $_______ per person.

ITEM 255 **EXCESS VALUATION (EVC)**

1. Carrier will be liable for all loss, damage, undue delay, missed delivery or other result occurring to freight in its possession, unless caused by acts of god. Except for crated HHG, carrier liability for loss/damaged cargo will be limited to $.50 per pound per piece or $50.00 per piece, whichever is greater, but not to exceed actual value of articles lost or damaged plus the amount of applicable transportation charges.

2. Should the consignor desire to declare and establish cargo liability for an amount greater than that in paragraph 1, the carrier agrees to provide this increased liability coverage for EVC(1) $______ for each $100 or fraction thereof.

ITEM 260 **FREIGHT ALL KINDS - DOD UNIQUE NUMBER 999914 (See NOTE)**

1. Freight All Kinds (FAK) consists of those commodities which carriers offer to transport at one inclusive rate or charge, regardless of their differing transportation characteristics.

2. The following commodities **may not** be included as FAK:

a. Narcotics and dangerous drugs
b. Ammunition and explosives (Class 1)
c. Inhalation hazard poisons
d. Radioactive materials, except those which may be transported by air in accordance with the provisions set forth in Title 49 CFR, Parts 172.101 and 173.421.
e. Etiologic agents
f. Hazardous or dangerous commodities
g. Corpses
h Coins, currency, and precious metals
i Stamps
j. Art

3. Carriers filing FAK tender rates may not restrict the application of such rates by imposing any further exclusions. Tender commodity description "Freight All Kinds" (999914) will be understood to include all commodities except those in paragraph 2.

4. Except as required by regulation or law, shipments described on bills of lading as Freight All Kinds (999914) will not be further described as to individual commodities contained in the shipment.

5. Released value of FAK under this item shall not exceed $.50 per pound per piece or $50 per piece, whichever is greater, but not to exceed actual value of articles lost or damaged plus the amount of applicable transportation charges.. (See ITEM 265, FREIGHT ALL KINDS - 999931.)

NOTE: See ITEM 255, EXCESS VALUATION.

ITEM 265 **FREIGHT ALL KINDS - DOD UNIQUE NUMBER 999931 (see NOTE)**

1. Freight All Kinds (FAK) - DOD Unique Number 999931 consists of those commodities which carriers offer to transport at one inclusive rate or charge regardless of their differing transportation characteristics.

2. The following commodities **may not** be included as FAK:

a. Radioactive materials.
b. Ammunition and explosives (Class 1)
c. Inhalation hazard poisons
d. Narcotics
e. Etiologic agents
f. Corpses
g. Coins, currency, and precious metals
h Stamps
i Art

ITEM 265 (Continued)

3. Carriers filing FAK tender rates may not restrict the application of such rates by imposing any further exclusions. Tender commodity description "Freight All Kinds (999931)" will be understood to include all commodities except those in paragraph 2.

4. Except as required by regulation or law, shipments described on bills of lading as "Freight All Kinds (999931)" will not be further described as to individual commodities contained in the shipment.

5. Released value of FAK under this item shall not exceed $.50 per pound per piece or $50 per piece, whichever is greater, but not to exceed actual value of articles lost or damaged plus the amount of applicable transportation charges. (See ITEM 260, FREIGHT ALL KINDS-999914.)

NOTE: See ITEM 255, EXCESS VALUATION.

ITEM 270 **INADVERTENCE RULE**

Tenders inadvertently accepted and distributed by TCAQ-I/A, which are later found not to be in compliance with DOD tender filing instructions or the applicable rules publication, are subject to immediate rejection. The issuing carrier will be notified.

ITEM 275 **INSPECTION OF SHIPMENTS**

Carriers shall have the right to inspect shipments to determine applicable rates. When shipments are found to be incorrectly described on the bill of lading, consignor will issue BL Correction Notice (SF 1200), and freight charges will be assessed according to the proper description.

ITEM 280 **LOCATION OF GOVERNMENT INSTALLATIONS**

1. Government installations named in the origin or destination blocks of the BL will be recognized as the intended origin or destination regardless of any conflict with a post office address.

2. Transportation charges will apply from or to the Government installation at origin or destination designated regardless of the location of the receiving or shipping facilities within the installation boundaries.

3. Tenders submitted by carriers showing the Standard Point Location Code (SPLC) of a city, with its corresponding narrative information, will be applicable to **all** DOD installations and other consignors within the corporate limits of that city. Those SPLC's, applicable to the corporate limits of all cities, consist of six numbers only; but in entering these SPLC's in the DOD tender, the six numbers must be followed by three zeros to complete the entire nine-position SPLC field.

OVERSIZED FREIGHT ***(See NOTE)***

ITEM 285

1. Consignor must make advance arrangements with the air carrier to transport the following oversized shipments:

a. Piece(s) which exceed 125 inches in length and/or prevent other freight from being loaded on the same pallet(s) because of special tie-down requirements.

b. Piece(s) which exceed 88 inches in width but are less than 125 inches in width and/or prevent other freight from being loaded on the same pallet(s) because of special tie-down requirements.

c. Piece(s) which exceed 59 inches in height.

2. If transportation for such shipments will be provided on pallets (width 88 inches, length 125 inches), carrier will not assess a rental charge for the use of the pallets.

3. Charges. On shipments of oversized freight, as described in paragraph 1 above, carriers will be entitled to a surcharge of 3% which will be applied against the line-haul charge.

4. Oversized freight shipments will allow for an additional (1) day of transit time unless otherwise agreed to by the shipper and the carrier.

NOTE: See ITEM 230, CHARGES FOR WEIGHT and ITEM 240, DESCRIPTION OF SHIPMENTS.

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ITEM 290 **PACKAGING AND MARKING REQUIREMENTS**

1. Shipments must be so prepared or packed as to ensure safe transportation with ordinary care in transportation.

2. Any commodity susceptible to damage by ordinary handling must be adequately protected by proper packing and must be marked and labeled.

3. Any commodity susceptible to damage as a result of any conditions which may be encountered in air transportation, such as high or low temperatures, high or low atmospheric pressure, or sudden changes in either, must be adequately protected by proper packing.

4. Each piece of a shipment must be legibly and durably marked with the name and address of the consignor and consignee.

5. Pieces with a floor bearing weight in excess of that which can be loaded on available aircraft must be provided with a suitable skid or base which will distribute the weight to that which can be loaded on available aircraft. The weight of such skid or base shall be included in the weight of the shipment.

6. Hazardous materials must be packaged in accordance with CFR 49, IATA, or ICAO regulations governing the commercial airline industry when such shipments are tendered to a scheduled airline or a freight forwarder which utilizes a scheduled airline to transport air freight.

7. DOD consignors using the services of nonscheduled carriers or freight forwarders which own/operate leased or corporation aircraft may, at the option of carrier and consignor, continue to package hazardous materials in accordance with CFR 49 regulations.

ITEM 295 **PICKUP AND DELIVERY ON SATURDAY, SUNDAY, OR HOLIDAY OR ON NORMAL BUSINESS DAYS BEFORE OR AFTER NORMAL BUSINESS HOURS (HOL/PUD/SAT)**

1. When consignor/consignee requests pickup or delivery service on Saturday, Sunday, or holiday or on normal business days before 8:00 a.m. or after 5:00 p.m., carrier will provide such service subject to the following charges:

a. On a normal business day, pickup-and-delivery service before 8:00 a.m. or after 5:00 p.m. shall be performed for a charge of PUD(1) $_______ per CWT subject to a minimum charge of PUD(2) $_______ .

b. Saturday pickup-and-delivery service shall be performed for a charge of SAT(1) $_______ per CWT subject to a minimum charge of SAT(2) $_______ .

c. Sunday and holiday pickup-and-delivery service shall be performed for a charge of HOL(1) $_______ per CWT subject to a minimum charge of HOL(2) $_______ .

2. Consignor/consignee must clearly annotate on the BL the request for pickup/delivery before or after normal weekday business hours or on Saturday, Sunday, or holiday.

ITEM 300 **POWERTRACK**

1. PowerTrack will be used by all parties for the payment of services covered by this publication.

2. PowerTrack is an electronic freight transaction tracking and payment system that eliminates the paperwork traditionally associated with transportation processes. Its many features include rapid payment, capturing of freight data, streamlining freight accounting, and simplified billing procedures. The Secretary of Defense has mandated the use of PowerTrack for most procurements of DOD transportation, including all procurements covered by this publication. Therefore, effective September 30, 2000, carriers, even if otherwise qualified, which are not PowerTrack certified will not be eligible to carry any DOD freight which is subject to the rules of this publication.

3. The contractor shall have a signed U.S. Bank PowerTrack Trading Partner Agreement in place by the effective date of the tender. Providing a signed copy of the Trading Partner Agreement or formal notification in writing /email to the CO shall constitute verification.

4. When discrepancies arise which affect freight payments, PowerTrack provides online tools to enable a quick resolution of any disputed charges. In particular, PowerTrack's eBill process can be used for adjustments to various freight charges (e.g. accessorials, detention, and demurrage).

5. Payment of charges for transportation services shall be made only upon completion of the services as evidenced by the carrier or the carrier's agent certification of delivery at destination. Such certification shall be made electronically using PowerTrack, and shall not be made until the shipment has actually been delivered. Any certification of delivery prior to actual delivery could result in the disqualification or disbarment of the carrier from government transportation programs and procurements.

6. Carriers wishing to become PowerTrack certified should contact US Bank at 1-800-417-1844 as soon as possible.

Additional information on PowerTrack is available at:

www.usbank.com/powertrack

7. Additionally, the contractor shall work with each service representative and military installation to develop individual PowerTrack Trading Partner Agreements. This process shall commence once contacted by the installation and/or the service representative to begin testing for accurate PowerTrack billing EDI interfaces. The contractor shall coordinate with U.S. Bank, shipper, and service representative to facilitate to the maximum extent possible PowerTrack implementation.

ITEM 305 **RECONSIGNMENT/DIVERSION (RCC)**

1. Carriers will provide Reconsignment or Diversion Service upon written request, or upon oral request confirmed in writing, subject to the following:

a. The terms "reconsignment" and "diversion" are considered to be synonymous, and the use of either will be considered to mean:

(1) A change in the name of the consignee within the original destination point;

(2) A change in the place of delivery within the original destination point;

(3) A change in the original destination point; or

ITEM 305 (Continued)

(4) A change in the route or other instructions that require a change in billing or an additional movement of the shipment.

b. Carriers will make a diligent effort to execute a request for reconsignment but will not be responsible if such service is not affected.

c. Only entire shipments, not portions of shipments, may be reconsigned.

d. Where a request is made by the consignor to divert a shipment to a motor carrier, the contract of carriage between the consignor and the originating air carrier or air forwarder shall terminate upon acceptance of the shipment by the motor carrier.

2. For performing Reconsignment/Diversion Service, the charge will be RCC(1) $_______ per CWT subject to a minimum weight of RCC(2) $_______ . When the performance of this service involves a change in the original destination point, this charge will be in addition to the applicable rates to and from the reconsignment point.

3. Installations incurring charges under this item will be billed direct. See ITEM 315, SUBMISSION OF CHARGES FOR ACCESSORIAL SERVICES.

ITEM 310 **REDELIVERY (RCL)**

1. When a shipment is tendered for delivery and through the fault of the consignee such delivery cannot be accomplished, carrier will notify consignee, by telephone if practicable, that the shipment is on hand, and arrange for a mutually-agreeable redelivery date.

2. The charge for Redelivery service shall either be RCL(1) $_______ per CWT, subject to a minimum charge of RCL(2) $_______ per shipment, a maximum charge of RCL(3) $_______ per shipment. In lieu thereof, the carrier may establish a flat charge of RCL(4) $_______ per shipment. If RCL(4) is selected, RCL(1), RCL(2), and RCL(3) will not be applicable.

3. If, after being notified that the shipment is on hand, the consignee elects to pick up the shipment at carrier's terminal, no Redelivery charges will apply.

4. Installations incurring charges under this item will be billed direct. See ITEM 315, SUBMISSION OF CHARGES FOR ACCESSORIAL SERVICES.

ITEM 315 **SUBMISSION OF CHARGES FOR ACCESSORIAL SERVICES REQUESTED BY CONSIGNOR/CONSIGNEE**

Charges for accessorial services described in ITEM 210, AIRCRAFT ORDERED BUT NOT USED; ITEM 310, REDELIVERY; and ITEM 320, WAITING TIME, will be chargeable to the appropriation and allotment designated by the military department or Government agency which has jurisdiction over the local activity where the charges actually accrued. Carriers will submit all invoices for these charges to the Transportation Officer at the local activity involved.

ITEM 320 **WAITING TIME (WTG)**
(Applicable only to Air Taxi)

1. When the aircraft of an air taxi carrier is delayed or detained for loading/unloading and such delay or detainment is attributable to the consignor or consignee, the shipment or multiple shipments being loaded or unloaded will be subject to the following provisions:

a. One hour free time will be allowed for loading or unloading carrier's aircraft. Free time shall begin from the time carrier's employee notifies a responsible representative of the consignor or consignee that the aircraft is available and ready for loading/unloading provided that it is within the consignor's or consignee's normal business hours, or acceptance hours as annotated on the bill of lading.

b. If loading or unloading extends beyond the allowable free time, the charge will be WTG(1) $_______ for each hour or fraction thereof the aircraft is delayed beyond the allowable free time, subject to a maximum charge WTG(2) $_______ of eight hours for each 24-hour period.

2. Installations incurring charges under this item will be billed direct. See ITEM 315, SUBMISSION OF CHARGES FOR ACCESSORIAL SERVICES REQUESTED BY CONSIGNOR/CONSIGNEE.

ITEM 325 **EXCUSABLE DELAYS**

The following is the only allowable definition for what events constitute an excusable delay:

The delivery commitment guarantee does not apply when the delays in delivery are caused by acts of God or of the public enemy, acts of the Government in either its sovereign or contractual capacity, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, and unusually severe weather. In each instance the failure to perform must be beyond the control and without the fault or negligence of the Carrier (FAR 52.249-8 (c) (1-9).

SECTION 4

RULES GOVERNING THE MOVEMENT OF

HAZARDOUS, CLASSIFIED, AND PROTECTED (SENSITIVE) MATERIALS

See Item 130, LEASED EQUIPMENT RESTRICTIONS

For Explanation of Abbreviations, Codes, Definitions, and Reference Marks

See SECTION 5.

ITEM 400 **APPLICATION**

The rules and regulations provided in this section are applicable to DOD movements of Ammunition and Explosives (Class 1), Poisons (Class 6 and Division 2.3), Classified and Protected (Sensitive) Material, Radioactive Material, and other Dangerous Commodities. The term "other Dangerous Commodities" shall include, but not be limited to, the following: Flammable Liquids, Flammable Solids, Oxidizing Materials, Corrosive Liquids, Compressed Gases, and Poisonous Substances.

ITEM 405 **ARRIVAL OF SHIPMENTS DURING OTHER THAN NORMAL BUSINESS HOURS**

Shipments should be delivered during normal business hours of the consignee; however, when a shipment arrives at an installation during other than normal business hours due to circumstances beyond the control of the carrier, a temporary holding area will be provided for shipments that cannot be unloaded immediately. These areas will be subject to the regulation of the cognizant military service for handling and safeguarding explosives. Normal installation fire and security protection will be provided. The carrier or its representative will be advised that responsibility for the shipment will remain with the carrier until formal delivery of the shipment has been affected.

ITEM 410 **ASSISTANCE TO CARRIERS**

1. For the purpose of promoting safety, expediting transportation, and delivering shipments of explosives and other dangerous commodities, commanders of military installations may extend any technical assistance and aid considered necessary in connection with moving, salvage demolition, neutralization, or other disposition of Government owned shipments being transported or stored by carriers. Regulations of the military services prescribe policies, responsibilities, and procedures for the disposal of explosive ordnance material and commercial shipment of explosive-contaminated scrap metals.

2. Assistance given in accordance with paragraph 1 above will be for carrier's account, and carrier may be held responsible for all expenses incurred by the Government, including salaries and wages paid by the Government, as these personnel act and perform in those instances as carrier agents. Government personnel assigned to assist carriers will retain their status as employees of the United States Government and, as such, will be entitled to the benefits as provided by law. The Government will not recognize or submit to any action for property damage in connection with such assistance furnished, when actual labor supervision or other services are performed at the carrier's request.

3. Except under emergency conditions, when delay might contribute to further hardships or possible disaster when Government personnel are called upon to give assistance to a carrier, the transportation officer will prepare a self-addressed letter in the form of a request for Government service, including the important points in Paragraph 2 above, to be signed by the carrier's representative. The letter will state clearly that the carrier acknowledges responsibility for performance of the services requested from the Government and that performance of the services by Government personnel does not relieve the carrier of liability. When assistance is given under emergency conditions and there is no time to prepare the required letter in advance, it will be prepared and signed after the service is performed.

4. Collection of sums of money for services rendered under these provisions will be in accordance with the Defense Finance and Accounting Center procedure. Checks will be made payable to "Treasurer of the United States" and will be submitted to the billing office of the applicable military service.

ITEM 410 (Continued)

5. Carrier will not be billed or held responsible for any service performed by DOD personnel that was not requested by the carrier, such as dispatching of representatives to observe transfer of shipments or to suggest corrective measures in connection with seal breakage, shifting of loads or bracings, accidents, or other adjustments.

6. For assistance during transportation emergencies:

a. Commanders of military installation having appropriate facilities will grant safe haven to military sponsored shipments of Class 1, Divisions 1.1, 1.2, 1.3, 1.4, 1.5, and 1.6 ammunition and other cargo described in ITEM 400, APPLICATION covered by a Government Bill of Lading (GBL), or a Commercial Bill of Lading (CBL) annotated for conversion to a GBL, at the request of SDDC, when such material is endangered by civil disturbance or natural disaster or prevented from proceeding to destination by circumstances beyond the control of the carrier. Commanders may also grant safe haven to other Federal agency shipments of such materials when requested.

b. The SDDC Deployment Support Command (DSC) **(1-800-524-0331)** will coordinate requests from carrier representatives or dispatchers for safe haven during emergencies. Availability of installations affording safe haven will be determined by the SDDC DSC from the appropriate Transportation Facilities Guide. Authorization of the proposed safe haven will be obtained by SDDC from the commander of the selected installation before providing the carrier representative with the location of the safe haven and a point of contact. Vehicles accorded safe haven will be parked inside an appropriate security area, preferably a fenced area. When required, installation activity security will be extended to provide reasonable protection. The compatibility restrictions and quantity distance requirements of the DOD Explosives Safety Board's DOD Ammunition and Explosives Safety Standards (DOD 6055.9 STD), as implemented by service directives, will be observed.

7. Shipping documents will be examined to prevent surreptitious entry of any unauthorized shipments into the installation/activity. Each carrier whose vehicle is granted safe haven must be apprised by the SDDC DSC that providing safe haven does not relieve the carrier of liability under the contract of carriage, nor does the DOD assume responsibility for the shipment or equipment, so long as terms and conditions of providing safe haven are not inconsistent with those of carrier's contract of carriage. In this regard, it will be within the prerogative of the installation commander to permit carrier personnel to remain with the vehicle for constant surveillance purposes or to decline to extend safe haven. Further, the carrier will be advised that the safe haven accorded is strictly temporary in nature and the vehicle must be removed from the military premises as soon as the installation commander or appropriate civil authority determines that the shipment is no longer endangered by local conditions. The consignor and the consignee of the material will be notified by the carrier of the shipment delay. At the discretion of the commander of the installation/activity, inspection provisions will be applied for shipments granted safe haven on the activity. Costs for providing safe haven will be processed for reimbursement in accordance with Paragraph 4 above.

8. Shipping activities will provide a secure holding area when assistance is required to protect a carrier's vehicle transporting sensitive or classified cargo that arrives after hours or at the discretion of an installation commander when no emergency exists.

ITEM 415 **CARRIER APPROVAL**

Shipments of ammunition and explosives (Class 1), inhalation hazard poisons, or radioactive yellow-III label material or classified and protected (sensitive) materials will be tendered only to a carrier authorized to transport these commodities.

ITEM 420 **DRIVER REQUIREMENTS**

1. Shipping Paper and Emergency Response Information for Hazardous Materials Transported by Government Vehicles (DD Form 836) will be used for issuing instructions to drivers of all commercial and military vehicles transporting explosives or certain other dangerous commodities for the military departments over public roads within CONUS. This form provides the shipping transportation officer with a medium for disseminating precautionary procedural instructions to the driver. The driver will require such instruction to learn how best to protect himself, the lading, the vehicle, and other life and property from such hazards as fire, accident, and vehicle breakdown. Depending upon the type of commodities involved, the transportation officer will supplement the instructions contained in the form with specific instructions to ensure that the driver will take every precaution while transporting these commodities. The driver must transfer the form to each successive driver, if any, for delivery to the consignee at destination.

2. When a shipment of ammunition and explosives (Class 1), inhalation hazard poisons, or radioactive yellow-III label material is involved in an accident or is delayed en route for a period of 12 hours or more, the carrier's driver will notify the consignor and consignee by the fastest available means. Refer to ITEM 215, ASTRAY FREIGHT AND EMERGENCY NOTIFICATION, for emergency telephone numbers.

ITEM 425 **INSPECTION OF VEHICLES**
(Applicable only to motor portion of Air Freight shipments)

1. When transporting ammunition and explosives (Class 1, Divisions 1.1, 1.2, and 1.3), inhalation hazard poisons, and radioactive yellow-III label material by motor vehicle over public highways, the carrier is required to comply with safety regulations prescribed by transportation regulatory bodies and the Department of Defense.

2. Shipping activities will inspect vehicles at the following points, using the Motor Vehicle Inspection (Transporting Hazardous Materials) form (DD Form 626):

a. Before loading, complete Sections I and II. Only vehicles against which no unsatisfactory conditions are noted will be accepted for loading. Vehicles will not be rejected, however, if deficiencies are corrected by the carrier before loading.

b. After loading, complete Section III. All items will be completed; additional pages may be used if necessary. Vehicles will not be released for transportation until all items are satisfactory

3. The receiving installation must inspect vehicles at the following points, using applicable items on the DD Form 626:

a. Before they are accepted for delivery. Deficiencies must be corrected by the carrier before the vehicles are permitted to enter sensitive or restricted areas..

b. Prior to unloading. Deficiencies will be corrected at the time of inspection, if practical and considered necessary for safe delivery of the shipment to the unloading area. If any deficiencies are not corrected at the time of inspection, proper action will be taken to ensure safe delivery of the shipment

4. Deficiencies which exist at the time of inspection and are corrected before loading/unloading the vehicle will be entered in the "Comments" column of the DD Form 626.

ITEM 430 **REGULATORY COMPLIANCE**

1. Everyone participating in the shipment of explosives and other dangerous commodities is responsible for compliance with rules and regulations of regulatory bodies governing the safe transportation of those commodities. All matters pertaining to the establishment, amendment, or clarification of such rules and regulations as they concern Department of Defense shipments will be referred to the SDDC Operations Center, 661 Sheppard Place, Fort Eustis, VA 23604 for coordination, determination or further handling with regulatory bodies.

2. Regulations require that certain conspicuous and distinctive labels or markings be attached to or made upon containers used in transporting shipments of explosives or other dangerous commodities, and that placards be applied to equipment used to transport such shipments. Labeling or marking of containers and vehicles is the responsibility of the consignor. No unit of transportation equipment loaded with explosives or other dangerous commodities will be released without proper labeling of containers therein and proper placarding of the equipment as required by the appropriate regulatory or supervisory authority as described herein. Labels will not be applied to packages containing commodities which are not subject to the Code of Federal Regulations, Title 49, Parts 171-179. When DOT regulations exempt the package(s) from labeling, the exemption must be indicated by the words "No Labeling Required" immediately following the Description of Commodities on the BL.

3. The government agrees to package hazardous materials for both cargo and passenger aircraft in compliance with the IATA Dangerous Goods Regulation and the ICAO in addition to packaging requirements put forth in CFR 49.

4. Carriers will propose separate tenders for HAZMAT.

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SECTION 5

EXPLANATION OF ABBREVIATIONS, CODES, DEFINITIONS AND REFERENCE MARKS

Headquarters
Air Mobility Command
Directorate for Logistics—Air Transportation Division
Scott AFB, IL 62225

ITEM 500 **ABBREVIATIONS AND CODES**

045	Advancing Charges
675	Signature and Tally Record Service
AA	Airport-to-Airport Service
AFN	Aircraft Ordered but Not Used
AFTRP	AIR Freight Traffic Rules Publication
AMC	Air Mobility Command
BL	Bill of Lading
CBL	Commercial Bill of Lading
CFR	Code of Federal Regulations
CIS	Constant Surveillance Service
CONUS	Continental United States
CWT	Hundred Pounds
D1	Overnight Service
D2	Second-Day Service
D3	Deferred Service
DD	Door-to-Door Service
DDD	Desired Delivery Date
DDN	Dual Driver Protective Service with National Agency Check
DDP	Dual Driver Protective Service
DEL	Delivery Before Noon
DOD	Department of Defense
DOT	U. S. Department of Transportation
DSC	Deployment Support Command (formerly SDDC Area Command(s))
ECR	Escorts/Couriers
EDI	Electronic Data Interchange
EVC	Excess Valuation
FAK	Freight All Kinds
GBL	Government Bill of Lading
HAZ	Hazardous Handling
HOL	Pickup/Delivery on Sunday/Holidays
SDDC	Surface Deployment Distribution Command
NAC	National Agency Check
NMFC	National Motor Freight Classification
PSS	Protective Security Service
PUD	Pickup/Delivery on Normal Business Days
RCC	Reconsignment/Diversion
RCL	Redelivery
RDD	Required Delivery Date
SAT	Pickup/Delivery on Saturday
SEV	Security Escort Vehicle Service
SG	Priority Service
TDR	Transportation Discrepancy Report
TPS	Transportation Protective Service
WTG	Waiting Time

ITEM 505 **DEFINITIONS**

AIR TAXI - Air transportation from a carrier offering non-scheduled air services of passengers or cargo, on a charter or contract basis. Aircraft, having a gross takeoff weight of less than 12,500 pounds and operating under the requirements of Federal and State bodies, can be either fixed-wing or helicopter.

BILL OF LADING - A generic term for shipment documentation that is used interchangeably with "Government Bill of Lading (GBL)" or "Commercial Bill of Lading (CBL)".

CLEARED CARRIER - A commercial carrier that has met the following criteria for handling SECRET shipments:

a. Can provide the Transportation Protective Service (TPS) requirement established by a transportation officer.

b. Has authorization by law or regulation to provide the required transportation protective service.

c. Has a SECRET facility clearance issued by the Defense Investigative Service (DIS).

d. Has furnished SDDC with an applicable tender, agreement, or contract that provides for Protective Security Service (PSS).

CONTINENTAL UNITED STATES - (CONUS) - United States territory located within the North American continent between Canada and Mexico.

DESIRED DELIVERY DATE - (DDD) - A specific date by which delivery of a shipment should be accomplished by the carrier at the CONUS destination or CONUS air/water terminal.

EMERGENCY - Any situation which would prevent a shipment of classified or protected material from safely reaching its destination, such as undue delay caused by accidents, equipment failure, civil disturbance, labor strikes or natural disasters.

LEGAL HOLIDAYS - New Year's Day, Martin Luther King Day, President's Day, Memorial Day, Independence Day, Labor Day, Veterans' Day, Columbus Day, Thanksgiving Day, Christmas Day.

QUALIFIED CARRIER REPRESENTATIVE - A person employed by a carrier or terminal involved in the handling of DOD shipments moving in security service, and who is:

a. Designated by carrier or terminal management to attend a transportation conveyance.

b. Aware of the sensitivity of DOD material moving under transportation protective service(s).

c. Knowledgeable of the safety, security and emergency procedures that must be followed.

d. Authorized to move a transportation conveyance and has the means and ability to do so.

e. Cleared under the DOD Industrial Security Program to handle SECRET shipments and has carrier-issued identification when providing Protective Security Service.

REFUGE LOCATION - Emergency assistance provided by an installation to a carrier's vehicle transporting arms, classified (SECRET or CONFIDENTIAL) materials, or Division 1.4 ammunition. The criteria for granting assistance are the same as for safe haven, except the installation does not have to consider quantity-distance factors.

ITEM 505 (Continued)

RELEASED VALUATION RATE - A rate applied subject to limitations with respect to the liability of carriers for loss of and/or damage to a shipment.

REQUIRED DELIVERY DATE (RDD) - Date when material is required by the consignee.

ROUTING OR ROUTE ORDER - An order issued by Military Traffic Management Command specifying the mode of transportation and the means within that mode by which shipment will move.

SAFE HAVEN - Emergency assistance provided by an installation to a carrier's vehicle transporting Division 1.1, 1.2, or 1.3 ammunition and explosives due to circumstances beyond a carrier's control (such as severe weather or vehicle breakdown). A primary consideration by the installation commander is whether the load poses an unacceptable hazard to personnel or operations. This involves an analysis of the quantity-distance factors involved and the ability to locate the vehicle away from populated areas.

SECURED AREA - An area to which access is controlled and which is under the regular, periodic surveillance of security personnel.

SECURE HOLDING AREA - In non-emergency situations, protection provided by an installation to a carrier's vehicle transporting sensitive or classified cargo that arrives after hours or at the discretion of an installation commander. The installation **commander must make the same kinds of determinations as for "safe haven" or "refuge."**

SECURITY CAGE - A structure fabricated of steel grating which can be used for temporary storage of classified or protected material within low security structures, including carrier terminals.

SENSITIVE CARGO - Small arms, ammunition, and explosives that are a potential danger to public safety and can be used by militant, revolutionary, criminal, or other elements for civil disturbances, domestic unrest, or criminal actions.

SHIPMENT - A shipment is a quantity of freight tendered for transportation by one consignor, at one point, on one day, on one bill of lading, for delivery to one consignee at one destination.

TIME DEFINITE DELIVERY CONDITION - A requirement that a shipment be delivered no later than a specified or calculable particular time and/or date when unexcused failure to deliver the shipment by that time or date results in a reduced entitlement to payment.

ITEM 510 **REFERENCE MARKS**

(N) Denotes new item.

(C) Denotes change in text.

Critics say Air Force rule creates shipping headaches
BY: Roxana Tiron, The Hill
04/18/2008

A package sent by the Air Force from a depot in Corpus Christi, Texas, to a National Guard Unit in Lexington, Okla., traveled 2,243 miles before reaching its destination, even though the two cities are only 576 miles apart.

The reason? A complicated Air Force rule that is sometimes interpreted as a requirement that a shipment be flown for at least one leg of the delivery route. The result, according to congressional critics, is that military shipments cost taxpayers millions of dollars more than they should.

The package from Corpus Christi was first driven by truck to Houston International Airport. From there it was flown to Fort Wayne, Ind. Then it was flown back to Dallas, Texas, before finally being driven to Lexington.

The freight company hired to do the job could have driven the package in one day. Instead of paying about $400 for delivery, the government ended up paying twice that amount.

Lawmakers are befuddled by the process. Rep. Solomon Ortiz (D-Texas), chairman of the House Armed Services Readiness subcommittee, has been investigating the inefficiencies that result from the Air Force's regulation for more than a year.

Ortiz recently asked the Government Accountability Office to review the Pentagon's transportation policies and assess how much money has been wasted by the Air Force's rule.

Ten years ago, the Pentagon amended its transportation regulations to operate more like a company in the private sector would. The new "mode-neutral" rule no longer dictated the means of transporting a package. Instead, shipping decisions should depend on when the customer needed the package.

But the Air Force's Air Mobility Command operates under the Air Freight Traffic Regulation Policy No. 5, which is still mode-specific instead of mode-neutral.

The complications arise when the Air Force applies the rule to so-called "air freight forwarders." Not to be confused with air carriers, airfreight forwarders do not own their planes but have access to planes, trucks and other means of transportation. They usually pick the mode of transportation that would get a shipment to its destination by a required date for a lower rate than an air carrier would charge.

Other services allow air freight forwarders to ship by truck only. But under Air Force rules, companies that deliver a package by truck without flying the shipment by air can face stiff fines, said Brandon Fried, the executive director of the Airforwarders Association .

Complicating the process is that airlines now fly smaller regional airplanes that are too small to deliver some military packages. That change has made it harder to find the appropriate plane or airport for air delivery, Fried said.

A carrier shipping a 462-pound package from the air base in Dover, Del., to the military depot in New Cumberland, Pa., had to fly it from Philadelphia to Fort Wayne, Ind., then fly it back to Baltimore, and then drive it by truck to New Cumberland.

After some prodding from lawmakers, Gen. Norton Schwartz, the head of the U.S. Transportation Command, which oversees shipping for all the military services, said last year that the Air Force's regulation was not meant to require air freight forwarders to use the air to transport a shipment.

But congressional sources said the clarification has not resolved the issue. Transportation officers still choose air for next-day delivery because they think it's the most efficient method of delivery, the sources said.

Ortiz and Rep. Randy Forbes (R-Va.), the subcommittee's ranking member, pointed out in a recent letter to John Young, the Pentagon's acquisition chief: "It ... appears that there is confusion between the term 'air carrier' and the term 'air freight forwarder,' leading many in the [Department of Defense] to erroneously assume that by selecting an air freight forwarder" the Air Force's one-leg-by-air regulation applies.

"This confusion is generated by lack of clear guidance (including no definitions of the terms) and poor training and is resulting in inefficiency and unnecessary cost to the taxpayer," the lawmakers added.

Schwartz responded that the transportation command is in the process of overhauling its freight system and developing a request for industry to offer mode-neutral transportation and rates by this summer.

Revision of Certain Air Force Regulations Required (Sec. 355)

(a) REVISION REQUIRED.—Not later than 90 days after the date of the enactment of this Act, the Secretary of the Air Force shall revise the Air Freight Transportation Regulation Number 5, dated January 15, 1999, to conform with Defense Transportation Regulations to ensure that freight covered by Air Freight Transportation Regulation Number 5 is carried in accordance with commercial best practices that are based upon a mode-neutral approach.

(b) MODE-NEUTRAL APPROACH DEFINED.—For purposes of this section, the term ''mode neutral approach'' means a method of shipment that allows a shipper to choose a carrier with a time definite performance standard for delivery without specifying a particular mode of conveyance and allows the carrier to select the mode of conveyance using best commercial practices as long as the mode of conveyance can reasonably be expected to ensure the time-definite delivery requested by the shipper.

United States Air Force

Report to Congressional Committees

Initial Report on Implementation of NDAA 2009, Business Transformation Initiatives for the Military Departments (Sec. 908)

July 2009

Introduction

This report is being provided to the Congressional Defense Committees as directed in Public Law 110-417, Section 908, National Defense Authorization Act Fiscal Year 2009.

Business Transformation Initiatives for the Military Departments (Sec. 908)
(a) IN GENERAL.—The Secretary of each military department shall, acting through the Chief Management Officer of such military department, carry out an initiative for the business transformation of such military department.

(b) OBJECTIVES.—The objectives of the business transformation initiative of a military department under this section shall include, at a minimum, the following:

(1) The development of a comprehensive business transformation plan, with measurable performance goals and objectives, to achieve an integrated management system for the business operations of the military department.

(2) The development of a well-defined enterprise-wide business systems architecture and transition plan encompassing end-to-end business processes and capable of providing accurate and timely information in support of business decisions of the military department.

(3) The implementation of the business transformation plan developed pursuant to paragraph (1) and the business systems architecture and transition plan developed pursuant to paragraph (2).

(c) BUSINESS TRANSFORMATION OFFICES.—

(1) ESTABLISHMENT.—Not later than 180 days after the date of the enactment of this Act, the Secretary of each military department shall establish within such military department an office (to be known as the ''Office of Business Transformation'' of such military department) to assist the Chief Management Officer of such military department in carrying out the initiative required by this section for such military department.

(2) HEAD.—The Office of Business Transformation of a military department under this subsection shall be headed by a Director of Business Transformation, who shall be appointed by the Chief Management Officer of the military department, in consultation with the Director of the Business Transformation Agency of the Department of Defense, from among individuals with significant experience managing large-scale organizations or business transformation efforts.

(3) SUPERVISION.—The Director of Business Transformation of a military department under paragraph (2) shall report directly to the Chief Management Officer of the military department, subject to policy guidance from the Director of the Business Transformation Agency of the Department of Defense.

(4) AUTHORITY.—In carrying out the initiative required by this section for a military department, the Director of Business Transformation of the military department under paragraph (2) shall have the authority to require elements of the military department to carry out actions that are within the purpose and scope of the initiative.

(d) RESPONSIBILITIES OF BUSINESS TRANSFORMATION OFFICES.— The Office of Business Transformation of a military department established pursuant to subsection (b) may be responsible for the following:

(1) Transforming the budget, finance, accounting, and human resource operations of the military department in a manner that is consistent with the business transformation plan developed pursuant to subsection (b)(1).

(2) Eliminating or replacing financial management systems of the military department that are inconsistent with the business systems architecture and transition plan developed pursuant to subsection (b)(2).

(3) Ensuring that the business transformation plan and the business systems architecture and transition plan are implemented in a manner that is aggressive, realistic, and accurately measured.

(4) Such other responsibilities as the Secretary of that military department determines are appropriate.

(e) REQUIRED ELEMENTS.—In carrying out the initiative required by this section for a military department, the Chief Management Officer and the Director of Business Transformation of the military department shall ensure that each element of the initiative is consistent with—

(1) the requirements of the Business Enterprise Architecture and Transition Plan developed by the Secretary of Defense pursuant to section 2222 of title 10, United States Code;

(2) the Standard Financial Information Structure of the Department of Defense;

(3) the Federal Financial Management Improvement Act of 1996 (and the amendments made by that Act); and

(4) other applicable requirements of law and regulation.

(f) REPORTS ON IMPLEMENTATION.—

(1) INITIAL REPORTS.—Not later than nine months after the date of the enactment of this Act, the Chief Management Officer of each military department shall submit to the congressional defense committees a report on the actions taken, and on the actions planned to be taken, by such military department to implement the requirements of this section.

(2) UPDATES.—Not later than March 1 of each of 2010, 2011, and 2012, the Chief Management Officer of each military department shall submit to the congressional defense committees a current update of the report submitted by such Chief Management Officer under paragraph (1).

Executive Summary

The Air Force established the Office of Business Transformation and named the Air Force Deputy Chief Management Officer (DCMO) as Director of Business Transformation. A strong team has been formed, comprising continuous process improvement, strategic planning, project planning, vocabulary support and other key competencies. Air Force governance processes have been modified to give appropriate representation to the Chief Management Officer (CMO) and Deputy Chief Management Officer in leadership forums to support business transformation objectives.

The Air Force published a Strategic Plan which contains business objectives. We are proceeding with execution of those business objectives and have established metrics to measure progress against those objectives. In addition, we are participating with the OSD staff in the update of the DoD Strategic Management Plan. Once the objectives in that plan are established and following completion of the Quadrennial Defense Review, the Air Force will update its Strategic Plan and adjust business objectives to ensure alignment to DoD goals.

The Air Force maintains a robust architecture process, and aligns its activities to the DoD Business Enterprise Architecture. This effort has been reviewed favorably by the GAO, and we work continuously to improve content and applicability of the architecture.

Report

The Air Force (AF) is in full support of the objectives of National Defense Authorization Act FY2009 (NDAA 2009), Section 908, and sees it as the next logical step in the business transformation guided by Congress through NDAA FY2005 (Section 332) and NDAA FY2008 (Section 904).

<u>Business Transformation Office</u>

Pursuant to NDAA FY2008 (Section 904), the Under Secretary of the Air Force is the CMO, and reporting directly to the Secretary of the Air Force has responsibility to oversee Air Force business transformation. This responsibility was codified in an update to the Mission Directive that describes the functions of the Under Secretary of the Air Force. In addition, effective 4 September 2008, the Air Force also created the position of DCMO and selected Mr. David Tillotson to support the CMO in carrying out Air Force business transformation responsibilities. The position of Under Secretary of the Air Force is currently vacant. Mr. Tillotson, the Air Force DCMO, is performing the duties of the CMO.

In accordance with NDAA FY2009 (Section 908), the Secretary of the Air Force has established the Office of Business Transformation reporting to the Air Force CMO. The Secretary of the Air Force has appointed the DCMO as the Director of the Office of Business Transformation. The Office of Business Transformation is comprised of two branches:

1. Business and Mission Transformation – This branch is responsible for developing and maintaining a capabilities portfolio based approach to business transformation, for recommending enterprise-level performance goals and monitoring progress against them, and for monitoring and overseeing enterprise business transformation initiatives.

2. Transformation Support – This branch is responsible for supporting enterprise business transformation initiatives with advice, resources, tools, approaches and processes in key competencies, including process re-engineering, vocabulary/ontology development, training and change management.

On 15 May 2009, the DCMO completed initial standup of the Office of Business Transformation with the transfer of the Air Force Smart Operations for the 21st Century (AFSO21) team and strategic planning, project planning, and vocabulary support functions from the Office of the Chief, Warfighting Integration and CIO to the Office of Business Transformation.

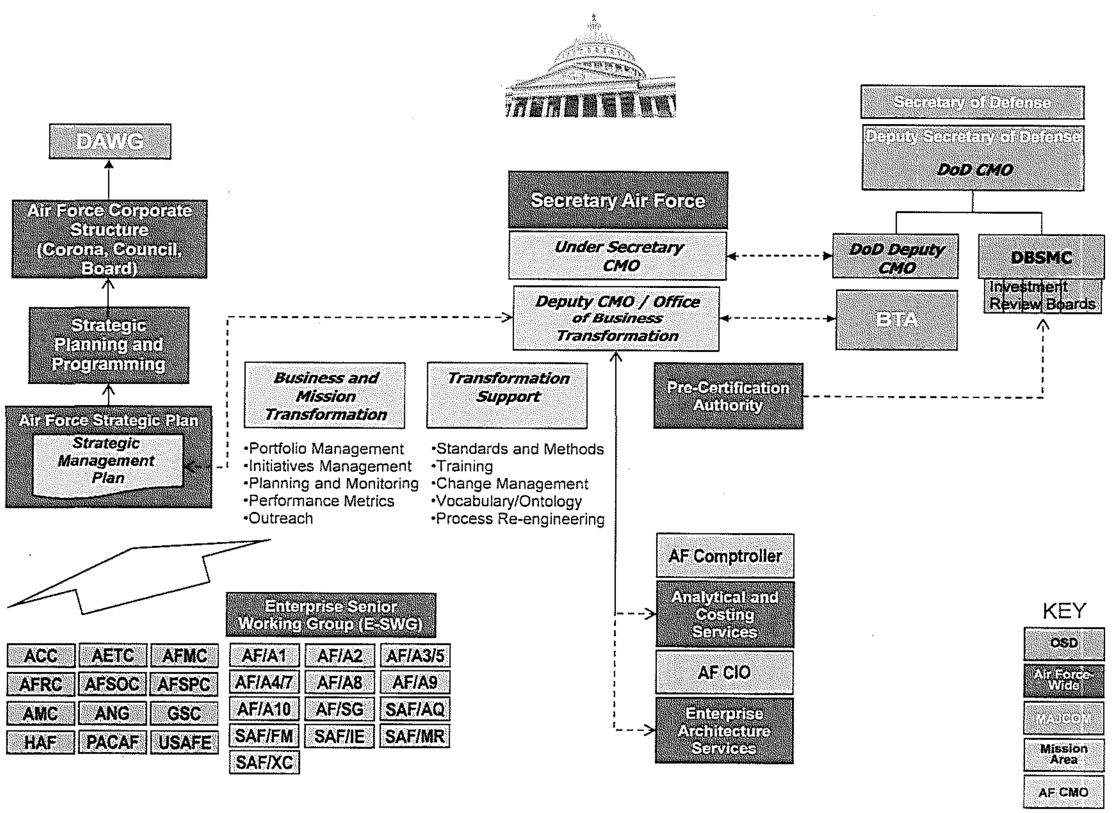

Fig. 1 – Organization and Key Interactions – AF Office of Business Transformation

In addition to the standup of the Office of Business Transformation, the Air Force modified its governance processes to ensure that the CMO was firmly embedded in key decision making within the Air Force. Our overall strategy has been to make business transformation an integral part of overall Air Force strategy and management. Figure 1 diagrams the interactions of the Office of Business Transformation with the broader Air Force governance processes.

The key bodies through which the Secretary of the Air Force (SecAF) and Chief of Staff of the Air Force (CSAF) direct activities are CORONA, the Air Force Council and the Air Force Board.

1. CORONA is a three times yearly meeting of the SecAF, CSAF, Major Command Commanders and key Assistant Secretaries. Agendas are focused on setting strategic direction and aligning major command activities toward key DoD, Combatant Command and Air Force objectives. The Under Secretary of the Air Force is a key member of this review, and is therefore positioned to represent business transformation issues.

2. The Air Force Council is comprised of the key Air Staff and Secretariat leadership at Headquarters Air Force. The group meets weekly to ensure key direction from CORONA is carried out, and provides a regular forum for addressing resource issues and strategic direction across the Air Force. Previously chaired solely by the Vice Chief of Staff, as part of the management change to better address business transformation, the Under Secretary of the Air Force now co-chairs this forum with the Vice Chief of Staff.

3. The Air Force Board is comprised of representatives at the major general (or civilian equivalent level) from the Air Staff, the Secretariat and the major commands. This group is the working body for the Air Force Council. Previously chaired by either the Director of Programs or Director of Budget depending on meeting content, the DCMO now serves as the chair of the Air Force Board when that body addresses business transformation matters.

4. Below the Air Force Board, the Director of Business and Mission Transformation in the Office of Business Transformation chairs a bi-weekly Senior Working Group comprised of transformation leads from all Air Staff and Secretariat offices. This group focuses on detailed synchronization of business system and business process deployments across the Air Force. Issues requiring resource reallocation or reorganization across the Air Force are referred from this group to the Air Force Board, Council or CORONA as appropriate for final decisions. This group has existed for over five years, and is now aligned under the Office of Business Transformation for oversight.

The DCMO serves as the Pre-Certification Authority for the AF under NDAA 2005, Section 332. To discharge these responsibilities, the DCMO works closely with the Chief Information Officer of the Air Force and leverages the enterprise architecture services and IT investment compliance processes that have been put in place in accordance with NDAA 2005.

Business Transformation Office Next Steps

In order to realize real efficiencies and effectiveness improvements, we are focusing on converting several years' worth of good initiatives at unit level into Air Force-wide standard work. To that end, we are providing a method for replication of such projects at enterprise level and using the revised governance process to ensure Air Force support in the form of funding or expertise to scale up these projects. We are putting in place a means to identify initiatives as they occur and to track them through deployment.

We will also be using the revised governance processes to put business transformation topics on the decision agendas at the Air Force Council and CORONA. We will bring forward the necessary decision information as a result of business process and business system changes to these bodies for implementation. We will also be using the metrics established to track progress on efficiency and effectiveness to shape strategic discussion and adjust actions. We will cover progress on establishing metrics against the plan in the next sections of this report.

We will be working on improved business case development and cost tracking to support the Air Force governance processes.

Finally, we will be institutionalizing training in process improvement techniques for the Air Force. To date, much of the training has been obtained through academic institutions. We will be evaluating use of other Service and Joint training venues, as well as implementing training in basic problem solving techniques into Air Force education and training programs.

Comprehensive Transformation Plan

The Air Force has maintained a Strategic Plan for the last two years. Our approach is to include business transformation priorities within that Strategic Plan and then to flow that strategic guidance to our major commands and Headquarters Air Force functionals for their more detailed strategic planning.

In October 2008, the Air Force released its 2008 Air Force Strategic Plan, identifying priorities and goals that will shape Air Force-wide actions over the next three to five years. These priorities to reflect priorities flowed down from the Secretary of Defense (SecDEF) and from the Federal government, as well as mission priorities from Combatant Commanders and Air Force major commands. The five priorities identified by SecAF and CSAF are:

1. Reinvigorate the nuclear mission
2. Partner with the Joint and Coalition Team to win today's fight
3. Develop and care for Airmen and their families
4. Modernize air and space inventories, organizations and training

5. Recapture acquisition excellence

Champions have been assigned for each focus area, and major commands are in the process of aligning their strategic planning to the Air Force Strategic Plan. Performance metrics for the Air Force Strategic Plan have been developed. These metrics will measure progress toward achieving objectives in the AF Strategic Plan. Broader Air Force enterprise metrics will measure overall performance of the Air Force in terms of its mission performance in support of Joint and Coalition objectives, maintenance of the force and measures of efficiency in terms of personnel time, dollars and energy savings. These metrics will be displayed on a dashboard for the SecAF, CSAF, major command commanders, and key Air Staff and Secretariat leadership. The first implementation of the dashboard is active, and we expect to have a more robust dashboard by the end of FY09.

We are also working to align objectives among multiple reporting channels. The first version of the new DoD Strategic Management Plan did not contain performance objectives, and we are working with the DCMO office at OSD, along with the other components and agencies, to define those OSD level performance objectives. At the same time, the OSD staff is working on the DoD FY10 Budget Request Performance Improvement Plan. Again, the components and agencies are participating with the OSD staff in development of that plan. We are capturing and modifying objectives from the Enterprise Transition Plan the DoD has been providing to Congress in response to NDAA 2005 guidance. Finally, the Quadrennial Defense Review may result in final modification within those objectives.

Comprehensive Transformation Plan Next Steps

We will focus on making the metrics an integral part of the CORONA review process among the SecAF, CSAF and major command commanders. As we measure our progress, we expect to use the metrics to focus actions and serve as a basis for action adjustments. Through use, we will refine and modify the metrics to ensure we are actually measuring accomplishment against objectives.

We will work with the Air Force Director of Strategic Planning to align major command strategic plans to the Air Force Strategic Plan and solidify the process for Air Force strategic planning.

We will work with the OSD staff to rationalize performance objectives among three potentially competing plans that DoD needs to provide to Congress and to OMB. We want to ensure that we are in fact focused on the right mission outcomes, as well as eliminating redundant and potentially contradictory guidance.

We will anticipate the need to identify revisions to business transformation objectives at the end of the QDR cycle.

Enterprise-wide business systems architecture and transition plan

A May 2009 GAO report on DoD Business Systems Modernization acknowledged Air Force's progress in its architecture efforts and commented that the investment management structures we have established are consistent with those envisioned in the Act. In addition to improving the management of business information technology (IT) system portfolios across the Air Force, these efforts supported by NDAA guidance have provided a foundation for Air Force enterprise business operations transformation. Functional IT business system portfolios and a tiered accountability approach allows functional Chief Information Officers (CIO) to manage their portfolios, while the HQ Air Force Enterprise Senior Working Group (E-SWG) performs cross domain review and IT investment recommendations (Air Force level view) to the Air Force's Pre-Certification Authority. Further, the Air Force is employing industry best practices in the development of a service oriented architecture (SOA) approach for future IT planning. These enterprise information transparency and technology support capabilities are key enablers for the business transformation being driven by the Office of Business Transformation.

Enterprise-wide business systems architecture and transition plan next steps

We will support continuous evolution of the DoD Business Enterprise Architecture and will ensure updates are flowed into our planning process.

Conclusion

We look forward to reporting significant progress in the annual updates of this initial report.

Distribution

The Honorable Daniel K. Inouye
Chairman
Committee on Appropriations
United States Senate
Washington, DC 20510

The Honorable Thad Cochran
Vice Chairman
Committee on Appropriations
United States Senate
Washington, DC 20510

The Honorable Daniel K. Inouye
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Subcommittee on Defense
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The Honorable David Obey
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United States House of Representatives
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The Honorable Jerry Lewis
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The Honorable John P. Murtha
Chairman
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United States House of Representatives
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The Honorable C.W. Bill Young
Ranking Minority Member
Subcommittee on Defense
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United States House of Representatives
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The Honorable Ike Skelton
Chairman
Committee on Armed Services
United States House of Representatives
Washington, DC 20515-6035

The Honorable Howard P. McKeon
Ranking Minority Member
Committee on Armed Services
United States House of Representatives
Washington, DC 20515-6035

United States Air Force

Report to Armed Services Committees

Report on Air Force Civilian Personnel Consolidation Plan

January 2009

Introduction

This report is being provided to the congressional defense committees as directed in the Duncan Hunter National Defense Authorization Act for Fiscal Year 2009, Public Law 110-417, Section 325:

Report on Air Force Civilian Personnel Consolidation Plan (Sec. 325)
(a) REPORT REQUIRED.—Not later than 90 days after the date of the enactment of this Act, the Secretary of the Air Force shall submit to the Committees on Armed Services of the Senate and House of Representatives a report on the Air Force plan for implementing the direction of the Base Realignment and Closure Commission for the consolidation of transactional workloads from the civilian personnel offices within the service components and defense agencies, retaining sufficient positions and personnel at the large civilian centers to perform the personnel management advisory services, including non-transactional functions, necessary to support the civilian workforce.
(b) CONTENTS OF REPORT.—At a minimum, the report required by subsection (a) shall address the steps taken by the Air Force to ensure that such direction is implemented in a manner that best meets the future needs of the Air Force, and shall address each of the following:

(1) The anticipated positive or negative effect on the productivity and mission accomplishment of the managed workforces at the different commands.

(2) The potential future efficiencies to be achieved through an enterprise-wide transformation of civilian personnel services.

(3) The size and complexity of the civilian workforce.

(4) The extent to which mission accomplishment is dependent upon the productivity of the civilian workforce.

(5) Input from the commanders of the large civilian centers regarding the effect of consolidation on workforce productivity and costs.

(6) The status of ongoing consolidation efforts at the Air Force Personnel Center at Randolph Air Force Base, Texas, and the target timelines for delivery of services to the various installations.

(7) The advantages and disadvantages of retaining certain personnel management and advisory services functions at the large civilian centers under local command authority to include on-site control of staffing of positions filled through internal or external recruitment processes, employee management relations, labor force planning and management, and managing workers compensation programs.

(8) The standards and timeliness for transitioning the personnel classifications currently performed by large civilian centers, the transition plan, particularly as it assures ready access to classifications needed for staffing and other purposes by the large civilian centers, and the expected performance and evaluation standards for providing classification services to the large civilian centers once the transition is complete.

(c) UPDATES OF REPORT.—The Secretary of the Air Force shall submit to the Committees on Armed Services of the Senate and House of Representatives biannual updates of the report required under subsection (a) until January 3, 2012.

Executive Summary

The 2005 Defense Base Closure and Realignment Commission (BRAC) Recommendation #137 recommended consolidation of all transactional workload from the Civilian Personnel Offices within the Service Components and Defense Agencies. For the Air Force, the Commission recommended consolidation of transactional workload to Randolph AFB, TX from the Air Force Interim Personnel Centers (Bolling AFB, DC, Hill AFB, UT; Robins AFB, GA; Tinker AFB, OK; and Wright-Patterson AFB, OH), henceforth referred to as Large Civilian Centers. It also directed that the Air Force retain sufficient positions and personnel at the Large Civilian Centers to perform the personnel management advisory services, the non-transactional functions, necessary to support the civilian workforce.

As directed by the Duncan Hunter National Defense Authorization Act for Fiscal Year 2009, Section 325 this report addresses the planning actions that are being developed to implement BRAC at Large Civilian Centers. The actions captured in this report are scheduled to be completed by 15 Sep 11 in order to comply with BRAC timelines.

Since 2006, the Air Force has been evaluating its civilian personnel functionality to analyze which capabilities are determined to be transactional workload that must be transferred to Randolph AFB, TX. Concurrently, the Air Force has also been developing an optimum service delivery model for both the capabilities to be transferred and the capabilities that will remain resident at the Large Civilian Centers. Taking into account the potential impact to mission productivity, the dynamic personnel environment at the Large Civilian Centers, and the ability for the Air Force to standardize and transform its personnel capabilities to gain enterprise efficiencies, the Air Force has made a preliminary determination that an optimum solution for the Large Civilian Centers is to consolidate transactional work to the Air Force Personnel Center and the Air Force Manpower Agency at Randolph AFB, TX; to establish Air Force Personnel Center Operating Locations resident at four of the five Large Civilian Centers; and to retain a cadre of personnel experts resident at the installation and under the control of the local command authority to direct and administer the personnel management advisory services, the non-transactional functions, necessary to support the civilian workforce.

While the overarching strategy and framework have been developed, the Air Force is in the process of building the implementation and operational plans to affect the changes. This inaugural submission of the Congressional report addresses the factors and impacts that were considered to derive the desired end state. Since this report is a biannual requirement through 2011, the Air Force will be able to provide greater specificity on consolidation schedules, and workforce and productivity impacts in future report submissions as the implementation progresses

Report

The Secretary of the Air Force is required to biannually update the Committees on Armed Services of the Senate and House of Representatives on the Air Force's plan for implementing Base Closure and Realignment Commission Recommendation #137, which directed the Air Force to consolidate civilian personnel transactional workload to Randolph AFB, TX from the Air Force Interim Personnel Centers (Bolling AFB, DC, Hill AFB, UT; Robins AFB, GA; Tinker AFB, OK; and Wright-Patterson AFB, OH) and retain sufficient positions and personnel at those locations to perform the personnel management advisory services, the non-transactional functions, necessary to support the civilian workforce.

The update is required to address the steps taken by the Air Force to ensure that BRAC Recommendation #137 is implemented in a manner that best meets the future needs of the Air Force, and is required to address the following issues:

(1) The anticipated positive or negative effect on the productivity and mission accomplishment of the managed workforces at the different commands.

(2) The potential future efficiencies to be achieved through an enterprise-wide transformation of civilian personnel services.

(3) The size and complexity of the civilian workforce.

(4) The extent to which mission accomplishment is dependent upon the productivity of the civilian workforce.

(5) Input from the commanders of the large civilian centers regarding the effect of consolidation on workforce productivity and costs.

(6) The status of ongoing consolidation efforts at the Air Force Personnel Center at Randolph Air Force Base, Texas, and the target timelines for delivery of services to the various installations.

(7) The advantages and disadvantages of retaining certain personnel management and advisory services functions at the large civilian centers under local command authority to include on-site control of staffing of positions filled through internal or external recruitment processes, employee management relations, labor force planning and management, and managing workers compensation programs.

(8) The standards and timeliness for transitioning the personnel classifications currently performed by large civilian centers, the transition plan, particularly as it assures ready access to classifications needed for staffing and other purposes by the large civilian centers, and the expected performance and evaluation standards for providing classification services to the large civilian centers once the transition is complete.

In developing its preliminary implementation strategy, the Air Force has given consideration to and weighed the impact of each of the areas identified above. While a formal, implementation strategy is still under development and coordination, the Air Force's goal is to develop a service delivery model to apply that recognizes the dynamic personnel delivery environment of providing support to a large civilian workforce and maintaining the ability to adapt to mission change, while also enabling the Air Force to leverage ongoing transformation efforts to achieve standardization and efficiencies in the overarching Air Force Personnel Service Delivery Model. The Air Force will use a blended approach that enables on-site retention of functions that are critical to mission success of the Large Civilian Centers, as well as establishing central command operating locations (OL). This framework is a point of departure from the service delivery model that is currently applied at other Air Force installations and takes into account the unique civilian personnel capabilities that are needed at the Large Civilian Centers,

DELIVERY MODEL EVALUATION FACTORS

Section 1: The anticipated positive or negative effect on the productivity and mission accomplishment of the managed workforces at the different commands.

The Air Force anticipates positive results from the consolidation of transactional civilian personnel workload. This BRAC recommendation combined with the Air Force's Personnel Services Delivery Transformation (PSDT) initiative enables the Air Force to realize the completion of a transformation program that began in 1995, was placed in hiatus in 1998 and reinvigorated in 2001. The Air Force's personnel modernization efforts are focused on transforming how the Air Force delivers Manpower, Personnel and Services support to the Total Force (i.e., Regular Air Force, Guard, Reserve and Civil Servants). The Air Force vision is to transform the personnel force into a deeper and stronger career field by using process redesign and streamlining techniques, creating established career paths, and building the capability to deliver Total Force services to any location. Under this initiative, military and civilian personnel transactional services would be provided through the most efficient channels – web based applications and a reach-back Total Force service delivery center, while focusing our field professionals to provide analytical and advisory support to commanders. The synergistic effect of BRAC and PSDT will reap immediate benefits in offsetting the current workload requirements from the loss of manpower spaces during the Program Budget Decision (PBD) 720 through consolidation and process redesign.

The Air Force's overall operational objective is to complete the realignment actions as expeditiously as possible with minimal impact to the affected service delivery organizations' ability to support their worldwide commitments.

Section 2: The potential future efficiencies to be achieved through an enterprise-wide transformation of civilian personnel services.

The manner in which Air Force delivers personnel services to its Total Force customers is one of the business operations targeted by the Air Force for transformation. The Personnel Services Delivery (PSD) Transformation vision is to transform Air Force personnel processes, technology, people, and organizations, to enable Manpower, Personnel and Services professionals to focus on the strategic delivery of the <u>right</u> people, to the <u>right</u> place, at the right time. Furthermore, the Air Force's goal is to standardize processes and programs across the AF enterprise for the Total Force which enable it to deliver a global, 24/7 Total Force personnel service capability with integrated, standardized platforms that are easy for customers to access and use. The Air Force expects to derive benefits from efficiencies gained due to standardized business processes and systems.

To meet that vision, the Civilian Personnel community will continue the transformation effort by consolidating functions and resources from base-level to central service delivery organizations, integrating civilian classification with manpower, and completing the civilian regionalization process directed by BRAC. The transformation will change service delivery, which defines how customers (Airmen, commanders/leaders, retirees, and families) retrieve information, accomplish personnel transactions, and receive answers/advice.

The Air Force's personnel transformation goals are to:

- Design integrated and standardized personnel service delivery processes
- Rapidly implement reliable and integrated information technology to improve personnel services delivery accessibility and usability
- Posture the A1 community to successfully deliver transformed personnel services at all A1 organizational levels
- Ensure Airmen are prepared to access and use modernized personnel services

Transformation of civilian personnel processes will be implemented in an incremental approach, using an effective change management program to enable a smooth transition to new capabilities and organizations within the Civilian Personnel community and the greater Air Force. Analytical and decision support tools will be implemented to assist key advisors, managers, and Commanders in the management of their organizations and development of their Airmen.

Continuous improvement of civilian processes will be an on-going activity for the personnel community as the Air Force focuses on optimizing process efficiencies, contact center capabilities, and introducing new supporting technologies.

Section 3: The size and complexity of the civilian workforce.

The five Large Civilian Centers service over 60,000 civilian employees across several separate and distinct pay and personnel systems. There are over 230 occupational series encompassing Acquisition and Contracting, Aircraft Maintenance, Weapons Systems, Engineering, Program and Policy Management, Finance, Information Technology, Logistics and Medical, working in diverse organizations with widely differing missions, from the operational level to the Headquarters. Over 50% of those populations are employees represented by several labor unions with complex, unique programs.

Section 4: The extent to which mission accomplishment is dependent upon the productivity of the civilian workforce

The civilian workforce represents ~80% of the total organic workforce across the five Large Civilian Centers and the Air Force relies heavily upon the stability and longevity of the civilian workforce to provide consistency to the mission. Three-fourths of the Large Civilian

Center's abilities to deliver capabilities to the war fighter comes directly from the civilian workforce.

Section 5: Input from the commanders of the large civilian centers regarding the effect of consolidation on workforce productivity and costs.

At this stage of BRAC implementation planning, it is premature for the Large Civilian Center Commanders to determine impact on workforce productivity and costs until they have an opportunity to review the results from BRAC implementation. While the Air Force is formulating plans for the transfer of workload and mitigation strategies on workforce productivity impact, the Large Civilian Center commanders cannot provide a quantitative assessment on the costs until actual implementation. During this planning stage, Large Civilian Center Commanders have indicated that the Air Force should avoid any effort that either adversely affects their ability to effectively manage their civilian workforce or drives significant risk to their mission. As the consolidation moves from a planning stage to an implementation/operational stage, the Large Civilian Center commanders will provide input on impacts to their organization in subsequent submissions of the biannual report.

Section 6: The status of ongoing consolidation efforts at the Air Force Personnel Center at Randolph Air Force Base, Texas, and the target timelines for delivery of services to the various installations.

The Air Force will realign specified civilian personnel transactional functions from each of the Large Civilian Centers to the Air Force Personnel Center through a phased approach, beginning in 2009 and completing by September 2011. A formal schedule, with milestone increments, is in the early development stages. As specific target dates for capability consolidation are developed, the Air Force will include the schedule in future submissions of this report.

Section 7: The advantages and disadvantages of retaining certain personnel management and advisory services functions at the large civilian centers under local command authority to include on-site control of staffing of positions filled through internal or external recruitment processes, employee management relations, labor force planning and management, and managing workers compensation programs.

There are advantages and disadvantages to delivering personnel services under the existing delivery model being applied at the Large Civilian Centers. From an advantage standpoint, retaining certain personnel functions with the local commanders at the Large Civilian Centers will allow for on-site mission priorities to be immediately addressed by the local Civilian Personnel Office, enabling them to be proactive in meeting changes to mission requirements. Commanders and the local Civilian Personnel Offices will have the ability to review mission requirements and draft action plans for realignment of resources on an as needed basis. However, from an enterprise personnel service delivery perspective there are also disadvantages to retaining capability on-site under local authority. As discussed under Section 1 of this report, the Air Force vision is to transform the personnel force into a deeper and stronger career field by using process redesign and streamlining techniques, creating established career paths, and building the capability to deliver Total Force services to any location. Under this initiative, military and civilian personnel transactional services would be provided through the most efficient channels – web based applications and a reach-back Total Force service delivery center, while focusing our field professionals to provide analytical and advisory support to commanders. Today, each LCC performs personnel functions differently. The key tenets of standardization and centralization are the reduction in layers of bureaucracy and streamlining of organizations. Retaining the current service delivery model would impede the Air Force's ability to achieve the efficiencies for which it is striving.

Based on weighing the advantages and disadvantages addressed above, the Air Force has preliminarily determined that the functions could be delivered in the following manner:

- Labor Management Relations; Employee Management Relations (to include Discipline, Performance Management, and Grievances Processing); and Workforce Planning and Management could be retained on-site, under local command authority, since these are non-transactional, advisory personnel functions that are critical to depot success that should remain co-located with mission.

- Internal and external recruitment processes, non-transactional functions, could be retained on-site, but under the control of a central command authority. This approach balances the Air Force's enterprise personnel transformation goals in this functional area, while recognizing that the complexity and diversity of the different missions drive unique skill requirements and that the civilian personnel servicing model must remain flexible at the Large Civilian Centers to recruit, train, retain and maintain the productivity of the civilian workforce. This new model would enable the Air Force to implement standardization and efficiencies in the staffing delivery model, while giving the local Civilian Personnel Office an ability to maintain an operational and strategic situational awareness of the local labor market for recruiting new employees and salaries for their specific areas, which will allow for an immediate ramp-up in the workforce.

- Workers Compensation Programs could potentially be accomplished from a centralized location under central command authority, in collaboration with the large civilian centers. Based on evidence of successful centralization of this function in the Department of the Navy for similarly situated workload and workforce demographics, the Air Force intends to explore whether or not the Navy model can be applied to the Air Force Large Civilian Centers.

Section 8: The standards and timeliness for transitioning the personnel classifications currently performed by large civilian centers, the transition plan, particularly as it assures ready access to classifications needed for staffing and other purposes by the large civilian centers, and the expected performance and evaluation standards for providing classification services to the large civilian centers once the transition is complete.

The Large Civilian Center's classification function is identified to be consolidated to the Air Force Manpower Agency, which is the Air Force's centralized classification service delivery organization. The consolidation is scheduled to be completed by July 2010. If it is determined that additional preparation needs to be accomplished to transition the classification workload, the Air Force Manpower Agency and the Large Civilian Centers will have the ability to negotiate a revised target date within BRAC compliance timelines to complete centralization of civilian classification. The Air Force Manpower Agency is engaged with the Air Force Materiel Command Directorate of Manpower, Personnel, and Services, the Air Force District of Washington, and the Large Civilian Centers to plan and assist with civilian classification centralization efforts.

In recognition of expected performance and evaluation standards for providing classification services to all bases once transition is complete, the Air Force Manpower Agency employs and tracks daily, weekly and monthly performance metrics. There are currently two performance metrics for processing Requests for Personnel Action (RPA): “complex” (goal: 90% complete within 20 calendar days of receipt) or “non-complex” (goal: 95% complete within 3 calendar days of receipt). Once centralization efforts are complete, the Air Force Manpower Agency, working with the Large Civilian Centers, will revisit the current metrics to ensure they are both realistic and responsive to customer needs and expectations. To maximize customer satisfaction and provide ease/standardization of effort, AFMA has made available to the field 903 Standard Core Personnel Documents (SCPDs) for General Schedule and Wage Grade employees and 617 Standard Position Descriptions (SPDs) for NSPS employees. The Air Force Manpower Agency is working with Headquarters Air Force Materiel Command and the Air Force District of Washington to further evolve the classification library to enable the Large Civilian Centers to utilize the templates. This collaboration, coupled with the implementation of “mandatory-use” policy will accelerate the classification and civilian hire processes for commanders in the field.

Distribution

The Honorable Carl Levin
Chairman
Committee on Armed Services
United States Senate
Washington, DC 20510-6050

The Honorable John McCain
Ranking Minority Member
Committee on Armed Services
United States Senate
Washington, DC 20510-6050

The Honorable Ike Skelton
Chairman
Committee on Armed Services
United States House of Representatives
Washington, DC 20515-6035

The Honorable John McHugh
Ranking Minority Member
Committee on Armed Services
United States House of Representatives
Washington, DC 20515-6035

SECRETARY OF THE AIR FORCE
WASHINGTON

MAR 0 6 2009

The Honorable Daniel K. Inouye
Chairman
Committee on Appropriations
United States Senate
Washington, DC 20510-6028

Dear Mr. Chairman:

This memorandum is in response to the Fiscal Year 2009 Defense Appropriations Joint Explanatory Statement (HR 2638), Stop Loss Impact Report. Specifically, the Department of Defense is required to provide stop loss data and a report to the Congressional Defense Committees that examines the impact, if any, stop loss has had on recruiting and any correlations between extended deployments, often involving stop-lossed service members, and domestic assaults, sexual assaults, and alcohol offenses.

Since Fiscal Year 2003, the Air Force has not exercised authority to implement stop loss.

A similar letter has been sent to the Ranking Minority Member of your Committee and to the Chairmen and Ranking Minority Members of the other Congressional Defense Committees.

Sincerely,

Michael B. Donley

Michael B. Donley

SECRETARY OF THE AIR FORCE
WASHINGTON

MAR 0 6 2009

The Honorable Thad Cochran
Ranking Minority Member
Committee on Appropriations
United States Senate
Washington, DC 20510-6028

Dear Senator Cochran:

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Committee on Appropriations
United States Senate
Washington, DC 20510-6028

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SECRETARY OF THE AIR FORCE
WASHINGTON

MAR 0 6 2009

The Honorable David Obey
Chairman
Committee on Appropriations
U.S. House of Representatives
Washington, DC 20515-6015

Dear Mr. Chairman:

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SECRETARY OF THE AIR FORCE
WASHINGTON

MAR 0 6 2009

The Honorable Jerry Lewis
Ranking Minority Member
Committee on Appropriations
U.S. House of Representatives
Washington, DC 20515-6015

Dear Representative Lewis:

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WASHINGTON

MAR 0 6 2009

The Honorable John P. Murtha
Chairman
Subcommittee on Defense
Committee on Appropriations
U.S. House of Representatives
Washington, DC 20515-6018

Dear Mr. Chairman:

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WASHINGTON

MAR 0 6 2009

The Honorable C.W. Bill Young
Ranking Minority Member
Subcommittee on Defense
Committee on Appropriations
U.S. House of Representatives
Washington, DC 20515-6018

Dear Representative Young:

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MAR 0 6 2009

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Committee on Armed Services
United States Senate
Washington, DC 20510-6050

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MAR 0 6 2009

The Honorable John McCain
Ranking Minority Member
Committee on Armed Services
United States Senate
Washington, DC 20510-6050

Dear Senator McCain:

This memorandum is in response to the Fiscal Year 2009 Defense Appropriations Joint Explanatory Statement (HR 2638), Stop Loss Impact Report. Specifically, the Department of Defense is required to provide stop loss data and a report to the Congressional Defense Committees that examines the impact, if any, stop loss has had on recruiting and any correlations between extended deployments, often involving stop-lossed service members, and domestic assaults, sexual assaults, and alcohol offenses.

Since Fiscal Year 2003, the Air Force has not exercised authority to implement stop loss.

A similar letter has been sent to the Chairman of your Committee and to the Chairmen and Ranking Minority Members of the other Congressional Defense Committees.

Sincerely,

Michael B. Donley

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SECRETARY OF THE AIR FORCE
WASHINGTON

MAR 0 6 2009

The Honorable Ike Skelton
Chairman
Committee on Armed Services
U.S. House of Representatives
Washington, DC 20515-6035

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MAR 0 6 2009

The Honorable John McHugh
Ranking Minority Member
Committee on Armed Services
U.S. House of Representatives
Washington, DC 20515-6035

Dear Representative McHugh:

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Congressional Report

United States Air Force Academy
Infrastructure Recapitalization Master Plan

Senate Report 109-286, page 17

U.S. AIR FORCE

Introduction

This report is being provided to [refer to Congressional language for which committees] as directed in House (or Senate) Report 109-286, page 17 which states:

> *The Congressional Committee is interested in the Air Force's infrastructure recapitalization plan for the Academy, and urges the Air Force to provide resources needed to improve the infrastructure at USAFA over the long-term. Therefore, the Committee directs the Air Force to submit a master infrastructure recapitalization plan for USAFA facilities by no later than March 16, 2007. The plan should include descriptions of the projects that are needed to improve the infrastructure required for educating, training, and equipping the cadets at USAFA; and a funding plan showing when the Air Force would expect to support the projects listed.*

Executive Summary

An average annual funding rate of $49M in Operation and Maintenance (O&M) Sustainment, Restoration and Modernization (SRM) funds and average annual investment of $11.7M (MILCON) through fiscal year 2013 followed by an annual investment of 2.43% of the Plant Replacement Value (PRV) for fiscal year 2014 and beyond will "Fix USAFA".

- In fiscal year 2006 AF funded $38 million in SRM funds for Mitchell Hall, Cadet Gym, Field House and other facilities
- In fiscal year 2007 AF budgeted $20 million in SRM funds for Fairchild Hall, Mitchell Hall, Cadet Gym, and other facilities
- The fiscal year 2008 President Budget contains $58 million in SRM funds for repair of facilities and infrastructure

Background

The language requiring this report is from the Senate Military Construction/Quality of Life appropriations bill. The Committee notes that most of the United States Air Force Academy's [USAFA's] campus, including its dormitories, classrooms, gymnasiums, training centers, and administrative buildings, were constructed in the late 1950s. The Committee language states the Air Force invested a sizable amount of military construction funding, totaling $310,000,000, and operation and maintenance facility and infrastructure sustainment funding, totaling $437,600,000, at the Air Force Academy from fiscal year 2000 to fiscal year 2006. The Committee supported these requests and notes they were helpful in alleviating some concerns about the Academy's infrastructure. The Committee understands that these requests are not sufficient to address the overall rapidly deteriorating condition of a significant portion of the USAFA campus. The Committee encourages the Air Force to continue its strong commitment to the Academy's infrastructure.

Report

Master Infrastructure Recapitalization Plan for USAFA

The following chart shows USAFA's planned year of investment by facility category.

PRI	TITLE	Year Built	07	08	09	10	11	12	13	14	15
1	Fairchild Hall	1958									
2	Mitchell Hall	1959									
3	Cadet Gymnasium	1960									
4	Vandenberg Hall	1958									
5	High Temp Hot Water (HTHW)	Multi									
6	Field House	1968									
7	Arnold Hall	1958									
8	Roads & Parking	Multi									
9	Airfield Pavements	Multi									
10	Dams & Bridges	Multi									
11	Water Systems	Multi									
12	Fairchild Annex (CETF)	1996									
13	Cadet Chapel Roof	1963									
14	Non-Water Infrastructure	Multi									
15	Support Buildings	Multi									
20	Program Development										

It should be noted that the USAFA investment strategy will be revised as necessary to reflect changes in mission priorities and ongoing assessments of the condition of USAFA facilities.

Description of Projects

Number 01-Fairchild Hall

Fairchild Hall is the primary USAFA academic facility consisting of 1.2 million square feet. Constructed in 1958, the facility consists of classrooms, laboratories, numerous support functions to include the Dean of Cadets and supporting academic staff, the Commandant and associated staff, library, PMEL, communication, audio-visual, photo lab and medical clinics. The facility was untouched until three phases of a five phase military construction program renovated various areas in FY97, FY98, and FY00. Phase IVA is currently under construction, Phase IVB and V are scheduled to be funded in FY08 and FY10. Approximately $30 million in S/R&M repairs have been phased to start in FY11 to include replacing the exterior window system, roof repairs and interior finish work in areas not touched with military construction.

Number 02-Mitchell Hall

Mitchell Hall is the Cadet Wing dining facility, serving three meals a day year round. Constructed in 1959, the food delivery, preparation, handling, and storage areas have been untouched. Additionally, the waste handling systems are also original and need upgrade. The overall facility layout is inefficient and unsanitary for today's food handling requirements. Over $40 million in facility and equipment requirements have been identified to repair this facility to current building code and industry layout standards. Phase 1 was awarded in FY06. Phases 2 - 6 are currently in design.

Number 03-Cadet Gymnasium
The Cadet Gymnasium supports intramural, physical education, intercollegiate and personal physical fitness programs. The introduction of new sporting events since it was built in 1960 along with the introduction of co-ed programs has left this facility woefully inadequate to meet current demands. Additionally, the facility requires extensive HVAC and functional repairs to bring it up to current building codes and industry standards. Over $30 million was identified to repair this 440,000 square foot facility. Phase 1 was awarded in FY06. Phases 2 - 7 are currently in design.

Number 04-Vandenberg Hall
Vandenberg Hall is the larger of two cadet living quarters. Constructed in 1958, it is comprised of 1,300 cadet rooms and various other functions. The last significant upgrade was in 1993 when cadet rooms were updated with new finishes. A top to bottom analysis identified approximately $60 million required to bring the infrastructure up to current building codes. Key upgrade elements include glass curtain wall replacement, HVAC mechanical room equipment replacements and latrine upgrades. Design for all phases of this 833,000 square foot facility is ongoing.

Number 05-High Temperature Hot Water
The cadet area and the Community Center/Medical areas are linked to a High Temperature/Hot Water (HTHW) boiling plant for both heating and process water. Constructed in 1959, HTHW lines feeding the cadet area are in utility tunnels greatly extending their useful life. Approximately 17,700 feet of lines feeding the remaining areas are direct buried. These lines are rapidly deteriorating. In many places the insulation has worn away negating the value of the insulation and placing an additional heat load on the heat plant. Various leaks have been detected with recorded ground temperatures of up to 165 degrees. Seven phases are 100 percent designed with an estimated cost of $19.5 million.

Number 06-Fieldhouse
The cadet fieldhouse was constructed in 1968 and can simultaneously seat over 6,000 in the basketball arena, over 2,500 in the hockey rink area, and over 1,000 in the multipurpose/indoor track. Additional support staff and athletes combined can bring the total occupancy to over 10,000 during simultaneous events. Original mechanical and electrical systems are beyond useful life and must be replaced. There are many safety and code upgrades that are required to make the facility more energy efficient and safe for the large volume of occupants that accompany intercollegiate athletic events. Safety hand rails, door replacements, improved security screening, seat replacement and general facility upgrades are required to bring this facility up to current building and safety standards. Over $17 million in upgrades identified with design nearing completion.

Number 07-Arnold Hall
Arnold Hall is the primary cadet social center hosting numerous social, academic and military training functions throughout the year. Constructed in 1959, the facility remains virtually untouched in terms of building code upgrades. Primary upgrade elements for this 178,000 square foot facility include fire suppression and electrical upgrades along with significant safety upgrades in the auditorium. Approximately $4.3 million in upgrades identified.

Number 08-Roads & Parking
There are over 170 miles of paved and unpaved roadways and numerous parking lots on the Air Force Academy which equates to over 2.6 million square yards of surface area to continuously maintain and repair. There is an unending requirement for maintenance and repair projects. Projects worth almost $20 million have been identified with a continual stream of requirements being identified.

Number 09-Airfield Pavements
The Air Force Academy airfield is comprised of three active runways and one cross-wind runway. Together with taxiways and ramp space the total surface area exceeds 360,000 square yards. The airfield is the busiest Visual Flight Rules (VFR) in North America and is home to the largest sail plane program in the world. Continual maintenance and repair projects are required to keep the airfield in operational condition. Almost $2 million worth of projects has been identified with more anticipated as the current winter weather dissipates and the spring thaws occur.

Number 10-Dams & Bridges
The Air Force Academy has 12 potable and non-potable dams or reservoirs. Additionally there are three bridges on primary thoroughfares and one on a secondary road. All are original construction and showing signs of requiring extensive repairs to meet state and federal standards. To keep these essential structures operational over $11 million in projects have been identified.

Number 11-Water Systems
The Air Force Academy mission includes caretaker for over 18,000 acres of land. Various functions are dispersed throughout the reservation. Over 280 miles of water, sewer and non-potable water mains are required to keep the USAFA mission operating. Maintenance and repair projects are continuous. Over $30 million in projects have been identified in the FYDP with over $30M more identified beyond FY13.

Number 12-Fairchild Annex/Consolidated Education and Training Facility (CETF)
The CETF was constructed in 1996. In 2001, noticeable cracks began to appear at various places throughout the facility. Phase three of a multi-phase study is almost completed which will provide extensive data concerning actual deflection information due to stress on the facility. Foundation concerns have already been eliminated so focus has been on structural elements above the foundation. It is anticipated that extensive repairs will be required to remediate structural distress.

Number 13-Cadet Chapel Roof

The cadet chapel is the primary architectural feature that defines the Air Force Academy. Constructed in 1963, the 17 spires and interior spaces are the most visited man-made tourist attraction in Colorado. The chapel is listed in the National Historic Register. Almost from the time of construction the chapel has leaked during inclement weather. The spires are constructed with aluminum and glass. One expands and contracts greatly between cold and hot weather, the other does not. Caulking between these two dissimilar materials is inadequate to stop the leaks. Various caulking experts to include NASA have been consulted in recent years, all without success. The original designers identified that key flashing was value engineered out of the project during construction that would have eliminated the problem. Consequently, it is estimated that over $30 million will be required to remove the 71,300 square feet of aluminum cladding, install flashing and repair the roof structure.

Number 14-Non-Water Infrastructure

The Air Force Academy mission includes caretaker for over 18,000 acres of land. Various functions are dispersed throughout the reservation. The extensive network of electric and gas lines required to keep the mission going includes over 180 miles of electrical primary and secondary lines, over 3,000 street lights and two electrical sub-stations. Additionally, over 28 miles of gas mains exist. Other infrastructure systems include cadet plaza, cathodic protection and over 83 miles of telephone ducts. There is a continual need to maintain and repair this myriad of utility systems. Projects totaling $29 million have been identified in the FYDP with another $18 million identified for accomplishment beyond FY13.

Number 15-Support Buildings

There are over 1,200 facilities on USAFA of various sizes and types. Many of them were originally constructed in the late 1950s when USAFA was first constructed. Many have been added since then such as airfield structures. There is over 8 million square feet of non-housing real property on USAFA. Projects identified in this category represent over 6 million square feet of facility space which requires continual maintenance and repair to maintain operational capabilities. Over $46 million in support facility projects have been identified for accomplishment by the end of the current FYDP.

Number 20-Program Development

An annual budget to provide project design, bring industry experts for various facility types, conduct long range planning support and military construction concept documents are required to support the annual construction program at USAFA.

O&M (SRM) Multi-Year Investment Strategy

Below is our O&M investment plan based on the FY08 President's Budget. The particular projects and investment strategy are subject to the availability of funds and other mission priorities.

O&M (SRM) Investment Strategy								
Multi Yr Category ($K)	2007	2008	2009	2010	2011	2012	2013	Grand Total
01 Fairchild Hall	99	315	1,401		800	9,088	8,600	20,303
02 Mitchell Hall	2,700	9,534	2,698	8,672	4,828			28,431
03 Cadet Gymnasium	5,082	4,665	3,272	3,995	6,658	5,217		28,889
04 Vandenberg Hall		6,552	9,415	10,032	10,060	7,491	12,700	56,250
05 High Temp Hot Water		5,022	5,200	6,000	3,050			19,272
06 Fieldhouse		1,204	7,500	156		90		8,950
07 Arnold Hall	24	4,250						4,274
08 Roads & Parking	4,598	6,121	4,802	4,809	3,389			23,719
09 Airfield Pavements		100	1,165	490	67			1,822
10 Dams & Bridges		4,307	4,129	300	2,515			11,251
11 Water Systems		3,371	447	650	3,093	15,241	8,100	30,901
12 Fairchild Annex (CETF)	3,247	825	660				7,500	12,232
14 Non-Water Infrastructure	350	1,439	5,293	3,034	6,083	7,325	5,425	28,949
15 Support Buildings	2,984	6,867	12,963	12,631	5,978	2,323	5,378	49,124
20 Program Development		3,000	4,500	3,800	3,500	3,500	3,500	21,800
Grand Total	19,084	57,570	63,443	54,569	50,021	50,275	51,203	346,166

MILCON Multi-Year Investment Strategy

Below is our current military construction investment plan based on the FY08 President's Budget. The particular projects and investment strategy are subject to the availability of funds and other mission priorities.

USAFA MILCON Investment Strategy			
FY	BASE PRI	TITLE	COST ($K)
8	1	Upgrade Academic Facility Phase IV B	15,000
10	2	Upgrade Academic Facility Phase V	15,000
10	3	Constr Cadet Fitness Center	11,500
11	4	Constr Emergency Operations Center	10,000
12	5	Constr South Gate Vehicle Search Fac	7,400
12	6	Constr Base Operations Fac (AETC)	5,000
13	7	Add to Community Center Gym	8,900

Conclusion

The Academy commissions more second lieutenants than any other commissioning source. These cadets/future second lieutenants are "our Air Force's competitive advantage" to win the Global War on Terrorism as well as all future wars. The Air Force has invested a sizable amount of military construction and operations and maintenance funds to upgrade and repair the infrastructure at USAFA. We are committed to continued support of these inputs as it will increase our ability to win the war on terror, prepare for the next war, and develop facilities that demonstrate caring for our Airmen. Your continued support of these requests will be helpful in alleviating USAFA's infrastructure concerns.