



## Testimony

Before the Subcommittee on Disaster  
Prevention and Prediction, Committee on  
Commerce, Science, and Transportation,  
U.S. Senate

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# POLAR-ORBITING OPERATIONAL ENVIRONMENTAL SATELLITES

## Cost Increases Trigger Review and Place Program's Direction on Hold

Statement of David A. Powner, Director  
Information Technology Management Issues



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# Highlights

Highlights of [GAO-06-573T](#), a testimony before the Subcommittee on Disaster Prevention and Prediction, Committee on Commerce, Science, and Transportation, US Senate

## Why GAO Did This Study

Polar-orbiting environmental satellites provide data and imagery that are used by weather forecasters, climatologists, and the military to map and monitor changes in weather, climate, the oceans, and the environment. They are critical to long-term weather prediction, including advance forecasts of a hurricane's path and intensity. Our nation's current operational polar-orbiting environmental satellite program is a complex infrastructure that includes two satellite systems, supporting ground stations, and four central data processing centers.

In the future, the National Polar-orbiting Operational Environmental Satellite System (NPOESS) is to combine the two current systems into a single, state-of-the-art environment-monitoring satellite system. NPOESS is considered critical to the United States' ability to maintain the continuity of data required for weather forecasting and global climate monitoring through the year 2020. The National Oceanic and Atmospheric Administration (NOAA), the Department of Defense (DOD), and the National Aeronautics and Space Administration (NASA) have formed a tri-agency integrated program office to manage NPOESS.

GAO was asked to determine the NPOESS program's current status and plans and to discuss considerations in moving the program forward.

[www.gao.gov/cgi-bin/getrpt?GAO-06-573T](http://www.gao.gov/cgi-bin/getrpt?GAO-06-573T).

To view the full product, including the scope and methodology, click on the link above. For more information, contact David Powner at (202) 512-9286 or [pownerd@gao.gov](mailto:pownerd@gao.gov).

# POLAR-ORBITING OPERATIONAL ENVIRONMENTAL SATELLITES

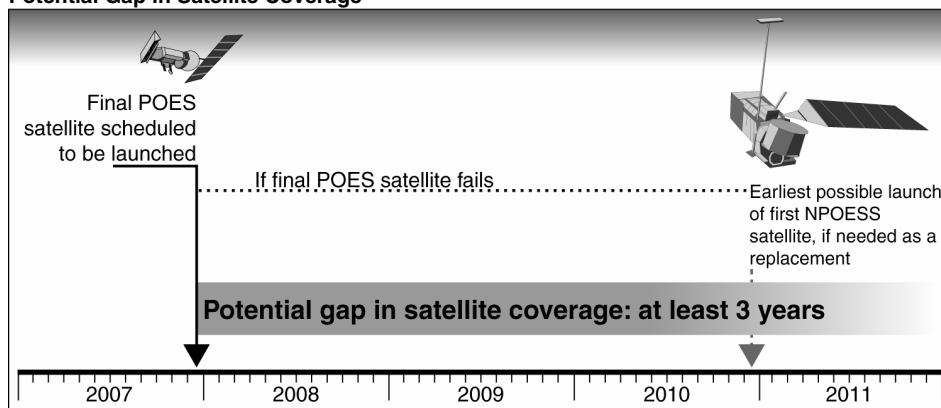
## Cost Increases Trigger Review and Place Program's Direction on Hold

### What GAO Found

The future direction of the NPOESS program—what will be delivered, at what cost, and by when—is currently on hold pending a decision on how to proceed. In recent years, the program has experienced significant cost increases and schedule delays, with cost estimates increasing to about \$10 billion and launch delays approaching 3 years. These factors triggered the need for difficult decisions about the program's direction and capabilities. In mid-November 2005, GAO reported that the NPOESS executive committee expected to make a decision by December 2005 on the direction of the program. GAO noted the importance of making a decision quickly so that the program could proceed. However, in late November 2005, NPOESS cost growth exceeded a legislatively mandated threshold that requires DOD to certify the program to Congress. This placed any decision about future direction on hold until certification takes place in June 2006. In the meantime, the program office has implemented an interim plan to continue work on key sensors and other program elements using fiscal year 2006 funding. Following certification, a decision on future direction should be clear. Proceeding will require a new program baseline and renegotiated contracts—efforts that could take up to a year.

As NPOESS undergoes the Defense certification process and important decisions are made on how the program is to proceed, there are several important considerations. First, NOAA and NASA representation in the DOD certification process is imperative. It will be important for these agencies to remain active players in the deliberation of options and the final decision on how to move the program forward. Second, continued indecision increases the risk of a gap in satellite coverage if the final satellite in the predecessor satellite series (the Polar-orbiting Operational Environmental Satellites or POES) were to fail (see figure). Thus, once program direction is decided, it will be important to move quickly to adjust agency budgets and contracts. Third, continuing oversight of program and executive management is essential to avoid repeating past problems.

### Potential Gap in Satellite Coverage



Source: GAO analysis based on NPOESS Integrated Program Office data.

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Mr. Chairman and Members of the Subcommittee:

We appreciate the opportunity to participate in today's hearing to discuss our work on the planned National Polar-orbiting Operational Environmental Satellite System (NPOESS) program. NPOESS is expected to be a state-of-the-art environment-monitoring satellite system that will replace two existing polar-orbiting environment satellite systems. Polar-orbiting satellites provide data and imagery that are used by weather forecasters, climatologists, and the military to map and monitor changes in weather, climate, the oceans, and the environment. The NPOESS program is considered critical to the United States' ability to maintain the continuity of data required for weather forecasting (including severe weather events such as hurricanes) and global climate monitoring through the year 2020. Three agencies share responsibility for NPOESS: the National Oceanic and Atmospheric Administration (NOAA), the Department of Defense (DOD), and the National Aeronautics and Space Administration (NASA). To manage the program, these agencies established a tri-agency integrated program office. At your request, we will discuss the program's current status and plans, as well as considerations in moving the program forward.

This statement builds on other work we have done on environmental satellite programs over the last several years.<sup>1</sup> An overview of the approach we used to perform this work (our objectives, scope, and methodology) is provided in appendix I.

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<sup>1</sup>GAO, *Polar-orbiting Operational Environmental Satellites: Technical Problems, Cost Increases, and Schedule Delays Trigger Need for Difficult Trade-off Decisions*, [GAO-06-249T](#) (Washington, D.C.: Nov. 16, 2005); *Polar-orbiting Environmental Satellites: Information on Program Cost and Schedule Changes*, [GAO-04-1054](#) (Washington, D.C.: Sept. 30, 2004); *Polar-orbiting Environmental Satellites: Project Risks Could Affect Weather Data Needed by Civilian and Military Users*, [GAO-03-987T](#) (Washington, D.C.: July 15, 2003); *Polar-orbiting Environmental Satellites: Status, Plans, and Future Data Management Challenges*, [GAO-02-684T](#) (Washington, D.C.: July 24, 2002); *National Oceanic and Atmospheric Administration: National Weather Service Modernization and Weather Satellite Program*, [GAO/T-AIMD-00-86](#) (Washington, D.C.: Mar. 29, 2000); and *Weather Satellites: Planning for the Geostationary Satellite Program Needs More Attention*, [GAO-AIMD-97-37](#) (Washington, D.C.: Mar. 13, 1997).

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## Results in Brief

The future direction of the NPOESS program—what will be delivered, at what cost, and by when—is currently on hold pending a decision on how to proceed. In recent years, the program has experienced significant cost increases and schedule delays, with cost estimates increasing to about \$10 billion and launch delays approaching 3 years. These factors triggered the need for difficult decisions about the program's direction and capabilities. In mid-November 2005, we reported that the NPOESS executive committee expected to make a decision by December 2005 on the direction of the program. We noted the importance of making a decision quickly so that the program could proceed. However, in late November 2005, NPOESS cost growth exceeded a legislatively mandated threshold that requires DOD to certify the program to Congress. This placed any decision about future direction on hold until certification takes place in June 2006. In the meantime, the program office has implemented an interim plan to continue work on key sensors and other program elements using fiscal year 2006 funding. Following certification, a decision on future direction should be clear. That will require a new program baseline<sup>2</sup> and renegotiated contracts—efforts that could take up to a year.

As NPOESS undergoes the Defense certification process and important decisions are made on how the program is to proceed, there are several important considerations. First, NOAA and NASA representation in the DOD certification process is imperative. It will be important for these agencies to remain active players in the deliberation of options and the final decision on how to move the program forward. Second, continued indecision increases the risk of a gap in satellite coverage. NPOESS is the backup satellite for the final satellite in the predecessor satellite series. If this predecessor satellite were to fail, there could be a significant data gap until NPOESS is launched and operational. Thus, once a program direction is decided, it will be important to move quickly to adjust agency budgets and contracts. Third, continuing oversight of

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<sup>2</sup>A program baseline is a plan for what will be delivered, when it will be delivered, and at what cost over the life of the program.

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program and executive management is essential to avoid repeating past problems.

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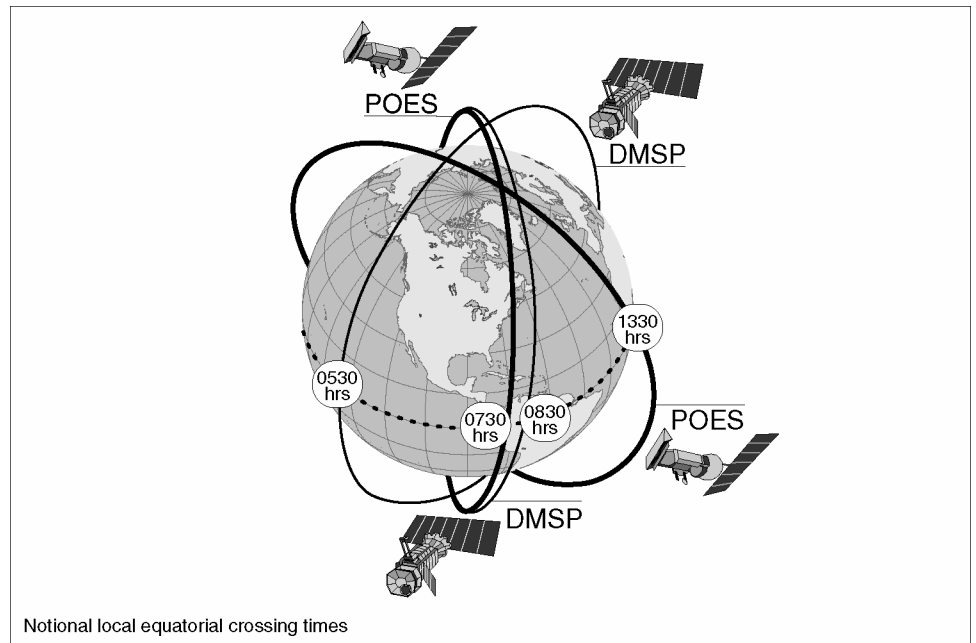
## Background

Since the 1960s, the United States has operated two separate operational polar-orbiting meteorological satellite systems: the Polar-orbiting Operational Environmental Satellite (POES) series, managed by the National Oceanic and Atmospheric Administration (NOAA) and the Defense Meteorological Satellite Program (DMSP), managed by the Department of Defense (DOD). The satellites obtain environmental data that are processed to provide graphical weather images and specialized weather products and are the predominant input to numerical weather prediction models. These models are a primary tool for forecasting weather 3 or more days in advance, including forecasting the path and intensity of hurricanes. The models are used to predict the potential impact of severe weather so that communities and emergency managers can help prevent and mitigate their effects. Polar satellites also provide data used to monitor environmental phenomena, such as ozone depletion and drought conditions, as well as data sets that are used by researchers for a variety of studies, such as climate monitoring.

Unlike geostationary satellites, which maintain a fixed position above the earth, polar-orbiting satellites constantly circle the earth in an almost north-south orbit, providing global coverage of conditions that affect the weather and climate. Each satellite makes about 14 orbits a day. As the earth rotates beneath it, each satellite views the entire earth's surface twice a day. Currently, there are two operational POES satellites and two operational DMSP satellites that are positioned so that they can observe the earth in early morning, mid-morning, and early afternoon polar orbits. Together, they ensure that, for any region of the earth, the data provided to users are generally no more than 6 hours old. Figure 1 illustrates the current operational polar satellite configuration. Besides the four operational satellites, six older satellites are in orbit that still collect some data and are available to provide some limited backup to the operational satellites should they degrade or fail. In the future, both NOAA and DOD plan to continue to launch additional POES and

DMSP satellites every few years, with final launches scheduled for 2007 and 2011, respectively.

**Figure 1: Configuration of Operational Polar Satellites**



Source: GAO, based on NPOESS Integrated Program Office data.

Each of the polar satellites carries a suite of sensors designed to detect environmental data that are either reflected or emitted from the earth, the atmosphere, and space. The satellites store these data and then transmit them to NOAA and Air Force ground stations when the satellites pass overhead. The ground stations then relay the data via communications satellites to the appropriate meteorological centers for processing. The satellites also broadcast a subset of these data in real time to tactical receivers all over the world.

Under a shared processing agreement among four satellite data processing centers—NOAA’s National Environmental Satellite Data and Information Service (NESDIS), the Air Force Weather Agency, the Navy’s Fleet Numerical Meteorology and Oceanography Center, and the Naval Oceanographic Office—different centers are responsible for producing and distributing, via a shared network, different environmental data sets, specialized weather and

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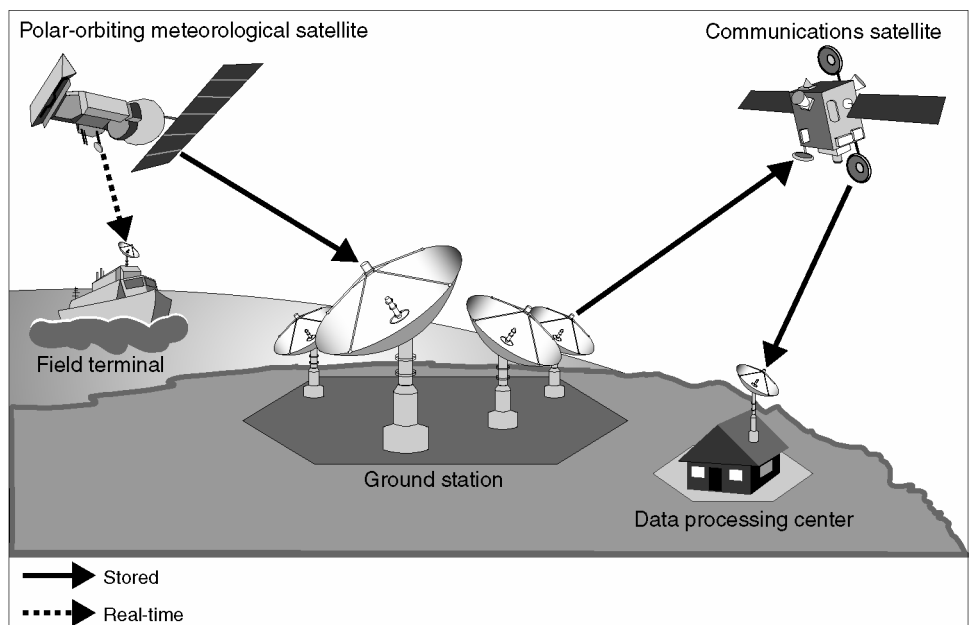
oceanographic products, and weather prediction model outputs.<sup>3</sup> Each of the four processing centers is also responsible for distributing the data to its respective users. For the DOD centers, the users include regional meteorology and oceanography centers, as well as meteorology and oceanography staff on military bases. NESDIS forwards the data to NOAA's National Weather Service for distribution and use by government and commercial forecasters. The processing centers also use the Internet to distribute data to the general public. NESDIS is responsible for the long-term archiving of data and derived products from POES and DMSP.

In addition to the infrastructure supporting satellite data processing noted above, properly equipped field terminals that are within a direct line of sight of the satellites can receive real-time data directly from the polar-orbiting satellites. There are an estimated 150 such field terminals operated by U.S. and foreign governments and academia. Field terminals can be taken into areas with little or no data communications infrastructure—such as on a battlefield or a ship—and enable the receipt of weather data directly from the polar-orbiting satellites. These terminals have their own software and processing capability to decode and display a subset of the satellite data to the user. Figure 2 depicts a generic data relay pattern from the polar-orbiting satellites to the data processing centers and field terminals.

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<sup>3</sup>These environmental data sets, specialized weather and oceanographic products, and weather prediction model outputs are produced through algorithmic processing. An algorithm is a precise set of procedures that enable a desired end result, such as a measurement of natural phenomena.

**Figure 2: Generic Data Relay Pattern for the Polar Meteorological Satellite System**



Source: GAO, based on NPOESS Integrated Program Office data.

## NPOESS Overview

With the expectation that combining the POES and DMSP programs would reduce duplication and result in sizable cost savings, a May 1994 Presidential Decision Directive<sup>4</sup> required NOAA and DOD to converge the two satellite programs into a single satellite program capable of satisfying both civilian and military requirements. The converged program, NPOESS, is considered critical to the United States' ability to maintain the continuity of data required for weather forecasting and global climate monitoring through the year 2020. To manage this program, DOD, NOAA, and NASA formed a tri-agency Integrated Program Office, located within NOAA.

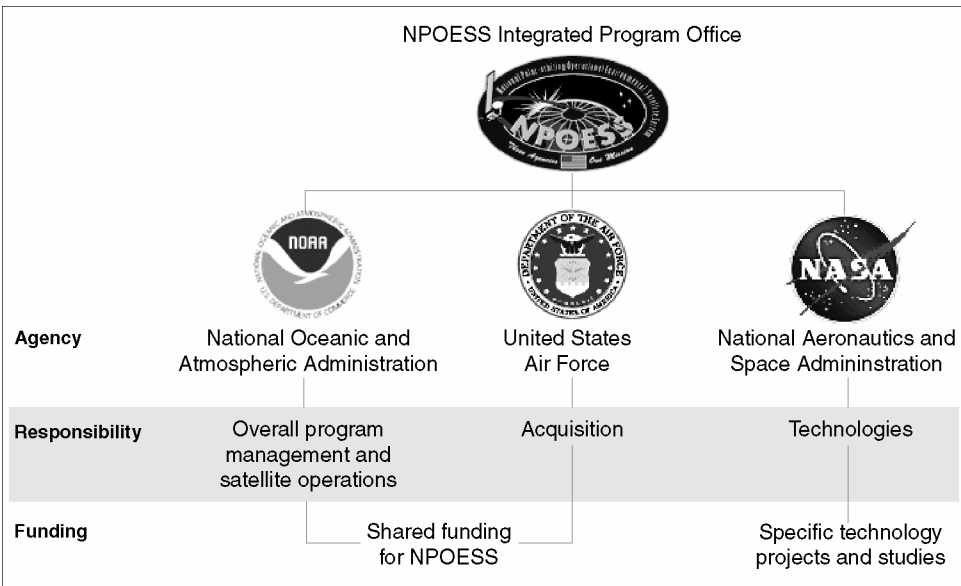
Within the program office, each agency has the lead on certain activities. NOAA has overall program management responsibility for

<sup>4</sup>NSTC-2, May 5, 1994.



the converged system and for satellite operations; DOD has the lead on the acquisition; and NASA has primary responsibility for facilitating the development and incorporation of new technologies into the converged system. NOAA and DOD share the costs of funding NPOESS, while NASA funds specific technology projects and studies. Figure 3 depicts the organizations that make up the Integrated Program Office and lists their responsibilities.

**Figure 3: Organizations Coordinated by the NPOESS Integrated Program Office**



Source: GAO, based on NPOESS Integrated Program Office data.

Current program acquisition plans call for the procurement and launch of six NPOESS satellites over the life of the program, as well as the integration of 13 instruments, consisting of 10 environmental sensors and 3 subsystems. Together, the sensors are to receive and transmit data on atmospheric, cloud cover, environmental, climate, oceanographic, and solar-geophysical observations. The subsystems are to support nonenvironmental search and rescue efforts, sensor survivability, and environmental data collection activities.

According to the program office, 7 of the 13 planned NPOESS instruments involve new technology development, whereas 6 others are based on existing technologies. In addition, the program office considers 4 of the sensors involving new technologies critical,

because they provide data for key weather products; these sensors are shown in bold in table 1, which lists the planned instruments and the state of technology on each.

**Table 1: Expected NPOESS Instruments**

Note: Critical sensors in bold.

Instrument name	Description	State of technology
<b>Advanced technology microwave sounder</b>	Measures microwave energy released and scattered by the atmosphere and is to be used with infrared sounding data from NPOESS's cross-track infrared sounder to produce daily global atmospheric temperature, humidity, and pressure profiles.	New
Aerosol polarimetry sensor	Retrieves specific measurements of clouds and aerosols (liquid droplets or solid particles suspended in the atmosphere, such as sea spray, smog, and smoke).	New
<b>Conical-scanned microwave imager/sounder (CMIS)</b>	Collects microwave images and data needed to measure rain rate, ocean surface wind speed and direction, amount of water in the clouds, and soil moisture, as well as temperature and humidity at different atmospheric levels.	New
<b>Cross-track infrared sounder</b>	Collects measurements of the earth's radiation to determine the vertical distribution of temperature, moisture, and pressure in the atmosphere.	New
Data collection system	Collects environmental data from platforms around the world and delivers them to users worldwide.	Existing
Earth radiation budget sensor	Measures solar short-wave radiation and long-wave radiation released by the earth back into space on a worldwide scale to enhance long-term climate studies.	Existing
Ozone mapper/profiler suite	Collects data needed to measure the amount and distribution of ozone in the earth's atmosphere.	New
Radar altimeter	Measures variances in sea surface height/topography and ocean surface roughness, which are used to determine sea surface height, significant wave height, and ocean surface wind speed and to provide critical inputs to ocean forecasting and climate prediction models.	Existing
Search and rescue satellite aided tracking system	Detects and locates aviators, mariners, and land-based users in distress.	Existing
Space environmental sensor suite	Collects data to identify, reduce, and predict the effects of space weather on technological systems, including satellites and radio links.	New
Survivability sensor	Monitors for attacks on the satellite and notifies other instruments in case of an attack.	Existing
Total solar irradiance sensor	Monitors and captures total and spectral solar irradiance data.	Existing
<b>Visible/infrared imager radiometer suite (VIIRS)</b>	Collects images and radiometric data used to provide information on the earth's clouds, atmosphere, ocean, and land surfaces.	New

Source: GAO, based on NPOESS Integrated Program Office data.

In addition, the NPOESS Preparatory Project (NPP), which is being developed as a major risk reduction and climate data continuity initiative, is a planned demonstration satellite to be launched several years before the first NPOESS satellite is to be launched. It is planned to host three of the four critical NPOESS sensors (the visible/infrared imager radiometer suite (VIIRS), the cross-track infrared sounder, and the advanced technology microwave

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sounder), as well as a noncritical sensor (the ozone mapper/profiler suite). NPP will provide the program office and the processing centers an early opportunity to work with the sensors, ground control, and data processing systems. Specifically, this satellite is expected to demonstrate the validity of about half of the NPOESS environmental data records<sup>5</sup> and about 93 percent of its data processing load.

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## NPOESS Acquisition Strategy

NPOESS is a major system acquisition that consists of three key phases: the concept and technology development phase, which lasted from roughly 1995 to early 1997; the program definition and risk reduction phase, which began in early 1997 and ended in August 2002; and the engineering and manufacturing development and production phase, which began with the award of the development and production contract in August 2002 and will continue through the end of the program. Before the contract was awarded in 2002, the life cycle cost for the program was estimated to be \$6.5 billion over the 24-year period from the inception of the program in 1995 through 2018. Shortly after the contract was awarded, the life cycle cost estimate was estimated to be \$7 billion.

When the NPOESS development contract was awarded, program officials identified an anticipated schedule and funding stream for the program. The schedule for launching the satellites was driven by a requirement that the satellites be available to back up the final POES and DMSP satellites should anything go wrong during the planned launches of these satellites. In general, program officials anticipate that roughly 1 out of every 10 satellites will fail either during launch or during early operations after launch.

Early program milestones included (1) launching NPP by May 2006, (2) having the first NPOESS satellite available to back up the final POES satellite launch in March 2008, and (3) having the second NPOESS satellite available to back up the final DMSP satellite

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<sup>5</sup>Environmental data records are weather products derived from sensor data records and temperature data records.

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launch in October 2009. If the NPOESS satellites were not needed to back up the final predecessor satellites, their anticipated launch dates would have been April 2009 and June 2011, respectively.

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## NPOESS Has Experienced Continued Cost Increases and Schedule Delays

Over the past several years, the NPOESS program has experienced a series of cost increases and schedule delays. In 2003, we reported that changes in the NPOESS funding stream caused a delay in the program's schedule.<sup>6</sup> Specifically, a DOD program official reported that between 2001 and 2002 the agency experienced delays in launching a DMSP satellite, causing delays in the expected launch dates of another satellite. In late 2002, DOD shifted the expected launch date for the final satellite from 2009 to 2010. As a result, the department reduced funding for NPOESS by about \$65 million between fiscal years 2004 and 2007. According to program officials, because NOAA is required to provide the same level of funding that DOD provides, this change triggered a corresponding reduction in funding by NOAA for those years. As a result of the reduced funding, program officials were forced to make difficult decisions about what to focus on first. The program office decided to keep NPP as close to its original schedule as possible, because of its importance to the eventual NPOESS development, and to shift some of the NPOESS deliverables to later years. This shift affected the NPOESS deployment schedule. To plan for this shift, the program office developed a new program cost and schedule baseline.

After this new baseline was completed in 2004, we reported that the program office increased the NPOESS cost estimate from about \$7 billion to \$8.1 billion, and delayed key milestones, including the planned launch of the first NPOESS satellite—which was delayed by 7 months.<sup>7</sup> The cost increases reflected changes to the NPOESS contract as well as increased program management funds. According to the program office, contract changes included extension of the development schedule, increased sensor costs, and additional funds needed for mitigating risks. Increased program

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<sup>6</sup>GAO-03-987T.

<sup>7</sup>GAO-04-1054.

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management funds were added for noncontract costs and management reserves.

At that time, we also noted that other factors could further affect the revised cost and schedule estimates. Specifically, the contractor was not meeting expected cost and schedule targets on the new baseline because of technical issues in the development of key sensors, including the critical VIIRS sensor. Based on its performance through May 2004, we estimated that the contractor would most likely overrun its contract at completion in September 2011 by \$500 million. In addition, we reported that risks associated with the development of the critical sensors, integrated data processing system, and algorithms, among other things, could contribute to further cost increases and schedule slips.

Most recently, in our November 2005 testimony, we noted that NPOESS schedules, costs, and trends had continued to worsen.<sup>8</sup> We reported that over the past year, NPOESS cost increases and schedule delays demonstrated worsening trends, and that there were continuing problems in the development of a key sensor. We further noted that contractor data showed that costs and schedules were likely to continue to increase in the future. Our trend analysis at the time showed that the contractor would most likely overrun costs by \$1.4 billion, resulting in a life cycle cost of about \$9.7 billion, unless critical changes were made. We also noted that program risks, particularly with the development of critical sensors, could further increase NPOESS costs and delay schedules. At the November hearing, program officials confirmed that the program's life cycle cost estimate would likely grow to \$10 billion unless critical changes were made to the program. Table 2 provides a summary of recent growth in program cost estimates.

As for schedule changes, in November 2005, we noted that the program office anticipated at least a 10-month delay in the launch of the first satellite (totaling at least a 17-month delay from the time the contract was awarded) and a 6-month delay in the launch of the second satellite. A summary of those schedule changes is shown in

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<sup>8</sup>[GAO-06-249T](#).

table 3. The effect of these delays is evident in the widening gap between when the last POES satellite is expected to launch and when the first NPOESS satellite could be available if needed as a backup. This is significant because if the last POES satellite fails on launch, it will be at least 3 years before the first NPOESS satellite could be launched. During that time, critical weather and environmental observations would be unavailable—and military and civilian weather products and forecasts could be significantly degraded.

**Table 2: Changes in NPOESS Life Cycle Cost Estimates through November 2005**

As of	Life cycle cost estimate	Life cycle range
July 2002	\$6.5 billion	1995–2018
July 2003	\$7.0 billion	1995–2018
September 2004	\$8.1 billion	1995–2020
November 2005	\$10 billion <sup>a</sup>	To be determined

Source: GAO analysis, based on Integrated Program Office data.

<sup>a</sup>Anticipated decisions on program direction are likely to affect this estimate.

**Table 3: Changes in NPOESS Schedule Estimates as of November 2005**

<b>Milestones</b>	<b>As of August 2002 contract award</b>	<b>As of February 2004 (rebaseline)</b>	<b>As of August 2005</b>	<b>Net change from contract award</b>	<b>Minimum change from rebaseline</b>	<b>Potential data gap</b>
NPP launch	May 2006	October 2006	April 2008	23-month delay	18-month delay	Not applicable
Final POES launch <sup>a</sup>	March 2008	March 2008	December 2007	4-month advance		Not applicable
First NPOESS satellite planned for launch	April 2009	November 2009	September 2010	17-month delay	10-month delay	Not applicable
First NPOESS satellite launch if needed to back up the final POES	March 2008	February 2010 <sup>b</sup>	December 2010 <sup>c</sup>	33-month delay		3-year data gap if final POES fails on launch
Final DMSP launch <sup>a</sup>	October 2009	May 2010	October 2011	24-month delay		Not applicable
Second NPOESS satellite planned for launch	June 2011	June 2011	December 2011	6-month delay	6-month delay	Not applicable

Source: GAO analysis, based on NPOESS Integrated Program Office data.

<sup>a</sup> POES and DMSP are not part of the NPOESS program. Their launch dates are provided because of their relevance to the NPOESS satellite schedules.

<sup>b</sup> A program official reported that if the first NPOESS satellite is needed to back up the final POES satellite, the contractor will prepare the satellite to be launched in a different orbit with a different suite of sensors. These factors will prevent launch from taking place until February 2010.

<sup>c</sup> If the first NPOESS satellite is needed to back up the final POES satellite, the contractor will prepare the satellite to be launched in a different orbit with a different suite of sensors, adding 3 months to the September 2010 launch date.

Problems involving multiple levels of management—including subcontractor, contractor, program office, and executive leadership—played a role in bringing the NPOESS program to its current state. For example, the VIIRS sensor development issues were attributed, in part, to the subcontractor’s inadequate project management. Specifically, after a series of technical problems, internal review teams sent by the prime contractor and the program office found that the subcontractor had deviated from a number of contract, management, and policy directives set out by the main office and that both management and process engineering were inadequate. Neither the contractor nor the program office had recognized the underlying problems in time to fix them. After these issues were identified, the subcontractor’s management team was replaced. Further, in January 2005, the NPOESS Executive Committee (Excom) called for an independent review of the VIIRS

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problems. This independent review, delivered in August 2005, reported that the program management office did not have the technical system engineering support it needed to effectively manage the contractor, among other things. We also reported that the involvement of NPOESS executive leadership had wavered from frequent heavy involvement to occasional meetings with few resulting decisions. Specifically, the Excom had met five times over the preceding 2 years. Most of these meetings did not result in major decisions, but rather triggered further analysis and review.

Sound management is critical to program success. In our reviews of major acquisitions throughout the government, we have reported that key factors determining a project's ability to be delivered on time, within budget, and with promised functionality include sound program management, contractor oversight, risk identification and escalation, and effective and timely executive level oversight.<sup>9</sup> Given the history of large cost increases and the factors that could further affect NPOESS costs and schedules, we reported that continued oversight, strong leadership, and timely decision making are more critical than ever.

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## NPOESS Status and Plans: Decision on Program's Future Direction on Hold, Interim Efforts Under Way

The future direction of the NPOESS program—what will be delivered, at what cost, and by when—is currently on hold pending a decision on how to proceed. Over the last few years, NPOESS has experienced continued cost increases and schedule delays, requiring difficult decisions about the program's direction and capabilities.

In mid-November 2005, we reported that the NPOESS executive committee expected to make a decision in December 2005 on the direction of the program. This involved deciding among options

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<sup>9</sup>For example, GAO, *High-Risk Series: An Update*, [GAO-05-207](#) (Washington, D.C.: January 2005) and *Major Management Challenges and Program Risks: Department of Transportation*, [GAO-03-108](#) (Washington, D.C.: January 2003).



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involving increased costs, delayed schedules, and reduced functionality. We urged the committee to make a decision quickly so that the program could proceed. However, in late November 2005, NPOESS cost growth exceeded a legislatively mandated threshold that requires the Department of Defense to certify the program to Congress. This placed any decision about the future direction of the program on hold until the certification takes place in June 2006.

In the meantime, the program office has implemented an interim plan to continue work on key sensors and other program elements using fiscal year 2006 funding. Following certification, a decision on future direction should be clear. That will require developing a new program baseline and renegotiating contracts—efforts that could take up to a year.

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## Nunn-McCurdy Process Puts Program Direction on Hold

The Nunn-McCurdy Act<sup>10</sup> requires DOD to take specific actions when a major system acquisition exceeds certain cost thresholds. Key provisions require the Secretary of Defense to notify Congress when a major defense acquisition is expected to overrun its project baseline by 15 percent or more, and to certify the program to Congress when it is expected to overrun its baseline by 25 percent or more. Certification is an assurance that

- the program is essential to national security,
- there are no alternatives to the program that will provide equal or greater military capability at less cost,
- the new estimates of the program's cost are reasonable, and
- the management structure for the program is adequate to manage and control cost.

In August 2005, the NPOESS program office determined that it could not execute its planned program within the constraints of its current baseline and notified its executive committee. In turn, Congress was

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<sup>10</sup> 10 U.S.C. section 2433, as amended by Pub. Law No. 109-163, Div. A, section 802.

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notified that the program was expected to overrun its baseline by 15 percent. Subsequently, in late November 2005, it was determined that at completion the final program cost would be greater than 25 percent over its baseline. At the beginning of January 2006, DOD notified Congress that NPOESS was expected to overrun its baseline by more than 25 percent and began the process of certifying the program.

The Nunn-McCurdy Act pertains to Defense acquisitions, but because NPOESS is a joint program, the certification process was expanded to include input from NOAA and NASA. Specifically, the Defense Acquisition Executive, who is responsible for the certification process, invited the NPOESS executive committee members to participate in the process, with principal stakeholders from each NPOESS partner agency serving as intermediaries between the executive committee members and working groups set up to address each of the four certification elements. Additionally, these working groups are made up of DOD, NOAA, and NASA personnel, as well as others (such as representatives of the NPOESS senior user advisory group) as warranted.

As part of the certification process, DOD is evaluating options for the future of the program. These options could include reducing the number or function of NPOESS satellites, relying on European satellites, increasing costs, delaying planned launch dates, or canceling the program. According to Defense officials, a decision is expected to be announced during the first week of June 2006. However, the completion of the certification process does not end the negotiations on this program. Any major cost changes will need to be worked into the respective agencies' budgets, and any major program changes will need to be worked into a new baseline describing what will be delivered by when and then negotiated with the contractor. According to program office officials, a revised baseline will likely take 6 to 12 months to develop and implement from the time a decision is made.

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### Program Office Has Interim Efforts Under Way

The NPOESS Integrated Program Office has several initiatives under way—both to improve its management of the program and to keep

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NPOESS sensor development moving forward—as it waits for completion of the Nunn-McCurdy process. To address concerns about program management that we and others have raised, the program office has

- increased staffing of cost analysts and earned value management experts to improve contractor and subcontractor oversight,
- increased the presence of system engineers on sensor development initiatives,
- developed a proposal for restructuring the program office and overall satellite program to allow for clearer decision-making authority and more timely decisions, and
- taken steps to improve communications among the program office, tri-agency executives, and contractors.

These initiatives should help improve program management, but they are not yet fully implemented—and will not guarantee success. The proposed management changes still need to be approved, funded, and implemented. Further, NPOESS development is technically challenging. Thus, stringent oversight and risk management will continue to be important throughout the life of the project.

As for continuing sensor development, because any major changes to the program will not be known until the certification process is completed, the program office has implemented an interim plan to continue work on key sensors and other program elements within the fiscal year 2006 funding profile. Officials stated that they chose work activities that would be needed regardless of the option chosen for the future direction of the program.

Based on contractor-provided data, our analysis indicates that NPOESS is making mixed progress against the fiscal year 2006 interim plan. Between October 2005 and January 2006, the contractor outperformed its program cost and schedule targets and completed some unplanned work. However, the contractor continued to experience cost overruns on the development of its critical sensors—VIIRS and CMIS. The primary cost drivers were the

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extensive manpower beyond what was planned to resolve technical issues.

The development of VIIRS is of particular importance because it is to be demonstrated on the NPP satellite, which is currently scheduled for launch in April 2008. While CMIS is not part of NPP, its development is important because it is one of four critical sensors providing data for key weather products. Over the past year, work on CMIS was deferred in order to fund efforts to fix VIIRS and to keep NPP on schedule.

In November, we reported that VIIRS was experiencing continued problems dealing with the technical complexity of the ground support equipment. VIIRS also experienced problems with the development of the cryoradiator,<sup>11</sup> excessive vibration of sensor parts, and errors in the sensor's solar calibration. Since November, the program office has taken positive steps to contain these technical risks. In particular, VIIRS now has a baseline plan for serial development of the sensor design, an approach that is intended to minimize rework. The program office also added decision gates to provide management review and approval of progress.

We also reported in November on the problems experienced on CMIS. Specifically, CMIS continued to face technical challenges in the design of the receivers, the sensor structure, and the antenna calibration system. In addition, it experienced system reliability and thermal issues, among other things. Since November, work has been ongoing to simplify the CMIS design. These design changes are intended to reduce the weight of the CMIS structure by moving several subsystems from the instrument onto the spacecraft. Additionally, the program office reported that the contractor has demonstrated that a complex component of the CMIS receiver is feasible.

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<sup>11</sup>The cryoradiator is a key component of the VIIRS sensor. It is intended to cool down components of the sensor.

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While positive measures have been taken in the development of both of these sensors, the program office continues to consider VIIRS to be a high-risk initiative because of technical challenges that it is facing. VIIRS is fast approaching a critical developmental milestone that will determine the extent of progress made. Specifically, a prototype is expected to begin thermal vacuum testing in summer 2006. This testing will assess the stability of the current sensor design. If the current design fails to meet its performance metrics, VIIRS could be in danger of falling further behind in cost and schedule. Program officials acknowledge that CMIS requires a watchful eye, but note that there is more time available to meet its development requirements. To the program office's credit, however, it is aware of these risks and is using its risk management plans to help mitigate them.

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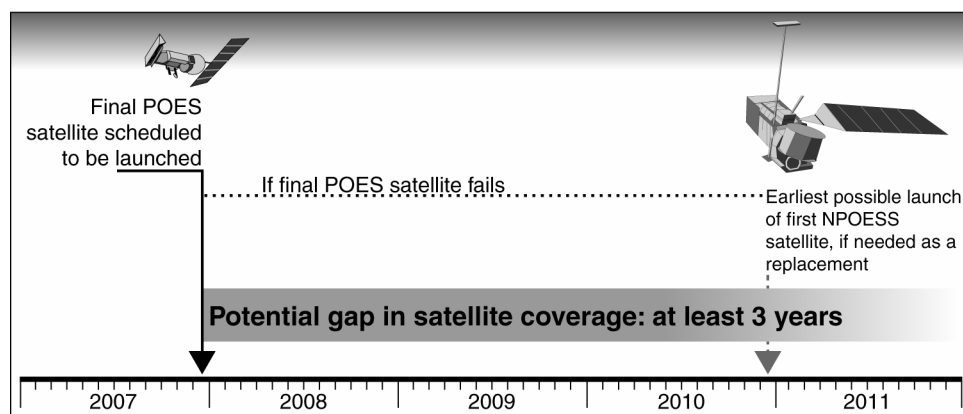
## Considerations in Moving the NPOESS Program Forward

As NPOESS undergoes the Nunn-McCurdy certification process and important decisions are made on how the program is to proceed, there are several important considerations.

- *NOAA and NASA representation in the DOD Nunn-McCurdy certification process is imperative.* As a joint program, NPOESS is expected to fulfill many military, civilian, and research requirements for environmental data. Thus, it is important that all agency partners have a voice in the DOD proceedings. As noted earlier, DOD has included NOAA and NASA in its process—both in an executive advisory capacity and on the teams working to address each of the four certification requirements. Further, NOAA and NASA officials reported that they believe that they are being effectively involved in the certification process. However, because this is a DOD process and decision, and because Defense requirements differ from NOAA and NASA requirements, there is risk that the chosen alternative could sacrifice NOAA and NASA requirements. It will be important for NOAA and NASA to remain active players in the deliberation of options and the final decision on how to move the program forward.
- *Indecision increases the risk of a gap in satellite data.* The potential for a gap in polar-orbiting satellite data is increasing with

every day of delay on the NPOESS program. Specifically, if the final satellite in the predecessor satellite series (the Polar-orbiting Operational Environmental Satellites or POES) were to fail, there would be a gap in satellite coverage until the first NPOESS satellite was launched and put into operation (see fig. 2). Such a gap could have a devastating effect on our national ability to forecast severe weather events, such as those associated with future hurricane seasons. Since a decision on how the NPOESS program is to proceed is not expected until June 2006, and there will likely be at least another year while a new baseline is established and the contract modified, it is important that the departments move expeditiously to fund their chosen program direction and to implement contract changes.

**Figure 4: A Potential Gap in Satellite Coverage**



Source: GAO analysis based on NPOESS Integrated Program Office data.

- *Continuing oversight of program and executive management is warranted.* Management problems at multiple levels—subcontractor, contractor, project office, and executive oversight—led to NPOESS recent cost and schedule overruns. As the program implements a new management structure and increased contractor oversight, it will be important to measure and report on the progress of these changes so as to not repeat past problems.

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In summary, in November 2005, we reported that NPOESS was “a program in crisis” because of technical problems on critical sensors, escalating costs, poor management at multiple levels, and the lack of a decision on how to proceed with the program. Today, the program is still troubled, and its future direction is not yet known. The program office and contractor are addressing problems on the critical sensors and have adopted strategies that are expected to reduce risks on these sensors. Additionally, the program office is working to address management challenges by increasing program office skills and staffing, increasing contractor oversight, and restructuring the program office to allow for more timely and authoritative decisions. Further, the Nunn-McCurdy certification in June 2006 is expected to result in a firm decision on how to proceed with the program. Over the next few months, it will be important for all of the agency partners to have a voice in the final decision on how to proceed. Once this decision is made, it will be important to move quickly to implement the decision in agency budgets and contracts. Further, as the project continues, it will be critical to ensure that the management issues of the past will not be repeated.

This concludes my statement. I would be pleased to respond to any questions that you or other members of the Subcommittee may have at this time.

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## Contact and Acknowledgements

If you have any questions regarding this testimony, please contact David Powner at (202) 512-9286 or by e-mail at [pownerd@gao.gov](mailto:pownerd@gao.gov). Individuals making contributions to this testimony include Colleen Phillips (Assistant Director), Carol Cha, Barbara Collier, Neil Doherty, Kathleen S. Lovett, and Karen Talley.

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## Appendix I. Objectives, Scope, and Methodology

Our objectives were to determine the National Polar-orbiting Operational Environmental Satellite System's (NPOESS) current status and plans, and to discuss considerations in moving the program forward. To accomplish these objectives, we focused our review on the Integrated Program Office, the organization responsible for the overall NPOESS program. We also interviewed officials from the Department of Defense (DOD), the National Aeronautics and Space Administration (NASA), and NOAA's National Weather Service and National Environmental Satellite Data and Information Service to determine plans for the program.

To identify schedule and cost changes related to NPOESS's status we reviewed program office data and interviewed program officials. We compared changes in NPOESS cost and schedule estimates to prior cost and schedule estimates as reported in our July 2002, July 2003, and November 2005 testimonies and in our September 2004 report.<sup>12</sup>

To further analyze trends that could affect the program in fiscal year 2006, we assessed the prime contractor's cost and schedule performance. To make these assessments, we applied earned value analysis techniques<sup>13</sup> to data from the contractor earned value and variance analysis reports. We compared the cost of work completed with the budgeted costs for scheduled work during January 2006 to

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<sup>12</sup>GAO, *Polar-orbiting Environmental Satellites: Status, Plans, and Future Data Management Challenges*, [GAO-02-684T](#) (Washington, D.C.: July 24, 2002); *Polar-orbiting Environmental Satellites: Project Risks Could Affect Weather Data Needed by Civilian and Military Users*, [GAO-03-987T](#) (Washington, D.C.: July 15, 2003); *Polar-orbiting Environmental Satellites: Information on Program Cost and Schedule Changes*, [GAO-04-1054](#) (Washington, D.C.: September 30, 2004); and *Polar-orbiting Operational Environmental Satellites: Technical Problems, Cost Increases, and Schedule Delays Trigger Need for Difficult Trade-off Decisions*, [GAO-06-249T](#) (Washington, D.C.: November 16, 2005).

<sup>13</sup>Earned value analysis is a means of placing a dollar value on a project's status in order to compare budget versus actual costs versus project status in dollar amounts. For our analysis, we used standard earned value formulas to calculate cost and schedule variances.



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show trends in cost and schedule performance against the interim plan for fiscal year 2006.

NOAA and DOD officials generally agreed with the facts presented in this statement and provided some technical corrections, which we have incorporated. We performed our work at the Integrated Program Office, DOD, NASA, and NOAA offices in the Washington, D.C., metropolitan area, between February 2006 and March 2006, in accordance with generally accepted government auditing standards.

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