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Washington, DC 20548

September 12, 2007

The Honorable Bill Nelson
Chairman
The Honorable Jeff Sessions
Ranking Member
Subcommittee on Strategic Forces
Committee on Armed Services
United States Senate

The Honorable Ellen O. Tauscher
Chairwoman
The Honorable Terry Everett
Ranking Member
Subcommittee on Strategic Forces
Committee on Armed Services
House of Representatives

The Honorable Silvestre Reyes
House of Representatives

Subject: *Space Based Infrared System High Program and its Alternative*

The U.S. relies on infrared satellites to provide early warning of enemy missile launches and protect the nation, its military forces, and allies. In 1996, the Department of Defense (DOD) initiated the Space Based Infrared System (SBIRS) program to replace the nation's current missile detection system and provide expanded capabilities to support intelligence, surveillance, and reconnaissance missions. DOD expected to field SBIRS by 2004 at a cost of about $4.2 billion. However, over the past 11 years, SBIRS has proven to be technically challenging and substantially more costly. In an effort to stem cost increases and schedule delays, DOD has restructured the program multiple times, including revising program goals.[1] SBIRS is now estimated to cost over $10.4 billion, and the first satellite launch is expected in 2008. Because of continuing problems with SBIRS, DOD began a parallel alternative effort in 2006 known as the Alternative Infrared Satellite System (AIRSS), to compete with SBIRS and ensure that the nation's missile-warning and defense capabilities are sustained, or possibly provide a follow-on capability to SBIRS.

You requested that we assess both SBIRS and AIRSS. As agreed with your office, with respect to SBIRS, we focused on the extent to which DOD is prepared to deliver the first two SBIRS satellites within revised cost, schedule, and performance goals. With respect to AIRSS, we examined the adequacy of DOD's decision to proceed with AIRSS as an alternative to SBIRS as well as whether DOD is attaining

[1] DOD restructured the program, to include setting new cost and schedule goals, in 2002, 2004, and 2005.

the knowledge it needs to position the program for success. To address these objectives, we reviewed schedule and funding information and performed our own analysis of cost and schedule projections using the contractor's 2006 cost performance report data. We also examined the resources committed and planned as well as users' needs for the competing effort. We presented our preliminary findings on SBIRS and AIRSS in briefings to your staffs in March 2007. This letter transmits the information provided in that briefing. We conducted our work between August 2006 and March 2007 in accordance with generally accepted government auditing standards. A copy of the briefing is enclosed.

Results in Brief

Over 12 months after its restructuring, SBIRS still faces challenges in meeting cost, schedule, and performance goals—particularly relating to the development of spacecraft and ground system software. At the time of our review, for example, spacecraft software development efforts were behind schedule by as much as 32 percent. Moreover, management reserves—designed to cover unanticipated work—were being depleted at a much higher rate than anticipated. In addition, DOD has not adequately justified its decision to proceed with AIRSS, and there is disagreement within the department on the purpose and scope of the program. DOD has also not adequately positioned the program for success. For example, a demonstration satellite is not being planned in a way that would maximize DOD's ability to incorporate knowledge gained into the AIRSS program. Based on these findings, we recommend that DOD reexamine the AIRSS program. DOD concurred with our findings and recommendation.

Background

DOD initiated the SBIRS program to meet all military infrared surveillance requirements through a single, integrated system and to provide better and timelier data to the Unified Combatant Commanders, U.S. deployed forces, U.S. military strategists, and U.S. allies. SBIRS is to replace the existing infrared system, the Defense Support Program (DSP), which has provided early missile warning information since the 1970s. The SBIRS program was originally conceived as having high- and low-orbiting space-based components and a ground segment for mission data processing and control to improve current capabilities. However, in 2001, the SBIRS Low component was transferred from the Air Force to the Missile Defense Agency and renamed the Space Tracking and Surveillance System. The Air Force continued developing SBIRS High (herein referred to as "SBIRS"). It, along with its associated ground segment, is one of DOD's highest priority space programs. Originally, SBIRS consisted of four satellites in geosynchronous earth orbit (GEO), two infrared sensors placed on separate host satellites in highly elliptical orbit (HEO)—known as "HEO sensors"—and a ground segment for mission-data processing and control. The Air Force also had planned to acquire a fifth GEO satellite to serve as a spare that would be launched when needed.

Since its inception, SBIRS has been burdened by immature technologies, unclear requirements, unstable funding, underestimated software complexity, poor oversight, and other problems that have resulted in billions of dollars in cost overruns and years in schedule delays. These problems have been documented in GAO reports as well as independent teams chartered by DOD.[2] In addition, the program has been

[2] GAO, *Defense Acquisitions: Despite Restructuring, SBIRS High Program Remains at Risk of Cost and Schedule Overruns*, GAO-04-48 (Washington, D.C.: Oct. 31, 2003) and GAO, *Defense Acquisitions: Assessments of Selected Major Weapon Programs*, GAO-07-406SP (Washington, D.C.: Mar. 30, 2007). *Report of the Defense Science Board/Air Force Scientific Advisory Board Joint Task Force on Acquisition of National Security Space Programs*, (May 2003) (also referred to as the "Young Panel report") and the July 2004 update to this report. Space-Based Infrared System Independent Review Team, Final Report, February 2002.

restructured several times to account for cost and schedule problems. The Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics (USD (AT&L)) directed the Air Force to begin parallel efforts to develop a viable competing capability for SBIRS, referred to as AIRSS. USD (AT&L) identified three overall objectives for AIRSS:

- motivate successful execution of the SBIRS program by initiating a viable competing capability;
- pursue an alternative approach, with acceptable technical risk that offers DSP-like missile warning capability to ensure current capabilities are sustained, if SBIRS GEO falters; and
- develop a next-generation SBIRS system to meet worldwide surveillance requirements by initiating efforts for technology risk reduction, system definition, and evaluation of alternative sensor architectures.

In 2006, the Air Force completed studies that provided recommendations for technology development, a road map for inserting those technologies, options for future infrared systems that offer the potential to improve the performance and reduce the cost of SBIRS, and an acquisition strategy for AIRSS. In 2006, program officials awarded contracts that aim to advance key technologies and capabilities. USD (AT&L) directed the Air Force to have the first AIRSS satellite available for launch no later than May 2015. The Air Force has budgeted over $3.3 billion for AIRSS, from fiscal year 2007 through 2013.

Space Based Infrared System

Although the Air Force has acted to reduce risks in the SBIRS program and has had some recent successes, the program still faces risk of not delivering promised capabilities within its revised goals. To reduce risk, the SBIRS program cut back on quantity and capability in the face of escalating costs. It deferred capabilities, such as mobile data processors for the Air Force and the Army and a fully compliant backup mission control facility, and it pushed off a decision to procure the third and fourth satellites. The Air Force also concurrently initiated AIRSS as a secondary means of achieving the same capability. However, about 11 months after the most recent SBIRS program's restructuring, a November 2006 assessment report by the Defense Contract Management Agency (DCMA) showed that some efforts within the program were experiencing significant cost increases and schedule overruns and that the outlook is worsening. Furthermore, the program is rapidly spending its management reserves—funds set aside to address unexpected problems.

DCMA projected additional cost increases in some areas, including satellite sensor and software development as well as satellite integration, test, and assembly. Our analysis of data from the contractor's cost performance reports shows that some of these areas have been particularly problematic and are still exceeding cost and schedule goals, even after the program's recent restructuring. For example, we estimate that the cost of the satellite's pointing and control assembly will increase about $25 million by the time its fabrication is complete. Although the program has put into place strategies for deferring work that can be completed at a later time—thereby reducing cost and schedule risks—some work cannot be deferred. For example, some software development activities for the satellite's pointing and control assembly can be completed at a later date. However, all of the software related to the satellite's flight system must be completed before launch. In addition, DCMA program assessment reports through November 2006 indicated that efforts to develop software are significantly behind schedule. In particular, efforts to develop software for the spacecraft lagged behind schedule—by as much as 32 percent. Furthermore, due to the growing amount of rework resulting from unresolved software discrepancies, DCMA estimated that further schedule slips in software delivery are likely to occur. During our review, program officials acknowledged that some of the problems identified by DCMA were still an issue.

In addition, the contractor's management reserve, which is supposed to last through 2012, has decreased from about $232 million to $166 million (about 28 percent) within a span of about 7 months, indicating that unexpected problems continue to emerge. For example, additional development and testing for spacecraft software and issues with the satellite sensors have necessitated additional expenditures. Our analysis shows that if this expenditure rate continues, an additional $500 million, or more, will be required through September 2012. In addition, the program has deferred needed capabilities to meet cost and schedule goals, but the costs associated with these capabilities are not part of the program's total cost estimate. The cost associated with fully fielding these capabilities is estimated to be about $491 million.

Alternative Infrared Satellite System

In reviewing DOD's decision to pursue AIRSS, we found that USD (AT&L) established objectives for the program that were incompatible given the time frame and budget to complete the work under each objective. One was to solely ensure current missile-warning and defense capabilities are sustained, and the other was to develop the next generation of missile-warning and defense systems. The first would require DOD to pursue a low-risk technology path in order to deliver capability quickly. The second would require DOD to advance technologies and/or design and, thus, budget more time for knowledge building in advance of an acquisition program. In other words, one objective served as an insurance policy for SBIRS; the other was a major effort to advance the way DOD detects missile launches.

Subsequently, USD (AT&L) never clarified what was wanted from the program, and the Air Force, in turn, set out to develop advanced capabilities. Moreover, we found that there was disagreement within OSD as to whether the approach being pursued for AIRSS was the only and/or best option available to the Air Force. For example, DOD's Cost Analysis Improvement Group as well as Program Analysis and Evaluation staffs expressed concern that the focus on developing technology would hinder delivery of an AIRSS satellite available for launch in 2015. During our review, it also became evident that AIRSS could not realistically serve as a back-up to SBIRS because the proposed satellite delivery schedule is very aggressive for meeting the 2015 launch availability date, according to AIRSS program officials.

In addition, in its effort to pursue advanced capability, the Air Force has not positioned the AIRSS program for success. First, in our opinion, not enough time is budgeted for developing and launching the first satellite. At the direction of USD (AT&L), the Air Force set 2015 as the launch date for the first satellite. Our assessment found the period planned between "preliminary design"review and "critical design" review for AIRSS is shorter than for most other major space programs.[3] Specifically, the program is allowing only 12 months from preliminary to critical design review, and 4 years from critical design review to satellite delivery. By contrast, the SBIRS High program took 44 months from preliminary design review to critical design review. Two newer programs, Space Radar and Transformational Satellite Communications System (TSAT), have planned for 16 and 27 months respectively. AIRSS Program officials acknowledged that the current time frame is very optimistic.

Second, the AIRSS program may be optimistic in its assumptions about technology risk. The program's schedule shows critical technologies reaching a high level of maturity at program start, and most are

[3]Preliminary design review determines whether preliminary designs are complete and if the program is prepared to start detailed design and test procedure development. Critical design review assesses the systems final design, and according to GAO best practices, at least 90-percent of engineering drawings should be completed to provide tangible evidence that the design is stable.

now rated at a technology readiness level of 5 or higher—meaning that the basic components have been integrated with reasonably realistic supporting elements in order that the technology can be tested in a simulated environment. These readiness levels are comparatively higher than other satellite programs we have reviewed. However, we found that the program was still facing considerable technical risk since it is working to build an infrared telescope with a large viewing capability that has never before been developed and it is planning to use "cryocoolers" that have yet to demonstrate low levels of jitter, high efficiency, and long life, and a sensor chip whose assembly's performance level has yet to be verified.[4]

Third, the Air Force's research laboratory officials have stated that on-orbit testing is the only way to validate the proposed capability for AIRSS and reduce risk to an acceptable level. To achieve these results, the Air Force is proposing to launch a small-scale demonstration satellite in late 2010. However, the results from the on-orbit demonstration satellite will not be ready in time to fully inform the development of the first AIRSS satellite. Furthermore, AIRSS officials plan to award contracts for the first satellite before data from on-orbit testing is completed. Our analysis shows that if the tests do not go well, DOD will not have time to return to an approach using lower-risk technology.

Conclusion

SBIRS continues to face risks that endanger DOD's ability to sustain, replace, and expand its current missile-warning and defense capabilities. Moreover, the program still has complex and difficult work ahead as it undertakes efforts to integrate technology. Recognizing these risks, the Office of the Secretary of Defense made a sound decision in pursuing the AIRSS program to act as an alternative to the third SBIRS GEO satellite. However, the program has since diverged from this purpose and opted to pursue a higher risk effort in order to advance capability. Moreover, the Air Force has added risk to this effort by compressing the schedule and limiting the knowledge gained from the demonstration effort. While it is acceptable in any given portfolio to take some high risks, it is not sound for all investments to be high risk—particularly when the capability is as critical to the conduct of military operations as the mission-warning capability is.

Recommendation

We recommend that the Secretary of Defense direct the Under Secretary of Defense for Acquisition, Technology, and Logistics to reassess its investment in AIRSS and alternative ways of reducing the risk posed by the SBIRS program, to more confidentially assure that current missile-warning and defense capabilities are sustained.

Agency Comments and Our Evaluation

We provided draft copies of this letter to DOD for review and comment. DOD concurred with our findings and recommendation. DOD's letter is reprinted as Enclosure I.

Scope and Methodology

[4]"Cryocoolers" are refrigeration devices used to reach cryogenic temperatures, or very low temperatures (below –238 °F, –150 °C, or 123 K). Cryogenic refrigeration technology for satellites enables the performance of onboard infrared sensors to enhance missile detection, conduct intelligence gathering, and enable space situational awareness.

To determine the SBIRS program's ability to meet cost and schedule projections, we examined schedule and funding information for developing hardware and software. We reviewed formal program reviews and DCMA and contractor-performance reports. In addition, we performed our own analysis of cost and schedule projections using the contractor's, Lockheed Martin Space Systems Company, 2006 cost performance-report data. To determine the potential problems and risks relating to cost, schedule, and performance that are still facing the SBIRS program, we reviewed technical reports and program briefings and held discussions with program and contractor officials regarding ongoing challenges.

To assess efforts in attaining the knowledge DOD needs before the start of a competing effort, we examined the resources (technology, communications infrastructure, and funding) committed and planned for the competing effort as well as the users' needs for the competing system. We considered DOD's plans for maturing the critical technologies when we obtained technology-readiness information for each critical technology against best-practice standards to determine if technologies will be sufficiently mature when DOD plans to start product development. We also reviewed risk-management plans and concept-development information.

We will send copies of the correspondence to Department of Defense and interested congressional committees. We will also make copies available to others upon request. In addition, the report will be available at no charge on GAO's Web site at http://www.gao.gov.

Should you or your staff have any questions on matters discussed in this correspondence, please contact me at (202) 512-4841 or chaplainc@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this correspondence. Principal contributors to this report were Arthur Gallegos, Assistant Director; Maricela Cherveny; Claire Cyrnak; Jean Harker; Leslie Pollock; and Greg Campbell.

Sincerely yours,

Cristina Chaplain
Director
Acquisition and Sourcing Management

Enclosure I: Comments from the Department of Defense

OFFICE OF THE ASSISTANT SECRETARY OF DEFENSE
6000 DEFENSE PENTAGON
WASHINGTON, DC 20301-6000

NETWORKS AND INFORMATION INTEGRATION

August 31, 2007

Ms. Christina T. Chaplain
Director, Acquisition and Sourcing Management
U.S. Government Accountability Office
441 G. Street, NW
Washington DC 20548

Dear Ms Chaplain:

The Department agrees with comments to GAO Report No. 07-1088R, "Space Based Infrared System High Program and its Alternative," August 1, 2007. Consistent with the GAO recommendations, we are reassessing the Alternative Infrared Space System (AIRSS) and are likewise investigating alternative ways of reducing the Space Based Infrared System (SBIRS) risks.

One such example of the commitment to aggressively investigate alternative SBIRS risk reduction strategies is the Under Secretary of Defense for Acquisition, Technology and Logistics (USD(AT&L)) involvement in conducting quarterly program reviews to address cost, schedule, and performance issues with senior leadership across the Department and our industry partners. Additionally, the Acting USD(AT&L) has established a team of software experts under the Director, Defense Research and Evaluation (DDR&E) to assess the software development effort and assist the SBIRS Wing in minimizing programmatic risk.

The Department is also reexamining the AIRSS program to clarify program objectives and ensure our nation's missile warning and defense capabilities are sustained. It is expected these changes will be reflected in the Fiscal Year (FY) 2009 budget that will continue technology maturation for future space-based infrared applications. We look forward to continuing the close relationship the Department has with the GAO on space-based infrared systems.

Sincerely,

John R. Landon
Deputy Assistant Secretary of Defense
(C3ISR & IT Acquisition)

Enclosure II: Briefing Slides

Missile Detection Systems Development

SBIRS/AIRSS Briefing to Congressional Staff
Preliminary Findings
March 13, 2007

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Briefing Overview

- Due to extreme cost, schedule, and technical problems, DOD has recently restructured the Space Based Infrared System (SBIRS) High missile detection satellite program and undertaken a competing effort, known as the Alternative Infrared Satellite System (AIRSS), in order to ensure continuity of missile detection operations.

- Per requests by the Subcommittee on Strategic Forces, Senate Armed Services Committee and the Subcommittee on Strategic Forces, House Armed Services Committee and discussions with committee staff members, we assessed both SBIRS High and AIRSS.

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Briefing Overview

• Due to extent and significance of findings, we plan to brief first on SBIRS High, then on AIRSS

- SBIRS High
  - Background
  - Program Status
  - Objective
  - Results in Brief
  - GAO Findings
- AIRSS
  - Background
  - Program Status
  - Objectives
  - Results in Brief
  - GAO Findings
- Conclusions
- Scope and Methodology

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Background

- SBIRS High was undertaken in 1996 to improve DOD's missile detection/warning capabilities.
- The program has experienced schedule slips of at least 6 years and cost increases that have triggered legislative requirements to reassess and recertify the program several times—most recently in spring 2006.
- While DOD’s total program cost estimate was about $4.1 billion, it is now $10.4 billion—more than a 300 percent unit cost increase.
- Our reviews have attributed past problems to an acquisition approach that decreased oversight of contractors, technology challenges, and software development problems.

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Background: Space Based Infrared Systems

Capabilities

Legacy System: Defense Support Program (DSP)

- Missile Warning (with a classified Probability of Detection) for North America
- Detection and reporting of strategic and theater ballistic missiles and other infrared events of interest

In Development: SBIRS High

- DSP Successor
- Higher Sensitivity—Sees Dimmer Objects, More Often
- Taskable Sensor—Can do Many Missions at Once
- More Accurate Estimate of Missile Location—Including Launch Point and Impact Point

In Development: Space Tracking and Surveillance System

- Space Tracking and Surveillance System formerly called SBIRS Low
- Critical Element of the Ground-based Midcourse Defense — Managed by Missile Defense Agency
- Tracks Threat Missiles Through Entire Flight—From Launch to Intercept
- Sees Extremely Dim Targets—Can Track and Discriminate Objects That are Not Burning
- Inherent Capabilities Also Support Other Missions

MISSIONS	DSP	SBIRS H	STSS
MISSILE WARNING	X	X	o
MISSILE DEFENSE		X	X
TECHNICAL INTEL		X	o
BATTLESPACE CHARACTERIZATION		X	o

X – Primary Mission o – Offers Inherent Capability

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SBIRS High Program Status: Restructured Acquisition Strategy

- Restructured Acquisition Baseline
  - Up to 3 GEO satellites and 2 highly elliptical orbit (HEO) sensors on classified hosts
  - Milestone Decision Authority will decide whether to procure GEO 3 based on the performance of GEO 1
  - Worldwide system requirements can not be met with 3 GEO satellites--a constellation of 4 satellites is needed
    - A plan for follow-on missile warning satellites is needed
- December 2005 Acquisition Decision Memorandum (ADM)
  - Directs that maintaining schedule, even at the sacrifice of performance, should be the key to program management

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SBIRS High Program Status: Recent Program Accomplishments

HEO PAYLOAD

- Initial on orbit performance exceeding specifications

GEO PAYLOAD:

- 100% of GEO 1 payload components delivered and integrated
- September 2006: Completed Acoustic Testing

GEO BUS:

- 95% GEO 1 bus components delivered and integrated
- August 2006: Completed Spacecraft Functional Testing
- December 2006: Began First-time Thermal Vacuum Testing

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Objective: SBIRS High

- **Determine to what extent DOD is prepared to deliver the first two SBIRS satellites within cost, schedule and performance goals.**

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Findings: SBIRS High

- In brief, we found that SBIRS High continues to face substantial risks as it enters what is perhaps the most difficult phase of development—integration. Even though the program has just recently been restructured, management reserves[1] are being spent at higher than anticipated rates, and cost and schedule variances are deteriorating.
- Faces challenges in meeting cost and schedule goals
- Total program cost not fully accounted for
- Faces challenges in software development

[1]A management reserve budget is an amount of the total allocated budget withheld by contractors for management control purposes.

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Finding:
Challenges to Meet Cost and Schedule Goals

- SBIRS High program not meeting cost and schedule goals
  - Program assessment reports by the Defense Contract Management Agency (DCMA), after restructuring, show that cost and schedule variances are deteriorating
    - November 2006 DCMA report shows Variance at Completion at about $25.6 million; causes include integration test and operations, thermal vacuum test preparations, and engineering rework
  - GAO analysis shows that some efforts that were having trouble before the February 2006 re-baseline, such as assembly, integration, and test, are still over-running cost and schedule, and that contractor estimates are overly optimistic

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Finding (cont.): Challenges to Meet Cost and Schedule Goals

- Management Reserve (MR) expenditure rate is not sustainable and may result in a need for additional funding
  - Contractor (Lockheed Martin) spent approximately 28 percent ($66 million) of its MR from April 2006 to November 2006
  - MR designed to last to 2012; at current rate contractor MR will deplete by May 2008 (5 months before projected GEO 1 launch date)
  - If this trend continues, $500 million in additional MR will be required through September 2012

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Finding:
Total Program Cost Not Fully Accounted For

- To meet SBIRS validated operational requirements, 2 HEO payloads and 4 GEO satellites are needed to complete the constellation and achieve required coverage
- Current program unit cost for GEOs 1-3 is about $3.5B
- Fourth GEO satellite not part of current acquisition baseline
  - Cost of GEO 4 and/or 5 satellites have been estimated but there are uncertainties due to several factors including industrial base issues, technology obsolescence, number of satellites to be procured, and engineering rework

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Finding (cont.): Total Program Cost Not Fully Accounted For

- SBIRS High program has deferred needed capabilities to meet cost and schedule goals; these capabilities are not part of the program's total cost estimate
- Additional funds will be needed if these and other deferred capabilities are eventually provided

Capability	FY06-FY11 ($ mil.)	To Completion ($mil.)	Total ($ mil.)
Mission Control Station-Backup Facility	$75	$0	$75
Integrated Training Suite Increment 2	71	7	78
Air Force Multi-Mission Processors	79	15	94
Army Multi-Mission Processors	62	10	72
Relay Ground Station 3rd Antenna	61	5	66
Ground Refresh	105	0	105
Total	**$453**	**$38**	**$491**

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Finding:
Challenges in Software Development

Spacecraft Software Challenges:

- DCMA program assessment reports through November 2006 show software development is behind schedule
  - Most recent report shows schedule variance around -32 percent
  - DCMA high risk threshold for schedule variance is -5 percent
- Pointing and Control Assembly (PCA) software
  - Restructured work to allow viable off-ramp options
  - Off-ramp options may lower risk
- Flight Software System (FSS)
  - All FSS capabilities are needed for launch – no off-ramp possible
  - Increased schedule risk due to delayed qualification
- Tracking algorithms and software not yet completed or demonstrated
- Hundreds of open deficiency reports -- and growing
- According to the DCMA, there is not enough schedule margin to accommodate unforeseen risks

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Finding (cont.): Challenges in Software Development

Ground Software Challenges:

- The program office is attempting to reduce the length of time it will take to certify the accuracy of the data processed from GEO 1 (currently about two years) by accelerating ground software development
- Late delivery of space software databases to inform the ground software development team has created a lack of coordination between the space and ground systems
- GAO is assessing reported software capability of contractor

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Alternative Infrared Satellite System (AIRSS)

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AIRSS Background

- After the most recent Nunn-McCurdy breach, DOD restructured the SBIRS High program and directed the Air Force to begin developing a competing capability to ensure that the nation's missile warning capability is sustained
- The December 2005 Acquisition Decision Memorandum (ADM) also stated the AIRSS effort should:
  - "plan for a new program for space-based Overhead Non-imaging Infrared that generates competition for the SBIRS High GEO 3 satellite"
  - "perform technology risk reduction, perform system definition, and evaluate alternative sensor architectures"
  - "provide insurance against further difficulties encountered on the SBIRS program"
  - "pursue an approach with acceptable technical risk that offers DSP-like missile warning capability"
- There is no full cost estimate of AIRSS because the system has not been defined due to its early stage of development

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AIRSS Background

- Congress reduced the fiscal year 2007 AIRSS budget by $35 million for program moderation
- The latest program cost estimate from Fiscal Year 2007 through 2013 is over $3.3 billion

	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Total FY 2007-2013
Cost ($ in Millions)	67.552	230.887	354.308	543.534	708.657	722.287	736.998	3364.223

Source: Air Force

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AIRSS Status: Activities since Acquisition Decision Memorandum

- DOD completed 30-day and 120-day studies into alternative infrared concepts (including Wide Field of View (WFOV))
- Space and Missile Systems Center (SMC)/Air Force Research Laboratory issued two Broad Agency Announcement contracts for development of WFOV technologies to Raytheon ($54.4 million) and SAIC ($26 million)
- SMC issued two Program Research and Development Announcement contracts for system design to General Dynamics ($23.3 million) and Northrop Grumman Space Technology ($24.8 million)
- Air Force Space Command drafted a requirements document for global space infrared surveillance systems, a family of systems that includes AIRSS as the SBIRS High follow-on
  - review by the Joint Requirements Oversight Council is scheduled for summer 2007
- National Security Space Office (NSSO) completed its infrared architecture study in December 2006

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Objectives: AIRSS

- Determine how DOD has justified its decision to proceed with preliminary efforts for an alternative to SBIRS High, known as the Alternative Infrared Satellite System (AIRSS)

- Determine to what extent DOD is taking the steps necessary to build the knowledge it needs to pursue AIRSS

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Findings: AIRSS

- Specifically, AIRSS is not being pursued as a “plan B” program as originally envisioned. Rather than seek to maintain continuity of operations, the program is focused on advancing capabilities. Moreover, it is doing so within highly compressed timeframes. There is disagreement among DOD stakeholders as to the wisdom of this approach, given past experiences with space acquisitions.

- The Air Force is moving forward and pursuing two potentially incompatible objectives within one program:
  1) ensure sustainment of current missile warning capability, and
  2) develop next-generation SBIRS High

- Faces challenges in meeting its target delivery date of 2015

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Finding: Air Force pursuing incompatible goals within AIRSS

- The December 2005 ADM directs the Air Force to:
  - develop a competitor for GEO 3 to ensure sustainment of missile warning capability (DSP-like)
  - pursue technology risk reduction
- However, the AIRSS program is primarily focused on technology that is newer than the technology on SBIRS GEO
  - FY07 funding is largely being spent pursuing these technologies that pose technical challenges
- The AIRSS on-orbit demonstration satellite results will not be ready in time to fully inform development of the first AIRSS satellite

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Finding (cont.): Air Force pursuing incompatible goals within AIRSS

- Some DOD officials believe AIRSS should be following lower-risk approach in order to assure continuity of missile detection capability
  - Cost Analysis Improvement Group and Program Analysis and Evaluation staff expressed concern that the focus on technology development will hinder the delivery of an AIRSS satellite available for launch in 2015
- According to AIRSS officials, the Air Force wants to look to the future promised by current technologies, not spend time resurrecting DSP-like technologies. They assert that there are no viable alternatives beyond these two paths. However, others in DOD disagree and believe the 120-day study should have been more robust.

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Finding: AIRSS may face challenges in meeting launch date of FY 2015

- AIRSS program technology schedule shows critical technologies reaching a high level of maturity by program start. Moreover, most are now rated at a technology readiness level (TRL) 5 or higher.
- However, the WFOV capability has not been achieved with the materials and technologies specifically planned for AIRSS. For example,
    - Mercury-cadmium-telluride sensor chip assembly performance level has yet to be verified
    - Full-earth infrared telescope has yet to be developed and demonstrated
    - Cyrocoolers have yet to demonstrate low jitter, high efficiency and long life

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Finding: AIRSS may face challenges in meeting launch date of FY 2015

- Some DOD stakeholders also believe the WFOV technology development schedule is optimistic.
- Moreover, according to the Air Force Research Laboratory, flight testing is the only way to validate the WFOV approach to a point where risk is significantly lowered. But this test is not scheduled to happen until 2010.
- GAO believes that if the flight test does not go well, DOD will not have time to return to a lower risk technology effort that focuses on sustaining current capability.

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Finding (cont.): AIRSS may face challenges in meeting launch date of FY 2015

- The AIRSS office assessed current and projected technology readiness levels (TRLs) for enabling technologies for a WFOV capability. Although the technologies offer varying levels of performance, final WFOV design will determine which technologies will be used.

Item	TRL	
	2006	2008
Focal Plane Array Sensor		
•Sensor Chip Assembly – (mercury-cadmium-telluride, or HgCdTe)	5-6	8
•Hybrid Focal Plane Assembly	5-6	8
•Read-out Integrated Circuits	6	8
Cryocooler		
110K (for HgCdTe)	7	8
Spatial filtering algorithms for theater reporting	6-7	7-9
Radiation hardened Field Programmable Gate Arrays (FGPAs)		
•30K gates	8	9
•400K gates	5	6
Processor (300 multimode interference photonic switches (MIPS))	8	9
18º Infrared Telescope	5-6	6
Spacecraft (structure, power, attitude control system (ACS), etc.)	8	8
Communications suite	8	8

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Finding: AIRSS may face challenges in meeting launch date of FY 2015

- AIRSS officials acknowledge its schedule is “very aggressive” for meeting a 2015 launch availability date
  - 12 months from preliminary to critical design review (CDR)
  - 4 years from CDR to satellite delivery
- AIRSS officials plan to award system contracts before data from key sensor on-orbit testing is completed.
- GAO has reported that it is important for DOD to gain knowledge about technology readiness prior to proceeding with system development.

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Conclusion

While it is okay in any given portfolio to take some high risks, it is not sound for all investments to be high risk—particularly if the capability being pursued is critical to the conduct of military operations and national security. The SBIRS High program continues to face risks that endanger DOD's ability to sustain its missile detection capability. Recognizing this risk, DOD made a sound decision in pursuing AIRSS to act as an alternative to the third GEO satellite, envisioning this as a low-risk approach. However, the program is now pursuing a higher risk effort than originally envision because it believes there are not other viable alternatives. Given internal disagreements about whether there are other alternatives, DOD should direct the Air Force to further explore the availability of more mature technologies and designs, or justify its decision not to do so.

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Scope and Methodology

To determine the program's ability to meet cost and schedule projections, we examined schedule and funding information for developing hardware and software. We reviewed formal program reviews, DCMA and contractor performance reports. In addition, we performed our own analysis of cost and schedule projections using Lockheed Martin's 2006 cost performance report data. To determine the problems and potential risks relating to cost, schedule, and performance that are still facing the SBIRS High program, we reviewed technical reports and program briefings and held discussions with program and contractor officials regarding ongoing challenges.

To assess DOD's efforts in attaining the knowledge it needs before the start of a competing effort, we examined the resources (technology, communications infrastructure, and funding) committed and planned for the competing effort as well as the users' needs for the competing system. We considered DOD's plans for maturing the critical technologies when we obtained technology-readiness information for each critical technology against best practice standards to determine if they will be sufficiently mature when DOD plans to start product development. We also reviewed risk management plans and concept development information.

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Scope and Methodology (cont.)

- Key documents reviewed and analyzed:
  - SBIRS High Acquisition Decision Memorandum
  - SBIRS High Program Review Updates to AT&L
  - SBIRS High Program office and prime contractor schedules and technology development plans
  - SBIRS High Program Assessment Reports – Defense Contract Management Agency, Lockheed Martin Sunnyvale
  - SBIRS High Lockheed Martin Cost Performance Reports
  - AIRSS Office update briefings
  - AIRSS 120-day study report
  - National Security Space Acquisition Policy
  - Selected Acquisition Reports for major DOD space acquisitions
  - DOD budget documentation for SBIRS High and AIRSS

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Scope and Methodology (cont.)

Locations for interviews and documentation:

- Air Force
  - SBIRS High Program Office and AIRSS office, Los Angeles Air Force Base
  - Air Force Space Command, Peterson Air Force Base, CO
  - Air Force Research Laboratory, Kirtland Air Force Base, NM
  - Office of the Under Secretary of the Air Force, Washington, DC

- Other Defense
  - Office of the Secretary of Defense, Program Analysis and Evaluation, Arlington, VA
  - Office of the Secretary of Defense, Cost Analysis Improvement Group, Arlington, VA
  - Office of the Joint Chiefs of Staff (J-2 and J-8), Arlington, VA
  - Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, Arlington, VA

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Scope and Methodology (cont.)

- Other Defense (cont.)
  - National Security Space Office, Fairfax, VA
  - U.S. Strategic Command, Offutt Air Force Base, NE
  - U.S. Naval Research Laboratory, Washington D.C.
  - Defense Contract Management Agency, Alexandria, VA and Sunnyvale, CA
- SBIRS High Contractors
  - Northrop Grumman Space Technology, Azusa, CA
  - Lockheed Martin Space Systems Company, Sunnyvale, CA

We conducted our work from August 2006 to February 2007 in accordance with generally accepted government auditing standards.

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