Description of document:	**6 National Aeronautics and Space Administration (NASA) Audit Reports, 1996-1998**
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National Aeronautics and
Space Administration

Office of Inspector General
Washington, DC 20546-0001

FEB 19 2010

SUBJECT: Freedom of Information Act (FOIA) Request
NASA OIG FOIA Request Number 2009-36

I am responding to your July 17, 2009, request for several audit reports released between June 1996 and September 2000. After receiving an email message from Beth Richardson, Associate Counsel, advising you that some reports are posted on the OIG web site, you withdrew your request for IG-99-013, Hubble Space Telescope Cost Reduction Initiatives; IG-99-030, Review Report on the Advanced Air Transportation ...; IG-00-005, X-39 Crew Return Vehicle (CRV) Project Management; IG-00-002, Letter to Hon. James Sensenbrenner, Jr.; IG-00-034, Controls over Foreign National Visitors to NASA ...; IG-00-044, Transfer of External Tank Displace to KSC Visitor Center; IG-00-047, Kennedy Space Center Proposed Media Center Building; and IG-00-053, NASA's Aviation Safety Program.

My initial determination is to provide redacted copies of the following audit reports. Individuals' signatures are being withheld under FOIA exemption (b)(6) to protect personal privacy. 5 U.S.C. § 552(b)(6).

JS-96-003, Space Shuttle Safety Review.
IG-97-008, ARC Support of SETI's High Resolution Microwave Survey Program.
(Please note that page B-1 is missing from the report; it is not being withheld under a FOIA exemption.)
IG-97-0019, Reusable Launch Vehicle Program.
IG-97-027, ARC Support of SETI's High Resolution Microwave Survey Program.
IG-98-013, Dissemination of Earth Science Program Data and Information.
G-98-011, Flight Termination Systems Assessment. In addition to the signature, specific information about command generation and decoding is being withheld under FOIA exemption (b)(2) to protect substantial internal matters, the disclosure of which would risk circumvention of a legal requirement. 5 U.S.C. § 552(b)(2).

The following reports could not be located: A-GO-96-006, Survey of NASA Space Operations Consolidation; JS-96-007, Russian Involvement in the ISS Program; A-KE-96-001, Orbiter Valuation; G98-018, Modifications to NASA's Safety Reporting System; IGMEMO 11, (*sic*); and an unredacted version of IG-99-036, X-38/Crew Return Vehicle Operational Testing.

You have the right to appeal this initial determination to the Inspector General. Under 14 CFR § 1206.605(b), the appeal must: (1) be in writing; (2) be addressed to the Inspector General, NASA Headquarters, Washington, DC 20546; (3) be identified clearly on the envelope and in the letter as an "Appeal under the Freedom of Information Act"; (4) include a copy of the request for the Agency record and a copy of the contested initial determination; (5) to the extent possible, state the reasons why you believes the contested initial determination should be reversed; and (6) be sent to the Inspector General within 30 calendar days of the date of receipt of the initial determination.

Jim Morrison
Assistant Inspector General for Audits
OIG FOIA Officer -- Audits

Enclosures

JS-96-003

AUDIT REPORT

SPACE SHUTTLE SAFETY REVIEW

JOHNSON SPACE CENTER

June 28, 1996

National Aeronautics and Space Administration

OFFICE OF INSPECTOR GENERAL

National Aeronautics and
Space Administration
Headquarters
Washington, DC 20546-0001

Reply to Attn of: W

JUN 28 1996

TO: Johnson Space Center
ATTN: AA/Director

FROM: W/Assistant Inspector General for Auditing

SUBJECT: Final Audit Report
Space Shuttle Safety Review
Assignment No. A-JS-94-005
Report No. JS-96-003

The NASA Office of Inspector General (OIG) has completed an audit of Space Shuttle safety. Survey work was performed at the Johnson Space Center, Kennedy Space Center, and NASA Headquarters. The original audit objective was to determine whether Shuttle safety is adequate. Based on survey findings, we determined this audit objective was too broad for a single audit. Consequently, we revised the audit objective and limited the scope to a review of Shuttle crew escape safety issues. We determined that NASA has implemented processes and procedures for ensuring Shuttle safety and metrics to evaluate the extent that the safety goals are being met. However, the Shuttle crew escape system and related crew egress training procedures need increased management attention.

We issued a May 8, 1995, management letter to you that summarized the astronauts' responses to our questionnaire on Shuttle safety. We found that the majority of the astronauts expressed no serious safety issues and believe NASA management listens to their concerns and has made the Shuttle program as safe as possible considering the current configuration, i.e., mature state of the Shuttle hardware and the economic environment. However, there were several astronaut responses that we felt warranted NASA management attention. Our management letter with those astronaut responses is presented as Appendix 1.

Additionally, the audit showed that: (1) astronauts could be physically unable to perform an emergency egress following reentry into Earth's atmosphere because current flight crew training does not simulate the affects of microgravity while wearing 91 pounds of Shuttle crew escape equipment; and (2) the reliability of a Criticality 1 pip pin that fastens the crew escape pole to the Shuttle Orbiter's middeck ceiling during ascent and entry should be improved. Because of earlier meetings held to discuss the findings of this audit, JSC opted to respond directly to our February 16, 1996, discussion draft report and waive an exit conference. Management's written response was received on June 4, 1996. JSC concurred with the five report recommendations.

The Center's written response is presented after each recommendation and is included in its entirety as Appendix 2 in this final report. The NASA OIG concurs that the actions planned and taken by JSC are sufficient for the closure of recommendations 1, 2, and 3. In accordance with NMI 9910.1A, please include our office in the concurrence cycle for closing recommendations 4 and 5.

Debra A. Guentzel

Enclosure

cc:
HQ/M/W. Trafton
JSC-BU/P. Ritterhouse
MA/T. Holloway
W/J. Goodnight (w/o enclosure)

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ACRONYMS

ASAP	Aerospace Safety Advisory Panel
GAO	General Accounting Office
JSC	Johnson Space Center
KSC	Kennedy Space Center
STS	Space Transportation System

SPACE SHUTTLE SAFETY REVIEW

JOHNSON SPACE CENTER (JSC)
HOUSTON, TEXAS

EXECUTIVE SUMMARY

INTRODUCTION

The NASA Office of Space Flight mission is to provide safe, assured, and economic transportation to and from space for people and payloads. During the design of the Space Shuttle, the idea was to avoid single point failures and, with respect to avionics, avoid double point failures. The complexity and sophistication of the Shuttle made it very difficult to design out all potential risk factors. However, the Agency has implemented processes and procedures for ensuring Shuttle safety. Also, private contractors have been commissioned to assess how well Shuttle safety is being accomplished. Nonetheless, problems with crucial Shuttle parts and NASA budget cuts have raised fears of another Challenger disaster.

OBJECTIVES

The original audit objective was to determine whether Shuttle safety is adequate. During the survey phase, we performed limited tests of significant management controls to assess processes and procedures for ensuring Shuttle safety and metrics for evaluating whether safety goals were being met. However, we determined the original audit objective was too broad for a single audit and, following the survey phase, limited our review to the Shuttle crew escape system. The revised audit objectives for the detailed audit phase were to review the emergency crew egress and assess the reliability of the crew escape pole pip pin fastener.

RESULTS OF AUDIT

NASA has implemented processes and procedures for ensuring Shuttle safety and metrics to evaluate the extent that the safety goals are being met. However, the Shuttle crew escape system and related crew egress training procedures need increased management attention. Astronauts could be physically unable to perform an emergency egress following reentry into Earth's atmosphere because current flight crew training does not simulate the affects of microgravity while wearing 91 pounds of Shuttle crew escape equipment. Also, the reliability of a Criticality 1 pip pin that fastens the crew escape pole to the Shuttle Orbiter's mid-deck ceiling during ascent and entry should be improved.

RECOMMENDATIONS We recommended:

1. The Space and Life Sciences Directorate's Medical Sciences Division determine the extent that the weight and mass of the crew escape equipment reduce/obstruct crew mobility following an extended exposure to microgravity.

2. The Mission Operations Directorate's Space Flight Training Division collaborate with the Medical Sciences Division to develop and implement flight crew training procedures that appropriately relate to the physical requirements of an emergency egress after exposure to microgravity.

3. The Engineering Directorate's Extra-Vehicular & Spacesuit Systems Branch identify hardware modifications and, where feasible, the JSC Projects Office provide adequate funding so that the weight of the crew escape equipment is reduced and crew mobility is enhanced.

4. The JSC Engineering Directorate and JSC Projects Office identify reliable space fasteners with redundant safety features that can be used to replace the Criticality 1 pip pin that attaches the crew escape pole to the Shuttle Orbiter's mid-deck ceiling.

5. The JSC Projects Office, if deemed feasible, provide the necessary funds to purchase the space fasteners identified in Recommendation 4.

INTRODUCTION

NASA has well defined processes and procedures for achieving Space Shuttle safety. Specifically, the Agency performs a Failure Modes and Effects Analysis during the design phase for all Shuttle hardware. This analysis documents the worst case effects of failure at the worst time of occurrence. The resultant effect of not properly providing the function determines the "functional criticality" as: "1" for possible loss of life or vehicle; "2" for possible loss of mission or prime mission objective; and "3" for all others. Open hardware problems are reported and maintained in an automated database where they are tracked and managed until closure is made. Program Change Reviews and Configuration Control Boards look at and evaluate all proposed Shuttle changes to determine the safety impact. Finally, NASA conducts a series of readiness reviews at designated times prior to launch in order that Space Shuttle problems/issues are sufficiently discussed and dispositioned to ensure all safety risks associated with the upcoming mission are nominal.

To evaluate the extent that Shuttle safety goals are being met, NASA has several metrics. On several occasions, the Agency has commissioned private contractors to perform independent safety reviews of NASA activities and operations. Further, the Aerospace Safety Advisory Panel (ASAP), established by Section 6 of the NASA Authorization Act of 1968, provides oversight and counsel to the NASA Administrator and Congress on the safety aspects of NASA's programs. ASAP submits an annual report to the Administrator and Congress. Finally, the Agency has developed the NASA Safety Reporting System so that individuals can make anonymous reports of Shuttle safety concerns and issues.

Still, the risk of catastrophic failure during the Shuttle's ascent into orbit is estimated by NASA at about 1 in 75 missions and by private experts at about 1 in 60. Following the Challenger accident, the Rogers Commission recommended that NASA provide a crew escape system. Accordingly, NASA developed a bailout crew escape system for in-flight emergencies and an emergency slide and sky genie for post-landing events.

For an in-flight bailout, the crew must be able to release from their Shuttle Orbiter seats, move to the side hatch door, connect to the escape pole, and jump out of the vehicle. For post-landing emergencies, the astronauts must be capable of reaching the Shuttle Orbiter's side hatch door and exiting the vehicle via the emergency egress slide or climbing through an overhead window and using the sky genie to escape the Shuttle Orbiter.

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OBJECTIVES, SCOPE, AND METHODOLOGY

OBJECTIVES

The original audit objective was to determine whether Shuttle safety is adequate. During the survey phase, we performed limited tests of significant management controls to assess processes and procedures for ensuring Shuttle safety and metrics for evaluating whether safety goals were being met. However, we determined the original audit objective was too broad for a single audit and, following the survey phase, limited our review to the Shuttle crew escape system. The revised audit objectives for the detailed audit phase were to review the emergency crew egress and assess the reliability of the crew escape pole pip pin fastener.

SCOPE AND METHODOLOGY

We interviewed key NASA and contractor personnel, reviewed pertinent records, and performed limited tests of management controls. Audit field work was conducted from June 1994 through July 1995 at the Johnson Space Center (JSC), Kennedy Space Center (KSC), and NASA Headquarters.

Specifically, we:

- Attended the Pre-Launch Assessment Review at JSC and the Flight Readiness Review at KSC for the Space Transportation System (STS) 65 mission.

- Met with NASA Headquarters managers who are responsible for Shuttle operations and safety. Separate meetings were held with the Deputy Associate Administrator for Space Shuttle, the Director of Space Flight Safety and Mission Assurance Division, and the Director of Safety & Risk Management Division. We discussed NASA's overall goal, mission, and issues/concerns involving Shuttle safety. Also, we met with the Staff Director for the ASAP and discussed ASAP's overall assessment of the adequacy of Shuttle safety.

- Conducted teleconference calls and meetings with the General Accounting Office (GAO) evaluators that are performing audits at NASA that relate to Shuttle safety. We wanted to preclude any audit duplication and establish our audit scope. Specifically, we had discussions with the evaluator who is assessing whether NASA is sufficiently considering safety when identifying ways to reduce Shuttle Program costs. Therefore, our audit does not address how cost and budget

constraints affect Shuttle safety. Also, we met with the GAO evaluators reviewing how NASA identifies, assesses, and manages Shuttle risks.

- Identified and reviewed selected NASA Safety Reporting System files to evaluate whether NASA had taken appropriate corrective actions regarding Shuttle safety concerns that had been reported anonymously.

- Developed and issued an open-ended astronaut questionnaire to obtain the flight crew members' concerns and comments on Shuttle safety. Astronaut responses that we felt warranted management attention were discussed with managers in JSC's Flight Crew Operations Directorate and summarized in a management letter to the JSC Director (see Appendix 1).

- Reviewed NASA policy for granting flight waivers. Also, reviewed some Launch Commit Criteria flight waivers to determine the frequency of waivers and why they were issued.

- Identified and reviewed safety issues related to the Shuttle crew escape system.

- Met with JSC management and discussed our Finding and Attribute Lead Sheets.

MANAGEMENT CONTROLS REVIEWED

We reviewed significant management controls to determine NASA's:

- processes and procedures for achieving Shuttle safety; and

- metrics for evaluating the extent that Shuttle safety goals are met.

AUDIT STANDARDS

The audit was accomplished in accordance with generally accepted government auditing standards and included such examinations and tests of applicable records and documentation as were considered necessary.

OBSERVATIONS AND RECOMMENDATIONS

OVERALL EVALUATION

NASA has implemented processes and procedures for ensuring Space Shuttle safety and metrics for evaluating the extent that the safety goals are being met. However, the Shuttle crew escape system and related crew egress training procedures need increased management attention.

EMERGENCY CREW EGRESS

Current flight crew egress training does not simulate how exposure to microgravity affects an astronaut's ability to perform an emergency egress. The Shuttle crew escape system and related crew egress training procedures should provide the capability for astronauts to safely escape the Shuttle during emergency situations. However, current flight crew training does not simulate the affects of microgravity because JSC management believes it is extremely improbable events will occur that require an emergency egress during reentry/landing. Astronauts wearing 91 pounds of escape equipment who have not been properly trained could be unable to perform an emergency egress.

MICROGRAVITY DECONDITIONS ASTRONAUTS

The microgravity environment of low Earth orbit causes the astronauts to become deconditioned. The technical publication, "Space Physiology and Medicine," Third Edition, expounds on the degrading physiological changes that occur to the human body after exposure to microgravity. The publication states that:

> "A...study of five Space Shuttle crewmembers conducted during flight concluded that total body water decreased by 3.4% after 1 to 3 days in flight.... When a crewmember with reduced fluid volume first stands in 1 g [gravity], large portions of the fluid, including plasma, tend to pool in the lower extremities, leaving that crewmember susceptible to ... the possibility of fainting.... These ... adaptations influence ... the capacity of the astronauts to stand and to ambulate upon return to the 1 g environment.... Exposing humans to weightlessness during space flight seems to induce significant structural changes in the muscle and spindle fibers. ...manifested as loss of

muscle size and strength ... including muscle fatigue, abnormal reflex behavior, and diminished neuromuscular efficiency.... When an individual first enters weightlessness, fluids shift toward the head and torso.... In-flight decrements in calf girth of up to 30% provide additional evidence of the headward migration of fluids ... the body responds to the need to eliminate the fluid-volume overload by reducing the central volume [through diuresis].... Plasma volume declines during missions within hours and stabilizes about 12% below normal.... Although these physiological changes begin during flight, they pose the most significant operational concern during landing, when astronauts must be able to pilot the Shuttle and exit quickly in the event of an emergency. [Emphasis added.]"

CREW ESCAPE SYSTEM AND EGRESS TRAINING SHOULD PROVIDE EMERGENCY ESCAPE CAPABILITY

The Shuttle crew escape system and related crew egress training procedures should provide the capability for astronauts to safely escape the Shuttle Orbiter during emergency situations. After exposure to the microgravity environment of low Earth orbit, astronauts must be sufficiently strong, mobile, and adequately trained to perform NASA's prescribed emergency egress procedures.

The bailout crew escape system requires the astronauts be physically able to attach and slide down a crew escape pole extended out of the Shuttle Orbiter's side hatch door and parachute below into a body of water. The astronauts are expected to bailout during a two-minute period. Bailout should be initiated at about 25,000 feet. Since the minimum altitude to enable full parachute opening is 1,200 feet and the Shuttle has a nominal descent rate of approximately 4,000 feet per minute, the total bailout must be completed in approximately 6.5 minutes.

For post-landing emergencies such as a cabin fire, the flight crew must jettison the Shuttle Orbiter side hatch and manually activate the emergency egress slide from the mid-deck through the egress side hatch opening. Then the flight crew must pull a lanyard to inflate the slide and proceed to evacuate the Shuttle Orbiter. If the Shuttle Orbiter side hatch fails to jettison, the flight crew must jettison the overhead emergency escape panel and use the sky genie descent devices to lower themselves to the ground.

EGRESS TRAINING FAILS TO SIMULATE THE EFFECTS OF MICROGRAVITY

Current flight crew egress training does not simulate how exposure to microgravity affects an astronaut's ability to perform an emergency egress. In order to train the astronauts for emergency egresses, the Mission Operations Directorate conducts the following courses:

- "Bailout 2102" (1 hour - Workbook) provides information on the crew escape system and procedures used for inflight bailout.

- "Escape System Introduction 2101" (3 hours - Classroom) introduces the student to crew-worn equipment, cabin vent and hatch jettison, escape pole and slide deployment, parachute operation, sky genie usage, survival gear, and search and rescue operations.

- "Escape Procedures 2120" (4 hours - Crew Compartment Trainer) provides experience on procedures for bailout and postlanding slide egress.

- "Bailout 2127" (3 hours - Weightless Environment Training Facility) is performed at the Weightless Environment Training Facility to enable the crew members to experience bailout, water entry, and water survival procedures.

- "Water Survival 2101" (2 hours - classroom) discusses in detail the inflight bailout procedures including parachute operations, survival/rescue gear usage and the Search and Rescue posture.

Rather than incorporate ground-based microgravity simulations into crew egress training, NASA flight doctors interview the returning astronauts following each STS mission. The flight doctors then use that data to inform upcoming flight crews of problems and limitations that might be experienced due to physiological changes induced by time spent in a microgravity environment.

On February 22, 1995, we observed the crew for STS-70 perform bailout training in the mocked-up Full Fuselage Trainer at JSC. The training did not require that the crew complete the bailout in the maximum 6.5 minutes available for an emergency egress. More importantly, we noted that the training did not simulate the loss of strength and mobility that is experienced after exposure to microgravity and how that phenomenon will impact the crew's ability to effectively perform an emergency egress.

We believe it is imperative that flight crews be adequately trained to perform Shuttle emergency egress procedures when they are deconditioned.

NASA MANAGEMENT BELIEVES AN EMERGENCY CREW EGRESS FOLLOWING REENTRY IS IMPROBABLE

However, current flight crew training does not simulate the affects of microgravity because JSC management believes it is extremely improbable events will occur that require an emergency egress during reentry/landing. Nonetheless, a recent NASA-commissioned study estimated there was a 1 in 97.4 chance that a bailout maneuver would be required during reentry/landing for the STS-71 Shuttle/Mir mission and identified 38 events that could have required an emergency crew egress. The study recognized that on STS-71, there were three crew members (two Russian cosmonauts and one U.S. astronaut) so deconditioned that they would have been constrained by their lack of strength and would have needed to crawl over the Shuttle Orbiter seats/floor to reach the exit hatch in case of a bailout.

ASTRONAUTS COULD BE UNABLE TO EGRESS

Astronauts who are wearing 91 pounds of escape equipment and have not been properly trained could be unable to perform an emergency egress. The 91 pounds of crew escape equipment could make it extremely difficult or impossible to perform an emergency egress when deconditioned following exposure to microgravity. According to a NASA flight doctor, the Agency has not performed any studies to determine how each pound of mass, i.e., crew escape equipment, impacts the mobility of a deconditioned crew member upon re-exposure to Earth's gravitational forces.

Based on biographical data, we determined that 29 (28 percent) of NASA's 104 astronauts weighed 150 pounds or less. For this group of astronauts, the escape equipment represents 60 percent or more of their body weight. The heavier elements of the crew escape equipment are the 16.5 pound advanced crew escape suit overalls, the 20.5 pound torso harness and harness sub-assembly, and the 26.2 pound parachute assembly. NASA engineers advised us that the weight of the parachute assembly could be reduced by 8 to 10 pounds. This parachute modification would cost the Shuttle program an estimated $500,000 to $600,000 primarily for certification testing. We believe that reducing the weight of the crew escape equipment would enhance the crew's ability to perform an emergency egress and offset any hardware modification costs by allowing NASA to lift heavier payloads on STS missions.

A NASA flight doctor explained that the extent of deconditioning caused by microgravity will vary based on the size and strength of each crew member and the amount of time spent in the weightless environment of low Earth orbit. Still, NASA has not incorporated any ground-based microgravity simulations into its emergency crew egress training procedures. "Space Physiology and Medicine" states that several ground-based simulations have yielded a great deal of insight into how the various body systems respond to conditions resembling those of brief and extended space flight. Particularly, it mentions that "bed rest," the most widely used simulation of the space flight environment, causes decreased orthostatic tolerance similar to that demonstrated by returning astronauts. Further, it notes that the "dry immersion" technique has resulted in physiological changes that are caused by microgravity. We believe that NASA should carefully consider the feasibility of using proven ground-based microgravity simulations during crew egress training to better prepare the astronauts for an emergency escape when they are deconditioned after spending time in a weightless environment.

RECOMMENDATION 1 The Space and Life Sciences Directorate's Medical Sciences Division should determine the extent that the weight and mass of the crew escape equipment reduce/obstruct crew mobility following an extended exposure to microgravity.

Management's Response We concur with the recommendation. Neuroscience investigations indicate the crewmembers experience significant postural and locomotor disturbances following space flight. The Launch Escape Suit parachute combination introduces a greater stresser to postural stability particularly in smaller crewmembers. The added weight and physical constraining properties of the Launch Escape Suit may bring crewmembers closer to their instability boundaries during the critical early readaptation phase immediately after flight. Even without the parachute, the physical loads of egress, escape slide or rappelling down an overhead window, and then ambulating "x" meters upwind will be substantial. The hardware will all weigh more or less the same, but astronauts come in a wide range of sizes, so the relative load on a small astronaut will be proportionately greater than the relative load on a large astronaut. Orthostatic worst case is bail-out, due to hanging in a parachute harness which is an ideal way to sequester blood volume in the passive legs. The post-landing egress involves less orthostatic stress, more exercise stress. Recent data from exercise investigations suggest that crewmembers may not be able to walk immediately after landing even with minimal weight on their backs. However, post-land readaptation is rapid and egress from the Orbiter after some sort of landing could conceivably be aided by other

crewmembers or the crash rescue team. We consider the current procedures and the on-going investigations as responsive to the recommendation, and with your acceptance of these actions, this recommendation will be considered closed upon issuance of the final report.

Evaluation of Management's Responses

JSC's on-going investigations of microgravity's impact upon crewmembers' ability to perform an emergency Shuttle egress are responsive to Recommendation 1. The NASA OIG concurs that the current procedures and the on-going investigations are sufficient for closure of this recommendation.

RECOMMENDATION 2

The Mission Operations Directorate's Space Flight Training Division should collaborate with the Medical Sciences Division to develop and implement flight crew training procedures that appropriately relate to the physical requirements of an emergency egress after exposure to microgravity.

Management's Response

A study on locomotion postflight is being conducted, with STS-75 crew the first participants. For this study, crewmembers will exit into the Crew Transfer Vehicle (CTV) and walk on a treadmill in the back of the CTV wearing the full Launch Escape Suits/Advanced Crew Escape Suits. Results of this study could reveal information that might lead to changes in the egress training. The Mission Operations Directorate Crew Systems personnel continue to work with the medical branch concerning a project designed to evaluate the way NASA currently trains astronauts for stressful situations. In order to gain insight, medical personnel will participate as suited subjects in the Weightless Environment Training Facility bailout sessions and in a modified version of the Escape Procedures. In addition, the Engineering Directorate is working on lighter-weight equipment such as parachutes and harnesses. In training exercises, the returning station crewmembers train jointly with Shuttle crewmembers for all phases of flight and for all emergency egress scenarios including egress by parachute during freeflight and by the hatch/chute while on the ground. An example of this type of training occurred for STS-71 with MIR-18 crew training with the Shuttle crew prior to launch. The mid-deck astronaut worked with the three returning cosmonauts (who would be in space for more than 90 days) to develop techniques for rapid egress, even when the long-duration crewmember was completely immobile. All crews on flights bringing back MIR crewpersons are given extra training in the recumbent seats. We expect this type collaborative training to continue. We consider the

current procedures and the on-going studies as responsive to the recommendation, and with your acceptance of these actions, this recommendation will be closed upon issuance of the final report.

Evaluation of Management's Responses

Current flight crew training and on-going studies to improve emergency Shuttle egress procedures are responsive to Recommendation 2. The NASA OIG concurs that the actions planned and taken are sufficient for closure of this recommendation.

RECOMMENDATION 3

The Engineering Directorate's Extra-Vehicular & Spacesuit Systems Branch should identify hardware modifications and, where feasible, the JSC Projects Office provide adequate funding so that the weight of the crew escape equipment is reduced and crew mobility is enhanced.

Management's Response

We concur with the recommendation. The Engineering Directorate is presently addressing alternatives for reducing escape equipment weight. An effort is under way to reduce the weight and descent rate of the present parachute. The amount of weight reduced will be small as reducing the overall weight of the escape system would require deletion of specific survival equipment. The implementation of the full pressure advanced crew escape suit (ACES) will improve mobility. With the addition of the thermal electric cooling system, the crew comfort during entry and postlanding is greatly enhanced, resulting in improved crew physiologic condition at end of mission. With actions currently under way, and your acceptance of those actions, this recommendation will be closed upon issuance of the final report.

Evaluation of Management's Responses

On-going efforts to reduce the weight and descent rate of the present parachute and to improve crew mobility by the implementation of the ACES are responsive to Recommendation 3. The NASA OIG concurs with management's decision to close this recommendation.

RELIABILITY OF CREW ESCAPE POLE PIP PIN FASTENER

A Criticality 1 pip pin that fastens the 275-pound crew escape pole to the Orbiter's mid-deck ceiling does not have a redundant lock and, in effect, is a single point of failure. The escape pole must remain firmly affixed to the mid-deck ceiling during the mission ascent and entry phases in order to accommodate an in-flight emergency crew bailout.

Some JSC managers are confident that the current pip pin is sufficiently reliable, even though it only has a single-acting lock. However, a single failure of the current pip pin fastener could cause the escape pole to inadvertently release from the Orbiter's mid-deck ceiling.

POLE MUST REMAIN AFFIXED TO ORBITER CEILING BY PIP PIN

The crew escape pole must remain firmly affixed to the mid-deck ceiling during the mission ascent and entry phases in order to accommodate an in-flight emergency crew bailout. One end of the pole's 126.75 inch arched housing is attached by the pip pin to the mid-deck ceiling above the airlock hatch and the other end in the 2 o'clock position above the side hatch door. In case a bailout is required, the escape pole will be deployed from its housing assembly and extended approximately 9.8 feet out of the Orbiter's side hatch door. Sliding down the pole will allow the crew member to fall below the wing and free of the Orbiter.

PIP PIN DOES NOT HAVE REDUNDANT LOCK

A Criticality 1 pip pin that fastens the 275-pound crew escape pole to the Orbiter's mid-deck ceiling does not have a redundant lock and, in effect, is a single point failure. Two retention balls at the end of the pip pin provide the sole safety locking mechanism. The two retention balls have been designed to recess only when the release button is depressed. However, human errors (poor quality, inadequate hardware processing/inspection) and/or environmental impediments (hardware corrosion, foreign objects embedded around the pin retention balls or inside the pip pin) could render the pip pin ineffective for securing the pole. Two of the three mission specialists in the Orbiter mid-deck are seated beneath the escape pole.

NASA MANAGERS FEEL PIP PIN RELIABLE

Some JSC managers are confident that the current pip pin is sufficiently reliable even though it only has a single-acting lock. However, we found that astronauts carry a spare, identical pip pin in the Orbiter crew cabin for use in reinstalling the pole for landing phases in the event the primary pin fails. JSC managers may have not sufficiently discussed the pip pin safety issue and the feasibility of procuring more reliable replacement space pins with redundant safety features. We were advised that JSC Engineering had been busy redesigning the Orbiter seats and had not contacted the managers in JSC Projects Office concerning the pip pin replacement. However, Engineering recognized the safety risks associated with the current pip pin and, therefore, had obtained vendor quotes for replacement space pins. One vendor had given Engineering a written quote of $3,750 for 15 space pins with redundant locks. At a February 1, 1995 meeting,

some JSC managers insisted that the $3,750 quote was too low and, subsequently, provided an updated cost estimate of $13,000 for redundant pip pins with hitch pins. The JSC managers stated that, regardless of the replacement cost, Shuttle program funds are scarce and should be spent on expenditures other than the acquisition of a redundant lock for the escape pole pip pin.

AN INOPERABLE OR MALFUNCTIONING PIP PIN COULD CAUSE THE ESCAPE POLE TO FALL FROM SHUTTLE ORBITER'S MID-DECK CEILING

However, a single failure of the current pip pin fastener could cause the escape pole to inadvertently release from the Orbiter's mid-deck ceiling. As a result, the 275-pound crew escape pole could fall onto the astronauts seated in the Orbiter's mid-deck. Also, the weight and force of a falling pole could tear a hole into the Orbiter's exterior wall above the side hatch door. Such a tear in the Orbiter's exterior wall would cause a sudden loss of cabin pressure and potentially a loss of the Shuttle vehicle. Finally, if a pip pin failure caused the pole assembly to fall from the mid-deck ceiling during ascent or entry, the astronauts could not perform an emergency bailout.

RECOMMENDATION 4

The JSC Engineering Directorate and JSC Projects Office should identify reliable space fasteners with redundant safety features that can be used to replace the Criticality 1 pip pin that attaches the crew escape pole to the Shuttle Orbiter's mid-deck ceiling.

Management's Response

We concur with the recommendation. The Engineering Directorate and JSC Projects Office will initiate a search for a reliable fastener, with redundant safety features, that will lead to an assessment on replacing the existing pip pin on the Escape Pole.

Evaluation of Management's Responses

The actions planned by JSC are responsive to Recommendation 4.

RECOMMENDATION 5

The JSC Projects Office, if deemed feasible, should provide the necessary funds to purchase the space fasteners identified in Recommendation 4.

Management's Response

We concur with the recommendation. As stated in the above response to recommendation 4, efforts are under way to identify a reliable space fastener.

Evaluation of Management's Responses

The actions planned by JSC are responsive to Recommendation 5.

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GENERAL COMMENT

We appreciate the courtesy, assistance, and cooperation extended by JSC, KSC, Headquarters, and contractor personnel contacted during the audit.

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MAJOR CONTRIBUTORS TO THIS AUDIT

JOHNSON SPACE CENTER	Janice Goodnight, Acting Program Director, Human Exploration and Development of Space
	Ken Sidney, Auditor-in-Charge
	Ellis Lee, Auditor

National Aeronautics and
Space Administration

Office of Inspector General
Lyndon B. Johnson Space Center
Houston, Texas 77058

APPENDIX 1

Reply to Attn of:
W

May 8, 1995

TO: Johnson Space Center
Attn: AA/Director

FROM: W-JS/OIG Center Director

SUBJECT: Management Letter on Space Shuttle Safety
Assignment No. A-JS-94-005

The NASA Office of Inspector General (OIG) is performing an audit of Shuttle safety. The overall purpose of this audit is to determine whether Shuttle safety is adequate. As part of the audit, we developed an Astronaut Questionnaire (see Enclosure 2) to facilitate a record of the crew members' comments, opinions, and suggestions concerning Shuttle safety.

On August 24, 1994, we met with some Johnson Space Center (JSC) Flight Crew Operations Directorate (FCOD) managers and discussed our plans for issuing an astronaut questionnaire. The FCOD managers suggested that interviews with knowledgeable management personnel would provide a more informed source for response to questions regarding Shuttle safety. We explained that the OIG is very interested in obtaining the views of NASA management. Therefore, during July 1994, we conducted separate interviews at NASA Headquarters with the Deputy Associate Administrator for Space Flight (Space Shuttle); the Director, Space Flight Safety and Mission Assurance Division; the Director, Safety and Risk Management Division; and the Staff Director, Aerospace Safety Advisory Panel to obtain NASA's corporate views regarding Shuttle safety. However, we told the FCOD managers that it is imperative the Shuttle is, in fact, safe and perceived as such by the astronaut crews that operate the vehicle. We cited the following rationale why an astronaut questionnaire should logically be an integral part of our review of Shuttle safety.

- Astronauts play a pivotal role in the Shuttle program with enormous safety implications regarding planning, training, and operations. Can the flight crew perform effectively if safety concerns exist?;

- Astronauts occupy a unique position in the Shuttle program that is not duplicated elsewhere--they travel in the space vehicle;

- Astronauts assume a degree of risk unparalleled by other program participants;

- The astronauts' opinion/perspective on safety is a logical component of a safety audit; and

- It is extremely beneficial to determine if the astronauts have any personal safety concerns or can identify potential Shuttle issues that require management attention.

The FCOD managers generally agreed with our rationale for wanting to know how the astronauts feel about Shuttle safety. However, they expressed concerns regarding: (1) the "factual bases" for individual crew responses to the questionnaire; and (2) the potential divisiveness that unsubstantiated crew comments could create between the Astronaut Office and cognizant NASA support organizations, i.e., safety, mission operations, engineering, etc. In response to the concerns raised by the FCOD managers, we modified our questionnaire. The crew members were asked to specify how long they have been astronauts and consider their flight experiences and training when answering the questions. Further, we agreed to meet with the FCOD managers to discuss and ensure the validity of the questionnaire results before including such information in an audit report.

The astronaut questionnaire was initially sent out on August 29, 1994, and resubmitted on September 27, 1994. One hundred and four questionnaires were sent out and 68 responses were received. We found that the majority of the astronauts expressed no serious safety concerns and believe NASA management has made the Shuttle program as safe as possible considering the current configuration, i.e., mature state of the Shuttle hardware, and economic environment. Also, crew members generally feel that the Shuttle Program Office listens to their concerns.

However, there were several crew responses that we believe warrant NASA management attention. Those astronaut responses are listed in Enclosure 1. Questions where the astronauts expressed no serious concerns are omitted. On March 3, 1995, we met with the FCOD managers and discussed the crew responses in Enclosure 1. The FCOD managers expressed minor concerns over some comments regarding training but, overall, indicated that the astronaut responses were generally accurate.

We hope that the astronaut responses contained herein will assist NASA management efforts to ensure Shuttle safety. Since we did not validate or perform a detailed review of the astronaut responses, there will be no formal recommendations on this audit based upon the crew comments. We appreciate the astronauts' openness and diligence in responding to the questionnaire. Also, the overall crew response rate was enhanced by FCOD's management support and cooperation in this matter.

Our Acting Deputy Assistant Inspector General for Auditing will transmit a copy of this management letter to Codes M and Q. If you have any questions or desire additional information, please call Janice Goodnight, Audit Manager, or me at extension 34773.

W. Preston Smith

Enclosures

cc:
JSC-BU/D. Westfall
HQs-W/C. Little
JMC/P. Chait

Space Shuttle Safety Review
A-JS-94-005

Summary of Responses to Astronaut Questionnaire

Each of the following bullets is an individual astronaut response to the question that was asked.

QUESTION #2. Comment on training procedures that should be modified to improve Shuttle safety.

- Budget pressures have pushed people and facilities to a bare minimum. The tremendous station assembly challenge will burn people out.
- Budget cuts have adversely impacted the astronauts' input to operational development and the ongoing research and testing to improve flight techniques and procedures that include training.
- Fly crew more often and train to fly as a crew. Reduce long technical assignments that interfere with training.
- Use of a mission specialist training aircraft to shuttle astronauts back and forth to training in Huntsville would reduce aircrew fatigue.
- Make simulators work correctly, multiple simulators, all with different models and lack of state of the art visuals.
- Add two organized reviews of vehicle Loss of Control (LOC) as a crew. Currently, LOC is a table top review.
- Training improvements would be in the areas of workload preflight and ground controllers.

QUESTION #4. Is NASA management receptive to astronaut concerns regarding Shuttle safety? Explain.

- Yes, unless it costs them money or makes the Shuttle weigh more.

  example #1 The crews who fly the Shuttle would like to have a better escape system (i.e., ejection seats).

  example #2 NASA management wants to raise crosswind limits for the Return to Launch Site abort contingency. The crew office doesn't really like the idea. However, it will probably help launch probability. Therefore, the program managers will probably raise the limits anyway.

QUESTION #4. (cont.) **Is NASA management receptive to astronaut concerns regarding Shuttle safety? Explain.**

- Yes, they listen politely but their budgets are limited. The really important improvements to Shuttle safety, assisted egress from the crew compartment during powered flight, have never been considered seriously enough.

- In an environment of reduced resources, it often becomes the task of the person raising a safety concern to prove there is a problem rather than the task of the system to prove their plan of operation is really safe despite the expressed concern.

- Depends on the issue. Why do we continue to push for increased crosswind limits without crosswind Detailed Test Objective? Let's get a landing with 10 knots of crosswind so we can feel confident landing with 15.

- Only if budget will allow and/or the software memory will allow and/or there are no other operational issues which get more attention. In software, it's very difficult to sell an expensive software change for a (10) -8 probability of occurrence (i.e., 3-engine out) if it's competing with an operational change we'd use every flight. Software should insure crew safety by doing things the crew can't do, especially during degraded ops.

- I'm not sure. There seem to have been several issues (landing at KSC, clearing... Shuttles for launches with known problems) in which there was significant disagreement within the astronaut office over possible safety issues.

- Sometimes they are and sometimes they are not. Two examples: In 1993 the Return To Launch Site crosswind limit was waived in order to launch STS-52. I never heard a rational technical argument that supported waiving this Launch Commit Criteria. In 1989, 1990, or 1991, NASA management decided to start landing at KSC against the recommendations of JSC's Flight Crew Operations and Mission Operations directorates. These groups recommended delaying returning to KSC for end of mission until after the orbiters received the dragchute, new brakes and improved nose steering.

QUESTION #7. **What are some suggested improvements/changes that would enhance Shuttle safety? What safety procedures need to be revised or updated to be more effective?**

- NASA is making arbitrary budget cuts to the Shuttle to preserve dollars for Station. This will lead us to cut budgets below the safety threshold until it bites us.

- Pay more attention to crew 16-hour work days. This may cause mental fatigue and subsequent error.

QUESTION #7. (cont.) **What are some suggested improvements/changes that would enhance Shuttle safety? What safety procedures need to be revised or updated to be more effective?**

- Spacing out the launch schedule so there's more time between landing and the next launch.
- Use available technology to obtain real time wind data at launch and landing sites, using wind balloons yields potentially inaccurate data.
- Hazard review process should be reviewed/streamlined/baselined/or eliminated.
- Emphasize personnel attitudes and critical effect on safety.
- Don't let budget cuts lull us into cutting training or margin of safety.
- Emphasize a fleet leader analysis program to analyze aging equipment.
- De-emphasize reports, paperwork and accounting.
- Improvements to Space Shuttle Main Engines & turbopumps is critical and ongoing.
- A new pressure garment is needed for launch and re-entry.
- Ensure the Shuttle program is funded properly.
- Add ejection system or crew module separation mechanism for powered flight, if you are serious about improving our chances of survival during a Shuttle accident.
- Upgrade cockpit to Multifunctional Electronic Display System and fund follow-on's.
- Incorporate a functional Global Positioning System.
- The intact abort capability should be enhanced, down range aborts to runways.
- Fly sleep stations on single shift flights.
- Target 39 degrees inclinations to avoid sleep shifting when performance and payload allow higher than 28.5 degrees.
- Automate three engine out aborts in software.
- Develop better abort capabilities for 51.6 degrees inclination launch, and the implementation of a Global Positioning System.
- Preservation of talent in Shuttle workforce at KSC/JSC.

QUESTION #11. How might the crew escape system be improved to facilitate crew safety should emergency evacuation become necessary during the Shuttle ascent and landing phases?

- Install ejection seats.
- Have a crew escape capsule on a future vehicle.
- Lighter and less bulky suits.
- ACES suits are coming on line slowly and are better suits.
- Liquid cooling needed for all on a crew.

QUESTION #12. Do you know of any cases where Shuttle payload, or ferry hardware were not adequately certified for flight? If so, elaborate.

- No, but certification for late breaking changes close to flight is shaky, especially in payloads. STS-39 Infrared Background Signature Survey/Shuttle Pallet Satellite sun sensor improper software code resulted in improper altitude -- could have lost all science. STS-51: Super zip fired in improper sequence resulting in shrapnel in payload bay. STS-46 late added bolt to cable reel caused reel to stop unwinding -- could have jammed and caused safety concern.
- I think the tethered Satellite System failure (caused by an improperly added bolt to the tether housing or an inadequately understood addition) and the control system failure of the Wake Shield Facility.
- We inadvertently did some entry flight tests on STS-50 which placed the elevons out of our certification envelope (from a thermal standpoint).
- One of the biggest areas that needed work was toxic/hazard materials associated with payloads in spacelab, spacehab, or mid-deck environment.

QUESTION# 13. Describe any instances where the issuance of flight waivers resulted in unsafe flight operations.

- The only one that comes to mind right off is STS-52 when the Mission Management Team (MMT) re-interpreted/over-ruled the Return to Launch Site (RTLS) crosswind landing rule, against the recommendation of the Flight Director. It was <u>potentially</u> unsafe, not <u>actually</u> unsafe, because they did not do an RTLS!

QUESTION# 13. (cont.) Describe any instances where the issuance of flight waivers resulted in unsafe flight operations.

- I think the only example I can give really didn't take a waiver (as I recall) but a change in "rule interpretation," that was the crosswind exceeded for the launch of STS-52. Houston Flight was not "GO" based on his interpretation of the wind readings at the Shuttle Landing Facility, yet the MMT had a different view of the readings given by the wind towers. We have since changed our rules to make this case less ambiguous. But on that particular day we probably should not have launched. In general, I think waiver processing is treated very seriously and never accomplished without adequate rationale.

- Auxiliary Power Units (APUs) on STS-46 and STS-43. We flew with known, "understood" problems to say we could get one more flight on some hardware and save Orbiter Processing Facility time. As it turns out, not only did we not understand the problem, we had trouble on other APUs. We have dodged several bullets in the name of schedule and expediency.

QUESTION #14. Comment on Shuttle hardware/software issues that may compromise safety of the crew, vehicle, or mission?

- The biggest challenge in the safety area are the mods to increase payload weight to orbit for station lift requirements, and flight rule changes to make the 5 minute station launch windows. We will reduce operating margins and increase risk no matter what anyone says about it.

- The lack of three engine out capability (specifically hardware capability of external tank-orbiter attach support structure is a concern).

- Lack of budget that makes us force a system or software to really be broke; or we won't fix it.

- The range safety boundaries compromise crew safety on 57 degrees inclination launches. The crew must delay a contingency East Coast Abort Landing to avoid crossing the range safety boundaries and subjecting themselves to being destroyed. The range safety package theoretically protects a person on the ground from being killed by the external tank's return to earth. The range safety destruct package (explosives) present an unnecessary risk to astronauts.

- Why don't we have Global Positioning System so we can emergency de-orbit to a multitude of runways around the world? We have them in the T-38 and don't have them in the Shuttle.

QUESTION #14. (cont.) Comment on Shuttle hardware/software issues that may compromise safety of the crew, vehicle, or mission?

- There are hardware and software improvements that are driven by safety concerns. Many of these are in development and not yet implemented in the program. Some of these include: main engine upgrades, additional contingency abort software, Multifunctional Electronic Display System, Advanced Crew Escape System, Global Positioning System, On-board display capability, improved Thermal Protection System. Some improvements are not implemented as rapidly as we would like to see, normally due to budget cuts. Improvements that have been recently incorporated include: carbon brakes, dragchute, auto contingency abort, and liquid cooling.

QUESTION #15. Do you feel that the Shuttle program is safe? Address the strengths and weaknesses.

- In general, yes. I still think the pressure to launch and meet the schedule is too much of a factor for launch decisions. I have concerns that the poor morale (due to layoffs, budget cuts and poor leadership) may influence safety in the future. Budget cuts may directly increase risks and impact safety.

Enclosure 2

NAME _____ DATE_____

NASA OFFICE OF INSPECTOR GENERAL
Johnson Space Center
Houston, Texas 77058

Space Shuttle Safety Review
A-JS-94-005

Astronaut Questionnaire

1. To what extent has Shuttle safety been incorporated into crew training?

2. Comment on training procedures that should be modified to improve Shuttle safety.

3. Are there adequate avenues available to express safety concerns and issues without fear of reprisal? If not, what changes do you recommend?

4. Is NASA management receptive to astronaut concerns regarding Shuttle safety? Explain.

5. What input or direct involvement do you have for ensuring Shuttle safety?

   Is the current level of astronaut involvement appropriate? Explain.

6. How long have you been with NASA? Astronaut tenure? Have you worked on any safety review panels? Which Shuttle missions have you flown?

7. What are some suggested improvements/changes that would enhance Shuttle safety? What safety procedures need to be revised or updated to be more effective?

8. Do you feel adequately informed about the safety risks associated with Space Shuttle flights? Explain.

9. On the morning of August 18, 1994, mission STS-68 was aborted on the launch pad within two seconds of the scheduled lift-off when onboard computers shutdown the Shuttle main engines. Are the procedures for crew evacuation, under these circumstances, adequate? Explain.

10. How do you feel about the Crew Escape System (CES) and the opportunity(ies) that it affords for crew evacuation during the Shuttle's ascent-to-orbit and landing phases? Comment on the flight conditions (altitude range, vehicle speed, etc.) that must prevail, along with the probability that such conditions can be obtained in order that the CES be used during Shuttle ascent and landing.

11. How might the CES be improved to facilitate crew safety should emergency evacuation become necessary during the Shuttle ascent and landing phases?

12. Do you know of any cases where Shuttle, payload, or ferry flight hardware were not adequately certified for flight? If so, elaborate.

13. Describe any instances where the issuance of a flight waiver(s) resulted in unsafe flight operations.

14. Comment on Shuttle hardware/software issues that may compromise the safety of the crew, vehicle, or mission.

15. Do you feel that the Shuttle Program is safe? Address strengths and weaknesses.

National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
2101 NASA Road 1
Houston, Texas 77058-3696

APPENDIX 2

MAY 31 1996

Reply to Attn of: BU

TO: W-JS/OIG Audit Field Office Manager

FROM: AA/Director

SUBJECT: Management Response to Draft Audit Report, Space Shuttle Safety Review, Assignment No. A-JS-94-005

Because of earlier meetings held to discuss the findings of this audit, JSC opted to respond directly to the draft audit report and waive an exit conference. We have addressed the recommendations and findings individually in the enclosure. In addition, we acknowledge the statement found in the management letter dated May 8, 1995, which transmitted a summary of the questionnaire to the astronauts. As shown in this letter, the majority of the astronauts expressed no serious safety concerns and believe NASA management has made the Shuttle program as safe as possible.

With actions taken or procedures in place that we consider responsive to the recommendations, and your acceptance of those actions, recommendations 1, 2 and 3 will be considered closed upon issuance of the final report. If you have any questions, please contact Pat Ritterhouse at 483-4220.

George W. S. Abbey

Enclosure

cc:
CA/D. C. Leestma
EA/L. S. Nicholson
DA/J. D. Shannon
FA/J. H. Greene
SA/D. Short
HQ/JM/P. I. Chait

Management Response to Draft Audit Report, Space Shuttle Safety Review, Assignment No. A-JS-94-005

Auditors Findings

"The Shuttle crew escape system and related crew egress training procedures should provide the capability for astronauts to safely escape the Shuttle Orbiter during emergency situations. After exposure to the microgravity environment of low Earth orbit, astronauts must be sufficiently strong, mobile, and adequately trained to perform NASA's prescribed emergency egress procedures."

Recommendation 1

"The Space and Life Sciences Directorate's Medical Sciences Division should determine the extent that the weight and mass of the crew escape equipment reduce/obstruct crew mobility following an extended exposure to microgravity."

JSC's Comments

We concur with the recommendation. The Space and Life Sciences Directorate has reviewed the audit findings regarding the impact of weight and mass of the crew escape equipment in emergency egress following extended exposure to microgravity. While weight and mass is a factor in emergency egress, all organizations work together to make the Shuttle program as safe as possible.

There are two primary types of crew escape: (1) bail-out before landing, followed by parachute descent into ocean or onto land, and (2) egress from the Orbiter after some sort of landing. Both probably put the same stress on the crewmember from seat egress through side-hatch egress, except bail-out requires carrying the parachute along, whereas post-landing does not. Data show the single greatest orthostatic stress in space flight occurs on first standing up after landing. Post-landing readaptation is rapid. Either of these types of crew escape could be unaided or aided by other crewmembers, and egress from the Orbiter after some sort of landing could conceivably involve aid from the crash rescue team.

Even without the parachute, the physical loads of egress, escape slide or rappelling down from an overhead window, and then ambulating "x" meters upwind will be substantial. The hardware will all weigh more or less the same, but astronauts come in a wide range of sizes, so the relative load on a small astronaut will be proportionately greater than the relative load on a large astronaut. Orthostatic worst case is bail-out, due to hanging in a parachute harness which is an ideal way to sequester blood volume in the passive legs. The post-landing egress involves less orthostatic stress, more exercise stress.

Recent data from exercise investigations suggest that crewmembers may not be able to walk immediately after landing even with minimal weight on their backs. Th effect of adding additional weight would be to further hinder their ability to move 400 meters in a minimal period of time (our goal is 5 minutes). The slower they move, the more likely

Enclosure

they will run out of oxygen, resulting in having to open their helmets and breathe air potentially containing toxic fumes. There is probably a direct relationship between weight carried and speed of locomotion. If it takes crewmembers more than about 8 minutes to get 400 meters away (the assumed safe distance), then they will run out of air.

Neuroscience investigations indicate that crewmembers experience significant postural and locomotor disturbances following space flight. The Launch Escape Suit (LES) parachute combination introduces a greater stresser to postural stability particularly in smaller crewmembers. The added weight and physical constraining properties of the LES may bring crewmembers closer to their instability boundaries during the critical early readaptation phase immediately after flight.

Some egress scenarios may require jumping from a particular height. Our experimental data indicate that unsuited subjects experience significant modification in the ability to program the lower limbs to effectively absorb energy on impact following a voluntary jump (30 cm in height) after flight. This change in motor control is a neural adaptation related to alterations in central nervous system reinterpretation of acceleration following the space flight. The operational implication is that crewmembers have a higher probability of falling post flight following even a relatively small jump. However, even if the landing following the jump is successful, more energy is transmitted through the body up to the head which in turn will exacerbate on-going neuro-vestibular disturbances. This change in energy modulation will also contribute to oscillopsia (blurred vision) during any running required followng an emergency egress. The additional mass provided by the LES may increase the severity of these problems.

We consider the current procedures and the on-going investigations as responsive to the recommendation, and with your acceptance of these actions, this recommendation will be considered closed upon issuance of the final report.

Recommendation 2

"The Mission Operations Directorate's Space Flight Training Division should collaborate with the Medical Sciences Division to develop and implement flight crew training procedures that appropriately relate to the physical requirements of an emergency egress after exposure to microgravity."

JSC Comments

We concur with the recommendation. We believe that all reasonable methods are currently being used to acquaint and prepare the crews for the environments that might be associated with the various emergency egress modes. We continue to look for improvements in the tools and techniques for providing effective training as well as working to reduce the probabilities of having to invoke an emergency. A study on locomotion postflight is being conducted, with STS-75 crew the first participants. For this study, crewmembers will exit into the Crew Transfer Vehicle (CTV) and walk on a treadmill in the back of the CTV wearing the full Launch Escape Suits/Advanced Crew Escape Suits (LES/ACES). Results of this study could reveal information that might lead to changes in the egress training.

The Mission Operations Systems Division performs crew emergency egress training which covers the crew escape suit, pad emergency egress training, postlanding emergency egress (slide), and bailout. There is no reasonable way to simulate a deconditioned state during egress training that does not significantly increase the risk of injury to crewmembers, or that is too impractical. To subject the crew to bed rest or add-on weights would impose far greater risk of injury to the crew in training than the risk of having to use one of the emergency escape modes. The MOD Crew Systems personnel continue to work with the medical branch concerning a project designed to evaluate the way NASA currently trains astronauts for stressful situations. In order to gain more insight, medical personnel will participate as suited subjects in the Weightless Environment Training Facility (WETF) bailout sessions and in a modified version of the Escape Procedures. In addition, the Engineering Directorate is working on lighter-weight equipment such as parachutes and harnesses.

For normal Shuttle flights, the major effects seen at landing are orthostasis and neurovestibular effects. The incidence of orthostasis is about 10 percent and is usually mild. For the most part, if crews exercise, maintain hydration inflight, fluid load properly, use the G-suit and liquid cooling, they have minimal symptoms if any. Orthostasis does not seem to worsen with increasing mission length. While studies indicate that a week of bed rest can give similar effects, this is not practical.

Neurovestibular symptoms affect postflight, to a mild degree, about 93 percent of the flown people. About 9 percent have severe symptoms with severe balance instability, moderate to severe motion illusions (vertigo), and severe nausea and vomiting. There are no known preventatives nor ways to simulate this effect while on the ground, but prophylactic medications are available for crewmembers with histories of severe symptoms, and crew are briefed extensively by the crew surgeon before flight. New crewmembers are also briefed about the expected environments by experienced crews and by the crew escape instructors based on multiple interviews with experienced crews.

For missions of Space Station length, muscle deconditioning is expected in addition to the above problems. The amount of muscle deconditioning varies by individuals but can be decreased by inflight exercise. Bed rest of at least a week would be required to simulate this environment. Additional weight during training would significantly increase the risk of injury to crewmembers. Crews are informed of the likely environment and are trained to invoke the "buddy" system for station crew-return flights. Medical personnel brief the crew twice during their training flow on the effects of microgravity on the human body and potential problems which might result. When a long-duration crew is returned from a station, they are placed in reclining (recumbent) seats on the mid-deck. A member of the Space Shuttle crew is flown in the mid-deck with them to assist during any type of egress, including emergency egress. In training exercises, the returning station crewmembers train jointly with the Shuttle crewmembers for all phases of flight and for all emergency egress scenarios including egress by parachute during freeflight and by the hatch/chute while on the ground. An example of this type of training occurred for STS-71 with the MIR-18 crew training with the Shuttle crew prior to launch. The mid-deck astronaut worked with the three returning cosmonauts (who would be in space for more than 90 days) to develop techniques for rapid egress, even when the long-duration crewmember was completely immobile. All crews on flights

bringing back MIR crewpersons are given extra training in the recumbent seats. We expect this type collaborative training to continue.

We consider the current procedures and the on-going studies as responsive to the recommendation, and with your acceptance of these actions, this recommendation will be closed upon issuance of the final report.

Auditors Findings

"Based on biographical data, we determinded that 29 (28 percent) of NASA's 104 astronauts weighed 150 pounds or less. For this group of astronauts, the escape equipment represents 60 percent or more of their body weight. The heavier elements of the crew escape equipment are the 16.5 pound advanced crew escape suit overalls, the 20.5 pound torso harness and harness sub-assembly, and the 26.2 pound parachute assembly. NASA engineers advised us that the weight of the parachute assembly could be reduced by 8 to 10 pounds. This parachute modification would cost the Shuttle program an estimated $500,000 to $600,000 primarily for certification testing. We believe that reducing the weight of the crew escape equipment would enhance the crew's ability to perform an emergency egress and offset any hardware modification costs by allowing NASA to lift heavier payloads on STS missions."

Recommendation 3

"The Engineering Directorate's Extra-Vehicular & Spacesuit Systems Branch should identify hardware modifications and, where feasible, the JSC Projects Office provide adequate funding so that the weight of the crew escape equipment is reduced and crew mobility is enhanced."

JSC Comments

We concur with the recommendation. The Engineering Directorate is presently addressing alternatives for reducing escape equipment weight. An effort is under way to reduce the weight and descent rate of the present parachute. The amount of weight reduced will be small as reducing the overall weight of the escape system would require deletion of specific survival equipment. The implementation of the full pressure escape suit (the advanced crew escape suit-ACES) will improve mobility. With the addition of the thermal electric cooling system (TELCS), the crew comfort during entry and postlanding is greatly enhanced, resulting in improved crew physiologic condition at end of mission.

With the actions currently under way, and your acceptance of those actions, this recommendation will be closed upon issuance of the final report.

Auditors Findings

"A Criticality 1 pip pin that fastens the 275 pound crew escape pole to the Orbiter's middeck ceiling does not have a redundant lock and, in effect, is a single point failure. Two retention balls at the end of the pip pin provide the sole safety locking mechanism."

Recommendation 4

"The JSC Engineering Directorate and JSC Projects Office should identify reliable space fasteners with redundant safety features that can be used to replace the Criticality 1 pip pins that attach the crew escape pole to the Shuttle Orbiter's middeck ceiling."

JSC Comments

We concur with the recommendation. The Engineering Directorate and JSC Projects Office will initiate a search for a reliable fastener, with redundant safety features, that will lead to an assessment on replacing the existing pip pin on the Escape Pole.

Recommendation 5

"The JSC Projects Office, if deemed feasible, should provide the necessary funds to purchase the space fasteners identified in Recommendation 4."

JSC Comments

We concur with the recommendation. As stated in the above response to recommendation 4, efforts are under way to identify a reliable space fastener.

IG-98-013

AUDIT REPORT

DISSEMINATION OF EARTH SCIENCE PROGRAM DATA AND INFORMATION

JUNE 8, 1998

National Aeronautics and Space Administration

OFFICE OF INSPECTOR GENERAL

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NASA Headquarters
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Washington, DC 20546

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ACRONYMS

DAAC	Distributed Active Archive Center
EOS	Earth Observing System
EOSDIS	Earth Observing System Data and Information System
ESDIS	Earth Science Data and Information System
FY	Fiscal Year
JPL	Jet Propulsion Laboratory
OES	Office of Earth Science

TABLE OF CONTENTS

DISSEMINATION OF EARTH SCIENCE PROGRAM DATA AND INFORMATION

EXECUTIVE SUMMARY

INTRODUCTION

The Earth Science Program is a scientific endeavor seeking to provide understanding of the Earth and how it is changing, both naturally and as the result of human interaction. The Earth Science Program comprises integrated spacecraft and measurement capabilities; information management systems to acquire, process, archive, and distribute global data sets; and research and analysis programs to convert data into new knowledge of the Earth.

AUDIT OBJECTIVE

The audit objectives were to determine whether (1) NASA's efforts to disseminate Earth Science Program information accomplish the program's goals and (2) NASA explored cost-efficient and effective methods to disseminate Earth Science Program information.

RESULTS OF AUDIT

Earth Science Program and Earth Science Data and Information System (ESDIS) project officials have made significant strides toward creating an advanced system network capable of disseminating the program's data and information products. Further, the Distributed Active Archive Centers (DAACs) have taken initiatives to enhance services by creating web sites and products that will make Earth Science Program data and information more accessible (Exhibit 1 highlights DAAC management best practices that successfully improved operations through reinvention and innovation). The audit showed that Earth Science Program data and information products are designed to support the scientific research community. Although stated Agency goals are to disseminate and enable the productive use of Earth science data and information by a broad spectrum of users, the Earth Science Program is not meeting its goals. The program is not meeting its goals because four of the five intended user groups are not making significant use of the program's data and information products. We were unable to evaluate the cost-effectiveness of dissemination efforts because neither NASA nor the DAACs account for dissemination costs.

RECOMMENDATIONS

We made recommendations to establish and fund a formal outreach plan to focus dissemination efforts on nonscientific customers and to integrate customers more fully into ESDIS data dissemination activities. Management concurred with the report recommendations, and we consider planned actions responsive.

BACKGROUND

The Earth Science Program (formerly known as Mission To Planet Earth), NASA's contribution to the U.S. Global Change Research Program, is a scientific endeavor seeking to provide understanding of the Earth and how it is changing, both naturally and as the result of human interaction. The Earth Science Program comprises an integrated slate of spacecraft and in situ measurement capabilities; data and information management systems to acquire, process, archive, and distribute global data sets; and research and analysis programs to convert data into new knowledge of the Earth. The Earth Observing System (EOS), the centerpiece of the Earth Science Program, is a program of multiple spacecraft and interdisciplinary, investigative science teams to provide a 15-year data set of key parameters needed to understand global climate change. For Fiscal Year (FY) 1997, the Earth Science Program budget was approximately $1.4 billion.

Earth Science Program officials established the ESDIS Project Office to oversee the Earth science data and information products. The ESDIS Project Office, at the Goddard Space Flight Center, performs program oversight for the EOS Data and Information System (EOSDIS) and the DAACs. The DAACs are the operational data management and user services arm of the EOSDIS. DAACs have responsibility for Earth Science Program/EOS data ingest; data product generation; archive, catalog, distribution, and user support--in other words, getting the data and information to the public. A total of eight DAACs, in various regions of the United States, will carry out this activity. NASA selected the DAACs based on their host institution's existing expertise in various scientific areas relating to the study of changes in a global environment.

The EOSDIS network connects the eight DAACs. After entering the network, a user can request products from any DAAC. While automated access is the most common method for obtaining data, less sophisticated users may obtain data and information simply by telephone or written requests for data products.

Each DAAC manages specific data product libraries related to its scientific area of expertise. DAAC product libraries consist of data and information from Earth Science Program and EOS remote sensing satellite missions. Data may include satellite instrument measurements

taken over a given period or area, or images taken directly from remote sensing satellites. Generally, "data" serve scientific users, that is, researchers and scientists. "Information," as opposed to data, involves higher level applications that use and interpret data measurements. Information makes remote sensing data useful to nonscientific users, that is, the commercial sector, the educational community, and the general public. (Exhibit 2 lists the DAACs, along with their areas of expertise and FY 97 budgets.)

OBJECTIVES, SCOPE, AND METHODOLOGY

OBJECTIVES

The audit objectives were to determine whether:

- NASA's efforts to disseminate Earth Science Program data and information accomplish the program's goals.
- NASA has explored cost-efficient and effective methods to disseminate Earth Science Program data and information.

SCOPE AND METHODOLOGY

This audit is one of three performed to assess various scientific aspects of the Earth Science/EOS programs. We performed this audit because wide dissemination of Earth Science Program data and information is critical to meeting the goals of the program's Strategic Enterprise Plan. The audit reviewed combined efforts by the Earth Science Program Office, the ESDIS Project Office, and the DAACs to disseminate Earth science data and information products. The audit focused on dissemination efforts to reach users outside the scientific researcher community.

The audit included examinations and tests of applicable records and documentation, dated from August 1996 to September 1997. Specifically, we conducted interviews of Earth Science Program, ESDIS, and DAAC officials and reviewed policies, procedures, and documents relevant to the audit objectives. We also conducted two surveys: (1) a judgementally selected sample of Earth Science Program data and information requesters and (2) user working group members from DAACs at the Earth Resources Observation System Data Center and the National Snow and Ice Data Center.

AUDIT FIELD WORK

We performed audit field work from March 1997 through January 1998 at the following six locations:

- NASA Headquarters, Washington, D.C.
- Goddard Space Flight Center, Greenbelt, Maryland
- Langley Research Center, Hampton, Virginia
- Earth Resources Observation System Data Center, Sioux Falls, South Dakota
- National Snow and Ice Data Center, Boulder, Colorado
- Jet Propulsion Laboratory (JPL), Pasadena, California

We conducted the audit in accordance with generally accepted government auditing standards.

OBSERVATION AND RECOMMENDATIONS

NASA NEEDS TO IMPROVE EFFORTS TO WIDELY DISTRIBUTE EARTH SCIENCE PROGRAM DATA AND INFORMATION

NASA's dissemination efforts have not resulted in a highly diverse customer base for Earth Science Program data and information. Only the scientific research community has been making significant use of the program's data and information. Other users, such as the commercial, technological, public sector, educational, and the general public have not made significant use of Earth Science Program data and information. This condition occurred because:

- the ESDIS Project Office has not emphasized customer outreach activities,
- DAAC user working groups are not diversified, and
- ESDIS project officials did not follow up on the user model conference report.

As a result, NASA's Earth Science Program data and information are not reaching four of its five intended user groups. Consequently, four of the intended user groups will not achieve their desired results.

STRATEGIC ENTERPRISE PLAN DEFINES PROGRAM GOALS

The Earth Science Program's mission is "to develop understanding of the total Earth system and the effects of natural and human-induced changes on the global environment." The Mission To Planet Earth Strategic Enterprise Plan, 1996 through 2002 defines three goals to further the program mission. Two of these goals are:

- Disseminate information about the Earth system.
- Enable the productive use of the program's science and technology in the public and private sectors.

The strategic enterprise plan illustrates NASA's vision of a broad spectrum of users as shown in Exhibit 3. The plan more specifically defines this broad spectrum by classifying users in one of five categories: scientific researchers, commercial users, public sector users, educational community and general public, and technology users. In addition, the plan describes desired results each of the user groups can accomplish using Earth Science Program data and information. Exhibit 4 shows the desired results.

DIVERSE CUSTOMER BASE DOES NOT EXIST

A highly diverse customer base for Earth Science Program data and information do not currently exist. The majority of customers

requesting products from the DAACs are from the scientific research community. Although we attempted to quantify customers from the various user communities, the DAACs could not provide accurate statistics for the total percentage of nonscientific customers. Current DAAC practices do not include a data collection mechanism to determine the number of scientific and nonscientific customers.

Managers from each DAAC we visited described most of their customers as scientific users, specifically, Earth Science Program Instrument or Interdisciplinary Science Team members, NASA or federally funded researchers, or academic institution researchers. While most DAAC managers could identify some customers from the educational community, few could identify specific customers from the commercial, public, or technology sector communities.

In an attempt to quantify nonscientific users at two of the DAACs visited, we surveyed a judgmentally selected sample of actual data or information requesters. Since the DAACs do not record how requesters use the data, two user services managers gave us listings of requesters believed to be nonscientific users. Discussions with 22 of the requesters showed that only 8 used the data for nonscientific purposes. The remaining 14 used the data for scientific purposes.

The eight nonscientific requesters used or are attempting to use the data for the following purposes.

NONSCIENTIFIC USES OF EARTH SCIENCE DATA AND INFORMATION

Requesters	Data and Information Uses
4 Education Users	1. Publication of college-level text books. 2. K-12 Science Projects. 3. K-12 Educational maps. 4. Products under development.
2 NASA Users	1. Validation of EOS Science Data Plan. 2. JPL Scientific and Outreach Programs.
2 Commercial Users	1. Commercial software under development. 2. Publish maps with pipeline or electrical overlays.

Our sample showed that two (one each from the educational and commercial communities) of the eight nonscientific users are still in the developmental stages for their products.

We identified three primary causes, discussed below, that have contributed to the lack of a highly diverse customer base.

ESDIS PROJECT OFFICE HAS NOT EMPHASIZED CUSTOMER OUTREACH ACTIVITIES

The ESDIS Project Office has not established formal outreach plans for dissemination efforts and does not require the DAACs to prepare such plans. In addition, the ESDIS Project Office does not separately fund outreach programs in the annual DAAC budget request. ESDIS project officials stated that they do not mandate how much the DAACs spend on outreach unless a DAAC requests approval for a specific outreach project.

ESDIS project officials consider the user services group to be the focal point for outreach activities. This group, consisting of the user services manager from each DAAC, identifies conferences and other outreach events. The group then assigns staff from the DAACs to attend events related to their scientific areas of expertise.

According to ESDIS project and DAAC officials, the major reason for insufficient outreach is lack of funding. Generally, program officials support outreach activities if they do not negatively affect the DAACs' responsibilities to process Earth science data in support of NASA's science research priorities. Consequently, most of the DAAC user services managers stated that while they would like to do more in the outreach area, funding constraints prohibit these efforts. To meet the goals of the strategic enterprise plan, Earth Science program officials should establish and fund a formal outreach plan.

DAAC USER WORKING GROUPS ARE NOT DIVERSIFIED

The DAAC user working group memberships are not diverse. User working groups are advisory panels for each DAAC, made up of EOS interdisciplinary investigators and members of the broader Earth science community that each DAAC serves. DAAC user working groups directly affect customer focus because they approve DAAC data and information activities. Specifically, the groups set priorities for the data to be collected, processed, archived, and distributed at each DAAC and provide other user services.

Individuals with EOS, Earth science, or other scientific research backgrounds made up 100 percent of the user working group memberships at four DAACs we visited (JPL, Langley Research Center, National Snow and Ice Data Center, and the Earth Resources Observation System Data Center). Because NASA funds the DAACs'

operations, DAAC managers must be responsive to the advice and recommendations of their respective NASA-appointed user working group.

We surveyed 24 user working group members from two DAACs. Sixteen of the members responded to the survey. Of those 16, 11 responded that the Earth science community was the primary customer for their DAAC. When asked about official priorities for data dissemination, six stated that Earth Science Program/EOS and Earth scientists were priority while six stated that the data and information were available to anyone. The remaining four either did not know official priorities or did not respond.

We also asked how the DAACs were reaching the broader community, particularly those users outside the scientific community. Responses ranged from participation at conferences and establishing web sites to data does not lend itself to nonscientific users. Some members responded that outreach is important as long as it is not a detriment to the Earth science community. Others suggested that outreach should be funded through joint efforts or special grants.

Although 90 percent of those surveyed supported outreach, primarily through conferences and web sites, approximately 70 percent viewed the Earth science community as the DAACs' priority. One way to ensure that a highly diverse customer base develops for Earth Science Program data and information is to diversify the composition of the DAAC user working groups. Diversification would ensure that dissemination efforts are equally emphasized among a broader spectrum of users than the Earth science community.

ESDIS Project Officials Did Not Follow Up on User Model Conference Report

In 1995, the ESDIS Project Office held a user model conference to identify potential customer groups. The stated purpose of the conference was to provide an authoritative statement of the needs and characteristics of potential EOSDIS users. The conference participants defined 12 potential user group categories for Earth Science Program data and information as follows:

1. Retrospective Research
2. Field Campaigns and Individual Data Providers
3. Persistent Information Production for Research
4. Scientific Environmental Assessment
5. Commercial Users
6. Operational Users
7. Resource Planners and Managers

8. Policy Formulation and Decision Making
9. Legal Community
10. K-12 Education
11. Collegiate and Professional Education
12. Libraries, Press, and the Public.

The user model conference participants issued a report with specific conclusions and recommendations for each potential user category. The conference report also contained general conclusions and recommendations considered significant by all the participating groups.

Four of the seven general conclusions were:

1. The potential user community is large, diverse, and has many shared values and needs.

2. All potential user groups believe they could benefit from EOSDIS.

3. Under current resource allocations, EOSDIS cannot support everyone.

4. Awareness and information about EOSDIS are inadequate.

Four of the general recommendations were:

1. EOSDIS personnel must continually evaluate user needs and seek to improve feedback mechanisms.

2. EOSDIS personnel should work to meet the needs of the broader user community directly and through partnerships.

3. EOSDIS personnel should seek innovative ways to educate the potential user community about the utility of their data, information, tools, and services.

4. EOSDIS personnel should convene a follow-on conference in approximately 2 years to review the success achieved in meeting the needs of the broader user community.

Although the conference participants issued a formal report with recommendations, the ESDIS Project Office did not take any actions

to implement the report's recommendations and did not require follow-up actions by DAAC management. Surveys of 2 DAAC user working groups showed that only 3 of the 16 members who responded were aware of the report's existence. The user model conference report was an excellent tool that could be used to augment development of a broad and diverse customer base for Earth Science Program data and information. Implementation of the report's recommendations that apply to current operations could be another way to ensure that Earth Science Program data and information are disseminated to a diverse user community.

PUBLIC AND PRIVATE USERS ARE UNINFORMED AND UNABLE TO ACHIEVE DESIRED RESULTS

The combined efforts of Earth Science Program, ESDIS Project Office, and DAAC officials have not resulted in dissemination of data and information to a broad spectrum of customers or the productive use of data and information by a diverse user community, as required by the Mission To Planet Earth Strategic Enterprise Plan, 1996 through 2006. Specifically, NASA has not developed four of the five Earth Science Program data and information user categories. Without more emphasis on formal outreach plans, broader representation within the user working groups and follow-up on the user model conference report, Earth Science Program data and information will not be disseminated to the intended user community. In turn, the user community will not achieve desired results such as (1) new knowledge of the Earth, (2) tools for improved decisionmaking to increase return on investment, (3) tools for decision makers in areas of public management and policy responsibility, (4) products and services to enhance educational quality and public awareness, and (5) advanced technologies to bring new or cheaper products and services to market or public use.

RECOMMENDATION 1

The ESDIS Project Office should establish and fund a formal outreach plan to focus dissemination efforts on nonscientific customers.

MANAGEMENT'S RESPONSE

NASA management concurred with the recommendation. NASA's Office of Earth Science (OES) established a division that will address dissemination of data to nonscientific customers. The OES is planning an outreach program to include implementation by the ESDIS Project Office. The complete text of management's response is in Appendix A.

EVALUATION OF MANAGEMENT'S RESPONSE

The actions planned are considered responsive to the intent of the report recommendation.

RECOMMENDATION 2

The ESDIS Project Office should review user working group composition at each DAAC to ensure that members represent the diverse customer base described in the Mission To Planet Earth Strategic Enterprise Plan, 1996 to 2002.

MANAGEMENT'S RESPONSE

Management concurred with the recommendation. The OES will review user working group composition and make needed changes by mid-July. The newly formed Applications and Outreach Division will manage the review and modification of working group membership to ensure consistency with program requirements and diversity of membership. The OES also plans other changes such as:

- Adding milestones to each DAAC to measure utilization of Earth science data by customer type.
- Documenting the cost of access and distribution to users.
- Adding a minimum success criterion to delineate numbers of users in all categories expecting to access data.

EVALUATION OF MANAGEMENT'S RESPONSE

The actions planned are considered responsive to the intent of the report recommendation.

RECOMMENDATION 3

The ESDIS Project Office should review the user model conference report recommendations and implement recommendations that apply to current operations.

MANAGEMENT'S RESPONSE

NASA management concurred with the recommendation. The OES will revisit the user model conference report and implement recommendations that show potential for improving current operations.

EVALUATION OF MANAGEMENT'S RESPONSE

The actions planned are considered responsive to the intent of the report recommendation.

EXHIBIT 1

DAAC BEST PRACTICES

The following two areas illustrate how management successfully improved operations through reinvention and innovation.

Customer Approach	The Goddard DAAC applied two "customer centered" approaches that produced measurable results. First, management identified three metrics that create customer value: data usefulness, system throughput, and user efforts to access data. By analyzing operations against the metrics, management found specific changes they needed to make. Second, staff prepared profiles for each customer group. Profiles defined customers' needs. By comparing existing products to the profiles, management found ways to improve products. According to DAAC management, these two approaches decreased the cost per requested product from $200 to $67.
Outreach CD-ROM	The Earth Resources Observation System Data Center received thousands of requests for the Spaceborne Imaging Radar-C* educational CD-ROM. JPL developers of the CD-ROM noted nine key points for other educational CD-ROM developers: (1) Don't try to do too much. Project details are not the main interest of teachers or students. (2) Keep user interfaces simple. (3) Try to use a web interface. It provides a dynamic, interactive product. (4) Involve teachers, with varied backgrounds, early in the project. (5) Get school system science coordinators involved. Their endorsement will advertise your product. (6) Obtain teacher feedback at all stages and incorporate feedback into product. (7) Test products in real classrooms before release. (8) Conduct teacher workshops after release. (9) Partner with existing educational and commercial resources: universities, educational companies, Internet service providers, etc.

*Imagery data collected from an imaging radar system launched aboard the space shuttle in 1994.

EXHIBIT 2

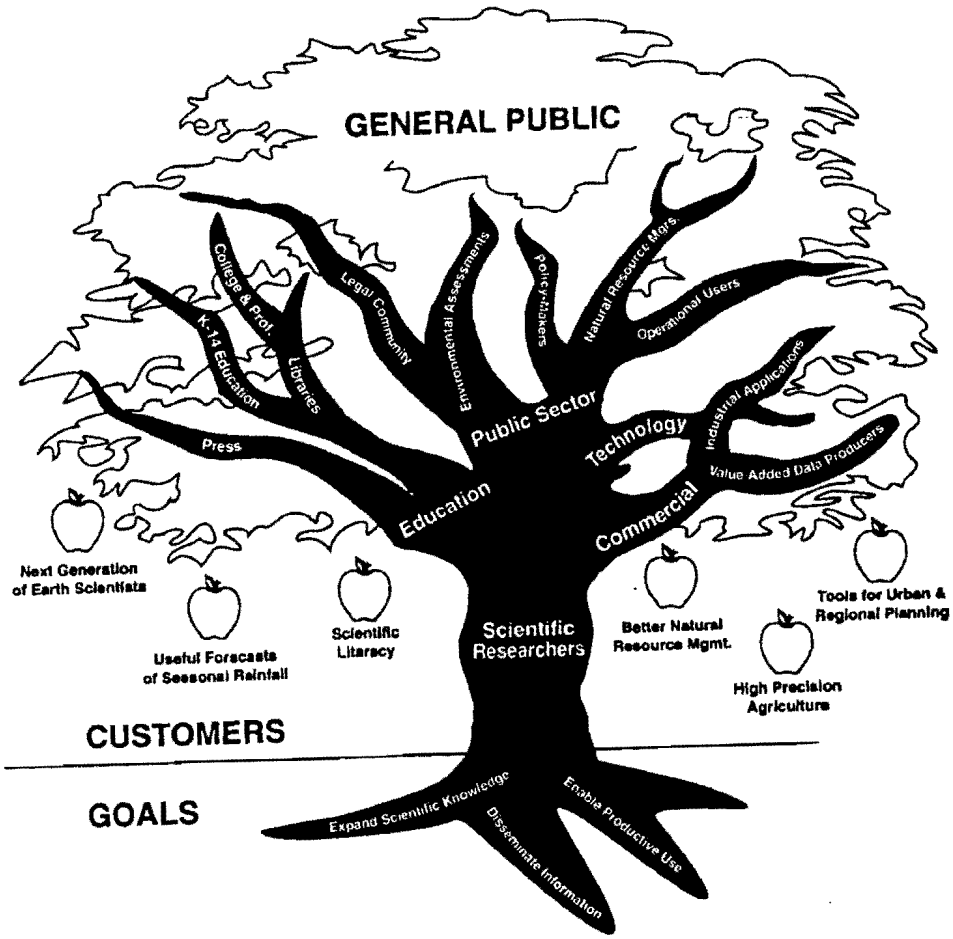
DISTRIBUTED ACTIVE ARCHIVE CENTERS

DAAC	AREAS OF EXPERTISE	FY 1997 BUDGET ($ in Millions)
Alaska Synthetic Aperture Radar Facility	Ice, Snow and Sea Surface Imagery	$3.2
Earth Resources Observation System Data Center	Land Processes	$4.3
Oak Ridge National Laboratory	Biogeochemical Cycles and Field Campaign Data	$1.9
National Snow and Ice Data Center	Polar Oceans and Ice	$2.6
Jet Propulsion Laboratory	Physical Oceanography	$3.9
Langley Research Center	Clouds, Radiation, Aerosols	$2.7
Goddard Space Flight Center	Climate, Meteorology, Ocean Biology	$3.8
Socio-Economic Data and Applications Center	Human Dimension of Global Change	$3.0
TOTAL		**$25.4**

Note: The total budget figure does not include civil service support, which is applicable at some DAACs.

EXHIBIT 3

EARTH SCIENCE PROGRAM GOALS AND DATA AND INFORMATION CUSTOMERS



Source: Mission To Planet Earth Strategic Enterprise Plan, 1996 through 2002

EXHIBIT 4

DESIRED RESULTS FOR PUBLIC AND PRIVATE SECTOR USERS OF EARTH SCIENCE PROGRAM DATA AND INFORMATION

USER CATEGORY	DESIRED RESULTS
Scientific Users	New knowledge of the Earth system. --Data on natural and anthropogenic phenomena. --Predictive models' coupling elements of the Earth system.
Commercial Users	Tools for improved decisionmaking to increase return on investment; increased synergy of Earth Science Program and commercial data. --Forecasts for agriculture. --Images revealing the health and maturity of forests or surface features for land use planning. --Images pointing to the location and health of fish stocks.
Public Sector Users	Tools for decision makers in areas of public management and policy responsibility. --Integration of remotely sensed data into State and local decision processes. --Land cover and land use change detection. --Assessments of environmental quality. --Evaluation of effectiveness of international agreements. --Atmospheric data, including volcanic eruption consequences for aviation safety and guidance for aerospace manufacturers. --Improved flood warning and vulnerability assessments. --Identification of rapidly deforming land surfaces in seismically active urban areas.
Education/General Public	Products and services to enhance educational quality and public awareness. --Pre-service and in-service teacher training. --Communications products and tools to enhance public understanding of Earth Science Program via both direct access and media coverage. --Curriculum enhancements with better data access and data visualization techniques.
Technology Users	Advanced technologies to bring new or cheaper products and services to market or public use. --Advanced instruments for weather monitoring . --Techniques for monitoring facilities and resources that reduce costs. --Information and data processing technologies.

Source: Mission To Planet Earth Strategic Enterprise Plan, 1996 through 2002

APPENDIX A

National Aeronautics and
Space Administration

Headquarters
Washington, DC 20546-0001

Reply to Attn of: YF

MAY 6 1998

TO: W/Assistant Inspector General for Auditing

FROM: Y/Associate Administrator for Earth Science

SUBJECT: Response to the Office of Inspector General (OIG) Draft Report, Audit of Dissemination of Earth Science Program Data and Information (Assignment Number A-HA-97-035)

NASA has completed its review of the subject draft report dated April 10, 1988. We agree that NASA has not developed a strong outreach program in four of five Earth Science Program data and information user categories. However, we have put in place an organizational structure and a strategy to mitigate these concerns.

OIG Recommendation 1 - The Earth Science Data Information System (ESDIS) Project Office should establish and fund a formal outreach plan to focus dissemination efforts on non-scientific customers.

NASA Response: Concur. The Office of Earth Science (OES) has formed a new division within the OES, Applications and Outreach Division, to specifically address this issue. This office is planning a program of outreach, which includes implementation by the ESDIS Project Office.

One of the ongoing programs in this division addresses the need of establishing a broader user base. It is the Earth Science Applications Research Program (ESARP). The goal of ESARP is to extend the uses of Earth science research, information and products beyond the needs of global change research to a broader user community, including other Federal agencies, state, and local governments, value-added companies, private sector users, and various non-governmental organizations. In the process, ESARP helps to define the needs of the broader user community and identify space assets and science results that can meet those needs.

Two NASA Research Announcements (Establishment of Regional Earth Science Application Centers and Remote Sensing Applications Research in Agriculture, Forestry, and Range Management) will be awarded this year. These are an integral part of the ESARP and respond to the challenge to develop new methods for bringing together the research, service, and end-user communities to develop and apply Earth science and information to practical problems.

Proposals were also selected in November 1997, to be continued for 5 years in response to the Cooperative Agreement Notice (CAN), Extending the Use and Applications of Missions to Planet Earth Data and Information to the Broader User Community. This CAN establishes 12 Type-3 Earth Science Information Partners

(ESIP's) designed to extend Earth science results to the broader user community, for example, agriculture and land use planning, etc.

While it is true that customer outreach has not been its highest priority, Distributed Active Archive Center (DAAC) User Services does perform or directly support outreach on a continuing basis. In the month of November, the Earth Resources Observation System (EROS) Data Center (EDC) DAAC, for example, participated as an exhibitor at the Twelfth International Conference on Applied Geologic Remote Sensing held in Denver, Colorado. The staff distributed brochures and fact sheets on data sets available at the DAAC. The 507 conference attendees represented 21 states and 25 countries. Julian Dumarski from the World Bank visited the DAAC. As a result the EDC contributed data sets for a demonstration at a World Bank Exposition. This same DAAC hosted 510 visitor in November, including 5 tour groups at the K-12 education level. This is the outreach performance of one DAAC in one month. The outreach potential of a DAAC is tremendous. We will continue to emphasize outreach at the DAAC's, especially in the future as new Earth Science data sets are received.

OIG Recommendation 2 - The ESDIS Project Office should review User Working Group composition at each DAAC to ensure members represent the diverse customer base described in the Earth Science Program Strategic Enterprise Plan, 1996 to 2002.

NASA Response: Concur. OES will review User Working Group composition by mid-June and make appropriate changes by mid-July. We do not agree that this function is an ESDIS Project Office responsibility. The working groups were initially established by the Mission To Planet Earth Program Office, for each DAAC to ensure consistency with program requirements. The review and modification of working group membership will be managed by the newly-formed Applications and Outreach Division, to ensure consistency with program requirements and diversity of membership. We also plan to initiate other changes, such as add milestones to each DAAC, to measure percentage utilization of Earth science data by customer type; document the cost of access and distribution to users; and add a minimum success criteria to delineate numbers of users in all categories expecting to access data.

OIG Recommendation 3 - The ESDIS Project Office should review the User Model Conference Report recommendations and implement recommendations that apply to current operations.

NASA Response: Concur. The User Model Conference Report has been put on the Internet and can be located at http://rsrunt.geog.ucsb.edu/eosdis.html. We will revisit its contents and will implement those recommendations that show potential for improving our current operations. We will accomplish this action by mid-July.

In conclusion, the OES agrees with the recommendations of the OIG draft report and will work through our Earth System Science Program Office to ensure that the desired results are reached quickly. We also appreciate the efforts of the NASA OIG to assist us in seeking cost effective, efficient ways to disseminate Earth Science Program information to the general public.

Ghassem R. Asrar

APPENDIX B

REPORT DISTRIBUTION

National Aeronautics and Space Administration (NASA) Headquarters
Code A/Office of the Administrator
Code AD/Deputy Administrator
Code B/Chief Financial Officer
Code B/Comptroller
Code G/General Counsel
Code J/Associate Administrator for Management Systems and Facilities
Code JM/Management Assessment Division
Code L/Associate Administrator for Legislative Affairs
Code M/Associate Administrator for Space Flight
Code S/Associate Administrator for Space Science

NASA Field Installations
Director, Ames Research Center
Director, Dryden Flight Research Center
Director, Goddard Space Flight Center
Director, Jet Propulsion Laboratory
Director, Lyndon B. Johnson Space Center
Director, John F. Kennedy Space Center
Director, Langley Research Center
Director, Lewis Research Center
Director, George C. Marshall Space Flight Center
Director, John C. Stennis Space Center

NASA Offices of Inspector General
Ames Research Center
Jet Propulsion Laboratory
Lyndon B. Johnson Space Center
John F. Kennedy Space Center
Langley Research Center
Lewis Research Center
George C. Marshall Space Flight Center
John C. Stennis Space Center

Non-NASA Federal Organizations and Individuals
Assistant to the President for Science and Technology Policy
Deputy Associate Director, Energy and Science Division, Office of Management and Budget
Budget Examiner, Energy Science Division, Office of Management and Budget
Associate Director, National Security and International Affairs Division,
General Accounting Office
Professional Assistant, Senate Subcommittee on Science, Technology and Space
Special Counsel, House Subcommittee on National Security, International Affairs, and Criminal Justice

APPENDIX B

Chairman and Ranking Minority Member - Congressional Committees and Subcommittees

Senate Committee on Appropriations
Senate Subcommittee on VA, HUD, and Independent Agencies
Senate Committee on Commerce, Science and Transportation
Senate Subcommittee on Science, Technology and Space
Senate Committee on Governmental Affairs
House Committee on Appropriations
House Subcommittee on VA, HUD, and Independent Agencies
House Committee on Government Reform and Oversight
House Committee on Science
House Subcommittee on Space and Aeronautics

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National Aeronautics and
Space Administration

Headquarters
Washington, DC 20546-0001

Reply to Attn of

W

OCT - 6 1999

TO: A/Administrator

FROM: W/Inspector General

SUBJECT: **INFORMATION:** Flight Termination Systems Assessment, G-98-011

The Office of Inspector General has conducted a review of NASA's use of Flight Termination Systems (FTS). We found that NASA's practices do not conform to national policy. Further, the Agency does not make decisions regarding whether to use secure FTS based on appropriate risk-based assessments. We have made recommendations to enhance program security and address the Agency's top priority, safety.

BACKGROUND

NASA launches its vehicles from various facilities. To minimize the possibility of injuries and property damage, most of the vehicles launched from these facilities are equipped with a FTS. The FTS gives the Range Safety Officer the ability to terminate the flight whenever the Officer judges that the vehicle can no longer be controlled to remain within the authorized airspace and public safety is at risk.

There are two categories of FTS—non-secure and secure. The difference between the non-secure and secure systems is in the command generation and the decoding of the command on board the vehicle. b2

Following the release of our draft report in February 1999, we issued a letter on July 16, 1999, to the Office of Safety and Mission Assurance and the Office of Aero-Space Technology on the recent crash of the Air Force's Global Hawk Unmanned Aero Vehicle. The loss of the $45 million Global Hawk was due largely to the lack of frequency coordination between ranges. Under the same mishap scenario, a secure FTS would have provided protection against the accidental destruction of this vehicle. We believe this incident as well as others underscore the need for a secure FTS especially for vehicles that have the size, altitude, and flight paths outside traditional range boundaries for which the inadvertent activation of the FTS could pose a public safety hazard.

Our review indicates that the majority of NASA's FTS do not provide adequate safeguards to ensure only authorized command of NASA's launch vehicles and do not comply with national policy. With the expanded use of autonomous flight control, the FTS is quickly becoming the sole means of controlling a vehicle from the ground. This approach, coupled with the emergence of launch vehicles such as the X-33 and X-34 with flight paths that will take them beyond the traditional range boundaries, makes it even more critical that the FTS meet the highest degree of assurance to ensure mission success and public safety.

RECOMMENDATIONS

We recommend that NASA continue to work with other appropriate Federal agencies to review and update NTISSP No. 100.[1] In the meantime, NASA should comply fully with existing national policy and Agency guidance governing the application of communications security (CONSEC) to FTS. NASA should initiate a risk assessment process to determine which launches require a FTS and, based on these assessments, ensure that launches utilize an appropriate FTS. Launches should use a secure FTS to the maximum extent possible. The decision to not use a secure FTS should be made by a senior level official at NASA Headquarters designated by the Administrator.

NASA also needs to develop COMSEC guidelines that include specific requirements for the application of encryption and authentication for secure FTS and explore adapting low-cost, lightweight space COMSEC and compatible ground-based supporting infrastructure to NASA flights requiring a FTS.

MANAGEMENT RESPONSE AND OIG EVALUATION

We received the Office of Management System's (Code J) response on August 18, 1999. NASA generally agreed with the intent of our report and fully concurred with two of the six recommendations. However, NASA only partially concurred with the first four recommendations which deal with the need for a secure FTS as well as the need for other interim measures to better protect and control its launches

Recently, Code J has proposed changes that would modify their partial concurrences to concur with all of our recommendations. We are currently working with Code J on these issues and we will release an update to our report.

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[1] National Telecommunications and Information Systems Security Policy (NTISSP) No. 100, *National Policy on Application of Communications Security to Command Destruct Systems*, establishes the requirement to protect command destruct systems (or FTS) for launch vehicles and ballistic missiles.

CONCLUSION

Our recommendations provide a gradual transition that will allow NASA to employ interim as well as long-term solutions to developing a more secure FTS. Moreover, these recommendations advance the priority you place on safety of the public, our employees, and our assets.

Roberta L. Gross

Enclosure:
Final Report on Flight Termination Systems Assessment

IG-97-008

AUDIT REPORT

ARC SUPPORT OF SETI'S HIGH RESOLUTION MICROWAVE SURVEY PROGRAM

AMES RESEARCH CENTER

November 14, 1996

National Aeronautics and Space Administration

OFFICE OF INSPECTOR GENERAL

National Aeronautics and
Space Administration
Headquarters
Washington, DC 20546-0001

Reply to Attn of:

W

November 14, 1996

TO: B/Chief Financial Officer
D/Center Director, Ames Research Center

FROM: W/Assistant Inspector General for Auditing

SUBJECT: Final Rapid Action Report on ARC's Support of the SETI Institute
Ames Research Center, Assignment No. A-AR-96-002
Report No. IG-97-008

An OIG audit of ARC's Support of the SETI Institute has identified matters requiring immediate management attention and/or action by the Center. The enclosed rapid action report is intended to provide early advice on these matters. Six additional copies of the report have been forwarded to the ARC/OIG Audit Liaison Representative for further distribution at the center.

The OIG's audit work to date indicates that ARC continued to support the SETI Institute's High Resolution Microwave Survey (HRMS) project after Congress terminated funding of the project effective October 1, 1993. In March 1995, ARC used SBIR funds to purchase almost $0.6 million of HRMS equipment, with the intent of loaning the equipment (a data recorder) to the SETI Institute. Although the Center maintained that its support of research on the data recorder was based on its "commercial uses," ARC still had not identified a commercial user for the equipment as of September 18, 1996.

Additionally, the Center needed to close a $0.5 million contract awarded in November 1988, to acquire a signal detector for use in the HRMS project. ARC deobligated the contract's remaining balance on September 26, 1995, but did not close the contract until September 17, 1996.

The OIG issued a draft rapid action report to ARC management and to Code B, NASA Headquarters on October 10, 1996. We incorporated into the report managements' responses to the report's four recommendation. If you have any questions regarding this report, please call me at 202-358-1232.

for Debra A. Guentzel

Enclosure

cc:
OIG Liaison Representative, ARC (w/6 encl.)

TABLE OF CONTENTS

ARC SUPPORT OF SETI'S HIGH RESOLUTION MICROWAVE SURVEY PROGRAM

AMES RESEARCH CENTER, CALIFORNIA

INTRODUCTION

The NASA Office of Inspector General is conducting a survey of NASA Ames Research Center's (ARC) continued relationship with the High Resolution Microwave Survey (HRMS) project. The project had been conducted by NASA and the Search for Extraterrestrial Intelligence (SETI) Institute prior to October 1, 1993, and since then by the Institute. The purpose of the survey is to determine whether ARC complied with the congressional mandate to terminate NASA funding of the project, and with applicable property controls. During our survey, we identified certain conditions that warrant management's immediate attention. We have issued this rapid action report due to the significance and time sensitivity of these conditions.

In the early 1970s, ARC began to consider the technology required for an effective search for extraterrestrial intelligence. By the late 1970s, SETI programs had been established at ARC and the Jet Propulsion Laboratory (JPL). Using large microwave radio telescopes, ARC would examine 1,000 Sun-like stars in a targeted search and JPL would sweep all directions in a sky survey.

The SETI Institute was founded in 1984 as a nonprofit corporation for scientific and educational projects concerning the nature, distribution, and prevalence of life in the universe. The Institute conducts and/or encourages research and related activities in all science and technology aspects of astronomy and the planetary sciences, chemical evolution, the origin of life, biological evolution, and cultural evolution.

NASA began funding the SETI Institute's HRMS project in 1985 (then called the Microwave Observing Program), under NASA cooperative agreement NCC 2-336. In Fiscal Year 1993, NASA funding of the HRMS project totaled about $12 million.

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ARC SUPPORT OF SETI'S HIGH RESOLUTION MICROWAVE SURVEY PROGRAM

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NASA began funding the SETI Institute's HRMS project in 1985 (then called the Microwave Observing Program), under NASA cooperative agreement NCC 2-336. In Fiscal Year 1993, NASA funding of the HRMS project totaled about $12 million.

In September 1993, in a Senate floor debate on NASA's Fiscal Year 1994 Appropriations Act, Senator Richard H. Bryan - Nevada, cited other funding priorities as his reason for wanting to terminate the Microwave Observing Program, and expressed concern that the program had continued after it was eliminated from the authorizing legislation. Senator Bryan served on the Senate Commerce Committee, which was the authorizing committee for the program. He highlighted the program's legislative history as follows:

> *" . . . last year, fiscal year 1993, the program* [i.e., the Microwave Observing Program] *was eliminated in the authorizing legislation. This program had been known for many, many years as the Search for Extraterrestrial Intelligence, . . . After this legislation was enacted, NASA failed to carry out the mandate of the Congress in eliminating the program, but rather changed the characterization --, that is, the name -- of the program. So no longer do we have a search for extraterrestrial intelligence. Now we have a new program whose function is identical in all respects to the program that we have been seeking to eliminate. It is called the high resolution microwave survey."* (September 20, 1993.)

On September 22, 1993, Senator Bryan submitted Amendment No. 911 to NASA's appropriations bill for Fiscal Year 1994, to prohibit the use of funds for the HRMS project. Effective October 1, 1993, Congress withdrew its support of the HRMS project.

The Appropriations Act, Public Law 103-124, dated October 28, 1993, stated "*Provided, That not to exceed $1,000,000 under this Act shall be available for the Towards Other Planetary Systems/High Resolution Microwave Survey Program (also known as the Search for Extraterrestrial Intelligence Project).*" The conference report explained the purpose of the funds as follows:

> "*Finally, the conferees have agreed to include a provision proposed by the Senate and modified to limit to $1,000,000 any funds made available under this act for the Towards Other Planetary Systems/High Resolution Microwave Survey Program (also known as the Search for Extraterrestrial Intelligence Project). The $1,000,000 included for this activity is available only for termination costs.*"

OBJECTIVES, SCOPE, AND METHODOLOGY

OBJECTIVES

The objectives of the survey are to determine whether NASA:

- Terminated funding for the HRMS project as mandated by Congress on October 1, 1993; and
- Properly transferred/loaned equipment to the SETI Institute.

SCOPE AND METHODOLOGY

In addressing our objectives, we interviewed ARC and SETI Institute officials; examined ARC's funding and expenditure records; examined transactions concerning the purchase, maintenance, transfer/loan of equipment; and reviewed other relevant documents. Our audit work to date has primarily focused on the first objective and is continuing on both objectives.

MANAGEMENT CONTROLS REVIEWED

We reviewed management controls to the extent needed to satisfy the survey objectives, including controls over:

- Funding and administration of cooperative agreement NCC 2-336.
- Equipment loaned to the SETI Institute.
- Use of Intergovernmental Personnel Act (IPA) agreements.
- Award of Small Business Innovation Research (SBIR) contracts to acquire HRMS equipment.

AUDIT FIELD WORK

Audit field work began in January 1996 and is continuing. Field work is being performed at ARC and the SETI Institute. The audit is being performed according to generally accepted government auditing standards, and includes such examinations and tests of applicable records and documents as are considered necessary in the circumstances.

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OBSERVATIONS AND RECOMMENDATIONS

INTERIM RESULTS OF AUDIT

ARC has continued to support the SETI Institute's High Resolution Microwave Survey (HRMS) project, despite actions taken by Congress to terminate it. Audit work to date indicates that ARC awarded a $0.6 million contract (NAS 2-14245) to purchase equipment for the HRMS project, after Congress terminated NASA funding of the project effective October 1, 1993. The contractor was expected to deliver the equipment to ARC in September 1996. The audit also disclosed a contract (NAS 2-12936) to purchase HRMS equipment, awarded before Congressional termination, that ARC continued to fund for work performed after termination. As of August 26, 1996, ARC still had not issued a change order to close the contract.

TAKE ACTION ON DATA RECORDER CONTRACT

Contract NAS 2-14245 (HRMS data recorder) -- ARC planned to lend to the SETI Institute almost $0.6 million of HRMS equipment that ARC purchased after Congress terminated NASA funding of the project. After the OIG expressed its concerns to the Center on this matter, an ARC official advised that ARC had changed its position and would either modify the data recorder for use with other NASA equipment, or make the recorder available to other government agencies. If the equipment is loaned to the Institute, NASA will use $0.6 million of funds for a purpose not intended by the Congress. Details follow.

Report to Congress on HRMS Funding Activities

On January 5, 1994, ARC awarded an SBIR Phase I contract (NAS 2-13974) for $69,957, to determine the feasibility of adapting a data recorder for the HRMS project. Fiscal Year 1993-94 funds were used to fund the contract. According to the Phase I Final Report, "*the fundamental goal of this SBIR project* [Phase I] *is to find a way to use the VLBA* [Very Long Baseline Array] *Recorder for recording and playing back SETI data.*" (Emphasis added)

On March 24, 1995, ARC purchased HRMS equipment under a follow-on SBIR Phase II contract valued at $599,101. Fiscal Year 1995-96 funds were used to fund the contract. The Phase II contract was for the purchase of one Very Long Baseline Array (VLBA) data recorder consisting of a Modified DR 101-A high density tape

recorder and a high performance parallel interface (HIPPI) Test Set. According to the SBIR Phase II proposal,

> *"... Phase I work was carried out for the purpose of showing how SETI data may be recorded .... However, the HIPPI interface makes the system completely general and the recorder may be used for any data source for which the total required recording rate does not exceed the maximum for the configuration chosen."*

The former NASA Contracting Officer's Technical Representative (COTR) for this contract stated that the funds used to purchase the recorder were not subject to Congress' decision to terminate NASA funding.* He cited two reasons: (1) The SBIR funds used to purchase the equipment were not tied to the SETI program and were not part of the $1 million provided by Congress for project termination; and (2) the data recorder could be used in non-SETI applications. Notwithstanding the former COTR's rationale, we believe the Phase I and II contracts were clearly intended to further NASA's support of the HRMS project. NASA's intentions were evidenced by the many references to HRMS or SETI throughout the Phase I and II proposals, and by the names of officials associated with the HRMS project who signed various documents related to the proposals.

In our opinion, ARC's award of the Phase I and II contracts circumvented Congress' intent to limit funding of HRMS activities to termination costs only. Therefore, NASA should notify Congress that it used SBIR funds to support the HRMS project after Congress terminated NASA funding of the project.

Provide Data Recorder to an Authorized User

The data recorder was expected to arrive at ARC in September 1996. According to the current COTR for this contract, the COTR planned to transfer the data recorder under a loan to the SETI Institute's HRMS project where it would have been used to help search for extraterrestrial radio transmissions.

---

* The former COTR is now the Institute's Senior Scientist and Manager of Project Phoenix, formerly called the HRMS project.

ARC should not loan this equipment to the SETI Institute without Congressional approval to release it. If such approval is not forthcoming, then ARC should find another use for the equipment within NASA, or properly dispose of the equipment.

TERMINATE SIGNAL DETECTOR CONTRACT

Contract NAS 2-12936 (SETI signal detector) -- ARC needs to close contract NAS 2-12936 to avoid incurring possible additional contract costs and, in turn, using funds that Congress intended for other purposes. Specifically, the results of our survey showed that ARC awarded this $500,000 SBIR Phase II contract on November 18, 1988, to acquire a "SETI Signal Detector Prototype System 86-1," for use in the HRMS project.

ARC continued to spend money on this contract through March 1994, for additional contractor work performed on the equipment after October 1, 1993. (The amount expended after October 1, 1993, totaled $45,000; funds for this contract were obligated in Fiscal Year 1990.) ARC has made no contract payments since March 1994. The contract has remained open almost 6 years beyond the original completion date (November 17, 1990), and almost 3 years after Congress terminated NASA's support of the HRMS project. Progress payments totaled $230,000. ARC deobligated the remaining $270,000 on September 26, 1995. Almost one year later, ARC still had not issued a change order to close the contract.

The former COTR for this contract advised the OIG that ARC was justified in continuing to fund the contract after October 1, 1993, because SBIR funds were not tied to the HRMS project. We believe ARC circumvented Congressional intent by using SBIR funds as a means to continue supporting the HRMS project.

As of August 6, 1996, the Center anticipated issuing a change order that would close the contract. Because the contract is still open, the Center should expedite the contract closeout process.

RECOMMENDATION 1

The NASA Chief Financial Officer/Comptroller, Code B, should report to Congress that NASA used SBIR funds to support the HRMS project after Congress terminated funding of the project.

Management's (Code B) Response

Although the recommendation was specifically directed to Headquarters' Code B, both Code B and ARC management responded. The Chief Financial Officer, Code B, deferred to ARC's

response, stating *"Should the Ames response to this draft report be unconvincing to you, we would have no objection to disclosing your findings to the Congress."*

ARC maintained that at the time it recommended awarding the SBIR Phase I contract, ARC had not been directed to terminate spending on the HRMS program. ARC further maintained that although the related proposal was written in terms of its specific application to the HRMS program, the VLBA equipment had a broader application, as well as commercialization potential. When ARC received notice to terminate HRMS support, ARC said it again reviewed the proposal and decided to continue with the award based on the potentially wider application of the work within NASA and on its high commercialization potential.

The full text of the Code B and ARC responses is included as Appendices A and B to the report.

Evaluation of Management's Responses

Headquarters' Code B and ARC management have not adequately supported their response to Recommendation 1. Our reasons follow:

1. The proposal stated that Phases I & II of the proposed SBIR contracts were to:

> *" . . . formulate a plan for using the Very Long Baseline (VLBA) tape recorder for recording High Resolution Microwave Survey data (HRMS)."*
>
> *" . . . find a way to use the VLBA Recorder for recording and playing back SETI data."*
>
> *" . . . make the signal and control interfaces sufficiently general so that the upgraded VLBA Recorder may be used in a variety of applications. This is to be done both for NASA and with the objective of finding commercial uses."*

ARC continued to support a research effort that Congress had specifically terminated. It now maintains that it justifiably supported research on the data recorder based on the "commercial uses" (Goal 3) that it expected to find for the recorder. Notwithstanding ARC's position, Goals 1 and 2

directly supported the HRMS program and, according to the Phase II proposal, Goal 2 represented the "fundamental goal" of the contract.

Agencies can use SBIR contracts only to support authorized "technical topics." Because Congress had previously terminated the HRMS program, the HRMS program could no longer be considered an authorized technical topic. Accordingly, ARC awarded contract NAS2-14245 for an unauthorized purpose (i.e., "to modify a VLBA recorder for use in HRMS recording").

Goal 3 is common to any SBIR contract and was of secondary importance. In this regard, if the quest for commercial uses of NASA-funded new technology were the sole reason for SBIRs, then NASA could embark on virtually any research endeavor it pleased, without consideration to whether the research supported an authorized NASA program. Clearly, SBIRs confer no such "blanket" authority on the sponsoring agency.

2. ARC had ample time to eliminate the frequent and specific references to HRMS-oriented goals in the Phase I and II proposals and contracts. ARC made no such revisions. Specifically, ARC made no substantive changes to the Phase I proposal during the 3-month period from October 1, 1993, to January 5, 1994 (date of the Phase I contract). Also, ARC made no substantive changes to the Phase II proposal during the 9-month period from July 1, 1994, to March 24, 1995 (date of the Phase II contract). ARC did not even change the title of the Phase II proposal or contract, which remained: "Use of the VLBA Recorder for HRMS Recording." The absence of substantive revisions to the HRMS-orientation of these proposals and contracts strongly suggests that ARC intended to continue supporting the HRMS program after Congress had terminated it. Finally, ARC's statement that it continued to fund the proposals only because of their non-HRMS applications, is not supported by the documentation that ARC presented to the OIG.

3. The Phase II contract made no mention of other possible users. In fact, ARC had not identified other potential users of the data recorder equipment until after the OIG advised ARC of its concerns regarding the intended recipient, the SETI Institute. Specifically, on May 15, 1996, the COTR for contract NAS 2-14245 advised the OIG that he planned to have the data recorder delivered to the SETI Institute because it was the most likely user of the equipment. We then advised the COTR of our concerns regarding the propriety of his plan. As of about September 18, 1996, when we requested a meeting with ARC officials on this subject, ARC still had not identified another user for the equipment. On September 25, 1996, the date of our audit exit conference, ARC officials indicated they would probably have the data recorder shipped to the National Radio Astronomy Observatory in New Mexico.

ARC's actions after October 1, 1993, have shown a pattern of continued support to the HRMS program. Accordingly, we believe ARC circumvented Congressional intent and improperly expended additional hundreds of thousands of dollars.

Code B has stated its willingness to disclose the OIG's findings to the Congress. Code B's notification to Congress will satisfy the intent of the recommendation.

RECOMMENDATION 2

If NASA wants to provide equipment purchased under contract NAS 2-14245 to the SETI Institute, then the NASA Chief Financial Officer/Comptroller, Code B, should obtain approval from Congress to do so.

Management's (Code B) Response

Concur. Code B stated *"The Center concurs with this recommendation. However, ARC has not provided, and does not intend to provide, any hardware developed under this SBIR contract to the SETI Institute, or to any other company, for use on the HRMS project."*

Evaluation of Management's Response

The Center's response satisfies the intent of the recommendation.

RECOMMENDATION 3	If Congressional approval is not obtained regarding contract NAS 2-14245, then ARC should initiate actions to find another use for the equipment within the agency, or properly dispose of the equipment.
Management's (ARC) Response	Concur. ARC stated *"It was the stated intent in the Phase II proposal to identify non-HRMS users during the Phase II contract. The National Radio Astronomy Observatory (NRAO) in Socorro, New Mexico, has been identified as such a user. Negotiations are presently underway to conduct the test program there."*
Evaluation of Management's Response	The Center's response satisfies the intent of the recommendation.
RECOMMENDATION 4	ARC should direct the contractor to cease work on contract NAS 2-12936, and expedite the termination process for this contract.
Management's (ARC) Response	Concur. ARC stated *"The contract was closed on September 17, 1996 (see Enclosure). We request that your final report reflect the closure."*
Evaluation of Management's Response	The Center's response satisfies the intent of the recommendation. The OIG acknowledges the closure of contract NAS 2-12936.

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GENERAL COMMENTS

We appreciate the courtesy, assistance, and cooperation extended to us by NASA and contractor officials contacted during this survey.

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Space Administrator

Headquarters
Washington, DC 20546-0001

NOV 4 1996

Reply to Attn of B

TO: W/Assistant Inspector General for Auditing

FROM: B/Chief Financial Officer

SUBJECT: Draft Rapid Action Report on ARC's Support of the SETI Institute, Ames Research Center, Assignment No. A-AR-96-002

We have reviewed the subject draft rapid action report and our comments on Recommendations 1 and 2 are as follows:

Recommendation No. 1:

The NASA Chief Financial Officer, Code B, should report to Congress that NASA used Small Business Innovation Research (SBIR) Funds to support the High Resolution Microwave Survey (HRMS) project after Congress terminated funding of the project.

The Center does **not concur** with this recommendation. The Center maintains that no SBIR funds were spent specifically in support of the HRMS project, only, after October 1, 1993, the Congressional mandated termination date.

The purpose of the NASA SBIR Program is to seek "innovative concepts in SBIR that meet NASA mission needs and have potential for commercial applications." Thus, the SBIR program has two purposes, both of which have been approved by Congress. Given the wide potential application of the technology proposed in the HRMS related SBIR's (both within NASA and for commercialization), it was decided to continue with the award of the SBIR contracts. It was also decided to redirect the contracted efforts toward non-HRMS uses, which was done.

Should the Ames response to this draft report be unconvincing to you, we would have no objection to disclosing your findings to the Congress.

Recommendation No. 2:

If NASA wants to provide equipment purchased under Contract NAS2-14245 to the SETI Institute, then the NASA Chief Financial Officer, Code B, should obtain approval from Congress to do so.

The Center **concurs** with this recommendation. However, ARC has not provided, and does not intend to provide, any hardware developed under the SBIR contract to the SETI Institute, or to any other company, for use on the HRMS project.

Should you have any questions regarding our response, please contact Ralph H. Robinson, Chief Financial Officer, ARC, at (415) 604-5068.

Arnold G. Holz

the commercialization potential. The notice to terminate HRMS was received before the actual award was made. After that notice, we reviewed the recommendation again. We decided that due to the potentially wide application of the work within NASA and the high commercialization potential, we would continue with the award.

SBIR Phase I contracts are short term activities; 6 months to do the work, write the Final Report, and submit the Phase II Proposal. Therefore, companies rely heavily on databases that they have readily at hand. The SBIR Phase I Final Report by Interferometrics for "Use of the VLBA Recorder for HRMS Data Recording" does state, as noted by the OIG, that "*the fundamental goal of the SBIR project is to find a way to use the VLBA Recorder for recording and playing back SETI data.*" The Final Report goes on to state, "*An equally important goal is to make the signal and control interfaces sufficiently general so that the upgraded VLBA Recorder may be used in a variety of applications. This is to be done both for NASA and with the objective of finding commercial uses.*"

The purpose of the NASA SBIR Program is to seek "innovative concepts in SBIR that meet NASA mission needs and have potential for commercial applications." Thus, the SBIR program has two purposes, both of which have been approved by Congress. Given the wide potential application of this technology as discussed in the Phase II Proposal (real-time spacecraft or wind tunnel data, as well as other large recording capacity users, i.e., EOS data streams, and non-NASA archival storage for movie industry, computer networks, super computer peripherals, etc.), it was decided to continue with the award of the Phase II contract to develop a prototype unit.

As also stated in the Phase II Proposal, the contractor intended to identify an appropriate testbed during the contract: "*We anticipate identifying a system within NASA or some other organization which meets those requirements and arranging for a field test.*" The National Radio Astronomy Observatory (NRAO) in Socorro, New Mexico, has been identified as this potential test-bed and negotiations are presently underway with them. No delivery of any hardware, developed under this SBIR contract, has been or will be made to the SETI Institute, or any other company, in support of the HRMS project at NASA's expense.

Contract NAS2-12936 (SETI signal detector): SBIR Phase II contract NAS2-12936 was awarded to Silicon Engines on November 18, 1988, to develop both analytical simulations of and a hardware prototype of a signal detector that would meet the needs of the SETI Program, as well as being applicable to other activities which require the detection and the identification of a low level signal against a noisy background (e.g., planetary detection, tape processing, etc.).

This award was made well before the termination of the HRMS project. Under normal conditions, hardware delivery would have been made in about two years. However, Silicon Engines had a great deal of difficulty bringing this work to fruition and requested several no cost extensions to continue the work. The ARC COTR developed a series of milestones for them to complete in order to continue the contract. Late in 1993, they apparently, reported to the COTR that they would be able

to complete the milestones associated with the simulation development, but would not be able to do the hardware prototype development. That simulation work was completed in March 1994, demonstrated to the COTR, and payment was made for the simulation effort. No deliveries were made to the SETI Institute for use in the HRMS project nor was any further work approved.

Over the past 2 years there have been three different COTRs for this contract. The contract was not deobligated in a more timely fashion because of extreme administrative workload and unusual staff turnover. However, no funds have been expended on this contract since March 1994.

RECOMMENDATION 3: CONCUR

If Congressional approval is not obtained regarding contract NAS2-14245, then ARC should initiate actions to find another use for the equipment within the agency, or properly dispose of the equipment.

It was the stated intent in the Phase II proposal to identify non-HRMS users during the Phase II contract. The National Radio Astronomy Observatory (NRAO) at Socorro, New Mexico, has been identified as such a user. Negotiations are presently underway to conduct the test program there.

RECOMMENDATION 4: CONCUR

ARC should direct the contractor to cease work on contract NAS2-12936, and expedite the termination process for this contract.

The contract was closed on September 17, 1996 (see Enclosure). We request that your final report reflect the closure.

Should you have questions regarding our response, please contact Wanda Riney at (415) 604-6628.

Joana M. Coleman

Enclosure

cc:
W:204-11/D. L. Gandrud

Ames Research Center

RECEIVAL AND INSPECTION REPORT

CONTRACTOR	ORDER NO.
Silicon Engines, Inc.	NAS2-12936

REC'D FROM	PKG. LIST NO.	SHIPPER'S WT

FRT. BILL NO.	GOVT. B/L NO.	VIA	NO. OF PIECES	ACTUAL WT.

ITEM	QUANTITY	DESCRIPTION
		Description of Procurement:
		SETI Signal Detector, SBIR Phase II
		1. Please sign the certification below, indicating that the subject contract/order is complete:
		CERTIFICATION
		All work required by the Gov't under the subject contract/order has been completed, delivered, and accepted. Contractor did not complete originally contracted for.
		TECHNICAL MONITOR'S SIGNATURE
		2. In addition, has all Government Furnished Property not accountable under the subject contract/order (if applicable), been returned to the Government, or been accounted for:
		YES _____ NO _____ N/A X
		Where NO is checked, please explain.

ORDER IS ☒ COMPLETE ☐ SHORT ☐ OVER ☐ DAMAGED

Del Abate

I certify that the supplies and/or services listed in this receival and inspection report have been received and conform to contract requirements.

9/13/96 — Date Received

9/13/96 — Date Signed

Signature of Authorized Government Representative

Technical Monitor — Title

PLEASE PRESS FIRMLY – ALL COPIES MUST BE LEGIBLE.

White – Acquisition 241-1 Yellow – Shipping & Receiving 255-3 Pink – Preparing Office
Goldenrod – Financial Mgmt. 203-18 Green – Equipment Mgmt. 255-2

ARC 76 (Rev. April 88) Previous editions of this form are obsolete.

94012

950 North California Ave., Suite 201
Palo Alto, CA 94303

Tel: 415-424-0480
Fax: 415-424-0480

APR 0 6 1994 409601

TO:		REMIT TO:
NASA-Ames Research Center Financial Analysis & Payments N203-18 Moffet Field, CA 94035		Silicon Engines, Inc. 950 North California Ave., Suite 201 Palo Alto, CA 94303 9409437355
Date: 14 Mar 94	**Terms:** Net 30	**Contact:** Jerome Duluk

Item	Description	Project	Amount	Totals
1	CAM IC Verilog Simulation Complete, Paragraph G.1, Item 13	SETI Signal Detector NAS2-12936	$15,000.00	

I certify that the supplies / services listed on this invoice have been received and accepted, except as noted above, and conform to the contract requirements

Signature _____ Contracting Officer / Administrator Date 3/23/94

3/28/94

JIMMY TSONG
CERTIFYING OFFICER

15,000.00
151.457
14,940.55

$15,000.00

Notes:
A previous invoice, Invoice Number 94002, for the "CAM Integrated Circuit Model Complete, Paragraph G.1, Item 13" has the incorrect item reference number compared to the contract. It should have been for item "Paragraph G.1, Item 12".

PAID
MAR

DISTRIBUTION LIST

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Code B/Chief Financial Officer/Comptroller
Code S/Associate Administrator for Space Science

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Non-NASA Federal Organizations and Individuals

Assistant to the President for Science and Technology Policy
Deputy Associate Director, Energy and Science Division, Office of Management and Budget
Budget Examiner, Energy Science Division, Office of Management and Budget
Associate Director, National Security and International Affairs Division, General Accounting Office
Special Counsel, Subcommittee on National Security, International Affairs, and Criminal Justice

Chairman and Ranking Minority Member - Congressional Committees and Subcommittees

Senate Committee on Appropriations
Senate Subcommittee on VA-HUD-Independent Agencies
Senate Committee on Commerce, Science and Transportation
Senate Subcommittee on Science, Technology and Space
Senate Committee on Governmental Affairs
House Committee on Appropriations

House Subcommittee on VA-HUD-Independent Agencies
House Committee on Government Reform and Oversight
House Committee on Science
House Subcommittee on Space and Aeronautics

National Aeronautics and
Space Administration

Office of Inspector General
Langley Research Center
Hampton, VA 23681-0001

Reply to Attn of: W

February 12, 1998

TO: Assistant Inspector General for Auditing RR 2/24/98

FROM: Independent Referencer, Auditor-in-Charge, and Program Director

SUBJECT: Certification of Independent Referencing, Audit Number A-HA-97-043.

The subject draft audit report has been independently referenced in accordance with IGM 9952.2 and all referencer comments have been satisfactorily resolved by the auditor-in-charge, Sandra L. Laccheo, and cleared by the referencer, Richard W. Hess. If you have any questions or need additional information, please call Lee T. Ball at 757-864-8500.

Independent Referencer

Auditor-in-Charge

Program Director

cc: Division Director, A

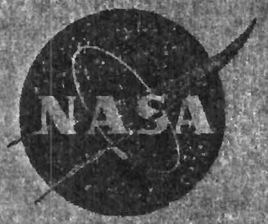
1998 FEB 23 PM 1:21

IG-97-019

AUDIT REPORT

REUSABLE LAUNCH VEHICLE PROGRAM

March 27, 1997



National Aeronautics and Space Administration

OFFICE OF INSPECTOR GENERAL

National Aeronautics and
Space Administration
Headquarters
Washington, DC 20546-0001

Reply to Attn of: W

March 27, 1997

TO: G/General Counsel
R/Director, Space Transportation Division

FROM: W/Acting Assistant Inspector General for Auditing

SUBJECT: Final Audit Report
Reusable Launch Vehicle Program
Assignment Number A-MA-96-001
Report Number IG-97-019

The NASA Office of Inspector General (OIG) has completed an audit of the Reusable Launch Vehicle (RLV) Program. The audit showed that RLV program and procurement planning was consistent with program goals and objectives. However, we found that NASA must continue its efforts to obtain Congressional approval of a waiver of indemnification for its private sector RLV partners. Also, NASA should continue its vigilance in addressing environmental issues and improve its record keeping to substantiate adherence to the Office of Management and Budget program criteria.

Your written response, dated March 14, 1997, is summarized in this report and is included in its entirety as Appendix A. We consider your comments responsive to the report recommendations. Consequently, recommendations 1, 2 and 3 are considered closed.

The OIG staff members associated with this audit express their appreciation to the NASA and contractor personnel for their courtesy, assistance, and cooperation. If you have any questions, or need additional information, please call Neddie Echerd, Audit Director at 205-544-0068, or me at 202-358-1232.

Robert J. Wesolowski

Enclosure

cc:
JM/D. Green
MSFC/BE01/D.Walker
MSFC/XX01/R. Bachtel

OBSERVATIONS AND RECOMMENDATIONS

OVERALL EVALUATION

Our review showed that RLV program and procurement planning was consistent with program goals and objectives. However, issues concerning third party liability claims and environmental impact remain unresolved. These unresolved issues pose a potential risk to achieving program cost and schedule expectations. We also determined that accurate information to substantiate adherence to OMB Phase II Programmatic Criteria was unavailable. The criteria provide the basis for go/no go program decisions. As a result, while management appears to meet the intent of the OMB guidelines, written records to substantiate their claims are inadequate.

Additionally, we are aware of problems with NASA's capacity to monitor cost, schedule and technical achievement. This issue is being addressed in a separate OIG audit.

THIRD PARTY LIABILITY

NASA has used waivers of liability for its aerospace activities to provide indemnification authority for previous test flights. These waivers are available under Section 308 of the National Aeronautics and Space Act (42 U.S.C. §2458 (b)). The waivers are available to users of NASA spacecraft and cover aerospace activities resulting from contract actions. For the X-33, however, the waivers are not available because: (1) NASA's industry partner will be the owner of the X-33; and (2) NASA is using a cooperative agreement, not a contract, for Phase II of the X-33.

Indemnification is required before the first test flight of X-33, scheduled to begin in the spring of 1999. The cost of insurance, however, may be prohibitive or unavailable due to the inherent risks with an experimental program. The industry partners are reluctant to undertake space flight activities unless the liability risks can be mitigated.

NASA has addressed liability relief concerns by proposing an amendment to Section 308 of the Space Act. Management officials expressed no concerns about the amendment's passage. They said it was not controversial, has Congressional support, and Congress has passed similar legislation in the past to address liability issues in the Commercial Space Launch Act (49 U.S.C. Subtitle IX, ch.701, §§70101-70119).

NASA also included language in the cooperative agreement, NCC8-115, acknowledging the potential liability to third parties. If the Section 308 amendment is enacted, NASA will agree to process the partner's application for indemnification against claims of third parties. The indemnification would cover claims for death, bodily injury, or loss of or damage to property resulting from flight testing of the X-33 vehicle.

NASA has been proactive with its proposed amendment to Section 308. The Agency also has been sensitive to industry liability concerns by including language to address the issue in the X-33 cooperative agreement. Liability issues, however, will remain unresolved until Congress enacts legislation or industry accepts responsibility for any third party liability.

If the proposed amendment fails, the industry partners are aware that they may be required, through insurance or otherwise, to accept responsibility. If this occurs, the partners can include the cost of insurance in their financial contribution, or take other measures to provide for financial protection against third party liability. This could alter the funding available to perform planned program tasks. It could also cause schedule delays due to renewed negotiations necessary to incorporate redefined tasks.

RECOMMENDATION 1

The Director, Space Transportation Division, and the NASA General Counsel (Code G) should continue to aggressively pursue resolution of third-party liability issues to ensure indemnification requirements are met before the planned X-33 test flights in the first quarter of 1999.

Management's Response

Management concurred with the recommendation.

Evaluation of Management's Response

Management's comments are responsive to the recommendation. This recommendation is closed.

ENVIRONMENTAL IMPACT

NASA has a responsibility to carry out the applicable provisions of the National Environmental Policy Act (NEPA), while pursuing its mission. The RLV program has actively embraced this duty by including an environmental focus in program planning. An environmental assessment was used to support the program decision to continue Phase II of X-33. Currently, the Final Environmental

Impact Statement (EIS) for the X-33 project is being prepared and is scheduled for release in September 1997.

Not surprisingly, significant environmental concerns have been raised because of the high risk nature of the X-33, an experimental flight test program. These concerns revolve around the potential risk of overflight to the human population and the environment. Potential environmental impact issues include systems reliability, debris impact consequences, sonic booms and the effects on cultural resources.

To date, the environmental analyses performed have not identified any issues that would preclude program continuation. NASA has and continues to review environmental effects of RLV technologies and flight operation sites. Alternate flight test operations, flight test operations facilities, flight test corridors, and propulsion systems for X-33 have been evaluated to identify and scope the magnitude of relevant environmental issues.

Further analyses will address environmental issues associated with the fabrication, assembly, testing and preparation of the flight operations and landing sites associated with the X-33. NASA will lead this effort in preparation of the EIS. Cooperating agencies include the U.S. Department of Defense, the Bureau of Land Management and the Federal Aviation Administration.

To help ensure that all issues will be explored, NASA has solicited comments from state and local governments. Also, NASA has held public meetings and issued formal requests for written comments to obtain input and coordination with all interested and affected parties. In addition, the NASA Office of Inspector General has made the RLV program office aware of environmental issues brought to its attention.

NASA's brisk and active application of NEPA is decisive in the pursuit of RLV program goals. Completion of the EIS by September 1997, is critical to the planned X-33 test flights. Any problems encountered could negatively impact the ambitious program schedules.

RECOMMENDATION 2 The Director, Space Transportation Division, should continue to vigorously pursue current and emerging environmental issues to ensure: (1) completion of the EIS by September 1997; and (2) RLV and X-33 program objectives and schedules can be met with minimal environmental impact.

Management's Response

Management concurred with the recommendation.

Evaluation of Management's Response

Management's comments are responsive to the recommendation. This recommendation is closed.

PROGRAM OFFICE SIZE

Accurate, reliable information to substantiate that the MSFC program office is being maintained in accordance with OMB Phase II Programmatic Criteria is unavailable. To achieve significant cost reductions, the OMB, the Office of Space Transportation Policy, and NASA developed programmatic standards to use as the groundwork for demonstrating a "new way of doing business." The criteria addressed the need for streamlined management methods to oversee RLV program development and demonstration efforts. It formally acknowledged that significant reductions in development and operations costs require a lean management plan.

According to Phase II Programmatic Criteria, "the use of small and efficient project offices is critical to demonstrating low cost development capabilities, streamlined acquisition strategies, minimal government oversight, and other cultural changes required to meet the cost reduction goals of the RLV technology program." This will be shown by maintaining the RLV program management office, including the X-33, X-34, DC-XA, and dedicated technology management offices, at a level no larger than twenty people. The criteria further specified that the personnel would be divided, with eight at NASA Headquarters (HQ) and twelve at MSFC.

According to standards established by the Comptroller General, program management has a responsibility to adopt an organization, methods, and procedures to ensure that resource use is consistent with laws, regulations, and policies. They are also tasked to obtain and maintain reliable resource data. More specifically, the RLV program has an agreement with the NASA Administrator to report program progress toward meeting the decision criteria set forth for the RLV program, Phases II and III, to OMB. The criterion stipulates that the MSFC RLV program management office be maintained at a level no larger than twelve people.

Our review of RLV program office organization documents revealed inconsistencies in data that NASA would use to demonstrate compliance with the OMB criteria. For example:

- The number of positions shown on organization charts varied from ten to seventeen.

- Payroll records showed ten RLV management positions; however, key personnel were not listed.

- Phone listings showed eight RLV management positions, but two employees not included as RLV management charged 100 percent of their time in fiscal year 1996, to a labor code reserved for RLV project managers.

Because the program office is small and management could identify, on an individual basis, the reasons for the data discrepancies, adequate record keeping was not considered a priority. While the RLV program appears to meet the intent of the OMB guidelines to maintain a small program office, written records to confirm the number of people maintained in the MSFC office are inadequate.

Pertinent information is required for management control of resources, to facilitate operations control and decision making abilities. The data must be sufficient to maintain its relevance and value to management. Incomplete and inaccurate documentation impedes management's ability to efficiently track the information. Accurate accounting for program personnel is required to confirm that OMB guidelines are being followed.

RECOMMENDATION 3 The Director, Space Transportation Divison, should ensure appropriate records are available to demonstrate compliance with OMB requirements.

Management's Response Concur. To assist in complying with OMB guidelines, RLV project management officials at MSFC now utilize a monthly report that provides the capability to monitor actual labor charges to the program. This will ensure only appropriate personnel charge their time and attendance to RLV project codes.

Evaluation of Management's Response Management's action is responsive to the recommendation. This recommendation is closed.

MAJOR CONTRIBUTORS TO THIS AUDIT

MARSHALL SPACE FLIGHT CENTER	Ned Echerd, Audit Director Teresa Danne, Auditor-in-Charge

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House Committee on Government Reform and Oversight
House Committee on Science
House Subcommittee on Space and Aeronautics

National Aeronautics and
Space Administration
Headquarters
Washington, DC 20546-0001

Reply to Attn of: R

MAR 14 1997

TO: W/Acting Assistant Inspector General for Auditing
THRU: G/General Counsel

FROM: R/Deputy Associate Administrator for
Aeronautics and Space Transportation Technology
(Space Transportation Technology)

SUBJECT: Draft Audit Report
Reusable Launch Vehicle Program
Assignment No. A-MA-96-001

I have reviewed the subject report and concur with the report's recommendations. The following comments are related to Recommendation 3:

> To assist in complying with OMB guidelines, RLV project management officials at MSFC now utilize a monthly report that provides the capability to monitor actual labor charges to the program. This will ensure only appropriate personnel charge their time and attendance to RLV project codes.

If you have any questions or need additional information concerning my comments, please call me at 358-4579.

Gary E. Payton

cc:
R/Dr. Whitehead
RB/Mr. Fuller

ADDITIONAL COPIES

To obtain additional copies of this audit report, contact the Assistant Inspector General for Auditing at 202-358-1232.

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NASA Headquarters
Code W
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Washington, DC 20546

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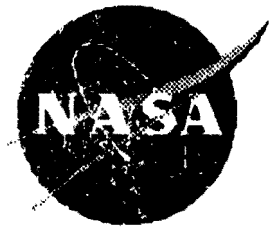
To report fraud, waste, abuse, or mismanagement, contact the NASA OIG Hotline by calling 1-800-424-9183; 1-800-535-8134 (TDD); or by writing the NASA Inspector General, P.O. Box 23089, L'Enfant Plaza Station, Washington, DC 20026. The identity of each writer and caller can be kept confidential upon request to the extent permitted by law.

IG-97-027

AUDIT REPORT

ARC SUPPORT OF SETI'S HIGH RESOLUTION MICROWAVE SURVEY PROGRAM

June 30, 1997



National Aeronautics and Space Administration

OFFICE OF INSPECTOR GENERAL

National Aeronautics and
Space Administration
Headquarters
Washington, DC 20546-0001

Reply to Attn of W

June 30, 1997

TO: 200-1/Director, Ames Research Center

FROM: W/Acting Assistant Inspector General for Auditing

SUBJECT: Final Audit Report on ARC Support of SETI's High Resolution Microwave Survey Program
Assignment No. A-AR-96-002
Report No. IG-97-027

The Office of Inspector General has completed an audit of ARC's support of the High Resolution Microwave Survey (HRMS) Program. We found that ARC improperly supported the HRMS Program after Congress terminated the program's funding. Support included purchasing unique, special purpose equipment; using an Intergovernmental Personnel Act assignment agreement; and, lending NASA-owned equipment to the Institute. The OIG issued a draft report to management on April 24, 1997. Management's response was considered responsive to our recommendations, and is included in its entirety as Appendix 2 of the report.

A copy of the report is enclosed. Additional copies have been forwarded to the ARC Audit Liaison Representative for further distribution. In accordance with NMI 9910.1B, please include our office in the concurrence cycle to close Recommendation 1 of the report. We consider Recommendations 2, 3, 4, and 5 closed. If you have any questions, please call me at 202-358-1232.

Robert J. Wesolowski

Enclosure

cc:
ARC/W/OIG Program Director (w/o encl.)
200-9/Director of Center Operations
241-11/Audit Liaison Representative (w/6 encl.)

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ARC SUPPORT OF SETI'S HIGH RESOLUTION MICROWAVE SURVEY PROGRAM

INTRODUCTION

The NASA Office of Inspector General (OIG) has completed an audit of NASA Ames Research Center's (ARC) continued relationship with the High Resolution Microwave Survey (HRMS) Program. NASA and the Search for Extraterrestrial Intelligence (SETI) Institute conducted the program before October 1, 1993. The Institute has conducted the program since that date. The purpose of the audit was to determine whether ARC complied with the Congressional mandate to terminate NASA funding of the program, and with applicable property controls.

On November 14, 1996, the OIG issued Rapid Action Report IG-97-008 that addressed other instances of HRMS Program support after the funding termination. The OIG and Headquarters' Code B agreed that NASA would postpone action on Recommendation 1 until the OIG issued this final report. ARC concurred with OIG Recommendations 2, 3, and 4.

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OBJECTIVES, SCOPE, AND METHODOLOGY

The attached rapid action report describes NASA's relationship with the HRMS Program, and the audit's objectives, scope and methodology. The report (page 2) also provides the background on Congress' termination of funding for the HRMS Program. We conducted our audit field work during the period January 1996 through December 1996, according to generally accepted government auditing standards. The audit included such examinations and tests of applicable records and documents as we considered necessary in the circumstances.

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OBSERVATIONS AND RECOMMENDATIONS

RESULTS OF AUDIT

ARC continued to support the SETI Institute's HRMS Program after October 1, 1993, when Congress terminated NASA's participation in the program. In Rapid Action Report (RAR) IG-97-008, we identified three Small Business Innovation Research (SBIR) contracts under which ARC improperly provided or planned to provide $714,058 of equipment and other support to the SETI Institute (contracts NAS 2-14245, NAS 2-13974 and NAS 2-12936).

Our subsequent audit work revealed the following additional instances of improper support.

- ARC purchased a Radio Frequency Interference (RFI) processor costing $490,120 for the HRMS Program.
- ARC assigned a manager to the Institute's HRMS Program under an 18-month Intergovernmental Personnel Act (IPA) agreement. We estimated the HRMS-related cost of the agreement at $70,000.
- ARC lent or transferred other NASA equipment to the Institute estimated to cost $59,480.
- ARC allowed 11 of the Institute's HRMS employees to continue using ARC facilities until October 1994. We estimated the value of facilities improperly provided at $12,569.

Appendix 2 summarizes the total amount of unauthorized support ($1,346,227) identified by this audit and the rapid action report.

We discuss the additional instances of improper support below. We believe each instance violated the Congressional funding termination for the HRMS Program.

RFI PROCESSOR IMPROPERLY BOUGHT AND NEVER USED

Two weeks after Congress terminated NASA funding for the HRMS Program, ARC awarded a contract for a unique, special purpose RFI processor for the HRMS Program. ARC subsequently lent the processor to the Institute where it remained unused for 11 months. The Institute then returned the processor to ARC where it awaits disposition. ARC should find an alternate use for the RFI processor or dispose of it according to prescribed property disposal procedures.

On October 15, 1993, ARC awarded an SBIR Phase II contract (NAS 2-13920) for a unique, special purpose RFI processor for the HRMS Program. Sometime during the period October 1 - 15, 1993, ARC's cognizant contract specialist asked the then Microwave Observing Project (i.e., HRMS) manager whether ARC should award the contract considering the Program's termination. The manager stated that *"this proposal was still in effect and this contract should be awarded so that this research can continue . . . this is still needed research and the closure of SETI office should have no influence on this award."* ARC then awarded the contract for the RFI processor at a cost of $490,120.

After accepting delivery of the equipment, ARC lent the processor to the SETI Institute on October 25, 1995. The Executive Director, SETI Institute, advised the OIG that the Institute had never used the equipment since the day NASA delivered it to the Institute. Exhibit 1 is a photograph of the RFI processor in its unused state at the SETI Institute.

On October 3, 1996, following the Executive Director's discussion with the OIG, the Institute returned the processor to ARC. As of January 28, 1997, ARC was still attempting to find an alternate use for the equipment.

IPA IMPROPERLY USED

ARC assigned a NASA employee to the Institute's HRMS Program under an 18-month Intergovernmental Personnel Act (IPA) assignment agreement. We estimated the HRMS-related cost of this assignment to be $70,000.

The SETI Institute Director advised ARC that termination activities were completed as of March 31, 1994. According to ARC records, ARC employees were reassigned from HRMS activities to other programs as of March 31, 1994. On April 1, 1994, ARC assigned Dr. D. Kent Cullers, SETI Signal Detection Scientist, to the SETI Institute under an IPA agreement. The initial period of the agreement was 6 months. ARC later extended the agreement by an additional 12 months. Under the terms of the agreement, Dr. Cullers participation was essential to completing "detection systems and strategies to be used by the SETI Institute." The agreement said that completion of the detection systems would ensure that the government investment in SETI research would be used effectively, and that the technology developed by NASA would be efficiently transferred to the private sector.

During the 18-month term of the IPA agreement, ARC paid Dr. Cullers' full salary and benefits. Dr. Cullers advised the OIG that during this period, he spent about 50 percent of his time on HRMS activities and about 50 percent of his time on other NASA activities. We estimated his HRMS-related salary (burdened) during the 18-month period, at $70,000. ARC paid his salary and benefits with Research & Program Management funds.

ARC assigned Dr. Cullers to the Institute because of his background and expertise in HRMS activities. After working 18 months with the Institute under the IPA agreement, Dr. Cullers resigned from NASA to become an employee of the SETI Institute. He is currently the Institute's Senior Scientist and Manager of Project Phoenix, formerly called the HRMS Program.

EQUIPMENT IMPROPERLY LENT

During the period October 1994 to December 1994, ARC allowed SETI Institute personnel to physically relocate 29 pieces of NASA-owned equipment, costing $59,480, to the Institute's facilities in Mountain View, California. ARC did not follow prescribed procedures governing the equipment transfer. Further, ARC's property records showed that the equipment was still at ARC and not at the Institute. ARC should immediately recover all NASA property being used by the Institute's HRMS Program.

NASA Handbooks 4200.1D and 4200.2 require that NASA officials approve any movement of NASA-owned equipment, whether by borrowing, loaning, leasing, or transferring. The Institute had informed ARC of its plans to relocate 15 of the 29 pieces of equipment. However, ARC took no action to formally transfer the equipment to the Institute. Property management officials were unable to explain why ARC had seemingly ignored NASA's property transfer procedures and were not aware that the Institute had relocated the equipment to its facilities in Mountain View.

Most of the relocated equipment consisted of general purpose personal computers, printers, and monitors. The Institute's records showed that the Institute had assigned most of the equipment to Institute personnel who worked on the HRMS Program. As of January 1997, the status of the 29 pieces of equipment was as follows:

No. of Items	Total Cost	Location
4	$11,867	Returned to ARC in 8/95
11	10,480	Returned to ARC in 11/96
1	800	Unknown
3	10,975	SETI's observatory at Greenbank, Maryland
10	25,358	SETI Institute
29	$ 59,480	Total

ARC allowed the Institute's HRMS Program to continue using Government-owned property, long after Congress terminated NASA's funding for the program. To ensure that ARC complies with the intent of Congress, ARC should immediately recover all NASA property being used by the Institute's HRMS Program and comply with prescribed property controls regarding the release of Government-owned property to ARC contractors and grantees.

OTHER IMPROPER SUPPORT

ARC allowed 11 Institute HRMS employees to work at ARC after Congress terminated NASA funding for the HRMS Program. ARC and the SETI Institute agreed that Institute employees would remain at ARC through March 1994, to phase out all HRMS work at ARC. The SETI Institute Executive Director notified ARC that HRMS termination activities were completed as of March 31, 1994. However, these employees continued to occupy office space at ARC and use Government property including laboratory and office equipment during the period April through October 1994. Using cost data provided by ARC's Financial Management Division, we estimated the value of facilities support (office space) to these 11 Institute employees at $12,569. Data were not adequate to estimate the value of laboratory and equipment support used.

CONCLUSION

The audit showed that ARC had improperly provided various types of support to the HRMS Program after Congress terminated NASA funding of the program. In recognition of the findings stated in this report and our previously issued rapid action report, we make the following recommendations.

RECOMMENDATION 1

The NASA Chief Financial Officer/Comptroller, Code B, should report to Congress that NASA used SBIR and other funds to support the HRMS Program after Congress terminated funding of the program.

Management Response

Concur, with conditions. ARC understands that the actions taken may have created the appearance of having continued to fund the HRMS program after Congressional direction to terminate funding. While the Center maintains that no improper actions were taken, we concur with the recommendation that NASA should inform Congress of the actions taken.

Evaluation of Management's Response

ARC maintains that the actions referenced in this report and the attached rapid action report "may have created the appearance" of continued funding; nonetheless, it states that it did not act improperly. We disagree. Our audit findings disclosed a pattern of continued, unauthorized support that began when Congress terminated NASA funding of the program, and ended more than 3 years later after the OIG issued its reports on the HRMS program.

A memo from ARC's Manager, HRMS Survey Project, to ARC University Affairs, dated January 14, 1994, helps illustrate ARC's intention to continue supporting the program (in this case, with direct transfers of equipment) -- despite Congress' attempts to terminate it. The manager stated:

> *"The HRMS itself is terminating as a NASA project by March 31, 1994. . . . it is our plan to provide as much of the material of the HRMS to the Institute through direct transfer and loans to make their continuation successful."*

The actions to be taken satisfy the intent of the recommendation.

RECOMMENDATION 2

ARC should find an alternate use for the HRMS RFI processor (total cost $490,120) or dispose of the processor according to prescribed property disposal procedures.

Management Response

Concur. The RFI Processor was shipped to the SETI Institute for verification testing of the contract deliverable. The COTR of the SBIR contract attended the testing. After the testing was accomplished, the processor should have been returned to ARC, but was instead left at the Institute. The Institute did not use the processor in their HRMS Program, or any other program to our knowledge. ARC has had the RFI processor returned to ARC. We have reviewed other possible uses for the processor, but have not identified any at this time. We will dispose of the processor according to prescribed property disposal procedures.

Evaluation of Management's Response	The actions to be taken satisfy the intent of the recommendation.
RECOMMENDATION 3	ARC should immediately recover all NASA property (total estimated cost $59,480) being used by the SETI Institute's HRMS Program.
Management Response	Concur. Review of this property revealed that property passes were improperly used for this equipment. Twenty-four of the 29 items have been returned to ARC for use on other programs. The remaining five items have been properly added to the SETI Institute loan agreement.
Evaluation of Management's Response	The actions taken satisfy the intent of the recommendation.
RECOMMENDATION 4	ARC should comply with prescribed property controls regarding the release of Government-owned property to ARC contractors and grantees.
Management Response	Concur. ARC agrees that we should assure that prescribed property control procedures should be followed in the use and loan of government equipment. A review found that proper procedures were not followed for all items. Proper documentation has been completed, and our employees have been reminded of the procedures and the necessity to follow them.
Evaluation of Management's Response	The actions taken satisfy the intent of the recommendation.
RECOMMENDATION 5	ARC should ensure that it does not use Intergovernmental Personnel Act (IPA) Assignment Agreements to circumvent funding controls.
Management Response	Concur. ARC agrees that the IPA should not be used in such a manner as to give the appearance of frustrating the intent of Congressional guidance. With regard to SETI, we would note there was no legal issue as to the funding controls since the Congressional action did not extend to the research and program management appropriation. In the case of Dr. Kent Cullers, ARC believes that proper procedures to review and approve his IPA to support the transfer of technology to a not-for-profit organization were used.
Evaluation of Management's Response	While ARC may have used proper procedures to review and approve the IPA agreement, we believe ARC has ignored the main issue; that is, that Congress intended to terminate **all** NASA funding for the

HRMS program. To illustrate, Senator Richard H. Bryan - Nevada (see page 2 of our earlier rapid action report), had expressed concern that the program had continued after it was eliminated from the Fiscal Year 1993 authorizing legislation. In highlighting the program's legislative history, Senator Bryan stated:

> *" . . . After legislation was enacted* [i.e., FY 1993], *NASA failed to carry out the mandate of the Congress in eliminating the program, but rather changed the characterization --, that is, the name -- of the program. So no longer do we have a search for extraterrestrial intelligence. Now we have a new program whose function is identical in all respects to the program that we have been seeking to eliminate. It is called the high resolution microwave survey."*

The response satisfies the intent of the recommendation.

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GENERAL COMMENTS

We appreciate the courtesy, assistance, and cooperation extended to us by NASA and contractor officials contacted during this audit.

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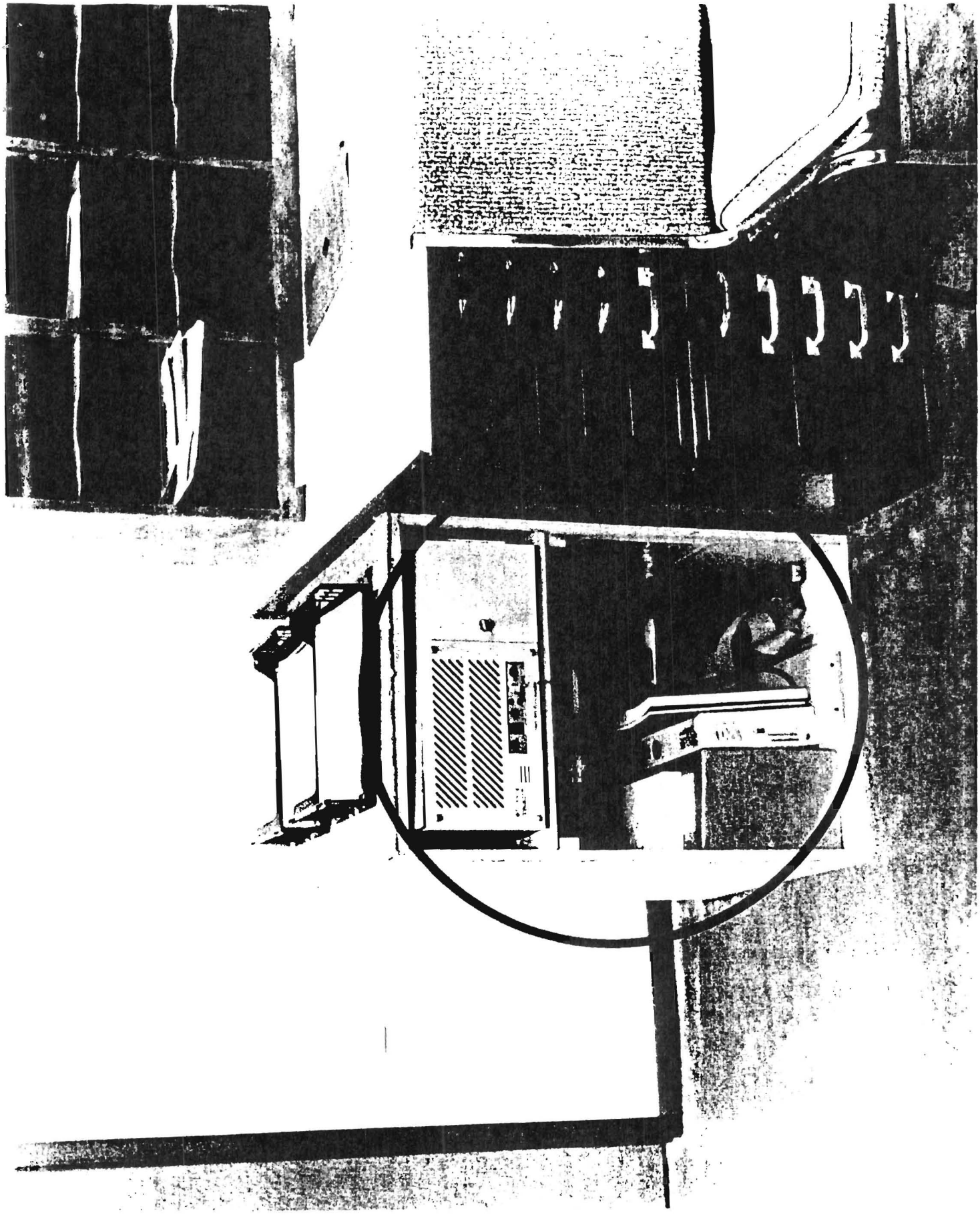
EXHIBIT 1



HRMS RFI Processor at SETI Institute (circled area)

IG-97-008

AUDIT REPORT

RAPID ACTION

ARC'S SUPPORT OF SETI'S HIGH RESOLUTION MICROWAVE SURVEY PROGRAM

AMES RESEARCH CENTER

November 14, 1996

National Aeronautics and Space Administration

OFFICE OF INSPECTOR GENERAL

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National Aeronautics and
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Headquarters
Washington, DC 20546-0001

Reply to Attn of

W

November 14, 1996

TO: B/Chief Financial Officer
D/Center Director, Ames Research Center

FROM: W/Assistant Inspector General for Auditing

SUBJECT: Final Rapid Action Report on ARC's Support of the SETI Institute
Ames Research Center, Assignment No. A-AR-96-002
Report No. IG-97-008

An OIG audit of ARC's Support of the SETI Institute has identified matters requiring immediate management attention and/or action by the Center. The enclosed rapid action report is intended to provide early advice on these matters. Six additional copies of the report have been forwarded to the ARC/OIG Audit Liaison Representative for further distribution at the center.

The OIG's audit work to date indicates that ARC continued to support the SETI Institute's High Resolution Microwave Survey (HRMS) project after Congress terminated funding of the project effective October 1, 1993. In March 1995, ARC used SBIR funds to purchase almost $0.6 million of HRMS equipment, with the intent of loaning the equipment (a data recorder) to the SETI Institute. Although the Center maintained that its support of research on the data recorder was based on its "commercial uses," ARC still had not identified a commercial user for the equipment as of September 18, 1996.

Additionally, the Center needed to close a $0.5 million contract awarded in November 1988, to acquire a signal detector for use in the HRMS project. ARC deobligated the contract's remaining balance on September 26, 1995, but did not close the contract until September 17, 1996.

The OIG issued a draft rapid action report to ARC management and to Code B, NASA Headquarters on October 10, 1996. We incorporated into the report managements' responses to the report's four recommendation. If you have any questions regarding this report, please call me at 202-358-1232.

for Debra A. Guentzel

Enclosure

cc:
OIG Liaison Representative, ARC (w/6 encl.)

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TABLE OF CONTENTS

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IG-97-008

ARC SUPPORT OF SETI'S HIGH RESOLUTION MICROWAVE SURVEY PROGRAM

AMES RESEARCH CENTER, CALIFORNIA

INTRODUCTION

The NASA Office of Inspector General is conducting a survey of NASA Ames Research Center's (ARC) continued relationship with the High Resolution Microwave Survey (HRMS) project. The project had been conducted by NASA and the Search for Extraterrestrial Intelligence (SETI) Institute prior to October 1, 1993, and since then by the Institute. The purpose of the survey is to determine whether ARC complied with the congressional mandate to terminate NASA funding of the project, and with applicable property controls. During our survey, we identified certain conditions that warrant management's immediate attention. We have issued this rapid action report due to the significance and time sensitivity of these conditions.

In the early 1970s, ARC began to consider the technology required for an effective search for extraterrestrial intelligence. By the late 1970s, SETI programs had been established at ARC and the Jet Propulsion Laboratory (JPL). Using large microwave radio telescopes, ARC would examine 1,000 Sun-like stars in a targeted search and JPL would sweep all directions in a sky survey.

The SETI Institute was founded in 1984 as a nonprofit corporation for scientific and educational projects concerning the nature, distribution, and prevalence of life in the universe. The Institute conducts and/or encourages research and related activities in all science and technology aspects of astronomy and the planetary sciences, chemical evolution, the origin of life, biological evolution, and cultural evolution.

NASA began funding the SETI Institute's HRMS project in 1985 (then called the Microwave Observing Program), under NASA cooperative agreement NCC 2-336. In Fiscal Year 1993, NASA funding of the HRMS project totaled about $12 million.

In September 1993, in a Senate floor debate on NASA's Fiscal Year 1994 Appropriations Act, Senator Richard H. Bryan - Nevada, cited other funding priorities as his reason for wanting to terminate the Microwave Observing Program, and expressed concern that the program had continued after it was eliminated from the authorizing legislation. Senator Bryan served on the Senate Commerce Committee, which was the authorizing committee for the program. He highlighted the program's legislative history as follows:

> *" . . . last year, fiscal year 1993, the program* [i.e., the Microwave Observing Program] *was eliminated in the authorizing legislation. This program had been known for many, many years as the Search for Extraterrestrial Intelligence, . . . After this legislation was enacted, NASA failed to carry out the mandate of the Congress in eliminating the program, but rather changed the characterization --, that is, the name -- of the program. So no longer do we have a search for extraterrestrial intelligence. Now we have a new program whose function is identical in all respects to the program that we have been seeking to eliminate. It is called the high resolution microwave survey."* (September 20, 1993.)

On September 22, 1993, Senator Bryan submitted Amendment No. 911 to NASA's appropriations bill for Fiscal Year 1994, to prohibit the use of funds for the HRMS project. Effective October 1, 1993, Congress withdrew its support of the HRMS project.

The Appropriations Act, Public Law 103-124, dated October 28, 1993, stated "*Provided, That not to exceed $1,000,000 under this Act shall be available for the Towards Other Planetary Systems/High Resolution Microwave Survey Program (also known as the Search for Extraterrestrial Intelligence Project).*" The conference report explained the purpose of the funds as follows:

> "*Finally, the conferees have agreed to include a provision proposed by the Senate and modified to limit to $1,000,000 any funds made available under this act for the Towards Other Planetary Systems/High Resolution Microwave Survey Program (also known as the Search for Extraterrestrial Intelligence Project). The $1,000,000 included for this activity is available only for termination costs.*"

OBJECTIVES, SCOPE, AND METHODOLOGY

OBJECTIVES

The objectives of the survey are to determine whether NASA:

- Terminated funding for the HRMS project as mandated by Congress on October 1, 1993; and
- Properly transferred/loaned equipment to the SETI Institute.

SCOPE AND METHODOLOGY

In addressing our objectives, we interviewed ARC and SETI Institute officials; examined ARC's funding and expenditure records; examined transactions concerning the purchase, maintenance, transfer/loan of equipment; and reviewed other relevant documents. Our audit work to date has primarily focused on the first objective and is continuing on both objectives.

MANAGEMENT CONTROLS REVIEWED

We reviewed management controls to the extent needed to satisfy the survey objectives, including controls over:

- Funding and administration of cooperative agreement NCC 2-336.
- Equipment loaned to the SETI Institute.
- Use of Intergovernmental Personnel Act (IPA) agreements.
- Award of Small Business Innovation Research (SBIR) contracts to acquire HRMS equipment.

AUDIT FIELD WORK

Audit field work began in January 1996 and is continuing. Field work is being performed at ARC and the SETI Institute. The audit is being performed according to generally accepted government auditing standards, and includes such examinations and tests of applicable records and documents as are considered necessary in the circumstances.

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OBSERVATIONS AND RECOMMENDATIONS

INTERIM RESULTS OF AUDIT

ARC has continued to support the SETI Institute's High Resolution Microwave Survey (HRMS) project, despite actions taken by Congress to terminate it. Audit work to date indicates that ARC awarded a $0.6 million contract (NAS 2-14245) to purchase equipment for the HRMS project, after Congress terminated NASA funding of the project effective October 1, 1993. The contractor was expected to deliver the equipment to ARC in September 1996. The audit also disclosed a contract (NAS 2-12936) to purchase HRMS equipment, awarded before Congressional termination, that ARC continued to fund for work performed after termination. As of August 26, 1996, ARC still had not issued a change order to close the contract.

TAKE ACTION ON DATA RECORDER CONTRACT

Contract NAS 2-14245 (HRMS data recorder) -- ARC planned to lend to the SETI Institute almost $0.6 million of HRMS equipment that ARC purchased after Congress terminated NASA funding of the project. After the OIG expressed its concerns to the Center on this matter, an ARC official advised that ARC had changed its position and would either modify the data recorder for use with other NASA equipment, or make the recorder available to other government agencies. If the equipment is loaned to the Institute, NASA will use $0.6 million of funds for a purpose not intended by the Congress. Details follow.

Report to Congress on HRMS Funding Activities

On January 5, 1994, ARC awarded an SBIR Phase I contract (NAS 2-13974) for $69,957, to determine the feasibility of adapting a data recorder for the HRMS project. Fiscal Year 1993-94 funds were used to fund the contract. According to the Phase I Final Report, "*the fundamental goal of this SBIR project* [Phase I] *is to find a way to use the VLBA* [Very Long Baseline Array] *Recorder for recording and playing back SETI data.*" (Emphasis added)

On March 24, 1995, ARC purchased HRMS equipment under a follow-on SBIR Phase II contract valued at $599,101. Fiscal Year 1995-96 funds were used to fund the contract. The Phase II contract was for the purchase of one Very Long Baseline Array (VLBA) data recorder consisting of a Modified DR 101-A high density tape

recorder and a high performance parallel interface (HIPPI) Test Set. According to the SBIR Phase II proposal,

> *"... Phase I work was carried out for the purpose of showing how SETI data may be recorded .... However, the HIPPI interface makes the system completely general and the recorder may be used for any data source for which the total required recording rate does not exceed the maximum for the configuration chosen."*

The former NASA Contracting Officer's Technical Representative (COTR) for this contract stated that the funds used to purchase the recorder were not subject to Congress' decision to terminate NASA funding.* He cited two reasons: (1) The SBIR funds used to purchase the equipment were not tied to the SETI program and were not part of the $1 million provided by Congress for project termination; and (2) the data recorder could be used in non-SETI applications. Notwithstanding the former COTR's rationale, we believe the Phase I and II contracts were clearly intended to further NASA's support of the HRMS project. NASA's intentions were evidenced by the many references to HRMS or SETI throughout the Phase I and II proposals, and by the names of officials associated with the HRMS project who signed various documents related to the proposals.

In our opinion, ARC's award of the Phase I and II contracts circumvented Congress' intent to limit funding of HRMS activities to termination costs only. Therefore, NASA should notify Congress that it used SBIR funds to support the HRMS project after Congress terminated NASA funding of the project.

Provide Data Recorder to an Authorized User

The data recorder was expected to arrive at ARC in September 1996. According to the current COTR for this contract, the COTR planned to transfer the data recorder under a loan to the SETI Institute's HRMS project where it would have been used to help search for extraterrestrial radio transmissions.

---

* The former COTR is now the Institute's Senior Scientist and Manager of Project Phoenix, formerly called the HRMS project.

ARC should not loan this equipment to the SETI Institute without Congressional approval to release it. If such approval is not forthcoming, then ARC should find another use for the equipment within NASA, or properly dispose of the equipment.

TERMINATE SIGNAL DETECTOR CONTRACT

Contract NAS 2-12936 (SETI signal detector) -- ARC needs to close contract NAS 2-12936 to avoid incurring possible additional contract costs and, in turn, using funds that Congress intended for other purposes. Specifically, the results of our survey showed that ARC awarded this $500,000 SBIR Phase II contract on November 18, 1988, to acquire a "SETI Signal Detector Prototype System 86-1," for use in the HRMS project.

ARC continued to spend money on this contract through March 1994, for additional contractor work performed on the equipment after October 1, 1993. (The amount expended after October 1, 1993, totaled $45,000; funds for this contract were obligated in Fiscal Year 1990.) ARC has made no contract payments since March 1994. The contract has remained open almost 6 years beyond the original completion date (November 17, 1990), and almost 3 years after Congress terminated NASA's support of the HRMS project. Progress payments totaled $230,000. ARC deobligated the remaining $270,000 on September 26, 1995. Almost one year later, ARC still had not issued a change order to close the contract.

The former COTR for this contract advised the OIG that ARC was justified in continuing to fund the contract after October 1, 1993, because SBIR funds were not tied to the HRMS project. We believe ARC circumvented Congressional intent by using SBIR funds as a means to continue supporting the HRMS project.

As of August 6, 1996, the Center anticipated issuing a change order that would close the contract. Because the contract is still open, the Center should expedite the contract closeout process.

RECOMMENDATION 1

The NASA Chief Financial Officer/Comptroller, Code B, should report to Congress that NASA used SBIR funds to support the HRMS project after Congress terminated funding of the project.

Management's (Code B) Response

Although the recommendation was specifically directed to Headquarters' Code B, both Code B and ARC management responded. The Chief Financial Officer, Code B, deferred to ARC's

response, stating *"Should the Ames response to this draft report be unconvincing to you, we would have no objection to disclosing your findings to the Congress."*

ARC maintained that at the time it recommended awarding the SBIR Phase I contract, ARC had not been directed to terminate spending on the HRMS program. ARC further maintained that although the related proposal was written in terms of its specific application to the HRMS program, the VLBA equipment had a broader application, as well as commercialization potential. When ARC received notice to terminate HRMS support, ARC said it again reviewed the proposal and decided to continue with the award based on the potentially wider application of the work within NASA and on its high commercialization potential.

The full text of the Code B and ARC responses is included as Appendices A and B to the report.

Evaluation of Management's Responses

Headquarters' Code B and ARC management have not adequately supported their response to Recommendation 1. Our reasons follow:

1. The proposal stated that Phases I & II of the proposed SBIR contracts were to:

> *" . . . formulate a plan for using the Very Long Baseline (VLBA) tape recorder for recording High Resolution Microwave Survey data (HRMS)."*
>
> *" . . . find a way to use the VLBA Recorder for recording and playing back SETI data."*
>
> *" . . . make the signal and control interfaces sufficiently general so that the upgraded VLBA Recorder may be used in a variety of applications. This is to be done both for NASA and with the objective of finding commercial uses."*

ARC continued to support a research effort that Congress had specifically terminated. It now maintains that it justifiably supported research on the data recorder based on the "commercial uses" (Goal 3) that it expected to find for the recorder. Notwithstanding ARC's position, Goals 1 and 2

directly supported the HRMS program and, according to the Phase II proposal, Goal 2 represented the "fundamental goal" of the contract.

Agencies can use SBIR contracts only to support authorized "technical topics." Because Congress had previously terminated the HRMS program, the HRMS program could no longer be considered an authorized technical topic. Accordingly, ARC awarded contract NAS2-14245 for an unauthorized purpose (i.e., "to modify a VLBA recorder for use in HRMS recording").

Goal 3 is common to any SBIR contract and was of secondary importance. In this regard, if the quest for commercial uses of NASA-funded new technology were the sole reason for SBIRs, then NASA could embark on virtually any research endeavor it pleased, without consideration to whether the research supported an authorized NASA program. Clearly, SBIRs confer no such "blanket" authority on the sponsoring agency.

2. ARC had ample time to eliminate the frequent and specific references to HRMS-oriented goals in the Phase I and II proposals and contracts. ARC made no such revisions. Specifically, ARC made no substantive changes to the Phase I proposal during the 3-month period from October 1, 1993, to January 5, 1994 (date of the Phase I contract). Also, ARC made no substantive changes to the Phase II proposal during the 9-month period from July 1, 1994, to March 24, 1995 (date of the Phase II contract). ARC did not even change the title of the Phase II proposal or contract, which remained: "Use of the VLBA Recorder for HRMS Recording." The absence of substantive revisions to the HRMS-orientation of these proposals and contracts strongly suggests that ARC intended to continue supporting the HRMS program after Congress had terminated it. Finally, ARC's statement that it continued to fund the proposals only because of their non-HRMS applications, is not supported by the documentation that ARC presented to the OIG.

3. The Phase II contract made no mention of other possible users. In fact, ARC had not identified other potential users of the data recorder equipment until after the OIG advised ARC of its concerns regarding the intended recipient, the SETI Institute. Specifically, on May 15, 1996, the COTR for contract NAS 2-14245 advised the OIG that he planned to have the data recorder delivered to the SETI Institute because it was the most likely user of the equipment. We then advised the COTR of our concerns regarding the propriety of his plan. As of about September 18, 1996, when we requested a meeting with ARC officials on this subject, ARC still had not identified another user for the equipment. On September 25, 1996, the date of our audit exit conference, ARC officials indicated they would probably have the data recorder shipped to the National Radio Astronomy Observatory in New Mexico.

ARC's actions after October 1, 1993, have shown a pattern of continued support to the HRMS program. Accordingly, we believe ARC circumvented Congressional intent and improperly expended additional hundreds of thousands of dollars.

Code B has stated its willingness to disclose the OIG's findings to the Congress. Code B's notification to Congress will satisfy the intent of the recommendation.

RECOMMENDATION 2

If NASA wants to provide equipment purchased under contract NAS 2-14245 to the SETI Institute, then the NASA Chief Financial Officer/Comptroller, Code B, should obtain approval from Congress to do so.

Management's (Code B) Response

Concur. Code B stated *"The Center concurs with this recommendation. However, ARC has not provided, and does not intend to provide, any hardware developed under this SBIR contract to the SETI Institute, or to any other company, for use on the HRMS project."*

Evaluation of Management's Response

The Center's response satisfies the intent of the recommendation.

RECOMMENDATION 3	If Congressional approval is not obtained regarding contract NAS 2-14245, then ARC should initiate actions to find another use for the equipment within the agency, or properly dispose of the equipment.
Management's (ARC) Response	Concur. ARC stated *"It was the stated intent in the Phase II proposal to identify non-HRMS users during the Phase II contract. The National Radio Astronomy Observatory (NRAO) in Socorro, New Mexico, has been identified as such a user. Negotiations are presently underway to conduct the test program there."*
Evaluation of Management's Response	The Center's response satisfies the intent of the recommendation.
RECOMMENDATION 4	ARC should direct the contractor to cease work on contract NAS 2-12936, and expedite the termination process for this contract.
Management's (ARC) Response	Concur. ARC stated *"The contract was closed on September 17, 1996 (see Enclosure). We request that your final report reflect the closure."*
Evaluation of Management's Response	The Center's response satisfies the intent of the recommendation. The OIG acknowledges the closure of contract NAS 2-12936.

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GENERAL COMMENTS

We appreciate the courtesy, assistance, and cooperation extended to us by NASA and contractor officials contacted during this survey.

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National Aeronautics and
Space Administration

Headquarters
Washington, DC 20546-0001

NOV 4 1996

Reply to Attn of B

TO: W/Assistant Inspector General for Auditing

FROM: B/Chief Financial Officer

SUBJECT: Draft Rapid Action Report on ARC's Support of the SETI Institute, Ames Research Center, Assignment No. A-AR-96-002

We have reviewed the subject draft rapid action report and our comments on Recommendations 1 and 2 are as follows:

Recommendation No. 1:

The NASA Chief Financial Officer, Code B, should report to Congress that NASA used Small Business Innovation Research (SBIR) Funds to support the High Resolution Microwave Survey (HRMS) project after Congress terminated funding of the project.

The Center does **not concur** with this recommendation. The Center maintains that no SBIR funds were spent specifically in support of the HRMS project, only, after October 1, 1993, the Congressional mandated termination date.

The purpose of the NASA SBIR Program is to seek "innovative concepts in SBIR that meet NASA mission needs and have potential for commercial applications." Thus, the SBIR program has two purposes, both of which have been approved by Congress. Given the wide potential application of the technology proposed in the HRMS related SBIR's (both within NASA and for commercialization), it was decided to continue with the award of the SBIR contracts. It was also decided to redirect the contracted efforts toward non-HRMS uses, which was done.

Should the Ames response to this draft report be unconvincing to you, we would have no objection to disclosing your findings to the Congress.

Recommendation No. 2:

If NASA wants to provide equipment purchased under Contract NAS2-14245 to the SETI Institute, then the NASA Chief Financial Officer, Code B, should obtain approval from Congress to do so.

The Center **concurs** with this recommendation. However, ARC has not provided, and does not intend to provide, any hardware developed under the SBIR contract to the SETI Institute, or to any other company, for use on the HRMS project.

Should you have any questions regarding our response, please contact Ralph H. Robinson, Chief Financial Officer, ARC, at (415) 604-5068.

Arnold G. Holz

National Aeronautics and
Space Administration

Ames Research Center
Moffett Field, CA 94035-1000

Reply to Attn of J:241-11

OCT 25 1996

TO: NASA Headquarters
Attn:W/Debra A. Guentzel, Assistant Inspector General for Auditing

FROM: Director of Center Operations

SUBJECT: Draft Rapid Action Report on ARC's Support of the SETI Institute
Ames Research Center Assignment No. A-AR-96-002

The Center has reviewed the subject draft report and appreciates the opportunity to respond. The following are our comments regarding the Observations and Recommendations 3 and 4, as requested.

RESPONSE TO OBSERVATIONS:

The Center does not agree with the first sentence of the "Observations and Recommendations" section of the report. We understand, however, how a review of the relevant documents could result in such a determination. Unfortunately, the documentation was not kept current. The language used in the SBIR contracts should have been changed, after the termination of the HRMS project, to accurately reflect the broader application of the efforts and modified non-HRMS emphasis, thereby avoiding this confusion regarding intent.

The Center maintains that no SBIR funds were spent in support of the HRMS project after the October 1, 1993, Congressional mandated termination date. The following comments about the SBIR contracts in question are provided with the two SBIR efforts addressed in the order to which they are referred in the subject report.

Contract NAS2-14245 (HRMS data recorder): The SBIR Phase I contract NAS2-13974 was awarded on January 5, 1994, to Interferometrics to determine the feasibility of adapting the VLBA data recorder (originally developed by the National Radio Astronomy Observatory - NRAO) to high rate, high data load usage. The successful Phase I was followed by a Phase II contract, NAS2-14245, on March 24, 1995, to do the technology development and delivery of a general purpose, prototype high speed, bulk storage tape recorder.

At the time the award of the Phase I contract was recommended, we had not been directed to terminate spending on the HRMS program. Thus, the proposal was written in terms of its specific application to the HRMS program. However, the proposal and the evaluation of it made reference to the broader application to NASA's mission and

the commercialization potential. The notice to terminate HRMS was received before the actual award was made. After that notice, we reviewed the recommendation again. We decided that due to the potentially wide application of the work within NASA and the high commercialization potential, we would continue with the award.

SBIR Phase I contracts are short term activities; 6 months to do the work, write the Final Report, and submit the Phase II Proposal. Therefore, companies rely heavily on databases that they have readily at hand. The SBIR Phase I Final Report by Interferometrics for "Use of the VLBA Recorder for HRMS Data Recording" does state, as noted by the OIG, that "*the fundamental goal of the SBIR project is to find a way to use the VLBA Recorder for recording and playing back SETI data.*" The Final Report goes on to state, "*An equally important goal is to make the signal and control interfaces sufficiently general so that the upgraded VLBA Recorder may be used in a variety of applications. This is to be done both for NASA and with the objective of finding commercial uses.*"

The purpose of the NASA SBIR Program is to seek "innovative concepts in SBIR that meet NASA mission needs and have potential for commercial applications." Thus, the SBIR program has two purposes, both of which have been approved by Congress. Given the wide potential application of this technology as discussed in the Phase II Proposal (real-time spacecraft or wind tunnel data, as well as other large recording capacity users, i.e., EOS data streams, and non-NASA archival storage for movie industry, computer networks, super computer peripherals, etc.), it was decided to continue with the award of the Phase II contract to develop a prototype unit.

As also stated in the Phase II Proposal, the contractor intended to identify an appropriate testbed during the contract: "*We anticipate identifying a system within NASA or some other organization which meets those requirements and arranging for a field test.*" The National Radio Astronomy Observatory (NRAO) in Socorro, New Mexico, has been identified as this potential test-bed and negotiations are presently underway with them. No delivery of any hardware, developed under this SBIR contract, has been or will be made to the SETI Institute, or any other company, in support of the HRMS project at NASA's expense.

Contract NAS2-12936 (SETI signal detector): SBIR Phase II contract NAS2-12936 was awarded to Silicon Engines on November 18, 1988, to develop both analytical simulations of and a hardware prototype of a signal detector that would meet the needs of the SETI Program, as well as being applicable to other activities which require the detection and the identification of a low level signal against a noisy background (e.g., planetary detection, tape processing, etc.).

This award was made well before the termination of the HRMS project. Under normal conditions, hardware delivery would have been made in about two years. However, Silicon Engines had a great deal of difficulty bringing this work to fruition and requested several no cost extensions to continue the work. The ARC COTR developed a series of milestones for them to complete in order to continue the contract. Late in 1993, they apparently, reported to the COTR that they would be able

to complete the milestones associated with the simulation development, but would not be able to do the hardware prototype development. That simulation work was completed in March 1994, demonstrated to the COTR, and payment was made for the simulation effort. No deliveries were made to the SETI Institute for use in the HRMS project nor was any further work approved.

Over the past 2 years there have been three different COTRs for this contract. The contract was not deobligated in a more timely fashion because of extreme administrative workload and unusual staff turnover. However, no funds have been expended on this contract since March 1994.

RECOMMENDATION 3: CONCUR

If Congressional approval is not obtained regarding contract NAS2-14245, then ARC should initiate actions to find another use for the equipment within the agency, or properly dispose of the equipment.

It was the stated intent in the Phase II proposal to identify non-HRMS users during the Phase II contract. The National Radio Astronomy Observatory (NRAO) at Socorro, New Mexico, has been identified as such a user. Negotiations are presently underway to conduct the test program there.

RECOMMENDATION 4: CONCUR

ARC should direct the contractor to cease work on contract NAS2-12936, and expedite the termination process for this contract.

The contract was closed on September 17, 1996 (see Enclosure). We request that your final report reflect the closure.

Should you have questions regarding our response, please contact Wanda Riney at (415) 604-6628.

Jana M. Coleman

Enclosure

cc:
W:204-11/D. L. Gandrud

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NASA

Contract Completion Statement

APPENDIX 1

1. FROM: (Office administering contract)

NASA Ames Research Center
Procurement Office, Code JAC
M/S 241-1
Moffett Field, CA 94035-1000

2a. CONTRACT NUMBER
NAS2-12936

2b. LAST MODIFICATION NUMBER
Modification Seven (7)

2c. CALL/ORDER NUMBER

3. TO: (Name and Address of Purchasing Office and Office Symbol of the PCO, if known)

NASA Ames Research Center
Acquisition Division, Code JA
M/S 241-1
Moffett Field, CA 94035-1000

4. CONTRACTOR NAME AND ADDRESS

Silicon Engines, Inc.
950 N. California Ave. Ste. 20
Palo Alto, CA 94303

5. EXCESS FUNDS ☐ YES ☒ NO
$ _____

6a. IF FINAL PAYMENT HAS BEEN MADE, COMPLETE ITEMS 6b., AND 6c.	6b. VOUCHER NUMBER	6c. DATE
	94012	3-14-94

7a. IF FINAL APPROVED INVOICE FORWARDED TO FINANCIAL MANAGEMENT OFFICE OF ANOTHER ACTIVITY AND STATUS OF PAYMENT IS UNKNOWN, COMPLETE ITEMS 7b. AND 7c.	7b. INVOICE NUMBER	7c. DATE FORWARDED

8. REMARKS

Contract will be closed as of the date of final payment and upon receipt of a copy of t final paid voucher from Fiscal.

Invoice No. 94012, dated March 14, 1994, in the amount of $15,000.00 was forwarded to Fiscal on 3/23/94.

COMPLETED

9a. ALL CONTRACT ADMINISTRATION ACTIONS REQUIRED HAVE BEEN FULLY AND SATISFACTORILY ACCOMPLISHED. THIS INCLUDES FINAL SETTLEMENT IN THE CASE OF A PRICE REVISION CONTRACT.

9b. TYPED NAME OF RESPONSIBLE OFFICIAL	9c. SIGNATURE	9d. DATE
Dolores M. Morrison Contracting Officer		9-17-96

FOR PROCUREMENT OFFICE USE ONLY

10a. ALL PROCUREMENT OFFICE ACTIONS REQUIRED HAVE BEEN FULLY AND SATISFACTORILY ACCOMPLISHED. CONTRACT FILE OF THIS OFFICE IS HEREBY CLOSED AS OF:

☒ DATE SHOWN IN ITEM 9d. ABOVE.

☐ DATE SHOWN IN ITEM 10a. BELOW. *(Check this box only if final completion of any significant procurement office action extends more than three months beyond close-out date shown in item 9d. above. In such cases, submit a copy of the completed form upon final accomplishment of all procurement office actions to the office administering contract. (Upon receipt, the office administering contract shall extend its contract file close-out date accordingly.))*

10b. REMARKS

A copy of the final paid voucher was received on September 17, 1996. the contract is hereby closed.

10c. TYPED NAME OF RESPONSIBLE OFFICIAL	10d. SIGNATURE	10e. DATE
Dolores M. Morrison Contracting Officer		9-17-96

NASA
Ames Research Center

APPENDIX 1

RECEIVAL AND INSPECTION REPORT

CONTRACTOR	ORDER NO.
Silicon Engines, Inc.	NAS2-12936

REC'D FROM	PKG. LIST NO.	SHIPPER'S WT

FRT. BILL NO.	GOVT. B/L NO.	VIA	NO. OF PIECES	ACTUAL WT.

ITEM	QUANTITY	DESCRIPTION
		Description of Procurement:
		SETI Signal Detector, SBIR Phase II
		1. Please sign the certification below, indicating that the subjec
		contract/order is complete:
		CERTIFICATION
		All work required by the Gov't under the subject contract/order has been
		completed, delivered, and accepted. Contractor did not
		Complete originally contracted labor.
		TECHNICAL MONITOR'S SIGNATUR
		2. In addition, has all Government Furnished Property not accountal
		under the subject contract/order (if applicable), been returned
		to the Government, or been accounted for:
		YES _____ NO _____ N/A X
		Where NO is checked, please explain.

ORDER IS ☒ COMPLETE ☐ SHORT ☐ OVER ☐ DAMAGED

Dee Abolle

I certify that the supplies and/or services listed in this receival and inspection report have been received and conform to contract requirements.

9/13/96 — Date Received

9/13/96 — Date Signed

Signature of Authorized Government Representative

Technical Monitor — Title

PLEASE PRESS FIRMLY – ALL COPIES MUST BE LEGIBLE.

White – Acquisition 241-1 Yellow – Shipping & Receiving 255-3 Pink – Preparing Office
Goldenrod – Financial Mgmt. 203-18 Green – Equipment Mgmt. 255-2

ARC 76 (Rev Apr 88) Previous editions of this form are obsolete

Silicon Engines Inc.

950 North California Ave., Suite 201
Palo Alto, CA 94303

Tel: 415-424-0480
Fax: 415-424-0480

Invoice Numbe. 94012

APPENDIX 1

APR 0 6 1994 409601

TO:	REMIT TO:
NASA-Ames Research Center Financial Analysis & Payments N203-18 Moffet Field, CA 94035	Silicon Engines, Inc. 950 North California Ave., Suite 201 Palo Alto, CA 94303 9409437355

Date:	Terms:	Contact:
14 Mar 94	Net 30	Jerome Duluk

Item	Description	Project	Amount	Totals
1	CAM IC Verilog Simulation Complete, Paragraph G.1, Item 13	SETI Signal Detector NAS2-12936	$15,000.00	

I certify that the supplies / services listed on this invoice have been received and accepted, except as noted above, and conform to the contract requirements.

Signature _____ 3/23/94
Contracting Officer / Administrator Date

15,000.00
1,451.457
14,949.55

JIMMY FONG
CERTIFYING OFFICER

3/2

$15,000.00

Notes:
A previous invoice, Invoice Number 94002, for the "CAM Integrated Circuit Model Complete, Paragraph G.1, Item 13" has the incorrect item reference number compared to the contract. It should have been for item "Paragraph G.1, Item 12".

PAID
MAR

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DISTRIBUTION LIST

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Code S/Associate Administrator for Space Science

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Jet Propulsion Laboratory
Lyndon B. Johnson Space Center
John F. Kennedy Space Center
Langley Research Center
Lewis Research Center
George C. Marshall Space Flight Center
John C. Stennis Space Center

Non-NASA Federal Organizations and Individuals

Assistant to the President for Science and Technology Policy
Deputy Associate Director, Energy and Science Division, Office of Management and Budget
Budget Examiner, Energy Science Division, Office of Management and Budget
Associate Director, National Security and International Affairs Division, General Accounting Office
Special Counsel, Subcommittee on National Security, International Affairs, and Criminal Justice

Chairman and Ranking Minority Member - Congressional Committees and Subcommittees

Senate Committee on Appropriations
Senate Subcommittee on VA-HUD-Independent Agencies
Senate Committee on Commerce, Science and Transportation
Senate Subcommittee on Science, Technology and Space
Senate Committee on Governmental Affairs
House Committee on Appropriations

House Subcommittee on VA-HUD-Independent Agencies
House Committee on Government Reform and Oversight
House Committee on Science
House Subcommittee on Space and Aeronautics

TOTAL UNAUTHORIZED SUPPORT IDENTIFIED BY THE OIG

ITEM	AMOUNT
(1) SBIR Contract NAS 2-14245 (RAR IG-97-008)	$ 599,101
(2) SBIR Contract NAS 2-13974 (RAR IG-97-008)	69,957
(3) SBIR Contract NAS 2-12936 (RAR IG-97-008)	45,000
(4) Improper purchase of RFI processor	490,120
(5) Equipment improperly relocated to the SETI Institute	59,480
(6) Improper use of IPA	70,000
(7) Other improper support	12,569
Total	$1,346,227

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National Aeronautics and
Space Administration
Ames Research Center
Moffett Field, CA 94035-1000

Reply to Attn of: J:241-11

May 28, 1997

TO: NASA Headquarters
Attn: W/Robert Wesolowski, Assistant Inspector General for Auditing

FROM: Director of Center Operations

SUBJECT: Draft Audit Report on ARC's Support of the
SETI Institute's HRMS Program
Assignment No. A-AR-96-002

The Center has reviewed the subject draft report and appreciates the opportunity to respond. The following are our comments regarding the recommendations contained in the report.

RECOMMENDATION 1: CONCUR, WITH CONDITIONS

The NASA Chief Financial Officer/Comptroller, Code B, should report to Congress that NASA used SBIR and other funds to support the HRMS Program after Congress terminated funding of the program.

ARC understands that the actions taken may have created the appearance of having continued to fund the HRMS program after Congressional direction to terminate funding. While the Center maintains that no improper actions were taken, we concur with the recommendation that NASA should inform Congress of the actions taken.

RECOMMENDATION 2: CONCUR

ARC should find an alternate use for the HRMS RFI processor (total cost $490,120) or dispose of the processor according to prescribed property disposal procedures.

The RFI Processor was shipped to the SETI Institute for verification testing of the contract deliverable. The COTR of the SBIR contract attended the testing. After the testing was accomplished, the processor should have been returned to ARC, but was instead left at the Institute. The Institute did not use the processor in their HRMS Program, or any other program to our knowledge. ARC has had the RFI processor returned to ARC. We have reviewed other possible uses for the processor, but have not identified any at this time. We will dispose of the processor according to prescribed property disposal procedures.

RECOMMENDATION 3: CONCUR

ARC should immediately recover all NASA property (total estimated cost $59,480) being used by the SETI Institute's HRMS Program.

Review of this property revealed that property passes were improperly used for this equipment. Twenty-four of the 29 items have been returned to ARC for use on other programs. The remaining five items have been properly added to the SETI Institute loan agreement.

RECOMMENDATION 4: CONCUR

ARC should comply with the prescribed property controls regarding the release of Government-owned property to ARC contractors and grantees.

ARC agrees that we should assure that prescribed property control procedures should be followed in the use and loan of government equipment. A review found that proper procedures were not followed for all items. Proper documentation has been completed, and our employees have been reminded of the procedures and the necessity to follow them.

RECOMMENDATION 5: CONCUR

ARC should ensure that it does not use Intergovernmental Personnel Act (IPA) Assignment Agreements to circumvent funding controls.

ARC agrees that the IPA should not be used in such a manner as to give the appearance of frustrating the intent of Congressional guidance. With regard to SETI, we would note there was no legal issue as to the funding controls since the Congressional action did not extend to the research and program management appropriation. In the case of Dr. Kent Cullers, ARC believes that proper procedures to review and approve his IPA to support the transfer of technology to a not-for-profit organization were used.

Should you have questions regarding our response, please contact Wanda Riney at (415) 604-6628.

Jana M. Coleman

CONCURRENCE:

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Comptroller
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Director, Resources Management Office
NASA HQ/Code R

cc:
ARC/W:204-11/D. L. Gandrud

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House Committee on Government Reform and Oversight
House Committee on Science
House Subcommittee on Space and Aeronautics

Congressional Members

The Honorable Richard H. Bryan, U.S. Senate
The Honorable Pete Sessions, U.S. House of Representatives

MAJOR CONTRIBUTORS TO THIS REPORT

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