HISTORY OF THE

SPACE AND MISSILE SYSTEMS CENTER

1 October 1998 – 30 September 2001

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VOLUME I

CHAPTER 7

SPACE BASED INFRARED SYSTEMS

The Air Force began developing space-based infrared surveillance systems in the mid-1950s, and SMC had managed development programs in this area since its original organizational predecessor, the Western Development Division, had assumed responsibility for the first Air Force satellite program in 1955. During the period under consideration, FY 1998 through FY 2001, the Defense Support Program (DSP) provided 24-hour worldwide infrared surveillance for detecting strategic and tactical missile launches. After DSP detected a launch, it quickly provided an early warning so the US command authorities would be alerted about a possible missile attack. Its development had begun in 1963, and it had been in operation in various evolutionary phases since 1970.[1]

SMC developed the planned successor of DSP, known as the Space Based Infrared Systems (SBIRS). The SBIRS concept included two planned satellite systems, referred to during this period as SBIRS High and SBIRS Low. Both were heirs of infrared technology developed for the Ballistic Missile Defense Program (earlier known as the Strategic Defense Initiative) during 1983-1995. The baseline architecture for SBIRS would include four satellites in Geosynchronous Earth Orbit (GEO), two payloads on hosted satellites in Highly Elliptical Orbit (HEO), and about 24 satellites in Low Earth Orbit (LEO), ground facilities in the continental United States (CONUS) and overseas, and related communication links. SBIRS High would focus on the detection and tracking of missiles during the earlier phase of their flight while their motors generated heat and infrared signatures in short-wave and mid-wavelengths. SBIRS Low would add the capability of tracking and reporting other data about missiles during the middle portions of their flight when their infrared signatures were at longer wavelengths. The SBIRS High and Low component programs were complementary but independent. Each program contributed to the satisfaction of the overall SBIRS Operational Requirements Document (ORD).[2]

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[1] History of SMC (FOUO, extract is not FOUO), October 1994 - September 1997, p. 101; Fact Sheet (U), SMC/PA, "Defense Support Program," 14 February 2004 (Doc 7-1); Supplemental Environmental Assessment (SEA) and Finding of No Significant Impact (FONSI) (U), SMC, "Space Based Infrared System (SBIRS) Mission Control Station for Defense Support Program Consolidation," March 2001, p. 1-1 (Doc 7-2).

[2] History of SMC (FOUO, extract is not FOUO), October 1994 - September 1997, p. 101; Single Acquisition Management Plan (SAMP) (U), SMC/MT, "Space Based Infrared System (SBIRS) High Component," 30 June 2002, p. 1-1 (Doc 7-3); Fact Sheet (U), SMC/PA, "Space Based Infrared Systems," January 2001, (Doc 7-4); Supplemental Environmental Assessment (SEA) and Finding of No Significant Impact (FONSI) (U), SMC, "Space Based Infrared System (SBIRS) Mission Control Station for Defense Support Program Consolidation," March 2001, p. FONSI (Doc 7-2).

The SMC SBIRS Program Office (office symbol SMC/MT) managed the development and acquisition of the DSP and SBIRS programs. It strived to procure these space systems according to schedules and delivery dates, and within the budget and the staffing resources assigned to it. In 2000, the program office had over 400 personnel assigned to it. The SBIRS System Program Director (SPD) had the authority to make decisions and allocate the resources based on the needs of the program. The SPD reported the SBIRS program status and issues to the Program Executive Officer for Space and the Under Secretary of the Air Force. The SBIRS SPDs during this time period included Col Daniel Burkett (4 July 1997 to 17 April 2000), Col Michael Booen (17 April 2000 to 25 June 2001) and Col Mark Borkowski (17 April 2000 to beyond FY 2001).[3]

Defense Support Program

[redacted]The primary mission of the Defense Support Program (DSP) was to detect and report launches of both land-based and submarine-launched ballistic missiles to the National Command Authority and to theater commanders. Although it was designed for strategic missile detection, DSP was also capable of detecting tactical missile launches. An example of tactical launch detection was the warning it gave about SCUDs that had been launched by Iraq during Operation Desert Storm. [redacted] In times of conflict, additional uses were found for DSP's fused

[3] History of SMC (FOUO, extract is not FOUO), October 1994 - September 1997, p. B-6; Single Acquisition Management Plan (SAMP) (U), SMC/MT, "SBIRS High Component," 30 June 2002, p. 4-3 (Doc 7-3); Chronology (U), SMC/MT, "SBIRS High Program," 10 February 2005, pp. 19, 22 (Doc 7-5); Biography (U), Col Michael Booen, SMC/MT SPD, August 2000 (Doc 7-6); Biography (U), Col Mark Borkowski, SMC/MT SPD, December 2001 (Doc 7-7); Program Management Directive (FOUO, nothing referenced), SAF/AQS, "PMD 2362(4), PE# 35911F/35915F/35922F/ 63441F/64441F/64442F, Program Management Directive for Defense Support Program and Space Based Infrared Systems (Space Based Early Warning Systems IWSM Program)," 17 March 2000 (Doc 7-8); Program Management Directive (FOUO, nothing referenced), SAF/AQS, "PMD 2362(5), PE# 35911F/35915F/35922F/64441F/ 64442F, Program Management Directive for Defense Support Program and Space Based Infrared Systems (Space Based Early Warning Systems IWSM Program)," 10 August 2001 (Doc 7-9).

multisatellite observations, which led to the definition of new tactical missions for the ground system that produced this information.[4]

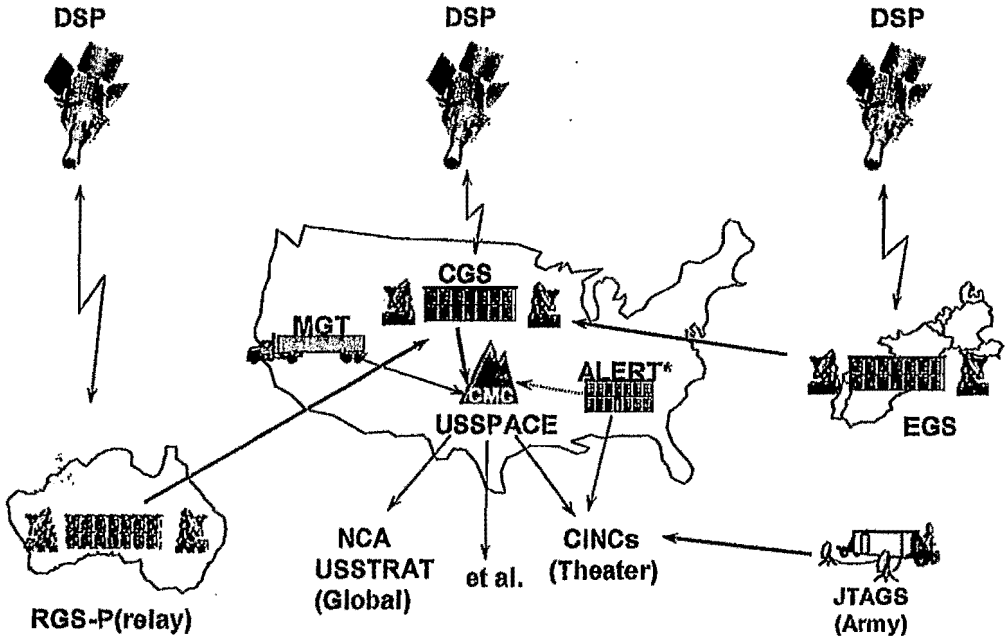

Illustration 7-1: DSP System Architecture

[redacted]DSP also performed the secondary missions of detecting space launches and nuclear detonations as well as other sources of radiation. It used the same sensors for space launches that it used for missile launches. However, it carried additional sensors to detect, locate, and report on nuclear detonations and background radiation. These sensors were called the NUDET (Nuclear Detonation) Detection System (NDS). They were contained in two packages known as Advanced Radiation Detection Capability (RADEC) I and Advanced RADEC II. [redacted] They could detect nuclear detonations both inside the earth's atmosphere and in space, and they could monitor background radiation in space. (Global Positioning System (GPS) satellites also carried NDS secondary payloads during this period. See Chapter 5 of this history.)[5]

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[4] Descriptive Pamphlet (U), SMC/MT, "Space Based Infrared System, SBIRS," 1998, pp. 14-16 (Doc V-4 of History of SMC, October 1994 –September 1997); Theodore W. Polk, Aerospace Corporation, comments (FOUO), 21 November 2001.

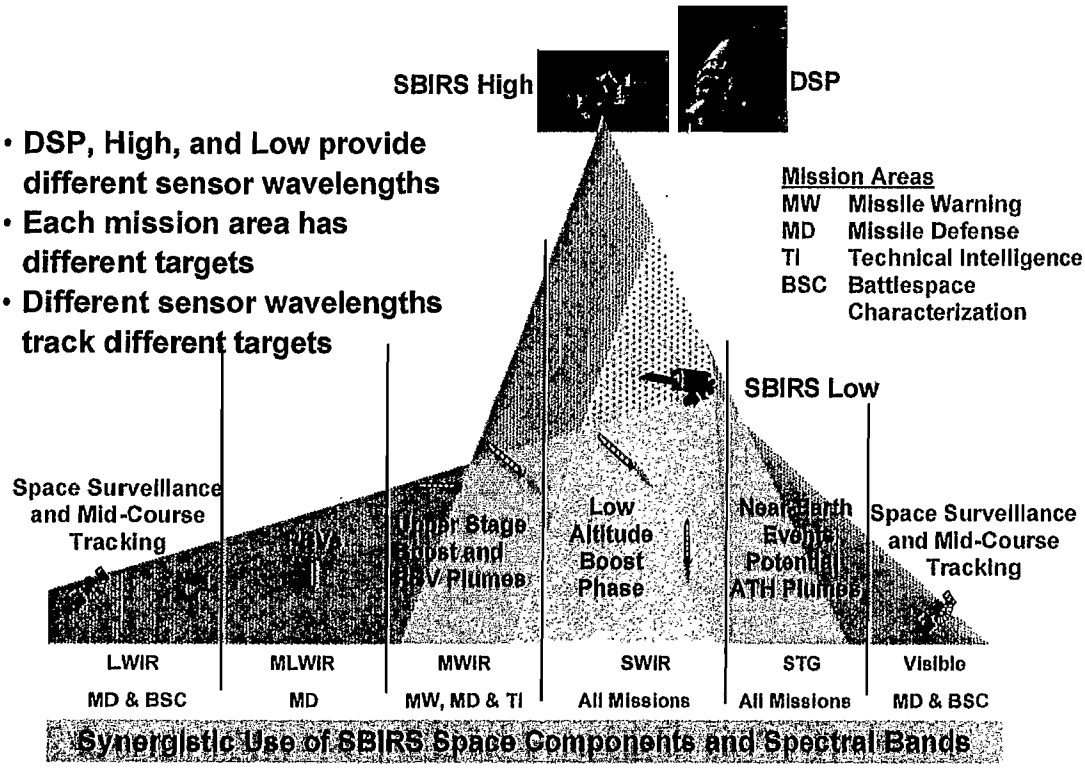

Illustration 7-2: Frequency Bands of Infrared Sensors on DSP and SBIRS Satellites

Spacecraft

[redacted] The current and last configuration of the DSP satellite was known as DSP-1. It was one of the largest and heaviest military spacecraft in operation, weighing roughly 5,250 pounds and extending 32.8 feet long by 22 feet in diameter when fully deployed in orbit. DSP-1 satellites could be launched on either the Space Shuttle or expendables because they had been designed before military spacecraft were removed from the Shuttle's manifest by the implications of the Challenger disaster of January 1986. The operational and spare satellites were in essentially geostationary orbits—24-hour orbits at a radial distance of 22,767 nautical miles from the earth. Each satellite rotated about its earth-pointing axis, which allowed its telescope to scan the entire terrestrial hemisphere visible from that point in space on every sweep. The layout of sensors on the telescope's focal plane was designed to distinguish signals both above and below the horizon (meaning inside or outside the circle made by the earth's outer edge).[6] The major components of the telescope and sensors are indicated in Illustration 7-3.

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[5] History of SMC (FOUO), October 1994 - September 1997, p. 110.

[6] Theodore W. Polk, Aerospace Corporation, comments (FOUO), 21 November 2001.

Table 7-1

Characteristics of DSP Satellites by Major Blocs, 1970-2001[7]

	PHASE I	PHASE II	MOS/PIM	PHASE II UG	DSP-1
FLIGHT #	1,2,3,4	5,6,7	8,9,10,11	12,13	14-23
LAUNCH YEARS	1970-1973	1975-1977	1979-1984	1984-1987	1989-
WEIGHT (lbs)	2000	2300	2580	3690	5250
POWER (Watts)	400	480	500	680	1275
DESIGN LIFE (Years)	1.25	2.0	3.0	3.0	3.0
DETECTORS					
2000 (PbS) (SWIR)	X	X	X		
6000 (PbS) (SWIR)				X	X
2nd Color (HgCdTe) (MWIR)				Demo	X
CAPABILITY					
Below the Horizon (BTH)	X	X	X	X	X
Above the Horizon (ATH)		Demo		X	X

Abbreviations: HgCdTe=Mercury Cadmium Teluride; MOS/PIM=Multi-Orbit Satellite/Performance Improvement Modification; MWIR=Medium Wave Infrared; PbS=Lead Sulfide; SWIR=Short Wave Infrared; UG=Upgrade.

[redacted] Mounted inside each telescope was an array of over 6,000 non-imaging photoelectric cells, called detectors. The telescope picked up infrared radiation from a variety of sources, including the hot exhaust gases given off by missiles during launch. The photoelectric cells absorbed this radiation and produced electrical charges—signals—whose amplitude was proportional to the brightness of the radiation. The system then had to discriminate between signals representing missile launches and

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[7] History (U), Maj James J. Rosolanka, Defense Support Program (DSP), A Pictorial Chronology, 1970-1998," 1998 (Doc 5-3 of History of SMC, October 1994 – September 1997).

signals representing less interesting sources of radiation. This task was initiated by signal processing electronics within the sensor and was later completed by computers at the ground stations. Detectors with two different compositions operated in two wavebands. Lead sulfide detectors worked in the shortwave infrared spectrum, and mercury cadmium teluride detectors worked in the mediumwave infrared.[8]

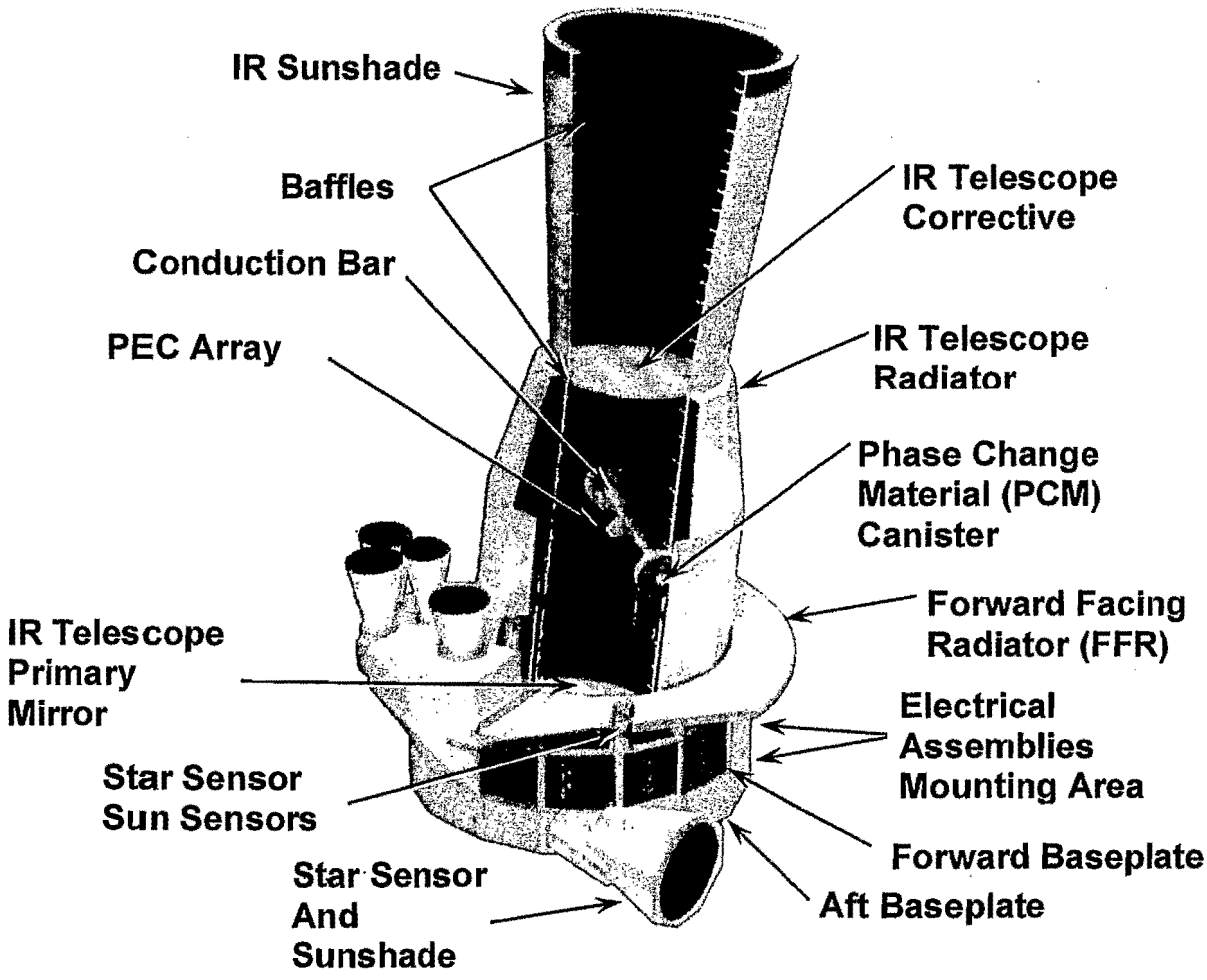

Illustration 7-3: Diagram of Aerojet Sensor on DSP Satellites, Flights 18-21

[8] History of SMC (FOUO), October 1994 - September 1997, pp. 104-107; History (U), Maj James J. Rosolanka, Defense Support Program (DSP), A Pictorial Chronology, 1970-1998, 1998.

Table 7-2
Major DSP Contracts in Effect During FY 1998-2001[9]

Contract Number	Contractor	Efforts	Start Date	Projected Completion Date	Approxima Value In 2001
F04701-96-C-0030	TRW, Inc.	DSP Satellite Post-Production Support	Oct 96	October 2002	$250 Millio
F04701-96-C-0031	Aerojet General Corp.	DSP Sensor Post-Production Support	Oct 96	October 2002	$284 Millio
F04701-96-C-0004	Aerojet Electronic Systems Division	Central Theater Processing Program [ALERT System]	Sep 95	September 2001 (consolidated into F04701-96-C-0031)	

TRW, Incorporated, was responsible for developing, fabricating, and supporting the spacecraft, and Aerojet Electronic Systems Division was responsible for the sensors. TRW performed its work under contract FO4701-96-C-0030, and Aerojet worked under contract FO4701-96-C-0031, known as the DSP Sensor Post-Production Support Contract.

Launches

As Table 7-4 indicates, three more DSP satellites—F-19 (spacecraft DSP-22), F-20 (DSP-21), and F-21 (DSP 19)—were launched during FY 1998-2001. All of the launches employed Titan IVB launch vehicles and Inertial Upper Stages. Unfortunately, on 9 April 1999, the first of these launches placed satellite F-19 into an unusable orbit because the first and second stages of the Inertial Upper Stage (IUS-21) did not separate cleanly. Four DSP satellites remained in the unlaunched inventory. They would have to be launched and brought into operation without any failures in order to stretch the lifetime of the DSP constellation until the follow-on SBIRS systems were fully operational. Launch schedules and vehicles had already been assigned to three of the remaining DSP satellites by April 1999. They were:

[9] Briefing Charts (U), SMC/MT, "Program Management Review: DSP Increment 0," 1 November 2001 (Doc 7-10).

Table 7-3

DSP Launch Assignments in April 1999 After Launch Failure Affecting F-19

Spacecraft	Planned Launch Date	Planned Launch Vehicle	Actual Launch During FY98-01
DSP-21 (F-20)	1st Quarter FY00	Titan IV with IUS	8 May 2000
DSP-19 (F-21)	1st Quarter FY01	Titan IV with IUS	6 August 2001
DSP-18 (F-22)	4th Quarter FY02	Titan IV with IUS	
DSP-23 (F-23)	FY03	Delta IV Heavy	

Table 7-4

DSP Satellites Launched 1970-2001[10]

Flight #	Block #	Space-craft #	Sensor #	Launch Date	Launch Site	Launch Vehicle	Launch Result
F-1	Phase I	DSP-1	R	11-6-70	CCAFS LC-40	Titan IIIC Transtage	Success
F-2	Phase I	DSP-3	T	5-5-71	CCAFS LC-40	Titan IIIC Transtage	Success
F-3	Phase I	DSP-4	U	3-1-72	CCAFS LC-40	Titan IIIC Transtage	Success
F-4	Phase I	DSP-2	S	6-12-73	CCAFS LC-40	Titan IIIC Transtage	Success
F-5	Phase II	DSP-8	9	12-14-75	CCAFS LC-40	Titan IIIC Transtage	Success
F-6	Phase II	DSP-7	8	6-26-76	CCAFS LC-40	Titan IIIC Transtage	Success
F-7	Phase II	DSP-9	5	2-6-77	CCAFS LC-40	Titan IIIC Transtage	Success
F-8	MOS/PIM	DSP-11	13	6-10-79	CCAFS LC-40	Titan IIIC Transtage	Success
F-9	MOS/PIM	DSP-10	10	3-16-81	CCAFS LC-40	Titan IIIC Transtage	Success
F-10	MOS/PIM	DSP-13	12	3-6-82	CCAFS LC-40	Titan IIIC Transtage	Success
F-11	MOS/PIM	DSP-12	11	4-14-84	CCAFS LC-40	Titan 34D Transtage	Success

[10] History (U), Maj James Rosolanka (SC/MT), "Defense Support Program (DSP): A Pictorial Chronology, 1970-1998," 1998; Briefing Charts (U), Aerospace Corporation, "Flight 21 President's Review," 11 July 2001.

F-12	Phase II UG	DSP-6R	7R	12-22-84	CCAFS LC-40	Titan 34D Transtage	Succe
F-13	Phase II UG	DSP-5R	6R	11-29-87	CCAFS LC-40	Titan 34D Transtage	Succe
F-14	DSP-1	DSP-14	17	6-14-89	CCAFS LC-41	Titan IVA IUS	Succe
F-15	DSP-1	DSP-15	15	11-13-90	CCAFS LC-41	Titan IVA IUS	Succe
F-16	DSP-1	DSP-16	16	11-24-91	KSC LC-39A	STS IUS	Succe
F-17	DSP-1	DSP-17	14	12-22-94	CCAFS LC-40	Titan IVA IUS	Succe
F-18	DSP-1	DSP-20	21	2-23-97	CCAFS LC-40	Titan IVA IUS	Succe
F-19	DSP-1	DSP-22	22	4-9-99	CCAFS LC-41	Titan IVB IUS	Failu
F-20	DSP-1	DSP-21	18	5-8-00	CCAFS LC-40	Titan IVB IUS	Succe
F-21	DSP-1	DSP-19	19	8-6-01	CCAFS LC-40	Titan IVB IUS	Succe

Acronyms: CCAFS = Cape Canaveral Air Force Station; D1 = Device 1; D2 = Device 2; DSP = Defense Support Program; IUS = Inertial Upper Stage; KSC = Kennedy Space Center; LC = Launch Complex; MOS = Multi-Orbit Satellite; PIM = Performance Improvement Modification; STS = Space Transportation System; UG = Upgrade.

Processing requirements dictated that Titan IV launches take place about six months apart because one of the two Titan IV launch complexes was being converted to launch EELVs. Since other programs were also scheduled to use the Titan IV, DSP satellites could be launched on Titan IVs no more often than a year apart. However, the schedule for F-22 could be accelerated by launching F-22 on the Space Shuttle instead. SMC brought its replenishment options for the DSP constellation to the Joint Chiefs of Staff's Joint Requirements Oversight Council (JROC), which agreed on 26 July 1999 to request emergency supplemental funding to prepare F-22 for a Shuttle launch. Nevertheless, the supplemental appropriation had not materialized by early 2000. The successful launch of F-20 on 8 May 2000 relieved much of the scheduling pressure on the remaining DSP satellites, since the rest of the DSP constellation was also healthy.[11]

At the end of 2001, F-19 was still the only launch failure in the program's 31-year history. (For more details about the launches during this period, see Table 3-1 in Chapter 3 of this history.) F-21 was successfully launched on 6 August 2001, using Titan IVB-31

[11] Staff Summary Sheet (U), SAF/AQS to SAF/AQS (PEO/Space), "New Start Reprogramming of Missile Procurement (3020 Appropriation) FY99 Funds for Inertial Upper Stage and Defense Support Program to Preserve Shuttle Launch Option," 11 August 1999 (Doc 7-11); Staff Summary Sheet (U), SMC/CLTO to SMC/CV, "Comments on 'New Start Reprogramming of Missile Procurement (3020 Appropriation) FY99 Funds for Inertial Upper Stage and Defense Support Program to Preserve Shuttle Option,'" 17 August 1999 (Doc 7-12); Staff Summary Sheet (U), SMC/CLTO to SMC/CV, "IUS-23 Requirements From NASA," 18 August 1999 (Doc 7-13); Letter (U), SMC/CV to AFSPC/DO, "Inertial Upper Stage (IUS) Vehicle 23 Requirement," 4 October 1999 (Doc 7-14).

with an Inertial Upper Stage (IUS-16). The satellite completed on-orbit testing and was transferred to Air Force Space Command on 5 September 2001 for movement to its operational location. By the end of September 2001, only two more DSP satellites remained in the inventory to be launched: DSP-18 and DSP-23. DSP-18 was scheduled for launch as F-22 on a Titan IVB in April 2003. The program office rescheduled DSP-23 for launch as the second payload for the Delta IV Heavy EELV in late August 2003. It would be known as flight F-23.[12]

Ground Sites

[redacted] Until 1995, DSP's ground stations had consisted of three permanent ground sites [redacted] and one support facility. Two of the permanent sites were known as Large Processing Stations. They were the Overseas Ground Station (OGS) at Woomera, Australia, and the Continental U.S. Ground Station (CGS) at Buckley AFB, Colorado. The primary mission of the OGS was to process data from DSP satellites over the eastern hemisphere—data concerning the satellites' mission, health, and status—and to provide reports to the National Command Authority. The CGS did the same for satellites over the western hemisphere. The third permanent site was the European Ground Station (EGS). [redacted] The support facility was called the Multi-Purpose Facility. It provided telemetry and mission data analysis, software trouble-shooting for development of upgrades, and operational training for personnel.[13]

In March 1995, a fourth ground site became operational. It contained the Attack and Launch Early Reporting to Theater (ALERT) system, exploiting DSP's potential for warning of missile attacks within local theaters of war such as the Persian Gulf region during Operation Desert Storm. It also improved the dissemination of tactical information to other users. To do so, the system drew together data from the complete DSP constellation as well as data and communications lines from other resources into a single location housed in the National Test Facility at Schriever AFB, Colorado. The data was integrated by a system of data processors, displays, and software collectively known as a Central Tactical Processing Element (CTPE). The resulting warning and cueing reports were transmitted to theater commanders to provide extremely rapid warning information by means of existing tactical communications networks. The program achieved dramatic improvements in the accuracy, description, and timeliness of warning data. The improved warning information contained estimates of missile launch

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[12] Briefing Charts (U), SMC/MTD, "Program Management Review: DSP Increment 0," 1 November 2001 (Doc 7-10); News Release (U), Boeing, "U.S. Air Force Assigns Fifth Delta IV Launch," 25 April 2001 (Doc 7-15).

[13] History of SMC (FOUO), October 1994 - September 1997, p. 110-111.

point location, time, and heading, as well as post-boost trajectory data including the predicted impact area. ALERT operations officially began in 1995, and SMC awarded a contract (FO4701-96-C-0004) to Aerojet Electronic Systems Division for maintaining and upgrading the CTPE portion of the ALERT system. Plans called for continuing tactical improvements for DSP until Increment 1 of the SBIRS Ground Segment achieved initial operational capability. At the end of September 2001, with integrated operational test and evaluation (IOT&E) of Increment 1 progressing satisfactorily, the program office consolidated Aerojet's ALERT contract into Aerojet's contract for DSP Sensor Post-Production Support.[14]

A mobile, tactical ground system known as the Army and Navy Joint Tactical Ground Station (JTAGS) became operational in 1997. It provided in-theater warning of a missile attack to theater commanders. This system could receive and use data directly from DSP satellites as well as processed warning information from communications networks. The data would be applied by units in the war zone to aim radars and antimissile weapons at incoming missiles. In the field, the JTAGS units were equipped with antennas to receive telemetry directly from the DSP satellites, a processing and communications unit housed in a shelter measuring 8x8x20 feet, a 60-kilowatt generator, and a HMMWV (High Mobility Multipurpose Wheeled Vehicle).[15]

All four of the existing primary DSP ground sites were close to being phased out by the end of September 2001. Increment 1 of the developing SBIRS would replace the three DSP strategic control centers (the OGS, CGS, and EGS) and the ALERT facility with a new SBIRS Mission Control Station (MCS) at Buckley AFB in Aurora, Colorado. The MCS, which was being developed by Lockheed Martin under its SBIRS High contract (FO4701-95-C-0017), would employ new software designed to be compatible with the SBIRS High and SBIRS Low systems being developed by SMC as well as with DSP. Lockheed Martin was also developing a backup MCS and a mobile MCS under the same contract.[16]

The newly built MCS was accepted by the Air Force early in FY 2001 and entered the prescribed period of initial operational test and evaluation (IOT&E) by the

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[14] See Table 7-2 in this history. For background, see History of SMC (FOUO, extract is not FOUO), October 1994-September 1997, pp. 111-112. See also Briefing Charts (U), SMC/MT to SMC/CC, "DSP Increment 0," 1 November 2001 (Doc 7-10).

[15] History of SMC (FOUO, extract is not FOUO), October 1994-September 1997, p. 112.

[16] News Release (U), SMC/PA, "SBIRS Facility Opens in Colorado," 29 March 2001 (Doc 7-16); News Release (U), Lockheed Martin, "Air Force Begins Independent Test of SBIRS Ground Station," 18 June 2001 (Doc 7-17); Fact Sheet (U), USAF, "Space Based Infrared Systems Mission Control Station," 13 December 2001 (Doc 7-18); News Release (U), Lockheed Martin, "Air Force Accepts New Missile Warning Control Station From Lockheed Martin," 7 January 2002 (Doc 7-19).

Air Force Operational Test and Evaluation Center (AFOTEC) in late May 2001. The system passed the effectiveness phase of IOT&E near the end of June and immediately began the suitability phase. Testing progressed satisfactorily, despite some minor issues. At Air Force Space Command's request, the program office arranged a pause in IOT&E of several days during August to fix a software problem. Testing resumed immediately, however, and the program office expected IOT&E to be completed during December 2001. If the testing did not turn up any major deficiencies, the MCS would then achieve initial operational capability and begin taking over the duties of the DSP control centers early in 2002. Later in 2002, it would also take over the duties of the ALERT tactical DSP facility.[17]

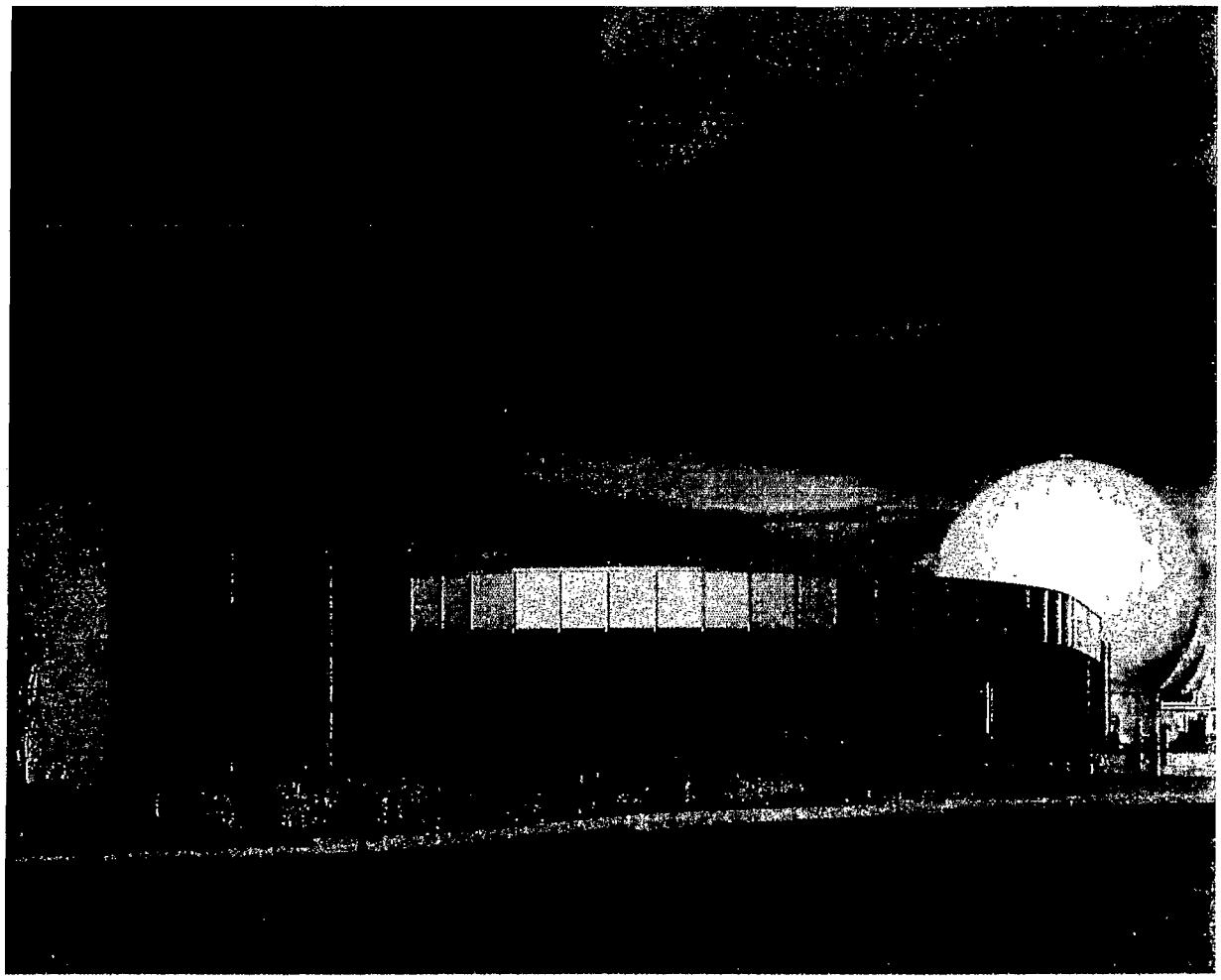

Illustration 7-4: Artist's Concept of SBIRS Mission Control Station at Buckley AFB

[17] SMC Monthly Highlights (U), SMC/PA, June 2001, July 2001, August 2001, September 2001, October 2001.

Space Based Infrared Systems (SBIRS)

During FY 1992 and FY 1993, SMC pursued concepts and technologies for follow-on systems to replace DSP. By 1994, the concept for a system to succeed DSP became known as the Space Based Infrared Systems (SBIRS). The overall SBIRS architecture would be an integrated missile warning system that would support several missions--missile warning, missile defense, battlespace characterization, and technical intelligence. It would integrate various infrared systems into a single architecture that employed multiple constellations of different satellites in different orbits (geosynchronous, elliptical, and low earth) and an evolving ground element. The program office called the combination of all these elements "a system of systems."[18]

SBIRS High

The Office of the Secretary of Defense (OSD) approved the plan for SBIRS in November 1994 and soon approved the program's entry into the early phase of development. The program's rapid first steps occurred through one of the earliest and most thorough applications of the Air Force's initiatives in streamlined acquisition reform. On 4 August 1995, SMC awarded two 15-month contracts for the SBIRS Architecture Definition and Technology Demonstration (pre-EMD): one (FO4701-95-C-0017) to the team led by the Lockheed Martin Missiles and Space Company (LMMS) as the prime contractor, with Loral and Aerojet as subcontractors, and the other (FO4701-95-C-0018) to the team of Hughes Aircraft Company and TRW. The efforts included the entire system architecture, the ground system for all mission processing, the space element for geosynchronous orbit, and satellite ground control. Each contract had a value of $80 million, and each had a schedule to end on 4 November 1996. These efforts and plans underwent a Milestone II review by the Defense Acquisition Executive, Under Secretary of Defense for Acquisition and Technology Paul Kaminski, on 3 October 1996. As a result, he approved the SBIRS High program for entry into the Engineering and Manufacturing Development (EMD) phase.[19]

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[18] History of SMC (FOUO, extract is not FOUO), October 1994 - September 1997, p. 113; Article (U), Ronea Alger, "Early warning system safeguards our nation," Astro News, 31 March 2000, p. 5 (Doc 7-20); Article (U), Richard Newman, "Space Watch, High and Low," Air Force Magazine, July 2001, pp. 35-38 (Doc 7-21); Fact Sheet (U), SMC/PA, "Space Based Infrared Systems," January 2001 (Doc 7-4).

[19] History of SMC (FOUO, extract is not FOUO), October 1994 - September 1997, p. 114-115.

After evaluating the contractors' proposals, SMC selected LMMS and its subcontractors to continue into the EMD phase on 8 November 1996. The subcontractors included Aerojet Electro Systems to provide payload integration and mission data processing; Lockheed Martin Federal Systems to provide satellite and ground system control as well as telemetry and tracking operations; Northrop Grumman to provide the telescope and focal plane assembly along with a cryoradiator; and Honeywell to provide on-board data processing. The new work on the contract (FO4701-95-C-0017) had a value of $2.1 billion for efforts over the next 10 years.[20]

Spacecraft

[redacted] The planned system to be developed for SBIRS High consisted of the following major elements. It would have four GEO satellites (and one spare), two HEO payloads (installed in hosted satellites by another organization), and associated ground elements. The spare GEO satellite would be acquired and available if a launch failure occurred. The SBIRS High space segment would provide all the DSP functionality while improving radiometric sensitivity and performance, plus upgraded missile defense, technical intelligence, and battle space characterization capabilities. The sensors would include a scanning infrared sensor for rapid global coverage and a staring infrared sensor to detect and track missiles in theaters of conflict. The satellite bus would be a Lockheed Martin A2100 spacecraft—already in commercial production—adapted for military requirements. The original plan scheduled the first GEO satellite launch for the third quarter of FY 2002, and the following satellites would be launched a year apart. They would be launched with Evolved Expendable Launch Vehicles (EELVs). The SBIRS High contractors would also deliver the two HEO payloads. These payloads would share a common design and common components with the GEO sensors, creating economies of scale for sensor production. However, they would be integrated into the spacecraft for a different, classified system that also used an elliptical orbit.[21]

SBIRS High would have several improvements over DSP. SBIRS would provide more reliable, accurate and timely information on missile launches than DSP. These improvements would include better missile launch point determinations and impact point predictions in support of offensive and defensive operations. The faster, more accurate launch data would increase the probability for a successful defense against a missile attack. SBIRS would have significant improvements in sensor flexibility and sensitivity

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[20] History of SMC (FOUO, extract is not FOUO), October 1994 - September 1997, pp. 115-116.

[21] History of SMC (FOUO), October 1994 - September 1997, pp. 116-117; Single Acquisition Management Plan (SAMP) (U), SMC/MT, "Space Based Infrared System (SBIRS) High Component," 30 June 2002, pp. 1-1, 2-4 (Doc 7-3); News Release (U), SMC/PA, "SBIRS High payload successfully passes key test," 27 March 2001 (Doc 7-22); Fact Sheet (U), SMC/PA, "Space-Based Infrared System," September 1998 (Doc 7-23).

enabling it to provide much more surveillance capability. Sensors would cover short-wave infrared (like DSP), but expanded mid-wave infrared and see-to-ground bands would allow SBIRS to perform an expanded set of missions.[22]

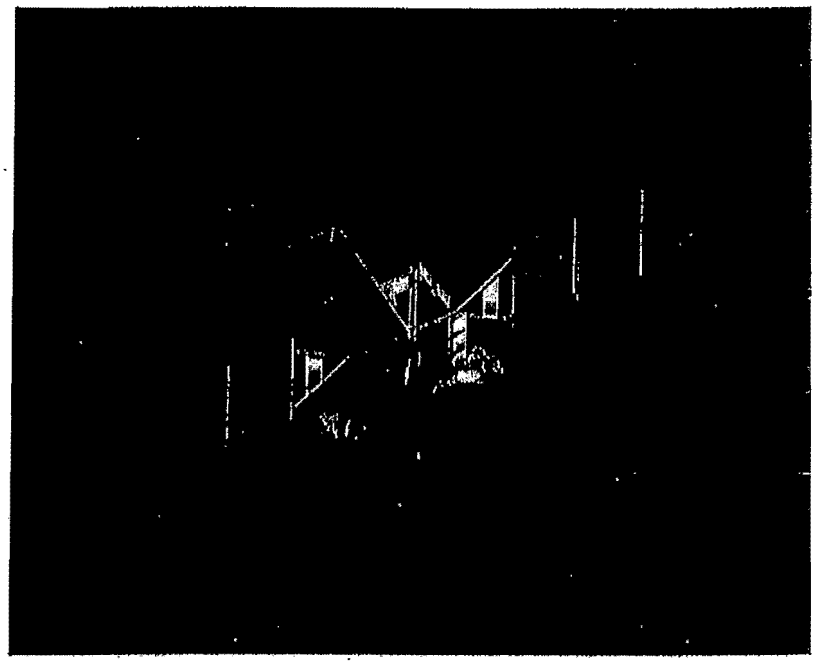

Illustration 7-5: Artists' concepts of SBIRS High GEO satellite

[redacted] Like DSP satellites, the SBIRS High satellites would include a set of sensors to detect, locate, and report nuclear detonations inside and outside of the atmosphere. The detection package was called the Space and Atmospheric Burst Reporting System (SABRS). It would be essential for the detection and identification of nuclear bursts in the upper atmosphere, as well as relatively low-energy bursts, such as those that might be detonated by countries only beginning to develop nuclear capabilities.

[redacted] The SABRS package would consist of two sensor modules that weighed about 75 pounds, and would draw an estimated power total of 53 watts from the host satellite. The first SBIRS flight

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[22] Fact Sheet (U), SMC/IS, "Space Based Infrared Systems (SBIRS)," January 2005 (Doc 7-24); Article (U), Ronea Alger, "SBIRS: 'System of systems' stands guard in space," Astro News, 31 March 2000, p. 5 (Doc 7-20); Briefing Charts (U), SMC/MT, "SBIRS the First Step in a Credible Missile Defense," circa 2002, p. 6 (Doc 7-25); Article (U), Richard Newman, "Space Watch, High and Low," Air Force Magazine, July 2001, pp. 35-38 (Doc 7-21); SEA and FONSI (U), SMC, "Space Based Infrared System (SBIRS) Mission Control Station for Defense Support Program Consolidation," March 2001, p. 1-2 (Doc 7-2).

that the SABRS package could be carried on would be the third GEO launch, pending future production approval from OSD.[23]

Ground Segment

[redacted] The ground segment to be developed for SBIRS High would consist of the following facilities and capabilities: the continental United States (CONUS) based MCS at Buckley AFB; a backup (MCSB) at Schriever AFB; a survivable MCS (SMCS); Relay Ground Stations (RGSs) located overseas - RGS-Europe (RGS-E) and a Relay Ground Station-Pacific 1 (RGS-P1); a survivable RGS (SRGS), and Multi-Mission Mobile Processors (M3Ps) with associated infrastructure. The ground segment for SBIRS High would build on the existing ground segment for DSP, first consolidating and updating the DSP capabilities. The first step would consolidate three legacy DSP strategic warning centers located in the United States and overseas—along with their associated communications networks—into the MCS at Buckley. The MCS would replace the DSP ground control centers and fuse all the data from the infrared sensors and other sources into a product of the greatest utility to national and theater command authorities. The SBIRS ground segment was originally scheduled to attain its Initial Operational Capability (IOC) around June 1999, but software development problems delayed the IOC certification for about 18 months.[24]

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[23] History of SMC (FOUO), October 1994 - September 1997, p. 117; E-mail (FOUO), Susan Swift, SMC/ISA, to Robert Mulcahy, SMC/HO, "FW: SABRS (FOUO)," 12 June 2006 (Doc 7-26); Internet Document, Federation of American Scientists (FAS), "SBIRS High Nuclear Exo-atmospheric Detonation (NUDET) Package," 10 September 1998, http://www.fas.org/spp/military/program/nssrm/initiatives/sbirsnp.htm (Doc 7-27).

[24] History of SMC (FOUO), October 1994 - September 1997, p. 117; Fact Sheet (U), SMC/MT, "Space Based Infrared Systems (SBIRS) Mission Control Station (MCS)," March 2003, (Doc 7-28); Request for Proposal (RFP) (U), SMC/MT, "RFP F04701-98-R-0006 SBIRS Low Component - Program Definition (PD) Effort," 23 July 1998, p. 21 (Doc 7-29); Chronology (U), SMC/MT, "SBIRS High Program," 10 February 2005, p. 14 (Doc 7-5); Article (U), Maj Richard Williamson, SMC/MT, "Defense Support Program Following in the footsteps of America's earliest silent sentry," Astro News, 5 October 2001, pp. 3-4 (Doc 7-30); Briefing Charts (U), SMC/MT, "Space Based Infrared Systems," circa 2002, p. 13 (Doc 7-31); Document (U), DefenseLink, "[SBIRS MCSB]," 8 September 1998 (Doc 7-32); Document (U), DefenseLink, "[SBIRS Combined Task Force facility]," 21 November 2000 (Doc 7-33); News Release (U), SMC/PA, "SBIRS Facility Opens in Colorado," 29 March 2001 (Doc 7-16); Document, DefenseLink, "[SBIRS upgrades for ground systems operations facility]," 6 April 2001 (Doc 7-34); Article (U), Lt Col Kelly Hazel, "SBIRS ground segment in final test phase," Astro News, 15 June 2001, pp. 1, 3 (Doc 7-35); Memo w/1 atch (U), SAF/SX to AFPEO (Space), "SBIRS Remote Ground Station Europe (RGS-E) Radome Installation at RAF Menwith Hill," 23 June 2000; Atch 1 Memo, SAF/SX to SEC(AS)1 Ministry of Defense UK, "[Change in Color in Radomes Covering two SBIRS Antennas at RAF Menwith Hill

Acquisition

Between 1996 and 2001, SBIRS High became one of the pilot programs to implement an Air Force's Acquisition Reform program that intended to streamline large and complex space system acquisitions. The Air Force assigned Total System Program Responsibility (TSPR) to the contractor under this reform program. The decision to implement the TSPR acquisition strategy was directed at the May 1996 Single Acquisition Management Plan (SAMP) review with the Assistant Secretary of the Air Force for Acquisition (SAF/AQ). SMC implemented the new strategy for the SBIRS High acquisition, and planned to evolve the same strategy for the SBIRS Low acquisition as it matured.[25]

The acquisition reform intended to make the contractors more accountable for the acquisition, and reduce the government role and oversight with the intent to deliver to the space system on schedule and within budget ("faster, better, cheaper"). With optimism for the new acquisition strategy, it was predicted that the SBIRS High program would have a cost savings of $2.5 billion during its planned life cycle. The reform intended to reduce research and development with fewer government approvals that would lower the unit cost of the product. The SBIRS High TSPR gave LMMS the responsibility for the product design, development, production (for both the space and ground systems), integration (space, ground and launch support), delivery, and the sustainment. LMMS would determine the development approach (how the product would be built), the implemental approach (what the product would look like), and LMMS would set the agenda (integrated management schedule). The acquisition reform process had no detailed design/approval verification, no Independent Readiness Reviews, no Software (S/W) independent verification and validation, and minimal independent engineering analysis. The government determined the performance requirements, and the contracting would be performance based. SMC depended on the SBIRS Award Fee and Corporate

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Station, UK]," 22 June 2000 (Doc 7-36); Article (U), "Air Force Turns to SGI For Early Warning," Space Daily, 31 October 2000 (Doc 7-37); News Release (U), Lockheed Martin, "Air Force Begins Independent Test of SBIRS Ground Station," 18 June 2001 (Doc 7-17); Article, "House Panel Withholding OK to Initiate Revised SBIRS High Contract," Inside the Air Force, 22 October 1999 (Doc 7-38); Article (U), "Software Problems, More Tests Delay Start of SBIRS Ground Segment," Inside the Air Force, 22 October 1999 (Doc 7-39); Article (U), "Air Force Official Says Inaugural SBIRS High Launch Remains on Track," Inside the Air Force, 16 June 2000 (Doc 7-40).

[25] Product Support Evaluation Plan (U), SMC/MT, "Space Based Infrared System, Innovative Product Support," circa 2000, pp. 3, 4-5, 7, 17 (Doc 7-41); Document (U), SAF.AQ, "Acquisition Reform Success Story," 2 December 1996 (Doc 7-42); Briefing Charts (U), SMC/MT, "SBIRS Review to Independent Strategic Assessment Group," 1 May 2006, p. 9 (Doc 7-43).

Commitment Plan (AFCCP) as the primary means and incentive for keeping the contractor to the Cost as an Independent Variable (CAIV) cost goals.[26]

From 1996 through FY 2001, the SBIRS SPO planned for three increments in the SBIRS High acquisition. Increment 1 would consolidate and replace the DSP ground assets to support the space operations of the remaining DSP satellites, and provide an infrastructure for the new SBIRS space assets. The Increment 1 ground segment would consolidate DSP processing stations and the Attack and Launch Early Reporting to Theater (ALERT) assets into the MCS at Buckley (including the RGS equipment). The Increment 1 architecture included an Interim MCS Backup (IMCSB), along with the SMCS and its associated SRGS. It also included the two RGS in Europe and the Pacific for connectivity between the MCS and the DSP satellites that were not in view of the MCS. The MCS was originally scheduled to be on line in 1999, but technical and organizational problems deferred this milestone until after FY 2001. Increment 1 should attain its IOC around December 2001.[27]

Increment 2 would replace the DSP space segment with the SBIRS High constellation and its associated ground software and hardware modifications. SBIRS High would include a space segment, a ground segment, and the support services (including the launches) needed to complete the mission. The SBIRS High space segment, when fully fielded at the completion of Increment 2, would have four satellites in GEO, the payloads with infrared sensors hosted on two satellites in HEO, and any residual on-orbit DSP satellites. The Increment 2 ground segment would add ground capabilities to help the transition from DSP, and provide launch and mission operations of the GEO satellites and HEO infrared sensors. The Increment 2 ground stations would

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[26] Briefing Charts (U), SMC/MT, "SBIRS Review to Independent Strategic Assessment Group," 1 May 2006, pp. 9-12 (Doc 7-43); Product Support Evaluation Plan (U), SMC/MT, "Space Based Infrared System, Innovative Product Support," circa 2000, pp. 3, 4-5, 12, (Doc 7-41); Document w/1 atch (U), SMC/MT, "[Air Force Association] Schriever Award Narrative for Space Based Infrared Systems (SBIRS System Program Office," 1999; Atch 1 Citation, AFA, "Major General Bernard A. Schriever Award for Outstanding Product Management," 1999 (Doc 7-44); E-mail (U), Capt Daniel McCutchon, SMC/MT, to SMC Directors et al., "Total Ownership Cost Briefing Slide," 27 July 1998 (Doc 7-45); Memo (U), SMC/CC to Col Daniel Burkett, SMC/MT, "[Congratulations for 1999 DoD Defense Value Engineering Award]," 17 July 1999 (Doc 7-46).

[27] Single Acquisition Management Plan (SAMP) (U), SMC/MT, "Space Based Infrared System (SBIRS) High Component," 30 June 2002, p. 3-1 (Doc 7-3); Staff Summary Sheet w/1 atch (U), SMC/MTSG to SMC/CV et al., "Time-On-Station (TOS) Waiver for Maj Falkenstein," 12 June 2000; Atch 1 Memo, SMC/CV to AFSPC/DP, "Time-On-Station (TOS) Waiver for Maj Falkenstein," 12 June 2000 (Doc 7-47).

include the MCS, MCSB, RGS-H, RGS-M2 (and its backup RGS-B), RGS-E, RGS-P2, and the M3P. Increment 3 would deploy the SBIRS Low constellation.[28]

SMC awarded modifications and increases to the SBIRS High contract during this time period. The more costly modifications included the following contract adjustments. On 3 February 1998, SMC awarded LMMS a $39,400,000 face value increase to the cost plus award fee contract (F04701-95-C-0017 P00027) to extend the delivery dates for the HEO payloads by three months, and the first three GEO space vehicles and the ground increment by four months. On 4 October 1999, SMC awarded LMMS a $37 million modification to its cost plus award fee contract (F04701-95-C-0017 P00079) to provide the required design and system evaluations for the integration of the SBIRS High and Low components. The work should be complete by 2006. On 23 January 2001, SMC awarded LMMS a $35,713,200 modification to its cost plus award fee contract (F04701-95-C-0017 P00113) to establish an integrated training capability that supported operation of the SBIRS MCS. The work should be complete by 2008.[29]

Around July 1998, LMMS identified 19 August 1998 as the expiration date for the current funding for SBIRS High. LMMS planned to complete the year's tasks with their own funds. In response, on 21 August 1998 the SBIRS SPD sent LMMS a memo stating that LMMS had no obligation to continue performing the SBIRS High contract without additional funding, and the government would not be obligated to reimburse LMMS for any costs in excess of the funds allotted to the contract.[30]

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[28] Single Acquisition Management Plan (SAMP) (U), SMC/MT, "Space Based Infrared System (SBIRS) High Component," 30 June 2002, p. 2-4 (Doc 7-3); Fact Sheet (U), SMC/PA, "Space Based Infrared Systems," January 2001 (Doc 7-4).

[29] Internet Document (U), DefenseLink, "[SBIRS High and Low components]," 4 October 1999, http://www.defenselink.mil/contracts/1999/c10041999_ct460-99.html (Doc 7-48); Internet Document (U), DefenseLink, "[SBIRS integrated training capability]," 23 January 2001, http://www.defenselink.mil/contracts/2001/c01232001_ct037-01.html (Doc 7-49); Document (U), DefenseLink, "[SBIRS High delay Geo Space vehicles...]," 3 February 1998 (Doc 7-50); Document (U), DefenseLink, "[SBIRS Satellite Control System 21 software]," 19 October 1998 (Doc 7-51); News Release (U), AFPN, "Schriever expands mission with SBIRS backup," 13 July 2001, http://www.af.mil/news/Jul2001/n20010713_0955.shtml (Doc 7-52).

[30] Monthly Acquisition Report (U), SMC/MT, "SBIRS High," July 1998 (Doc 7-53); Memo w/1 atch (U), SMC/MT to LMMS et al., "Rules of Engagement for Interacting with Lockheed Martin Missile and Space (LMMS) Prior to the Allotment of Additional Funds, F04701-95-C-0017," 21 August 1998; Atch 1 Statement, SMC/MT to LMMS, "[Concerning Additional Funding for Contract Number F04701-95-C-0017], August 1998 (Doc 7-54); Budget Item Justification Sheet (U), Federation of American Scientists (FAS), "Space Based IR Arch (EMD) (Space)," February 1999 (Doc 7-55).

On 15 September 1998, the Air Force submitted the Budget Estimate Submission (BES) for FY 2000 that had a restructured SBIRS High program and delayed the first GEO launch from 2002 to 2004. The schedule slip occurred so the Air Force could save an estimated $395 million in its FY 2000 budget, and to reduce the funding needs for the SBIRS High Increment 1. The $395 million had to be replaced in the future, in addition to an estimated cost penalty of $400 million about four to six years later. On 1 December 1998, Program Budget Decision 023 acknowledged the Air Force decision to delay the first GEO launch to 2004. The Pentagon decided it could continue depending on DSP for early warning surveillance during the SBIRS delay.[31]

Weeks after the president's FY 2000 defense budget had been submitted, the Pentagon informed Congress that LMMS estimated the SBIRS High costs grew between $240 million to $320 million, independent of the schedule slip. In response to this disclosure, on 2 March 1999 Darleen Druyun, Principal Deputy Assistant Secretary of the Air Force for Acquisition and Management (SAF/AQ), chartered a Joint Estimation Team (JET) comprised of contractor (LMMS), DoD and Air Force personnel to review the SBIRS High contract structure and determine the true cost of the restructured SBIRS High program. On 4 May 1999, the JET briefed its recommendations to restructure the SBIRS High program to the Secretary of the Air Force. The Air Force and the DoD supported the revised schedule and strategy recommended by the JET that delayed the first launch until 2004.[32]

[redacted] In June 1999, the Defense Subcommittee, House Committee on Appropriations did not approve the initial JET proposal to restructure the SBIRS High contract. The Appropriations Committee objected to the strategy to increase hardware concurrency and to the proposed incremental funding of the project rather than the full

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[31] Chronology (U), SMC/MT, "SBIRS High Program," 10 February 2005, pp. 13, 14 (Doc 7-5); Article (U), TSgt Timothy Hoffman, AFSPC/PA, "Senate committee focuses on military space programs, people," Air Force News, 25 March 1999 (Doc 7-56); Memo w/1 atch (U), DEPSECDEF to Office of Management and Budget Director, "[SBIRS High Funding]," 14 April 1999; Atch 1 FY 2000 Budget Amendment, "For Space Based Infrared System (SBIRS)," April 1999, p. 2 (Doc 7-57); Article (U), "House Panel Withholding OK to Initiate Revised SBIRS High Contract," Inside the Air Force, 22 October 1999 (Doc 7-38).

[32] Article (U), "SBIRS High Team Projects Lower Delay Costs Than Contractor Anticipated," Inside the Air Force, 30 April 1999 (Doc 7-58); Chronology (U), SMC/MT, "SBIRS High Program," 10 February 2005, p. 16 (Doc 7-5); Single Acquisition Management Plan (SAMP) (U), SMC/MT, "Space Based Infrared System (SBIRS) High Component," 30 June 2002, p. 3-1 (Doc 7-3); Memo w/1 atch (U), DEPSECDEF to Office of Management and Budget Director, "[SBIRS High Funding]," 14 April 1999; Atch FY 2000 Budget Amendment, "For Space Based Infrared System (SBIRS)," April 1999, p. 6 (Doc 7-57); Article (U), "House Panel Withholding OK to Initiate Revised SBIRS High Contract," Inside the Air Force, 22 October 1999 (Doc 7-38).

funding policy that had normally been used. On 20 July 1999, the House Committee on Appropriations directed (in H.R. Report 106-244) that no more than $100 million of the funds provided for SBIRS High would be obligated until the Secretary of Defense (SECDEF) certified that the production program complied with all DoD funding policies, and that the program concurrency risk had been minimized. The Pentagon modified its acquisition strategy, and the House Appropriations Committee approved the SBIRS High contract restructure. Although the JET provided strategies that minimized the cost increases, delaying the first launch increased the SBIRS High costs by over $500 million. On 17 December 1999, the SBIRS SPO awarded LMMS a $531,117,229 modification to its cost plus award fee contract (F04701-95-C-0017 P00075) to restructure the SBIRS High Engineering and Manufacturing Development Program to reflect the slip of the first launch (GEO 1) from 2002 to 2004. On 18 January 2000, the SECDEF sent a letter to Congress stating that the Air Force would comply with the full-funding policy for production satellites in the SBIRS High acquisition.[33]

On 14 October 1999, the SBIRS SPO halted the combined development testing and operational testing on the Increment 1 ground segment software. The ground segment had software development problems and required more time to reduce the operational risk, to decrease the training and development concurrency, to conduct certification testing, and to show delays in the delivery of equipment provided by the government. The SBIRS SPD declared an acquisition program baseline schedule breach to the Increment 1 software certification threshold date on 22 December 1999. A chartered management assessment team made determinations as to why the breach occurred and identified corrective actions.[34]

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[33] Memo w/1 atch (FOUO), SAF/FMB to Under Secretary of Defense (Comptroller), "PBD 172 - Space Programs," 8 November 1999; Atch Program Budget Decision No. 172 (FOUO), "SBIRS High," circa November1999, pp. 5-6, 19 (Doc 7-59);Chronology (U), SMC/MT, "SBIRS High Program," 10 February 2005, pp. 17, 18, 19 (Doc 7-5); Letter (U), Chairman of the House Appropriations Defense Subcommittee to SECDEF, "Lewis Letter to Cohen on SBIRS High," 10 June 1999 (Doc 7-60); Article (U), "House Panel Withholding OK to Initiate Revised SBIRS High Contract," Inside the Air Force, 22 October 1999 (Doc 7-38); Article (U), Gigi Whitley, "After Months of Debate, Pentagon Tells Congress of New SBIRS Plans," Inside the Air Force, 13 August 1999 (Doc 7-61); Article (U), "House Appropriations Committee Rejects Overhauled SBIRS High Program," Inside the Air Force, 18 June 1999 (Doc 7-62); E-mail w/1 atch (U), Capt Heather McGee, SMC/XPC, to Harry Waldron, SMC/HO, "RE: Gen Lyles visit: 1-2 Jun 00," 8 June 2000; Atch Issue Paper, SMC/MTPP, "The SBIRS compliance with Congressional direction," 19 May 2000 (Doc 7-63); Internet Document (U), DefenseLink, "[SBIRS first launch delay]," 17 December 1999, http://www.defenselink.mil/contracts/1999/c12171999_ct575-99.html (Doc 7-64).

[34] Single Acquisition Management Plan (SAMP) (U), SMC/MT, "Space Based Infrared System (SBIRS) High Component," 30 June 2002, p. 3-1 (Doc 7-3); Chronology (U), SMC/MT, "SBIRS High Program," 10 February 2005, p. 18 (Doc 7-5); Article (U),

LMMS initiated an Over Target Baseline (OTB) in August 2000 that started the Increment 1 recovery plan and various risk reduction proposals. A new SBIRS High spacecraft design and concept of operations was implemented into the technical baseline to recover some of the shortfalls in the Key Performance Parameters. The baseline incorporated technical, cost, and schedule challenges. A Defense Acquisition Executive (DAE) program review occurred on 9 November 2000 to review the SBIRS High program schedules, to endorse program initiatives that reduced schedule risks, to validate updated cost estimates and related funding strategy, and to obtain approval of revised APB thresholds. The overall program strategy and management initiatives received support, but some issues remained relating to cost growth and test strategy. As a result, the proposed APB did not get approved due to the uncertainty of the SBIRS cost.[35]

The SBIRS High program had serious cost and schedule problems that became apparent in early 2001. Test failures and technical issues with the HEO payload were the main problems, but each Integrated Product Team (IPT) also had cost growth. Many of the technical risks inherent in the OTB occurred. By June 2001, the SBIRS SPD had indications that the SBIRS program had significant problems, and in July the SPD estimated a cost overrun of $368 million. LMMS had ongoing problems with cost control, its technical effort, and maintaining program schedules. SMC criticized the ineffective LMMS business management of the program between 1 May 2001 and 30 September 2001, and rated the LMMS overall cost control effort during this time period as unsatisfactory. The inability of LMMS to control costs and its inability to complete many of the significant events during that period led to program scheduling slips and the necessity to restructure the SBIRS High program again after this time period (FY 2001). In September 2001, SMC estimated that the SBIRS High cost overrun could exceed a billion dollars.[36]

"Software Problems, More Tests Delay Start of SBIRS Ground Equipment," Inside the Air Force, 22 October 1999, pp. 9-10 (Doc 7-39).

[35] Single Acquisition Management Plan (SAMP) (U), SMC/MT, "Space Based Infrared System (SBIRS) High Component," 30 June 2002, p. 3-1 (Doc 7-3).

[36] Single Acquisition Management Plan (SAMP) (U), SMC/MT, "Space Based Infrared System (SBIRS) High Component," 30 June 2002, p. 3-1 (Doc 7-3); Staff Summary Sheet w/1 atch (U), SMC/MTI to AFPEO/SP, "SBIRS High Fee Determining Official Period 10 Letter, LMSSC contract # F04701-95-C-0017," 15 January 2002; Atch 1 Memo, AFPEO/SP to Lockheed Martin Missiles & Space Company, Inc., "[SBIRS High Fee Determining Official Period 10]," 14 January 2002 (Doc 7-65); Article (U), Robert Wall, "New Space-Based Radar Shaped By SBIRS Snags," Aviation Week & Space Technology, 18 February 2002 (Doc 7-66); Briefing Charts (U), SMC/MT, "SBIRS Lessons Learned Overview," 22 October 2002, pp. 4, 24 (Doc 7-67).

In August 2001, the Increment 2 System Critical Design Review occurred and formed the technical basis for a preliminary "quick look" Estimate at Completion (EAC) analysis in October 2001. The EAC analysis provided the initial step in the process to determine a realistic estimate of the total program costs. Initial findings indicated substantial cost growth and schedule delays. It would be determined that SBIRS High had exceeded its budget by $2 billion and would have a schedule delay of another two years. The reactions and responses to the excess costs and the schedule slip would occur in FY 2002.[37]

SBIRS Low

SBIRS Low would provide Over-the-Horizon (OTH) mid-course missile tracking to enable ballistic missile defense of CONUS and theater. The technological basis for the low-altitude follow-on system to provide tracking and discrimination data for missiles in the middle portion of their trajectories had also been a Strategic Defense Initiative (SDI) program. It had been known as the Space Surveillance and Tracking System (SSTS) during the mid and late 1980s. After that, it went through several restructurings and changes in concept as its planned constellation of satellites became smaller and cheaper. In July 1990, the SDI Organization (SDIO) renamed the program Brilliant Eyes. By 1992, Brilliant Eyes became a simpler system as interest shifted from protection against a massive attack of Soviet strategic missiles toward protection against a small number of shorter range, third-world missiles. By FY 1995, the concept for a SBIRS system using Low Earth Orbit (LEO) infrared sensors to track missiles in the middle portion of their trajectories became known as SBIRS Low.[38]

National Missile Defense

The 1998 Rumsfeld Commission (chaired by former Secretary of Defense Donald Rumsfeld) concluded in July 1998 that the possibility of a nuclear ballistic missile attack against the US was more serious and evolved than the intelligence community had estimated. Rogue states such as North Korea and Iran posed a growing threat to the US. Secretary of Defense (SecDef) William Cohen acted upon the conclusions of the Rumsfeld Commission. On 22 July 1999, the National Missile Defense Act of 1999 (Public Law 106-38) was signed into law. The law committed the US to deploying an effective National Missile Defense (NMD) system, as soon as technologically possible, that could defend the territory of the US against a limited ballistic missile attack. The initial primary mission of the NMD program in 1999 was the defense of the US (all 50 states) against the threat of a limited strategic ballistic missile attack by a rogue nation.

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[37] Single Acquisition Management Plan (SAMP) (U), SMC/MT, "Space Based Infrared System (SBIRS) High Component," 30 June 2002, pp. 1-1, 3-1 (Doc 7-3).

[38] History of SMC (FOUO, extract is not FOUO), October 1994 - September 1997, pp. 121-122; Document (U), SMC/MT, "SBIRS Low," Printed 13 April 2000, (Doc 7-68).

The NMD would detect the launch of attacking ballistic missiles, track their progress in flight, then engage and destroy the ballistic missile warheads above the earth's atmosphere.[39]

SBIRS Low would augment the NMD program's Capability-3 (C3) architecture by tracking any launched ballistic missiles heading towards the US. In 1993, the Clinton administration renamed the SDIO as the Ballistic Missile Defense Organization (BMDO). The SBIRS SPO worked together with the BMDO during the SBIRS Low acquisition so both organizations could have the requirements they needed from SBIRS Low. The 7 May 1999 Memorandum of Agreement (MOA) between the SBIRS SPO and BMDO assigned a liaison officer from the SBIRS SPO to the BMDO at the Pentagon. The liaison officer provided communications between the SPO and the BMDO by representing the SBIRS program to the BMDO, and representing the BMDO activities to the SBIRS SPO.[40]

Segments

The concept for SBIRS Low continued to evolve, driven by the work of TRW and Rockwell under the Brilliant Eyes contracts and the work of the program office to shape the acquisition and schedule. By 1997, the concept for an operational system included four segments: a launch segment, a space segment, a ground segment, and a support

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[39] Internet Document (U), Federation of American Scientists (FAS), "National Missile Defense," 27 June 2000, http://www.fas.org/spp/starwars/program/nmd (Doc 7-69); Internet Document (U), MissileThreat.com, "National Policy on Ballistic Missile Defense Act of 1999," circa June 1999, http://missilethreat.com/law/federal/nmdact99.html (Doc 7-70); Internet Document (U), Senate, "National Missile Defense Act of 1999," 18 May 1999 (Doc 7-71); Internet Document (U), Library of Congress, "House Report 106-039 Purpose and Background," circa June1999 (Doc 7-72); Internet Document (U), White House, "National Policy on Ballistic Missile Defense Fact Sheet," 20 May 2003, http://www.whitehouse.gov/news/releases/2003/05/print/20030520-15.html (Doc 7-73); Internet Document (U), DefenseLink, "Cohen Announces Plan to Augment Missile Defense Programs," 20 January 1998, http://www.defenselink.mil/news/Jan1999/b01201999_bt018-99.html (Doc 7-74).

[40] Internet Document (U), Wikipedia, "Ballistic Missile Defense Organization (BMDO)," 14 June 2006, http://www.wikipedia.org/wiki/Ballistic_Missile_Defense_Organization (Doc 7-75); Internet Document (U), Federation of American Scientists (FAS), "National Missile Defense," 27 June 2000, http://www.fas.org/spp/starwars/program/nmd (Doc 7-69); Article (U), "SBIRS Low Requirements on the Table for Trade Studies," Defense Daily 19 October 1999 (Doc 7-76); Article (U), Amy Butler, "Contractors Estimate SBIRS Low Costs are Within Air Force's Budget," Inside Missile Defense, 20 September 2000 (Doc 7-77); Memorandum of Agreement (MOA) (U), SMC/MT and BMDO, "Space Based Infrared System Program Office Liaison Officer at Ballistic Missile Defense Organization," 7 May 1999 (Doc 7-78).

segment. The launch segment would employ Delta II launch vehicles that would launch three LEO satellites at a time.[41]

The ground segment would build on the overall SBIRS ground segment that had been under development for the SBIRS High portion of the architecture since 8 November 1996. The unique software and equipment for SBIRS Low would be developed during its Engineering and Manufacturing Development (EMD) Phase as a discrete addition (referred to as a "plug") to the basic MCS developed under SBIRS High. The result would be a consolidated SBIRS ground processing station.[42]

The SBIRS Low space segment would consist of about 24 LEO satellites. Although their low altitude would require a greater number of satellites in orbit to provide adequate coverage of the earth, their proximity to potential targets would make it easier for their sensors to acquire longwave infrared radiation from missiles in mid-flight and to provide surveillance of theaters of conflict at higher resolutions.[43]

Each satellite would have two primary infrared sensors. They would cover a wide part of the electromagnetic spectrum, enabling them to observe targets of different temperatures. They would also be able to conduct surveillance of space objects and battlefields. The first sensor, the Acquisition Sensor, would be a scanning infrared sensor operating in the shorter wavelengths. It would cover the visible area in a fast scan mode from horizon to horizon, using a wide field of view and a small aperture to acquire missile targets during their boost phase. After the Acquisition Sensor initiated a two-dimensional track of the target, it would then pass information about the target to the Tracking Sensor.[44]

The Tracking Sensor would be a staring infrared sensor with a narrow field of view and large aperture that would be mounted on a two-axis gimbal. After receiving the target from the Acquisition Sensor, it would verify the target, lock on to it, and track it through midcourse trajectory into re-entry. If a target left a given satellite's field of view, that satellite would use an inter-satellite crosslink to hand off the target to another satellite in a better viewing position. This crosslink would enable any satellite to communicate with all other satellites in the constellation.[45]

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[41] History of SMC (FOUO, extract is not FOUO), October 1994 - September 1997, p. 122.

[42] *Ibid* (FOUO, extract is not FOUO), p. 123.

[43] *Ibid* (FOUO, extract is not FOUO), p. 123; Fact Sheet (U), SMC/PA, "Space Based Infrared Systems," January 2001, (Doc 7-4).

[44] History of SMC (FOUO, extract is not FOUO), October 1994 - September 1997, pp. 123-124.

[45] *Ibid* (FOUO, extract is not FOUO), pp. 124-125.

The satellites' on-board data processors would determine the target missile's trajectory, predict its impact point, and relay the information to the NMD ground-based interceptor (GBI) missile sites that would intercept and destroy the target. The SBIRS Low sensors would cover a wider area than the ground-based radars used to aim any particular anti-missile weapons. They would allow such GBI missile sites to take several shots at any given hostile missile, and to do so at a safer range.[46]

Acquisition

In 1998, Phase I of the SBIRS Low acquisition was scheduled to begin during the first quarter of FY 1999 and end in the first quarter of FY 2001. The SBIRS SPO contracted for two SBIRS Low Flight Demonstration System (FDS) satellites to validate the program capabilities to detect and track ballistic missiles throughout flight, to distinguish between missile warheads and decoys, and to perform kill assessments. On 2 May 1995, SMC awarded the FDS flyer contract to TRW to design and build two FDS satellites to be launched together on a Delta II launch vehicle in FY 1999. The actual contractual mechanism was a restructuring of the Brilliant Eyes Demonstration and Validation Contract (FO4701-92-C-0062). The additional work had a value of $15.314 million. On 8 March 1996, SMC added another $214.1 million to the contract to cover the remaining provisions for fabrication, test, and operation of two FDS satellites to validate the Space and Missile Tracking System (SMTS), as SBIRS Low was sometimes called.[47]

The SBIRS SPO issued another flyer contract to make Phase I more competitive. On 2 September 1996, SMC awarded the contract (FO4701-96-C-0044) to Boeing North American to conduct this risk reduction effort as a cost-effective alternate design concept for SBIRS Low. The product of Boeing North American's efforts was known as the Low

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[46] *Ibid* (FOUO, extract is not FOUO), p. 125; Internet Document (U), Federation of American Scientists (FAS), "National Missile Defense," 27 June 2000, http://www.fas.org/spp/starwars/program/nmd (Doc 7-69).

[47] History of SMC (FOUO, extract is not FOUO), October 1994 - September 1997, pp. 125-127; Briefing Charts (U), SMC/MTAS, "SBIRS Industry Day (RFP Update)," 21 April 1998, p. 5 (Doc 7-79); Internet Document (U), Gunter's Space Page, "SBIRS-Low-FDS 1, 2," 16 June 2006, http://space.skyrocket.de/doc_sdat/sbirs-low-fds.htm (Doc 7-80); Report (U), General Accounting Office (GAO), "Space-Based Infrared System-Low at Risk of Missing Initial Deployment Date," February 2001, p. 24 (Doc 7-81); Internet Document (U), DefenseLink, "[FDS Hardware and Software Modifications]," 26 February 1998, http://www.defenselink.mil/contracts/1998/c02261998_ct087-98.html (Doc 7-82); Internet Document (U), DefenseLink, "[Definitize the FDS Contract]," 7 April 1998, http://www.defenselink.mil/contracts/1998/c04071998_ct157-98.html (Doc 7-83).

Altitude Demonstration System (LADS). Boeing planned to launch the LADS satellite on a Lockheed Martin booster, and it would also operate a ground demonstration payload.[48]

The Air Force scheduled the launch of the two FDS satellites and the LADS satellite for the third quarter of FY 1999. They were not prototype SBIRS satellites. The Air Force planned for the demonstration satellites to provide a year of on-orbit testing that would have verified the SBIRS Low concept. In October 1998, SMC announced that the launch schedule for the two FDS satellites had slipped from October 1999 until an undetermined date in 2000.[49]

[redacted] Although the sensors and satellites for the FDS and LADS demonstration satellites neared completion, the Air Force terminated the two contracts at the convenience of the government on 5 February 1999. The Air Force halted the contracts due to a major change in the risk reduction strategy that shifted the emphasis from on-orbit functional demonstrations to concentrating on mitigating the risks directly related to the development of the operational system. The Air Force also wanted to avoid the likely cost and schedule impacts to the deployment of the operational SBIRS Low component that could occur if the projects continued. The contracts had schedule slips and significant cost overruns estimated to have reached $79 million, and the recovery plans were inefficient. The Air Force determined that it had gained enough information from the demonstration satellite projects, and didn't need to spend its limited funds launching the satellites. Instead of depending on information from the cancelled demonstration satellites, the SPO intended to base its decision to enter SBIRS Low into

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[48] History of SMC (FOUO, extract is not FOUO), October 1994 - September 1997, p. 127.

[49] *Ibid* (FOUO, extract is not FOUO), p. 127; Report (U), General Accounting Office (GAO), "Space-Based Infrared System-Low at Risk of Missing Initial Deployment Date," February 2001, pp. 9, 26 (Doc 7-81); Statement (U), Lt Gen Lester Lyles (Director BMDO) to Subcommittee on Strategic Forces Committee on Armed Services US Senate, "[DoD NMD Program]," 24 February 1999, pp. 8, 10 (Doc 7-84); Internet Document (U), Space Daily, "Integration and Test of SBIRS-Low Satellite Begins," 26 August 1998, http://www.spacedaily.com/news/sbirs-98a.html (Doc 7-85); Article (U), "SBIRS Flight Test, Contracts Delayed Again," Satellite News, 26 October 1998 (Doc 7-86); Article (U), "Raytheon, TRW Finish payload Sensors Fabrication on Air Force SBIRS Project," Satellite News, 25 January 1999 (Doc 7-87); Monthly Acquisition Report (U), SMC/MT, "SBIRS Low," January 1998 (Doc 7-88); Monthly Acquisition Report (U), SMC/MT, "SBIRS Low," July 1998 (Doc 7-89); Internet Document (U), Gunter's Space Page, "SBIRS-LADS," 14 June 2006, http://space.skyrocket.de/index_frame.htm?http://space.skyrocket.de/doc_sdat/sbirs-lads.htm (Doc 7-90).

the EMD and production phases based on information obtained from ground-based testing and various on-orbit demonstrations to confirm the satellite design.[50]

In 1994, SMC planned to launch the first SBIRS Low satellite in 2006, but Congress mandated that the schedule be accelerated to 2004. On 15 September 1998, the Air Force submitted its Budget Estimate Submission (BES) for FY 2000. The Research Development Test and Evaluation (RDT&E) Budget Item Justification Sheet had a restructured SBIRS Low program with the first LEO launch delayed from FY 2004 to FY 2006. The Air Force assessed that the 2004 launch date would be too risky and impractical due to technical and scheduling problems. The Air Force also pointed out that BMDO did not plan to deploy the NMD systems until 2006, and the DSP missile warning satellites continued to last longer than expected. The Congressional Research

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[50] Memo draft (FOUO), SMC/MTKA to SAF/AQC, "Contract Termination, 1412 Report, Boeing North American, Inc. Contract F04701-96-C-0044," circa January 1999 (Doc 7-91); Document (U), SMC/MT, "SBIRS Master Schedule," 2 December 1999 (Doc 7-92); Memo draft (FOUO), SMC/MTKA to SAF/AQC, "Contract Termination, 1412 Report, TRW, Inc. Contract F04701-92-C-0062," circa January 1999 (Doc 7-93); Memo w/1 atch (U), SMC/MT to AFPEO/SP et al., "Rules of Engagement for Interacting with Boeing North American, Inc. (BNA) Prior to the Allotment of Additional Funds, F04701-96-C-0044," 1 September 1998; Atch 1 Statement, SMC/MT to Boeing, "[Concerning Additional Funding for Contract Number F04701-96-C-0044], September 1998 (Doc 7-94); Article (U), Warren Ferster, "SBIRS Demonstration Projects Terminated," Space News, 15 February 1999, p. 1 (Doc 7-95); E-mail (U), Col Christopher Pelc, SMC/ISM, to Susan Swift, SMC/ISA, "FW: Livelink access Request for SMC History [FDS satellite contract]," 18 May 2006 (Doc 7-96); E-mail (U), Zorin Alexander, SAF/USAE, to Susan Swift, SMC/ISA, "[FDS Cancellation] RE: MOA Transferring Low to MDA," 19 May 2006 (Doc 7-97); Briefing Charts (FOUO), SMC/MT, "USD(A&T) Decision Briefing SBIRS Low Execution," 20 January 1999, pp. 1, 7, 8 (Doc 7-98); Statement (U), Lt Gen Lester Lyles (Director BMDO) to Subcommittee on Strategic Forces Committee on Armed Services US Senate, "[DoD NMD Program]," 24 February 1999, p. 9 (Doc 7-84); Article (U), James Peltz and Jeff Leeds, "Air Force Cancels Pacts With TRW and Boeing," Los Angeles Times, 6 February 1999, p. C1 (Doc 7-99); Article (U), "Air Force Asked to Reinstate Satellite Program," Los Angeles Times, 16 February 1999 (Doc 7-100); Article (U), "Flight-Test Debate Hinders SBIRS Low Design Awards," Space News, 5 July 1999, pp. 8-9 (Doc 7-101); Article (U), "Boeing Ponders Options Over Cancellation of SBIRS Low," Defense Daily, 9 February 1999 (Doc 7-102); Article (U), "Air Force Surprises Industry with SBIRS Low Award to Spectrum Astro," Inside the Air Force, 20 August 1999, p. 1 (Doc 7-103); Article (U), "Pentagon Decision on SBIRS Low Program is Delayed Until Funding Found," Inside the Air Force, 29 January 1999 (Doc 7-104); Article (U), "AF restructures Space Based Infrared System," Astro News, 12 February 1999, p. 1 (Doc 7-105); Report (U), General Accounting Office (GAO), "Space-Based Infrared System-Low at Risk of Missing Initial Deployment Date," February 2001, p. 9 (Doc 7-81).

Service stated in 2006 that funding issues were the primary reason for the schedule slip. Members of Congress complained because the Air Force delayed SBIRS Low without consulting Congress first. The House Intelligence Committee criticized both the delay in the schedule and the large cost growth that would result. Around May 1999, the House Intelligence Committee recommended that the management of SBIRS High and Low should be transferred from the Air Force to BMDO.[51]

The Phase I Program Definition (PD) effort proceeded at the same time as the FDS contract. The PD would provide for the initial system design that would be used to develop, manufacture, deliver, operate and sustain the LEO component of the SBIRS System-of-Systems (SoS) architecture. As a minimum, the design had to satisfy the objectives in the SBIRS Operational Requirements Document (ORD) as assigned to the Low Component in the SBIRS Requirements Allocation Document (RAD). The Air Force would conduct a source selection for the Engineering and Manufacturing Development (EMD) effort as the PD neared its completion. The successful conclusion of the PD objectives would support a Milestone II decision to enter into EMD.[52]

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[51] History of SMC (FOUO, extract is not FOUO), October 1994 - September 1997, pp. 127-128; Chronology (U), SMC/MT, "SBIRS High Program," 10 February 2005, p. 13 (Doc 7-5); Budget Item Justification Sheet (U), Air Force, "Space Based Infrared Sys(SBIRS) Low," February 1999 (Doc 7-106); Article (U), "Gen Estes: Moving SBIRS to BMDO 'A Bad Idea'," Defense Daily, 19 May 1999 (Doc 7-107); Statement (U), Lt Gen Lester Lyles (Director BMDO) to Subcommittee on Strategic Forces Committee on Armed Services US Senate, "[DoD NMD Program]," 24 February 1999, p. 9 (Doc 7-84); Presentation (U), Keith Hall (Director NRO) to Subcommittee on Strategic Forces Committee on Armed Services US Senate, "Space Policy, Programs and Operations," 22 March 1999, p. 2 (Doc 7-108); Report (U), Congressional Research Service (CRS), "Issues Concerning DOD's SBIRS and STSS Programs," 30 January 2006, p. 5 (Doc 7-109); Article (U), Robert Wall, "Pentagon Delays SBIRS Launches," Aviation Week, 18 January 1999, p. 26 (Doc 7-110); Article (U), Lisa Burgess, "SBIRS Delay?," Defense News, 5-11 October 1998, p. 4 (Doc 7-111).

[52] Briefing Charts (U), SMC/MTAS, "SBIRS Industry Day (RFP Update)," 21 April 1998, p. 5 (Doc 7-79); Request for Proposal (RFP) (U), SMC/MT, "RFP F04701-98-R-0006 SBIRS Low Component - Program Definition (PD) Effort," 23 July 1998, p. 21 (Doc 7-29); Internet Document (U), Federation of American Scientists (FAS), "Space Based Infrared System – Low Space and Missile Tracking System Brilliant Eyes," 31 August 1999, p. 3 http://www.fas.org/spp/military/program/warning/smts.htm (Doc 7-112); Statement of Objectives (SOO) (U), SMC/MT, "RFP F04701-98-R-0006 SBIRS Low Component," 1998 (Doc 7-113); Briefing Charts (U), SMC/MT, "SBIRS Low RFP and Source Selection Overview," 14 July 1998, p. 4 (Doc 7-114); News Release (U), SMC/MT, "Space Based Infrared System Contract Award," 18 August 1999 (Doc 7-115); Briefing Charts (U), SMC/MT, "SBIRS Low DAB Status Industry Day #5," 13 July 1998 (Doc 7-116).

SMC released a Request for Proposal (RFP) (F04701-98-R-0006) on 23 July 1998 for the SBIRS Low Component PD effort. The interested contractors had to respond by 2 September 1998 with their proposals. SMC negotiated for the contract until 21 May 1999. On 16 August 1999, SMC awarded a $275 million firm fixed-price contract to the TRW Space and Electronics Group (F04701-99-C-0047), and a $275 million firm fixed-price contract to the to Spectrum Astro Incorporated (F04701-99-C-0048) to conduct what the Air Force now called the Program Definition and Risk Reduction (PDRR) effort for SBIRS Low. The 38-month contract had an expected completion date in October 2002.[53]

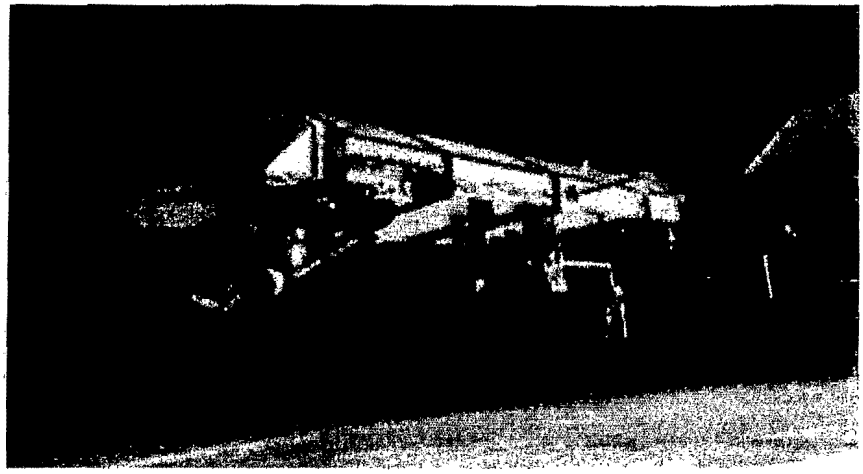

Illustration 7-6: SBIRS Low Design by Spectrum Astro/Northrop Grumman

The TRW Space and Electronics Group and Spectrum Astro Incorporated added different aerospace companies to their SBIRS Low PDRR efforts. Spectrum Astro teamed with Northrop Grumman. Spectrum Astro (prime contractor) led the team's design effort and had the responsibility for the spacecraft and the overall system architecture. Northrop Grumman led the Mission IPT that had the responsibility for the overall mission sensor design, related ground system data processing and ground segment

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[53] Monthly Activity Report (U), SMC/MT, "SBIRS Low," July 1998 (Doc 7-117); Request for Proposal (RFP) (U), SMC/MT, "RFP F04701-98-R-0006 SBIRS Low Component - Program Definition (PD) Effort," 23 July 1998, p. 21 (Doc 7-29); Internet Document (U), DefenseLink, "[SBIRS Low Component PD Contracts]," 17 August 1999, http://www.defenselink.mil/contracts/1999/c08171999_ct385-99.html (Doc 7-118); Article (U), "TRW/Raytheon Give Space Spy Definition," Space Daily, 18 August 1999, http://www.spacedaily.com/news/sbirs-99a.html (Doc 7-119); Article (U), "Top DoD Officials Visit Air Force Facility to Assess SBIRS Low Strategy," Inside the Air Force, 9 July 1999 (Doc 7-120); Article (U), "Air Force Surprises Industry with SBIRS Low Award to Spectrum Astro," Inside the Air Force, 20 August 1999, p. 1 (Doc 7-103); Article (U), "Despite Contract Awards, Open Competition for SBIRS Low EMD Planned," Inside the Air Force, 27 August 1999 (Doc 7-121); Monthly Activity Report (U), SMC/MT, "SBIRS Low," May 1998 (Doc 7-122).

integration. The Spectrum Astro/Northrop Grumman team also included Boeing, Lockheed Martin, Litton TASC, Logican, Analex Corporation, ITT Industries, and the Space Dynamics Laboratory of Utah State University. During the week of 23 April 2001, Spectrum Astro/Northrop Grumman completed its SBIRS Low System Design Review (SDR). The next milestone would be the Preliminary Design Review (PDR) scheduled for early 2002.[54]

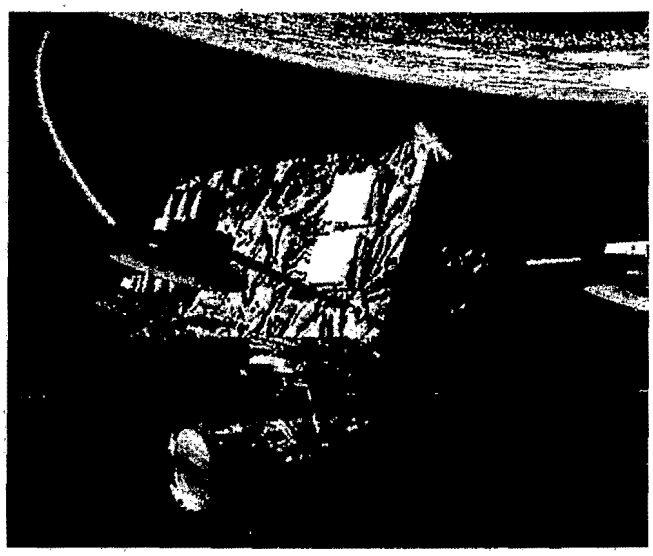

Illustration 7-7: SBIRS Low Design by TRW/Raytheon

TRW teamed with Raytheon for the SBIRS Low PDRR effort. The TRW/Raytheon team also included Aerojet, Motorola, Agilent, Honeywell, Ball Aerospace & Technologies, Sparta and PRA. By early April 2001, TRW/Raytheon completed its SDR for SBIRS Low.[55]

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[54] Internet Document (U), "Lockheed Martin and Boeing Join Spectrum Astro Northrop Grumman SBIRS Low Team," Space Daily, 19 March 2001, http://www.spacedaily.com/news/sbirs-01a.html (Doc 7-123); Internet Document (U), "TRW/Raytheon SBIRS Low Team Completes Initial System Design," Space Daily, 9 April 2001, http://www.spacedaily.com/news/sbirs-01b.html (Doc 7-124); Internet Document (U), "Spectrom Astro/Northrop Grumman Complete SBIRS Low Review," Space Daily, 7 May 2001, http://www.spacedaily.com/news/sbirs-01c.html (Doc 7-125); Internet Document (U), "Air Force Needs to 'Freeze' SBIRS Low Requirements," Inside the Air Force, 16 June 2000 (Doc 7-126).

[55] Internet Document (U), "Aerojet To Help Manage New Early Warning System Development," Space Daily, 22 November 1999, http://www.spacedaily.com/news/sbirs-99b.html (Doc 7-127); Internet Document (U), "TRW/Raytheon Puts the Scope SBIRS Program," Space Daily, 18 May 2000, http://www.spacedaily.com/news/sbirs-00a.html (Doc 7-128); Internet Document (U), "TRW/Raytheon SBIRS Low Team Completes Initial System Design," Space Daily, 9 April 2001, http://www.spacedaily.com/news/sbirs-01b.html (Doc 7-124).

SMC intended Phase II of the SBIRS Low acquisition (the EMD) to begin after the completion of the PDRR effort. SMC planned to award the EMD contract through a rolling downselect procedure. The EMD effort would have a single contractor to develop, deploy, and sustain the military operations of the SBIRS Low system. SMC planned the acquisition of this architecture to proceed in four increments as written in the 1 October 1996 SBIRS Single Acquisition and Management Plan (SAMP). Increment 1 would consolidate the DSP Attack Launch Early Report to Theater (ALERT) and the Joint Tactical Ground Station (JTAGS) ground stations. Increment 2 would be the deployment of the SBIRS High Block I. Increment 3 would add the SBIRS Low capabilities to the SoS architecture. Increment 4 would update the SBIRS High/Low system as needed to provide the best value to the government. The SBIRS Low program would be restructured in 2002.[56]

SecDef Cohen stated in August 1999 that the Pentagon planned to use the first six SBIRS Low satellites to obtain early on-orbit experience and to evaluate the performance of the system. The Pentagon intended to evaluate the performance of the first six satellites for a year while it concurrently purchased parts and manufactured the satellites that followed. The remainder of the LEO satellites would then begin launching after the one-year evaluation. SecDef Cohen stated that this approach would provide more complete and meaningful on-orbit data than the cancelled FDS and LADS demonstration satellites would have, and it would field the operational system at the earliest possible date. Cohen stated that this approach included concurrency between the on-orbit testing and satellite production, but he balanced the risk against the opportunity to deploy the system in a timely manner.[57]

In February 2001, the US General Accounting Office (GAO) issued a report (GAO-01-6) that evaluated the plans and progress of the SBIRS Low program. The GAO conducted its research between May 1999 and December 2000. The report concluded that the SBIRS Low acquisition schedule had a high risk of not delivering the system on time, at cost, or with the expected performance. The GAO had concerns about

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[56] Briefing Charts (U), SMC/MTAS, "SBIRS Industry Day (RFP Update)," 21 April 1998, p. 5 (Doc 7-79); Request for Proposal (RFP) (U), SMC/MT, "RFP F04701-98-R-0006 SBIRS Low Component - Program Definition (PD) Effort," 23 July 1998, pp. 20-21 (Doc 7-29); Internet Document (U), Federation of American Scientists (FAS), "Space Based Infrared System – Low Space and Missile Tracking System Brilliant Eyes," 31 August 1999, p. 3 http://www.fas.org/spp/military/program/warning/smts.htm (Doc 7-112); Briefing Charts (U), SMC/MT, "Space Based Infrared Systems," 27 June 2002, p. 10 (Doc 7-129).

[57] Article (U), Gigi Whitley, "After Months of Debate, Pentagon Tells Congress of New SBIRS Plans," Inside the Air Force, 13 August 1999 (Doc 7-61).

the lack of on-orbit testing of SBIRS Low satellites prior to production, the delays in the SBIRS Low system software, and the technical risks of the program.[58]

The SBIRS SPO disagreed with the conclusions of the GAO, and wrote that the GAO had reviewed an outdated acquisition strategy that had been revised and no longer existed. The SPO asserted that the Air Force had completely restructured the SBIRS Low acquisition strategy to considerably reduce concurrency and significantly reduce the risk of meeting the 2006 first launch. The revised strategy intended to reduce concurrency by increasing the on-orbit evaluation period to two years and spacing out the launches. The Air Force received approval for the revised strategy at a 14 December 2000 Defense Acquisition Review.[59]

The GAO had apprehension about the cancellation of the FDS and LADS demonstration satellites that would have provided a year of data and on-orbit testing of the satellite's functions and capabilities. These test results traditionally finalized the design of new satellites prior to production, but the on-orbit tests for SBIRS Low were not scheduled for completion until 2008, over five years after production of the satellites was planned to begin. If the Air Force identified design changes as a result of the 2008 testing, these changes would have to be integrated into satellites already under production. Parts that had already been purchased based on the initial design could be obsolete and need to be replaced with new parts, increasing program costs and causing schedule delays.[60]

The SPO stated that the GAO analyzed an outdated approach that had already been revised concerning the plan to finalize the SBIRS Low satellite design. The SPO planned to complete the satellite design earlier in the development program by conducting comprehensive, more cost-effective ground-based testing. The SPO planned for a two-year on-orbit test period as the integrated risk management plan. This approach began with the PDRR program to identify, develop, and implement risk management plans for various areas of the program. The SPO implemented a Ground Demonstration Program (GDP) during the PDRR as a risk reduction effort and to mature the satellite design. During the EMD phase of the program, the GDP would continue its central focus

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[58] Report (U), General Accounting Office (GAO), "Space-Based Infrared System-Low at Risk of Missing Initial Deployment Date," February 2001, pp. 4-5, 21 (Doc 7-81).

[59] Memo (U), SMC/MT to PEO/SP et al., "SBIRS Program Office Response to GAO Report," 1 March 2001 (Doc 7-130); Briefing Charts (U), SMC/MT, "SBIRS Low Overarching IPT," 6 December 2000, pp. 17-19, 21, 23 (Doc 7-131); Article (U), Jeremy Singer, "Air Force Official Slams GAO Report about SBIRS Low," Space News, 12 March 2001, pp. 3, 20 (Doc 7-132).

[60] Report (U), General Accounting Office (GAO), "Space-Based Infrared System-Low at Risk of Missing Initial Deployment Date," February 2001, pp. 3-4 (Doc 7-81).

on validating the performance of the various SBIRS Low components on the ground. The on-orbit test period would prove the on-orbit performance of the capabilities that could not be verified during the GDP. The results of the on-orbit tests would be used mainly to refine software algorithms used on board the spacecraft and the ground stations. The SPO concluded that the GAO assertion that the on-orbit testing would finalize the design had been incorrect, because the satellite design would be finalized and most of the testing accomplished long before the first launch.[61]

The GAO stated that in December 1999 the SPO concluded it could not complete the software needed to perform all the SBIRS Low missions a year before the scheduled first launch of the LEO satellites. The delay in the software schedule occurred due to an underestimation of the level and complexity of the effort. To maintain the FY 2006 first launch schedule, the SPO planned to use an evolutionary approach to develop the software in increments. The software needed to support the SBIRS Low missions was scheduled for completion in March 2010, more than three years after the planned first launch. The GAO had concerns that the schedule increased the risk that the software might not be available when needed or perform as required. The GAO wrote that the Air Force traditionally completed the software required to support a new satellite system a year before the first launch in order to reduce the risk by ensuring that the system's problems had been resolved, and the operators of the systems had been adequately trained. This had been the original schedule and plan for the SBIRS Low program. The evolutionary approach would develop the software to support the satellite launches, early on-orbit testing, ballistic missile defense, and the integration with SBIRS High, followed by the software required to support ancillary missions, such as technical intelligence, space surveillance, and battlespace characterization.[62]

The GAO report summarized the SPO schedule for the SBIRS Low software increments. The first two increments of software should be completed for the on-orbit test period for the first six SBIRS Low satellites in FY 2007. The two increments of software would provide all of the capabilities the ground control system and the satellites would need to conduct the on-orbit testing. The third increment, the ground control and space related software needed to operate the satellite constellation in support of ballistic missile defense, was scheduled for completion in FY 2008. The fourth software increment, scheduled for completion in mid-FY 2009, would integrate SBIRS Low with SBIRS High. The fifth increment, scheduled for completion in mid-FY 2010, would add

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[61] Memo (U), SMC/MT to PEO/SP et al., "SBIRS Program Office Response to GAO Report," 1 March 2001 (Doc 7-130); Briefing Charts (U), SMC/MT, "SBIRS Low Overarching IPT," 6 December 2000, pp. 26-27 (Doc 7-131); Article (U), Jeremy Singer, "Air Force Official Slams GAO Report about SBIRS Low," Space News, 12 March 2001, pp. 3, 20 (Doc 7-132).

[62] Report (U), General Accounting Office (GAO), "Space-Based Infrared System-Low at Risk of Missing Initial Deployment Date," February 2001, pp. 3-4, 12 (Doc 7-81); Article (U), Richard Newman, "Space Watch, High and Low," Air Force Magazine, July 2001, pp. 35-38 (Doc 7-21).

the software needed for SBIRS Low to conduct the ancillary missions. In 2001, the government estimated that the software required to support SBIRS Low had grown from 900,000 lines of code to over three million.[63]

The SPO disputed the GAO report's concerns about the software schedule. The SPO stated that the evolutionary software approach reduced the risk that the software would be available when needed and would perform as required. It also contradicted the GAO by stating the evolutionary development plan had been the industry standard and consistent with DoD Directive 5000.1 and DoD Instruction 5000.2 that endorsed the evolutionary acquisition strategies as the preferred approach to satisfy operational requirements. The SPO stressed that each software deployment would be enough to fully support the existing missions and hardware until the deployment of the next software increment. The software would be ready for testing one year prior to delivery and deployment. The evolutionary approach deployed the software as required to keep pace with the deployed system, so that the system capability grew steadily with hardware and software. The evolutionary software deployment plan reduced the software development schedule by matching the software development schedule with the satellite deployment schedule. The Air Force presented this approach to the Under Secretary of Defense for Acquisition and Technology [USD (AT&L)] in spring 2000 who endorsed the approach. On 14 December 2000, the DoD also responded to the GAO report and stated that the evolutionary approach reduced the schedule risk because having the software completed by the first launch would not be achievable.[64]

The GAO stated that the SBIRS Low program had high technical risks. SBIRS Low required six critical technologies to be in place for the system to function correctly. In the GAO report, the SPO rated five of the six most critical satellite technologies as immature for the current stage of the program, and at high risk levels for availability when needed or to perform as required. The technology readiness level should have been at readiness level six for each of the technologies when SBIRS Low began its PDRR phase in 1999. The SPO provided the following technology readiness level ratings: the scanning infrared sensor that would acquire ballistic missiles in the early stages of flight (readiness level four); the tracking infrared sensor that would track missiles, warheads,

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[63] Report (U), General Accounting Office (GAO), "Space-Based Infrared System-Low at Risk of Missing Initial Deployment Date," February 2001, pp. 13-14 (Doc 7-81); Report (U), Congress, "(107-298) Department of Defense Appropriations Bill, 2002 and Supplemental Appropriations, 2002," 19 November 2001, p. 250 http://thomas.loc.gov/cgi-bin/cpquery/T?&report=hr298&dbname=107& (Doc 7-133).

[64] Memo (U), SMC/MT to PEO/SP et al., "SBIRS Program Office Response to GAO Report," 1 March 2001, (Doc 7-130); Report (U), General Accounting Office (GAO), "Space-Based Infrared System-Low at Risk of Missing Initial Deployment Date," February 2001, p. 32 (Doc 7-81); Article (U), Jeremy Singer, "Air Force Official Slams GAO Report about SBIRS Low," Space News, 12 March 2001, pp. 3, 20 (Doc 7-132).

and other objects such as decoys during the middle and later stages of flight (readiness level four); the fore optics cryocooler (readiness level four) and the tracking infrared sensor cryocooler (readiness level four) that would be required to cool the tracking sensor optics and other sensor components to allow the sensor to detect missile objects in space; the satellite communications crosslinks that would enable the satellites to communicate with each other (readiness level five); and the on-board computer processors needed to perform the complex satellite operations for providing missile warning and location information in brief timeframes (readiness level six).[65]

The SBIRS SPO stated the GAO's claims about high technical risks were misleading. The SPO had confidence that the PDRR program would mitigate the technology risk. The PDRR planned for more time (38 months) than comparable acquisition programs and its risk reduction effort was well funded and competitive. The Air Force and the PDRR contractors provided funding to reduce the technical risk of SBIRS Low. In 2001, the Air Force planned to spend over $200 million on the development of SBIRS Low and accelerate the technology. The SPO reported that substantial progress had been accomplished on the six critical technologies by March of 2001, and predicted that the technologies would be ready when needed (the start of the EMD program).[66]

Ballistic Missile Defense Organization

The program management of SBIRS Low transferred from the Air Force to the BMDO on 1 October 2001. Congressional direction stated that ballistic missile defense would be the primary mission of SBIRS Low. In a 17 April 2000 memo, Air Force Secretary F. Whitten Peters and Chief of Staff Gen Michael Ryan stated that to meet the Congressional and SecDef direction, SBIRS Low should be more closely integrated into the BMDO architecture and program. They recommended that the best way to achieve this would be to transfer the SBIRS Low program and funding responsibility from the Air Force to the BMDO. They endorsed the transfer of SBIRS Low because the system had closer links to the BMDO mission. The FY 2001 Defense Authorization Act directed the transfer of the SBIRS Low program management from the Air Force to the BMDO no later than 1 October 2001. The SPO would continue working the details to fully integrate

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