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COMMAND AND CONTROL FOR NORTH AMERICAN AIR DEFENSE

1959-1963

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by

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FOREWORD

Command and Control for North American Air Defense, 1959-1963, is the third in a series of studies prepared by the USAF Historical Division Liaison Office (AFCHO) on command and control. This study discusses the issues and problems involved in centralizing authority and control over forces responsible for maintaining airspace vigilance in peacetime and combating any aircraft attack, as distinct from space (missile) attacks. Preliminary sections summarize the steps taken to remove the doctrinal and structural barriers which long served to dissipate the ability of air defense commanders to control their forces and trace conversion of the system from manual to semi-automatic operation. The main body of the study is concerned with the impact that the threat of missile attack had on aircraft defense command and control systems. A final section charts the likely course of future command and control developments as they appeared at the close of 1963.

This study forms a part of the larger History of Headquarters USAF, Fiscal Year 1963. It is being published separately to make it more readily available throughout the Air Force.

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COMMAND AND CONTROL FOR NORTH AMERICAN AIR DEFENSE

1959-1963

There are two basic elements to any military command and control system. The first includes the equipment, facilities, techniques, and technical personnel for collecting, displaying, and transmitting operational information. The second includes the commanders, the command framework, and the procedures designed to make the most effective use of information. The first element is technological in nature, the second organizational.[1]

By the mid-1950's, the technological element of the North American air defense command and control system had reached a temporary plateau of development. Further progress awaited the replacement of manual practices for gathering and passing data by automatic devices. These were already under development, but it would be several years before they became operational. Meanwhile, much had to be done to improve the organizational element, which was fragmented into several units and systems functioning under varying operational practices. If the air defenses were to keep pace with the ever-increasing threat, these had to operate as one unit and one system under one authority.

Strengthening the Organizational Element

Five loosely coordinated air defense systems had emerged on the continent by 1954. In the United States, USAF's Air Defense Command (ADC)

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operated the radar sensor network, the fighter interceptor squadrons, and the combat control centers. The Army's Antiaircraft Command operated what was in effect a second air defense system employing antiaircraft artillery, a few NIKE missiles (which soon afterwards replaced the artillery at all installations), and a well-developed network of fire control centers and target acquisition radars. The top administrative headquarters of both systems were on Ent AFB, Colorado Springs, Colo. The main battle control center--called the Combat Operations Center (COC)--was also located there. The Air Force had concentrated its radar stations and interceptors on the northern and coastal perimeters of the country, and its interior stations afforded unbroken aircraft tracking between defense areas and along logical approach routes. The Army sited its fire units around major military and industrial areas. The philosophy of the defenses was that interceptors would engage bombers as far from critical targets as possible with both interceptors and Army weapons engaging those bombers that penetrated the outer defenses. Department of Defense (DOD) and interservice agreements empowered the Air Force to assume operational control of all weapons during an attack. However, the Army believed that the Air Force command and control network was insufficiently reliable to allow proper control of its (Army) weapons in a crisis. Thus, the agreements notwithstanding, the two services were still poles apart on the issue of single control of weapons. And under the current structure, there

was little that the Air Force could do to overcome Army intransigence on the issue.[2]

In Alaska, the unified Alaskan Command established soon after the end of World War II was responsible to the Joint Chiefs of Staff (JCS) for air defense. Another system, deployed in the area of U.S. interest in the Canadian Northeast and Thule, Greenland, was similarly organized as the U.S. Northeast Command. In both areas, the unified commanders delegated the actual task of air defense to the USAF component whose commander worked out mutually acceptable terms of antiaircraft participation with his Army counterpart. The mission of the Alaskan system, directed from a USAF combat center on Elmendorf AFB at Anchorage, was twofold: to defend Alaska against air attack and to serve as a warning outpost for the continental U.S. system. The Northeast system, directed from a USAF combat center on Pepperell AB at St. Johns, Newfoundland, acted as a detection and warning line against attack on the United States from across the North Atlantic.

The Royal Canadian Air Force's Air Defence Command (RCAF ADC) operated the fifth of the air defense systems. Important Canadian contributions to North American air defense to this point had included support of the U.S.-built distant early warning (DEW) line across the top of the Northwest Territory. The Canadians had also built a second warning line, across mid-Canada, and had shared the cost of building and operating the Pinetree Line of radar warning and control stations across southern Canada.

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In the fall of 1954, JCS made a start toward strengthening the air defense organizational structure by creating the Continental Air Defense Command (CONAD). The air defense commands of the Air Force and Army were designated components of CONAD, and the Navy established a component for the new command. The commander of ADC became the Commander-in-Chief, CONAD, with operational control over all service elements assigned to continental U.S. air defenses. Officers holding major positions at each headquarters echelon in ADC donned a second hat for the comparable position in CONAD. The Air Force became executive agent for the joint command, with the CONAD commander reporting to JCS through the Chief of Staff, USAF.

The intent of the change was to remove U.S. air defense from the purview of the individual services and elevate it to a joint task under general USAF supervision. But vague terminology in CONAD's mission statement and the failure of JCS to authorize a separate CONAD staff raised more questions than the new organization settled.

It was not for another two years that truly significant strengthening of the air defense structure came about. In September 1956, as part of an overall revision of its unified command plan, JCS appointed a separate commander for CONAD, clarified and strengthened his authority, and furnished him with a joint staff. At the same time, JCS transferred responsibility for the air defense systems in Alaska and the Canadian Northeast from the unified commands in those areas to CONAD. The command arrangement in Alaska remained

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much as before except that the Alaskan commander now received directives on air defense operations directly from CONAD instead of from JCS. In the Canadian Northeast, both the unified command and its service components were eventually closed out and the air defense forces reassigned to ADC. Firm authority over U.S. air defenses everywhere on the continent was now centered in Colorado Springs, and CONAD promptly undertook to improve communications between the systems and weld them together under the same operational practices.

Meanwhile, at the direction of the U.S. and Canadian military chiefs of staff, officers from the two countries were studying the possibility of integrating their air defense systems. By early 1957, both countries had agreed on the wisdom of such a move and, on 12 September, the North American Air Defense Command (NORAD) was born with headquarters in Colorado Springs. RCAF officers joined officers of the three U.S. services on the NORAD staff. The CONAD commander assumed command of NORAD, while an RCAF air marshal became his deputy commander. The RCAF ADC became a component and its forces, with those of the three U.S. component commands, passed to the operational control of NORAD. The air defenses in the whole of the continent were now joined under one commander who received his orders from JCS and its Canadian counterpart.[3]

In the summer of 1958, the U.S. portion of the air defense structure was further strengthened in a general DOD reorganization.

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After NORAD's establishment, CONAD had continued as a U.S. command to handle matters of a strictly national nature, such as nuclear weapon development and U.S. air defense relationships with nations other than Canada. In the 1958 reorganization, the Secretary of Defense eliminated the executive agency system, and the air defense commander, when acting on CONAD matters, now reported directly to the Secretary through JCS.[4]

Anatomy of the Manual System

By the time direction of the continental air defenses was centralized at Ent AFB under the NORAD commander, construction of the aircraft radar warning and control stations initiated early in the decade was nearing completion. The DEW line was in operation from Cape Lisbourne, Alaska, to Cape Dyer, Canada. A western segment, extending warning coverage along the Aleutian chain, became operational in early 1959. An eastern segment, extending across the Greenland icecap, was under construction and would become operational in 1961. U.S. Navy picket ship and airborne radar barrier lines operated in far northern waters, complementing and extending DEW line coverage. The RCAF operated the second radar warning line, across mid-Canada. Eighteen radar stations, netted into the Elmendorf combat center, operated in Alaska.* In Canada, 23 radar

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*Unless otherwise noted, the term "radar station," as used in this paper, means a manned, land-based, heavy, long-range, and, as it is most often called in military correspondence, prime or primary station. Another type of station, the unmanned gap filler, fulfilled an important role in the air defenses over the years. As its name implies, this station complemented the primary system by affording low-altitude radar cover between widely-separated primary stations.

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stations stretched along the Pinetree Line from Vancouver Island to Nova Scotia; another 10 stations were operational north along the Newfoundland and Labrador coast. The RCAF operated 15 of these stations and ADC the remaining 18. Nine of the USAF-manned stations were in the Canadian Northeast, netted into the Pepperell combat center. The other nine were in the Pinetree Line and fed surveillance information back to U.S.-based stations, fulfilling the need for unbroken radar coverage north of U.S. cities and military bases located along the border. The Canadian-manned stations were tied into the RCAF's combat center on St. Hubert Air Station, near Quebec. One additional USAF radar station operated in the north on Pingarssuit Mountain near Thule AB.

In the United States, 118 radar stations were operational by early 1959. Seaward extension of radar coverage was provided by Navy picket ship and airborne radar stations off both coasts and by three USAF Texas Tower radar platforms located on shoals off the Atlantic coast. Like the Alaskan and Canadian radar stations, the U.S. stations were equipped and manned to perform varying duties. Some were surveillance stations that fed aircraft sightings back to ground control intercept (GCI) stations for identification. The GCI stations handled both surveillance and weapon control functions and were netted to master direction centers (MDC's). The MDC was the key unit of each complex, performing not only search and weapon control but also directing the employment of weapons to the best advantage throughout its subsector.

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Superimposed on this detection and weapon control framework were the decision-making posts. The continental U.S. MDC subsectors were grouped into 16 sectors by 1958. The sector combat centers performed no radar functions. From information fed them by the MDC's, the sector commanders sought to analyze the enemy's strategy then mass weapons within the subsectors against his mainstreams of attack. The sectors were grouped, in turn, into three regions--Eastern, Central, and Western. Their combat centers were located at Newburgh, N.Y.; Kansas City, Mo.; and San Francisco, Calif. Region centers and commanders operated in the same manner as sector, only on the larger scale. It was from the reports sent him by the three region commanders plus those forwarded from Elmendorf, St. Hubert, and Pepperell that the NORAD commander at Ent would form his analysis of the state of the air battle throughout the continent. Normally, major generals commanded the regions, colonels the sectors, lieutenant colonels the subsectors, and majors the GCI and surveillance stations.

The combat operations center at Ent operated in the early years from a room in a converted hospital building that housed the offices of the commander and several of his staff. Status reports from the tactical units reached it through the command and control chain via teletype and telephone. Airmen manually transcribed this information on the situation map and status boards. It was a slow operation, basically the same as the one the Royal Air Force had used during the

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Battle of Britain. In the mid-1950's, a new COC was built amidst the administrative buildings. It was an above-ground, windowless, cement block structure and afforded the battle staff a raised dais and a considerably more capacious and efficient working environment. Like the subordinate centers, however, it remained a manual operation.

Under most conditions, enemy bomber attacks would have been detected at the DEW and northern barrier lines and tactical warning flashed back to Ent in time for NORAD to alert the retaliatory forces and civil populace and prepare its own forces for action. For passive purposes, then, the command and control system for air defense was acceptably adequate by early 1959. For active defense it was dangerously obsolete, however. GCI and MDC stations were easily saturated because of the small number of tracks and simultaneous interceptions their controllers could handle. Equally important, weapons could not be employed effectively because the top commanders were not able to keep current on events. Combat data was manually transferred from the radar scopes into the teletype and phone communications which carried it up the chain. In each combat center the data then had to be recorded manually by technicians writing in reverse on the backs of vertical plexiglass plotting boards. The higher the information climbed through the system the less current it became. By the time it reached sector, region, and NORAD, the data was usually too old to enable the

commanders to frame effective decisions based on it. Consequently, decision-making frequently devolved on the MDC lieutenant colonels during training exercises. While some sectors struggled to bring enough weapons to bear on a main thrust, weapons in adjacent sectors which might have come to their aid remained on alert or patrol waiting for attacks which never came.

Thus, while the structural element of the North American air defense command and control system had satisfactorily centralized authority in the hands of the NORAD commander by early 1959, he and his subordinate commanders were unable to exercise their authority because of an outdated technological element. Needed was an automatic and rapid means for transmitting and displaying combat data. The Air Force believed it had found this means in the Semi-Automatic Ground Environment (SAGE) System which was just beginning to come into operation.[5]

Conversion to SAGE

Development of SAGE began in 1953 when the Air Force contracted with the Massachusetts Institute of Technology's Lincoln Laboratory to set up an experimental automatic air defense command and control system on Cape Cod, Mass. Here several long-range radar stations and gap filler stations were netted into a small direction center operation built around the Whirlwind I computer. With this test system, MIT scientists worked out the technique of converting radar sightings to digital bits and feeding them back over special communication lines for storage in the computer. Programs were then devised

which enabled the commander to draw from the computer the up-to-date picture he needed to make his battle decisions.[6]

By 1955 the experimental project had evolved into what seemed the answer to the data transmission and display problem. In January of that year, the National Security Council decreed that SAGE should be installed with all practicable speed and afterwards, kept current with threat developments. On this authority, the Air Force ordered equipment and drafted plans for computerizing the continental U.S. portion of the system.[7]

The first SAGE sector became operational in June 1958 in northeastern United States. The sector combat center, under the manual system, had been a makeshift affair at best, set up in one of the administrative buildings of the Air Force component headquarters. The new SAGE post, called a Direction Center (DC), was housed in a specially designed, above-ground, windowless, cement block building. Here were located the AN/FSQ-7 computer, operations room with raised dais and englassed observation rooms for commander and operations staff, console and communication center, support offices, and power facilities. Radar stations were now netted directly to the sector DC and the subsector centers (MDC's) were discontinued.

The first SAGE region battle post became operational at Syracuse, N.Y. in early 1959. Called a Combat Center (CC), it also operated from a new structure similar in design to the sector DC.

It employed a different computer, the AN/FSQ-8, since it performed no weapon control. The purpose of the new SAGE region was the same as the manual region's had been: to supervise the air battle in its subordinate sectors. Only now, through the computer, the region commander could get a near-instantaneous picture of the state of operations in his sectors. Major generals continued to command the regions but the rank of commanders of the new SAGE sectors was raised to brigadier general.

The gigantic job of constructing and equipping the SAGE DC and CC buildings, installing equipment in the radar stations for processing and automatically transmitting radar returns in digital form to the DC's, replacing the manual system's communication network with some two million miles of SAGE closed circuit communication lines, and training technicians to operate the system took over three years to complete. A total of 21 DC's and 3 CC's were built.* By mid-1959, 5 DC's and 1 CC were operational in the northeast. By the end of that year, 9 DC's and a second CC, at Madison, Wisc., were in operation. The third CC became operational at Tacoma, Wash., by June 1960, and the number of operational DC's had reached 12. In the next year, seven additional DC's became operational, and the last two DC's took their place in the system in September and December 1961, respectively.[8]

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*Actually, 22 DC's were built but one at Richards-Gebaur AFB was used solely for training technicians in SAGE procedures. As noted later, it eventually became a region command post.

The Air Force deployed all but three of the 21 DC's along the U.S. perimeters. Five were built on the west coast, 10 along the northern border, and three on the east coast. The other three were built in the interior to control the central and southern defenses.

The operational concept and structural alignment of the air defense command and control system were drastically altered in the switchover to SAGE. Weapon control functions performed by the numerous MDC subsectors and the decision-making functions performed by the 16 sectors in the manual system were now both performed at sector level from the new DC. In other words, with an entire echelon of operation eliminated, the same or greater number of weapons were now directed far more effectively by considerably fewer commanders. Between sector and NORAD headquarters, six region combat centers now functioned--the three SAGE CC's at Syracuse, Madison, and Tacoma, two "remoted" CC's at San Francisco and Kansas City, and a manual CC at Oklahoma City. The remoted CC's were equipped with standard SAGE displays but, for economy's sake, were wired to just one of the DC's in their region. These DC's were furnished composite CC/DC computer programs and the region commander, by switching action, could query and instruct the CC portion of the DC computer.[9]

SAGE CENTERS: December 1961

Operational Designation		Location Region Control Centers (CC's)	Location Sector Direction Centers (DC's)
Region	Sector		
25th		McChord AFB, Tacoma, Wash.	
	Seattle		McChord AFB, Tacoma, Wash.
	Portland		Adair AFS, Corvallis, Ore.
	Spokane		Larson AFB, Moses Lake, Wash.
26th		Hancock Field, Syracuse, N.Y.	
	Boston		Stewart AFB, Newburgh, N.Y.
	Bangor		Topsham AFS, Topsham, Me.
	Syracuse		Hancock Field, Syracuse, N.Y.
	New York		McGuire AFB, Wrightstown, N.J.
	Washington		Ft Lee AFS, Petersburg, Va.
28th		(Remoted CC in non-SAGE structure on Hamilton AFB, San Francisco, Calif.)	
	San Francisco		Norton AFB, San Bernardino, Cal.
	Reno		Stead AFB, Reno, Nev.
	Los Angeles		Beale AFB, Marysville, Cal.
	Phoenix		Luke AFB, Litchfield Park, Ariz.
29th		(Remoted CC in converted SAGE training facility on Richards-Gebaur AFB, Kansas City, Mo.)	
	Sioux City		Soux City Munic. Arpt, Iowa
	Great Falls		Malmstrom AFB, Great Falls, Mont.
	Minot		Minot AFB, N. Dak.
	Grand Forks		Grand Forks AFB, N. Dak.
30th		Truax Field, Madison, Wisc.	
	Chicago		Truax Field, Madison, Wisc.
	Detroit		Custer AFS, Battle Creek, Mich.
	Duluth		Duluth Int'l Arpt, Minn.
	Saulte Ste. Marie		K.I. Sawyer AFB, Gwinn, Mich.
32d		(Manual CC, Oklahoma City AFS, Oklahoma)	
	Montgomery		Gunter AFB, Montgomery, Ala.

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As for the system as a whole at the end of 1961, the NORAD commander now exercised authority and control through a total of eight region centers--the six in the United States and the two manual ones at Elmendorf and St. Hubert. These regions were divided into 21 SAGE and 4 manual sectors.* Three of the manual sectors were assigned to the Canadian region./ The fourth, the U.S.-manned sector in the Canadian Northeast, functioned under the operational control of the Canadian combat center at St. Hubert. At the same time, it was responsible directly to Ent on matters concerning the U.S. defenses in Greenland. When Pepperell AB closed in 1960, the combat post for the Canadian Northeast defenses moved to Goose AB, Labrador, and the defense area was renamed the Goose NORAD/CONAD sector. In Alaska, that region was divided into two manual sectors for a time. But these were closed out in late 1960 and the radar stations netted to manual direction centers which then fed directly into the Elmendorf region center. The same number of radar stations operated in Alaska and Canada as in early 1959. The number of continental U.S. stations had increased from 118 to 130.

Decision on Hardening

The Problem of Survival

Thus, after eight years of development and construction, an automated air defense command and control system was operational within

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*There were also three sectors which either contained no forces or so few that they did not warrant a sector combat center. These were the Hudson Bay, Denver, and Oklahoma City sectors. Data from the few sensors in the latter two sectors fed into the system through other sector combat centers.

/Two of these were closed down [redacted] lowing year.

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the critical areas of the United States. Peacetime air surveillance data flowed through the battle centers with speed and accuracy. The massive, confidence-inspiring, concrete block houses, with their wondrous computers and consoles, quickly became the pride of communities and favorite inspection stops for dignitaries. The Air Force shared this pride, and rightly so. For this was part of a pioneer effort that soon would revolutionize the military, industrial, and business data handling techniques throughout the world. However, Air Force pride was tempered by its concern that Soviet intercontinental ballistic missiles (ICBM's) might destroy SAGE before the first Soviet bombers penetrated NORAD's radar screen. The above-ground structures, hardened to withstand over-pressures of only 5 pounds per square inch (psi), and their unhardened communications probably would not live to control the air defenses against bomber attacks if the enemy struck first with missiles.

Planners of the original SAGE had anticipated the advent of the ICBM and had considered construction of underground SAGE centers and communications. However, they abandoned the idea for fear it would raise SAGE costs beyond a figure that an economy-minded administration would accept. The only alternatives were redundancy and dispersal, and the plan, as approved and funded in 1955, sought survival through these means. It called for 32 DC's and 8 CC's, so deployed that when one was destroyed others could take over its defense area.[10] As noted earlier, the completed system fell far short of this original

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plan. Only 21 DC's and 3 CC's were eventually built. And 8 of the DC's were placed on or near Strategic Air Command (SAC) bomber bases and ICBM sites while another 3 shared bases with the SAGE CC's. It could be assumed that these 11 centers would likely be destroyed as bonuses in a missile attack on SAC bases. Thus, the original safety-in-numbers proposal had deteriorated to the point where over 50 percent of the centers were almost certain casualties should the enemy launch his attack with ICBM's.

The Super Combat Center Plan

Events leading to reduction of the original SAGE system had their inception in an ADC plan of 1958 intended to increase SAGE quality and survivability. The IBM Corporation, manufacturer of the SAGE computers, and the Air Research and Development Command (ARDC)* had developed a solid state computer by 1958 that could handle five to seven times more data than the vacuum tube computers then on order for SAGE. ADC wanted to install these new computers in Super Combat Centers (SCC) dug 300-500 feet into the earth. This would harden the SCC's to 100-200 psi. Communications would be similarly hardened for a distance of 14 miles or more out from the centers. Whereas the currently programmed soft CC's were to be netted only to their subordinate DC's, the hardened SCC's would also be netted directly to the radar stations. Some of the SCC's could then handle both DC

*In April 1961, ARDC was reorganized and designated Air Force Systems Command (AFSC).

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and CC functions on a regular basis and all could take over operations within sectors as soft DC's were destroyed. Thus, it was possible to eliminate not only the soft CC's from the program but a number of the DC's as well, with the savings applied to construction of the SCC's.[11]

The Air Staff approved the plan in February 1959 and quickly obtained OSD approval in principle. In its final form, the plan called for the continental U.S. forces to be aligned into nine regions, with a tenth in Canada. Each region would be controlled from an underground SCC equipped with one of the new computers. The regions would be divided into 27 sectors. Twenty-two would have above-ground DC's as then programmed, and all but one of these would be equipped with the vacuum tube computer. The other would have a solid state computer. In the other five sectors, the SCC's would perform DC duties as well. Since it would take longer to complete the SCC's, three CC's in the northern United States would be completed and operate until the SCC's became operational, then close down. The money saved by immediately deleting 5 CC's and 10 DC's and an additional $193 million would complete the new program. (Subsequently this figure doubled.)[12]

The plan for the Canadian center called for a combined CC/DC to be dug into a mountain at North Bay, Canada, northwest of Ottawa. In December 1958, the two nations reached agreement on financing the new facility and converting the Canadian system to SAGE operation. The agreement also called for adding 7 heavy radar stations, 45 gap filler

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radar stations, and 2 Bomarc unmanned interceptor sites to the Canadian system. Canada would construct the new facilities, provide unit equipment, and pay about one-third of the cost. The program was called CADIN, for Continental Air Defense Integration North.[13]

Master Plan for Air Defense

Secretary of Defense Neil H. McElroy informed Congress of the SCC plan in his fiscal year 1960 budget presentation. Early in the hearings, considerable controversy arose between the Senate and House committees over the comparative merits of the Bomarc and Nike weapons that expanded into general inquiry on the status of air defense. Specifically, Congress wanted to know if it would insure the future as well as the current safety of the nation.

The complicating factor was the new threat posed by the ICBM. Since 1957, ballistic missile defense had been accorded top priority by the President and Congress. The Air Force was building a three-station ballistic missile early warning system (BMEWS) and the Army hoped to develop the Nike Zeus missile as an active defense against the ICBM. Thus, the nation would have warning of an ICBM attack and hoped eventually to be able to counter it. Congressional concern was primarily over whether these anti-missile programs were adequately supported or if they were lagging because too much was being spent on anti-bomber defenses. In short, was the DOD air defense program in proper balance with the changing threat?[14]

Secretary McElroy asked JCS and certain of his staff in May 1959 to review and propose revisions t[redacted] plans in the light of the

changing conditions. Within two weeks, JCS had gathered service opinions and submitted its recommendations. The staff of the Office of the Secretary of Defense (OSD) reconciled service disagreements, of which there were many, and drew up what it called the Master Plan for continental air defense. Secretary McElroy announced the findings on 19 June. For the SAGE system, SCC construction would continue, as the Air Force and JCS had recommended. But for economy reasons, only six of the nine U.S. centers would be hardened. The three for the central and south central areas would be above ground. As another economy measure, the one DC planned with a solid state computer would instead be equipped with the vacuum tube version. Subsequently approved by Congress and the President, the Master Plan became the official guide for air defense planning.[15]

By the end of the year, the Air Force, hard-pressed to meet other air defense commitments from within the ceilings imposed by Master Plan guidance, chose to cancel two of the three soft SCC's and the DC reoriented to the vacuum tube computer. The program now called for establishing 21 sectors in the continental U.S., each controlled from an above-ground DC. Three above-ground CC's, with vacuum tube computers, would be completed. These would close down when the seven SCC's with solid state computers became operational. The Canadian SCC and SAGE conversion activities, now governed by the CADIN agreement, would continue as originally planned.[16]

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Cancellation of the Super Combat Centers

It was not difficult to foresee that the Master Plan would soon have to be overhauled. It was too hastily prepared and too general in nature to serve as a valid guide to future development.[17] Too, Congressional inquiries on the extent of the ICBM threat had opened a Pandora's box of crucial questions which the Master Plan did not satisfactorily answer. Finally, the 1958 DOD reorganization had greatly strengthened JCS and OSD staffs, and they were gradually discerning the extent of weakness of their own command and control resources. They were in about the same position as the NORAD commander was before SAGE; there was authority and a basically sound structure, but the equipment and procedures for exercising this authority were either outmoded, cumbersome to the point of inefficiency, or nonexistent. To this point, the services had pretty much decided the portion of their budgets spent on command and control. In the future, however, JCS and OSD intended to examine closely service recommendations to make certain they fitted into the gradually evolving national command and control system. Service headquarters, in turn, would apply the same criteria when considering field recommendations.*

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*For example, an Air Force Objectives Series Paper (AFOS 2/10) published in 1963 set forth the broad concepts and objectives for USAF command and control through 1975. It called for "a single, integrated USAF Command and Control System," with the major elements conceived, acquired, managed, and operated as separate packages to meet the needs of the commander they served. They should, however, remain under the unifying influence of an overall broad doctrine and across-the-board management.

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The cost of recommended improvements would also play an increasingly important role in these decisions. Higher authorities might agree with a field commander that an improvement was greatly desirable, but if the budget did not permit, OSD would turn down the request. The SAGE SCC program was destined to become one of the early casualties of this frequently distressing yet unquestionably necessary policy.

In November 1959, OSD advised the Air Staff that it was re-examining the Master Plan in the light of a recent revision of the missile threat. Intelligence credited the Soviet Union with having, by 1963-1965, a 60-megaton ICBM capable of striking within a mile or less of North American targets. As a result of this and other new estimates of requirements, the President's Scientific Advisory Committee had asked its Air Defense Panel to reassess the terms and objectives of the Master Plan. The panel, in turn, had asked OSD's Director of Defense Research and Engineering (DDR&E) to assist. Pending completion of the project, OSD placed a hold order on SCC procurement.[18]

One result of these investigations was DDR&E's recommendation to cancel the SCC program. Hardening the SCC's would not insure their survival against ballistic missiles of the potency which the Soviets could hurl against them by the time the centers became operational. The NORAD commander protested, labeling the move "a decided step backward in our limited capability for air defense." But OSD approved, and the Air Force and JCS concurred. On 26 March 1960, Acting Secretary of Defense James H. Douglas officially cancelled the program,

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allowing only the soft SAGE program of 3 CC's and 21 DC's (plus the training DC at Kansas City). As for Canada, the CADIN plan for replacing the manual center at St. Hubert with an underground CC/DC at North Bay and expanding and converting the Canadian radar system to SAGE would continue. However, since no solid state computers would now be ordered, the North Bay center would be furnished with a modified AN/FSQ-7.[19]

In summary, the expense of constructing underground centers and of purchasing the improved computers figured importantly in the decision to cancel the SCC plan. Equally important, the planners feared that even if the money were spent on the project--at the expense, perhaps, of other vital programs--the ability of the system to function after a missile attack remained in doubt. For one thing, they felt the SCC's could not be dug in deeply enough to prevent their destruction; for another, hardening the SCC's alone would not assure overall system survival. Since it would be too costly and time-consuming to harden every element of the system, it was better just to scrap the SCC project entirely before construction started.[20]

New Concepts for New Conditions

Backup for SAGE

With the SCC's cancelled, NORAD, ADC, and Headquarters, USAF had to knit the remnants of its command and control program into as efficient and secure a system as possible. One fact was certain: the soft SAGE centers were critically vulnerable to ballistic missile attack.

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Conceivably, the centers might be wired so that when one was destroyed another took over its functions. This had been the intent under the original SAGE program, but abandoned when OSD approved the SCC plan. However, as noted earlier, over 50 percent of the centers were now located on bases considered prime targets for missile attack. To return to the original emergency operations plan offered little promise; it would, in too many instances, simply link one foredoomed center with another facing the same prospect. Also, it was excessively expensive.

NORAD offered the most promising expedient. This called for re-equipping certain radar stations and allowing them to assume manual control of weapons upon the destruction of their parent DC's. Accordingly, in his first budget address to Congress in March 1961 President Kennedy asked for and subsequently obtained additional fiscal year 1962 funds to enable the Air Force to start work on such a backup system. The new Secretary of Defense, Robert S. McNamara, explained to the House Armed Services Committee that he wanted to provide "a sustained manual GCI capability" at those radar stations located outside probable target areas and therefore likely to survive an enemy's initial missile attack.[21]

Under the Kennedy administration, U.S. military command and control systems world-wide came immediately under close study. The President said that he was determined to make all systems "more flexible, more selective, more deliberate, better protected, and under

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ultimate civilian authority at all times." With supplemental funds granted for that purpose he set the Defense Department immediately to work on improving the national system. These measures, he promised, were just the beginning of an effort to create "a truly unified, nation-wide, indestructable system to insure high-level command, communication and control and a properly authorized response under any condition."[22]

Secretary McNamara wasted little time putting this promise into action. His first need was for better information on the systems currently in operation. To obtain it in the air defense area, he asked DDR&E to restudy the air defense sensor and control system and to note especially how effectively it permitted "the duly constituted authority to react to an attack in a deliberate position." Among the specific items that he wanted DDR&E to explore were the alternatives open with regard to SAGE: what were the advantages and disadvantages of (1) operating SAGE as currently programmed, (2) supplementing it, or (3) closing it out completely?[23]

In its report of May 1961, DDR&E recommended that the Air Force divert much of the money allocated for improving anti-bomber sensors to backup command and control and other survival systems. SAGE should continue but be viewed only as a pre-battle system.[24] After soliciting and studying their comments, McNamara on 5 June 1961 notified the Air Force and JCS that he agreed with DDR&E's concept of SAGE. In the future, he would not consider any proposal for improving SAGE's

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post-battle capabilities. McNamara emphasized that money currently set aside for such improvements and future air defense appropriations should be concentrated on developing the backup control system and the missile early warning systems and for achieving a greater dispersal of the interceptor force.

McNamara asked NORAD to prepare several alternate plans for achieving a survivable air defense system within this general guidance. He amplified on these instructions a few days later by asking JCS to do a full-dress air defense review, which he called OSD Project 126. He wanted JCS to evaluate the projects in the fiscal year 1963 budget, conduct a cost and effectiveness analysis on a projection of 10 years on how to protect the wartime function of each of the anti-bomber elements of the system from missile attack, and list alternate ways and means for creating a system that absorbed a missile attack and then countered a small (300-500) follow-on bomber attack.[25]

JCS delegated the study to NORAD, and the Air Staff instructed ADC to assist.[26] NORAD forwarded a preliminary plan in July 1961 and its final, detailed recommendations the following month. On the matter of command and control, NORAD, with the full support of ADC, proposed the creation of what in effect was a little SAGE system. It would equip 70 radar stations with small, solid state computers and display consoles. As a first step, the Air Force would complete the work currently under way of equipping and manning radar stations outside

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primary target areas for manual control. Then, as funds allowed, the Air Force would convert this manual system to a semi-automatic operation. Since the new computers could not handle the loads of the SAGE computers, there would be more of them and placed in far more secure areas.[27]

The Air Force and OSD approved the plan in principle. But as events transpired, the final plan fell considerably short of NORAD's proposal. In its review of USAF's 416L System budget submission for fiscal year 1963 (covering the whole of the air defense command and control ground environment), OSD agreed to the requirement of an automated backup system for SAGE but reiterated its instructions of several months earlier that the money for such improvement had to come from reducing other elements of 416L. OSD directed the Air Force to reorient its submission, eliminating programmed equipment where this could be done at "minimum loss to over-all system performance." The scope of the backup system would then be decided on the basis of savings accruing from this re-examination.[28]

The Air Force reviewed its air defense programs and estimated that by reducing purchase orders on such items as improved radars it could raise about $100 million for automated backup control along the lines suggested by NORAD. On 1 November 1961, it notified ADC of the cancellations.[29] ADC and AFSC then prepared an operations plan for a backup system based on the funding limitation. Dr. Brockway McMillan, Assistant Secretary of the Air Force for Research

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and Development, sent the plan to OSD in January 1962, and Deputy Secretary of Defense Roswell L. Gilpatric approved it on 13 March.

The Backup Interceptor Control (BUIC) project called for two phases. In the first, carefully selected radar stations--ones with a good chance of surviving missile attack--would continue to be outfitted as manually operated centers. In the second, 17 of the stations would be equipped for semi-automatic control operations; if they lived up to expectation, the Air Force would modify another 17. In his approval, Gilpatric warned the Air Force not to spend over $100 million on the second phase, including procurement, installation, test, check out, and the purchase of initial spares.[30]

Thus, the Phoenix which rose from the ashes of the SCC plan was considerably less the bird he had been. JCS summarized the rationale of the new plan in a reply to the NORAD commander after he had asked for reconsideration of center hardening. Let the BUIC program continue as planned, the NORAD commander had proposed, but only as a "stepping stone" to a hardened form of SAGE. JCS replied that cost and length of time to complete a hardened system militated against such action: "Since time is of the essence, the only feasible and timely solution available appears to be a dispersed back-up system which, together with the primary SAGE control facilities, provides a degree of redundancy that will insure some survivable command and control capability."[31]

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Search for Balance in the Missile Era

Having guided air defense programs onto roads which he felt would lead more quickly and cheaply to an adequate defense, Secretary McNamara now began to explore the possibility of closing down those stations whose value, in the light of the changing concepts of defense, was questionable. Any savings could then be applied to the ever-mounting development and construction costs for missile defense and to the recently approved survival programs.

After personally discussing the state and future needs of the air defenses with Gen. John K. Gerhart, NORAD's commander, in the summer of 1962, McNamara asked him to consider the possibility of phasing out some of the early warning radar stations. Subsequently, McNamara expanded this request to include a cost effectiveness analysis of possible measures to reduce operating costs without seriously degrading system capabilities.[32]

Gerhart's study of September 1962 made no formal recommendations or conclusions. However, he did suggest the possibility of closing 10 SAGE DC's and 20 radar stations by June 1964 and applying the savings to equipping 12 fighter squadrons with an improved manned interceptor (IMI) and to expanding the BUIC system and making it transportable. Once the IMI's and the mobile control system (called TRACE, for Transportable Control Environment) became fully operational, he could close down the remaining SAGE DC's and make additional reductions in the number of radar stations.

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In Gerhart's opinion, the key to insuring an adequate anti-bomber defense by 1967 was the IMI. The current anti-bomber program offered no hope for an effective defense. The system could achieve a modest increase in capability by equipping the current interceptors with a better fire control system, increasing the reliability of missile warning systems, and replacing BUIC with TRACE. But adding the IMI to these improvements would afford the system an excellent chance of doing the complete job. It could survive missile attack and would have the range and punch to successfully engage any follow-on bomber attack.[33]

The Air Staff and OSD took no formal action on the Gerhart study, but they carefully weighed its proposals and it played a significant role in subsequent decisions. The Air Staff fully shared General Gerhart's view that the anti-bomber defenses could not possibly be fully effective unless the IMI was procured. Unlike current interceptors, the IMI would operate beyond the contiguous radar cover of the U.S. stations and function well even under degraded command and control conditions. The Air Force agreed that if it were necessary to trade off elements of the currently operating system for the IMI, then that was the course to take. However, the Air Staff disagreed, at least initially, with Gerhart on the amount of equipment that could be eliminated from the current system without seriously jeopardizing its capability.[34]

Secretary of the Air Force Eugene M. Zuckert and Gen. William F. McKee, Vice Chief of Staff, presented these views to McNamara on

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7 November 1962, when they formally submitted a Program Change Proposal (PCP) to include the IMI in the fiscal year 1964 budget. Zuckert said that the Air Force shared Gerhart's position on the IMI but believed that his proposals on the TRACE ground environment and on various aspects of weapon deployment needed further detailed study. Concerning the proposal to close down radar stations and control centers to help fund the IMI, the Air Force said it could not concur in the proposed "degree of reduction," feeling that it "might degrade optimum employment of contemporary interceptors prior, during, or subsequent to acquisition of the IMI." Instead, the Air Force would limit reduction to 5 DC's and 6 radar stations in fiscal year 1964. This would reduce the risk involved "to the minimum commensurate with achieving the capability urgently required, and provided by, the IMI in the post 1967 period."[35]

On 13 November 1962, McNamara sent the military departments his decision on the course which the air defenses should take over the next five years and asked for their comments before dispatching it to the President. The currently operated and programmed system had to be "substantially reorganized" over the next few years, McNamara said. It was still too heavily oriented toward the threat of an initial, large bomber attack rather than toward a small follow-on attack. It cost $2 billion a year to operate but could not be sure of destroying more than a few percent of the follow-on bombers. While the Gerhart recommendations would "provide a substantially

improved air defense against a range of bomber threats," McNamara did not feel that any of them should be approved for fiscal year 1964 funding. He was not convinced that the IMI in its current design would fit the bill: "The primary issue concerns the survival of the interceptor force. The IMI, with a 4.5 hour endurance and dependence on a special fuel, would be particularly vulnerable to a defense suppression attack." He believed that the "interceptor choice...is dependent on the expected nature and size of the bomber threat, which must be considered highly uncertain at the present time." For these reasons, he deferred a decision on the IMI.

McNamara found the TRACE concept appealing and complimented Gerhart and staff on their imaginative approach to the problem. However, he planned no change to currently programmed control systems until there was a better understanding of the control needs of the future interceptor. Too, the surveillance and control system finally chosen might have to serve civilian as well as military peacetime needs, and no one at this point knew what this entailed.[36]

Thus, Secretary McNamara chose not to recommend funding for the IMI or for backup command and control beyond the currently programmed BUIC system in the 1964 budget. At the same time, he preferred to eliminate immediately stations that duplicated the work of other stations or were almost certain to fall victim in an initial

missile attack and to use the badly needed operation and maintenance funds elsewhere. Consequently, he recommended that the Air Force close down 10 SAGE DC's by mid-1965 and apply the $80 million this would save annually to other projects. He also recommended closing 22 long-range radar stations over the same period at a saving of $25 million. "I am convinced that [the reductions] can be made prior to the development of a new interceptor without impairing the effectiveness of our air defense system," he said, and "would facilitate the transition to the desired future posture and...ease the funding requirements."[37]

JCS, speaking also for the Air Force, warned against making such severe reductions before introducing the IMI into the system. Although station closings would bring considerable dollar savings, these had to be weighed against the ability of the system to continue to do its job. However, Secretary McNamara was not dissuaded and, on 3 December 1962, recommended to President Kennedy the initial close down of 6 DC's and 17 radar stations by mid-1964. The President quickly approved.[38]

In the meantime, the Air Force had submitted an official "reclama" on the closings, stating that it was "militarily unsound" to discontinue SAGE elements before providing suitable substitutes. It supported ADC's proposal to keep SAGE in its current state until an improved BUIC system became operational. At that time, the Air Force could close out SAGE completely. NORAD, too, had protested that the closings were premature.

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Later, in 1963, communities affected economically by the closings sought confirmation that they were absolutely necessary. The chairman of the House Armed Services Committee, Representative Porter Hardy, Jr., went so far as to charge Secretary McNamara with not fully advising the President on the extent and effect of the closings. McNamara and his staff duly noted these cautionings and rebutted Hardy's charges. The President and McNamara envisioned the closings as an essential prelude to "a continuing long-range program to make the air defense system more compatible with the changing nature of the threat." Therefore, the close-out orders stood as issued.[39]

The Continuing Search for Balance

The future direction of the air defenses now appeared set, at least in principle: stations and other elements of the system not able to survive an initial missile attack or not needed to combat a follow-on bomber attack would be closed down. The problem was to identify these elements, by total number and specific location. As mentioned earlier, the several echelons of the Defense Department were divided, at least in the beginning, over the closings already directed. OSD felt that the closings would not weaken the defenses; JCS, the Air Force, and the field commands disagreed, believing the stations should not be closed in such large numbers until they could obtain weapons and systems which could perform the jobs as well or better. The course recommended by the military services was the

traditional one: keep what you have until you can get something better. But OSD could not afford such a course. The only hope of resolving the conflicting views or of establishing unanimity within the DOD on the issue was to restudy the air defense field and draft a detailed blueprint for its future.

Director of Defense Research and Engineering Harold Brown led off in December 1962 with the following request of Secretary Zuckert:[40]

> In order not to compromise our air defense capability by a rapid and unplanned phase down of facilities, and, in order to properly assess the FAA*/DOD requirements for a national airspace utilization system, I recommend that the Air Force initiate an engineering and technical study that will detail an orderly phase down of the NORAD ground environment that will be in consonance with NORAD and FAA requirements. The study and detailed implementation plan should insure that adequate air defense surveillance and control capabilities will exist during the transition of an installed and checked out BUIC system.

In early January 1963, McNamara asked Zuckert to expand the study to include air defense weapon and control system needs through 1975. McNamara wanted an evaluation of the size and characteristics of the Soviet bomber threat during the period, as well as alternative recommendations on the type of interceptor and control system to combat effectively this threat. "I am particularly concerned that we move toward a low fixed-cost ground environment that can be augmented or reduced as the bomber threat develops," he said.

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*Federal Aviation Agency

Specifically, McNamara asked that the Air Force fully explore the following points: (1) the military needs for surveillance and air traffic control in peacetime; (2) the type of control system each of the alternative advanced air defense weapons would require; (3) any additional reductions in SAGE elements--DC's, radar stations, warning lines, manning, etc.--that could be made prior to the introduction of advanced weapon and control elements into the system; and (4) improvements in air traffic control and secure wartime identification that would accrue through equipping the system with better beacons and electronic identification gear.

"To assure a broad agreement on ground rules and study procedures and a broad understanding of the study results," McNamara asked the Air Force to work closely with NORAD and ADC and to keep JCS and OSD fully informed of its findings during the course of the study. He wanted the study completed in time to serve as a framework on which to base his fiscal year 1965 budget decisions.[41]

The Air Staff selected Maj. Gen. Arthur C. Agan, Jr., Deputy Chief of Staff for Plans, Headquarters, ADC to head the study group. In an initial directive to his members, Agan spelled out the intent and goal of the work: "Because the Continental Air Defense Study (CADS) will provide the major basis for USAF and DOD actions on air defense for the next few years, the quality of its contents is of supreme importance. Our thinking must be sound, backed by unequivocal facts, logically developed and clearly presented."

Agan divided his men into three task groups. One studied the threat, another the weapon alternatives, and the third the surveillance and control alternatives. By early March, the study group had submitted a statement of facts, assumptions, and procedures that would guide its work, and OSD had approved it. At the end of April, a draft report went to the Air Staff for review, and Secretary Zuckert forwarded a copy to McNamara on 13 May.

The Air Staff required two months to complete its review and to form its recommendations. In a preliminary analysis on 10 July, Zuckert informed McNamara that "we believe the study is valid and sufficiently comprehensive to provide the basic framework for the major decision on air defense weapons and control systems that must be made." Zuckert and Gen. Curtis E. LeMay, Chief of Staff, forwarded the detailed USAF commentary on 26 July.[42]

The CADS group had considered every conceivable command and control option and had finally recommended a combination ground/airborne system that Zuckert and LeMay also supported. First, the currently programmed BUIC would be expanded from 34 to 46 centers. This would place three of them in most of the 16 SAGE sectors in the United States and Canada. At the same time, the Air Force would modify the BUIC computer to handle inputs from 10 radar stations, twice its programmed capacity, and give the BUIC center a far better sector surveillance and battle management capability. As these improved BUIC centers became operational and assumed the primary

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control responsibility, the SAGE centers would close down. To insure the survival of surveillance capability and to backup the unhardened surface BUIC system, the Air Force would establish an airborne warning and control system (AWACS) of 42 aircraft, preferably C-135's. These would replace USAF and Navy aircraft and Navy picket ships currently operating off the coasts and in the warning barriers, and perform their operations better and at less cost. They would also provide a survivable command and control capability. Finally, the merging of air defense and FAA surveillance and traffic control operations wherever possible would allow the Air Force and RCAF to operate with fewer radar stations than currently scheduled. Thus, the proposed overall system would be cheaper to operate, far more survivable, and far more effective.[43]

OSD solicited General Gerhart's views on the CADS recommendations, who forwarded them to JCS on 23 August 1963. Gerhart noted NORAD's general agreement with the proposals, adding that if they were adopted "destruction of the enemy well outside of contiguous cover may at long last become a capability." NORAD was in full agreement on AWACS and improved BUIC. On the latter, Gerhart suggested the possibility of designing this equipment for installation in vans to allow easy and inexpensive conversion should it be decided to make the system mobile. JCS sent Gerhart's comments to McNamara on 23 September, recommending that his staff consider them along with the CADS conclusions.[44]

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OSD did not comment officially on the CADS report or on the NORAD, USAF, and JCS commentaries concerning it. As he had done the year previously, McNamara in early October 1963 circulated a draft of the recommendations he planned to send the President on the fiscal year 1965 air defense budget. Again, he elected to defer decisions on major improvements to the system, observing that he could not make them until there were firm plans on such programs as civil defense and anti-ballistic missile defense. At the same time, he stated that he was considering further cuts in the anti-bomber defenses during the coming year, among them the closing down of more SAGE centers and radar stations.

The Air Staff and JCS recommended that McNamara postpone further reductions in weapon and warning and control systems until he had approved the Improved BUIC, AWACS, and integrated DOD/FAA radar operation proposals and they were functioning. He subsequently modified his decision on the closings, directing on 27 November 1963 that only four additional SAGE DC's be closed in fiscal year 1966 and two SAGE CC's in fiscal year 1968.[45]

In late October, Air Force submitted a PCP on the Improved BUIC system, noting that coincident with its establishment the remaining SAGE centers could be closed down. JCS concurred in the requirement in early November, but OSD deferred action pending decisions on the other related projects noted earlier. However, OSD instructed the Air Force to consider every possible option on Improved BUIC in preparation for resubmitting the PCP at a later date.[46]

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Adjusting to the New Concepts

Closing of DC's and Anti-Bomber Sensors

The closing of stations, which under the revised estimates of the threat were either too vulnerable or offered too little to merit the expense of their continued operation, began in February 1963. The Air Staff directed ADC at this time to select 6 DC's and 17 radar stations and close them by July 1964. The selection of DC's was complicated at first by a DOD/FAA agreement of 1961 on the joint use of DC's in the northern tier states.* The two agencies abrogated the agreement, however, freeing ADC to select DC's at Minot and Grand Forks for closing, in addition to those at Spokane, Sault Ste. Marie, and San Francisco. For the final one, ADC chose to

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*In October 1961 DOD and FAA completed a study on the joint use of air defense centers for peacetime control of air traffic. Called the Project Beacon Report, it only partially addressed the issue. Accordingly, President Kennedy directed FAA to consult with DOD and the President's scientific advisor toward development of a system that made the most economic use of all government facilities in the safe control of airspace. In accordance with this Presidential directive, the concerned parties began a study called Northern Tier, exploring the joint use of SAGE DC's in Montana and North Dakota. By mid-1962, the Air Force and FAA had agreed to move the FAA enroute centers at Great Falls and Minneapolis into the DC's at Great Falls, Minot, and Grand Forks. Assistant Secretary of the Air Force Joseph S. Imirie cited the agreement as a major achievement. To this point, FAA had not believed that the two functions could be combined in the SAGE centers. It was this agreement that was cancelled when ADC chose to close down the Minot and Grand Forks DC's. Later, however, a new agreement was signed for the joint use of the Great Falls DC and, by the end of 1963, this center was performing both FAA and air defense functions. (Memo, Asst SAF (Mat) to SOD, 15 Jun 62, subj: Status of FAA Considerations of SAGE Use, OSAF 49-62; memo, McMillan to SAF, 26 Mar 62, subj: SAGE, OSAF 49-62; DOD/FAA Memo of Agreement, 20 Jun 63, subj: Joint Use of the Great Falls Direction Center, OSAF 638-63; Hist, D/Operations, Jul-Dec 63, Sec VII.)

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eliminate the CC at Syracuse, N.Y., by shifting its functions to Newburgh, N.Y., and converting the DC there to a CC. This action would effect the elimination of a DC while increasing chances of survival in the northeast region since both a CC and DC had operated at Syracuse.*[47]

Among the 17 radar stations selected for closing were the two remaining Texas Towers. (In January 1961, the third had collapsed under the pounding of hurricane winds and waves, killing 29 men.) Problems of evacuating and guarding the two whenever storms threatened and the discovery that they too were weakening had already caused the Air Force to plan on closing them at the earliest possible time. McNamara's order merely hastened their demise. ADC selected eight radar stations from the southern manual sectors, on the basis that they were less important than those on the perimeters. Finally, the command chose the other seven stations for one or more of the following reasons: they were highly vulnerable, their coverage

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*The vacated SAGE structures were not to lie fallow. In June 1963, Secretary McNamara instructed Secretary Zuckert to study the possibility of using them in support of other DOD projects. Assistant Secretary Imirie concluded that it was technically feasible to convert them into automatic communication switching centers. McNamara then approved (for budgetary purposes) the modification of the former Syracuse CC and Spokane DC structures for this purpose and instructed the Air Force, JCS, and the Defense Communications Agency to plan the change. Study on the use of the other facilities was under way at the end of the year. (Memo, SOD to SAF, 4 Jun 63, subj: Alternate Use of SAGE Facilities, OSAF 638-63; memo, Asst SAF (Mat) to SOD, 19 Jul 63, subj: Alternate Use of SAGE Facilities, OSAF 638-63; memo, SOD to SAF, DCA, CJCS, 29 Aug 63, subj: Alternate Use of SAGE Facilities, OSAF 638-63; memo, Asst SAF (R&D) to SOD, 17 Oct 63, subj: Alternate Use of SAGE Facilities, OSAF 638-63.)

overlapped that of other stations, and they were not scheduled to participate in the joint DOD/FAA radar program.*[48]

ADC completed its selection in late February 1963, and the Air Force and NORAD approved shortly thereafter. Although the original directive had stipulated 30 June 1964 as the completion date, subsequent projections of the fiscal year 1964 budget for the air defense ground environment dictated that the Air Force begin the closings immediately. As a result, two DC's and 16 heavy radars were closed by May 1963. The other four DC's--to complete the six--were closed by October 1963. Closing of the 17th radar station was postponed until mid-1964. Meanwhile, the Air Staff, after weighing the issues involved, confirmed OSD's view that the closings did not jeopardize the nation's defenses. As Maj. Gen. John K. Hester, the Assistant Vice Chief of Staff, expressed it: "The loss of redundant radar coverage will have little impact on the overall detection and control capability of the system."[49]

The DEW line also underwent considerable change in 1963 as a result of the changed view of the nature of a bomber attack. Early in the year, the CADS group asked NORAD for its opinion on the future need for the line. NORAD answered that since missiles, not bombers, would make the first strike, the DEW line was no longer needed for early warning. BMEWS sensors would perform this function. However,

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*However, at the time, four of the stations chosen in the southern manual sectors were being considered for joint DOD/FAA use. For this reason, they were taken out of operation but retained in the USAF inventory pending a final decision on the DOD/FAA program.

SAGE CENTERS: December 1963*

Operational Designation		Location Region Control Centers (CC's)	Location Sector Control Centers (DC's)
Region	Sector		
25th		McChord AFB, Tacoma, Wash.	
	Seattle		McChord AFB, Tacoma, Wash.
	Portland		Adair AFB, Corvallis, Ore.
26th		Stewart AFB, Newburgh, N.Y. (in 1964)	
	Detroit		Custer AFS, Battle Creek, Mich.
	Boston		Hancock Field, Syracuse, N.Y.
	New York		McGuire AFB, Wrightstown, N.J.
	Washington		Ft Lee AFS, Petersburg, Va.
28th		(Remoted CC in non-SAGE structure on Hamilton AFB, San Francisco, Calif.)	
	Reno		Stead AFB, Reno, Nev.
	Los Angeles		Beale AFB, Marysville, Calif.
	Phoenix		Luke AFB, Litchfield Park, Ariz.
29th		(Remoted CC in converted SAGE training facility on Richards-Gebaur AFB, Kansas City. Mo.)	
	Sioux City		Sioux City Munic. Arpt, Iowa
	Great Falls		Malmstrom AFB, Great Falls, Mont.
30th		Truax Field, Madison, Wisc.	
	Chicago		Truax Field, Madison, Wisc.
	Duluth		Duluth Int'l Arpt, Minn.
32d		(Manual CC, Gunter AFB, Montgomery, Ala.)	
	Montgomery		Gunter AFB, Montgomery, Ala.
NNR/		(Combination CC/DC built under CADIN Program at North Bay, Canada)	
	Bangor		Topsham AFS, Topsham, Me.

*See December 1961 Chart, p 14, for designations and locations of centers abolished in the 1963 reductions.

/Northern NORAD Region

the line would still be needed to keep the Russians from trying to penetrate with bombers until after their missiles were detected; to do otherwise would cost them the element of surprise. In other words, DEW had become a tactical hold-back line, probably delaying any bomber attack by three to four hours. This would give the defenses time to recover and prepare for counterattack and afford SAC forces greater assurance of safe passage through the defense zones. For these reasons, NORAD recommended that the line be kept in operation or replaced with a system to perform the hold-back mission equally well.

On the other hand, NORAD stated, those elements of the DEW line--28 intermediate stations equipped with FPS-23 doppler radars--designed primarily to detect low-flying aircraft on a surprise attack were now superfluous and could be closed down. The Air Force concurred and, in February 1963, asked the RCAF to approve. Canada was deeply involved in the matter since 20 of the stations were in that country and manned, in part, by its people. Under the new concepts for the line, the Air Force explained, the FPS-19 rotating search radars at the remaining stations could provide reliable coverage. The RCAF agreed and, subsequently, both governments gave their permission. In July 1963, the 28 stations were closed.[50]

Action on another reduction began in September when RCAF members of the Canadian-U.S. board for joint military planning revealed that their government wanted to close out the Mid-Canada Line (MCL) and

save $15 million in annual operating costs. The NORAD commander recommended that Canada keep the MCL until the improved systems became operational. If reductions had to be made, he suggested the close-out of stations on either end of the line where SAGE-integrated radars overlapped MCL coverage. JCS agreed with this recommendation and it was the one finally adopted. In December, the Canadians closed down these stations.[51]

Meanwhile, the Alaskan Air Command had decided that it could close radar stations at Bethel, Ohlson Mountain, and Middleton without "serious degradation...of the mission" and so notified the Air Staff in February 1963. All were in southern Alaska, and bombers could escape detection before penetrating their areas of coverage only by an end-run of the Aleutian and Pacific barrier lines. Closing the stations would free 323 men for other duty and save over $3 million a year in operating and maintenance costs. The Air Staff and NORAD concurred in the proposal in March and JCS the following month. The stations were closed by mid-year.[52]

Aftermath and Prospectus

As a result of the closings and the completion or near-completion of the several improvement programs, the air defense command and control structure in December 1963 differed considerably from that of two years earlier, when the last SAGE center became operational.*

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*See page 15.

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The forces in the continental United States remained aligned under six regions. However, the SAGE CC formerly at Syracuse was now at Stewart and the manual CC at Oklahoma City had been closed and the SAGE DC at Montgomery given the added duty of serving as the region CC. The major change was at sector level, of course, where 15 SAGE DC's now performed the work formerly spread among 21.

The SAGE centers had stood alone in 1961. But they were now backed by the Phase I BUIC manual emergency control system, operational since late 1962. In case of attack, battle leaders would control operations through SAGE so long as its centers and communications stayed alive. As they went out, manual centers, equipped for subsector operations, would take over. If they too were destroyed, their subordinate GCI stations would assume control of USAF weapons and coordinate antiaircraft target engagements. In short, with the equipment and communications furnished them in this BUIC manual phase, the stations would perform in an emergency much as they had in the pre-SAGE days.[53]

It seemed highly probable that OSD would eventually approve the NORAD-USAF proposal to replace SAGE with Improved BUIC/AWACS. As of December 1963, however, the only improvement actually programmed and under way was that for the 34 automated BUIC centers--30 in the United States and 4 in Canada.* The first of these was due to become

*The currently programmed Phase II BUIC centers were to be manned for 8-hour operation daily, compared to SAGE's 24-hour a day manning. The BUIC AN/GSA-51 computer, military version of the manufacturer's (Burroughs Corporation) D-825 computer, was solid state and basically simplex with some element duplexing. In layman's language, this meant it did not have the reliability of the SAGE duplex computer. It could process 40 tracks and control 10 simultaneous interceptions; SAGE processed about 300 tracks and controlled 100 simultaneous interceptions.

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operational in early 1965. Unless the program changed, the ultimate North American system would consist of 11 SAGE DC's supported by BUIC.[54]

No major changes other than the closing of the three radar stations occurred in the Alaskan area in these two years. The system remained a manual one, with sensors netted to four manual control centers which, in turn, reported directly to Elmendorf region control. In 1961, there was an unsuccessful attempt to automate elements of the system with off-the-shelf commercial equipment. Intended to save time and money, it had the opposite result. The Air Staff then proceeded to develop and acquire an improved system in the normal way--by preparing specifications and inviting bids. The result was a program to install semi-automatic track inserters and teletype equipment at the radar stations for handling and passing data and to equip the four radar stations which also served as control centers and the Elmendorf center with computers and teletypes for handling, displaying, and passing data. According to the schedule, the system would become initially operational in early 1964.[55]

CADS analysts had not given the Alaskan defenses much hope for surviving the opening stages of attack. Medium-range ballistic missiles could wipe out Elmendorf and Eielson, the only major target complexes in Alaska, leaving only the few interceptors kept at advanced airstrips for air defense alert to harass any bomber streams

crossing Alaska. Even these airstrips would probably not survive long enough to give interceptors a second run. However, the CADS group recommended retaining the Alaskan defenses if only to protect U.S. sovereignty of airspace in peacetime.[56]

The Canadian system, as a result of the CADIN improvements, advanced greatly in the years 1961-1963. In mid-1961, the RCAF began to take over operation of the radar stations in its country. Until that time, ADC had manned 18 Canadian stations. Now the RCAF operated 33 stations while ADC operated only the six stations in Newfoundland and Labrador netted to the Goose sector command center. In September 1963, the region and sector commanders and battle staffs moved into the underground CC/DC at North Bay.* As one reporter described it, the facility was a "veritable city under the earth." Besides support elements, the chamber housed two command posts, one for the region and another for the sector. It contained 160,000 square feet of usable floor space and could withstand approximately 500 psi overpressure. Its communication lines were hardened out to a distance of 17 miles. The Canadian region, if all went according to schedule, would become operational with SAGE in early 1964.[57]

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*Called the Northern NORAD Region (NNR), it was commanded until August 1962 by the same officer who commanded RCAF's air defense forces. At that time, on RCAF's request, NORAD revised its regulation which stipulated that a commander of a component force would also command the NORAD element to permit the appointment of a separate NNR commander. When NNR region headquarters moved from St. Hubert to North Bay, the RCAF air defense headquarters and commander remained at St. Hubert.

From the mid-1950's, the region center on Richards-Gebaur Air Force Base in Kansas City had served as the alternate combat operations post (ALCOP); i.e., upon destruction of the Ent COC, direction of the defense effort would have continued from the ALCOP. Consideration for shifting the ALCOP to Canada began in October 1960 when JCS ordered the unified commands to set up hardened, dispersed, or mobile alternate command posts. At the time, the ALCOP was on the second floor of a wooden building which also housed the administrative offices of the Air Force component command for the region. Needless to say, the center was not adequate either as a region post or as an ALCOP.

It was at this time that NORAD proposed to install the ALCOP functions in the DC training structure on Richards-Gebaur. While it was not a hardened structure, it was dispersed in the sense that it was not collocated with a SAC or other high-priority target. Although the Air Force approved the use of the DC as the region CC and ALCOP, it did not agree with NORAD's proposal to automate the ALCOP. The Air Force felt that the center's chances of surviving nuclear attack were too slim to provide a realistic location for the ALCOP and recommended that NORAD explore the possibility of shifting it to North Bay when that facility was finished. In October 1962, the RCAF agreed to the move in principle, and the military chiefs of the two nations later also approved. By December 1963, the RCAF and Air Force, under terms of a NORAD agreement, had

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the requisite authority to proceed with the project. One of their major jobs was to strengthen the facility. While North Bay was well protected from blast, there were no provisions to safeguard buildings and equipment from ground shock or electromagnetic pulse.[58]

Plans for hardening the NORAD primary combat operations center by installing it deep within a Colorado mountain had also weathered the economy slashes of 1959 and 1960. The manual COC at Ent was critically vulnerable. Also, as Assistant Secretary of the Air Force Imirie noted, it was "incapable of providing the necessary information either accurately or timely enough to enable the commander and his staff to develop the best operational decisions." Furthermore, converting the COC to automated operation and integrating functions like BMEWS and the new Space Detection and Tracking System (SPADATS) into that operation required extensive expansion.* And the current structure was not designed to be easily expanded. For these reasons, during the discussions in early 1958 on the location for BMEWS display, NORAD proposed the integration of the display with other elements of the COC in an automated underground facility in the Colorado Springs area. Pentagon officials approved and, in early 1959, JCS placed responsibility for construction with the Air Force.

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*The Air Force established a SPADATS center at Ent after the Secretary of Defense in the fall of 1960 assigned responsibility for specific SPADATS elements to the Air Force and Navy under CINCNORAD's operational control.

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By the fall of 1959, the Air Force had selected Cheyenne Mountain, south of Colorado Springs, as the new COC site and obtained $10 million in the 1960 budget to build access roads and begin excavation. In October, however, after the Air Force had spent only $1.4 million on acquiring property and building roads, OSD froze the rest of the funds and deferred the project. This action coincided with the reassessment of Secretary McElroy's Master Plan.[59]

Matters stood at a standstill for more than a year, until early in 1961 when the Air Force obtained JCS support to a request for OSD to reprogram the frozen $8.6 million and allow excavation to begin. At the same time, the Air Force contracted for a technical analysis of the center. By May, OSD and Congress had approved the request, and the hard-rock miners of the Utah Construction and Mining Corporation began excavation.[60]

The Air Force planned to develop the NORAD COC (designated the 425L system) in five phases. OSD approved in November 1961, and three of the phases were completed or under way by December 1963. In Phases A and B, SPADATS operations were integrated with the other functions of the soft COC. Phase C consisted of the construction of a special structure on Ent and the installation and testing of new equipment destined for the underground center. Phase D, to take place in 1964, called for the dismantling of the experimental facility and the moving of equipment into the mountain while operations

continued from the soft COC. Phase E would include activation of the underground center as the director of the defenses and the phase out of the Ent center.[61]

The Air Force estimated the cost of the project at $64.1 million. This increased to $88.7 million in March 1962 to take care of unforeseen construction problems and additional equipment and functional requirements. Contract engineering services, formerly provided from USAF resources, also increased the cost.[62]

By the end of 1962, excavation was finished except for reinforcing unforeseen rock faults, and building construction started shortly thereafter. Some three miles of tunnels and chambers had been excavated, with the chambers varying from 30 to 60 feet in height. Construction plans called for 11 buildings set on steel coils to absorb shock and protected from blast by absorption tunnels and locks. NORAD would occupy 154,500 square feet of building space and the Defense Communications Agency another 16,000 feet. Fuel and water adequate for at least 30 days of isolated operations would be stored in special tunnels. While work proceeded on the buildings, the experimental engineering facility on Ent, as part of Phase C, trained personnel and readied the Philco S-2000/211 computer and other equipment for the day when COC operations transferred to the new location. As of December 1963, the operational date was set for mid-1966.[63]

Although no additional closing of radar stations was programmed and 170 stations--115 in the United States, 39 in Canada, 15 in

Alaska, and 1 in Greenland--were or would soon be operational, there were at least two major reduction proposals pending. In the fall of 1963, the Canadian Government sought U.S. concurrence to close seven Pinetree stations in central Canada. JCS agreed with NORAD and the Air Force that Canada should retain the stations until the improvements listed in the CADS report were approved and put into operation. Secretary McNamara supported this recommendation in a personal letter to Mr. Paul T. Hellyer, the Canadian Defense Minister. At the end of the year, however, Canada still held to the view that the density of radar coverage in central Canada was such that at least five stations could be closed without degrading system capability. It seemed certain that Canada would close some stations by early 1965 whether the CADS improvements were instituted or not.[64]

It also appeared likely that some stations would close if DOD and FAA adopted the CADS proposal for the development of the National Airspace Utilization System (NAUS). The CADS report predicted that once the IMI and the Improved BUIC/AWACS became operational, only 134 radar stations--109 in the United States and 25 in Canada--would be needed to handle both air defense and FAA requirements. Ninety-four of the U.S. stations would serve both FAA and NORAD with FAA operating 41 stations and ADC 53. In addition, ADC would operate 15 stations solely for air defense purposes.[65]

NOTES

(Unless otherwise noted, the documents cited below are located in the Records Branch files of the Directorate of Plans, Headquarters USAF (RL), and in the Correspondence Control Division, Office of the Secretary of the Air Force (OSAF).)

1. Memo, SOD to Mil Depts, JCS, DDR&E, 31 Mar 62, subj: Technical Support of the National Military Command System, in RL (62) 27-5.

2. Unless otherwise cited, information on force levels, changes in station locations, designations, and functions, and system operations was obtained from the histories of ADC and NORAD/CONAD. These are on file in AFCHO.

3. Statement by Gen. E. E. Partridge, CINCNORAD, in Hearings before the House Subcmte on DOD Appropriations, 86th Cong, 1st Sess, DOD Appropriations for 1960, Part II, pp 339-40.

4. Ibid.; Statement by N. H. McElroy, SOD, and Gen. M. D. Taylor, Chmn JCS, in Hearings before the House Subcmte on DOD Appropriations, 86th Cong, 1st Sess, DOD Appropriations for 1960, Part I, p 13.

5. See n 2; Partridge Statement.

6. MITRE Corp Rpt TM-3108, 14 Jul 61, Current Command and Control Systems, in OSAF 507-61.

7. Rpt by Air Def Div, D/Ops, Jun 61, subj: DAF Response to a GAO Draft Report to the Congress on...SAGE, in OSAF 42-61; Summary, statement by C.J. Hitch, ASOD(Compt), before the Subcmte on Special Investigations, House Cmte on Armed Services (hereinafter cited as Hitch Statement), 87th Cong, 2d Sess, in OSAF 638-63.

8. Hist, D/Sys Acq & Integr, Jul-Dec 61; Hist, D/C-E, Jul-Dec 61; memo, B. McMillan, ASAF(R&D) to SAF, 26 Mar 62, subj: SAGE, with atch, subj: Narrative Report: Status of Air Defense Ground Environment in SAGE Areas, in OSAF 49-62.

9. C/S Policy Book, 1961, Item 13-40, 15 Jun 61.

10. Ltr, Col. W.H. Bruce Erwin, Dep Asst Dir for NSC Matters, D/Plans, to D/Ops, Joint Staff of PJBD Canada-U.S., 1 Apr 62, subj: SAGE Site Vulnerability (hereinafter cited as Erwin paper), in RL(62) 13.

11. Hist, D/C-E, Jul-Dec 59, p 97; C/S Policy Book, 1959, Item 158, 12 Dec 58.

[redacted]

12. Msg 55998, Hq USAF to ADC, 5 Feb 59, in RL (59) 25; memo, J.B. Macauley, Dep DDR&E, to ASAF(R&D), 9 Jan 59, subj: Solid-State Computer Program, in RL (59) 25; memo, M.A. MacIntyre, U/SAF to SOD, 22 Jan 59, subj: Reorientation of the SAGE Program, in RL (59) 25; memo, R.E. Horner, ASAF(R&D) to SOD, 14 Jan 59, subj: Reorientation of SAGE Program, in RL (59) 25; DDR&E Staff Study, 25 Jan 60, Consideration and Recommendations Concerning the Installation of Hardened Super Combat Centers in the SAGE System (hereinafter cited as Skifter Study), in OSAF 153-60.

13. Ltr, A/M Hugh Campbell, C/Air Staff, RCAF, to Gen. T.D. White, CSAF, 28 Jan 59, in RL (59) 25; ltr, White to Campbell, 19 Feb 59, in RL (59) 25; C/S Policy Book, 1959, Items 292, 12 Dec 58, and 319, 25 Feb 59.

14. House Committee on Government Operations, 11th Report, 2 Sep 59, Organization and Management of Missile Programs (cited in ADC Hist, Jan-Jun 59, p 2).

15. Memo, SOD to JCS, 19 May 59, subj: Continental Air Defense Program, in RL (59) 25; JCSM-211-59, 2 Jun 59, subj: Continental Air Defense Program, in RL (59) 25; memo, B/G G.W. Martin, Actg D/Plans, to CSAF, 21 May 59, subj: Air Defense Master Plan, in RL (59) 25; memo, SOD to JCS, 19 Jun 59, subj: Continental Air Defense Program, in RL (59) 25; memo, SOD to Secy/Army & AF, 19 Jun 59, subj: Continental Air Defense, RL (59) 25; Hitch Statement.

16. Hist, D/C-E, Jul-Dec 59, p 98; memo, M/G J.K. Hester, DCS/O, to AF Ofc/Leg Ln, 12 Apr 61, subj: Recapitulation of Readjusted Air Defense Program, in OSAF 777-61.

17. Skifter Study, 25 Jan 60.

18. Memo, B/G J.A. Dunning, Dep Dir/War Plans, D/Plans, 9 Nov 59, subj: Re-examination of Air Defense Program, in RL (59) 25; memo, Dr. H.R. Skifter, Asst DDR&E, to U/SAF, 28 Nov 59, subj: Computers for the SAGE SCC's, in RL (60) 25.

19. Memo, M/G H.T. Wheless, D/Plans to CSAF, 7 Jan 60, subj: SAGE SCC's, with atch, subj: Talking Paper on SAGE SCC's, in RL (59) 25; memo for record by Col. A.R. Shiely, Jr., Dir/Ops, 29 Dec 59, subj: OSD-RCAF Air Defense Meeting, in RL (59) 25; memo, CSAF to JCS, 17 Mar 60, subj: SAGE SCC's, in RL (59) 25; JCSM-113-60, 18 Mar 60, subj: SAGE Super Combat Centers, in RL (60) 25; Actg SOD to JCS, 26 Mar 60, subj: SAGE SCC's, in OSAF 153-60; ltr, CINCNORAD to JCS, 29 Jan 60, subj: Super Combat Center, in RL (59) 25; ltr, CSAF to CINCNORAD, 30 Mar 60, subj: Revised Air Defense Program, in RL (60) 25; CSAF to Air Staff, 31 Mar 60, subj: Revised Air Defense Program, in AFCHO files; Erwin paper.

[redacted]

20. Memo, Hester to SAF Ofc/Leg Ln, 12 Apr 61.

21. Hitch Statement.

22. 3d Ind, D/Plans, 25 Jan 62, to ltr, D/Maint Eng, 4 Dec 61, subj: National and DOD Command and Control Systems, in RL (62) 27-5.

23. Ltr, D/Ops to DCS's, Dirs et al, 11 May 61, subj: DDR&E Study on SAGE for DOD, in RL (61) 3.

24. DDR&E Rpt on Project No. 23, 1 May 61, in RL (61) 3; Decision on JCS 1899/649, 26 May 61, subj: Staff Study for SOD Project No. 23, in RL (61) 3; memo, SAF to SOD, 21 Apr 61, subj: Questions Relative to the Future of the SAGE System, in RL (61) 3.

25. Memo, SOD to Mil Depts & JCS, 5 Jun 61, subj: SAGE Reorientation, encl to JCS 1899/654, in RL (61) 3; memo, Mil Asst, Dep SOD to JCS, 14 Jun 61, subj: Continental Air Defense Study - Project 126, encl to JCS 2101/434, in RL (61) 3; JCS 1899/660, 5 Jul 61, in RL (61) 3; JCS 2101/434/2, 10 Aug 61, subj: Continental Air Defense Study (Project 126), in RL (61) 3; memo, SOD to Mil Depts, 22 Sep 61, subj: FY 1963 Program Package Guidance, encl to JCS 1800/471, in RL (61) 3.

26. JCS 1899/657, 16 Jun 61, in RL (61) 3; msg 998495, JCS to CINCNORAD, 5 Jul 61, in RL (61) 3; msg 84255, Hq USAF to ADC, 7 Jul 61, in RL (61) 3.

27. NADOP 63-73, 27 Jul 61 (Supplement to NADOP 63-67); memo, D/Plans to DCS's, Dirs et al, 26 Sep 61, subj: Project 126, NORAD Ten-Year Alternative Air Defense Plans, in RL (61) 3; memo, JCS to SOD, 18 Aug 61, subj: Continental Air Defense Study(Project 126), in RL (61) 3; msg XPD-4, ADC to CSAF, 22 Jul 61, in RL (61) 3.

28. Memo, JCS to SOD, 16 Nov 61, subj: Continental Air Defense Study (Project 126), in RL (61) 3; Hist, D/Sys Acq and Integr, Jul-Dec 61, pp 109-11.

29. Msg 75011, Hq USAF to ADC, 1 Nov 61.

30. Memo, McMillan to SOD, 22 Jan 62, subj: Central War Defensive Forces Program Package Annex (416L), in RL (62) 3; memo, R.L. Gilpatric, Dep SOD, to Mil Depts & JCS, 13 Mar 62, subj: Objectives for Continental Air and Missile Defense Forces, in RL (62) 3.

31. Memo, CINCNORAD to JCS, 30 Aug 61, subj: Survivability of SAGE, in RL (61) 3; JCSM-1239-61, 16 Nov 61, subj: Survivability of SAGE, in RL (61) 3.

32. Memo, SOD to CINCONAD, 16 Aug 62, subj: Improved Manned Interceptor, in RL (62) 3; memo, SOD to CINCONAD, 22 Aug 62, subj: Actions Stemming from the 14 August Conference, Headquarters NORAD, in RL (62) 3.

[redacted]

33. ASSS, D/Plans to DCS/P&P, 26 Sep 62, with atch, subj: Summary of CINCNORAD's Report to Secretary of Defense on Manned Bomber Defense and Nike Zeus Effectiveness, in RL (62) 3; ltr, Col. J.K. Dowling, NORAD IO to AF Ofc/Leg Ln, 11 Jun 63, subj: Statements for Armed Services Committee (hereinafter cited as Dowling Statements), in OSAF 143-63.

34. Memo for Record by D/Plans, 27 Sep 62, subj: RCAF/USAF Meeting re NORAD Report on Manned Bomber Effectiveness, in RL (62) 3.

35. Memo, SAF to SOD, 7 Nov 62, subj: Report on Manned Bomber Defense and Nike Zeus Effectiveness, in RL (62) 3; ltr, V/CSAF to SAF, 2 Nov 62, subj: Report on Manned Bomber Defense and Nike Zeus Effectiveness, in RL (62) 3.

36. Memo, SOD to JCS, 13 Nov 62, subj: Continental Air Defense, with atch, 12 Nov 62, subj: Draft Memo of SOD to President, in RL (62) 3.

37. Ibid.; Hitch Statement; memo, OSD Compt to SAF, 4 Dec 62, subj: Improved Manned Interceptor, cited in Hist, D/Plans, Jul-Dec 62, pp 37-8.

38. JCSM-933-62, 21 Nov 62, subj: Continental Air Defense, in RL (62) 3; memo, L/G G.P. Disosway, DCS/O, to DCS/P&P, 17 Nov 62, subj: Operations Position on the Proposed Memo for the President on Continental Air Defense, in RL (62) 3; Hist, D/Plans, Jul-Dec 62, pp 42-3; memo, B/G R.F. Worden, Dep Dir/Plans, DCS/P&P, to CSAF, Jan 63, subj: Background Paper on Phase-Down of 6 SAGE Centers and 17 Long Range Radars, in RL (63) 3.

39. See note above; msg 65734, CSAF to ADC, 4 Jan 63, in RL (63) 3; msg 8738, ADC to CSAF, 12 Feb 63, in RL (63) 3; Air Force Times, 13 Nov 63.

40. Memo, DDR&E to SAF, 13 Dec 62, subj: Reductions of the NORAD Ground Environment, in RL (62) 3.

41. Memo, SOD to SAF, 7 Jan 63, subj: A Study of Continental Air Defense, in RL (63) 3.

42. Memo, Worden to D/Plans, 17 Jan 63, subj: A Study of 1966 to 1975 Continental Air Defense, in RL (63) 3; memo, M/G A.C. Agan, DCS/Plans, ADC, to CADS Gp, 1 Apr 63, subj: Report Preparation, in RL (63) 3; memo for record by Agan, 17 Apr 63, in RL (63) 3; memo, SAF to SOD, 26 Jul 63, subj: Continental Air Defense Study, in RL (63) 3; ltr, CSAF to SAF, 26 Jul 63, subj: Continental Air Defense Study, in RL (63) 3; memo, SAF to SOD, 10 Jul 63, subj: Continental Air Defense Study, in OSAF 135-63.

43. Rpt by CADS Gp, 10 May 63, Continental Air Defense Study, in RL (63) 3; msg 77938, CSAF to CINCONAD, 11 Jul 63, in RL (63) 3; ltr, L/G D.A. Burchinal, DCS/P&P, to CINCONAD, 19 Aug 63, subj: Transmittal of Conclusions and Recommendations, Continental Air Defense Study (CADS), in RL (63) 3.

[redacted]

44. Ltr, CINCNORAD to JCS, 23 Aug 63, subj: NORAD Position Regarding CAD Study, in RL (63) 3; D/Plans Talking Paper for Use at the Meeting of the JCS on 3 Mar 64, 2 Mar 64, subj: Continental Air Defense Study Report, in RL (64) 3.

45. Talking Paper, as in n 44; Hist, D/Plans, Jul-Dec 63, pp 119, 93-94; USAF Current Status Rpt, Jan 64, p 3-25.

46. Hist, D/Ops, Jul-Dec 63, Sec VII.

47. Dowling Statements; memo, Worden to CSAF, Jan 63.

48. Dowling Statements.

49. Memo, M/G Hester to ASAF (Mat), 5 Apr 63, subj: Inactivation of Grand Forks and Minot SAGE DC's, in OSAF 638-63; ltr, AF Ofc/Leg Ln, to Asst to SOD (Leg Affairs), 29 Jul 63, subj: Investigation of 416L Phase-Down, Subcmte for Special Investigations, House Armed Services Cmte, in OSAF 638-63; Dowling Statements.

50. Msg 75167, CSAF to CINCNORAD, 8 Feb 63, in RL (63); msg NPPX-004, CINCNORAD to CSAF, 13 Feb 63, in RL (63) 3; ltr, CSAF to RCAF, 27 Feb 63, subj: Proposed Inactivation of Intermediate Stations on DEW Line, in RL (63) 3-4; rpt, USAF C-E Program (hereinafter cited as PC-66-1), Dec 63, pp 1-73; hist, D/Ops, Jul-Dec 63, Sec VII.

51. JCS 1541/279-2, 21 Dec 63, in RL (63) 3-4; hist, D/Ops, Jul-Dec 63, Sec VII; hist, D/Cmd Control & Commun, Jul-Dec 63, p 87.

52. Ltr, V/CSAF to CINCAL, 8 Mar 63, subj: Alaskan Air Defense, in RL (63) 3; ltr, CINCAL to JCS, 14 Mar 63, subj: Reduction of Forces, in RL (63) 3; JCS 1899/769, 4 Apr 63, in RL (63) 3.

53. C/S Policy Book, 1963, Item 13-24, 11 Dec 62.

54. Memo, DCS/P&O to Gen Counsel, OSAF, 14 Feb 64, subj: Amendment of CADIN Agreement to Include BUIC, in RL (64) 3.

55. Hist, D/Sys Acq & Integr, Jan-Jun 61, p 111; PC-66-1, pp 1-48; USAF Current Status Report, Jan 64, pp 3-26.

56. Rpt, Continental Air Defense Study (CADS), 10 May 63.

57. Hap Harris, "Triple Play in Air Defense," The Airman, Feb 64; JCS 2308/193, 29 Apr 63; PC-66-1; hist, D/Ops, Jul-Dec 63, Sec VII.

[redacted]

58. Msg 984609, JCS to Services and Cmdrs of Unified and Specified Cmds, 20 Oct 60, in RL (61) 27-5; ltr, CINCNORAD to JCS, 26 Mar 63, subj: NORAD Alternate Command Post (ALCOP), in RL (63) 27-5; JCS 2308/193, 29 Apr 63; ltr, B/G R.A. Yudkin, Dep Dir/Policy, to A/Cmdr G.H. Newsome, Air Member, Canadian Joint Staff, 26 Dec 63, in RL (63) 27-5; ltr, CSAF to ADC, 29 May 63, subj: Participation in a Joint USAF/RCAF Vulnerability Study, in RL (63) 27-5; msg 75899, CSAF to ADC, 3 Jul 63, in RL (63) 27-5.

59. Memo, ASAF (Mat) to ASOD (IL), 15 Sep 61, subj: 425L Program Objectives, in OSAF 603-61; memo, ASOD (IL) to JCS, 2 Sep 61, subj: Air Force Program 425L NORAD Combat Operations Center, in OSAF 603-61; memo for record by Maj. R.L. Royem, D/Plans, 18 Apr 61, subj: SM-906-59, Determination of Requirements, Development, and Production Management of NORAD COC, in RL (61) 17.

60. JCSM-9-61, 9 Jan 61, subj: Construction of NORAD COC, in RL (61) 17; memo, DCS/P&R to AFCCS, 21 Feb 61, subj: Requirement for NORAD COC, in RL (61) 17.

61. Hist, D/Sys Acq & Integr, Jul-Dec 61, pp 74-77.

62. Ibid., Jan-Jun 62, pp 62-3.

63. Hist, D/Opl Rqmts, Jul-Dec 62, p 8; PC-66-1, p 191; Harris, The Airman, Feb 64; Dick Woodbury, "Underground NORAD COC," Denver Post, 4 Apr 63; Wallace Turner, "Rockies Site is Excavated for Combat Operation Headquarters," New York Times, 12 Apr 63.

64. Ltr, P.T. Hellyer, Minister of Natl Def, Canada, to SOD, 11 Dec 63, in RL (63) 3-4; hist, D/Plans, Jul-Dec 63, pp 197-8; hist, D/Ops, Jul-Dec 63, Sec VII.

65. Rpt, Continental Air Defense Study (CADS), 10 May 63.

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G L O S S A R Y

ADC	Air Defense Command; also, Air Defence Command
AFSC	Air Force Systems Command
ALCOP	Alternate Command Post
A/M	Air Marshal
ASAF	Assistant Secretary of the Air Force
ASOD (Compt)	Assistant Secretary of Defense (Comptroller)
ASOD (IL)	Assistant Secretary of Defense (Installations and Logistics)
ASSS	Air Staff Summary Sheet
BMEWS	Ballistic Missile Early Warning System
BUIC	Backup Interceptor Control
CADIN	Continental Air Defense Integration North
CADS	Continental Air Defense Study
CC	Combat Center
Chmn	Chairman
CINCAL	Commander-in-Chief, Alaska
CINCNORAD	Commander-in-Chief, North American Air Defense Command
CINCONAD	Commander-in-Chief, Continental Air Defense Command
COC	Combat Operations Center
CONAD	Continental Air Defense Command
C/S	Chief of Staff
CSAF	Chief of Staff, USAF
DAF	Department of the Air Force
DC	Direction Center
D/C-E	Directorate of Communications - Electronics
DCS	Deputy Chief of Staff
DCS/O	Deputy Chief of Staff for Operations
DCS/P&O	Deputy Chief of Staff for Plans and Operations
DCS/P&P	Deputy Chief of Staff for Programs and Requirements
DDR&E	Director of Defense Research and Engineering
DEW	Distant Early Warning
D/Maint Engr	Director of Maintenance Engineering
DOD	Department of Defense
D/Opl Rqmts	Directorate of Operational Requirements
D/Ops	Directorate of Operations
D/Plans	Directorate of Plans
D/Sys Acq & Integr	Directorate of Systems Acquisition and Integration
FAA	Federal Aviation Agency

GAO	General Accounting Office
GCI	Ground Control Intercept (radar stations)
IBM	International Business Machines
ICBM	Intercontinental Ballistic Missile
IMI	Improved Manned Interceptor
JCS	Joint Chiefs of Staff
JCSM	Joint Chiefs of Staff Memorandum
Mat	Materiel
MCL	Mid-Canada Line
MDC	Master Direction Center
NADOP	NORAD Air Defense Objectives Plan
NAUS	National Airspace Utilization System
NORAD	North American Air Defense Command
NSC	National Security Council
ODDR&E	Office, Director of Defense Research and Engineering
Ofc/Leg Ln	Office of Legislative Liaison
OSAF	Office, Secretary of the Air Force
OSD	Office of Secretary of Defense
PCP	Program Change Proposal
PJBD	Permanent Joint Board on Defense
R&D	Research and Development
RCAF	Royal Canadian Air Force
SAC	Strategic Air Command
SAF	Secretary of the Air Force
SAGE	Semi-Automatic Ground Environment
SCC	Super Combat Center
SOD	Secretary of Defense
SPADATS	Space Detection and Tracking System
TRACE	Transportable Control Environment
USAF	United States Air Force
U/SAF	Under Secretary of the Air Force
V/CSAF	Vice Chief of Staff, USAF

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46.	AFOWX
47.	AFPDC
48.	AFPDP
49.	AFPDS
50.	AFPMP
51.	AFPTR
52.	AFPCP
53-54.	AFRDC
55.	AFRDD
56.	AFRDP
57.	AFRNE
58.	AFRRP
59.	AFRST
60.	AFSDC
61.	AFSLP
62.	AFSMS
63.	AFSME
64.	AFSPP
65.	AFSSS
66.	AFSTP
67.	AFSPD
68.	AFXDC
69-70.	AFXOP
71-73.	AFXPD
74.	AFTAC
75.	AFCVD

MAJOR COMMANDS

76.	ACIC
77.	ADC
78-79.	AFCS
80.	AFLC
81-85.	AFSC
86-87.	ATC
88-89.	AU
90.	AFAFC
91.	AAC
92.	USAFSO
93-94.	CONAC
95.	HEDCOM
96-100.	MATS
101.	OAR
102-106.	PACAF
107-113.	SAC
114-118.	TAC
119.	USAFA
120-124.	USAFE
125-127.	USAFSS

OTHER

128-129.	ASI
130-134.	ASI (HAF)
135-139.	ASI (HA)
140-200.	AFCHO (Stock)