

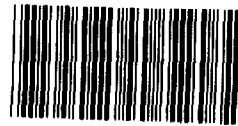
GAO

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

April 1991

ATTACK WARNING

Costs to Modernize NORAD's Computer System Significantly Understated



143575

**Information Management and
Technology Division**

B-242249

April 10, 1991

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

Dear Mr. Chairman:

At your request, we evaluated Department of Defense efforts to upgrade computerized subsystems within the North American Aerospace Defense Command's (NORAD) Integrated Tactical Warning and Attack Assessment (ITW/AA) system. These subsystems provide critical strategic surveillance and attack warning and assessment information to United States and Canadian leaders. Defense efforts to upgrade these subsystems—designated the Cheyenne Mountain Upgrade (CMU) program—will form the nucleus of the ITW/AA system in the future. The Air Force is responsible for operating and maintaining this system.

As agreed with your office, this report discusses (1) recent organizational changes for managing the CMU program and (2) whether the Air Force's \$1.58 billion cost estimate is realistic to develop and deliver a mission-ready system at Cheyenne Mountain. Appendix I describes our objectives, scope, and methodology in more detail.

Results in Brief

Defense and the Air Force have recently made some organizational changes to increase management oversight of the CMU program. Additionally, Air Force management has begun conducting quarterly program reviews to better monitor program progress and Defense has given the program more visibility by designating it a major system acquisition. While these changes are positive, system integration responsibilities remain fragmented and incomplete, and could impede resolution of system integration problems.

Air Force officials reported to the Congress in February 1990 that the CMU program would cost an estimated \$1.58 billion and be fully operational by 1996. However, the cost estimate is seriously understated. As of September 1990, Air Force documentation shows that the costs for

completing a fully-functional, mission-ready system will surpass \$1.9 billion, at least \$350 million more than was reported to the Congress.¹

Finally, the Air Force has deferred meeting some system requirements to keep the program within its near-term cost and schedule goals. This practice compresses system development efforts in later stages of the program, increases the work load that must be completed at that time, and significantly raises the risk that the system development will be more costly and take longer.

Background

NORAD is responsible for warning United States and Canadian leaders when North America is under air, missile, or space attack. This mission is supported by an automated ITW/AA system designed to identify and track enemy objects, and to provide our national leaders with timely information needed to defend our continent.

In the early 1980s, the Air Force initiated five separate programs to modernize selected computerized ITW/AA subsystems at Cheyenne Mountain Air Force Base in Colorado. These subsystems included the: (1) Communications System Segment Replacement to process and control most of the internal and external automated communications at Cheyenne Mountain; (2) Space Defense Operations Center IV to process space defense and space surveillance data; (3) Command Center Processing and Display System Replacement to process and display ballistic missile warning data received from sensors located throughout the world; (4) Survivable Communications Integration System to provide multiple survivable communications capabilities between missile warning sensors, command centers, and other users; and (5) Granite Sentry to process and display common data for use by all air defense, command post, battle staff, and weather support activities. In 1989 the Air Force consolidated the five modernization programs into one CMU program and added a backup facility at the Offutt Processing and Correlation Center in Nebraska. (See app. II for additional information on these subsystems.)

In October 1989, the Defense Acquisition Board approved \$1.58 billion for designing, developing, and completing the CMU program. This board, which is chaired by the Under Secretary of Defense for Acquisition,

¹We are defining these costs as those necessary for research, development, procurement, test and evaluation, and operation and maintenance of delivered portions of the system until a complete mission-ready system becomes operational.

reviews major system acquisitions at key decision points to ensure that they are ready to proceed into more advanced stages of development.

Some Program Management Changes Made, but More Needed

In July 1989, we reported that no single, accountable manager below the Air Force Chief of Staff had authority for the total ITW/AA system.² Without a single manager, several Air Force commands have been managing development and integration of the CMU program by consensus, through a number of boards and working groups.³ We recommended that Defense restructure the roles and responsibilities of the key program managers, designating a single manager with the responsibility, authority, and accountability to develop and maintain the ITW/AA system. Defense has not acted on this recommendation for resolving system integration issues. In the absence of a manager with full authority and responsibility for such issues, the Air Force continues to manage subsystem development and integration by consensus, through a number of boards and working groups across the involved commands.

To their credit, Defense and the Air Force have made some organizational changes to improve CMU program management. For example, detailed quarterly program reviews were initiated in October 1989 to provide an open forum for contractor and government program management officials to discuss issues that could threaten successful and timely program completion. Also, the Electronic Systems Division implemented a formal program-planning and management process for the CMU program which identifies and estimates the cost for each subsystem development task, and establishes a time frame when each task should be performed.

Further, Defense has designated the CMU program as a major system acquisition. As such, annual "Selected Acquisition Reports" will be submitted to the Congress setting forth cost and schedule status for the CMU program. Since 1969, Selected Acquisition Reports have been the primary means by which Defense informs the Congress of the status of

²Attack Warning: Better Management Required To Resolve NORAD Integration Deficiencies (GAO/IMTEC-89-26, July 7, 1989).

³These commands include Air Force Space Command, responsible for operating the system; Air Force Systems Command, responsible (through its Electronic Systems Division) for acquiring the system; Air Force Logistics Command, responsible for maintenance and logistics support; Air Force Communications Command, responsible for communications support; and Air Training Command, responsible for training support.

major system acquisitions.⁴ The report contains information on each system's cost, schedule, and performance, and compares it with earlier established estimates. According to Defense guidance on Selected Acquisition Reports, the program acquisition cost estimate is to include the cost of (1) development, including test and evaluation; (2) procurement; (3) system specific construction; and (4) acquisition-related operation and maintenance necessary to acquire the system. The report for the quarter ending December 31 is called the annual Selected Acquisition Report. However, quarterly Selected Acquisition Reports are submitted when total program costs increase by 5 percent or more, or when any milestone in a previous report is extended by 6 months or more. The first Selected Acquisition Report for the CMU program was submitted to the Congress in February 1990, and reported that the program would be acquired for \$1.58 billion and be fully operational by 1996.

Responsibility for System Integration Remains Split Between Air Force Organizations

While the Air Force has made some organizational changes to improve program management and oversight, other changes are still needed to ensure successful system integration. In July 1990, the Air Force Inspector General reported that no one organization had been assigned responsibility for system integration, and that this condition directly affected the Air Force's ability to identify and resolve system integration problems in the CMU program.⁵ According to the report, system integration was fragmented and incomplete, and responsibility for resolving integration problems was divided among NORAD and two separate and distinct Air Force commands—Air Force Space Command, and Air Force Systems Command.

The report recommended that responsibility for system integration be assigned to a single office, chief engineers for each subsystem be designated, and that direct lines of communication be established between each of the subsystem engineers and the single office to expedite decisions on key technical issues. We support the Inspector General's position on this matter. Until system integration is assigned to a single office, the ability of the various subsystem upgrades to work together effectively to accomplish NORAD's mission could remain unresolved.

⁴Major acquisitions are programs with research, development, test, and evaluation costs over \$200 million or procurement costs over \$1 billion.

⁵Report On Special Management Review Of The Integrated Tactical Warning/Attack Assessment (ITW/AA) System, Department of the Air Force TIG Report (PN89-510, July 24, 1990).

Program Cost Estimate Is Significantly Understated

In February 1990, the Air Force reported to the Congress that the CMU program would cost \$1.58 billion to complete. However, as of September 1990, Air Force documents show that a mission-ready system will cost at least \$350 million more. For example, the Air Force excluded from its estimate approximately \$182 million for testing, operating, and maintaining portions of the system until the complete system is delivered and becomes operational, and \$124 million for satisfying certain program requirements. The Air Force also excluded at least \$26 million for converting existing CMU communication protocols to new industry and government Open System Interconnection (OSI) protocols. Finally, during the past year, the Air Force has identified 11 new subsystem integration problems. The Air Force has estimated the cost to resolve 8 of these problems to be \$18 million.

Air Force Excluded Cost to Test and Maintain Delivered Portions of the System and Cost for Certain Known Requirements

The \$1.58 billion cost estimate does not include funds needed to test and maintain early system components prior to delivery of the fully operational system. According to Air Force documentation, \$182 million will be needed for items such as software changes and related documentation, acquisition of selected high-speed communication circuits, hardware maintenance, engineering support, and operation of subsystems during development and testing.

The Air Force also excluded approximately \$124 million in known requirements that are considered important by program officials, but not critical to delivering a working—but not complete—system to Cheyenne Mountain. Among requirements excluded from the program baseline was an estimated \$46 million to provide data communication links that are protected against electromagnetic interference between Cheyenne Mountain and its backup facilities. Without such protection, the Air Force cannot be assured of survivable data sharing among the facilities following a nuclear detonation (e.g., a nuclear detonation in the atmosphere). This protection is necessary to ensure that national decision makers are notified of an air, missile, or space attack against the United States. While the Air Force has deferred meeting this requirement, it plans to eventually have each of these facilities equipped with this protection.

In commenting on this report, Defense stated that protection against electromagnetic interference is not a critical requirement in accordance with the ITW/AA Concept of Operations. Our reading of that document refutes this statement. Moreover, to achieve ITW/AA system mission

requirements, Defense has repeatedly defined a need for protecting communication links between Cheyenne Mountain and its back-up facilities against electromagnetic interference. ITW/AA architectural documents dating back to February 1986 emphasize that one of the most important communication links within the system is a high-speed, survivable data line between Cheyenne Mountain and the Offutt Processing and Correlation Center. Defense Acquisition Board documents show that CMU communications must endure natural or man-made disturbances, jamming, sabotage, and other effects to ensure the availability of ITW/AA information in peacetime, and through all phases of conflict until physically destroyed. Finally, and most important, the CMU System Operational Requirements Document defines the requirement to connect NORAD's operational centers at Cheyenne Mountain and at the Offutt Processing and Correlation Center with a wide-band communications link that is protected against electromagnetic interference.

Another example of excluded costs, although the amount is uncertain, relates to a requirement for larger computer processors. Modeling results for the Survivable Communications Integration System program showed that the system's processor was undersized and could not meet originally planned processing requirements for ground-based ITW/AA sensors, space-based sensors, and summary message processing. The Air Force is currently considering two options—an upgrade to a larger processor or completely rebuilding the subsystem with larger processors from a different manufacturer. Program management officials told us that costs to resolve this problem could exceed several million dollars and are not included in the approved cost baseline for the CMU program.

In its comments on this report, Defense acknowledges that the Survivable Communications Integration System's central processor is undersized and will not meet performance requirements. While Defense admits its replacement will be costly, Defense states it has not yet determined what part of the cost, if any, will be borne by the government. Defense contends, and rightfully so, that the contractor remains responsible for providing the hardware and software to meet system requirements and that it is premature to conclude that the government will incur a cost increase to the overall Cheyenne Mountain Upgrade program.

We support Defense's position to hold the contractor responsible for the deliverable. It is a radical change from a similar condition that we observed 2 years ago with the Space Defense Operations Center IV program. The contractor for that program also built the system using a

computer that was too small to achieve the processing speeds needed to meet mission requirements. As discussed on pages 17 and 18 of this report, the Air Force eventually spent \$24 million to acquire larger, more powerful computer systems for this program.

Costs for Implementing New Protocols and Correcting New Integration Problems Not Included

At least \$26 million to convert CMU subsystems from existing to OSI communications protocols⁶ was not included in the \$1.58 billion cost estimate. In January 1988, Air Force Space Command adopted OSI protocols as the standard for all ITW/AA subsystems—a decision we support. However, in August 1988, the Air Force decided to postpone implementation of the OSI protocols for the CMU subsystems until after they begin operating at Cheyenne Mountain. The Air Force reiterated this approach in its June 1990 acquisition transition plan.

Our analyses show that the migration from the current protocols to a new protocol standard will be complex and costly. Such an effort requires careful software engineering to prevent problems, such as message overflow, from occurring. In 1988, Air Force Space Command requested \$26 million for converting communications protocols in the CMU subsystems to OSI protocols. The Air Force was directed to finance such conversions from within existing program budgets, and did not pursue this effort because of funding constraints and because it would cause an estimated 1-year program schedule delay. In our opinion, this conversion may be more costly than the Air Force anticipates. Deferring this requirement means that the Air Force is investing time and money implementing the current protocols, only to discard them later when it converts to the OSI protocols.

In commenting on this matter, Defense states that the probable cost for protocol conversion is now \$9 million. To support its claim, Defense provided us with a draft November 1990 cost/benefit study, which is subject to change and which is based on many assumptions that lead us to question whether the conversion can be completed for \$9 million. For example, the study focuses on developing, integrating, and testing a generic gateway interface to translate from existing to OSI protocols for only 2 of the 5 CMU subsystems—the Communications System Segment Replacement and the Command Center Processing and Display System Replacement. The cost estimate does not include costs for actual

⁶The Department of Defense has mandated the use of OSI protocols specified in the Government Open Systems Interconnection Profile (commonly identified as GOSIP). All new subsystems and major upgrades to existing subsystems initiated after August 1990 must meet this mandate.

software conversions or replacements for these two subsystems. The study points out that in 1988 the Communications System Segment Replacement contractor estimated OSI transition costs for just this subsystem at \$12 million, and that the 1990 cost is expected to be even higher.

The study also assumes that the Space Defense Operations Center IV and Granite Sentry subsystems will be developed using OSI protocols at substantial savings and not require additional costs for gateways and later conversions. The study is silent on protocol costs for the Survivable Communications Integration System. Moreover, the study does not address the technical risk and the extent of system performance degradation that can result from adding such gateways.

Finally, the Air Force has identified 11 new subsystem integration problems since establishing its \$1.58 billion cost estimate. Our analyses of available Air Force documentation showed that resolving 8 of these problems could cost about \$18 million.

Deferring Subsystem Requirements Raises Risk That Program Costs Will Increase

The Air Force has adopted a strategy of deferring some subsystem requirements on the optimistic assumption that these requirements can be achieved during later stages of system development. While such deferrals may permit the Air Force to meet revised near-term goals, they also mask the magnitude of total program cost and schedule problems. This strategy significantly raises the risk that system development will be more costly and take longer. To date, the Air Force has not formally evaluated the effects on cost and schedule, or the risks associated with deferring subsystem requirements.

For example, in order to keep the Granite Sentry program within approved program cost and schedule, the Air Force delayed meeting some requirements until later program phases. In August 1990, Air Force Space Command's Requirements Review Council for the ITW/AA system approved 19 deferrals to the phase II contract requirements. Four of these requirements were initially deferred from phase I into phase II, and have now been deferred to phase IV. Other requirement deferrals are discussed in appendix II.

Conclusions

Defense and the Air Force have made organizational changes to increase management focus on the CMU program and improve communications

between the Air Force and subsystem contractors. However, management responsibility for system integration continues to be spread across several Air Force organizations. Until these responsibilities are assigned to a single office, there can be no assurance that all system integration problems will be resolved. Accordingly, we agree with the Air Force Inspector General's July 1990 recommendation that one entity be made responsible for managing and resolving system integration issues.

The \$1.58 billion cost estimate reported to the Congress in the February 1990 Selected Acquisition Report is seriously understated. We believe that a more realistic estimate for delivering a mission-ready CMU system, including costs for satisfying all requirements, testing and maintaining delivered portions of the system, and correcting integration problems, will exceed \$1.9 billion. Moreover, because the Air Force continues to identify new system integration problems as the program proceeds, total program costs could go even higher.

Finally, we question whether it is prudent to follow a practice of deferring system requirements to meet near-term cost and schedule goals. Such action moves system development efforts to later stages of the program, and increases the work load that must be completed at that time. While this practice gives the impression that progress is being made in the near-term, it significantly raises the risk that the complete system will not be delivered on time and within cost. Moreover, the Air Force's approach to implementing some requirements, such as OSI protocols, may cause the completed system to cost more than was necessary. Further, if some deferred requirements are never satisfied, the system will have less capability than was initially envisioned. To date, the Air Force has not formally evaluated the cost, schedule, and performance risks associated with continuing to defer subsystem requirements.

Recommendations

We recommend that the Secretary of Defense ensure that the total costs to develop and deliver a fully functional, mission-ready CMU system be reported to the Congress in the next quarterly Selected Acquisition Report. These costs should include those for completing all requirements, testing and maintaining delivered portions of the system until a complete mission-ready system is operational, and correcting integration problems. We also recommend that the Secretary of Defense direct the Secretary of the Air Force to assess the cost, schedule, and performance risks to the overall program from deferring subsystem requirements to later stages of system development, and report the results of this assessment to congressional appropriations and oversight committees.

Agency Comments

The Department of Defense agreed with our recommendations and with most of the information contained in this report (See app. III.) Clarifications and updated information provided by Defense have been incorporated where appropriate.

In commenting on this report, Defense stated that program acquisition costs, totalling \$1.58 billion, were reported to the Congress in the December 1989 Selected Acquisition Report. These costs, however, do not reflect the total cost to field the system. They do not include costs for converting protocols, correcting new integration problems, resolving individual subsystem problems such as the Survivable Communications Integration System's hardware and software problems, and developing other known program requirements for obtaining a fully-functional, mission-ready system.

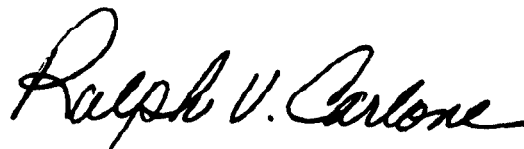
Defense agrees to provide the Congress with the total cost to develop and deliver a fully functional, mission-ready CMU system. This information will be provided through a separate special July 1991 report that will aggregate all CMU related life-cycle costs (operations, maintenance, test, software support, etc.). While the special report will provide the Congress with much needed information, Defense should not view it as a one-time report, but rather a requirement, according to Defense Instruction 7000.3, that needs to be included in all Selected Acquisition Reports submitted to the Congress.

We cannot overemphasize that Selected Acquisition Reports should include the costs to meet all program requirements—not just those included in the approved acquisition baseline each year. Defense states that the Air Force assesses the impact of requirement and cost changes to the acquisition process through its Program Planning and Management System. However, this process is being used to keep CMU program costs and schedule delivery dates stable. As new or higher priority requirements are identified and included in the baseline, others are removed to keep the program within the approved baseline and to meet the 1996 delivery date.

We are sending copies of this report to the Secretary of Defense; the Secretary of the Air Force; 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 in accordance with generally accepted government auditing standards 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 IV.

Sincerely yours,



Ralph V. Carlone
Assistant Comptroller General

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Abbreviations

CMU	Cheyenne Mountain Upgrade
GAO	General Accounting Office
GOSIP	Government Open Systems Interconnection Profile
IMTEC	Information Management and Technology Division
ITW/AA	Integrated Tactical Warning and Attack Assessment
NORAD	North American Aerospace Defense Command
OSI	Open System Interconnection

Objectives, Scope, and Methodology

In response to a request from the Chairman, Subcommittee on Defense, House Committee on Appropriations, we agreed to (1) identify recent Air Force and Defense organizational changes in managing the CMU program, and (2) assess whether the Air Force's \$1.58 billion cost estimate is realistic to develop and deliver a mission-ready system at Cheyenne Mountain.

We performed our work at Air Force headquarters, Washington, D.C.; Air Force Space Command, Colorado Springs, Colorado; Air Force Systems Command's Electronic Systems Division, Hanscom Air Force Base, Bedford, Massachusetts; Mitre Corporation, Bedford, Massachusetts, (which provides engineering support to the Electronic Systems Division); and at E-Systems, Incorporated, St. Petersburg, Florida, the prime contractor for building the Survivable Communications Integration System.

For each location visited and subsystem reviewed, we interviewed program officials and reviewed relevant program documents and records. The views of program management officials have been incorporated, where appropriate, throughout this report.

We interviewed program management officials and obtained relevant documentation to identify organizational changes within Defense and the Air Force for managing the CMU program. To identify and assess the adequacy of Defense's funding plan and schedule for completing the CMU program, we (1) obtained cost and schedule data for delivery of each of the subsystems, and analyzed the extent to which all system requirements were included in cost and schedule estimates approved by the Defense Acquisition Board; (2) assessed the potential cost and schedule impacts of known requirements not included in the baseline approved by the Defense Acquisition Board; (3) assessed technical and cost implications of selected subsystem development and integration problems to determine the impact, if any, that such problems would have on delivery of fully-integrated, mission-ready ITW/AA subsystems at Cheyenne Mountain.

Our work was performed between February 1990 and March 1991 in accordance with generally accepted government auditing standards.

The Six Subsystems Included in the Consolidated Cheyenne Mountain Upgrade Program

In the early 1980s, the Air Force began five modernization programs so 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 programs were expected to replace or upgrade computer subsystems at the NORAD Cheyenne Mountain Air Force Base. In 1989, the Air Force consolidated the programs and presented them to the Defense Acquisition Board as a single CMU program. At that time, the Air Force added the Offutt Processing and Correlation Center—a back-up facility for Cheyenne Mountain—as a sixth subsystem. A description of these six subsystems and their status at the time of our review follow.

Communications System Segment Replacement Program

The Communications System Segment Replacement program is intended to ensure uninterrupted communications to, from, and among ITW/AA subsystems. Messages received from the various missile, air, and space sensors are to be distributed by this subsystem to mission centers at Cheyenne Mountain for further processing. Through October 1988, this replacement subsystem was being developed in two separate blocks. Block I is a semi-automated technical control unit that is intended to automate the monitoring and technical control of communications lines entering Cheyenne Mountain. Block II is 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 replacement program.

In November 1988, we reported that the semi-automated technical control unit did not meet contract specifications, and that it was not compatible with other equipment in Cheyenne Mountain.¹ Formal qualification testing had shown that this unit, as developed, did not meet system specifications in 12 instances.² We reported that such deficiencies, if left unresolved, could degrade the technical control unit's mission performance. Consequently, we recommended that the Air Force not accept the semi-automated technical control unit from the contractor until after all deficiencies had been resolved and the unit had been completely retested. Formal qualification testing of this unit has been

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

²Formal 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.

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redone, and was successfully completed in February 1990. This testing demonstrated that all 12 problems in meeting system specifications had been resolved. This testing was done in a laboratory environment as part of the developmental test and evaluation for the overall replacement system.

The semi-automated technical control unit was installed in Cheyenne Mountain during August 1990. The Air Force has operated this unit and has demonstrated that its operators can identify and find communication faults within specified time frames. Initial operational capability for the technical control unit at Cheyenne Mountain is scheduled for April 1991. Although success has been achieved with this unit, the Air Force decided to use older existing communications control technologies for the back-up facility located at the Offutt Processing and Correlation Center.

The Air Force has continued developing the Communications System Segment Replacement's message distribution subsystem without determining if continued development is the most cost-effective approach in light of upgrades being made to the existing communications system segment in Cheyenne Mountain. In November 1988, Air Force engineering officials told us that interim upgrades being made to this segment, 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 determine the most effective and efficient approach for satisfying communications processing needs at Cheyenne Mountain before continuing with a \$209 million system development of the message distribution subsystem.

In November 1988, we also reported that the Communications System Segment Replacement, which must handle nearly all messages among the ITW/AA subsystems in Cheyenne Mountain, was being sized to process a smaller message work load than the other subsystems involved. The Mitre Corporation, an engineering support contractor for the CMU program, has since modeled the message processing work load for Cheyenne Mountain using numbers and types of messages provided by the Air Force and based on nine attack scenarios. In each of the nine scenarios analyzed, the Communications System Segment Replacement was shown to be incapable of processing the scenario's message loads. As a result, Mitre proposed the following types of flow control procedures to relieve processing capacity shortfalls: (1) message prioritization for further processing, (2) message aging to process newest messages first,

(3) large-raid processing, and (4) message journaling to save messages not processed, so they could be recalled at a later time for further processing. When Mitre added these flow control procedures to their model, they found that the message loading problem was manageable, and in some instances, solved.

Mitre officials told us that model results available during our review did not include data received at Cheyenne Mountain from other sources, such as mobile ground stations, which could significantly add to message processing work loads for the Communications System Segment Replacement subsystem. Moreover, the extent of system overhead created by the flow control procedures, and its impact on processing work loads was not known at the time of our review. Such overhead needs to be reflected in the models to accurately represent work loads to be processed.

During our audit work, the message distribution subsystem was being readied for formal qualification testing. According to the Command Manager for this program at Air Force Space Command, it is possible that the date of initial operational capability for the message distribution subsystem will slip 4 months, from April to August 1991.

Space Defense Operations Center IV Program

The Space Defense Operations Center IV 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 cataloging for the space object data base.

In April 1989, we reported that the Space Defense Operations Center IV program was marked by management problems, unrealized expectations, and program delays.³ At that point, the Air Force had invested over \$235 million in a system that was more than 4 years behind schedule and far from meeting its required operational capability.

In April 1988, the Air Force accepted block A without meeting specified requirements for controlled mode security, and for 16 of 23 required

³Space Defense: Management and Technical Problems Delay Operations Center Acquisition (GAO/IMTEC-89-18, Apr. 20, 1989).

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mission functions stated in the system development contract. After deferring each of these unresolved requirements to block B, the Air Force declared block A to be operational in April 1989. In the interim, however, the Air Force spent about \$24 million to acquire larger, more powerful IBM Model 3090 computers to replace the IBM Model 3083 machines that were unable to satisfy block A system performance specifications. Program management officials in the Electronic Systems Division told us that these larger machines satisfy all information processing requirements and performance specifications for blocks A and B of the subsystem development program, as well as provide growth for block C requirements.

Block B is intended to enhance current automated space surveillance functions for 400 high-interest satellites. The system test for this block was performed in October 1990, 4 months earlier than planned. The computer hardware for this block has been installed, and all equipment is operational in Cheyenne Mountain and in the off-site test facility at Peterson Air Force Base. The initial operational test and evaluation for block B was started in March 1991, and the initial operational capability has been set for June 1991.

Block C of this program is expected 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. The Air Force plans to award the systems development contract for block C after block B reaches its initial operational capability in June 1991. This represents a 2-month slippage in the Space Defense Operations Center IV program schedule approved by the Defense Acquisition Board.

According to the Command Manager for this program at Air Force Space Command, the IBM Model 3090 computers discussed above should be able to process all known block C requirements. No additional upgrades to these computers were anticipated by program officials at Air Force Space Command and at the Electronic Systems Division at the time of our review. The Command Manager at Air Force Space Command further told us that capabilities from block C should be delivered in three increments during 1993, 1994, and 1995.

Command Center Processing and Display System Replacement Program

The Command Center Processing and Display System Replacement program is intended to replace the current missile warning data processing system. Its purpose is to provide standardized ballistic missile warning display systems for national decision makers. Initial operational capability has slipped 1 year from September 1992 to September 1993, and the full operational capability milestone has slipped from December 1993 to December 1994. Installation of the Command Center Processing and Display System Replacement subsystem at the Offutt Processing and Correlation Center has also been delayed until after full operational capability is achieved at Cheyenne Mountain.

Survivable Communications Integration System Program

The Survivable Communications Integration System 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 (1) the use of up to five communications systems, and (2) a secure voice capability between individual sensor sites and command centers.

The contractor was unable to deliver an integrated hardware and software set for system testing in October 1990. In January 1991, the contractor proposed a recovery plan that would deliver the integrated set in May 1991 on a schedule to support critical interface testing with the Command Center Processing and Display System Replacement in June 1992. Defense is reviewing the impact of this delay to the CMU integrated schedule, possible alternatives to get the required survivable communications capability, and its legal position in regard to contractor non-performance.

Granite Sentry

The Granite Sentry program is intended to improve 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. Granite Sentry will be implemented in several phases to upgrade (1) the Air Defense Operations Center, (2) the NORAD Command Center, (3) air, missile, and space warning displays, (4) interfaces to other Cheyenne Mountain subsystems, and (5) the Battle Staff Support Center and Weather Support Unit.

Phase I of this program achieved initial operational capability during February 1989. The work on this phase provided an initial upgrade to air defense processing and display capability. Phase II of Granite Sentry is to provide missile warning display capabilities in the NORAD Command

Center and some enhancements to the phase I air defense display capabilities. Phase II was stopped in March 1990 because of serious problems that surfaced during development testing and evaluation. A replanned program was approved by the Air Force in November 1990. This replan is expected to slip the schedule for initial operational capability from May 1990 to August 1991. As a result of this schedule delay, the Air Force consolidated portions of phase III with phase II. For example, the Air Force will install missile warning displays directly into the new command center, as opposed to the original plan for installing the displays in an interim command center during phase II, and then moving them to the new command center during phase III.

The Granite Sentry Command Manager at Air Force Space Command told us that the budget approved by the Defense Acquisition Board is expected to be sufficient to support this replanned program through its final phase of operational capability at Cheyenne Mountain. What is not clear, however, is the extent that requirements will be deferred or changed to keep Granite Sentry development within the costs and schedules approved by the Board. For example, the current system cannot switch between data display screens as quickly as required by subsystem specifications. At the time of our review, the Air Force had accepted a display switching speed that reduced the original specified speed for critical screens from 2 seconds to 15 seconds (an increase in time of 650 percent) to avoid a potential 1-year schedule delay for phase II.

Offutt Processing and Correlation Center

The Offutt Processing and Correlation Center is a back-up facility for Cheyenne Mountain. It is being developed in two phases—phase I is the missile warning function, and phase II is the air defense function. Testing for phase I is scheduled to occur in 1993, with an initial operational capability scheduled for December 1994. The air defense function (phase II) is scheduled to achieve initial operational capability in November 1995.

Construction of the building that will house the equipment for this center was completed during August 1990. The missile warning function is expected to replicate communications and processing activities in the Command Center Processing and Display System Replacement being developed for use at Cheyenne Mountain, and will send out information to the same locations as the system located at the mountain. The air defense function is expected to operate in a similar manner.

**Appendix II
The Six Subsystems Included in the
Consolidated Cheyenne Mountain
Upgrade Program**

During preparation for a September 1989 review by the Defense Acquisition Board, the Air Force incorporated the Offutt Processing and Correlation Center into the consolidated CMU program as a separate subsystem. Subsequently, the Electronic Systems Division established a System Project Office within its Space and Missile Warning Systems Directorate to manage implementation of this subsystem.

Comments From the Department of Defense



COMMAND, CONTROL,
COMMUNICATIONS
AND
INTELLIGENCE

ASSISTANT SECRETARY OF DEFENSE

WASHINGTON, D.C. 20301-3040

March 14, 1991

Mr. Ralph V. Carlone
Assistant Comptroller General
Information Management and
Technology Division
U.S. General Accounting Office
Washington, DC 20548

Dear Mr. Carlone:

This is the Department of Defense (DoD) response to the General Accounting Office (GAO) Draft Report, "ATTACK WARNING: Costs to Modernize NORAD's Computer System Significantly Understated," Dated January 18, 1991 (GAO Code 510522), OSD Case 8589. The DoD generally agrees with the report.

The DoD is pleased that the report provides independent verification of the improved status of the development and integration of the computer system upgrades at the North American Aerospace Defense Command (NORAD). The report recognizes some of the many management changes that have been made to resolve previously identified problems.

A key finding in the current report is the lack of a single, system-level integration focal point for the overall Integrated Tactical Warning and Attack Assessment "system of systems." The DoD strongly endorses having a single focal point. The authority to appoint such a person is being delegated to the System Executive Manager by the Chairman, Joint Chiefs of Staff through a revision to Secretary, Joint Chiefs of Staff Memorandum SM-27-86, "Integrated Tactical Warning and Attack Assessment System Integration". That document should be in place by May 1991, at which time a single, system-level integrator will be established.

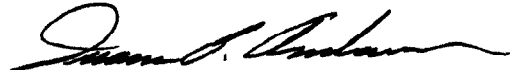
Clarification is offered regarding the GAO question on whether the DoD fiscal year 1991 budget and its accompanying multi-year defense plan fully fund the requirements to develop and deliver an integrated warning system at the NORAD. All costs have been identified. The total Cheyenne Mountain Upgrade program cost estimate was presented at the September 1989 Defense Acquisition Board Program Review. It included the acquisition program baseline cost of \$1.58 billion and related life cycle cost to support the program's phased deliveries until it achieves full operational capability in FY 1996--for a total

program cost of \$1.77 billion. The acquisition program costs were provided to Congress in the 1989 Selected Acquisition Report, using DoD guidelines for major programs. The related life cycle costs were included in the President's Budget in normal funding lines for operating and maintenance costs. Due to the questions raised by the GAO, and to provide better visibility of all costs related to the Cheyenne Mountain Upgrades, the Department will take two clarifying actions: (1) a review of the content of the Cheyenne Mountain Upgrade Selected Acquisition Report will be conducted to assure that costs identified are in accordance with Selected Acquisition Report guidelines; and (2) by July 1991, the Air Force will provide to the Congress a special report aggregating all Cheyenne Mountain Upgrade related life cycle costs included in the President's Budget. It is anticipated these actions will demonstrate that all costs related to the Cheyenne Mountain Upgrade have been fully disclosed and funded in the appropriate budgetary documents.

The GAO report also questioned whether the Air Force considered the impact of "deferred requirements" on the overall Cheyenne Mountain Upgrade program and notes the possibility of incurring increased cost and schedule risk in later years to meet "near term" deliveries. The Department concurs that there can be an increased risk in such cases; if the development changes are made without a thorough assessment of the consequences to the overall acquisition program. In the case of the Cheyenne Mountain Upgrades, however, proposed changes to requirements, technical performance, costs, schedule, or other pertinent factors are identified immediately through the Air Force Program Planning and Management System. The Program Planning and Management System process highlights subsystem interdependencies and enables rapid assessment of possible impact to cost and schedule from any kind of change. The process involves the active participation of both the developer and the user to mitigate risks to program delivery on time and within budget. The Program Planning and Management System process was recognized by the GAO as a key management improvement for the Cheyenne Mountain Upgrade program.

The Department appreciates the opportunity to comment on the report in draft form. The detailed DoD comments on the GAO findings and recommendations are enclosed. Additional technical corrections were separately provided.

Sincerely,



Duane P. Andrews

Enclosure

GAO DRAFT REPORT - DATED JANUARY 18, 1991
(GAO CODE 510522) OSD CASE 8589

"ATTACK WARNING: COSTS TO MODERNIZE NORAD'S COMPUTER
SYSTEM SIGNIFICANTLY UNDERSTATED"

DEPARTMENT OF DEFENSE COMMENTS

FINDINGS

- **FINDING A: Changes Made To Improve Management Of The Cheyenne Mountain Upgrade Program.** The GAO referenced a July 1989 GAO report, entitled--"ATTACK WARNING: Better Management Required To Resolve NORAD Integration Deficiencies" (OSD Case 7925). In that report the GAO identified several organizational problems--problems that have affected the DoD efforts to upgrade the subsystems within the North American Aerospace Defense Command Integrated Tactical Warning and Attack Assessment System, an effort designated as the Cheyenne Mountain Upgrade Program. The GAO noted that, in July 1990, at the request of the Assistant Secretary of Defense for Command, Control, Communications and Intelligence, the Air Force Inspector General also reported on management and organizational problems affecting the Cheyenne Mountain Upgrade Program.

The GAO found that the DoD has made some organizational changes to improve Program management. The GAO reported, for example, that detailed program reviews were initiated in October 1989, to provide an open forum for contractor and Government management officials to discuss Program issues. The GAO also found that the Air Force has implemented a formal program planning and management process for the Program. In addition, the GAO observed that the DoD has designated the Cheyenne Mountain Upgrade Program as a major system acquisition. As a result, the GAO explained that annual Selected Acquisition Reports will now be submitted to the Congress, setting forth Program cost and schedule status. The GAO concluded the described changes are positive ones--changes which should help improve program management and visibility. (p. 1, pp. 3-5, p. 9/GAO Draft Report)

DOD RESPONSE: Concur.

- **FINDING B: System Integration Responsibility Remains Fragmented And Incomplete.** The GAO observed that, in its 1989 report, it [the GAO] found that no single, accountable manager had authority for the total system, and recommended that a single manager be designated. The GAO found that the DoD has not acted on that particular recommendation--instead maintaining that the current management structure is adequate.

The GAO reported that the July 1990 Air Force Inspector General report similarly found that no one organization had been assigned responsibility for system integration. The Air Force concluded that lack of organizational accountability had directly affected the ability of the Air Force to identify and

Enclosure

resolve System integration deficiencies. The GAO explained that the Air Force Inspector General report stated that System integration was fragmented and incomplete, and responsibility for resolving integration problems was divided among the North American Aerospace Defense Command and two Air Force commands. The GAO also reported that the Air Force report recommended that (1) responsibility for System integration be assigned to a single program office, (2) chief engineers for each subsystem be designated, and (3) direct lines of communication be established between each of the subsystem engineers and the program office.

The GAO indicated support for the Air Force Inspector General position. During its current review, however, the GAO found that management responsibility for System integration continues to be spread across several Air Force organizations. The GAO concluded that, until System integration is assigned to a single program office, there can be no assurance that all System integration problems will be resolved. (pp. 1-2, pp. 3-6, pp. 9-10/GAO Draft Report)

DOD RESPONSE: Concur. While a single system-level integrator has not yet been identified, the DoD is in the process of doing so. The Cheyenne Mountain Upgrade is the modernization and enhancement of the central core of the Integrated Tactical Warning/Attack Assessment network's command and control, assigned through the Joint Chiefs of Staff Executive Management Structure in Secretary, Joint Chiefs of Staff Memorandum SM-27-86. A revision to that document, which will assign the System Executive Manager the responsibility to appoint a single, system-level integrator is in coordination. It is expected that the document will be finalized by May 1991, at which time a single system-level integrator will be established.

- **FINDING C: Costs For Certain Delivered Portions Of The System And Certain Known Requirements Not Included.** The GAO reported that, in February 1990, in the first Selected Acquisition Report submitted to the Congress, the Air Force indicated that the Cheyenne Mountain Upgrade Program would cost about \$1.58 billion to complete. According to the GAO, however, as of September 1990, Air Force documents show that a mission-ready system will cost at least \$350 million more. As one example, the GAO reported that the Air Force estimates about \$182 million more will be needed for such items as software changes and related documentation, acquisition of selected high speed communication circuits, hardware maintenance, engineering support, and operation of subsystems during development and testing.

In addition, the GAO found that the Air Force excluded about \$124 million in known program requirements, including an estimated \$46 million to provide data communication links between Cheyenne Mountain and its backup facilities that are protected against electromagnetic interference. The GAO explained that, without such protection, the Air Force cannot be assured of survivable data sharing following a nuclear detonation. According to the GAO, while the Air Force has deferred meeting the requirement, it plans eventually to have each of the facilities equipped with protected data links.

As another example, the GAO reported modeling results for the Survivable Communications Integration System program showed that the System processor was undersized and could not meet the originally planned processing requirements. The GAO reported that the Air Force is currently considering

two options--either upgrading to a larger processor or rebuilding the subsystem with larger processors. Although costs are uncertain, the GAO reported that program officials said it could cost several million dollars to resolve the problem. The GAO concluded the cited examples illustrate that the reported \$1.58 billion cost estimate is seriously understated. The GAO further concluded that a more realistic estimate for delivering a mission-ready Cheyenne Mountain Upgrade System will exceed \$1.9 billion. (p. 2, pp. 6-7, p. 10/GAO Draft Report)

DOD RESPONSE: Partially concur. The total Cheyenne Mountain Upgrade program acquisition cost estimate, plus its associated operations and maintenance costs, consistently have been defined and disclosed since the program's inception in 1989. The total costs include the acquisition program baseline cost of \$1.58 billion and related life cycle cost to support the program's phased deliveries, until it achieves Full Operational Capability in FY 1996--for a total program cost of \$1.77 billion. The acquisition program costs were provided in the 1989 Selected Acquisition Report, using DoD guidelines for major programs. The related life cycle costs were included in the President's Budget in normal funding lines for operations and maintenance costs. To provide full visibility of the other costs related to Cheyenne Mountain, the DoD will take the following two actions:

a review will be conducted of the content of the Cheyenne Mountain Upgrade Selected Acquisition Report to assure that all costs are identified in accordance with Selected Acquisition Report guidelines; and

the Congress will be provided with a special report that aggregates all Cheyenne Mountain Upgrade related life cycle costs (operations, maintenance, test, software support, etc.) included in the President's Budget. (See also the DoD response to Recommendation 1).

In response to the additional "\$124 million" identified by the GAO as known program requirements, including \$46 million for protection from electromagnetic interference on links between Cheyenne Mountain and its backup facilities, the DoD recognizes that there are additional valid requirements; however, none of them are defined by the Integrated Tactical Warning/Attack Assessment Concept of Operations, dated September 1990, as critical to the operational system to achieve the "mission ready" Cheyenne Mountain Upgrade. What constitutes a "mission ready" Cheyenne Mountain Upgrade was determined by the Air Force Space Command, in consultation with the Air Force Systems Command. The Air Force was very explicit in proposing to acquire the upgrade at "minimum essential capabilities and funding" at the Defense Acquisition Board in September 1989. A number of upgrades, changes, or other improvements to the Integrated Tactical Warning/Attack Assessment network were considered for inclusion in the final Cheyenne Mountain Upgrade program, but only those considered critical were included in the program and baseline. Electromagnetic pulse hardening, for instance, is not a critical requirement, in accordance with the Concept of Operations. The Integrated Tactical Warning/Attack Assessment Concept for Operations, dated September 1990, calls for the Offutt Processing and Correlation Center to provide the Cheyenne Mountain correlation facility during peacetime; however, during wartime, one center will be designated as prime for driving warning data to forward users. Protection against electromagnetic interference would be required to provide additional capability to switch

prime centers during a conflict, but that is not the minimum essential for a "mission ready" Cheyenne Mountain Upgrade program. If a change to the threat environment occurred that would make such protection a minimum essential requirement for tactical warning to the National Command Authorities, then additional funding might be required to provide it.

In regard to the "\$182 million more" needed for related costs, the Cheyenne Mountain Upgrade, like other phased acquisition programs, will have operational and maintenance costs. It will need interim maintenance and engineering support. The Cheyenne Mountain Upgrade subsystems will also need the biannual software updates to accommodate the constantly evolving Integrated Tactical Warning/Attack Assessment network. As in any other major program acquisition, the Cheyenne Mountain Upgrade will also incur operational test costs. The complete costs of the Cheyenne Mountain Upgrades acquisition, to include those related costs, were briefed to the Defense Acquisition Board. All the costs have been programmed for, and are funded through, the usual Operations & Maintenance, Automated Data Processing, and Operational Test & Evaluation line items in the President's Budget.

In response to the potential cost impacts associated with the Survivable Communications Integration System, the DoD concurs with the GAO that development test results to date show the Survivable Communications Integration System central processor is undersized to meet system performance requirements. While it is true an upgrade to current hardware or a move to a new hardware architecture is apparently essential and will be costly, it has not yet been determined what part of the additional cost will be a Government liability. Although specifications on some of the Survivable Communications Integration System processing requirements have been clarified since contract award in August 1986, it remains the contractor responsibility to provide the hardware and software systems to meet those requirements. It is, therefore, premature to conclude that the Government will incur a cost increase to the overall Cheyenne Mountain Upgrade program until the specific contractual remedies have been completed and have been assessed fully by the Air Force in the context of the total Cheyenne Mountain Upgrade baseline costs.

- **FINDING D: Costs For Implementing New Protocols And Correcting Integration Problems Not Included.** In addition to the costs discussed in Finding C, the GAO also identified other costs that have not been included in the \$1.58 billion cost for the Cheyenne Mountain Upgrade program reported to the Congress. As one example, the GAO noted that at least \$26 million, which will be required to convert subsystems from existing to Open System Interconnection protocols, was not included. The GAO explained that, although the protocols were adopted in January 1988 as the standard for all the subsystems, in August 1988, the Air Force decided to postpone their implementation until after they begin operating at Cheyenne Mountain. According to the GAO, its analyses indicated that the effort to migrate from current protocols to a new protocol standard will be complex and costly--and will require careful software engineering. The GAO noted that, in 1988, the Air Force requested \$26 million for the protocol conversion, but did not pursue the effort, due to funding constraints--and because it would cause an estimated one year schedule delay. The GAO concluded that the conversion may be more costly than the Air Force anticipates. The GAO also concluded that deferring the requirement means

the Air Force is investing time and money implementing current protocols, when it will only discard them later.

In addition to the protocol costs, the GAO reported that since the \$1.58 billion estimate was established, the Air Force had also identified 11 new subsystem integration problems. The GAO estimated that resolving eight of those problems could cost about \$18 million. The GAO concluded that the examples of omitted costs further illustrate that the reported \$1.58 billion Cheyenne Mountain Upgrade Program cost estimate is seriously understated. The GAO also concluded that, because the Air Force continues to identify new system integration problems as the Program proceeds, total Program costs could go even higher than the \$1.9 billion the GAO is now estimating. (p. 2, p. 6, pp. 8-9, p. 10/GAO Draft Report)

DOD RESPONSE: Partially concur. As indicated in the DoD response to Finding C, all costs necessary to acquire and install a "mission ready" Cheyenne Mountain Upgrade have been identified. The following provides clarification regarding the specific examples cited by the GAO:

The Air Force decided not to move to the Open Systems Interconnection DoD costandard protocol in 1989, due to operational, cost and schedule risks. The Air Force decided to use the well-proven costandard until after the Cheyenne Mountain Upgrade achieves its Full Operational Capability in 1996. Although the Open Systems Interconnection protocol is the new standard for the DoD, it is in the process of being enhanced by the National Institute of Standards and Technology. Implementing Open System Interconnection protocols would have increased cost and schedule risks significantly. As the GAO cites, an early cost estimate for switching to Open System Interconnection protocols was \$26 million. However, a September 1990 report, commissioned by the Air Force, put the probable cost now at \$9 million. The Air Force plans to switch to the Open System Interconnection protocols through a Pre-Planned Product Improvement effort after 1996. The plan will be reviewed periodically to insure that transition to the Open System Interconnection protocols can occur, while still meeting operational mission needs and also be cost-effective.

Concerning the subsystem integration issues referenced by the GAO, the DoD concurs that system integration issues must be carefully managed in a system as complex as the Integrated Tactical Warning/Attack Assessment System. In fact, the 1989 Defense Acquisition Board reviewed and approved the Air Force plan for an Integrated Tactical Warning/Attack Assessment systems engineering effort to address integration issues. The Defense Acquisition Board approved the Air Force proposed Systems Engineering effort and directed the Air Force to insure it was fully funded to preclude major problems from going undetected and/or unresolved within this complex "system of systems." Funding is currently available in the Cheyenne Mountain Upgrade baseline for the intra-system concerns. It is identified as project 3880 in Program Element 0102310F. Other funding is programmed for any additional integration problems that may arise between the Cheyenne Mountain Upgrade program and the other Integrated Tactical Warning/Attack Assessment subsystems. Those funds are programmed in project 3881 in the same Program Element.

- **FINDING E: Some Subsystem Requirements Have Been Deferred.** The GAO found that the Air Force has adopted a strategy of deferring some subsystem requirements on the optimistic assumption that they can be achieved during

later stages of system development. As an example, the GAO reported that, to keep the Granite Sentry Program within the approved program cost and schedule, the Air Force delayed meeting some requirements until later program phases. The GAO found that, in August 1990, the Air Force Space Command Requirements Review Council for the System approved 19 deferrals to the phase II contract requirements. According to the GAO, four of those requirements were initially deferred from phase I into phase II--and have now been deferred to phase IV. The GAO also found that the Air Force has not yet evaluated formally the effects on cost and schedule--or the risks associated with deferring subsystem requirements.

While acknowledging such deferrals may permit the Air Force to meet revised near-term goals, the GAO concluded that such deferrals also mask the magnitude of total program cost and schedule problems. Overall, the GAO questioned whether it is prudent to follow a practice of deferring System requirements to meet near-term cost and schedule goals, since that approach moves development efforts to later stages of the program and increases the workload that must be completed at that time. The GAO concluded that the deferral strategy raises the risk significantly that the complete System will not be delivered on time and within cost. (p. 2, p. 9, p. 10/GAO Draft Report)

DOD RESPONSE: Partially concur. All changes to current Tactical Warning/Attack Assessment systems are reviewed monthly by a rigorous configuration management process between the Air Force Space Command and the Air Force Systems Command for acquisition program impact. Twice a year the Air Force Space Command and Air Force Systems Command minutely scrutinize the required program for any changes against the programmed budget and schedule. Through the establishment of the program baseline for the Cheyenne Mountain Upgrade program, the quarterly Defense Acquisition Executive Summaries, and the quarterly reviews by the Integrated Tactical Warning/Attack Assessment System Executive Manager, the DoD has taken action to reduce the risk that total program cost and schedule goals can be masked effectively.

* * * * *

RECOMMENDATIONS

- **RECOMMENDATION 1:** The GAO recommended that the Secretary of Defense ensure that the total costs to develop and deliver a fully functional, mission-ready Cheyenne Mountain Upgrade System be reported to Congress in a quarterly Selected Acquisition Report for March 31, 1991. The GAO further recommended that those costs should include the costs for (1) completing all requirements, (2) completing all testing, (3) maintaining the delivered portions of the System until a complete mission-ready system is operational, and (4) correcting integration problems. (pp. 10-11/GAO Draft Report)

DOD RESPONSE: Concur. The Air Force briefed the total program costs to the Defense Acquisition Board in 1989 as \$1,580 million for program acquisition and \$190 million for additional life cycle costs to support the acquisition. Since

then, the program has been executing to that baseline. Due to the questions raised by the GAO concerning the proper disclosure of all related costs, the Air Force will review the content of the Selected Acquisition Report to verify its completeness and to assure that future Selected Acquisition Reports for the Cheyenne Mountain Upgrade System are prepared in accordance with established Selected Acquisition Report guidelines. In addition, to provide further insight (as discussed in the DoD responses to Findings C and D) the Air Force will provide the Congress with a special report that aggregates all Cheyenne Mountain Upgrade related life cycle costs (operations, maintenance, test, software support, etc.) in the President's Budget. The special report will be provided to the Congress in July 1991.

- **RECOMMENDATION 2:** The GAO recommended that the Secretary of Defense direct the Secretary of the Air Force to assess the cost, schedule and performance risks to the overall program; from deferring subsystem requirements to later stages of system development, and to report the results of that assessment to congressional appropriations and oversight committees. (p. 11/GAO Draft Report)

DOD RESPONSE: Concur. The Air Force already assesses the impact of changes to the acquisition program twice a year in rigorous reviews between Air Force Space Command and Electronics Systems Division. To ensure full program visibility, however, the Air Force will (1) develop a summary of changes to the cost, schedule, or performance requirements of the Cheyenne Mountain Upgrades that have occurred since the September 1989 Defense Acquisition Board review and will (2) provide that summary report to Congress by July 1991.

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Related GAO Products

Attack Warning: Defense Acquisition Board Should Address NORAD's Computer Deficiencies (GAO/IMTEC-89-74, Sept. 13, 1989)

Attack Warning: Better Management Required to Resolve NORAD Integration Deficiencies (GAO/IMTEC-89-26, July 7, 1989)

Space Defense: Management and Technical Problems Delay Operations Center Acquisition (GAO/IMTEC-89-18, Apr. 20, 1989)

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

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