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United States General Accounting Office

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

July 1992

ATTACK WARNING

Status of the Survivable Communications Integration System

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Information Management and
Technology Division

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July 9, 1992

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

Dear Mr. Chairman:

This report responds to your request for information on the Department of the Air Force's acquisition of the Survivable Communications Integration System (SCIS). Specifically, you asked for information on program cost and schedule overruns, and the status of design and development activities that affect SCIS' ability to satisfy the Department of Defense's attack warning and attack assessment communications requirements. Earlier this year, we briefed your staff on the results of our review. This report provides the details of that briefing. Appendix I contains our objectives, scope, and methodology, briefing charts, and explanatory narrative for each chart.

Background

SCIS is planned to be an automated communications system that will process and simultaneously send missile attack warning messages across different media to national decision makers. The system is being built as part of the Cheyenne Mountain Upgrade program to modernize the Integrated Tactical Warning and Attack Assessment system, which is used to support information processing needs for the North American Aerospace Defense Command (NORAD). NORAD is responsible for warning United States and Canadian leaders that North America is under attack. The command and control center for NORAD is the Cheyenne Mountain Air Force Base, Colorado, which houses data processing and communications equipment supporting the tactical warning and attack assessment mission.

Existing space- and ground-based sensor technology enables NORAD to identify missiles launched from anywhere in the world. Currently, if missiles are launched, warning information can be sent over 1 of 2 communication media—commercial high speed telephone lines (CHS) or the Jam Resistant Secure Communications (JRSC) satellite system—as discrete messages to Cheyenne Mountain and other command centers. Discrete messages contain information about each missile or warhead observed by the sensors, including launch time, latitude, longitude, and predicted location and time of impact. Once received at Cheyenne Mountain, the information is further processed and disseminated to various National Command Authority locations for use in defending our continent.

The current system cannot send messages concurrently over both media—a limitation that influenced the Air Force to develop a more survivable system, one that can send messages over many media at the same time. That system is SCIS. It is being designed and developed to process missile attack warning messages and provide highly-survivable communications through the use of multiple communications media over which messages will be sent concurrently, thus increasing the likelihood that attack messages will be received even if one or more media become inoperable. SCIS also will create summary messages, a grouping of discrete messages processed at regular time intervals, which provide general information such as the total number of missiles launched, the number of launches from each launch area, the number of missiles expected to hit different areas, and the initial predicted time of impact for each target area.

Results in Brief

Management and development problems with the SCIS program have contributed to a 65-percent increase in program costs (from $142 million to $234 million) and a 3-year delay in completion (from 1992 to 1995). After working on SCIS for 4 years, the prime contractor was unable to deliver a system that could process sensor data fast enough to meet Air Force specifications. To help solve the problem, the Air Force is allowing the contractor to replace the computer platform, for the second time at government expense, with a faster, more powerful model.

Further, the Air Force has reduced the number of communications media to be used from five to three, thus reducing its survivability—a key factor for its justification. Of the three remaining media, two (CHS and JRSC) are already available for communicating missile warning messages; the third (MILSTAR) is not expected to be operational until several years after SCIS is delivered.

According to the Air Force, CHS in all likelihood will be the first medium to go down during a nuclear attack. If a nuclear confrontation should occur before MILSTAR becomes operational, JRSC will be the only medium available to transmit attack warning messages.

As requested, we did not provide a draft of this report to the Department of Defense for review and comment. Instead, we discussed the information contained in it with appropriate Defense and contractor program officials including the Director, Strategic and Theater Nuclear Forces for Command, Control, and Communications and the Cheyenne Mountain

Upgrade Program Monitor. These officials generally agreed with our facts, and we incorporated their views where appropriate. We performed our work in accordance with generally accepted government auditing standards, from June 1991 to June 1992.

We are providing copies of this report to the Secretary of Defense; the Secretary of the Air Force; the Director, Office of Management and Budget; appropriate House and Senate Committees; and other interested parties. We will also make copies available to others upon request. Should you have any questions about this report, please contact me at (202) 512-6240. The major contributors to this report are listed in appendix II.

Sincerely yours,

Samuel W. Bowlin
Director, Defense and Security
Information Systems

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Abbreviations

AFSATCOM	Air Force Satellite Communications
CHS	commercial high speed telephone lines
GAO	General Accounting Office
GWEN	Ground Wave Emergency Network
IMTEC	Information Management and Technology Division
JRSC	Jam Resistant Secure Communications
MILSTAR	Military Strategic Tactical and Relay Satellite Communications
NORAD	North American Aerospace Defense Command
SCIS	Survivable Communications Integration System

GAO **Introduction Objectives/Scope/Methodology**

Objectives
- Provide information on program cost and schedule; identify design and development deficiencies

Scope and Methodology
- Interviewed program and contractor officials and reviewed and analyzed applicable documents

Objectives, Scope, and Methodology

The Chairman, Subcommittee on Defense, House Committee on Appropriations, requested that we obtain information on the status of SCIS' program costs and completion schedule, and on design and development deficiencies that may affect SCIS' ability to communicate critical missile warning messages.

We obtained cost and schedule documentation from the Air Force's Electronic Systems Center and from the SCIS Program Element Monitor in Washington, D.C. Information on design and development deficiencies was obtained by interviewing program officials and reviewing applicable documentation from (1) the U.S. Space Command, the user of the system; (2) the Air Force Space Command, the operator of the system; (3) the Electronic Systems Center, the Air Force acquisition component responsible for designing, developing, and acquiring the system; and (4) the ECI Division of E-Systems, Inc., the prime contractor.

We performed our work at Air Force headquarters, Washington, D.C.; U.S. Space Command and Air Force Space Command, Colorado Springs, Colorado; Air Force Materiel Command's Electronic Systems Center, Hanscom Air Force Base, Bedford, Massachusetts; Carnegie Mellon's Software Engineering Institute, Pittsburgh, Pennsylvania and the Mitre Corporation, Bedford, Massachusetts, which provide engineering support to the Electronic Systems Center; and the ECI Division of E-Systems, Inc., St. Petersburg, Florida, the prime contractor for building the SCIS.

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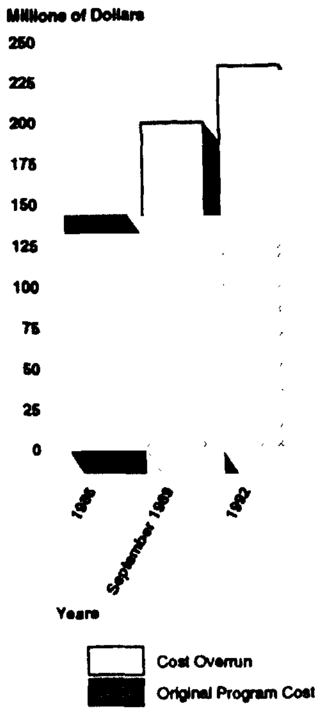
Program Status–SCIS Cost Overrun

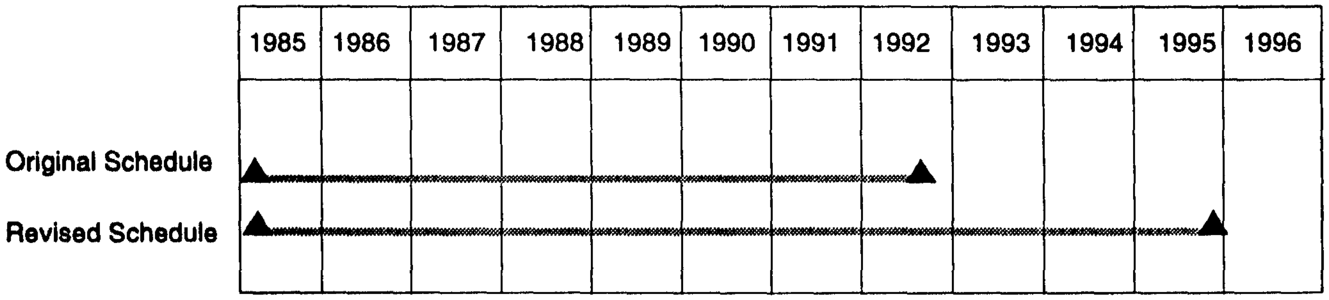


SCIS Cost Overrun

In 1986 the Congress approved the development of SCIS. The estimated cost for the program at that time was $142 million. Since that time, costs have steadily escalated. In September 1989, the Air Force told Defense it would need $187 million to complete the program. However, according to Air Force records, this estimate did not include costs for operations and maintenance, system testing, and for final review and acceptance by the Air Force. At that time, including these costs would have brought the total estimated cost for the program to $199 million—an increase of $57 million over the original estimate.

By 1992 costs rose to $234 million (a $92 million increase over the original cost estimate). This increase was primarily to cover the cost of acquiring a faster, more powerful computer platform and for either reworking existing software or for writing new software for use on the new platform. A new platform was necessary because the computer used in the original design was unable to satisfy revised message processing work loads and other quantitative performance requirements.

GAO Program Status–SCIS Schedule Slip



SCIS Schedule Slip

The Air Force originally planned to achieve full operational capability for this system in September 1992. This date has now slipped to November 1995. Some reasons for this program slip, discussed later in this report, include (1) prematurely selected computer hardware that was replaced with larger, more powerful models and (2) the Air Force's decision to redefine missile warning message requirements.

GAO Program Status–Prematurely Selected Hardware

	1985	1986	1987	1988	1989	1990	1991
Original Schedule							
Start	▲						
Preliminary Design Review			▲				
Critical Design Review				▲			
SCIS Hardware Selection							
Tolerant 032		▲					
Tolerant 332					▲		
DEC FT 410							▲

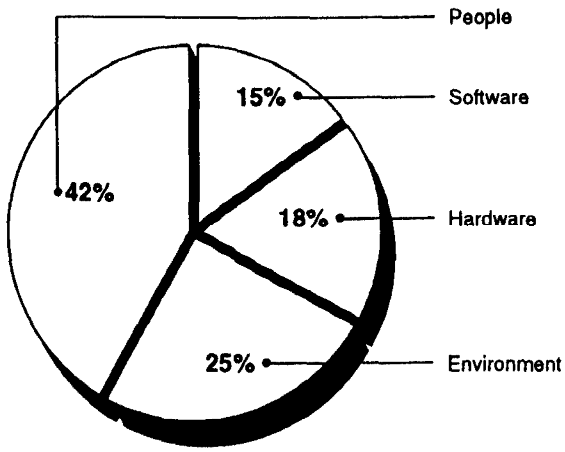
Prematurely Selected Hardware

In August 1986, the Air Force contracted with the ECI Division of E-Systems, Inc., to build SCIS based on a design that used Tolerant Model 032 computers. This design was approved by the Air Force at two key program decision points—preliminary design review in August 1987 and critical design review in January 1988. These reviews are typically done during the early stages of system development to provide assurance that the system being built will satisfy program requirements.

However, the Air Force did not validate all requirements and determine the system's processing work load prior to these design reviews. Despite this, the Air Force allowed the contractor to proceed with the program. In January 1990, 2 years after critical design review, the Air Force determined that SCIS was being built to process a work load significantly less than that needed to satisfy mission requirements. The Air Force then directed the contractor to build SCIS to process a message work load based on 50 percent of missile launches from known launch sites and 50 percent from unknown launch sites. The originally approved design expected only 5 percent of missile launches to be from unknown launch sites. Messages on missiles launched from unknown sites require significantly more computer processing capabilities than those on missiles launched from known sites.

Failure to define requirements and determine the processing capability needed has resulted in two replacements of the computer hardware. The Tolerant Model 032 was upgraded to a Tolerant Model 332 in February 1989; and in November 1991, that equipment was replaced with a Digital Equipment Corporation Model FT410. Air Force analyses conducted after the Tolerant upgrade revealed that the hardware could not process all required data and could not process the data fast enough to meet system requirements.

GAO **Program Status–Sources of Fault Tolerant System Outages**



Sources of Fault Tolerant System Outages

E-Systems, Inc., is designing and building a fault-tolerant system, that is, one that will be available most of the time. While the Air Force would like the system to run continuously, it recognizes that there will be a certain amount of down time (the estimated amount of down time is classified). According to Digital Equipment Corporation studies, system failures in fault-tolerant systems are caused by hardware problems 18 percent of the time; software errors 15 percent of the time; human error 42 percent of the time; and problems with the environment (for example, cooling or electrical failures) 25 percent of the time.

In November 1991, when E-Systems, Inc., changed hardware platforms to Digital Equipment Corporation processors, its analysis confirmed that the new hardware would meet the operational availability required in the system specification. However, E-Systems' analysis only considered down time caused by hardware problems. Since hardware problems are responsible for only a relatively small percentage of system failures, the Air Force cannot be certain of SCIS availability until an analysis is performed that includes all causes for system failures.

E-Systems is developing a model to revalidate system availability. This model is being designed to assess the impacts from hardware failures and operating system and application software errors. It does not consider impacts from errors in the communications system software or from down time caused by human error and problems with the environment.

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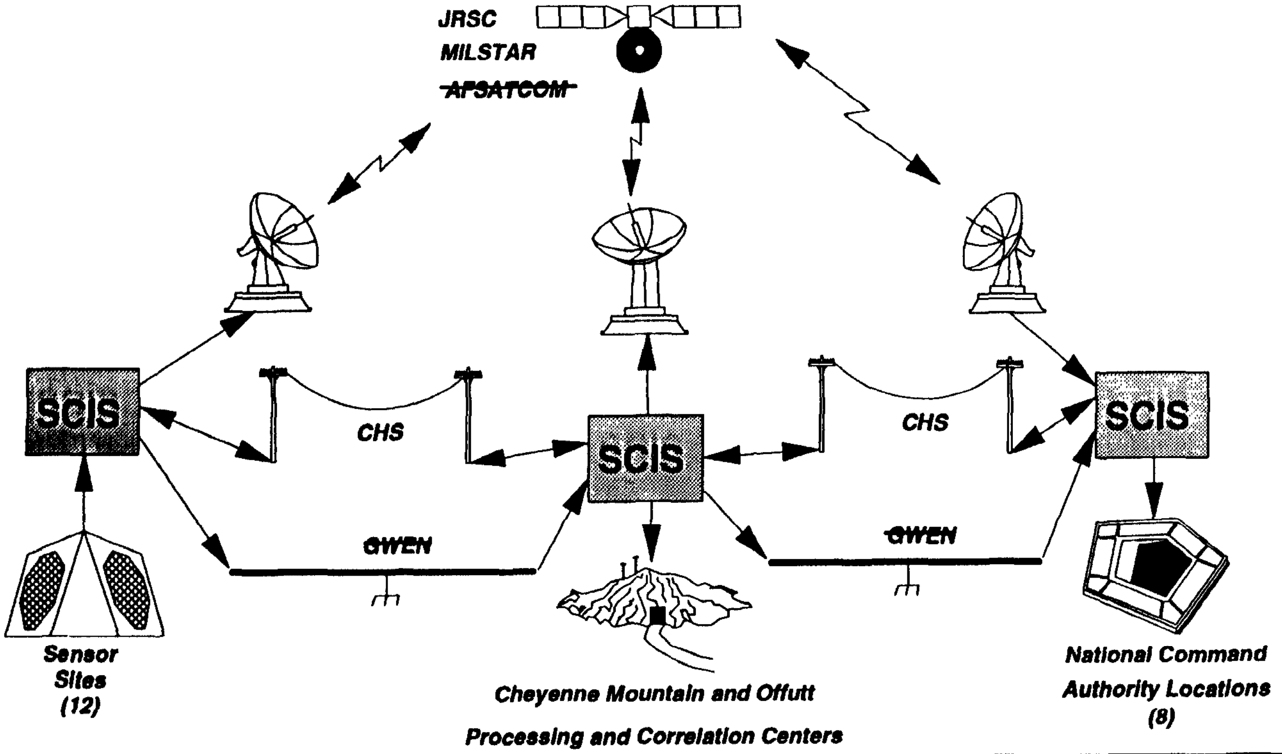
Program Status—Reductions in SCIS Communications Media



Reductions in SCIS Communications Media

SCIS was designed and justified to the Congress as a system to process and simultaneously transmit missile attack warning messages over multiple communication media among sensors, the Cheyenne Mountain Air Force Base and the Offutt Processing and Correlation Center, and several National Command Authority locations. Current missile attack warning messages are transmitted over one of two available communications media—commercial high-speed telephone lines (CHS) or the Jam Resistant Secure Communications (JRSC) satellite system—messages cannot be sent over both media at the same time. Under the original SCIS concept, all missile warning messages would be simultaneously transmitted over five media—the two mentioned above and the Military Strategic Tactical and Relay Satellite Communications (MILSTAR) system, the Air Force Satellite Communications (AFSATCOM) system, and the Ground Wave Emergency Network (GWEN). This approach was thought to enhance survivability because some media would continue to transmit messages even if others were destroyed.

In September 1991, the Air Force decided not to use two of the media. AFSATCOM was dropped because it is highly susceptible to jamming and will not be able to communicate when nuclear weapons are exploding. GWEN was eliminated because other higher priority messages preempted its availability to send missile attack warning information and because its area of coverage is limited to the continental United States. SCIS is now being designed to broadcast messages on three media. Two—CHS and JRSC—are currently used to communicate missile warning information. The third, MILSTAR, is Defense's next-generation satellite communication system and is expected to be operational several years after SCIS is delivered.

Air Force program management officials from the Electronic Systems Division told us that there are no other communication media available and that CHS, JRSC, and MILSTAR will be able to do the job. However, these officials also told us that CHS is the least survivable media and in all likelihood would be the first to go down during a nuclear missile attack. Under this scenario, the Air Force will only have JRSC to provide missile attack warning messages until MILSTAR becomes operational.

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