United States General Accounting Office

GAO

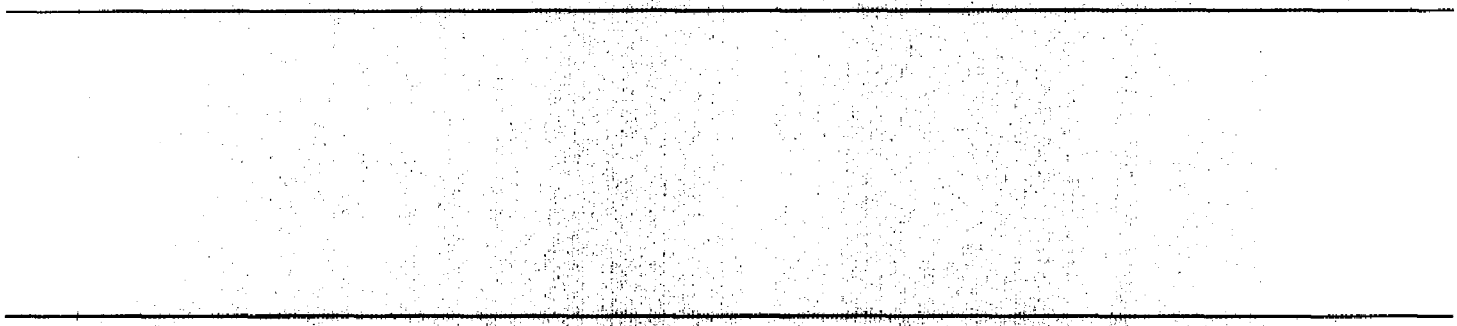
Report to the Chairman, Subcommittee on Defense, Committee on Appropriations, House of Representatives

September 1989

ATTACK WARNING

Defense Acquisition Board Should Address NORAD's Computer Deficiencies

GAO/IMTEC-89-74



GAO

United States
General Accounting Office
Washington, D.C. 20548

Information Management and
Technology Division

B-203028

September 13, 1989

The Honorable John P. Murtha
Chairman, Subcommittee on Defense
Committee on Appropriations
House of Representatives

Dear Mr. Chairman:

At the Committee's request, we evaluated Department of Defense efforts to consolidate the North American Aerospace Defense Command's (NORAD's) Integrated Tactical Warning and Attack Assessment (TW/AA) modernization programs and to correct identified program deficiencies. These programs, when they become operational, are designed to provide critical strategic surveillance and attack warning information to United States and Canadian leaders.

As agreed with your office, this report provides information on (1) Defense's progress in consolidating the management and funding of five separate TW/AA modernization programs into a single program for management review by the Defense Acquisition Board, (2) the Air Force's progress in correcting five critical program deficiencies, and (3) the extent to which the Air Force has implemented our recommendations to, among other things, conduct a cost/benefit analysis to determine the most effective and efficient means of meeting future communications processing needs at Cheyenne Mountain. Appendix I describes our objectives, scope, and methodology in more detail.

Results in Brief

The Air Force has consolidated five TW/AA modernization programs into a single integrated program for fiscal year 1990 budget requests. The Air Force expects the Defense Acquisition Board—the primary advisor to the Secretary of Defense on need, affordability, cost, and schedules for system acquisitions expected to exceed $1 billion—to review this program during September 1989.

In November 1988[1] we reported on 5 of 29 critical deficiencies that, if left unresolved, could have a dramatic impact on the ability of one modernization program—the Communications System Segment (CSS) replacement—to effectively carry out its mission. While the Air Force has

[1] Attack Warning: NORAD's Communications System Segment Replacement Program Should Be Reassessed (GAO/IMTEC-89-1, Nov. 30, 1988).

begun corrective action on three of these deficiencies, it has deferred action on the fourth, and is in the process of obtaining needed information to resolve the fifth deficiency. Accordingly, important data on how and when the Air Force will correct these deficiencies will not be available for the planned review by the Defense Acquisition Board. Finally, while the Air Force is acting on our recommendation to continue upgrading NORAD equipment, it has not acted on our recommendation to perform a cost/benefit analysis to determine the most efficient and effective means for satisfying Cheyenne Mountain's communication processing needs.

We are recommending that (1) if the Defense Acquisition Board advises the Secretary of Defense that program development should continue, as proposed by the Air Force, before a sound technical approach is developed for correcting critical deficiencies, the Board should clearly justify its rationale, specifically addressing the unresolved deficiencies and the fact that the most cost effective approach for satisfying NORAD's communication needs has not been established; and (2) the Secretary of Defense should not obligate fiscal year 1990 appropriations for continued development of the consolidated modernization program until the Defense Acquisition Board completes its review and submits its report to the Secretary.

Background

NORAD is responsible for warning United States and Canadian leaders when North America is under air, missile, or space attack. NORAD's mission is supported by an automated TW/AA system designed to identify and track enemy objects, and to provide our national leaders with timely information needed to defend our continent. The Department of the Air Force is responsible for maintaining and operating the TW/AA system located at the Cheyenne Mountain Air Force Base. Both NORAD and U.S. Space Command are users of the system, and Air Force Space Command is responsible for operating it. Air Force Systems Command, through its Electronic Systems Division, is responsible for acquiring TW/AA subsystems.

In the early 1980s, the Air Force began five modernization programs so that our nation's leaders would have critical, unambiguous warning and assessment information in the event of a missile or bomber attack on the United States. These five modernization programs, which will replace or upgrade computer systems at Cheyenne Mountain, include (1) the CSS

replacement program, (2) the Space Defense Operations Center IV program, (3) the Command Center Processing and Display System replacement program, (4) the Survivable Communications Integration System program, and (5) the Granite Sentry program. (See app. II for program details.)

These modernization programs are critical to our nation's security, and will be used at Cheyenne Mountain by NORAD to meet its mission. The Air Force expects to spend over $1.3 billion on these five modernization programs. However, after almost 8 years of development and an investment exceeding $775 million, none of the subsystems is fully operational.

Management and Funding for Modernization Programs Are Being Consolidated

In a September 1988 report,[2] the House and Senate Committee of Conference on Appropriations required that the TW/AA modernization programs could proceed in fiscal year 1989 only if they were consolidated into a single integrated program for Defense Acquisition Board review and a single line item for each affected appropriation. The conferees were concerned with the lack of management attention to these modernization efforts. The conferees noted that by fragmenting these programs, each with its own budget, Defense avoided subjecting them to cost and management oversight inherent in a Defense Acquisition Board review.

In response, the Air Force consolidated the five TW/AA modernization programs for fiscal year 1990 budget requests and management oversight. The Air Force has requested $117.6 million to continue these programs during fiscal year 1990. It also expects to spend an additional $617 million through fiscal year 1994 to complete the modernization effort.

Some Deficiencies Are Being Corrected, Others However, Remain Unresolved

While the Air Force has identified 29 unresolved issues critical to the five modernization programs, five issues could have a dramatic impact on the ability of the CSS replacement program to effectively carry out its mission. These include the need to (1) select and implement a standard communication protocol, (2) utilize consistent message load assumptions, (3) define a common message set or format, (4) select uniform wiring standards, and (5) eliminate cable congestion. If these issues are not addressed, the Air Force will develop five subsystems that cannot function together as a single system. The Air Force has begun to correct

[2]Conference Report: Making Appropriations for the Department of Defense, House of Representatives, 100th Congress, Second Session, Report 100-1002, Sept. 28, 1988.

some of the deficiencies. The lack of uniform wiring standards, cabling congestion, and the need for a standardized message set are being resolved. However, selection and implementation of a standard communication protocol and use of consistent message loading assumptions have not been resolved.

A Program to Establish Uniform Wiring Standards and Eliminate Cable Congestion Has Been Initiated, But Costs Are Escalating

In our November 1988 report on the CSS replacement program, the TW/AA subsystem that must handle nearly all messages transmitted to, from, and among other subsystems in Cheyenne Mountain, we identified two problems that could adversely affect installation and use of the technical control unit for the CSS replacement:[3] (1) the lack of uniform wiring standards, and (2) severe under-floor cable congestion within the technical control area in Cheyenne Mountain. The technical control unit was designed using wiring that was not compatible with other Cheyenne Mountain wiring, and cable congestion in the technical control area prevented installation of cables needed to service the technical control unit.

Air Force Space Command studies agreed with our conclusions. In its October 1988 report to the Congress on the CSS replacement program, the Air Force stated that it would implement plans to standardize wiring and reduce cable congestion within Cheyenne Mountain during fiscal year 1989. The report estimated that the effort would cost between $3 million and $5 million and take about 18 months to complete.

These plans are part of a larger project, the Technical Control Rebuild project, which Air Force Space Command started in December 1988 to redesign and rebuild the Cheyenne Mountain technical control facility to support installation of the CSS replacement. This redesign also includes an improved means for interconnecting future systems to help alleviate cable congestion and an effort to remove cable that is no longer being used. As of August 1989, approximately 2 miles of unused cable had been removed from the technical control facility.

[3]Through October 1988, the CSS replacement was being developed in two blocks. Block I is a semi-automated technical control unit, which is supposed to automate the monitoring and technical control of communication lines entering Cheyenne Mountain. Block II is an automated message processing and distribution capability, which is supposed to replace the existing CSS at Cheyenne Mountain. In November 1988, Electronic Systems Division consolidated these blocks into one CSS replacement effort.

However, while Air Force Space Command is making progress resolving wiring and cabling problems, its October 1988 cost and schedule estimates were overly optimistic. The Command now expects the project to be completed in 1993 at a cost of $11.5 million.

Contract Amendment for Common Message Sets in the CSS Replacement Awarded in May 1989

A message set, or format, is the form in which data is transmitted from the sensors, or radars, to computer subsystems. In November 1988, we reported that the CSS replacement was being designed to accommodate current message sets with variable formats, while other TW/AA subsystems that must communicate with the CSS replacement were being designed to accommodate a standard survivable message set with fixed formats—an incompatibility that the Air Force has been aware of since April 1985 and which will prevent communication among subsystems.

In response to our report, Defense stated that an engineering change proposal had been received from General Telephone and Electronics Corporation (GTE), the CSS replacement contractor, to incorporate standard survivable message sets into the CSS replacement. Program officials at the Electronic Systems Division completed negotiations with GTE in May 1989 to incorporate these message sets at a cost of $361,000. GTE expects to complete this message set conversion by August 1990.

Air Force Continues to Defer Use of Standard Communication Protocols

In November 1988, we reported that the TW/AA modernization programs are being built using different communication protocols[4] —the Survivable Communications Integration System program is using the Open System Interconnection (OSI) protocols, while the CSS replacement, Command Center Processing and Display System replacement, Space Defense Operations Center IV, and Granite Sentry programs are using the Transmission Control Protocol/Internet Protocol (TCP/IP). The use of dual protocols will make it necessary to develop and maintain gateways for reformatting and converting messages between systems that use different protocols. The Air Force recognizes that the use of gateways will increase the risk that messages may be altered in the process of translating between protocols.

In January 1988, Air Force Space Command adopted OSI protocols as the standard for all TW/AA computer subsystems. According to Air Force

[4]A communication protocol is a set of rules that govern communications among computer systems. By implementing a standard protocol, different manufacturers' computer systems can communicate and share information.

Space Command officials, $26 million was requested from Air Force Headquarters for converting TW/AA subsystems to OSI protocols. However, Air Force Space Command was directed to finance such conversions from within existing program budgets. As a result, in August 1988, Air Force Space Command decided that, due to funding constraints, converting to the new OSI protocol would be phased into TW/AA subsystems.

In August and September 1989, program officials at Air Force Space Command and Electronic Systems Division said that they plan to use TCP/IP protocols for communications among all TW/AA subsystems at Cheyenne Mountain. These officials said that the technology for using OSI protocols has not matured to the point where they are comfortable using the newer technology. Further, they stated that the Air Force is planning to use a phased implementation schedule for converting to OSI protocols after the subsystems are installed in Cheyenne Mountain and have become operational. However, the officials were unable to provide specific details on why they believe OSI protocols are not mature enough to use in four of the programs, but are mature enough for the fifth. Furthermore, they have not performed a convincing technical analysis to support the multi-protocol approach, which requires the use of a gateway.

Message Loading Analyses for Sizing TW/AA Subsystems Have Not Been Completed

Cheyenne Mountain computer subsystems are designed to process messages that contain critical attack warning and attack assessment information. These subsystems are sized, in part, based upon the number of messages that must be processed—the more messages to be processed, the larger the subsystem. In November 1988, we reported that several of the subsystems were being sized to process different numbers of messages. The CSS replacement, which is the most critical subsystem because it must process nearly every message sent through the Cheyenne Mountain subsystems, was being sized to process a smaller message work load than the other subsystems. Under this design, the CSS replacement may not, in some situations, be able to process all messages being sent to it. Accordingly, we concluded that inconsistent message load assumptions will affect communications among the CSS replacement and other Cheyenne Mountain subsystems.

Because of concerns about CSS replacement sizing, the Air Force tasked Electronic Systems Division in August 1988 to analyze message loading

issues. Electronic Systems Division used the Granite Vista II attack scenario.[5] Based on initial analyses performed by the Mitre Corporation, an engineering support contractor for Electronic Systems Division, the Air Force reported that the CSS replacement sizing may be adequate. However, after this initial determination, Mitre raised several issues regarding the assumptions used in its analyses. In December 1988, the Air Force and Mitre reached a consensus on most of the assumptions to be used in the message loading analysis, and Mitre was then asked to reanalyze message loading requirements in light of the agreed upon assumptions. In January 1989, Mitre raised additional issues regarding operational procedures and concepts that describe how the TW/AA system operates, and notified the Air Force that its final message loading analysis could not be completed until these issues are resolved.

The Commander of Air Force Systems Command agreed with Mitre's concerns and advised Air Force Space Command that continuing to develop TW/AA subsystems without a validated operational concept increases the risks involved in overall system development. As of August 1989, an overall TW/AA operational concept had not been developed. Nevertheless, the Air Force expects the operational concept and the final message loading analysis to be completed by November 1989—about 2 months after the Defense Acquisition Board is to review the ongoing TW/AA modernization program. Accordingly, important information will not be available to the Defense Acquisition Board on how and when the Air Force will correct this deficiency.

Air Force Has Not Fully Implemented Our Prior Report Recommendations

In November 1988, we reported that the block I semi-automated technical control unit for the CSS replacement program did not meet contract specifications, and that it was not compatible with other equipment in Cheyenne Mountain. Formal qualification testing[6] had shown that block I, as developed, did not meet system specifications in 12 instances. Left unresolved, these deficiencies could degrade the technical control unit's mission performance. Consequently, we recommended that the Air Force not accept the block I unit until after (1) all identified deficiencies had been corrected, (2) the unit had been completely tested, and (3) any additional problems identified as a result of the tests had been resolved.

[5]The Granite Vista II Attack Scenario is the Air Force's estimate of how the Soviet Union might attack the United States.

[6]Formal qualification testing, conducted under Air Force supervision at the contractor's plant, is designed to ensure that a system performs in accordance with specifications. Successful completion of this testing generally leads to operational system testing and final payment by the government.

We also raised concerns about the block II portion of the program. We reported that interim upgrades being made to the existing CSS, costing about $14 million, should satisfy all known communications processing requirements at Cheyenne Mountain through at least 1995, and possibly through the year 2000. We recommended that the Air Force (1) proceed with these interim upgrades, and (2) determine the most effective and efficient approach for satisfying communication processing needs at Cheyenne Mountain before continuing with the $209 million block II development of the CSS replacement. As of August 1989, the Air Force had not done a cost/benefit analysis that considered the interim upgrades to the CSS, in order to identify the best approach for satisfying communication processing needs at Cheyenne Mountain.

Block I Hardware Accepted; Acceptance Not Contingent on Passing Operational Tests

In October 1988, an Air Force report to the Subcommittee said that block I of the CSS replacement would be retested by July 1989. The report further stated that the Air Force would not accept the block I unit until after all testing requirements had been satisfied and an operational demonstration had been completed.

In November 1988, however, Electronic Systems Division accepted the block I hardware from GTE, without the software needed to run the block I unit. This hardware was accepted by Electronic Systems Division with the understanding that the contractor would correct known block I software deficiencies during system development for block II of the CSS replacement program, at no additional cost to the government. At the time of acceptance, Electronic Systems Division also agreed to pay GTE $3.3 million to maintain this hardware through 1991.

The block I hardware that Electronic Systems Division accepted was immediately returned to GTE as government-furnished equipment. This hardware is installed in Air Force Space Command's Test, Development, and Training Center, and at GTE. It was not moved during the transfer of ownership, and it is being used by GTE to correct the 12 outstanding block I software deficiencies and to develop portions of the block II CSS replacement. In March 1989, GTE conducted a system performance assessment on the block I unit to demonstrate GTE's progress in correcting known system deficiencies. During our review, however, program management officials at Electronic Systems Division did not provide us with information we requested on the detailed status for each of these deficiencies. The Air Force does not plan to formally test and close these deficiencies until July 1990. The Air Force plans to achieve initial operational capability for this unit during April 1991—

over 2 years after the block I hardware was accepted. Full operational capability is not planned until at least May 1993.

It is not clear what advantage the government derives from having accepted the hardware and the responsibility for maintaining it at government expense, when the software has yet to be completed and accepted. According to the CSS replacement program's command manager at Air Force Space Command, the Electronic Systems Division decided to accept the block I hardware. The command manager believes that acceptance of the hardware provides no particular benefit to Air Force Space Command because the Command has not accepted any part of block I from Electronic Systems Division. Air Force Space Command does not plan to accept the CSS replacement, or any part of it, until it is completed, fully tested, and meets all specified performance requirements.

The program manager at Electronic Systems Division said that a decision was made to accept block I so that emphasis could be shifted from completing this block to developing the block II CSS replacement, which needs to be completed in 1991. To accomplish this task, Electronic Systems Division accepted the hardware for block I, and deferred resolving the 12 unmet system specifications to block II, where they are to be resolved at no additional cost to the government.

Relative Costs and Benefits to Be Realized From CSS Interim Upgrades Were Not Considered in Block II Development Decision

In our November 1988 report, we recommended that the Air Force proceed with interim upgrades to the CSS costing about $14 million while it determines how best to achieve its communications processing needs at Cheyenne Mountain. These steps should be taken before the Air Force proceeds with its estimated $209 million block II CSS replacement effort. In following up this matter, we found that while the interim upgrades to the CSS are continuing, the Air Force has not performed the recommended cost/benefit analysis for determining the most efficient and effective means for satisfying communications processing requirements.

The CSS has two sets of computers; originally, each contained a Honeywell mainframe to identify and route messages, a communications multiplexor to collect and organize message data from the communications lines and forward it to the mainframe, and an inter-computer processor to handle communications from the mainframe to other Cheyenne Mountain subsystems. Recently, the Honeywell computers, and most of the peripheral equipment used in the existing CSS were replaced with newer and more powerful equipment. These upgrades were completed during

January 1989 at a cost of about $2.5 million. The computer manufacturer has agreed to maintain this new equipment through the 1990s. Further, the inter-computer processors are being replaced by a high speed local area network, and its configuration has been approved by the Air Force. This local area network is expected to be operational by September 1990, and can be maintained through the year 2000. The total estimated cost for this local area network is $4.5 million, of which $4 million has already been approved.

Finally, a very high speed integrated chip, which could replace the communications multiplexor, is being developed. Critical design review for this high speed integrated chip technology is expected during January 1990. Program officials at Air Force Space Command plan to continue developing this chip to replace the communications multiplexors in the existing CSS. Once this new technology is installed, the Air Force will have upgraded all computer equipment within the CSS.

According to the CSS replacement program command manager, Air Force Space Command has not, in response to our recommendation, conducted a cost/benefit analysis to determine the most effective and efficient approach for achieving Cheyenne Mountain's future communications needs (i.e., capabilities of the CSS interim upgrades versus the need for block II of the CSS replacement). He stated that the decision to continue the CSS replacement was based on a 1986 study that indicated the CSS replacement was the most viable approach to upgrading communications in Cheyenne Mountain. Additionally, the Air Force's October 1988 report on the CSS replacement program cites results of a study by an independent review team, formed by the Commander of Air Force Systems Command, that assessed CSS replacement program content and execution. However, neither of these studies specifically addressed the relative costs and benefits of the CSS interim upgrades versus the need for a block II replacement.

NORAD's View on the Progress of the CSS Replacement Program

In May 1989, NORAD's Commander—the user of the TW/AA system—advised the Congress on the importance of the modernization programs, noting his concerns about cost growth and program delays. He told the Congress that communications at Cheyenne Mountain would be reduced to telephone reporting and manual processing if the current CSS should fail during a crisis. He also acknowledged that other Cheyenne Mountain modernization programs would be affected if the CSS replacement is further delayed. Modernizations of other TW/AA subsystems rely on the CSS

replacement. Operationally, the Commander stated that he needs the CSS replacement.

According to the Commander, we are substantially correct. He noted that the Air Force should have begun resolving the cable congestion and wiring problems in Cheyenne Mountain earlier. Further, he would have liked to have selected standardized message sets and protocols earlier. He concluded that, due in part to our report and in part to Air Force initiatives prior to our report, actions have been taken to ensure that the CSS replacement program is under control.

Conclusions and Recommendations

The Air Force is aware of numerous management and critical deficiencies with the CSS replacement that must be resolved before the five modernization programs currently under development for Cheyenne Mountain can effectively communicate. NORAD's Commander has notified the Congress of the importance of the CSS replacement to his mission and his concerns over cost increases and schedule delays.

To gain needed assurances that the modernization programs meet user needs, the Congress has directed that the programs be subject to review by the Defense Acquisition Board. However, the Air Force will not complete analyses required to determine how and when to correct some of the critical deficiencies before this review. We believe these analyses are critical to the Board's efforts to thoroughly review the cost, schedule, and technical challenges facing the Air Force, and to recommend prudent actions in developing and integrating the five NORAD modernization programs.

The Air Force is taking action to resolve the management problems and to correct three of the five critical deficiencies discussed in this report. The Air Force has entered into a contract to standardize message sets, has removed over 2 miles of unused cable, and has begun a project to implement uniform wiring standards in Cheyenne Mountain. We believe the planned approach the Air Force has taken should provide sufficient information to allow the Defense Acquisition Board to assess these issues.

However, as of August 1989, two deficiencies—lack of standard communication protocols and inconsistent message loading assumptions—remain unresolved. The Air Force is continuing to use both the OSI and TCP/IP protocols in Cheyenne Mountain subsystems—an approach that

involves technical and performance risks. The Air Force could not sufficiently explain why they had not selected a single protocol; the only rationale given was that OSI protocols are immature. Moreover, the Air Force could not explain why OSI protocols are mature enough to be used in one of the subsystems but not others.

Finally, the Air Force continues to develop the CSS replacement using inconsistent message load assumptions. The CSS replacement is being sized to process a smaller message work load than the other subsystems. Under this design, the CSS replacement may not, in some situations, be able to process all messages being sent to it. As a result, the Air Force is at risk of building a subsystem that may not perform effectively under conditions of high message volume. Mitre has notified the Air Force that it cannot determine the proper size of the CSS replacement until the Air Force provides an operational concept for Cheyenne Mountain. The Air Force does not plan to complete the operational concept until November 1989—2 months after the planned Defense Acquisition Board review.

While we recognize that the CSS replacement may be needed, continuing its development without correcting the deficiencies—lack of standard communication protocols and inconsistent message loading assumptions—will not provide assurance that the system, when delivered, will meet the user's needs. Accordingly, we recommend that if the Defense Acquisition Board advises the Secretary of Defense that program development should continue, as proposed by the Air Force, before a sound technical approach is developed for correcting critical deficiencies, the Board should clearly justify its rationale, specifically addressing the unresolved deficiencies and the fact that the most cost effective approach for satisfying NORAD's communication needs has not been established.

We also recommend that the Secretary of Defense should not obligate fiscal year 1990 appropriations for continued development of the consolidated modernization program until the Defense Acquisition Board completes its review and submits its report to the Secretary.

As arranged with your office, we did not obtain official agency comments on a draft of this report; however, we discussed its contents with responsible Air Force officials and have included their comments where appropriate. We are sending copies of this report to the Secretary of Defense; the Secretary of the Air Force; the Chairman, Defense Acquisition Board; House and Senate Committees on Armed Services; Senate

Committee on Appropriations; and the Director, Office of Management and Budget. We will also send copies to other interested parties and make copies available to others upon request.

This report was prepared under the direction of Samuel W. Bowlin, Director for Defense and Security Information Systems, who can be contacted at (202) 275-4649. Other major contributors are listed in appendix III.

Sincerely yours,

Ralph V. Carlone
Assistant Comptroller General

Contents

Abbreviations

CSS	Communications System Segment
GAO	General Accounting Office
GTE	General Telephone and Electronics Corporation
IMTEC	Information Management and Technology Division
NORAD	North American Aerospace Defense Command
OSI	Open System Interconnection
TCP/IP	Transmission Control Protocol/Internet Protocol
TW/AA	Integrated Tactical Warning and Attack Assessment

Objectives, Scope, and Methodology

In response to a request from the former Chairman, Subcommittee on Defense, House Committee on Appropriations, we agreed to review (1) Defense's progress in consolidating the management and funding of five[1] separate TW/AA modernization programs into a single program for management review by the Defense Acquisition Board; (2) the Air Force's progress in correcting program deficiencies; and (3) the extent to which the Air Force has implemented our recommendations to, among other things, conduct a cost/benefit analysis to determine the most effective and efficient means of meeting future communications processing needs at Cheyenne Mountain.

We performed our work between January and August 1989 at Air Force Headquarters, Washington, D.C.; U.S. Space Command and Air Force Space Command at Colorado Springs, Colorado; Air Force Systems Command's Electronic Systems Division at Hanscom Air Force Base in Massachusetts; Mitre Corporation in Bedford, Massachusetts, which provides engineering support to Electronic Systems Division; and at General Telephone and Electronics Corporation in Needham, Massachusetts, the CSS replacement prime contractor.

We were principally concerned with the Defense Acquisition Board review scheduled for September 1989, and the resolution of problems in communication protocols, common message sets, message loads, and wiring standards. To obtain information on these matters we interviewed program officials responsible for the development, acquisition, and integration of the five modernization programs that will replace or upgrade current TW/AA subsystems at Cheyenne Mountain. We also examined relevant Air Force reports and contract documents that were provided to us.

We conducted our review in accordance with generally accepted government auditing standards. While we did not obtain official agency comments on a draft of this report, we discussed its contents with Air Force officials at Air Force Headquarters, Air Force Space Command, and Electronic Systems Division, and have included their comments where appropriate.

[1]The five modernization efforts include the Communications System Segment (CSS) replacement program, Space Defense Operations Center IV program, Command Center Processing and Display System program, Survivable Communications Integration System program, and Granite Sentry program. See appendix II for a description of each of these programs.

The Five TW/AA Modernization Programs

In the early 1980s, the Air Force began five modernization programs so that our nation's leaders would have timely, unambiguous warning and assessment information in the event of a missile or bomber attack on the United States. These five major programs will replace or upgrade computer systems at the NORAD Cheyenne Mountain Air Force Base. These programs are:

Communications System Segment Replacement Program: The program is intended to ensure uninterrupted communications to, from, and among other TW/AA subsystems at Cheyenne Mountain. Messages received from the various missile, air, and space sensor systems are to be distributed by this replacement system to mission centers at Cheyenne Mountain for processing. Through October 1988, the replacement system was being developed in two separate blocks. Block I is a semi-automated technical control unit intended to automate the monitoring and technical control of the communications lines entering Cheyenne Mountain. Block II is planned to be a message distribution subsystem that receives messages, checks them for completeness, and forwards them to various NORAD computer systems for processing. In November 1988, the Electronic Systems Division consolidated these blocks into one CSS replacement effort.

Space Defense Operations Center IV Program: The program is intended to be a data processing and communications center that can monitor space activities, provide timely warning of any threat or attack, and protect satellites by identifying and suggesting satellite maneuvers to avoid threats. The program is being implemented in three blocks. Block A is intended to provide computer equipment and software to automate existing manual space defense operations and to automate cataloguing for the space object data base. Block B is intended to enhance current automated space surveillance functions for 400 high-interest satellites. Block C is to complete the automated capability needed to consolidate the U.S. Space Command's space defense data processing functions into one command and control center.

Command Center Processing and Display System Replacement Program: The program is intended to replace the current missile warning data processing system. It is intended to provide computer systems with additional capability to support the ballistic missile warning and attack assessment mission.

Survivable Communications Integration System Program: The program is intended to enhance communications robustness by providing NORAD

with the capability to transmit critical missile warning messages simultaneously over multiple communications systems. It is intended to provide the ability to use up to five communications systems and a secure voice capability between individual sensor sites and command centers.

Granite Sentry: This program is intended to improve the U.S. Space Command's ability to perform a variety of attack warning and assessment missions. The program will replace the Modular Display System and the air defense portion of the NORAD Computer System. The program will be implemented in five phases. These phases will upgrade (1) the Air Defense Operations Center, (2) the Command Post through interim enhancements, (3) the NORAD Command Post, (4) interfacing to other Cheyenne Mountain subsystems, and (5) the Battle Staff Support Center and Weather Support Unit.

Major Contributors to This Report

Information Management and Technology Division, Washington, D.C.	Michael T. Blair, Assistant Director Leonard J. Latham, Technical Advisor Joseph E. Malloy, Evaluator Teresa M. Schlee, Writer-Editor
Boston Regional Office	Frederick R. Cross, Jr., Evaluator-in-Charge John E. McDonough, Evaluator Martin F. Lobo, Evaluator
Denver Regional Office	Barry A. Tidwell, Evaluator

Requests for copies of GAO reports should be sent to:

U.S. General Accounting Office
Post Office Box 6015
Gaithersburg, Maryland 20877

Telephone 202-275-6241

The first five copies of each report are free. Additional copies are $2.00 each.

There is a 25% discount on orders for 100 or more copies mailed to a single address.

Orders must be prepaid by cash or by check or money order made out to the Superintendent of Documents.

United States
General Accounting Office
Washington, D.C. 20548

Official Business
Penalty for Private Use $300

First-Class Mail
Postage & Fees Paid
GAO
Permit No. G100