NOAA SATELLITES: WILL WEATHER FORECASTING BE PUT AT RISK?

HEARING

BEFORE THE

SUBCOMMITTEE ON ENVIRONMENT, TECHNOLOGY, AND STANDARDS

COMMITTEE ON SCIENCE

HOUSE OF REPRESENTATIVES

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CONTENTS

July 15, 2003

NOAA SATELLITES: WILL WEATHER FORECASTING BE PUT AT RISK?

TUESDAY, JULY 15, 2003

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON ENVIRONMENT, TECHNOLOGY, AND STANDARDS,
COMMITTEE ON SCIENCE,
Washington, DC.

The Subcommittee met, pursuant to call, at 2 p.m., in Room 2318 of the Rayburn House Office Building, Hon. Vernon J. Ehlers [Chairman of the Subcommittee] presiding.

COMMITTEE ON SCIENCE
U.S. HOUSE OF REPRESENTATIVES

NOAA Satellites: Will Weather Forecasting Be Put At Risk?

Tuesday, July 15, 2003

2:00 PM – 4:00 PM
2318 Rayburn House Office Building (WEBCAST)

Witness List

Mr. Gregory Withee
Assistant Administrator for National Environmental Satellite Data and Information Service (NESDIS)
National Oceanic and Atmospheric Administration

Mr. Peter Teets
Undersecretary of the Air Force and
Department of Defense Executive Agent for Space

Mr. David Powner
Acting Director, Information Technology Management Issues
General Accounting Office

Mr. Wes Bush
President
Northrup Grumman Space Technology

Dr. Ronald McPherson
Executive Director
American Meteorological Society

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SUBCOMMITTEE ON ENVIRONMENT, TECHNOLOGY, AND STANDARDS

COMMITTEE ON SCIENCE

U.S. HOUSE OF REPRESENTATIVES

NOAA Satellites: Will Weather Forecasting Be Put at Risk?

TUESDAY, JULY 15, 2003
2:00 P.M.–4:00 P.M.
2318 RAYBURN HOUSE OFFICE BUILDING

Purpose

On Tuesday July 15, 2003 at 2:00 p.m., the House Science Committee's Subcommittee on Environment, Technology and Standards will hold a hearing to examine satellite programs at the National Oceanic and Atmospheric Administration (NOAA). NOAA procures and operates the Nation's environmental monitoring satellites, which provide raw data and processed data products to the National Weather Service (NWS), the Department of Defense (DOD), and the public for weather forecasting and prediction. NOAA performs these duties through its line office, the National Environmental Satellite, Data, and Information Service (NESDIS). NOAA is in the final preparation stages (and has awarded the prime contract) for the new National Polar-orbiting Operational Environmental Satellite System (NPOESS), which has a lifetime (23 years) cost of $6.5 billion. While NOAA is the lead agency, NPOESS is a tri-agency effort among NOAA, the National Aeronautics and Space Administration (NASA), and DOD to combine and integrate the polar satellite needs and capabilities of all three agencies. The procurement cost is shared equally between NOAA and DOD. Given the tremendous cost and important mission of NOAA's environmental satellites, the Subcommittee will be providing continuous oversight of this project.

The hearing will focus on these major concerns:

(1) The Administration's Fiscal Year (FY) 2004 budget request significantly delays when the first NPOESS satellite would be ready. This could create a 21-month gap in polar satellite coverage if the last satellite from the current NOAA polar series fails during launch or in orbit. A loss of polar satellite coverage could severely compromise three to seven day weather forecasts, prediction of severe weather events, such as hurricanes, and daily aviation operations.

(2) The Committee is concerned about possible cost increases in the development of NPOESS. Given the current budget climate, this could cause even further delays in availability of this new polar satellite program and possibly lead to a decision to drop some instruments from the satellites.

(3) Given the advanced untested technology, the new satellite's sensors and ground systems may have unforeseen technical difficulties, which could lead to further delay. NOAA may not be paying enough attention to this possibility.

(4) DOD may be withdrawing some of its funding support for NPOESS, because DOD's current weather satellites may last longer than originally anticipated. This is critical because NPOESS funding is equally shared between DOD and NOAA.

The Subcommittee plans to explore several overarching questions, including:

1. The Administration's FY 2004 budget request creates a 21-month gap between the launching of the last satellite from the current NOAA polar program (Polar-orbiting Operational Environmental Satellite or POES) and when the first NPOESS would be ready, but NOAA's internal satellite coverage policy states that such a gap is unacceptable. Why is NOAA willing to accept this potential loss of coverage?

2. If the last POES satellite fails, to what extent would three to seven day weather forecasts and prediction of severe weather such as hurricanes be compromised? What would be the specific ramifications of a loss of polar satellite coverage? Do NOAA and DOD have a contingency plan for this potential predicament?
3. What are NOAA and DOD doing to ensure the NPOESS program stays on budget and that the advanced technology requirements for satellite capabilities will be met?
4. Is DOD fully committed to the NPOESS procurement schedule?

Witnesses:

Mr. Gregory Withee, Assistant Administrator for National Environmental Satellite, Data, and Information Service (NESDIS), National Oceanic and Atmospheric Administration (NOAA). Mr. Withee represents the office responsible for carrying out NOAA's NPOESS obligations.

Mr. Peter Teets, Under Secretary of the Air Force and Department of Defense Executive Agent for Space. Mr. Teets is responsible for developing, coordinating and integrating plans and programs for space systems and the acquisition of DOD space defense acquisition programs.

Mr. David Powner, Acting Director Information Technology Management Issues, General Accounting Office. GAO has been following the development of NPOESS and is prepared to discuss its concerns with the program.

Mr. Wes Bush, President, Northrop Grumman Space Technology. Mr. Bush has general management responsibility for space technology businesses at Northrop Grumman, the prime contractor for NPOESS.

Dr. Ronald McPherson, Executive Director, American Meteorological Society. Prior to joining AMS, Dr. McPherson was director of the National Weather Service's National Centers for Environmental Prediction (NCEP).

Summary of Issues

The Administration's Fiscal Year (FY) 2004 budget creates a potential 21-month loss of polar satellite coverage if the last POES satellite fails during launch or in orbit. This is against NOAA's internal satellite risk policy, and NOAA apparently has no contingency plan for this potential problem. The December 2002 plan for NPOESS called for the first satellite to be ready by 2008. Based on the Administration's FY04 budget request, the first satellite will not be ready until 2010 or 2011. Why is this acceptable? According to NOAA there is a 4 to 10 percent chance of launch failure and a 4 percent chance of failure in orbit for satellites. Thus, there is a real possibility that the last POES satellite could fail. This situation actually happened in the early 1990s when NOAA's geostationary satellite program had a satellite fail in orbit, and there was a delay in the availability of the new satellite to replace it. Additionally, at that time, the one geostationary satellite remaining in orbit faced a real danger of orbital failure. The current budget situation with NPOESS could easily precipitate a similar situation.

9**A loss of polar satellite coverage could severely compromise three to seven day weather forecasts and prediction of severe weather events, such as hurricanes.** Industries as varied as aviation, agriculture, construction, emergency management, and climate research would be drastically affected by such a loss. In aviation, three to seven day weather forecasts are vital for planning flight paths to avoid major storm systems or volcanic ash. For emergency managers, more accurate forecasts of the paths of events like hurricanes can save millions of dollars, because it can cost up to $1 million a mile to evacuate a coastal community for a hurricane. Finally, polar satellites provide long-term climate records vital for validating global climate models and providing seasonal forecasts for industries such as energy distribution and agriculture.

Given the untested technology, the new satellite's sensors and ground systems may have unforeseen technical difficulties and potential cost overruns. The last major satellite acquisition program at NOAA, GOES-NEXT, was $1.4 billion over budget and five years behind schedule due to a lack of technical planning and program development delays similar to those that NPOESS is experiencing now. Also, while NPOESS has general risk reduction included in the program plan, it appears that NOAA has not prioritized these risks or made available its specific risk reduction plans for each risk. For example, the largest risk reduction part of NPOESS, a joint program with NASA, has already been delayed by six months. This program not only provides a platform for testing some of the new sensors that will be part of NPOESS, but also is a link between the last experimental Earth-observing satellite from NASA and the first NPOESS. If it is delayed any further, the continuity of climate data from these new sensors could be compromised. It is not clear how NOAA is addressing these concerns.

In December 2002, the contractor for NPOESS (Northrop Grumman) completed a detailed program plan, but when the Administration's FY04 budget request was released in February 2003, the total FY04–07 NPOESS funding was reduced by $130 million. This early funding reduction has forced Northrop Grumman to reformulate the program plan. Since satellite acquisition programs consist of three components—funding, equipment requirements, and schedule—if one component changes, another must be adjusted to compensate. For example, if funding decreases, the schedule must be delayed or the equipment requirements must be reduced. Currently the FY04-adjusted NPOESS program plan only incorporates schedule delays, but if future funding levels continue to drop, then at some point satellite capabilities may be compromised. By constantly readjusting the program schedule, our ability to test all of the components of the satellite system (satellite platform, sensors and ground systems) at the appropriate time is sacrificed. This makes the overall development of NPOESS less efficient than originally planned and could create unforeseen technical difficulties and cost overruns.

DOD may be withdrawing some of its funding support for NPOESS, because DOD's current weather satellites may last longer than originally anticipated. NPOESS is a tri-agency effort between NOAA, NASA, and the Department of Defense to combine and integrate the polar satellite needs and capabilities of all three agencies. The procurement cost is shared equally between NOAA and DOD. Currently, NOAA has its POES satellites and DOD uses its Defense Meteorological Satellite Program (DMSP) satellites for polar satellite coverage. However, loss of the polar-satellite coverage that POES provides will not only affect the civilian sector, but also the military. DOD relies heavily on NOAA POES satellites for some of its operations. In the recent war in Iraq, the Air Force used data from POES for planning operations and the Navy routinely using POES data for its ship routing. Since NPOESS funding is equally shared between NOAA and DOD, it is vital DOD maintain its financial commitment to the program.

Background

What is NESDIS?

The National Environmental Satellite, Data, and Information Service (NESDIS) acquires and operates NOAA's satellites and manages the processing, distribution, and archiving of their data and other environmental data through its National Data Centers. NOAA satellites are used for "operational" purposes, mostly for providing real-time data and products to the National Weather Service (NWS) and DOD, whereas NASA satellites are used mostly for research purposes. NOAA's mission requires at least two geostationary and two polar-orbiting satellites to be deployed in orbit at the same time to ensure full coverage. NESDIS also operates three National Data Centers, which together are the largest collection of atmospheric, geophysical, and oceanographic data in the world.

The FY04 budget request for NESDIS is $838 million of which $150 million is for regular operations, research and facilities and $687 million is for procurement, acquisition and construction of satellites. In FY03 NESDIS received $710 million of which $151 million was for regular operations, research and facilities and $559 million was for procurement, acquisition and construction of satellites.

What is NPOESS?

The National Polar-orbiting Operational Environmental Satellite System (NPOESS) is a tri-agency effort between NOAA, NASA, and DOD to combine and integrate the polar satellite needs and capabilities of all three agencies. As with NOAA, DOD currently operates two polar-orbiting satellites mostly for weather forecasting. NPOESS will replace the four NOAA/DOD satellites with three that the agencies will share at a total cost of $6.5 billion, split evenly between NOAA and DOD. The estimated savings from this collaboration is $1.8 billion.

NOAA has a policy that a backup satellite must be available at the time a new polar satellite is launched. Therefore, the first NPOESS satellite must be ready by 2008, to cover the possible launch failure of the last of the older generation of polar satellites. But, now it is more likely that the first NPOESS satellite will not be ready until 2010. This program is a significant portion of NOAA's overall budget, greater than the agency spends on all its oceans and atmospheric research.

NASA is providing technical help and was scheduled to fly many of the NPOESS sensors on a NASA satellite or airplane starting in 2005 to ensure the sensors work, and to allow NOAA time to view the data to ensure it can be incorporated into its models and made into products. However, that schedule is now delayed six months and it is uncertain how this will affect the overall NPOESS program.

From 2002 Federal agency NPOESS planning documents, the NOAA/DOD FY04 request for NPOESS was expected to be $608 million and remain at that level for several years before declining. However, the FY04 requests for NPOESS is only $554 million total. This decrease delays the availability of the first NPOESS satellite and creates a potential loss of polar satellite coverage if the last POES satellite fails during launch.

What happened in the early 1990's with GOES–NEXT?

There are concerns about these early funding decreases and delays in NPOESS primarily because of major problems with the last upgraded satellite procurement at NOAA, GOES-NEXT. In the end this program was $1.4 billion over budget and five years late in launch availability. Due to a series of events, this delay meant that from 1989 through 1992, NWS was forced to rely on only one GOES satellite, when normally it uses two GOES satellites. This meant that satellite coverage over the Pacific and Atlantic Ocean was compromised for that time. In addition, the one satellite that remained was nearing the end of its expected lifetime and it was a member of a series of satellites that had experienced extensive technical difficulties and operational failures. Had that satellite failed, the NWS would have been unable track severe weather in real time or provide continuous weather images of the United States. After 1992 the NWS was able to use a satellite from Europe to restore dual geostationary coverage until GOES–NEXT was available in 1994. Delays in NPOESS could result in similar problems with future polar-satellite coverage. Given the complexity of our weather models today, it is uncertain whether the U.S. could use other nations' satellites for polar coverage in the future.

Questions for Witnesses

Mr. Gregory Withee

1. Why is the Administration's FY04 budget request for NPOESS $70 million less than the level that was determined to be necessary at the Milestone Review of NPOESS by DOD, NOAA, and NASA in July 2002?
2. The Administration's FY 2004 budget request creates a 21-month gap between the launching of the last NOAA Polar-orbiting Operational Environmental Satellite (POES) and when the first National Polar-orbiting Operational Environmental Satellite System (NPOESS) satellite would be ready. If the last POES were to fail on launch, it would result in a loss of polar-satellite coverage. How would such a loss affect NOAA's ability to carry out its mission of providing weather and climate information to the Nation? What options would be available to NOAA to mitigate those effects? What plan does NOAA have in place to deal with this contingency?
3. To what extent could the FY04 budget request result in a reduction in the types of sensors NPOESS will carry? If funding were further reduced, at what level of funding would you be forced to reduce sensor capabilities or requirements? How would this affect NOAA's ability to carry out its mission of providing weather and climate information to the Nation?
4. Even if NPOESS operates as planned, how does NOAA plan to deal with the significant remaining technical challenges to ensure the NPOESS satellite data and data products can be properly maintained, archived, and distributed?

Mr. Peter Teets

1. The Administration's FY 2004 budget request creates a 21-month gap between the launching of the last NOAA Polar-orbiting Operational Environmental Satellite (POES) and when the first National Polar-orbiting Operational Environmental Satellite System (NPOESS) satellite would be ready. If the last POES were to fail on launch, it would result in a loss of polar-satellite coverage. How would such a loss affect DOD operations? What options would be available to DOD to mitigate those effects? What plan does DOD have in place to deal with this contingency?
2. To what extent could the FY04 budget request result in a reduction in the types of sensors NPOESS will carry? If funding were further reduced, at

what level of funding would you be forced to reduce sensor capabilities or requirements? How would this affect DOD operations?

3. Even if NPOESS operates as planned, how does DOD plan to deal with the significant remaining technical challenges to ensure the NPOESS satellite data and data products can be properly maintained, archived, and distributed?
4. If the last Defense Meteorological Satellite Program (DMSP) satellite lasts longer than anticipated, will DOD remain fully committed to the current NPOESS procurement schedule?

Mr. David Powner

1. What major concerns has GAO uncovered as it follows the National Polar-orbiting Operational Environmental Satellite System (NPOESS) project? Specifically, do you see any possible cost overruns, schedule delays or technical difficulties with sensor or ground system software development in the near future? What are the implications of these potential problems and what would you suggest the National Oceanic and Atmospheric Administration (NOAA) and the Department of Defense (DOD) should do to address these issues?
2. Knowing that the last major satellite procurement program for Geostationary Operational Environmental Satellites (GOES) had technical difficulties that resulted in $1.4 billion in cost-overruns and a five-year delay, has NOAA adequately applied lessons learned from that incident to prevent similar problems with NPOESS and the next generation of GOES satellites?
3. If there is a loss of polar satellite coverage, can other satellites be moved in to accommodate the needs of the National Weather Service and DOD? What is the agency contingency plan for this potential loss of polar satellite coverage?

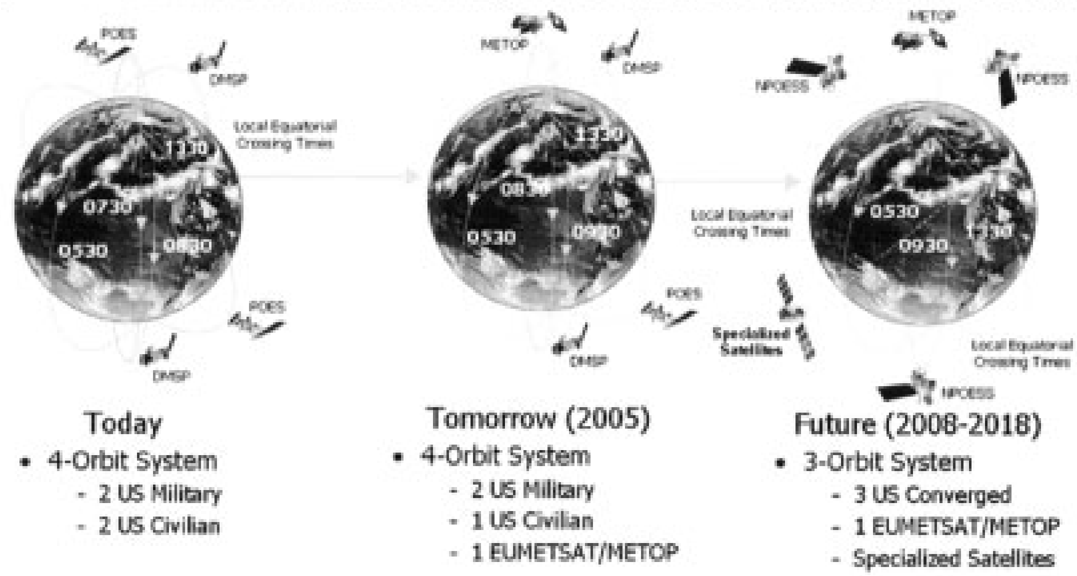
Mr. Wes Bush

1. How will the Administration's proposed funding decrease for the National Polar-orbiting Operational Environmental Satellite System (NPOESS), affect your ability to follow the schedule plan outlined in your contract?
2. What technical difficulties have you encountered and what challenges do you foresee in developing NPOESS, given that the sensors and ground systems for NPOESS are technologically advanced, new, and untested?
3. When will the new NPOESS program plan be ready? How will it address the proposed four-year $130 million budget decrease?

Dr. Ronald McPherson

1. From 1989 through 1992, the National Weather Service was forced to rely on only one Geostationary Operational Environmental Satellite system (GOES) satellite, when normally it would use two operational GOES satellites. What events led to this precarious situation? What would have been the implications if the single GOES satellite had failed, resulting in a loss of geostationary satellite coverage?
2. Is the Nation more dependent on satellite data for weather forecasting now than 10 years ago? Will our dependence continue to increase in the future?
3. How is polar satellite data used in weather forecasting? How will the instruments on the National Polar-orbiting Operational Environmental Satellite System (NPOESS) improve our ability to provide three to seven day weather forecasts and to predict severe weather events?
4. What major industries rely on three to seven day weather forecasts for business decisions?
5. If there was a loss of polar satellite coverage for 21 months, what effect would that have on industries that use weather forecasts from polar-satellite data? What effect would it have on climate data records?

Appendix A – Schematic of Polar Satellite Coverage Now and in the Future. EUMETSAT/METOP refers to European satellites.



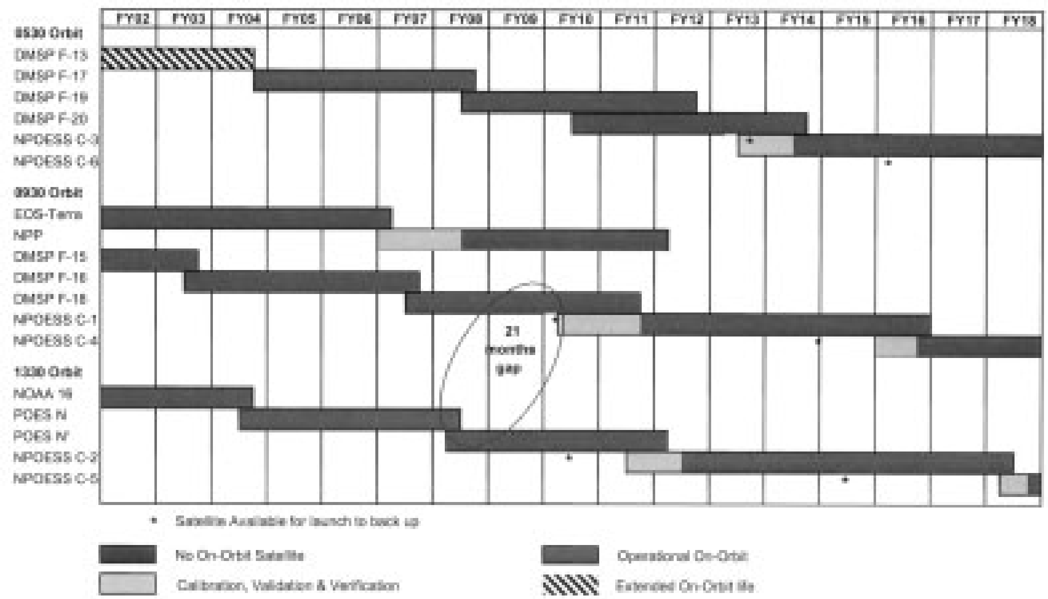
Appendix B – Total NPOESS Life-Cycle Cost Estimate Changes from FY03 to FY04. Numbers in millions of dollars;
* indicates actual appropriation; all other numbers are anticipated Administration request levels; n/a: not available at this time.

Date of Estimate	FY01 & prior	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15	FY16	FY17	FY18	Total
July 2002 agency planning documents	547*	308*	474	613	637	704	636	502	523	366	273	171	257	176	266	175	173	138	6482
March 2003 President's budget request plus FY03 supplemental	547*	308*	461*	543	607	684	626	517	573	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	6100
Difference			-13	-70	-30	-20	-10	+15	+50										-382

Appendix C – United States Polar Satellite Transition Schedule, March 2003.

Abbreviations:

FY: Fiscal Year
DMSP: Defense Meteorological Satellite Program, DOD
NPOESS: National Polar-orbiting Operational Satellite System, NOAA and DOD
EOS-Terra, EOS-Aqua, and NPP: NASA satellites
POES: Polar-orbiting Operational Satellite System, NOAA



Chairman EHLERS. Good afternoon. Welcome to this afternoon's oversight hearing on satellite programs at the National Oceanic and Atmospheric Administration, better known as NOAA.

While this topic may seem highly technical, it is actually an issue with implications for our day-to-day lives, because NOAA satellites provide the Nation and the world with critical information that makes possible our weather and climate forecasting. I am sure many of you have already heard my story about the Congressman who was opposed to all of this money we were spending on this issue. And when someone asked him about the weather, he says, "I don't need NOAA. I have got weather on my TV." And he lost his next election. So that shows just how important you are to every Member of Congress.

While many of us may take for granted the impressive satellite images that appear on our TV or computer screens when we look at weather forecasts, we must remember that the satellite systems that provide these images are highly complex and expensive. For example, NOAA's new Polar-orbiting Operational Environmental Satellite System, affectionately known as NPOESS, will cost the Federal Government $7 billion by the time it is completed. This represents a tremendous investment for an agency whose annual discretionary budget is $3.3 billion. One year of NPOESS funding is more than NOAA spends annually on all of its ocean and atmospheric research activities combined.

One role of Congress is to ensure that government investments are being used wisely. In the case of satellites at NOAA, this committee has cause for concern. In the early 1990's, NOAA was in the midst of upgrading its geostationary satellites. Severe technical problems, cost over-runs, and schedule delays resulted in that project being $1.4 billion over budget and five years behind schedule. The results were almost catastrophic. When one of the old satellites failed soon after launch, the Nation was forced to rely on only one geostationary satellite for three years, when the minimum requirement for complete coverage is two satellites. The one remaining satellite faced a real danger of failure itself. Had the new satellite program been on schedule, it would have been available to replace the failed old satellite and prevent this coverage problem.

Now NOAA is embarking on a new major polar satellite program, NPOESS. This joint program with the Department of Defense will merge and upgrade the polar-satellite systems of NOAA and DOD. NOAA should be given credit for learning from its experiences in the early '90's and applying these lessons to NPOESS. The new polar program incorporates risk reduction strategies and program management plans aimed at avoiding a similar coverage problem.

However, the Administration's fiscal year 2004 budget request for NPOESS is less than agency planning documents had anticipated, and creates a potential 21-month gap in polar satellite coverage. Also, DOD may be withdrawing some of its financial support for NPOESS, although I hope not. That is critical, because funding is shared equally between DOD and NOAA. At the same time, there is concern about potential technical difficulties in satellite sensor development that could lead to cost increases in the program. These schedule delays and potential cost increases are eerily similar to the problems with the geostationary satellite program that led to degraded coverage in the early 1990's. We do not want to repeat those mistakes.

Last year, this subcommittee held a hearing about issues with satellite data management at NOAA. We will continue to work with NOAA to ensure that the data from the new sensors on NPOESS will fully utilized.

Finally, although I never like to beat up witnesses, I do want to express my extreme disappointment that the testimony from NOAA did not arrive until just before the hearing, despite our efforts to provide them with more than sufficient time to answer our questions. This is a consistent problem that NOAA must address. And also, I must say when getting testimony late, that does not hold well for getting satellites up on time.

I look forward to hearing from our witnesses to learn more about budget considerations and systems development for the next generation of polar satellites at NOAA.

[The prepared statement of Mr. Ehlers follows:]

PREPARED STATEMENT OF CHAIRMAN VERNON J. EHLERS

Good afternoon and welcome to this afternoon's oversight hearing on satellite programs at the National Oceanic and Atmospheric Administration (NOAA). While this topic may seem highly technical, it is actually an issue with implications for our day-to-day lives, because NOAA satellites provide the Nation and the world with critical information that makes possible our weather and climate forecasting.

While many of us may take for granted the impressive satellite images that appear on our TV or computer screens when we look at weather forecasts, we must remember that satellite systems that provide these images are highly complex and expensive. For example, NOAA's new polar-orbiting satellite system, known as NPOESS, will cost the Federal Government $6.5 billion by the time it is completed. This represents a tremendous investment for an agency whose annual discretionary budget is $3.3 billion. One year of NPOESS funding is more than NOAA spends annually on all of its ocean and atmospheric research activities combined.

One role of Congress is to insure that government investments are being used wisely. In the case of satellites at NOAA, this committee has cause for concern. In the early 1990's NOAA was in the midst of upgrading its geostationary satellites. Severe technical problems, cost overruns, and schedule delays resulted in that project being $1.4 billion over budget and five years behind schedule. The results were almost catastrophic. When one of the old satellites failed soon after launch, the Nation was forced to rely on only one geostationary satellite for three years, when the minimum requirement for complete coverage is two satellites. The one remaining satellite faced a real danger of failure itself. Had the new satellite program been on schedule, it would have been available to replace the failed old satellite and prevent this coverage problem.

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I look forward to hearing from our witnesses to learn more about budget considerations and systems development for the next-generation of polar satellites at NOAA.

Chairman EHLERS. I now recognize Mr. Udall, a Member from Colorado, who is the Ranking Minority Member on the Environment, Technology and Standards Subcommittee, for his opening statement.

Mr. UDALL. Good afternoon. Thank you, Mr. Chairman, for convening this hearing on NOAA's satellite program. And I also welcome the panel. And I know a number of you have connections to Colorado, particularly Mr. Teets. It is nice to see you here.

Since the 1960's, we have relied upon satellites to gather global environmental information. We rely upon this information to make three to five day forecasts, to track severe storms, and to learn more about the Earth's environment. Our satellite systems have worked so well that we rarely consider the possible impacts of a break in a flow of this information, as the Chairman mentioned in the case of one of our colleagues.

A break in the flow would mean we would be without the primary data sources for our numerical weather prediction models. Our ability to make accurate forecasts would be impaired. And we would have diminished capacity to track the progress of severe storms.

We are now approaching the end of the current satellite series life span. In anticipation of this, in 1994, the Congress initiated the National Polar-orbiting Operational Environmental Satellite System, or NPOESS. For the first time, the decision was made to integrate the satellite programs of NOAA and the Department of Defense into a single satellite system to save money and, of course, improve efficiency. Past experience has taught that new projects of this magnitude will encounter technical difficulties and that schedules will be adjusted to accommodate unforeseen problems. This is beginning to happen in the NPOESS program.

I want to learn what steps NOAA and DOD have taken to consider the risks associated with this program and to address them. A few years from now, we do not want to find ourselves singing the line from that old song, "You don't know what you have got until it is gone." A break in the continuity of information from the satellite programs is not acceptable. We must do all we can to anticipate and identify problems to deal with them in a manner that will ensure that the information needs of NOAA and DOD will continue to be met in a reliable fashion.

As the Chairman mentioned, the funding levels for this program have changed from what was originally planned. As a result, the schedule for launching the first satellite has been extended by 21 months. I am anxious to hear what plans the Joint Program Office has made to ensure that we keep this program adequately funded and on track.

I appreciate the willingness of our witnesses to participate this afternoon, and I look forward to your testimony.

Thank you, Mr. Chairman.

[The prepared statement of Mr. Udall follows:]

PREPARED STATEMENT OF REPRESENTATIVE MARK UDALL

Good afternoon. Thank you, Mr. Chairman, for convening this hearing on NOAA's satellite program.

Since the 1960s we have relied upon satellites to gather global environmental information. We rely upon this information to make three-to-five day forecasts, to track severe storms, and to learn more about the Earth's environment.

Our satellite systems have worked so well that we rarely stop to consider the possible impacts of a break in the flow of this information. A break in the flow would mean we would be without the primary data sources for our numerical weather prediction models. Our ability to make accurate forecasts would be impaired, and we would have diminished capacity to track the progress of severe storms.

We are now approaching the end of the current satellite series lifespan. In anticipation of this, in 1994 Congress initiated the National Polar-orbiting Operational Environmental Satellite System, or NPOESS, program. For the first time, the decision was made to integrate the satellite programs of NOAA and the Department of Defense into a single satellite system to save money and improve efficiency.

Past experience has taught us that new projects of this magnitude will encounter technical difficulties and that schedules will be adjusted to accommodate unforeseen problems. This is beginning to happen in the NPOESS program. I want to learn what steps NOAA and DOD have taken to consider the risks associated with this program and to address them.

A few years from now we do not want to find ourselves singing the line from that old song: "You don't know what you've got 'til it's gone." A break in the continuity of information from the satellite programs is not acceptable. We must do all we can to anticipate and identify problems and to deal with them in a manner that will ensure that the information needs of NOAA and DOD will continue to be met in a reliable fashion.

The funding levels for this program have changed from what was originally planned. As a result, the schedule for launching the first satellite has been extended by 21 months. I am anxious to hear what plans the Joint Program Office has made to ensure that we keep this program adequately funded and on track. I appreciate the willingness of our witnesses to participate this afternoon and I look forward to their testimony.

Chairman EHLERS. If there is no objection, all additional opening statements submitted by the Subcommittee Members will be added to the record. Without objection, so ordered.

[The prepared statement of Mr. Smith of Michigan follows:]

PREPARED STATEMENT OF REPRESENTATIVE NICK SMITH

I'd like to thank Chairman Ehlers for holding this hearing today to examine the progress that has been made in building the new National Polar-orbiting Operational Environmental Satellite, Data, and Information System (NPOESS).

The National Oceanic Atmospheric Administration's (NOAA) existing polar-orbiting satellite system is crucial for a number of American industries including agriculture, construction, energy distribution, and outdoor recreation. It is estimated that our existing accuracy predicting weather saves $3 billion every hurricane season by reducing fatalities and limiting property damage by being prepared. Overall, polar-orbiting satellite systems create a net economic benefit of $8.8 billion per year.

NPOESS will consolidate the satellite capabilities of NOAA's current system with what is now a separate Department of Defense (DOD) system. This will result in an annual savings of $1.8 billion. Still, developing the satellite will be expensive. A recent GAO report estimates that the total cost will be close to $7 billion, up from an initial estimate of $6.4 billion. In addition, at the current rate of funding, NPOESS will not be completed until 21 months after the original target date. As a result, we could be without crucial polar-orbiting satellite data for a significant period of time.

This is not entirely surprising, considering that NOAA's last major satellite upgrade ended up $1.4 billion over budget and five years behind schedule. Unforeseen technical difficulties stemming from the incorporation of untested technologies into the new satellite system were largely to blame for this during the last upgrade, and it is my understanding that we are doing the same thing this time around. In the interest of conserving tax dollars as well as insuring the continuous availability of vital weather-related information, I would like to see some of the supposed technology enhancements dropped from the current design plan. At the very least, we should consider the need for additional satellites with the existing design to allow development of NPOESS to proceed under a more reasonable timeframe.

I thank all of you for coming here today to address the concerns that I and many of my colleagues have regarding NPOESS. I hope that we can have an open discussion about the direction of this project and look forward to working with you to insure that American tax dollars are spent in a responsible manner.

8 New Technologies Incorporated into NPOESS

Advanced technology microwave sounder: Will measure microwave energy released and scattered by the atmosphere. Used with infrared sounding data to produce daily global atmospheric temperature, humidity, and pressure profiles.

Aerosol polarimetry sensor: Retrieves specific aerosol (precipitation, sea spray, smog, and smoke) and cloud measures.

Conical microwave imager/sounder: Collects microwave images and data needed to measure rain rate, ocean surface wind speed and direction, amount of water in the clouds, soil moisture, as well as temperature and humidity at different atmospheric levels.

Cross-track infrared sounder: Collects measurements of the Earth's radiation to determine the vertical distribution of temperature, moisture, and pressure in the atmosphere.

Global positioning system occultation sensor: Measures the refraction of radio wave signals from the GPS and Russia's Global Navigation Satellite System to characterize the ionosphere.

Ozone mapper/profiler suite: Collects data needed to measure the amount and distribution of ozone in the Earth's atmosphere.

Space environmental sensor suite: Collects data to identify, reduce, and predict the effects of space weather on technological systems, including satellites and radio links.

Visible/infrared imager radiometer suite: Collects images and radio metric data used to provide information on the Earth's clouds, atmosphere, ocean, and land surfaces.

Chairman EHLERS. At this time, it is my pleasure to introduce an outstanding panel of witnesses. Mr. Gregory Withee is the Assistant Administrator for National Environmental Data—Satellite Data and Information Service within the National Oceanic and Atmospheric Administration, more commonly known by its acronym, NOAA. Mr. Peter Teets is the Under Secretary of the Air Force and also serves as the Department of Defense Executive Agent for Space. It is a very impressive title. Does that include the entire cosmos, Mr. Teets? Mr. David Powner is the Acting Director for Information Technology Management Issues at the General Accounting Office. Mr. Wes Bush is President of Northrop Grumman Space Technology. And Dr. Ronald McPherson is the Executive Director of the American Meteorological Society, which incidentally does an outstanding job of teaching teachers about meteorology and gets that spread through the classroom. And we should acknowledge that success.

I assume our witnesses know that spoken testimony is limited to five minutes each. And we have the lighting system here—there. The green means you are within the first four minutes. Yellow means you are in the last minute. Red means that your life is in danger. So we encourage you to try to—regardless of how lengthy or how good your written testimony is, we encourage you to try to give your spoken testimony within five minutes. Now after you complete your testimony, each Member of the Committee who is present will have five minutes to ask questions of you.

We will start with Mr. Withee.

STATEMENT OF MR. GREGORY W. WITHEE, ASSISTANT ADMINISTRATOR FOR NATIONAL ENVIRONMENTAL SATELLITE DATA AND INFORMATION SERVICE, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Mr. WITHEE. Thank you, Mr. Chairman.

Mr. Chairman and Members of the Subcommittee, as Director of the Nation's civil operational environmental satellite program, which resides in NOAA, I am pleased to have the opportunity to testify before you today on NOAA's future satellite programs. Vice Admiral Conrad Lautenbacher, the Administrator of NOAA, is out of town today, but asked me to relay his strong support to this important topic regarding NOAA's satellite programs.

I am also pleased to be joined by our colleagues on the panel. I would like to mention that NASA also plays an integral role in our efforts by providing important demonstrations of breakthrough technology and associated science and technological improvements.

The Nation is already accruing substantial benefits from NOAA's satellite systems in terms of saving life, property, and environmental monitoring, and we anticipate our future systems will add to these benefits.

I am pleased to report that the health of NOAA's civil operational environmental satellite systems is excellent. We are past the halfway point in our successful GOES I–M satellite series. And just last week, we finished negotiations that will ensure the first launch of the next GOES series, which we call –N through –P, in mid-2004. GOES is the sentinel on watch for severe weather for the United States, and because of that, a gap in coverage would be unthinkable. With the hurricanes upon us and Hurricane Claudette brewing in the Gulf of Mexico, I am sure the Subcommittee appreciates the importance of GOES satellites.

To that end, I am happy to report that NOAA is already working on a future GOES system called GOES–R to be launched in 2012. GOES–R will continue high-resolution weather coverage of the United States with improvements for our coastal services and climate programs, all accomplished within the cost per satellite year we have experienced for GOES I–M.

Our polar satellites, POES, are also performing well. Currently, we have an operational satellite in the morning and afternoon orbit. We anticipate launch of NOAA–N in 2004 and NOAA N–Prime in March 2008 and the first NPOESS satellite to be ready for launch in late 2009. The first METOP satellite, a partnership between NOAA and an organization in Europe called EUMETSAT, will launch in 2005 and will save the U.S. taxpayer over half a billion dollars.

Over the 40 years in the satellite business with unanticipated failures and delays in GOES, which you mentioned, Mr. Chairman, POES, and DMSP, strategic long-range planning is the key to delivering uninterrupted satellite data to our users. The planning of our future satellite series GOES–R and NPOESS is based on past experience and the most up-to-date information available. We have solid, rigorous planning and risk-reduction programs, which include the end-to-end NPOESS Preparatory Project, we call that NPP, mission with NASA and associated product generation, distribution, archive, and access.

I am aware that the Subcommittee is interested in the 21-month gap between POES and NPOESS and the potential impacts to weather forecasting if N–Prime fails. In the event N–Prime is lost to the launch of NPOESS, NOAA would rely on the only available satellite at the time, which would be, we hope, the European METOP satellite, which is in the morning orbit, as the sole available operational satellite that could meet NOAA's operational satellite data requirements. Of course, NOAA would continue to assess the capability of any orbiting spacecraft at the time and use the best available data, if possible.

The Department of Defense, Commerce, and NASA have jointly invested over $1 billion toward the development of the NPOESS sensors and spacecraft. Each of the center's suites were very carefully developed by the NPOESS program to satisfy validated requirements for all of the partners and users. At this point, there would be no cost savings to be realized by reducing the number of sensors without adversely affecting the quality and timeliness of data to the user, and I note, would also cause costly delays in satellite redesign. With already reduced budget profiles, the NPOESS program has attempted to preserve key sensor risk reduction activities, such as NPP, as close to the original plan as possible while moving the NPOESS launch stage further into the future. Among the NPOESS partners, we at NOAA have started to address the challenges of data utilization and data access and archive to ensure that the data are used operationally on the first day of availability.

In conclusion, NOAA joins our partners today to reiterate our full commitment to NPOESS and GOES–R. We are excited about developing these cost-effective satellites to meet validated user requirements for environmental data. And we anticipate substantial benefits to the Nation from these investments.

I see I am out of time, so I want to apologize on behalf of NOAA for getting the testimony in late, but hope that you think that the testimony before you and my oral remarks are useful. And thank you, Mr. Chairman, for this opportunity to testify on this extremely important matter. I would be happy to take questions.

[The prepared statement of Mr. Withee follows:]

PREPARED STATEMENT OF GREGORY W. WITHEE

Thank you, Mr. Chairman and Members of the Committee, for the opportunity to testify before you regarding National Oceanic and Atmospheric Administration's (NOAA) satellite, data and information services. Vice Admiral Conrad C. Lautenbacher is unable to attend this hearing today due to prior commitments. I am Gregory Withee, Assistant Administrator for NOAA's Satellite and Information Services and am responsible for end-to-end management of NOAA's satellite, data and information programs.

NOAA's satellite program is well on its way to addressing the exciting challenge of incorporating new technologies to improve the capabilities of our operational satellite systems to better serve the American people. My testimony today will review the steps we are taking and the lessons learned over the past 43 years as the Nation's operational civil space agency. It will lay out our plans for satellite data continuity as we move to the first National Polar-orbiting Operational Environmental Satellite System (NPOESS) spacecraft, the follow-on to the NOAA Polar-orbiting Operational Environmental Satellite (POES). The first NPOESS satellite (C–1) will be available for launch in 2009 and will continue our polar satellite data series, as well as provide important continuity for select National Aeronautics and Space Administration (NASA) research missions and climate activities. I will also address our plans for the next series of Geostationary Operational Environmental Satellites (GOES)—GOES–R—with a planned launch date of 2012.

While these dates seem very far in the future, our experience developing, launching and operating environmental satellites dictates that early planning, accompanied by rigorous risk-reduction activities, is essential. Equally important is the thorough preparation of the end-user to accept, use and benefit from the full economic and scientific value of these data streams, and the establishment of a comprehensive scientific data stewardship program that includes long-term access and archive infrastructure.

This subcommittee has been a strong advocate of our programs, and we look forward to continuing the dialogue to keep you informed of our progress.

NOAA's Satellite, Data and Information Program

Since the 1960s, when the United States launched its first civil polar-orbiting weather satellite (1960) and its first civil geostationary weather satellite (1966), the importance of data from these satellite systems has grown far beyond any planning assumptions made during their conception in the 1950's. Today, NOAA's satellites support all of NOAA's critical missions; numerous civil and military activities within Federal, State and local government agencies; academic endeavors; the private sector activities; the public; and international communities. NOAA's satellites are critical for all sectors of the U.S. economy, and are now considered environmental versus just weather satellites.

NOAA's mandate is to provide to its customers and users—without interruption—satellite data from its geostationary and polar-orbiting systems. As we move to the next generation of satellites, our operational mission requires that GOES–R and NPOESS are available to ensure continuous global satellite coverage essential to ensure the health and safety of our citizens. Additionally, these satellites provide data critical to unlocking the secrets of nature which are fundamental to our ability to reduce the uncertainties in important environmentally related decisions associated with long-term forecasts and global climate change.

NOAA's policy implements this mandate through a carefully planned and balanced requirements-based acquisition strategy which is detailed in the annual President's Budget Request. These budget requests include the annual funding required to enable NOAA to manage the technology and schedule risk inherent in these challenging satellite programs.

Requirements-based Mission Planning

NOAA uses a formal satellite requirements management process to identify, collect and assess *validated* environmental satellite observation requirements and allocate these requirements to specific observational systems. These requirements include satellite-based observations of all regions of the Earth's atmosphere; the Earth's oceans, coasts, and inland waters; observations of the Earth's land masses, including the mapping of high-resolution geospatial characteristics; and observations of the sun and near-Earth space environment.

This process provides important input into budget, planning, and management systems, and allows tracking of requirements from agency missions through to system allocations. As such, this process and its requirements documents represent the balance achieved among user needs, system technical capabilities and program affordability constraints. The credibility of the requirements process lies in the ability of this planning document to fulfill user needs within cost and schedule. This process has been used to develop the instrument and sensor suite on the GOES–R and NPOESS satellites.

The GOES–R Program Requirements Document (PRD) represents twelve agencies/groups needs from the U.S. civil, U.S. military, European and climate communities. The specific segment level documents to address all specifications for the end-to-end GOES–R system will be generated from the PRD.

For NPOESS, the Department of Defense (DOD) requirements process was used by the partner agencies (NOAA, DOD, and NASA) to develop an Integrated Operational Requirements Document (IORD). All three agencies worked with their user and customers throughout the Federal, State and local governments, academia, and industry to develop inputs into the mission and sensor performance requirements. The original IORD was approved by all agencies in 1996 and updated in December 2001. All sensors are traceable to specific requirement for one or all of the partner agencies. In many cases, a single sensor is required to meet different but equally important requirements of all three agencies and their customers and users.

Scientific Data Stewardship of NOAA's Archives

The concept of end-to-end management starts with the requirements process and ends with the access and archive of these data. NOAA continues to keep its data access and archive facilities at its NOAA National Data Center current with the latest technology to facilitate user access to its archived data.

NOAA Satellites and Information FY 2004 President's Budget Request

All aspects of the $837.5 million in the FY 2004 President's Budget Request have been carefully developed to ensure continuation of our existing operational programs, allow seamless transition to future satellite and data management activities, and satellite data continuity. Our partners—NASA and DOD—have worked with us to help manage the risk, schedule and funding estimates required to support the activities necessary to develop and launch the satellites and build the ground systems needed to maintain data continuity. The FY 2004 budget request will allow us to continue essential activities in support of GOES, POES, NPOESS, critical support for command and control of the spacecraft, product processing and distribution, and data management including access and archive functions.

NOAA Geostationary Program

The FY 2004 President's Budget Request includes $277.55 million NOAA's GOES program. Of that amount, $0.6 million to support GOES I–M activities; $172.23 million to continue development of GOES N series satellites and ground systems; and $104.7 million to support GOES–R preliminary design and risk reduction activities.

NOAA is responsible for the end-to-end aspects of the GOES program. NOAA's constellation of two operational GOES satellites and one on-orbit spare now provide continuous coverage of the Western Hemisphere, seeing as far east as the western tip of Africa and as far west as the eastern tip of New Guinea. These geostationary sentinels provide critical data to weather forecasters, and detect and track severe weather, such as tornadoes, hurricanes, flash floods, blizzards and other hazards (to include volcanic ash plumes and wildland fires). In addition, GOES data collection system (GOES DCS) platforms provide communication data relay capabilities for scientific surface platforms such as automated observing stations, ocean buoys, stream gauges, tide gauges, and rain gauges. The system relays environmental information such as river flooding, snow melt, ocean temperature, and wind measurements to forecasters and emergency managers. GOES also monitors space weather events such as radiation and geomagnetic storms though the Space Environment Monitoring sensors.

NOAA has a requirement to maintain two operational GOES satellites, one at 75 degrees West longitude (GOES–East) and another at 135 degrees West longitude (GOES–West). In order to ensure that a two GOES constellation is continuously available, an on-orbit stored spare is required. NOAA launches a replacement satellite once the on-orbit spare is placed into operation. NOAA also requires that a satellite be ready for launch within a year of the previous satellite launch to backup a launch failure. The placement of the operational satellites ensures continuous satellite coverage of U.S. interests on the East Coast, its territories in the Caribbean Basin and continental U.S., and West Coast, Hawaii, and U.S. territories in the Pacific.

This constellation is based on over 40 years of experience and our understanding of satellite and launch performance and incorporates the lessons learned from past future development.

First, launch of the satellite is the most vulnerable part of the entire mission from production to operational use. NOAA maintains an on-orbit spare, so it can recover quickly from a launch failure. This approach allows NOAA to replan another launch campaign, thus avoiding an extended outage in our on-orbit two operational satellite constellation. This was not possible when GOES failed on launch in 1986, resulting in one-satellite geostationary coverage for many years.

Second, having an on-orbit spare allows rapid replacement on failure of an operational satellite and ensures "no loss" of coverage or data for users in the event of a failure of one of the GOES operational satellites. By activation of the on-orbit spare, NOAA can restore full instrument operations and data within 7 days of failure of the previous satellite, and provide continuous data during the approximately 30–45 days it takes to move the spacecraft from the storage location to the operational location, as either GOES–East or GOES–West. Key users—NOAA's National Weather Service, Department of Defense, Federal Emergency Management Agency/Department of Homeland Security, State and local emergency managers, Federal Aviation Administration—demand uninterrupted access to satellite data to support their mission-critical activities.

Third, NOAA can perform systematic on-orbit post-launch testing of the spacecraft and instruments to ensure that instruments are performing according to specifications and will meet customer and user requirements. This on-orbit testing is a more complete evaluation of performance than is achievable on the ground. The approach of systematic on-orbit testing prior to putting a satellite into on-orbit storage also allows a more thorough investigation of, and if necessary, appropriate corrective action of anomalies without the pressures of meeting an operations schedule. A prime example of NOAA's recovering of potentially failed assets was GOES–10 and its failed solar-array drive in the forward direction. Creative engineering solutions allowed GOES–10 to become our operational West satellite in July 1998 which continues to the present.

Finally, having an on-orbit space can avoid launch pad conflicts. Due to limited launch facilities and NOAA's use of commercial launch services, if NOAA were to experience a failure during launch, it would take 12–18 months for the earliest possible launch of a replacement satellite because of existing commercial launch pad schedules. Commercial launch schedules maintain a rolling firm launch manifest of 12–18 months into the future. By Congressional directive, commercial launch services for NOAA programs require a rigorous process before NOAA could "bump" another commercial customer off the manifest. NOAA's launch policy avoids having to address this situation. Only under a multiple failure scenario would NOAA ever consider bumping another customer.

The GOES I–M Experience

In 1983, a decision was made to competitively procure follow-on satellites (GOES I–M) in the GOES program. Incremental changes to requirements were deemed achievable, with the only major advancement being a new requirement for full-time atmospheric sounding to monitor evolving temperature and moisture structure of the atmosphere to meet validated NOAA's National Weather Service requirements. This new requirement drove a design change in the basic spacecraft platform requiring full time Earth pointing versus the previous spin stabilized platform design. The satellite contract called for a launch availability in 1989. This need date was originally anticipated to protect against a GOES–G or GOES–H launch failure.

The new technology had no risk reduction program associated with it on the basis that instruments of this type had been flown in polar orbit, making the transition to geostationary orbit reasonably straightforward. It also assumed that the body stabilized technology had been proven sufficiently on geostationary commercial communication satellites.

The instrument and spacecraft development were found to be much more technically complex than originally thought, once the design was finalized. Changes in thermal characteristics between the polar and the geostationary orbit were not fully understood, and the original design for the instruments was found, in tests, not to work. On the spacecraft, stabilization for meteorological instruments was far more challenging than for a commercial communications platform. These problems led to almost five additional years of design effort and a billion dollar overrun.

Since GOES I–M Series had no end-to-end system architecture, no risk reduction was planned for algorithm development and data assimilation into numerical models. Therefore, the forecasters had no advance data, prior to launch, with which to learn and train and NOAA's National Weather Service required the better part of a year to make the image data operational, and almost four years to make the sounder data operational in forecast offices.

With the failure of one on-orbit GOES and a failure in 1986, by 1989 (the intended launch date of GOES–I), only one GOES satellite separated the United States from being completely unable to provide high temporal resolution monitoring of hurricanes at an early stage, monitor severe weather wherever it occurred, and miss important sounding information for short-term weather forecasts and warnings. This situation continued until GOES–I was launched in 1994.

GOES–R Planning

In response to validated user requirements for improved geostationary spatial and temporal observations, NOAA has started planning activities for the GOES–R series which is anticipated to launch its first satellite by 2012. History and experience have shown that it takes 10 years to develop a new satellite series. NOAA and our partner NASA have learned that environmental sensors for geostationary orbit are difficult to develop and build, and need the full 10 years for development, even with the excellent research provided through NASA or DOD. The GOES I–M and GOES–N series instrument technologies were first developed in the 1970's/80's. While they have served the Nation well, our customers' and users' validated requirements for data are beyond the capability that these heritage instruments can provide.

NOAA has incorporated the experiences of GOES I–M into GOES–R planning with the inclusion of rigorous and comprehensive concept, design, and risk reduction phases which includes an end-to-end system with its associated product generation, distribution, and archive and access. GOES–R is scheduled for readiness to back up the development of the last GOES–N series launch in 2012.

GOES–R will, for the first time, offer further benefits for other observations such as coastal and lightning data, provide improvements in spectral coverage (number of instrument channels), temporal coverage (how fast the satellite scans the Earth), spatial resolution (how sharp the images are horizontally for images and vertically for temperature and moisture profiles), and radiometric accuracy (how true are the temperatures measured). These improvements translate to product improvements such as three-hour temperature forecasts (25 percent accuracy improvement) and Atmospheric Instability forecasts (90 percent improvement in two-hour ahead Convective Weather watch area) which in turn are important to utility, transportation, agriculture, recreation, and other industries, and are vital to protecting lives and property in the event of severe weather. Preliminary estimates place the incremental benefits of the improvements from the GOES–R series of satellites at more than $4 billion over the life of the program. These benefits are in addition to the baseline benefits that the current GOES satellites provide.

In order to ensure a smooth transition from the GOES–N to the GOES–R series, NOAA needs to have all phases of a sound acquisition development in place: Phase A (Concept Definition); Phase B (Design and Risk Reduction); Phase C/D (System Production/Implementation). In the case of GOES I–M, the Phases A and B efforts were omitted. The result of skipping these key functions resulted in a five-year slip in the program with significant cost overruns.

To address alternative approaches to end-to-end solutions for GOES–R, NOAA is releasing to industry a Broad Agency Announcement to look at technology advancements in the following four areas: spacecraft; command, control, and communications; product generation, distribution, archive and access; and end-to-end systems integration. This will afford NOAA the opportunity to dialogue with industry to entertain their best and brightest ideas to minimize risk during GOES–R development.

Full funding of the FY 2004 GOES–R budget request of $104.7 million is needed to continue these activities and strengthen the overall risk reduction program to ensure that NOAA is developing the most appropriate system to meet our operational requirements and program funding constraints, and that NOAA will have retired sufficient risk to ensure that the GOES–R system is delivered on time to support the continuity of the essential GOES mission.

NOAA's Polar-orbiting Satellite Program

The FY 2004 President's Budget Request includes $391.1 million NOAA's polar-orbiting satellite program. Of that amount, $114.4 million is requested for POES satellites (NOAA K–N' series) and ground systems; and $276.7 million for NOAA's portion of NPOESS.

a) Polar-orbiting Operational Environmental Satellites (POES)

The POES mission is to provide an uninterrupted flow of global environmental information in support of operational requirements. The POES mission is comprised of two satellites, one in a morning orbit, and one in an afternoon orbit, to collect global environmental data, including the 3–D measurement of multiple parameters, which are critical for accurate forecasts beyond three days. In addition, they are important for establishing long-term global data sets for climate (stratospheric ozone, oceanic, vegetation, global warming) monitoring, change detection, and prediction. Data sparse areas such as the world's oceans are also observed primarily by NOAA POES. Like GOES, POES data collection platforms provide services such as search and rescue, and relay of tide, buoy, flood, and tsunami data from global and remote locations. POES sensors also make observations that support timely forecast of space weather events.

NOAA has established a POES program policy that a spacecraft and launch vehicle be available on or before the date of the launch of the preceding spacecraft. This helps protect against coverage gaps caused by a launch failure, early on-orbit failure of the satellite after launch, and sets a need-date for the next satellite to be produced.

In the scenario of NOAA N' failure and lack of access to timely backup, DOD, research, and international satellite data, significant impact to protection of life and property and climate monitoring services are possible. Potential impacts include degradation of hazard monitoring such as volcanoes, especially at high latitudes; breaks in the climate record which degrade the long-term climate record; loss of the ability to generate ozone and ultraviolet (UV) analyzes and forecasts used for public heath; and decreased forecast accuracy in global models, estimated to be 1–4 percent in Northern Hemisphere and 3–25 percent in the Southern Hemisphere.

The annual President's Budget Request is based on the anticipated need-date of the satellites. However, depending on launch success, and operational satellite life, these need dates may shift. Nominally, the time between call-up and the actual replacement of a POES is 180 days.

The normal replacement of a POES takes place whenever the flow of operational scientific and related instrument engineering data from designated critical satellite instruments is either interrupted or degraded significantly. In practice, any decision to launch a replacement satellite requires the consideration of several additional factors, such as: availability of older POES spacecraft in the orbit with functioning instrument(s) that can provide data continuity on an interim basis; operational condition of in-orbit NOAA POES spacecraft, in particular are other spacecraft or instruments displaying indications of early failure; availability of launch vehicles and spacecraft-to-launch vehicle integration facilities; the possibility of conflicts in access to launch pads and launch support facilities; the possibility of conflicts in availability of skilled personnel for launch preparations and other critical activities; ability of the ground system to support the launch, operations, and data processing and distribution for the replacement satellite.

b. National Polar-orbiting Operational Environmental Satellite System (NPOESS)

In May 1994, the President directed the convergence of the Department of Commerce/NOAA POES program and DOD's Defense Meteorological Satellite Program (DMSP). These two programs have joined to become the NPOESS which will satisfy both civil and national security operational requirements. In addition, NASA, through its Earth Observing System (EOS) efforts, offers new remote-sensing and spacecraft technologies that are being incorporated to improve the capabilities of the NPOESS.

The tri-agency NPOESS Integrated Program Office (IPO) and NPOESS contractor has established a design and production schedule to derive the maximum benefit from the risk-reduction missions of the NPOESS Preparatory Project (NPP) and the Windsat/Coriolis mission for critical risk reduction for the NPOESS C–1 satellite. The schedule will also provide a bridge between the transition from NOAA POES and DOD DMSP satellites, while providing continuity of select NASA EOS missions.

NPOESS FY 2004 Budget Request

The FY 2004 President's Budget Request for NPOESS is $544.4 million, of which DOC/NOAA's portion is $276.7 million, and DOD's portion is $267.7 million. This will support continued development of NPOESS, including the risk reduction missions, Windsat/Coriolis and NPP.

In the letter of invitation to testify at this hearing, the Subcommittee asked for a response to the $70 million reduction from the funding requirements included in the FY 2003 estimates. The FY 2004 President's Budget Request reflects the Administration's program needs for continued development of the NPOESS Program. IPO has directed the NPOESS contractor to conduct a replan, which resulted in deferred procurement of sensors and non-recurring engineering for NPP and the NPOESS satellites. Adjustments to the satellite launch schedule are reflected in the President's Budget Request.

Full funding of the total DOC and DOD NPOESS FY 2004 President's Budget Request is imperative to keep the program on its revised schedule.

NPOESS Risk Reduction Missions

The WindSat/Coriolis satellite, which was launched on January 6, 2003, is serving as risk reduction for the NPOESS Conical Scanning Microwave Imager/Sounder (CMIS). CMIS will measure ocean surface wind direction from space using polarimetic passive microwave technology, which requires a sensor with the capability to sense passive microwave emissions that are on the order of one-tenth as strong as the signals used by presently operational passive microwave sensors. This has not been done before from space and constitutes the highest technical risk associated with NPOESS.

The NPP satellite scheduled for launch in October 2006 will significantly reduce NPOESS program risks by demonstrating on-orbit sensor functionality and allowing scientists to develop NPOESS algorithms using data collected by actual sensors on-orbit instead of having to approximate data through synthetic generation as is usually done for new sensors. History demonstrates that the risk associated with advances in algorithm developments is dominated by how accurately the data used to develop the algorithms resemble the data that will be collected by the sensor on-orbit. This rationale applies to the following NPOESS sensors and their associated algorithms.

- Cross Track Infrared Sounder—3 environmental data records (EDR)
- Visible/Infrared Radiometer Suite—23 EDR
- Advanced Technology Microwave Sounder—3 EDR
- Ozone Mapping and Profiling Suite—1 EDR

NPP will also demonstrate proper functioning of the NPOESS Command and Control System.

Transition Between POES and NPOESS Satellites

The Subcommittee's letter of invitation also expressed interest in the transition between POES and NPOESS, specifically an estimated 21-month gap between the launch of NOAA N' and the availability of NPOESS C–1.

As a polar-orbiting satellite program, the NPOESS satellite availability strategy is similar to that noted earlier for NOAA POES with the additional constraints of required overlap with NPP for cross calibration and meeting the DOD early morning spacecraft requirement. Under the IORD, the first NPOESS satellite (C–1) is required to back up NOAA N' (the last of the NOAA POES series) or DMSP F20. While the replan has delayed the availability of the first NPOESS satellite by as much as 21 months, there is no projected gap in coverage, as long as the NOAA N and N' satellites are successfully launched, and are meeting operational lifetimes.

NOAA continues to monitor the status of the instruments on its operational POES to maximize the capability of those spacecraft. Our transition planning calls for the launch of the NOAA N (June 2004) and NOAA N ' (March 2008) into the afternoon orbit and the use of the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT) METOP polar satellite to fill the morning orbit requirement.

With respect to the Subcommittee's interest in contingency planning in the event of the failure of NOAA N', NOAA is working closely with EUMETSAT to ensure launch of the first METOP satellite in 2005 which will assume the morning orbit responsibilities. In the event there is a loss of NOAA N' prior to the launch of NPOESS C–1, NOAA would rely on the METOP satellite in the morning orbit.

For the afternoon orbits, NOAA would reassess the capability of older spacecraft that have been taken out of operational service and use the best available data. NOAA would also assess the utility of all available satellite data from DOD's DMSP, NASA EOS satellites, NPP missions, and foreign sources.

Status of the NPOESS Program Sensors

The Subcommittee has expressed an interest in any cost-savings that may be accrued from reducing the NPOESS sensors and impact this would have on meeting operational requirements.

The NPOESS Program Office, in consultation with the NPOESS Program Executive Committee, reviewed the status of the program, the FY 2003 Appropriations, FY 2004 budget request against the operational requirements in the IORD and satellite schedule. They determined that there will be no changes to the technical content of the program, specifically the number and types of sensors and their performance, the number of satellites, number of weather centrals. The NPOESS Program recommended, and the Committee approved, adjustments to the schedule to accommodate the available funds. The basis of the recommendation was that no single sensor, even if totally deleted, would provide significant reduction in the overall program cost. Additionally, the impact to the customer of the loss of data and services if sensors were reduced would be incalculable. Appendix 1 contains a list of the NPOESS sensor suite.

For illustrative purposes, the following is a review of the impact of deleting the Visible/Infrared Imaging Radiometer Suite (VIIRS) and the Conically-scanned Microwave Imager Sounder (CMIS) from the NPOESS sensor suite. VIIRS is designed to meet NOAA and DOD operational requirements and to continue the NASA EOS Moderate Resolution Imaging Spectroradiometer (MODIS) data to meet the climate community imagery requirements, provide continuity of the Sea-viewing, Wide-Field-of-view Sensor (SeaWiFS) instrument for ocean color, and provide enhancement on heritage NOAA POES and DMSP sensors. SeaWiFS data continuity is a critical requirement for the ocean sciences community.

CMIS is used to image the Earth's surface through clouds, which is especially important for sea and lake ice, for ocean surface wind speed and direction, and for soil moisture measurements (a key performance parameter from the DOD and useful for civilian agricultural and flood warning applications). The development costs of the VIIRS visible and infrared imager and the CMIS are approximately $180 million for each sensor suite. This amount includes three VIIRS sensors (NPOESS Preparatory Project, NPOESS C–1 and C–2), two CMIS sensors (NPOESS C–1 and C–2), and all the algorithms and software for both. Development of the sensors is far enough along that there would be no program cost savings from reducing the number or type of sensors from the NPOESS Program. In fact, deleting the VIIRS sensor eliminates all the imaging capability from NPP, C–1 and C–2. This would negate two thirds of the EDRs on NPOESS and result in NPOESS' inability to meet IORD performance requirements.

During the assessment to converge DMSP and POES into NPOESS, NOAA and DOD conducted cost benefit analyses and it was estimated that the program will realize cost avoidance of $1.3 billion over its life. Therefore, we have already realized a major cost benefit from effectively reducing the number of instruments in orbit. If further budget adjustments require that select sensors are dropped, NOAA would not be able to meet the mission requirements directed in the IORD.

NOAA would be affected more than DOD, since NOAA does have unique sensors such as Total Solar Irradiance Sensor (TSIS) and Earth Radiation Budget Sensor (ERBS) that do not meet DOD requirements, but do meet NASA and NOAA climate and scientific mission requirements. Removing any of the "critical" sensors, VIIRS, Cross-track Infrared and Microwave Sounding Suite (CrIS), Advanced Technology Microwave Sounder (ATMS), or CMIS, would result in violation of the key performance parameters of the IORD, which, according to DOD acquisition rules, could result in cancellation of the program. Since these sensors provide critical data for numerical forecasting to NOAA and the weather and climate community, the impacts would be significant and unacceptable.

Further, the near-term impact of the reduced funding results in loss of efficiency at the contractor facility, and instability in production schedules. The impact to the customer and user is an increased uncertainty whether they should develop programs based on the availability of NPOESS data. It also leads to inefficiencies in our customers' and users' readiness plans to invest in the critical information technology (IT) infrastructure required to facilitate use of NPP and NPOESS the data on "Day One of Its Availability."

NOAA's Preparations for NPOESS and GOES–R Data Streams

A discussion of NOAA's satellites and its preparation for future systems must also include the concept of end-to-end utilization of satellite data. As discussed at last year's hearing before this subcommittee, NOAA is committed to ensuring that the data from NPP, NPOESS, and GOES–R will be incorporated into operations on the first day of its availability, and the academic community, industry, and other users will be able to access climate-quality data from NOAA's archive.

The President's FY 2004 budget request contains $91.2 million to support our Environmental Observing Services. Within these amounts are activities designed to support current operations as well as prepare NOAA to utilize NPOESS and GOES–R satellite data on "Day One of Its Availability." A sampling of these activities include:

Use of Precursor NPOESS Sensors

NOAA has started to use and incorporate data from NASA EOS research instruments that are NPOESS precursor sensors (both sounders and imagers) into NOAA operations on a limited and experimental basis. As such, NOAA's National Weather Service, NOAA Oceans and Coasts, NOAA Research and other users are beginning to become familiar with the increased volume, variety, and complexity of the data. Indeed, already we have seen improvements in operations from these data and expect to realize further improvements as operators realize the full potential of the available data and make greater use of them.

NOAA has been systematically working on upgrading and enhancing current product development, processing and distribution capabilities to begin acquiring and exploiting in near real-time data from MODIS and Advanced Infrared Sounder (AIRS) on the NASA EOS Missions Terra and Aqua missions to directly support NOAA's operational missions that require remotely sensed data. Because the MODIS instrument is very similar to the VIIRS and the AIRS instrument is similar to CrIS that will be flown on the NPP mission and on the operational NPOESS spacecraft, these early NOAA efforts are critical to reduce the risk and gain experience with similar instruments; data handling, processing, storage, and communication of high volume data sets; and allow the users to gain early, pre-operational experience with NPP and NPOESS-like data sets, well before the first operational NPOESS spacecraft is launched.

Similar efforts are being pursued to build the capability to handle and process data from the future CMIS that will be flown on NPOESS to measure, among other parameters, the ocean surface vector wind field. Current efforts at NOAA (and the Navy) address the operational/tactical use of ocean surface vector winds from active scatterometer missions (e.g., SeaWINDS). Beginning with the launch of the joint DOD/DOC Windsat/Coriolis mission (a NPOESS risk reduction flight for the CMIS instrument), NOAA's processing capabilities for SeaWINDS will be transitioned to processing and utilizing data from the WindSat/Coriolis mission, in preparation for the first launch of NPOESS. Additional development work that is required to prepare for the NPOESS era will be performed in close cooperation with IPO and through the Joint Center for Satellite Data Assimilation, further described below.

Use of Surrogate Data Sources

NOAA actively assesses the utility of non-NOAA data to fill its mission. NOAA purchases data from Orbital Imaging to fulfill NOAA's operational requirement for ocean color data. NOAA also uses data from the joint NASA-European Space Agency's altimetry mission. These two cases are examples where NOAA has utilized alternate risk reduction activities to assess the utility of currently available data streams to support NOAA's missions prior to transitioning these capabilities onto NPOESS satellites.

Collaboration With the Science Community

In response to recommendations from the Chairman and this subcommittee at last year's hearing, we continue to actively seek collaborative partnerships with Universities and the broader academic community to address meeting the need for science or climate research quality data from NPOESS and GOES–R missions. NOAA is harnessing the best and brightest minds to work with us. Highlights include:

- Establishment of the Cooperative Institute for Oceanographic Satellite Studies (CIOSS) with the College of Oceanic and Atmospheric Sciences (COAS) at Oregon State University. COAS is rated among the top five oceanographic institutions in the Nation by the National Research Council. This partnership between COAS and NESDIS builds on COAS' recognized leadership in the fields of oceanographic remote-sensing and coastal ocean research.
- Continued relationships with the Cooperative Remote Sensing Science and Technology Centers (CREST) located at the City University of New York (CUNY). CREST is a partnership among NOAA, CUNY, Hampton University, University of Puerto Rico at Mayaguez, University of Maryland at Baltimore County, Bowie State University, and Columbia University. In addition to training future remote-sensing scientists, students within the CREST consortium have already started rotations within NESDIS's science programs in Wisconsin and Maryland.
- Continued partnerships with University Corporation for Atmospheric Research (UCAR) and the National Center for Atmospheric Research (NCAR) in Boulder, Colorado.
- NOAA continues to harness the knowledge through existing collaborations at the Massachusetts Institute of Technology, University of Maryland, University of Wisconsin, University of Colorado, Colorado State University, and other academic institutions.

NOAA's Science Advisory Board (SAB) is considering the establishment of an NPOESS Science Panel to assist in these efforts.

Not only do these opportunities fertilize NOAA's scientific programs, they create a demand for young scientists to enter fields that are critical to NOAA's future to build a workforce with which NOAA can initiate personnel succession planning.

Satellite Data Assimilation—Joint Center for Satellite Data Assimilation (JCSDA)

The FY 2004 President's Budget Request includes $3.35 million to support activities with JCSDA. NOAA appreciates the strong support this subcommittee has provided for JCSDA. JCSDA, initially a partnership between NOAA and NASA, has been expanded to include DOD, and is addressing the development of common algorithms that will be used by all the NPOESS customers.

The goal of JCSDA is to make better use of all sources of satellite data in operations including preparing for, assimilating, and using data from NPOESS sensors. This will ensure that operational users are ready and eager to use NPOESS data *on day one* of its availability. We already have some positive results from these efforts, such as a better way to use satellite data to locate hurricane centers, but we need to continue this work with the brightest minds in our government and universities. Accomplishments of JCSDA in the past year include: committed partnership among NOAA Line Offices (NOAA's National Weather Service, NOAA Research, and NOAA Satellites and Information), DOD (U.S. Air Force and U.S. Navy), NASA, and the academic community; incorporation of EOS AIRS data into NOAA's National Weather Service models; upgraded communications lines between NASA and NOAA in order to move data to operations processing centers at NOAA; improved computing capacity.

JCSDA will also play a critical role in GOES–R risk reduction activities.

Information Technology Reviews

The NPOESS partners and NPOESS contractor continue to undertake rigorous reviews of IT infrastructure and capacity to support NPOESS data assimilation at the NPOESS operational centers. We recognize and constantly monitor IT advances to ensure that we are harnessing the best technology available to address the challenges before us in the most cost-effective way. As noted above, the ability to develop the appropriate IT infrastructure to ensure that ground and processing systems are ready in time for NPP and NPOESS depends on available funding.

Partnerships With Other Space Agencies

In addition to NASA, DOD, academia, and industry, NOAA continues to develop and nurture critical partnerships with foreign space agencies in Japan, China, India, and Europe, (such as France, Italy and Russia). These partnerships allow us to leverage select data from these satellite systems at tremendous cost savings to the U.S. taxpayer by not flying duplicative satellites and sensors on NOAA spacecraft.

User Training and Education, and Public Outreach

NOAA continues to work with UCAR, the American Meteorological Society (AMS), DOD and other partners to develop and implement teaching modules for operational users regarding applications of NOAA satellite data in the classroom and through distance-learning such as E-learning. NPOESS and GOES–R will use these avenues to ensure that operators are ready and able to use satellite data from those systems when they become available. NOAA anticipates that advances in IT and E-learning will provide opportunities to increase training in the future. NOAA has also sponsored a number of national and international user workshops and meetings to discuss the NPOESS and GOES–R programs.

NOAA's Satellite Data Access and Archive

The NOAA National Data Centers—located in Maryland, Colorado, North Carolina and Mississippi—routinely incorporate the latest technologies to facilitate rapid and easy user access to the data, products, and information under NOAA's stewardship. The President's FY 2004 budget request of $59.074 million for NOAA data centers and information services continues the work to ensure that these invaluable data are available for many generations.

The IT revolution is changing the expectations and demands that customers have for access and use of observations, data, information, products, and services. Customers are now able to transfer and process vast quantities of data and expect easy and efficient web-based access and search capabilities via the worldwide web and broadband Internet. Entrepreneurs in the application of information and intellectual property are finding numerous innovative applications for NOAA data and information. This in turn, is driving the NOAA data centers to provide more rapid access, more timely and improved quality assurance and quality control of these data. The objective NOAA "quality assurance" stamp is critical to private industry and decision-makers who require confidence in the data when considering capital investments and annual business plans, as well as long-term policies.

In anticipation of the increases in data from NASA EOS, NPP, NPOESS, and GOES and the demand for access to these data on the first day of availability, NOAA has requested $3.6 million in the FY 2004 budget request to continue to develop the Comprehensive Large Array-data Stewardship System (CLASS) and an additional $3.0 million to incorporate the NASA EOS data into the CLASS infrastructure.

CLASS is NOAA's integrated enterprise archive architecture and management system that will provide rapid access and long-term scientific stewardship of large volumes of satellite, as well as airborne and *in-situ* (surface: land and ocean), environmental data, operational products, and respond to on-line users' requests. Full funding of these data management activities will help us to prepare for NPOESS and GOES–R data archiving challenges. CLASS is a critical foundation for the scientific data stewardship of NOAA's vast archive, a national treasure and resource. The CLASS program is NOAA's principal avenue to meeting the challenges of rapid advances in information technologies and a much more informed and demanding customer.

We are at a critical juncture in the development of CLASS in order to meet user requirements for NPP and NPOESS. NOAA received $2.9 million in appropriations of the $6.6 million requested in FY 2003 President's Budget Request to develop CLASS and provide the initial capability to include EOS Archive data into the CLASS infrastructure. Full funding of the FY 2004 budget request will allow NOAA to develop the enterprise architecture to ensure the stewardship (access and archive) for the NPP data and to meet the critical requirement of the climate research community.

In conclusion, Mr. Chairman and members of the Subcommittee, NOAA is pleased to have had the opportunity to provide you an update on the GOES–R and NPOESS, and our data management programs. We are actively managing the scheduling and technology risks associated with these systems, and look forward to working with the Congress and the Administration to minimize the funding risks. Support of the FY 2004 budget request is imperative to successful development, launch, and operation of the next generation of satellites. The validated, requirements-based data from these systems will vastly improve the health and safety of the people, the U.S. economy, and our global environment. A key element to our strategy is partnering with other agencies, such as NASA and DOD, the space industry, our international partners, and academia. These partnerships have proved to be wise investments for NOAA and the Nation. We have also greatly appreciated the continued support and interest expressed by this subcommittee.

Mr. Chairman and Subcommittee Members, this concludes my testimony. I would be happy to answer any questions.

Appendix 1

National Polar-orbiting Operational Environmental Satellite System Sensors:

- ***Visible/Infrared Imaging Radiometer Suite (VIIRS)*:**
  Three orbits, high precision, near constant resolution, multi-spectral imagery (22 "colors").
  - Imagery * [1]
  - Sea*, Ice and Land Surface Temperature
  - Aerosol Particle Size and optical thickness
  - Surface Albedo
  - Cloud cover, layers, particle size, optical thickness, height, and pressure/temperature of tops
  - Ocean color/chlorophyll
  - Precipitable water and suspended matter
  - Sea Ice characterization
  - Surface type and vegetative index

- ***Conically-scanning Microwave Imager and Sounder (CMIS)*:**
  Three orbits, imagery through clouds and sounding.
  - Sea Surface Winds*
  - Soil Moisture*
  - Cloud Base Height and Ice/Liquid Water
  - Atmospheric pressure, moisture and temperature vertical profiles (low resolution)
  - Sea, Ice and Land Surface Temperature through clouds
  - Precipitation type and rate
  - Snow cover and depth
  - Atmospheric Total Water Content
  - Surface type and sea ice characterization

- ***Cross-track Infrared and Microwave Sounding Suite (CrIMSS)*:**
  Pair of sounding instruments on two orbits (comprised of the Cross-track Infrared Sounder (CrIS) and the Advanced Technology Microwave Sounder (ATMS)).
  - Atmospheric pressure, moisture* and temperature* vertical profiles (high resolution)

- ***Ozone Mapping Profiler Suite (OMPS)*:**
  Single orbit of ultraviolet down looking and horizon viewing instruments.
  - Ozone total column map and vertical profile (Treaty Requirement)
- ***Space Environmental Sensing Suite (SESS)*:**
  Collection of instruments to measure ionospheric and electromagnetic space conditions.
  - Auroral Boundary, Energy Deposition and Imagery
  - Electric and Geomagnetic Fields
  - Electron Density and Neutral Density Profiles
  - Energetic Ions and Medium Energy Charged Particles
  - Supra-Thermal-Auroral Particles
  - In-situ plasma temperature and fluctuations
  - Ionospheric Scintillation (in-situ)

- ***Global Positioning System Occultation Sensor (GPSOS)*:**

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[1] * Note: Environmental data types with Key Attributes which would require replacement of a satellite if a sensor becomes unable to perform.

Ionospheric sounding instruments on one orbit.

- Electron Density Profile
- Ionospheric Scintillation (horizon)

* ***Earth Radiation Budget Sensor (ERBS)***:
  Single orbit to record balance of reflected and emitted energy. Used to help model the Earth's energy balance to understand climate.
  - Downward Radiance, long and short wave
  - Net heat flux
  - Net solar radiation, top of atmosphere
  - Outgoing long wave radiation, top of atmosphere

* ***Total Solar Irradiance Sensor (TSIS)***:
  Continuously measures energy from the Sun from a single orbit. Used to help model the sun's energy input to the Earth. With the ERBS, helps understand Earth's energy balance to understand climate.
  - Solar Irradiance

* ***Altimeter (ALT)***:
  Single highly precise radar altimeter.
  - Ocean Wave Characteristics
  - Sea Surface Height/Topography (used to see if the ocean is rising)
  - Wind Stress

* ***Aerosol Polarimetry Sensor (APS)***:
  Single sensor. Measures the distribution and shape of small particles suspended in the air. This gives indications as to source – natural or man-made.
  - Aerosol Optical Thickness, Particle Size and Refractive Index
  - Cloud Particle Size and Distribution

In addition, some satellites carry the following instruments:

* ***Search and Rescue Satellite Aided Tracking (SARSAT)*** - All satellites
* ***ARGOS Data Collection System (ADCS)*** - Two orbits
* ***Survivability Sensor (SS) attack warning sensor*** - All satellites

Three orbital planes are polar sun-synchronous orbits with local ascending node times of **1330**, **1730** and **2130**.

Instruments in 1330 orbital plane:

• VIIRS	• CMIS	• CrIS/ATMS	• OMPS	• SESS
• GPSOS	• ERBS	• SARSAT	• ADCS	• SS

Instruments in 1730 orbital plane:

• VIIRS	• CMIS	• CrIS/ATMS	• ALT	
• TSIS	• SARSAT	• ADCS	• SS	

Instruments in 2130 orbital plane:

• VIIRS	• CMIS	• APS	• SARSAT	• SS

All satellites can accommodate all instruments. The configuration launched is determined at the time of call-up depending on the operational needs of the environmental satellite data using community.

These strategies allow NOAA to develop and fund these activities at the best cost-benefit to the taxpayer while minimizing the risk of interruption of satellite data.

Chairman EHLERS. Thank you.
Mr. Teets.

STATEMENT OF MR. PETER B. TEETS, UNDER SECRETARY OF THE AIR FORCE AND DEPARTMENT OF DEFENSE EXECUTIVE AGENT FOR SPACE

Mr. TEETS. Yes. Good afternoon, Mr. Chairman, and thank you for giving me the opportunity to appear before you today.

I have been pleased to develop an association with Mr. Greg Withee as well as Admiral Lautenbacher in regard to our partnership in bringing online the NPOESS program. It is an important program to the Department of Defense and to our United States Air Force.

You probably are aware that in both Operation Enduring Freedom and Operation Iraqi Freedom, our ability to do accurate weather forecasting on a global basis has been an important element in our success. And so we within the Department of Defense fully recognize the importance of continuous and excellent weather forecasting ability globally. NPOESS offers us the promise of improved weather forecasting and improved prediction of weather conditions worldwide. And it is for that reason that we think of NPOESS as a very high priority within the Department of Defense.

The first NPOESS satellite is scheduled now for launch in late 2009 or early 2010, depending upon which orbit will be required to receive it. But in the meantime, we within the Department of Defense have five current satellites, DMSP, the Defense Meteorological Satellite Program, satellites numbers 16, 17, 18, 19, and 20, that are waiting to be launched in this interim period. Our assessment is that, with reasonable confidence, we believe we will have a continuous capability to predict weather worldwide to serve military needs.

But we are, indeed, careful about recognizing the fact that NPOESS is a significant development program. One of the items that I was interested in a year and a half ago when I first came on board this job, was to understand who the program manager for NPOESS would be and was pleased to learn that it was John Cunningham. John is a very highly capable, competent program manager who has a lot of scar tissue and a lot of development experience in managing significant satellite development jobs. John is assisted by Colonel Frank Hinnant, another true professional.

And I have enjoyed, over the course of this last year, the partnership developed between NOAA and our Air Force as well as NASA. Mr. Fred Gregory, Greg Withee, Admiral Lautenbacher, and I have met on several occasions. As a matter of fact, we were together and worked through together the source selection of the prime contractor to build the NPOESS's first satellite. That contractor is Northrop Grumman Space Technology, and you will hear from Mr. Wes Bush in that regard later today. But I was very pleased, as I say, to participate in that source selection, and one of the things we looked for were the structure of a program that would have appropriate risk reduction activity underway.

Our view is that the program planned by the NPOESS program management team, working in conjunction with Northrop Grumman, have put in place a program that we can have high confidence in. And so I believe that we have the budget that we must stay to. We must continue to see that it is filled out on a yearly basis between now and the end of this decade in a way that allows us to confidently launch NPOESS in the time frame proposed.

And with that, Mr. Chairman, I would conclude my opening remarks and be pleased to take any questions you might have.

[The prepared statement of Mr. Teets follows:]

PREPARED STATEMENT OF PETER B. TEETS

INTRODUCTION

I am honored to appear before you today to address this committee on a program critical to our nation, the National Polar-orbiting Operational Environmental Satellite System (NPOESS). I am also pleased to be joined today by one of my partners in the NPOESS program, Mr. Gregory Withee, Assistant Administrator for Satellite and Information Services, National Oceanic and Atmospheric Administration (NOAA).

In my testimony to the House Armed Services Committee Strategic Forces Subcommittee on March 19, 2003, I described some of the actions that we in the defense space community are taking to ensure that America's military forces have the finest space-based capabilities in the world. Since then, Operation IRAQI FREEDOM confirmed how important American dominance of space is to the successful conduct of military operations. A major pillar of this dominance has been our unparalleled ability to exploit weather and environmental data gathered from space, allowing our servicemen and women to fight and win in a wide range of weather conditions. In my testimony today, I will highlight the steps we in DOD are taking to ensure this high quality environmental data remains available to the warfighter—as well as civilian users—in the future.

CURRENT STATUS

Presidential direction established the NPOESS program in 1994 in order to combine the Department of Defense's Defense Meteorological Satellite Program (DMSP) and the Department of Commerce's Polar-orbiting Operational Environmental Satellite (POES) systems. We are executing the NPOESS program towards a first launch no earlier than November 2009, with Full Operational Capability in 2013. In order to meet the program's advanced technology infusion goals, we are also proud to have the National Aeronautics and Space Administration (NASA) onboard as a partner in our efforts. The NPOESS program office established within NOAA includes representatives from all three organizations.

NPOESS MANAGEMENT

As a joint program, NPOESS is overseen by an Executive Committee comprised of myself, Vice Admiral (Ret) Conrad C. Lautenbacher, Jr., the Under Secretary of Commerce for Oceans and Atmosphere and the Administrator of the National Oceanic and Atmospheric Administration, and Mr. Frederick Gregory, the Deputy Administrator of NASA. We have met three times in the last year to review the program's status, and I believe I speak for all of us in saying that NPOESS continues to be an excellent model of interagency space program cooperation.

The DOD and the Air Force are in the process of implementing recommendations from the Congressionally-directed Commission to Assess National Security Space Management. A major recommendation of the Commission was to designate the Air Force, and specifically the Under Secretary, as the DOD Executive Agent for Space, with oversight of DOD space acquisition efforts. Recently, the DOD has made this designation official, although I have been acting in this capacity for quite some time. I have spent much of my time in my current position emphasizing the importance of getting our space acquisition programs on track. Space programs—and specifically, military space programs—are complex systems with numerous unique characteristics, and as such, bring extraordinary acquisition challenges. As the DOD Executive Agent for Space, I am in a position to cut across traditional bureaucratic lines, and work with all interested parties, DOD and civil agencies, in improving the way we do business, ensuring that we do not repeat past mistakes in our future acquisitions.

A significant improvement we are making is in the implementation of a new acquisition policy tailored to the unique requirements of space systems. NPOESS is the first program to use the new DOD space acquisition policy and I am very satisfied with the results so far. A senior NASA expert led an independent review of the program's technical risks, and a combined Air Force and DOD cost agency team (a forerunner of a dedicated National Security Space Cost Assessment Team) is currently reviewing the program's proposed budget to ensure it is adequately funded.

PROGRAM REQUIREMENTS

As many of us in DOD have learned from difficult experience, achieving consensus on program requirements at the earliest possible point is essential to the success of any complex acquisition program. This is especially true with space systems, where the majority of our efforts and money are spent well before our systems ever get to orbit. For NPOESS, a robust requirements definition and validation process that includes all partners, modeled on the DOD process, was developed and to date has worked effectively. NPOESS requirements from all three agencies have been vetted through this disciplined process, and were validated by the Interagency Joint Agency Requirements Council. I am pleased to report that the system we are building meets the core set of requirements agreed upon by all of the partners.

ENHANCED SENSOR CAPABILITIES

With respect to those requirements, NPOESS is making significant progress in developing new sensors to give our user communities the capabilities they need. The NPOESS satellite will be designed to fly up to 14 sensors—five sensors are developmental, and the other nine sensors are heritage. While these new sensors face some development challenges, the wisdom of starting the NPOESS sensor development earlier than the satellite development is clearly evident as we proceed to resolve these challenges. Four of the five developmental sensors have passed their Critical Design Review, a major milestone in their acquisition. The final sensor will reach this point in August 2003. The early sensor development start is giving us the time we need to demonstrate prototype sensors.

The NPOESS program and the DOD, through the Navy Research Laboratory and the Space Test Program, successfully launched the Windsat/CORIOLIS satellite in January of this year. Windsat/CORIOLIS has completed a preliminary demonstration of one of the greatest technological advances that NPOESS will bring: the ability to determine ocean wind speed passively from space. We have plans to demonstrate determining wind direction from space in the coming months. This information is essential for Navy air and fleet operations, and is also needed by civil weather agencies for their forecasts. We have also begun work on four flight units for the NPOESS Preparatory Project (NPP), scheduled for launch no earlier than October 2006, as an end-to-end risk reduction experiment for NPOESS. These demonstrations will yield a better understanding of the issues, so that we can make any necessary technical adjustments to the NPOESS program.

The tri-agency partnership is in close cooperation in the development of these innovative capabilities. For example, NPOESS is now designed to carry an aerosol polarimeter sensor. This sensor measures reflected visible and infrared energy from multiple angles and can be used to determine the shape and origin of suspended vapors. This is a useful measurement in better understanding the climate, and is of importance to the NOAA community. I will tell you that this knowledge is also important for effective use of laser guided weapons and efficient collection by our Intelligence, Surveillance, and Reconnaissance (ISR) capabilities. NASA is planning to demonstrate this sensor's capability and performance on an early flight opportunity.

DATA PROCESSING SUCCESSES

The NPOESS program is also focused on reducing the time it takes to obtain environmental data, an important issue to all of our users. The best data in the world is of little use if it does not get to the right person at the right time. Today's weather satellites store their data on tape recorders and play it back down to ground stations. By the time the data is processed and distributed, it is between two and three hours old, which can be an eternity in wartime or during a weather emergency. NPOESS will reduce the amount of time that elapses between data collection and data delivery to the user by delivering over 95 percent of its data in less than 28 minutes; over half the data can be delivered in less than 15 minutes. This is over three to four times faster than current satellites' architectures, allowing more accurate and timely forecasting for all users.

These advanced capabilities would be of little use to anyone without the ability to efficiently process the received data. The NPOESS architecture contains a node to process raw data to be forwarded to our DOD strategic data centers. The program office will also provide the software necessary for ship or ground-based remote terminals to receive and process NPOESS data. Each DOD component is providing its own remote terminals for stand-alone operations. Building on our joint heritage, NOAA will continue to be responsible for archiving NPOESS data. Data archiving should be no different than it is today, except there will be more data available on a more timely basis. The NPOESS Preparatory Project will prove out many of these concepts.

A team of NOAA, Air Force, and Navy scientists and managers are dedicated to solving our processing challenges in order to ensure that all the partners will be able to use data from the NPOESS advanced sensors soon after they are launched. In demonstrating improved processing capabilities, NOAA and NASA have had great success with the NASA Advanced IR Sounder (AIRS) on the Aqua satellite. In addition, the National Weather Service is beginning to use the data from this experimental sensor, fully three years before the availability of the first NPOESS advanced IR sensor on the NPP satellite, and over six years before the first operational NPOESS satellite. The DOD is very interested in building upon the successes that our civil partners have had in the practical demonstration of improved environmental data similar to what will be delivered by NPOESS.

NPOESS FUNDING CHALLENGES

The DOD FY 2004 President's Budget Request of $267.7 million will fund NPOESS activities in support of a no earlier than October 2006 launch of the NPP satellite and a no earlier than November 2009 launch of the first NPOESS satellite, but budget instability still exists. I would like to say that NPOESS is in perfect shape, but that is not the case. As a jointly funded program, NPOESS has struggled to maintain budget stability in the past, and is undergoing a replan, which delays the first satellite availability by as much as 21 months from earlier projections. Prior to the approval of the replan, the NPOESS program office reviewed various sensors alternatives, which included:

- maintaining the current sensor suite at the expense of schedule, or
- reducing the sensor suite to maintain the schedule.

The review determined that there is no effective way to reduce sensor capabilities without additional impacts to cost and schedule. Furthermore, they found that all of the currently planned sensors are required to satisfy the full complement of mission requirements. Given those constraints, the replan, which delays the first satellite availability by as much as 21 months, was approved.

Even given the replan, the DOD will likely have sufficient DMSP satellites to ensure a seamless operational transition to NPOESS. However, the issue of the DOD's reliance on an on-time NPOESS delivery, which will support the maximum performance of our emerging weapons systems, remains. Thus, in many ways, NPOESS is a strategic partnership, both in funding and in requirements.

The risk of coverage gaps to our civil partners during the POES to NPOESS transition period appears much greater. NOAA has only two remaining POES satellites, which are currently scheduled for launch in 2004 and 2008. If either of the two remaining POES satellites suffers a failure, NOAA's weather forecasting and climate monitoring mission will suffer. The DOD takes advantage of POES and geostationary weather satellites, such as Geostationary Operational Environmental Satellites (GOES), for its weather predictions. The loss of POES, or any one of these sources of information, would degrade our weather prediction abilities. However, the Department could meet its minimum reporting requirement. The DOD also augments sounding data from DMSP Flight 16 and beyond with data from the POES satellites in our numerical weather prediction models. The loss of this data would also degrade our weather prediction accuracy. The DOD is in the preliminary stages of exploring courses of action to address these contingencies.

CONCLUSION

The environment has a tremendous impact on U.S. military capability. Just as an oft-stated goal of the U.S. military has been to "own the night," we must be prepared to fight and prevail in all types of weather. Advanced environmental monitoring capabilities can ensure that we choose the right weapons for the right weather for the right target. We demonstrated in Iraq and Afghanistan that our forces can fight and win in bad weather, but we know we can-and must-do better. NPOESS will be a vital component in our future space capabilities, a key force-multiplier for the entire warfighting spectrum. From a warfighter's perspective, the data from NPOESS will allow the identification of aerosols which can impact the operation of optical and laser guided precision guided munitions, it will provide information on soil moisture to improve the traffic flow of ground forces, it will measure sea temperature and collect icing data for naval operations, and finally, it will report on scintillation which is critical to navigation and accuracy of GPS guided munitions.

Our cooperation with NASA and the Department of Commerce's NOAA is breaking new ground in program acquisition. It is critical that we remain true to the

NPOESS vision outlined in the Presidential direction and the interagency agreements that established the program. The DOD remains fully committed to NPOESS. I look forward to working with the Congress and this Committee to deliver the capabilities of this important program for the good of the Nation.

Chairman EHLERS. Thank you.
Mr. Powner.

STATEMENT OF MR. DAVID A. POWNER, ACTING DIRECTOR, INFORMATION TECHNOLOGY MANAGEMENT ISSUES, GENERAL ACCOUNTING OFFICE

Mr. POWNER. Chairman Ehlers, Ranking Member Udall, and Representative Smith, we appreciate the opportunity to testify on NPOESS, a planned $7 billion satellite system that is to merge two separate polar-orbiting satellite programs managed by NOAA and DOD. Since we last testified before you one year ago, progress has been made on this program.

However, despite the progress, the program is currently faced with several risks that must be effectively addressed to keep this program on track and to ensure continuity of critical weather data. This afternoon, I will summarize two key programmatic and technical risks confronting NPOESS: first, schedule delays and resulting potential gaps in satellite coverage; second, issues with key sensor development. In addition, I will discuss potential cost increases that will likely result from delays in the program and efforts to address these risks.

First regarding schedule delays and resulting potential gaps in satellite coverage, when the NPOESS development contract was awarded, the schedule for launching the satellites was driven by a requirement that they be available as a backup should the final launch of the POES and DMSP programs fail. Now POES and DMSP are managed by NOAA and DOD respectively. What this meant was that the first NPOESS satellite be available to backup the final POES satellite launch in March of 2008.

However, program officials now tell us that as a result of changes in funding, the first NPOESS satellite will not be available for launch until December 2009. This is 21 months after it is needed to back up the final POES satellite. This means that should the final POES launch fail in March of 2008, there would be no backup satellites ready for launch, and there could be a gap in satellite coverage, especially since the operational satellites would be reaching the end of their useful lives.

The second risk area concerns key sensor development efforts that have experienced cost increases, schedule delays, and performance shortfalls. The cost estimates for each of the four critical sensors have increased with increases ranging from $60 million to $200 million. Further, while all of them are still expected to be completed before they are needed, many have slipped to the end of their schedule buffers, meaning that there is no additional time should additional problems arise. Additionally, program officials are working to address performance issues on two of the four critical sensors.

To the program's credit, it has been resolving sensor performance issues for the last several months. Earlier this year, all four critical sensors were at medium to high risk in performance related areas.

The program will likely continue to identify additional sensor issues, some of which will require additional costs and more time to address.

Mr. Chairman, efforts to address these programmatic and technical risks may result in increased costs to the overall program. However, the potential cost increases are currently unknown. The program office is working to develop a new cost estimate and schedule baseline for the NPOESS program and hopes to complete it by next month. This rebaselining is to result in a major contract renegotiation.

In summary, today's polar-orbiting weather satellite program is essential to a variety of civilian and military operations, ranging from weather warnings and forecasts to specialized weather products. This new satellite system is considered critical to the United States' ability to maintain continuity of data required for weather forecasting, climate monitoring, and critical military operations. Effectively managing key programmatic and technical risks will be essential to limiting the potential gap in coverage. Should this potential gap grow, the data needed for weather forecasts and climate monitoring would be put at further risk. Additionally, the extent of the potential overall program cost increases should be known by next month.

This concludes my statement. I would be pleased to respond to any questions you or other Members of the Subcommittee may have.

[The prepared statement of Mr. Powner follows:]

PREPARED STATEMENT OF DAVID A. POWNER

Mr. Chairman and Members of the Subcommittee:

We appreciate the opportunity to join in today's hearing to discuss our work on the planned National Polar-orbiting Operational Environmental Satellite System (NPOESS). At your request, we will provide an overview of our nation's current polar-orbiting environmental satellite program and the planned NPOESS program. We will also discuss key risks to the successful and timely deployment of NPOESS.

In brief, today's polar-orbiting environmental satellite program is a complex infrastructure encompassing two satellite systems, supporting ground stations, and four central data processing centers that provide general weather information and specialized environmental products to a variety of users, including weather forecasters, military strategists, and the public. NPOESS is planned to merge the two satellite systems into a single state-of-the-art environment monitoring satellite system. This new satellite system, currently estimated to cost about $7 billion, 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 2018.

However, the NPOESS program faces key programmatic and technical risks that may affect the successful and timely deployment of the system. Specifically, changing funding streams and revised schedules have delayed the expected launch date of the first NPOESS satellite by 21 months. Thus, the first NPOESS satellite will not be ready in time to back up the final POES satellite, resulting in a potential gap in satellite coverage should that satellite fail. Specifically, if the final POES launch fails and if existing satellites are unable to continue operations beyond their expected lifespans, the continuity of weather data needed for weather forecasts and climate monitoring will be put at risk. In addition, concerns with the development of key NPOESS components, including critical sensors and the data processing system, could cause additional delays in the satellite launch date.

The program office is working to address the changes in funding levels and schedule, and to make plans for addressing specific risks. Further, it is working to develop a new cost and schedule baseline for the NPOESS program by August 2003.

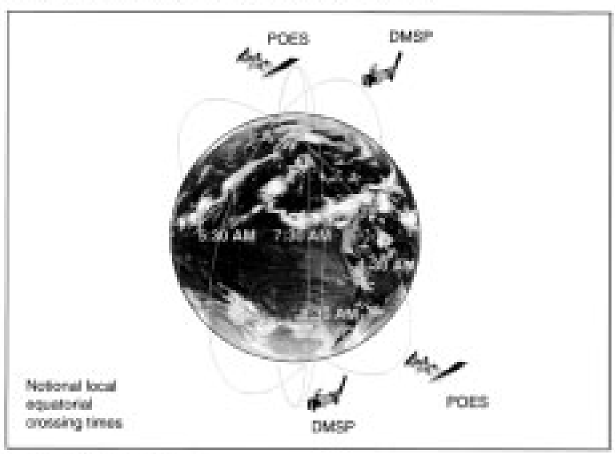
This statement builds on work we have done on environmental satellite programs over the last several years.[1] An overview of the approach we used to perform this work—our objectives, scope, and methodology—is provided in Appendix I.

Existing Polar Satellite Infrastructure

Since the 1960s, the United States has operated two separate operational polar-orbiting meteorological satellite systems. These systems are known as the Polar-orbiting Operational Environmental Satellites (POES), managed by the National Oceanic and Atmospheric Administration's (NOAA) National Environmental Satellite, Data, and Information Service (NESDIS), and the Defense Meteorological Satellite Program (DMSP), managed by the Department of Defense (DOD). These satellites obtain environmental data that are processed to provide graphical weather images and specialized weather products, and that are the predominant input to numerical weather prediction models—all used by weather forecasters, the military, and the public. 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. Today, 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, there are five older satellites 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 2008 and 2010, respectively.

Figure 1: Configuration of Operational Polar Satellites



Source: NPOESS Integrated Program Office.

Each of the polar satellites carries a suite of sensors designed to detect environmental data either reflected or emitted from the earth, the atmosphere, and space.

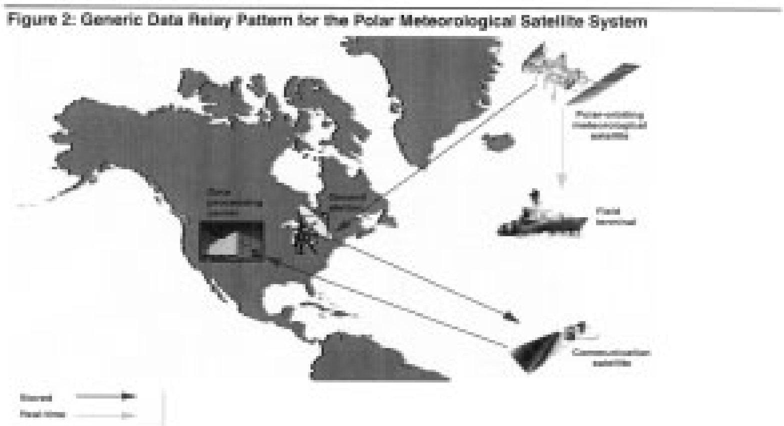
[1] U.S. General Accounting Office, *Polar-orbiting Environmental Satellites: Status, Plans, and Future Data Management Challenges,* GAO–02–684T (Washington, D.C.: July 24, 2002); *National Oceanic and Atmospheric Administration: National Weather Service Modernization and Weather Satellite Program,* 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).

The satellites store these data and then transmit the data 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.

Under a shared processing agreement among the four processing centers—NESDIS,[2] the Air Force Weather Agency, Navy's Fleet Numerical Meteorology and Oceanography Center, and the Naval Oceanographic Office—different centers are responsible for producing and distributing different environmental data sets, specialized weather and oceanographic products, and weather prediction model outputs via a shared network. 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 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 the U.S. government, many by DOD. Field terminals can be taken into areas with little or no data communications infrastructure—such as on a battlefield or 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.

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



Source: GAO.

Polar Satellite Data, Products, and Uses

Polar satellites gather a broad range of data that are transformed into a variety of products for many different uses. When first received, satellite data are considered raw data.[3] To make them usable, the processing centers format the data so that they are time-sequenced and include earth location and calibration information. After formatting, these data are called raw data records. The centers further process these raw data records into data sets, called sensor data records and temperature data records. These data records are then used to derive weather products called

[2] Within NOAH, NESDIS processes the satellite data, and the National Centers for Environmental Prediction (NCEP), a component of NOAA's National Weather Service, runs the models. For simplicity, we refer to the combined NESDIS/NCEP processing center as the NESDIS processing center.

[3] NOAA uses different nomenclature for its data processing stages: raw data are known as level 0 data; raw data records are known as level 1a data; sensor data records and temperature data records are known as level 1b data; and environmental data records are known as level 2 data.

environmental data records (EDR). EDRs range from atmospheric products detailing cloud coverage, temperature, humidity, and ozone distribution; to land surface products showing snow cover, vegetation, and land use; to ocean products depicting sea surface temperatures, sea ice, and wave height; to characterizations of the space environment. Combinations of these data records (raw, sensor, temperature, and environmental data records) are also used to derive more sophisticated products, including outputs from numerical weather models and assessments of climate trends. Figure 3 is a simplified depiction of the various stages of data processing.

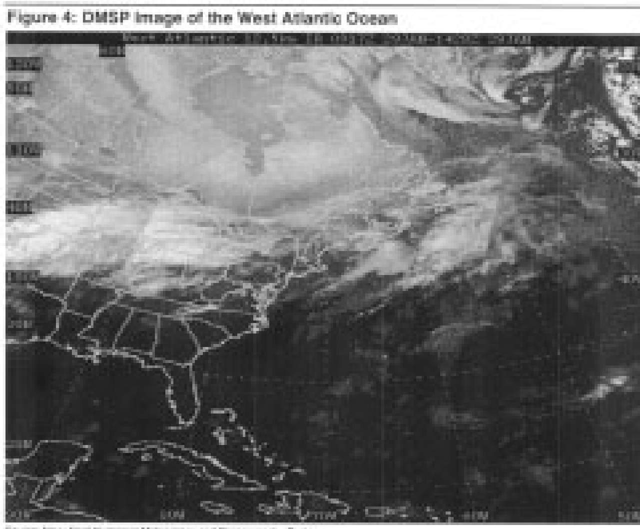
Figure 3: Satellite Data Processing Steps

Source: GAO.

EDRs can be either images or quantitative data products. Image EDRs provide graphical depictions of the weather and are used to observe meteorological and oceanographic phenomena to track operationally significant events (such as tropical storms, volcanic ash,[4] and icebergs), and to provide quality assurance for weather prediction models.

The following figures demonstrate polar-orbiting satellite images. Figure 4 is an image from a DMSP satellite showing an infrared picture taken over the west Atlantic Ocean. Figure 5 is a POES image of Hurricane Floyd, which struck the southern Atlantic coastline in 1999. Figure 6 is a polar-satellite image used to detect volcanic ash clouds, in particular the ash cloud resulting from the eruption of Mount Etna in 2001. Figure 7 shows the location of icebergs near Antarctica in February 2002.

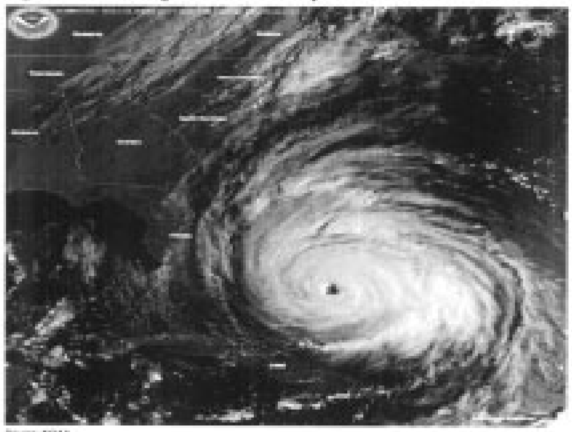
Figure 4: DMSP Image of the West Atlantic Ocean



Source: Navy Fleet Numerical Meteorology and Oceanography Center.

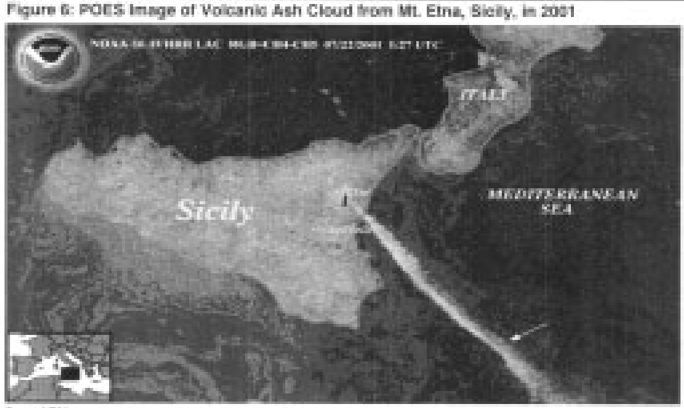
[4] Volcanic ash presents a hazard to aviation because of its potential to damage engines.

Figure 5: POES Image of Hurricane Floyd in 1999



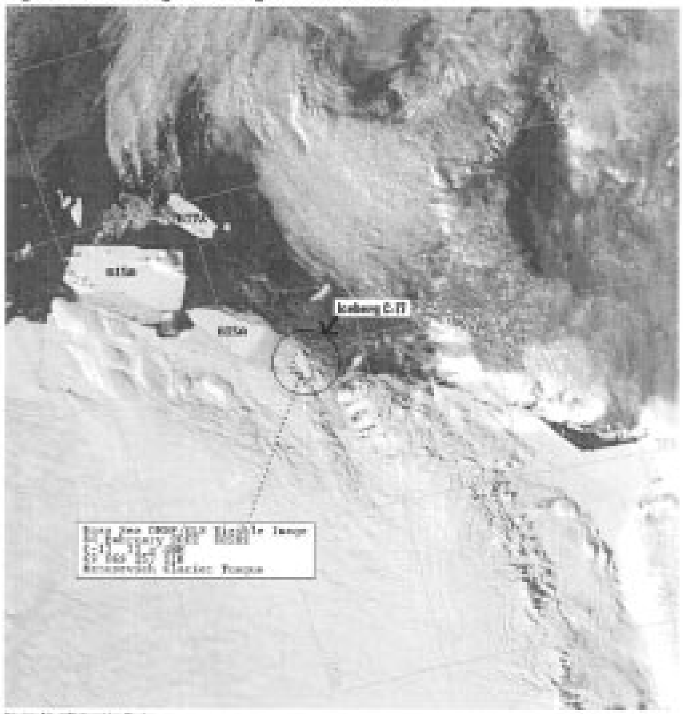
Source: NOAA

Figure 6: POES Image of Volcanic Ash Cloud from Mt. Etna, Sicily, in 2001



Source: NOAA

Figure 7: DMSP Image of Icebergs Near Antarctica



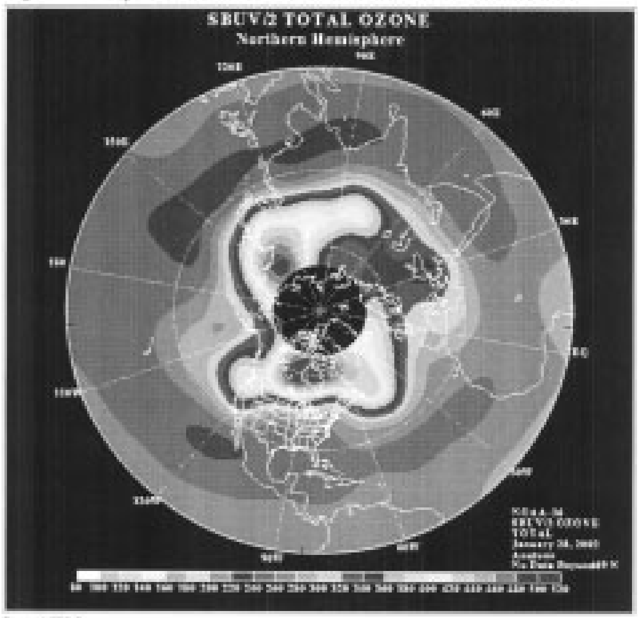
Source: Navy/National Ice Center

Quantitative EDRs are specialized weather products that can be used to assess the environment and climate or to derive other products. These EDRs can also be depicted graphically. Figures 8 and 9 are graphic depictions of quantitative data on sea surface temperature and ozone measurements, respectively. An example of a product that was derived from EDRs is provided in figure 10. This product shows how long a person could survive in the ocean—information used in military as well as search and rescue operations—and was based on sea surface temperature EDRs from polar-orbiting satellites.

Figure 8: Analysis of Sea Surface Temperatures from POES Satellite Data

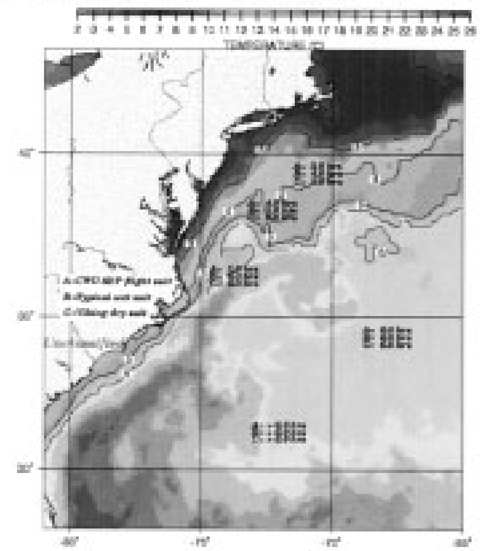
Source: NOAA/NESDIS.

Figure 9: Analysis of Ozone Concentration from POES Satellite Data



Source: NESDIS

Figure 10: Analysis of Water Survivability off the Atlantic Seaboard, January 2002



Source: Naval Oceanographic Office.

Note: Contour lines with blocked numbers depict survival time, in hours, without a survival suit.

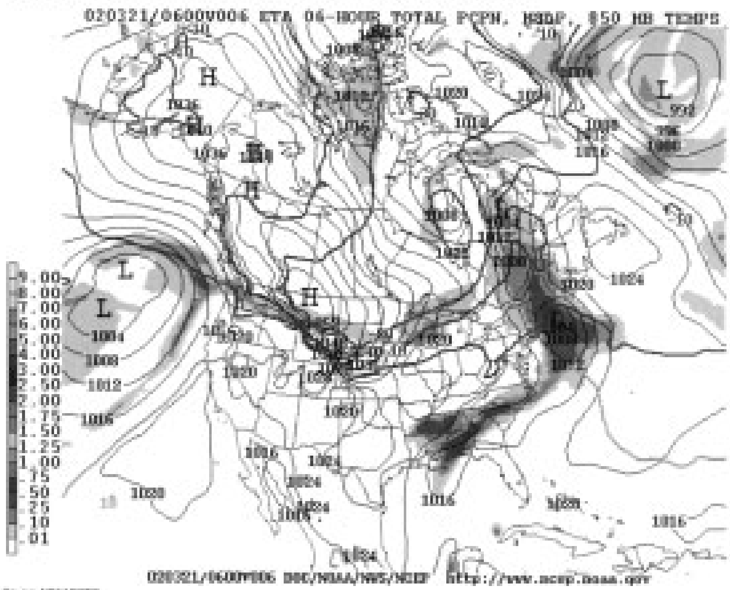
Another use of quantitative satellite data is in numerical weather prediction models. Based predominantly on observations from polar-orbiting satellites and supplemented by data from other sources such as geostationary satellites, radar, weather balloons, and surface observing systems, numerical weather prediction models are used in producing hourly, daily, weekly, and monthly forecasts of atmospheric, land, and ocean conditions. These models require quantitative satellite data to update their analysis of weather and to produce new forecasts. Table 1 provides examples of models run by the processing centers. Figure 11 depicts the output of one common model.

Table 1: Common Numerical Weather Prediction Models Used by Processing Centers

Model	Purpose	Processing center
Global Forecast System	Global weather forecasts	NESDIS/NCEP
Eta Model	Regional weather forecasts	NESDIS/NCEP
Mesoscale Model 5	Regional forecasts	Air Force Weather Agency
Advect Cloud Model	Global cloud forecast and analysis	Air Force Weather Agency
Navy Operational Global Atmospheric Prediction System	Global weather forecasts	Navy Fleet Numerical Meteorology and Oceanography Center
Coupled Oceanographic and Atmospheric Mesoscale Prediction System	Regional weather forecasts	Navy Fleet Numerical Meteorology and Oceanography Center
Wave Model	Regional oceanographic forecasts	Naval Oceanographic Office

Source: NOAA and DOD.

Figure 11: Model Output Depicting a 6-Hour Precipitation Forecast



Source: NOAA/NCEP

All this information—satellite data, imagery, derived products, and model output—is used in mapping and monitoring changes in weather, climate, the ocean, and the environment. These data and products are provided to weather forecasters for use in issuing weather forecasts and warnings to the public and to support our nation's aviation, agriculture, and maritime communities. Also, weather data and products are used by climatologists and meteorologists to monitor the environment. Within the military, these data and products allow military planners and tactical users to focus on anticipating and exploiting atmospheric and space environmental conditions. For example, Air Force Weather Agency officials told us that accurate wind and temperature forecasts are critical to any decision to launch an aircraft that will need mid-flight refueling. In addition to these operational uses of satellite data, there is also a substantial need for polar satellite data for research. According to experts in climate research, the research community requires long-term, consistent sets of satellite data collected sequentially, usually at fixed intervals of time, in order to study many critical climate processes. Examples of research topics include long-term trends in temperature, precipitation, and snow cover.

The National Polar-orbiting Operational Environmental Satellite System

Given the expectation that merging the POES and DMSP programs would reduce duplication and result in sizable cost savings, a May 1994 Presidential Decision Directive 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 is called the National Polar-orbiting Operational Environmental Satellite System (NPOESS), and it is considered critical to the United States' ability to maintain the continuity of data required for weather forecasting and global climate monitoring. To manage this program, DOD, NOAA, and the National Aeronautics and Space Administration (NASA) have 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 responsibility for the converged system, as well as 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.

NPOESS Overview

NPOESS is a major system acquisition estimated to cost almost $7 billion over the 24-year period from the inception of the program in 1995 through 2018.[5] The program is to provide satellite development, satellite launch and operation, and integrated data processing. These deliverables are grouped into four main categories: (1) the launch segment, which includes the launch vehicle and supporting equipment, (2) the space segment, which includes the satellites and sensors, (3) the interface data processing segment, which includes the data processing system to be located at the four processing centers, and (4) the command, control, and communications segment, which includes the equipment and services needed to track and control satellites.

Program acquisition plans call for the procurement and launch of six NPOESS satellites over the life of the program and the integration of 14 instruments, comprised of 12 environmental sensors and 2 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 non-environmental search and rescue efforts and environmental data collection activities. According to the Integrated Program Office, 8 of the 14 planned NPOESS instruments involve new technology development, whereas 6 others are based on existing technologies. The planned instruments and the state of technology on each are listed in Table 2.

Table 2: Expected NPOESS Instruments

Instrument name	Description	State of technology
Advanced technology microwave sounder	This sensor is to measure microwave energy released and scattered by the atmosphere, and is to be used with infrared sounding data from NPOESS' cross-track infrared sounder to produce daily global atmospheric temperature, humidity, and pressure profiles.	New
Aerosol polarimetry sensor	This sensor is to retrieve specific aerosol (liquid droplets or solid particles suspended in the atmosphere, such as sea spray, smog, and smoke) and cloud measurements.	New
Conical microwave imager/sounder	This sensor is to collect 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
Cross-track infrared sounder	This sensor is to collect measurements of the earth's radiation to determine the vertical distribution of temperature, moisture, and pressure in the atmosphere.	New

[5] The fiscal year 2004 President's Budget identified the $6.96 billion estimate in base year dollars.

5

Instrument name	Description	State of technology
Data collection system	This system collects environmental data from platforms around the world and delivers them to users worldwide.	Existing
Earth radiation budget sensor	This 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
Global positioning system occultation sensor	This sensor is to measure the refraction of radio wave signals from the Global Positioning System and Russia's Global Navigation Satellite System to characterize the ionosphere.	New
Ozone mapper/profiler suite	This sensor is to collect data needed to measure the amount and distribution of ozone in the earth's atmosphere.	New
Radar altimeter	This sensor 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	This system detects and locates aviators, mariners, and land-based users in distress.	Existing
Space environmental sensor suite	This suite of sensors is to collect data to identify, reduce, and predict the effects of space weather on technological systems, including satellites and radio links.	New
Survivability sensor	This sensor monitors for attacks on the satellite and notifies other instruments in case of an attack.	Existing
Total solar irradiance sensor	This sensor monitors and captures total and spectral solar irradiance data.	Existing
Visible/infrared imager radiometer suite	This sensor is to collect images and radiometric data used to provide information on the earth's clouds, atmosphere, ocean, and land surfaces.	New

Source: Integrated Program Office.

Unlike the current polar satellite program, in which the four centers use different approaches to process raw data into the environmental data records that they are responsible for, the NPOESS integrated data processing system—to be located at the four centers—is expected to provide a standard system to produce these data sets and products. The four processing centers will continue to use these data sets to produce other derived products, as well as for input to their numerical prediction models.

NPOESS is planned to produce 55 environmental data records (EDRs), including atmospheric vertical temperature profile, sea surface temperature, cloud base height, ocean wave characteristics, and ozone profile. Some of these EDRs are comparable to existing products, whereas others are new. The user community designated six of these data products—supported by four sensors[6]—as key EDRs, and noted that failure to provide them would cause the system to be reevaluated or the program to be terminated.

Acquisition Strategy

The NPOESS acquisition program 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 in August 2002 and is expected to continue through the life of the program. The concept and technology development phase began with the decision to converge the POES and DMSP satellites and included early planning for the NPOESS acquisition. This phase included the successful convergence of the command and control of existing DMSP and POES satellites at NOAA's satellite operations center.

The program definition and risk reduction phase involved both system-level and sensor-level initiatives. At the system level, the program office awarded contracts to two competing prime contractors to prepare for NPOESS system performance responsibility. These contractors developed unique approaches to meeting requirements, designing system architectures, and developing initiatives to reduce sensor development and integration risks. These contractors competed for the development and production contract. At the sensor level, the program office awarded contracts

[6] The four sensors supporting key EDRs are (1) the advanced technology microwave sounder, (2) the conical microwave imager/sounder, (3) the cross-track infrared sounder, and (4) the visible/infrared imager radiometer suite.

to develop five sensors.[7] This phase ended when the development and production contract was awarded. At that point, the winning contractor was expected to assume overall responsibility for managing continued sensor development.

The final phase, engineering and manufacturing development and production, began when the development and production contract was awarded to TRW in August 2002. At that time, TRW assumed system performance responsibility for the overall program. This responsibility includes all aspects of design, development, integration, assembly, test and evaluation, operations, and on-orbit support. Shortly after the contract was awarded, Northrop Grumman Space Technology purchased TRW and became the prime contractor on the NPOESS project.

Risk Reduction Activities Are Underway

In May 1997, the Integrated Program Office assessed the technical, schedule, and cost risks of key elements of the NPOESS program, including (1) overall system integration, (2) the launch segment, (3) the space segment, (4) the interface data processing segment, and (5) the command, control, and communications segment. As a result of this assessment, the program office determined that three elements had high risk components: the interface data processing segment, the space segment, and the overall system integration. Specifically, the interface data processing segment and overall system integration were assessed as high risk in all three areas (technical, cost, and schedule), whereas the space segment was assessed to be high risk in the technical and cost areas, and moderate risk in the schedule area. The launch segment and the command, control, and communications segment were determined to present low or moderate risks. The program office expected to reduce its high risk components to low and moderate risks by the time the development and production contract was awarded, and to have all risk levels reduced to low before the first launch. Table 3 displays the results of the 1997 risk assessment as well as the program office's estimated risk levels by August 2002 and by first launch.

Table 3: Actual Risk Levels in 1997, at Contract Award in August 2002, and Projected Risk Level by First Launch

	Risk levels in May 1997			Risk levels in August 2002			Projected risk levels by first launch (2009)		
Area assessed	Technical	Schedule	Cost	Technical	Schedule	Cost	Technical	Schedule	Cost
System integration	H	H	H	M	M	L	L	L	L
Launch segment	L	L	M	L	L	L	L	L	L
Space segment	H	M	H	L	M	L	L	L	L
Interface data processing segment	H	H	H	M	L	L	L	L	L
Command, control, and communications segment	L	L	L	L	L	L	L	L	L

Source: NOAA/Integrated Program Office.

In order to meet its goals of reducing program risks, the program office developed and implemented multiple risk reduction initiatives. One risk reduction initiative specifically targeted the space segment risks by initiating the development of key sensor technologies in advance of the satellite system itself. Because environmental sensors have historically taken 8 years to develop, the program office began developing six of the eight sensors with more advanced technologies early. In the late 1990s, the program office awarded contracts for the development, analysis, simulation, and prototype fabrication of five of these sensors.[8] In addition, NASA awarded

[7] The five sensors include (1) the conical microwave imager/sounder, (2) the cross-track infrared sounder, (3) the global positioning system occultation sensor, (4) the ozone mapper/profiler suite, and (5) the visible/infrared imager radiometer suite.

[8] The five program office-initiated sensors include (1) the conical microwave imager/sounder, (2) the cross-track infrared sounder, (3) the global positioning system occultation sensor, (4) the ozone mapper/profiler suite, and (5) the visible/infrared imager radiometer suite.

a contract for the early development of one other sensor.[9] Responsibility for delivering these sensors was transferred from the program office to the prime contractor when the NPOESS contract was awarded in August 2002.[10]

Another major risk reduction initiative expected to address risks in three of the four segments with identified risks is called the NPOESS Preparatory Project (NPP).[11] NPP is a planned demonstration satellite to be launched in 2006, several years before the first NPOESS satellite launch in 2009. It is scheduled to host three of the four critical NPOESS sensors (the visible/infrared imager radiometer suite, the cross-track infrared sounder, and the advanced technology microwave sounder), as well as two other non-critical sensors. Further, 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 about half of the NPOESS EDRs and about 93 percent of its data processing load.

Since our statement last year,[12] the Integrated Program Office has made further progress on NPOESS. Specifically, it awarded the contract for the overall program and is monitoring and managing contract deliverables, including products that will be tested on NPP. The program office is also continuing to work on various other risk reduction activities, including learning from experiences with sensors on existing platforms, including NASA research satellites, the WINDSAT/Coriolis weather satellite, and the NPOESS airborne sounding testbed.

NPOESS Faces Key Programmatic and Technical Risks

While the program office has made progress both on the acquisition and risk reduction activities, the NPOESS program faces key programmatic and technical risks that may affect the successful and timely deployment of the system. Specifically, changing funding streams and revised schedules have delayed the expected launch date of the first NPOESS satellite, and concerns with the development of key sensors and the data processing system may cause additional delays in the satellite launch date. These planned and potential schedule delays could affect the continuity of weather data. Addressing these risks may result in increased costs for the overall program. In attempting to address these risks, the program office is working to develop a new cost and schedule baseline for the NPOESS program, which it hopes to complete by August 2003.

NPOESS Funding and Schedule Are Changing

When the NPOESS development contract was awarded, program office 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 these satellites' planned launches. In general, program officials anticipate that roughly 1 out of every 10 satellites will fail either during launch or during early operations after launch.

Key program milestones included (1) launching NPP by May 2006 in order to allow time to learn from that risk reduction effort, (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 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.

However, 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 DMSP satellite. In late 2002, DOD shifted the expected launch date for the final DMSP satellite from 2009 to 2010. As a result, DOD reduced funding for NPOESS by about $65 million between fiscal years 2004 and 2007. According to NPOESS program officials, because NOAA is required to provide no more funding than DOD does, this change triggered a corresponding reduction in funding by NOAA for those years. As a result of the reduced funding, program office 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 will affect the NPOESS de-

[9] NASA contracted for the advanced technology microwave sounder sensor.

[10] In the case of the advanced technology microwave sounder sensor, NASA is responsible for developing the initial sensor while the NPOESS prime contractor is responsible for subsequent production of these sensors.

[11] NPP will not address risks in the launch segment.

[12] GAO–02–684T.

ployment schedule. Table 4 compares the program office's current estimates for key milestones, given current funding levels.

Table 4: Comparison of Key Milestones Related to the NPOESS Program

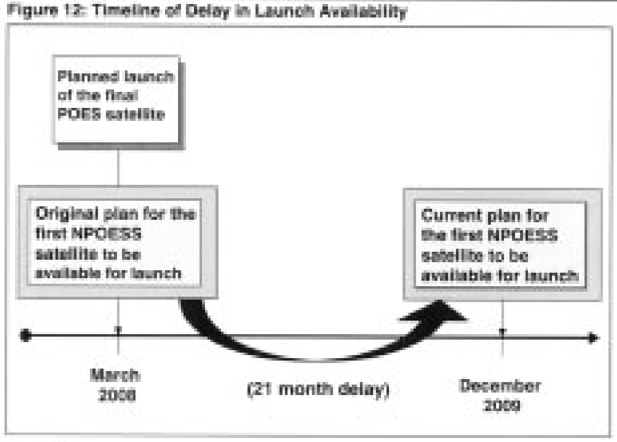
Milestone	As of August 2002 contract award	As of July 2003
NPP launch	May 2006	October 2006
Final POES launch	March 2008	March 2008
First NPOESS satellite available for launch	March 2008	December 2009
First NPOESS satellite planned for launch	April 2009	November 2009[a]
Final DMSP launch	October 2009	May 2010
Second NPOESS satellite available for launch	October 2009	April 2011
Second NPOESS satellite planned for launch	June 2011	June 2011

Source: Integrated Program Office, DOD, and GAO.

[a]A program official reported that if the first NPOESS satellite is not needed to back up the final POES launch in March 2008, the contractor will prepare the satellite to be launched in a different orbit with a different suite of sensors. These factors will allow the launch to take place earlier than if the satellite were to be used as a backup to the final POES launch.

As a result of the changes in funding between 2003 and 2007, project office officials estimate that the first NPOESS satellite will be available for launch 21 months after it is needed to back up the final POES satellite. This means that should the final POES launch fail in March 2008, there would be no backup satellite ready for launch. Unless the existing operational satellite is able to continue operations beyond its expected lifespan, there could be a gap in satellite coverage. Figure 12 depicts the schedule delay.

Figure 12: Timeline of Delay in Launch Availability



Source: GAO

We have reported on concerns about gaps in satellite coverage in the past. In the early 1990s, the development of the second generation of NOAA's geostationary satellites experienced severe technical problems, cost overruns, and schedule delays, resulting in a 5-year schedule slip in the launch of the first satellite; this schedule slip left NOAA in danger of temporarily losing geostationary satellite data coverage—although no gap in coverage actually occurred.[13] In 2000, we reported that geostationary satellite data coverage was again at risk because of a delay in a satellite launch due to a problem with the engine of its launch vehicle.[14] At that time, existing satellites were able to maintain coverage until the new satellite was

[13] GAO/AIMD–97–37.
[14] GAO/T–AIMD–00–86.

launched over a year later—although one satellite had exceeded its expected lifespan and was using several backup systems in cases where primary systems had failed. DOD experienced the loss of DMSP satellite coverage in the 1970s, which led to increased recognition of the importance of polar-orbiting satellites and of the impact of the loss of satellite data.

Key Sensor Development Efforts Are Experiencing Cost Increases, Schedule Delays, and Performance Shortfalls

In addition to the schedule issues facing the NPOESS program, concerns have arisen regarding key components. Although the program office reduced some of the risks inherent in developing new technologies by initiating the development of these sensors early, individual sensor development efforts have experienced cost increases, schedule delays, and performance shortfalls. The cost estimates for all four critical sensors (the ones that are to support the most critical NPOESS EDRs) have increased, due in part to including items that were not included in the original estimates, and in part to addressing technical issues.[15] These increases range from approximately $60 million to $200 million. Further, while all the sensors are still expected to be completed within schedule, many have slipped to the end of their schedule buffers—meaning that no additional time is available should other problems arise. Details on the status and changes in cost and schedule of four critical sensors are provided in Table 5. The timely development of three of these sensors (the visible/infrared imager radiometer suite, the cross-track infrared sounder, and the advanced technology microwave sounder) is especially critical, because these sensors are to be demonstrated on the NPP satellite, currently scheduled for launch in October 2006.

Table 5: Comparison of Costs and Schedules of Four Critical Sensors[a]

	Comparison of cost estimates (millions of dollars)			Comparison of schedule estimates: Critical design review			Comparison of schedule estimates: First unit delivery		
Critical sensors	Original	Current	Change	Contract award	Current date	Change	Contract award	Current	Change
Advanced technology microwave sounder[b]	$78.6	$137.8	$59.2	Dec 2001	May 2002	5 months	Oct 2004	Dec 2004	2 months
Cross-track infrared sounder	$74.1	$275.3	$201.2	Jan 2003	Aug 2003	7 months	Feb 2005	Oct 2005	8 months
Visible/ infrared imager radiometer suite	$297.6	$426.75	$129.15	Mar 2002	Mar 2002	0 months	Dec 2004	Nov 2005	11 months
Conical microwave imager/ sounder	$298.0	$384.5	$86.5	Apr 2004	Nov 2005	19 months	Apr 2006	Apr 2008	24 months

Source: Integrated Program Office and NASA data.

[a] Program officials noted that the recent estimates include items such as system integration and testing that were not included in the original estimates.

[b] NASA is incurring all costs for the development of the ATMS instrument, which is to fly on NPP. The program office expects to fund the other ATMS instruments at a cost of $206.6 million.

Critical sensors are also falling short of achieving the required levels of performance. As part of a review in early 2003, the program officials determined that all four critical sensors were at medium to high risk of shortfalls in performance. Program officials recently reported that since the time of that review, the concerns that led to those risk designations have been addressed, which contributed to the schedule delays and cost increases noted above. We have not evaluated the closure of these risk items. However, program officials acknowledge that there are still performance issues on two critical sensors which they are working to address. Specifically, officials reported that they are working to fix a problem with the radio frequency interference on the conical microwave imager/sounder. Also, the program of-

[15] Program officials noted that the more recent cost estimates include items that were not included in the original estimates, such as system engineering, integration, and testing; overhead costs; on-orbit support; and additional units of one of the sensors, as well as costs to address technical issues.

fice is working with NASA to fix problems with electrostatic discharge procedures and misalignment of key components on the advanced technology microwave sounder. Further, the program office will likely continue to identify additional performance issues as the sensors are developed and tested. Officials anticipate that there could be cost increases and schedule delays associated with addressing performance issues.

Program officials reported that these and other sensor problems are not unexpected; previous experience with such problems was what motivated them to begin developing the sensors early. However, officials acknowledge that continued problems could affect the sensors' delivery dates and potentially delay the NPP launch. Any delay in that launch date could affect the overall NPOESS program because the success of the program depends on learning lessons in data processing and system integration from the NPP satellite.

Level of Effort and Time Needed to Develop the Interface Data Processing System for NPP and NPOESS Is Not Known

The interface data processing system is a ground-based system that is to process the sensors' data so that they are usable by the data processing centers and the broader community of environmental data users. The development of this system is critical for both NPP and NPOESS. When used with NPP, the data processing system is expected to produce 26 of the 55 EDRs that NPOESS will provide, processing approximately 93 percent of the planned volume of NPOESS data. Further, the central processing centers will be able to work with these EDRs to begin developing their own specialized products with NPP data. These activities will allow system users to work through any problems well in advance of when the NPOESS data are needed. We reported last year that the volumes of data that NPOESS will provide present immense challenges to the centers' infrastructures and to their scientific capability to use these additional data effectively in weather products and models.[16] We also noted that the centers need time to incorporate these new data into their products and models. Using the data processing system in conjunction with NPP will allow them to begin to do so.

While the data processing segment is currently on schedule, program officials acknowledge the potential for future schedule delays. Specifically, an initial version of the data processing system is on track to be delivered at the end of July, and a later version is being planned. However, the data processing system faces potential risks that could affect the availability of NPP and in turn NPOESS. Specifically, program officials reported that there is a risk that the roughly 32 months allocated for developing the remaining software and delivering, installing, and verifying the system at two central processing centers will not be sufficient. A significant portion of the data processing system software involves converting scientific algorithms for operational use, but program officials noted that there is still uncertainty in how much time and effort it will take to complete this conversion. Any significant delays could cause the potential coverage gap between the launches of the final POES and first NPOESS satellites to grow even larger.

NPOESS Program Office Is Working to Address Risks

Program officials are working to address the changes in funding levels and schedule, and to make plans for addressing specific sensor and data processing system risks. They acknowledge that delays in the program and efforts to address risks on key components could increase the overall cost of the program, which could result on the loss of some or all of the promised cost savings from converging the two separate satellite systems. However, estimates on these cost increases are still being determined. The program office is working to develop a new cost and schedule baseline based on the fiscal year 2004 President's budget for the NPOESS program. Officials noted that this rebaselining effort will involve a major contract renegotiation. Program officials reported that they hope to complete the new program baseline by August 2003.

In summary, today's polar-orbiting weather satellite program is essential to a variety of civilian and military operations, ranging from weather warnings and forecasts to specialized weather products. NPOESS is expected to merge today's two separate satellite systems into a single state-of-the-art weather and environmental monitoring satellite system to support all military and civilian users, as well as the public. This new satellite system 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 2018, and the first satellite was expected to be

[16] GAO–02–684T.

ready to act as a backup should the launch of the final satellites in the predecessor POES and DMSP programs fail.

The NPOESS program office has made progress over the last years in trying to reduce project risks by developing critical sensors early and by planning the NPOESS Preparatory Project to demonstrate key sensors and the data processing system well before the first NPOESS launch. However, the NPOESS program faces key programmatic and technical risks that may affect the successful and timely deployment of the system. Specifically, changing funding streams and revised schedules have delayed the expected launch date of the first NPOESS satellite, and concerns with the development of key sensors and the data processing system may cause additional delays in the satellite launch date. These factors could affect the continuity of weather data needed for weather forecasts and climate monitoring.

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.

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. Individuals making key contributions to this testimony include Barbara Collier, John Dale, Ramnik Dhaliwal, Colleen Phillips, and Cynthia Scott.

Appendix I

Objectives, Scope, and Methodology

Our objectives were to provide an overview of our nation's current polar-orbiting weather satellite program and the planned National Polar-orbiting Operational Environmental Satellite System (NPOESS) program and to identify key risks to the successful and timely deployment of NPOESS.

To provide an overview of the Nation's current and future polar-orbiting weather satellite system programs, we relied on prior GAO reviews of the satellite programs of the National Oceanic and Atmospheric Administration (NOAA) and the Department of Defense (DOD). We reviewed documents from NOAA, DOD, and the National Aeronautics and Space Administration (NASA) that describe the purpose and origin of the polar satellite program and the status of the NPOESS program. We also interviewed Integrated Program Office and NASA officials to determine the program's background, status, and plans.

To identify key risks to the successful and timely deployment of NPOESS, we assessed the NPOESS acquisition status and program risk reduction efforts to understand how the program office plans to manage the acquisition and mitigate the risks to successful NPOESS implementation. We reviewed descriptions of the NPOESS sensors and interviewed officials at the Integrated Program Office, NASA, and DOD to determine the status of key sensors, program segments, and risk reduction activities. We also reviewed documents and interviewed program office on plans to address NPOESS challenges.

NOAA, DOD, and NASA officials generally agreed with the facts as presented in this statement and provided some technical corrections, which we have incorporated. We performed our work at the NPOESS Integrated Program Office, NASA headquarters, and DOD offices, all located in the Washington, D.C. metropolitan area. Our work was performed between April and July 2003 in accordance with generally accepted government auditing standards.

(310445)

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Highlights

Highlights of GAO-03-987T, a testimony before the Subcommittee on Environment, Technology, and Standards, Committee on Science, House of Representatives

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 ocean, and the environment. The current polar 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 merge the two current satellite systems into a single state-of-the-art environment monitoring satellite system. This new $7 billion satellite system 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 2018. In its testimony GAO was asked, among other topics, to discuss risks to the success of the NPOESS deployment.

www.gao.gov/cgi-bin/getrpt?GAO-03-987T.

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.

July 15, 2003

POLAR-ORBITING ENVIRONMENTAL SATELLITES

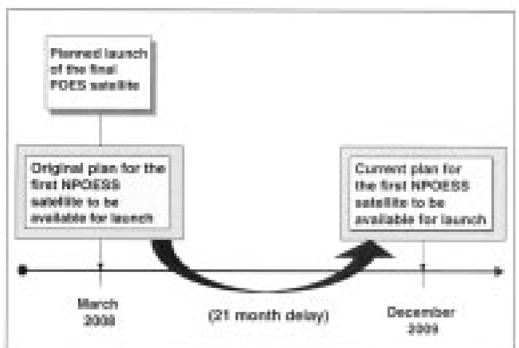
Project Risks Could Affect Weather Data Needed by Civilian and Military Users

What GAO Found

The NPOESS program faces key programmatic and technical risks that may affect the successful and timely deployment of the system. The original plan for NPOESS was that it would be available to serve as a backup to the March 2008 launch of the final satellite in one of the two current satellite programs—the Polar-orbiting Operational Environmental Satellite (POES) system. However, changing funding streams and revised schedules have delayed the expected launch date of the first NPOESS satellite by 21 months. Thus, the first NPOESS satellite will not be ready in time to back up the final POES satellite, resulting in a potential gap in satellite coverage should that satellite fail. Specifically, if the final POES launch fails and if existing satellites are unable to continue operations beyond their expected lifespans, the continuity of weather data needed for weather forecasts and climate monitoring will be put at risk. Moreover, concerns with the development of key NPOESS components, including critical sensors and the data processing system, may cause additional delays in the satellite launch date.

The program office is working to address the changes in funding levels and schedule, and to make plans for addressing specific risks. Further, it is working to develop a new cost and schedule baseline for the NPOESS program by August 2003.

Timeline of Delay in Launch Availability



Source: GAO.

Chairman EHLERS. Thank you.
Mr. Bush.

STATEMENT OF MR. WES BUSH, PRESIDENT, NORTHRUP GRUMMAN SPACE TECHNOLOGY

Mr. BUSH. Chairman Ehlers, Members of the Subcommittee, I am pleased to appear before you today to discuss NPOESS, a program for which Northrop Grumman is the prime contractor. I would like to thank you for holding this hearing on a subject of such extreme national importance.

Let me begin with a brief report on the program progress. Northrop Grumman is developing NPOESS under a contract awarded in August 2002 by the NPOESS Integrated Program Office, or IPO. We are responsible for overall system design, integration, and performance. In addition, as part of the NPOESS Preparatory Project, or NPP, we are providing three development sensors: command, control, ground-based communications and data processing, and on-orbit operations and support. When this program reaches its peak development, we will have more than 70 subcontracts with work being done in 17 states. More than 1,500 people currently support this contract.

The NPOESS program has benefited from a three-year program definition and risk reduction phase during which the IPO established five new sensor development contracts to retire risks associated with new technology developments. This phase provided the IPO and its contractors an important head start in high-risk reduction and program planning and enabled us to analyze and plan program execution schedules that optimized the program workflow. We were also able to coordinate concurrent development opportunities between NPOESS and NPP.

In February 2003, the IPO informed us of proposed funding cuts for the NPOESS program. These included a fiscal year 2003 reduction of $14 million and planned cuts in the Administration's budget of $70 million in fiscal year 2004 and $60 million in following years. To address these budget reductions, we assisted the IPO in conducting trade studies and evaluating the options. Following these studies, the IPO directed us to reschedule the NPOESS space segment activities to dates later in the future in order to avoid reducing performance requirements and to preserve the NPP launch schedule. We are currently executing our contract and development activities while at the same time working on program replan to address funding reductions.

Budget instability and the subsequent actions required in adjusting to new funding levels impact the program in several ways. First, they adversely impact the efficiencies created in the program baseline plan. The original imposed program baseline included the establishment of budget allocations for 32,000 tasks for the entire team. We will have to readdress all of those decisions in developing a new plan. In addition, we and our subcontractors are having put staffing plans on hold, reassigning people to other programs, or in some cases for some of our subcontractors, losing them to other companies. For example, reducing the Boeing Satellite System subcontract for the Conical Scanning Microwave Imager and Sounder instrument resulted in a staffing decrease from 150 people down to

50, which diminishes the efficiency of this instrument development. The shift in the IPO's space segment work also delays the availability of the first NPOESS satellite by 21 months, reducing the cost efficient overlap between NPOESS and the NPP development activities.

Lastly, replanning and delaying program implementation is costly. The replanning effort consumes about six months to evaluate the options and to negotiate a contractor vision with the IPO. The contractor team, including our subcontractors, have spent nearly $11 million just to develop the change proposals and convert them into contractual form.

We are currently working on a replan change proposal that we will submit to the IPO in August of this year that meets the reduced funding profile. This plan will deliver full mission capability, including the systems needed to support the NPP program, but it will be characterized by schedule delays in the development and delivery of the NPOESS space segment.

I would like to emphasize Northrop Grumman's capabilities in the development and deployment of advanced technologies for NPOESS. Northrop Grumman Space Technology has extensive experience since the very beginning of the space industry, integrating large, complex space programs that introduce new and evolving technologies. We have built many of the Nation's most sophisticated national security space systems as well as world-class civil space systems, many that were authorized by your Science Committee, including the Compton Gamma Ray Observatory, the Chandra X-ray Observatory, and the Earth Observing System's Aqua and Aura spacecraft. We have proven processes and procedures in place to address new technology development efforts and apply our system engineering expertise. We understand the system integration challenges. We have plans in place to address them, and our proven processes give us the confidence that we would be successful in meeting these challenges.

In summary, Northrop Grumman's biggest concern is executing the NPOESS contract with budget stability. The current reductions set us back on our program schedule and introduced inefficiencies to the program. However, we stand committed to provide the very best program performance within the funding profile that we are given.

Thank you very much. This concludes my remarks.

[The prepared statement of Mr. Bush follows:]

PREPARED STATEMENT OF WES BUSH

INTRODUCTION

Mr. Chairman, Members of the Subcommittee, my name is Wes Bush and I am pleased to appear before you today to discuss the National Polar-Orbiting Operational Environmental Satellite System (NPOESS). I am President of Northrop Grumman's Space Technology (NGST) sector. Northrop Grumman Corporation is a $25 billion global defense company headquartered in Los Angeles, California. We provide technologically advanced, innovative products, services and solutions to defense, government and commercial customers. I would like to thank you for holding this hearing on a subject of such extreme national importance.

NPOESS is composed of satellites, a ground control system and a data processing and dissemination network. The system will provide regional and global meteorological data; oceanographic, environmental, climatic, and space environmental information; surface data collection; and search and rescue capabilities.

NPOESS merges the existing polar systems from the Department of Commerce (DOC), the Polar-orbiting Operational Environmental Satellite (POES), and the Department of Defense (DOD), the Defense Meteorological Satellite Program (DMSP) into the next generation system that will meet operational requirements to 2020. The consolidation achieves significant economies and exploits newly available technologies necessary to meet civil and military environmental sensing requirements in a single national system.

NPOESS Prime Contractor Responsibilities

Northrop Grumman is now developing NPOESS under a contract awarded August 23, 2002, by the NPOESS Integrated Program Office (IPO), which is jointly funded by the DOC and DOD with participation from NASA. Northrop Grumman is the prime contractor, responsible for overall system design, integration and performance, as well as development of the space segment. Raytheon, our teammate, is responsible for command and control, mission data processing and system engineering support. In addition, as part of the NPOESS Preparatory Project (NPP), a NASA contract which will provide science continuity for NASA's Earth Observing System (EOS) and risk reduction for NPOESS, we are responsible for providing three development sensors; ground-based command, control, communications and processing; and on-orbit operations and support. When this program reaches its peak in development, we will have more than 70 subcontracts, with work being done in 17 states. More than 1,500 people currently support this contract.

When Northrop Grumman was awarded the NPOESS contract, we began an extensive baseline process and worked with the IPO to transition the development sensors from government contracts to Northrop Grumman subcontracts. The baseline process involved building a detailed program plan that consolidated 40 schedules into one single, integrated master schedule and established budget allocations for 32,000 tasks for the entire team. The IPO performed an intensive audit, and on February 14, 2003, NPOESS successfully completed the Integrated Baseline Review with a fully executable program.

Shortly thereafter, Northrop Grumman became aware of the Administration's FY04 and out-years' Budgets and FY03 Congressional budget reductions that directly impacted the baseline for NPOESS. These reductions necessitated a complete replan of the program that we are now developing with the IPO.

Current NPOESS Progress

We are currently executing our contract and development activities and are proceeding despite the budget constraints, although to a different schedule. Working closely with the IPO, our strategy is to preserve the NPP launch schedule while minimizing impacts to NPOESS. This requires that we continue our work to deliver the NPP sensors, the data processing system, and the command, control and communications systems. We have successfully completed the critical designs for NPP sensor suites, including the Visible/Infrared Imager Radiometer Suite (VIIRS) and Ozone Mapping and Profiler Suite (OMPS). We plan to hold the critical design review for the Cross-track Infrared Sounder (CrIS) in 5 weeks. We have also built engineering development units for all of these sensors, and each is in various stages of test and evaluation. We have ordered long-lead flight components for these sensors, and are planning to build the flight units based on lessons learned from the engineering development units. We are also making progress in accordance with our plan in the design of the ground hardware and software. We have procured high-speed computers, set up the software development facility, and have begun coding and testing software for command, control, communications and data processing.

We have also initiated validation, by simulation, of algorithms that work in conjunction with sensor hardware to produce the environmental data records, which are the ultimate product of the system. These algorithms will be converted to operational software to reside within the data processing system. The first three algorithms have been delivered and are undergoing test. This work must continue without interruption to support a successful NPP launch in the last quarter of 2006.

In addition to our work with NPP, we have also begun the detailed design of the more extensive NPOESS system. This involves the development, procurement, and design integration for 11 more sensor types onto operational spacecraft platforms that fly in three different orbits. It requires more algorithms for data processing, more extensive command and control, and a global communications network to support a 3-satellite constellation, which makes up the NPOESS final orbital configuration.

NPOESS FUNDING IMPACTS

Funding reductions in the Administration's FY04 Budget ($70M) along with out-year reductions ($60M) and the reduction in FY03 funding ($14M) for NPOESS from the original contracted baseline have caused us to shift work to the future in the overall program schedule. These reductions have resulted in loss of efficiency and have created significant cost impacts on the program.

There are three interrelated factors that govern our plan in executing the NPOESS program: requirements, budget and schedule. If one factor changes, it causes one or both of the other factors to change. Given the funding reductions, we faced the option of reducing performance requirements or changing the schedule, which in this case meant delaying either the NPP launch or the date when the first NPOESS satellite could be available to backup the POES N' launch, or both. After assisting the IPO with trade studies and evaluating the options, the IPO directed us to avoid reducing performance requirements and to reschedule the NPOESS Space Segment design, development, integration and test activities to dates later in the future. The IPO and NASA also decided to limit the slip of the NPP launch to 5 months to minimize any science continuity impacts with the EOS program. The shift in NPOESS Space Segment work resulted in delaying the availability of the first NPOESS satellite, which had been identified as a backup to POES N'. The first NPOESS satellite, per the replan, will be ready for launch February 2010, which occurs 21 months later than in the baseline plan.

Efficiency and Cost Impacts

The primary impact of the budget reductions is overall efficiency and increased cost for the execution of NPOESS. At establishment of the program baseline in February 2003, the IPO verified, through an extensive program audit, that we had an executable program. When the IPO informed us of the potential funding reductions, we stopped executing the staffing plan for the program, and in certain areas we reduced staffing, with their consent.

The budget reductions disrupted the program plan that we carefully developed over 3 years. The replanning effort consumes about six months to evaluate the options, establish a new baseline strategy with the IPO, develop a contract change proposal, negotiate contract changes with the affected subcontractors, and negotiate a contract revision with the IPO. This work isn't free; the contractor team, including our subcontractors, has spent nearly $11M just developing new proposals to put the replan changes into contractual form. The concurrent replan and program execution efforts also reduce our efficiency by diverting key personnel away from managing and executing the program plan to replanning the program to the new funding levels. There are many changes to our master schedule and budget allocations, which lead to re-negotiations and reduced efficiencies.

In addition, Northrop Grumman dramatically slowed the majority of the space segment work for the first NPOESS spacecraft, which froze our staffing level at 220 people instead of our baseline plan of 330. Before the funding reductions, we were adding people to the program to work specific tasks. When we were directed to take appropriate measures to perform contract work within a newly constrained funding profile, we initiated a staffing freeze in some areas, and staffing reductions in other areas, as did our subcontractors. The people affected by the staffing freeze and reductions were reassigned to other programs or chose to leave their companies. Many of these people will not be available to the program at the time their tasks resurface in the future, resulting in loss of learning and expertise that, in the baseline plan, were in the state of readiness to serve NPOESS.

We initiated few subcontracts and reduced the effort in other ongoing subcontracts. For example, we reduced the Boeing Satellites Systems subcontract for the Conical Scanning Microwave Imager/Sounder (CMIS) instrument, triggering a staffing reduction from 150 people to 50 people, which decreased the efficiency of this instrument development by introducing gaps in work flow, and increased its cost as a consequence of lost knowledge and stretched tasks. Our baseline plan called for work by 14 subcontractors in FY03; we deferred the activation of 6 subcontracts and adversely impacted 8 ongoing subcontracts. Our baseline plan involved 58 subcontractors in FY05; in our replan we anticipate delaying the activation of 18 subcontracts and adversely impacting 40 other subcontracts by introducing schedule stretches and gaps in workflow.

The delay of the launch date for an NPOESS backup to POES N' also reduces the cost-efficient overlap between NPP and NPOESS development activities, resulting in a loss of the efficiency we had incorporated into our baseline plan.

In summary, the Congressional FY03 action and the Administration's proposed funding decrease for NPOESS have created challenges for our management team, but with collaboration and guidance from the IPO, we immediately launched a significant effort to adjust our baseline plan and limit our spending to new funding constraints. We are fully committed to execute NPOESS within the new funding constraints. We are making significant development progress on the program. We are confident that we will continue to meet future key milestone dates and deliver our contractual requirements.

DEVELOPING TECHNOLOGICALLY ADVANCED CAPABILITIES

Northrop Grumman Space Technology has been developing space systems since the dawn of the space industry and has extensive experience integrating large, complex space programs that introduce new and evolved technologies. We have built many of the nation's most sophisticated national security space systems, as well as world-class civil space systems that were authorized by your House Science Committee, including the Compton Gamma Ray Observatory, the Chandra X-ray Observatory and the Earth Observing System's Aqua and Aura spacecraft. We have proven processes and procedures in place to properly address new development efforts and to solve technical difficulties and challenges. The stable system requirements for NPOESS continue to enhance our ability to methodically reduce risk and execute on the program.

Risk Reduction Activities

Many risk reduction activities have already occurred and more are planned for the future to support the NPOESS program. There are several risks that must be retired against sensors, ground systems, spacecraft, user-interface and overall systems integration. Northrop Grumman is working closely with the IPO, subcontractors and the user community to successfully conduct risk mitigation activities throughout the NPOESS program. However, Northrop Grumman's biggest concern in executing the NPOESS contract is not technical risk, but rather budget instability.

NPOESS is unique in a programmatic sense. Prior to the award of the NPOESS Prime contract, the IPO initiated a Program Definition and Risk Reduction phase, which included the selection of contractors for five new sensors. The IPO established these sensor development contracts to retire risks associated with new technology developments. The NPOESS program benefited tremendously by the IPO's early sensor risk reduction activities. Additionally, this phase of the program fundamentally affected our program execution plan by starting design work early and by having the preliminary design review as part of the proposal. Because of this process, we had already started staffing the program for execution, so funding reductions did not just delay program initiation, they stopped a substantial amount of on-going program work.

Within the context described above, one technical challenge we face is the final risk retirement for the new sensor developments. Fortunately, we are able to bring NGST's technical capabilities and proven processes to bear as the sensors proceed through the various maturity stages of their development. For example, the three NPP sensors that Northrop Grumman will provide to NASA have progressed in their design to the point where engineering development units have been built and are in various stages of test and evaluation. As these sensors move from design to flight fabrication, we are addressing typical production and re-design tasks such as detector yield, packaging integrity, and modulated instrument background interference. Northrop Grumman is drawing on domain knowledge across our corporation to assist the NPOESS sensor subcontractor teams to effectively resolve these challenges as they arise.

NPOESS System Integration

Northrop Grumman is working with its subcontractors and the IPO to ensure the proper, future integration of sensors, algorithms and entire program segments. For sensors, this involves the integration of sensor hardware to our satellites. We typically evaluate important technical design features such as data bus interfaces, mechanical interfaces, weight distributions, power consumption, thermal radiation, electromagnetic interference, fields-of-view, cleanliness requirements, and many others. We are addressing each of these, resolving and documenting them in sensor-spacecraft interface control documents. We benefit significantly in this area from the recent completion of the same activities on the NASA EOS Aqua satellite, which carries many instruments similar to those that will be on NPOESS. In this area, we are well up the learning curve. The integration of the system algorithms into the NPOESS Interface Data Processor (IDP) Segment is equally important. Northrop Grumman is performing independent simulations and analyses to confirm the quality of each data product the sensor system will provide. This information assists sensor subcontractors to evaluate and balance, in a "best value" sense, design, requirements, and specifications options as they complete their development. The overall integration between all the segments of the system is also important: the space segment; the command, control and communications segment; the IDP Segment; the Field Terminal Segment; and the Launch Support Segment.

Integrating NPOESS with the User Community

The integration of the entire NPOESS system with the user community involves incorporation of the NPOESS Concept of Operations within the Government Concept of Operations for environmental systems; the physical/electrical interfaces into the four weather centrals, the physical, electrical, and operational interfaces into the mission management centers; and the interfaces into various government data archive facilities. We understand these system integration challenges, have plans in place to address them, and proven processes give us the confidence that we will be successful meeting these challenges.

NEW NPOESS PROGRAM PLAN

Northrop Grumman will submit a replan change proposal in August 2003 based on the current funding profile. We will provide a plan that delivers full mission capability including our support for the development activities of the NPP program. But it will be a plan that is characterized by schedule delays in the development and delivery of the NPOESS Space Segment.

CONCLUSION

I want to clearly reinforce that NPOESS program schedule, efficiency and cost are adversely affected by funding reductions. Northrop Grumman's biggest concern in executing the NPOESS contract is not technical difficulty and risks, but rather budget instability. The budget reductions have impacted the program plan that we carefully developed over 3 years. They disrupt staffing plans, subcontract negotiations and other efforts that ripple through the entire subcontractor team. Any future reductions would generate similar adverse impact. While the reductions have been a setback, our replan will enable us to execute an outstanding NPOESS program that meets our nation's needs for environmental data. We stand committed to provide the very best program performance, within the funding profile we're given.

Chairman EHLERS. Thank you.

Dr. McPherson.

STATEMENT OF DR. RONALD D. McPHERSON, EXECUTIVE DIRECTOR, AMERICAN METEOROLOGICAL SOCIETY

Dr. MCPHERSON. Thank you, Mr. Chairman, Mr. Udall, Members of the Committee.

I am here today as a user of polar-orbiting satellite data, not associated with the project or the operation of the satellites, but as a user. For 30 years of my career, I was associated with the National Centers for Environmental Prediction, which is that part of NOAA where data from satellites meets numerical weather prediction models.

So I have—I was asked to address five questions, all of which—or most of which involve the polar-orbiters. You have my written statement, which addresses them all, but in the five minutes that I have now, I would like to summarize and discuss two main impacts of a potential gap, should a gap in the availability of polar-orbital data come about.

First, polar-orbital data have made a very significant contribution to the climate record. We are now at a time when decision-makers in government are asking that uncertainties in climate change science be reduced. A gap in the availability of polar-orbited data will not reduce the uncertainties in that climate record; it will create a disruption.

Secondly, polar-orbited data made possible the extension of useful weather forecasts from three days in the 1960's to seven days now, with the expectation of being able to go out to 10 days with daily forecasts in the—within the next couple of years. Polar-orbiting data, sounding data from the polar-orbiting satellites made that possible. If there is a gap in the availability of polar-orbiting data, the impact of that absence of data on the forecast of three to seven days will be very severe.

We have made enormous progress in weather forecasting over the last 30 years. If I could have the first slide there.

[Slide.]

This index, Mr. Chairman, shows in blue the increase in the skill index in the 36-hour forecast and in the red, in the 72-hour forecast over the period of time starting in 1955. And I am going to take that off, because I don't want your eyes to glaze over too quickly looking at that.

Measures like that are useful to meteorologists but to almost no one else. I find it much easier, and much more useful, to stand in supermarket checkout lines and eavesdrop on conversations that I hear, listening very carefully for those that are related to weather. And I can tell you that in the 1970's, one never heard a discussion in the supermarket checkout line of a decision being based on a weather forecast. One sometimes heard scurrilous comments about the weather forecast for that day that didn't work out, but never a decision.

And by the middle of the 1990's, such conversations, I can testify, were quite commonplace. I remember one in particular in January 1996 in which a woman—this was a Monday. The Weather Service had just issued a forecast for heavy snow in the mid-Atlantic region for that Friday. She was saying that she had reservations to go to Cancun on Friday, but had decided to move her reservations up to Thursday. Quite—discussions like that are quite commonplace.

[Slide.]

If there is a gap in the availability of polar data, headlines like this, which was from 1993, "A Wonderfully Well-forecast Snowstorm That Affected the Parade in Boston," would be replaced by ones which look like, oops, sorry—ones which look like this——

[Slide.]

—which was the spring forecast for here, heavy snowstorm two years ago, the storm before the calm actually turned out to be a very good forecast in New England, but not here. And what is more to some, we would have more of this sort of thing.

[Slide.]

Cartoons.

Mr. Chairman, we—this country, hooked or not—whether we know it or not, we are hooked on modern successful weather forecasts made possible by polar-orbited data. If that is interrupted, the impact will be very serious.

Thank you very much.

[The prepared statement of Dr. McPherson follows:]

PREPARED STATEMENT OF RONALD D. MCPHERSON

Chairman Ehlers, Mr. Udall, distinguished Members of the Committee: I am pleased to have the opportunity to testify before your Subcommittee on this very important topic. I speak to you today from the vantage point of long-time involvement with the polar orbiting meteorological satellite program, as a user of atmospheric observations from polar orbiting satellites. During my nearly 40-year career with the National Weather Service, much of my interest and energy was devoted to developing and improving the performance of computer-based weather forecasting models, and in particular to enhancing the effectiveness with which satellite data are used in those models. From 1990 until 1998, I was the Director of the National Centers for Environmental Prediction (NCEP), that component of NOAA's National

Weather Service responsible for the operations of the computer-based models that serve as the basis for virtually all weather forecasts in the United States. Since 1999, I have served as the Executive Director of the American Meteorological Society, the scientific and professional association of more than 11,000 scientists and practitioners in the atmospheric and related oceanic and hydrologic sciences and services.

I was asked to address five questions, having mostly to do with the prospect of a potential interruption in the availability of atmospheric observations from polar orbiting satellites as we transition from POES to NPOESS, and indeed the polar satellite program is the main focus of this statement. Nevertheless, it may be useful to briefly discuss a previous circumstance in which the meteorological enterprise was in the precarious position of possibly losing data from NOAA's geostationary satellite program.

The advent of geostationary satellites providing real-time images of global weather patterns has profoundly changed society's notions about global weather. Those images on local, national, and international television of immense cloud systems that span whole continents and sometimes cross hemispheres provide clear visual evidence of the connectivity of today's weather along the west coast with next weekend's weather in the mid-Atlantic region.

In the mid-1980s, a series of unfortunate policy and budget decisions and a satellite launch failure left the U.S. with a single geostationary satellite for almost six years, from January 1989 through January 1995. I was Deputy Director of the National Weather Service during a portion of that time. We dealt with that situation by shifting the one active U.S. geostationary satellite back and forth seasonally: during hurricane season, it covered the Atlantic, Gulf of Mexico and Caribbean, and during the winter it was positioned over the eastern Pacific to give coverage to the west coast for winter storms. We also "borrowed" an older, less capable geostationary satellite from the Europeans to help with coverage.

We made it through that difficult period without disastrous consequences. But if we had lost the single functioning geostationary satellite during that period, the National Weather Service's ability to warn citizens of tropical storms and large complexes of severe thunderstorms would have been very seriously compromised. The extraordinary importance of the satellite imagery to communicate serious weather problems to the public through television would have been lost.

Geostationary satellites are most valuable for real time monitoring of weather hazards such as hurricanes and severe thunderstorm systems. By contrast, polar orbiting satellites bearing instruments that sense quantities related to atmospheric temperature structure are most valuable as input to computer based forecast models; indeed, when these data became available, global weather predictions became practical. By the mid 1970s, improvements in modeling, computing capability, and accuracy of the polar orbiter data led to the operational production of global atmospheric predictions. There followed a period of steady improvement in the accuracy and range of weather forecasts in the U.S. and in developed and some developing countries around the world that continues today. It is worth noting that data from polar orbiters have contributed enormously to the development of the global climate record over the last 30 years. For example, in the IPCC (2001) report, 29 likelihood statements were made regarding observed climate trends, and 17 were based on data from NOAA's polar orbiting satellites.

By the mid-1980s, the skill of the three-day forecast was equivalent to that of the one-and-a-half day forecast 15 years earlier, and by 1990, skillful daily forecasts were being issued for five days in advance. Currently, the numerical forecast models provide skillful predictions out to seven or eight days, based largely on global observations provided by polar satellites. This progress depended on improvements in observing technology, advances in available supercomputers, research and development in understanding and modeling of the atmosphere, and in learning how to effectively use the observations from polar orbiting satellites.

The improvement in weather forecasting can be amply demonstrated by various, objective, statistical measures used by meteorologists. These measures are helpful to meteorologists, but are not very useful for laypersons. A more understandable, if less scientific, indicator is eavesdropping on conversations in the supermarket checkout lane. In the mid-1970s one would *never* hear ordinary citizens discussing their personal decisions based on a weather forecast beyond tomorrow, and rarely (and skeptically) on tomorrow's forecast. But by the mid 1990s, such conversations were quite common. In January 1996, for example, I overheard a shopper on Monday basing her winter vacation plans for Friday on a five-day forecast of heavy snow. She had airline reservations on Friday for a trip to Cancun, but on the basis of that forecast, changed her reservations to Thursday. It proved to be a good decision.

At least as important, a significant number of institutions in weather- and climate-sensitive economic sectors in the mid-1980s began to realize that weather forecasts out to five days in advance had achieved sufficient accuracy that business decision making processes could usefully factor them in, with due recognition of the predictions' inherent uncertainty. It is difficult to quantify this growth in the use of weather forecasts in business decisions, but it has led to a demonstrable and significant growth in the private weather information-provider industry. It is now estimated that between two and four trillion dollars of the U.S. economy is sensitive to weather and climate. A sound and continually improving prediction capability is essential to the efficiency of those weather and climate sensitive sectors.

Largely because of factors not related directly to weather and climate, we as a society are even more sensitive to weather and climate than was the case even ten years ago. For example:

- "Just-in-time" shipping. A Master of a container vessel that operates in and out of Baltimore harbor begins to make plans for docking when the ship is still two to three days out, in order to make sure that the delivery vehicles. . .trucks and railroads. . .will be available, for there is no warehouse: his vessel *is* the warehouse, and the longer it is unnecessarily at dock, the less revenue it generates for its owners. Thus the Master needs an accurate three-day forecast of wind, temperature, precipitation, and water level for Baltimore harbor.
- Energy deregulation. Prior to deregulation, electric utilities maintained excess generating capacity to be able to handle sharp, unexpected increases in demand, such as might be generated by an unexpected cold front passage in winter or a predicted sea breeze that failed to cool off a coastal city in summer. Now, it is uneconomical to maintain unused capacity; instead, a utility that has a need purchases energy from another utility, for fairly low prices if far enough in advance but at spectacular prices on short notice. Thus, an accurate forecast of temperature shifts several days in advance can make a very large financial difference.
- Commercial aviation. In the last ten years, three to seven day forecasts of major winter storms have permitted airlines to anticipate airport closures and move their aircraft out of the path of the storm, thus making recovery of normal operations after the storm more efficient.
- Highway and utility line maintenance. Skillful three to seven day forecasts allow local highway maintenance authorities and utility companies to plan their response to an incipient winter storm by pre-positioning crews, equipment, and materiel.

The instruments on NPOESS are technologically advanced compared to the current generation of polar orbiters. Perhaps one of the most important for three to seven day forecasts is the microwave sounder, data from which are relatively unaffected by clouds. Major international forecasting centers such as NOAA's NCEP have already begun to use observations from the research version of the new sounder that will be flown on NPOESS, and significant improvements in experimental forecasts have resulted. At NCEP, preparation for NPOESS depends crucially on the Joint Center for Satellite Data Assimilation, a joint activity of NOAA, NASA, DOD and NSF. Although under-funded in my view, the JCSDA houses research and development efforts essential to the effective use of NPOESS data.

The microwave sounders are also very important for climate monitoring and assessment. One of the questions currently being debated has to do with evidence that temperatures at the Earth's surface, averaged over the globe, have been increasing, and many scientists attribute this in significant degree to the increase in atmospheric carbon dioxide due to fossil fuels. In the atmosphere above the Earth's surface, however, temperatures have not changed in the same way, leading to considerable uncertainty in the scientific and policy debate over global warming. The microwave sounders on NPOESS will provide continuity in the record of upper air temperature structure essential to resolving the debate on the basis of sound evidence.

Thus, the prospect of a reduction in the availability of polar orbiter observations is dismaying; not so much from the standpoint of warnings of immediate weather hazards, but from the inevitable degradation of three to seven day forecasts and our ability to further extend them to ten days and beyond, as well as from the standpoint of the disruption of the climate record. The NPOESS orbiter that would be delayed is the first one that would carry the important microwave sounder mentioned above. The impact of an interruption in the availability of microwave data on the climate record would be severe and would greatly increase the uncertainty of the climate record at a time when decision-makers are demanding that climate scientists decrease the uncertainty.

The quality of weather forecasts would not likely revert to that of 30 years ago, for major improvements have been made in other aspects of the forecast process. Nevertheless, I believe that there be a serious decline in the accuracy and reliability of forecasts over the U.S. The impact would be felt by the industries noted above that have learned to depend on accurate three to seven day forecasts: transportation, energy, agriculture, construction, recreation, etc. And this would be felt not only in the U.S. but also worldwide, as all of the weather forecast centers in the world depend on observations from polar orbiter satellites. All of these sectors would be less efficient, and in some cases much more vulnerable.

As a final note, NPOESS will not do everything that is needed, and additional technological advances will be necessary for further improvements in weather forecast accuracy, as well as for monitoring and assessing climate trends For example, wind profiles over the world's oceans are badly needed, but cost-feasible technology is not yet available. When such technology becomes available, though, it will undoubtedly be deployed on polar orbiting satellites. Thank you very much for the opportunity to participate in this hearing and to comment on this very important issue.

Discussion

Chairman EHLERS. And thank you. I have to commend all of the speakers. They stayed within the five minutes or very nearly. I also appreciate your concern about having our eyes glaze over, but I would say never underestimate the ability of Congressmen to camouflage glazed eyes.

We appreciate the testimony and it has been very good. At this point, we will open our first round of questions. And the Chair recognizes himself for five minutes.

Just a quick comment on decisions. I make a lot of decisions every week based on weather forecasts. And my wife thinks I am crazy at times, but I watch the weekly planner on The Weather Channel every time I travel either to Washington or back to Michigan to decide whether to take a raincoat or a top coat or neither or sunscreen or what have you. And I think more and more people are doing precisely that.

Causes for Schedule Delays

The question for Mr. Powner and Mr. Bush. With the—you both talked about some of the consequences of delays. Now my first question is what is the reason for the delays. Are these delays—are the reasons technical or financial? Is it because the Administration doesn't budget sufficient funding each year or are you encountering technical obstacles that are creating problems with delays? We will let Mr. Powner have a chance first.

Mr. POWNER. Mr. Chairman, according to the program office, the schedule delays are currently attributed to budget shortfalls. Although I think it will be interesting to look at the current rebaselining that is about to come out next month and what are the various reasons for the new rebaselining and what are the costs associated with that. Clearly, as part of our review, we identified a number of sensors that had slipped to the end of their schedules and experienced cost increases. According to the program office, a lot of those schedule slips and cost increases were within anticipated schedule buffers. So supposedly, that has all be subsumed in the program to date, and the official word from the program office is that it is due to the funding delays.

Chairman EHLERS. Mr. Bush?

Mr. BUSH. Yeah, I might comment. In February of this year, just before we were aware of the schedule delays, we conducted an executability review with the IPO relative to the baseline schedule that we commenced the program with upon contract award back in August. The conclusion of that executability review, this is the IPO's conclusion as expressed to us, was full confidence that we had an executable program plan. The replanning work that we are doing today is solely associated with the changes in the funding now that we were notified of earlier this year. Those are the changes that I mentioned before, the $14 million in fiscal year 2003, $70 million in fiscal year 2004, and some $60 million in the following years. So that is the specific reason for the replanning activity.

Chairman EHLERS. Mr. Powner, isn't it true that attempting to save money by delaying its expenditure actually is costing us more?

Mr. POWNER. That is true. There is definitely some truth to that, although we are also concerned about some of the technical challenges. And when we hear that schedule and cost buffers are being used this early in the program, there is a concern going forward, because we still have plenty of time left in this program going forward.

Chairman EHLERS. Do you have any estimate of what the additional cost would be due to the delays?

Mr. POWNER. We don't have detailed cost information on the potential cost and increases. I can tell you that collectively when we looked at the sensor cost increases, the four critical sensors, there was a cost increase of about $475 million associated with those four sensors. There are many reasons for those additional cost increases that clearly is laid out in our written statement, but how that will equate to the overall program cost increases that likely will come out with the rebaselining and the contract renegotiation is unclear right now.

Chairman EHLERS. Mr. Withee, your testimony sounded quite optimistic, but what about the delays? In your testimony, you stated it is NOAA's policy for polar satellites that a backup must be available at the time of launch of a new satellite. However, the fiscal year 2004 budget request, even if fully funded, would create a 21-month gap between when the last POES is launched and when the first NPOESS is available. Given that your program officials state there is a one in ten chance that a satellite will fail either during launch or early operational stages, do you consider a 21-month gap acceptable? I mean, that is a 10 percent chance. Are you willing to gamble on a 10 percent chance?

Mr. WITHEE. Well, you quite rightly, Mr. Chairman, pointed out that our policy in NOAA, as we sit here today, is to have a replacement satellite ready when we launch a satellite. So when our last polar satellite, N-Prime, is launched, we would like to have, on the ground, ready to go, an NPOESS, which is a replacement satellite, first on the ground and ready to go. That is our policy. We now find ourselves in a situation where we can't implement that policy. We find ourselves with this 21-month gap.

We are concerned. We recognize the situation in the government in terms of the limitation of resources and are doing everything we can to try to reduce the gap and also to live within the gap. As you know, we do have severe weather problems in the north, particularly a polar program covers areas where the geostationary program does not, and particularly those are higher latitude programs. So severe weather, for your state, sir, and northward up in Alaska are going to be affected. We worry about that. We try to find replacement candidates the best we can. We are forecasting those now, but this is a seven-year forecast, so it is hard to predict what satellites would be available. We are concerned. We are also concerned for our climate community as well, because we need data continuity.

THE POTENTIAL GAP IN SATELLITE COVERAGE

Chairman EHLERS. The fiscal year 2004 budget request results in a 21-month gap, but you are still doing replan for this. Can we slip even further than 20 months—21 months, the way this is developing?

Mr. WITHEE. I would hope the budgets would remain intact such that in the future for 2005 and beyond that we would not slip beyond that 21 months. We in NOAA have been very strong about that. We are working those budgets now, of course, with our people in the Department of Commerce and OMB, and that is not yet done yet. But we are doing everything we can to avoid further slip, and I think our partners might have a comment on that, but they are working with us.

Chairman EHLERS. Yeah, just really that the August replan might end up showing an even further slip. I don't—Mr. Powner and Mr. Teets, do you want to comment on either of these questions?

Mr. TEETS. Yes, sir. I would offer a comment or two. I do think that, as Mr. Bush indicated, that the schedule slipping and the reprogramming activity that is going on right now is the result of a budget change. And one of the real challenges that we who are involved in the space world face is the fact that in terms of programming and planning for future satellite launches, it is difficult to predict how long current satellites will live on orbit. That is to say there is no certainty as to the time when POES–N or POES–N–Prime will actually fail on orbit. And so there—I recognize NOAA's policy here of wanting to have a satellite ready at the time of the last satellite launch in order to hedge against a launch failure, but I would also say that we have learned over time that no satellite should be launched before its need date. And as a result, I would say that we have found, again, over time, that satellites are living longer than are originally predicted. And so my own view of the replan and the take away from the activity ongoing is that we are taking a reasonable level of risk. I would call it a low risk that we will face a literal gap in polar weather prediction capability.

And I can assure you that my comments in my opening statement are very genuine. The Department of Defense needs these weather forecasts. We need them to win this global war on terrorism. And we think that the reprogramming that is going on now will create a program that is executable. I believe that John Cunningham has taken a mature view of recreating a program within some constrained budget limitations that still allows him to have adequate management reserve to handle problems in the program as they occur. And I am in support of what we are working together with our partners here at NOAA, and with NASA participation as well, in creating this revised program.

Chairman EHLERS. If the $130 million were restored, would you be able to get back on schedule or not or even if a fraction of it were?

Mr. WITHEE. In terms of numbers, we would have to get back to you with the accurate numbers. But money, at this point, on that order, will help us get back to minimize the gap from 21 months to approximately 12 months. There is, though, a point, which we have passed. We cannot restore all of the schedule and lost time because of the very problems that have been mentioned earlier and the physical limitation in time in trying to get some of these things put together. So on the one hand, that would help, on the other hand, as I have said, if that doesn't happen, we will do everything we can to help minimize the gap, within our ability, and also minimize the impact of the gap.

Chairman EHLERS. I have exceeded my time limit, and out of courtesy for my Ranking Member, I will give him extra time, too, if he wishes. So it is my pleasure to recognize——

MONITORING THE BUDGET PROCESS FOR GAPS

Mr. UDALL. Thank you, Mr. Chairman. And those were all very well directed questions in helping us understand the situation we face. My friend in—the Chairman mentioned that you should never underestimate the ability of a Member of Congress to camouflage glazed eyes. One of our former colleagues said, "If you can fake sincerity in this business, you have got it made." He is doing a pretty good job here right now, because he is serving as the Governor of New Mexico, not to mention any names. But when I plan to watch The Weather Channel, my wife says, "Why don't you just go outside and look at what the weather is doing?" And so I am going to use the weekly planner tactic the next time I find myself watching The Weather Channel.

But more seriously, I am going to direct my first question to Mr. Withee and Mr. Teets, and Mr. Bush; you did part of my question. When he described, Mr. Bush, your—developing an initial baseline, you worked, I think, from about September of 2002 until February of 2003. And the fiscal year 2003 appropriations process concluded at about the same time in February. And the fiscal year 2004 budget was presented about two weeks earlier. So it appears to me that we all went through this baseline exercise for about five months, and then it arrived dead, DOA, if you will. And can you explain how that is possible? And then as a follow-up, I wanted to talk about how we could make sure that this—we didn't find ourselves in that same situation, perhaps, in the fiscal year 2005 process. So I would direct it to Mr. Withee and Mr. Teets, but Mr. Bush, if you wanted to respond after those two, I would appreciate it as well.

Mr. WITHEE. I understand you want to explain the process of what we went through or how it is possible to do what?

Mr. UDALL. Yeah, how we ended up going through that process, well intended and in-depth process, for the original baseline exercise and then when we, and I use "we" in the broadest sense, we—

because we were all involved, the Congress, you, and the Administration, when that baseline arrived here, within days or even within days before it arrived, it was not relevant anymore. It was not a useful tool for us, so I imagine that was frustrating to everybody involved. But I am just curious to get an insight on how that could have happened and how we would apply that into this next cycle for the fiscal year 2005 cycle.

Mr. WITHEE. Yes, sir, that was a rugged exercise to go through. And as was testified by Mr. Bush, these exercises are not only costly in time, but they take resources to put together both on the government side and on the contracting side. Timing is everything in this business, and timing of that adjustment to our budget versus the timing of trying to get the program planned was just the wrong timing.

Mr. UDALL. Um-hum.

Mr. WITHEE. And I could say it will probably never happen again, but you never know about this business. Once we get in and are settled down here, and we intend to do that this year, then we hope we won't have many more cost adjustments to look at. And that is the best—it is—for acquiring satellites, you need cost, schedule, and performance. You need to know about those three things. If we can keep the cost fairly——

Mr. UDALL. Um-hum.

Mr. WITHEE [continuing]. Fixed, we can get these performance factors under control, and I must say that I monitor this with John Cunningham every week, and we are getting these sensor problems that were discussed under control. That is normal in a program. The instruments are very hard things to build, at the beginning, you are pushing the envelope on physical principles and trying to get things done cheaply and getting the right materials in there. And we are beyond that. In two of those four instruments, we have those under control and we have the cost parameters going back to normal and the schedule parameters going back to normal. We need to do that with the other two, and we need to keep those cost envelopes coming just as the present budget has put them forward to Congress.

Thank you.

Mr. TEETS. My view, sir, is that the December 2009 launch date is achievable with the restructured program, but I do believe that any additional out year cuts would jeopardize that one more time. And I don't think we can afford another schedule slip. I think the December 2009 time frame is a mark in the sand that we need to keep. And I can assure you that we will be trying very hard to maintain budget stability.

Mr. UDALL. Mr. Bush, did you care to comment or——

Mr. BUSH. Yeah, I would add only the perspective that it wasn't just in August when we were awarded the contract that we began the planning exercise. The IPO office conducted a three-year risk reduction phase in advance of awarding the contract. And as a part of that activity, we were creating this very detailed, fairly complex program schedule of these 32,000 milestones that I was referencing in my testimony. And what was put in place upon contract award was to converge our detailed program plan with the detailed program plans of the sensor contractors, which had been also undergoing this risk reduction phase. So we converged these 40 or so different major schedules into a single, large, integrated master schedule that we used to conduct a program of this nature.

Mr. UDALL. Um-hum.

Mr. BUSH. And it is the replanning of that activity that we commenced upon, understanding the change in the funding profile.

CHANGES TO THE BASELINE PROCESS

Mr. UDALL. Is it fair to say you had to start from a standstill and you started on that particular date and you moved ahead and the appropriations process here overlapped your work in such a way that, in the end, it was dead on arrival? But you now have a better sense of how this is unfolding and—so in the future we at least have more potential to avoid another——

Mr. BUSH. Yeah, we have——

Mr. UDALL [continuing]. Dead on arrival product?

Mr. BUSH. Yes, we have a very detailed understanding of the program resulting from having actually worked on it now for over three years as a part of the risk reduction activities. And so to make the point that Mr. Withee and Mr. Teets have made, our understanding of the program has enabled us to create a very high confidence rebaselining to give us very high confidence on—in regards to executability with respect to a 2009 launch.

THE NATURE OF TECHNICAL FAILURES AND CONTINGENCY PLANNING

Mr. UDALL. I am going to take advantage of the Chairman's offer to direct a little more time my way and ask one more question and direct it at Mr. Withee and Mr. Teets. I know it has been continuously planning, and if we, in fact, got to a position where we didn't have all of the new satellites up, but we have got some of the old satellites still performing, how does that unfold? What measures do we have in place? Or what steps could we take to respond to that kind of situation? And if you would, just to educate me, at least, when a satellite—when you say a satellite fails, it is generally not the satellite itself, it would be one or more of the sensors, and you don't necessarily have an indication of that or do you? It is not like a light bulb just goes out and then it is gone? You have no recourse at that point.

Mr. TEETS. I guess I will be first here to answer this one. Typically speaking, perhaps one of the instruments might fail, and that would essentially be a dim light bulb then——

Mr. UDALL. Uh-huh.

Mr. TEETS [continuing]. For a while, and it becomes something of a judgment call as to when you want to take a satellite out of full service. Sometimes there are hard failures, which is like a light bulb going entirely out all at once.

Mr. UDALL. Um-hum.

Mr. TEETS. But the thought that I was trying to give to you is that there is not a certainty in knowing how long these satellites will live. There is some reasonable estimate, based on past history, based upon the particular state and time it was built and the conditions under which it was launched and so on and so forth that drive those lengths of life. I can tell you that, as I mentioned in my testimony earlier, from the Department of Defense's point of view, we do have five satellites that have not yet been launched. The next DMSP, Defense Meteorological Satellite Program satellite will be launched in September of this year. And then depending upon it—how long it is until we experience another failure in one of our three orbiting platforms, that will drive when we will launch vehicle 17.

Mr. UDALL. Um-hum.

Mr. TEETS. Vehicle 17 is currently scheduled to be launched next year. But if we get longer life out of those assets that are on orbit, that could delay a little bit. And so what we are trying to do is put forth a reasonable risk profile to schedule these kinds of launches. And I can assure you that we are anxious to have NPOESS C–1 on orbit. It will give us something on the order of 20 times the amount of data that we are getting out of our DMSP satellite.

Mr. UDALL. Um-hum.

Mr. TEETS. It will give us 22 colors, where we get two colors out of DMSP.

Mr. UDALL. Um-hum.

Mr. TEETS. So it is a vastly improved satellite that will give us better capability than we have ever had. And so we are anxious to have it, and we want to fund for it accordingly. In terms of our budgeting process, we will be going through the 2005 budgeting process here. Well, we are in the midst of it right now. And I can assure you that my objective is to make certain that we have the necessary resources to be able to have this NPOESS capability in December of 2009.

Mr. UDALL. I think——

Mr. WITHEE. Certainly, you have hit on a very strong point in any operational satellite program, and that is you have to do contingency analysis constantly your mission is continuous supply of satellite and other operational data. And so we spend a lot of time trying to wrestle with the question that you asked. First of all, Under Secretary Teets has said you can get failures of many different types, and NOAA has had them all. NOAA–13, some people have told me because of the number, failed in two weeks, hard, lights out. Never heard from it again. It is still up there, perfectly good satellite, we think, with one possible problem, a fusion of one of the parts. That can happen. And that means you have to adjust your ideas of how long satellites last.

I might remark that four of the dates of N and N–Prime that we have been talking about, the March 2008, those have been adjusted in the last three years to reflect longer lifetimes. And so, instead of a two-year lifetime, which was contracted for by the corporation that built them, we have extended that 24 months to 45 months. And that is the basis of our calculations, which we call—it is a 50 percent need date. Expect a 50 percent probability that in March 2008 we are going to need a satellite, and that is what we tend to live with, about 50 percent. So we don't think we are too conservative but on the other hand, we are not going to wait—we are not going to project those need dates out until the 90 percent probability, that would be way out further than that.

Thirdly, in terms of contingency, it is not just working with reliability of satellites, but it is using other sensors from other satellites. If we have parts from some of our older satellites that are still working, we keep track of them. We keep our satellites on, and we are prepared to use those. That is sort of luck of the draw, but at any time we have two or three satellites with sensors that are working. We can not, though, use just any sensors. For example, the Defense Meteorological Satellite Program, while similar to NOAA's satellite program, is different. The mission is different.

Mr. UDALL. Um-hum.

Mr. WITHEE. The sensors are different. And we can not plug those sensors into our own algorithms and produce weather forecasts. For example, the DMSP does not have an infrared sounder at all, and the sounder is the instrument which makes long-term forecasts realizable.

Mr. UDALL. I want to thank you for your testimony and thank the Chairman for his indulgence in providing me with some additional time.

Chairman EHLERS. Thank you.

Mr. Smith from Michigan.

INTERNATIONAL SATELLITE DATA SHARING

Mr. SMITH OF MICHIGAN. Mr. Powner, good to have you here. I guess they had not—the paper this morning, the *Washington Post,* was—we were going to go in debt $450 billion this year. And so the question is is this technology such that we should be borrowing the money from what our kids—our grandkids haven't even made yet to pay for the technology, newest technology today. And so one of my questions is how much does the U.S. rely on polar satellites from other nations, such as Europe and Asia? And how much do they rely on us? And do we charge anyone for this data that we provide? If not, should we? Should that be some kind of a consideration? And if we lose U.S. polar satellite coverage, how much of that gap can be filled in by the weather satellites of other nations? And Mr. Withee and Mr. Teets probably to—I would direct that to.

Mr. WITHEE. Thank you.

Mr. SMITH OF MICHIGAN. You are welcome.

Mr. WITHEE. I will start with an answer on behalf of NOAA. We think these satellites are very important and integral to our missions, not just weather, which is where we started, but now climate and ocean and hazards are becoming really important parts of the satellite functions. So when you want to express how much is enough, you have to evaluate that total benefit. And we have studies underway. We would be happy to forward them to you on the cost benefit of these satellites that we are talking about.[1]

Mr. SMITH OF MICHIGAN. How much of a benefit is it to them? I am just trying to get the point across that we have got to be very conscious of every dollar that we spend. So my main question is are we so generous that we provide this information to the world and is it reasonable to consider charging some of the users for this in-

[1] The U.S. taxpayer will realize approximately $1.3 billion in savings by converging NOAA POES and DOD's DMSP into a single U.S. polar-orbiting system that will satisfy both civil and military needs.

formation, whether it is users in this country or whether it is users in the rest of the world?

Mr. WITHEE. In the satellite world, we have an international Committee on Earth-Observing Satellites, CEOS. I am the chair of that for the international committee. And the whole raison d'être for that committee is to provide a basis for planning, coordination, and sharing data. And I can assure——

Mr. SMITH OF MICHIGAN. How about sharing the cost?

Mr. WITHEE. We feel that sharing data is tantamount to sharing costs. If Europe builds a program, we get the data from it; I mentioned EUMETSAT. We have a firm partnership in both our geostationary and polar series. And as I say, their future polar program is defraying a half billion dollars of U.S. costs——

Mr. SMITH OF MICHIGAN. I don't know how to—my question—but just assume that you have a pie that represents all of the weather data that is accumulated. How much of that pie is paid for by the United States?

Mr. WITHEE. It is less than 50 percent.

Mr. SMITH OF MICHIGAN. Less than 50 percent. And who would be the main contributors to the other 50 percent?

Mr. WITHEE. Europe and Japan.

Mr. SMITH OF MICHIGAN. And how much—if we lose our polar satellite the 22 months ahead of time, how much can their facilities accommodate that potential gap or lag?

Mr. WITHEE. In the case of the polar program, as I said, the Europeans will fly a satellite in the morning. We will use that data, because that will be what we have in our models, and there will be a partial mitigation of our gap in coverage. So the Europeans will help us.

Mr. SMITH OF MICHIGAN. Mr. Teets, your comments?

Mr. TEETS. Yes, our Defense Meteorological Satellite Program satellites do have different sensors on board than the NOAA satellites. Our sensors are largely designed in order to accurately see cloud cover on a global basis. And we make our data available to NOAA and to NASA for their use on a government-to-government basis. We don't make our data available to other parties, unless it comes out in a form of weather forecasting coming out of NOAA. And so I would simply say that we don't depend on other countries' satellite information to serve our needs nor do we disseminate our data to other countries.

Mr. SMITH OF MICHIGAN. Do you—is there—do you classify any of the information?

Mr. TEETS. Some of the information is classified, but—having to do with timing of orbit and this sort of thing, but the information that we provide to NOAA and to NASA is not classified.

Mr. SMITH OF MICHIGAN. What is the new U.S. and European space organization agreement that Space News reported and does—what does that mean in terms of NPOESS as far as the future? Apparently an expanded agreement of sharing?

Mr. WITHEE. Yes, there were two agreements signed. The organization is called EUMETSAT. There is a representative in the audience today. And the agreements were, one, to share our geostationary data. That is the data that is both above Europe and above the U.S., which I might say was used in the campaign that we have gone through in Iraq. And secondly, that there is a polar orbiter agreement, which is the one I have been referring to, which says when they launch their first polar satellite, called METOP, that those data will be shared and will be available to the U.S. throughout the U.S. government and the commercial world for use here in the United States by all parties. So we think it is a very good agreement, and that is what it was all about.

Mr. SMITH OF MICHIGAN. Thank you, Mr. Chairman. Gentlemen, thank you for being here.

Chairman EHLERS. The gentleman's time has expired.

We will recognize the gentleman from Minnesota, Mr. Gutknecht.

Mr. GUTKNECHT. Well, let me just say, Mr. Chairman, I thank you for having this hearing, and—but my views are—my questions were very similar to Mr. Smith's. You know, it just strikes me that as a Member of the Budget Committee, we have to deal with what we want and what we need and what we can afford. And right now, we are looking at some huge deficits.

And just tag along with what Mr. Smith said. The unvarnished fact is government will be paid for. It will either be paid for now by current taxpayers, or it will be paid for in the future by our kids with interest. $7 billion is still a lot of money. And it seems to me before this subcommittee or the appropriators or anybody moves forward with this project, to use the words of the famous Cuban philosopher, Ricky Ricardo, when he would talk to Lucy, "You have got some 'splaining to do."

This is a big—and on—and you talk about 22 colors. Well, that is wonderful. I mean, does any other satellite in the world have 22 colors? I mean, this is very expensive stuff. And I am not sure, Mr. Withee, that your numbers are correct about how much we spend versus the rest of the world, because that does not square with some of the information this subcommittee has been given. In fact, I think we are spending over 60 percent of all of the money being spent on weather research today in the world. And we represent, just as a point of reference, less than seven percent of the world's population. Now I am not saying that people in Africa ought to be helping to pay for our satellites and the information. But it does strike me that for too long our friends in Europe and even in Japan and other developed countries in the world have sort of been getting a free ride on a lot of this information.

I think this is a tough sell. And if you are going to expect us to override what the President of the United States has requested, it seems to me that you have a big selling job with Members of this subcommittee, with Members of the Full Committee. And I would hope that you would spend some time up here on the Hill trying to explain why we have to spend this much money. And when you put this in context, it is just astronomical.

And I guess I am both blessed and cursed by the fact that I have actually been out to Boulder, and I was very impressed with NOAA's facilities. In some respects, we had just come from meetings at NIST. And we saw their labs, and then we saw the NOAA labs. And it was like going from the closet to the Taj Mahal. And I just—boy, I will tell you, I am sorry I missed the opening testimony. I apologize for that. We do have staff here. But there are going to be—a lot of questions are going to have to be answered before you are going to get a whole lot of support from some of the people, at least on this side of the panel, to spend $7 billion that the President has not requested.

I yield back my time.

Chairman EHLERS. I thank the gentleman for yielding back.

The—you undoubtedly heard the bells going off. It is probably—I think it is pretty well known that we are very Pavlovian in our behavior here, the bells ring and we go vote. But we would like to get a few more questions in before we leave for the vote. And my intent is to wrap this up before we go vote so you do not have to wait——

Mr. TEETS. Mr. Chairman? I wonder if I could, please, just respond to one point that was made by Mr. Gutknecht.

Sir, I feel the need to say unequivocally that I am in 100 percent support of the President's 2004 budget request, not more than the budget request but at the budget request.

Mr. GUTKNECHT. Thank you.

THE NOAA–DOD JOINT PROGRAM

Chairman EHLERS. I thank the gentleman for his comment. Mr. Teets, I would just like to follow-up my previous questioning. And you have emphasized a couple times in your testimony that satellites are lasting longer than we expect. And I understand that is the basis of your decision or the Department of Defense decision to launch your polar satellites every four years, therefore postponing the program as a result of that, because it is helping the program. And incidentally we do see your share of the cost because it is a duo program that required NOAA to also reduce its expenditures in this and delaying the project. It—I am concerned about that. It seems to me, as a cooperative project, this is something that should have been worked out together than—rather than DOD making the decision and forcing the issue. But as I pointed out later, delay could well lead to additional costs. I am just wondering how you can justify what apparently, at least from what we have seen, be solely a DOD decision rather than a cooperative decision, which I think has real implications for the program.

Mr. TEETS. Well, sir, I believe in operating very much in a fully cooperative manner. I—as I have mentioned to you before, I have met on numerous occasions with Mr. Withee and with Admiral Lautenbacher, with Fred Gregory from NASA. And I would just say that all of the budget deliberations that go on sometimes take on a life of their own. And in this case, the timing was very short, and the time when we put the final touches on the President's 2004 budget. And it was not as fully coordinated as I would like to have had it be, but it happened as it happened. And I am dedicated to making this partnership work. I think it is a positive stroke for the country, and I think we find ourselves in a situation where we can both benefit, working closely together on a matter like this. And my—I am dedicated to making certain that as we go forward, we nurture this partnership and that in point of fact, we put together a program which we can all go shoulder-to-shoulder with that will result in a launch capability in December of 2009 for this very capable polar-orbiting satellite.

Chairman EHLERS. Well, I appreciate that comment, and I certainly encourage you to do that. And I also certainly do not want to see any further delays because of the added uncertainty and potentially added cost. I have been in the scientific field to know long enough that you can make all kinds of estimates of lifetimes. It is the extremely short ones that kill you, as you found out with the one that the light turned out quickly, as you said. But just a—happening to hit some orbiting debris or anything else, catastrophic failure is the worst kind of failure you can have. And I think we have to be aware of that and guard against that happening, because I think it has tremendous ramifications, not just for NOAA and weather forecasting, but tremendous ramifications about our military ability should that happen.

And so I hope that we can proceed a pace at this point that the appropriations will be as scheduled for the rest of the project and that we will all reach a happy conclusion and continue to not only know what the weather is but know a lot more about our Earth's surface, which is useful for military purposes but also for climate change research, things of that sort.

I want to thank you all very much for being here. It is—I am sorry we are being cut just a little short, but I think we got most of the essence. I would ask that you be willing to respond to written questions, because we have a few things we haven't covered, and we will get those to you as soon as possible and ask for your response. So thank you. Your expertise has been very valuable, and I appreciate your comments.

Mr. TEETS. Thank you.

Chairman EHLERS. And with that, we stand adjourned.

[Whereupon, at 3:23 p.m., the Subcommittee was adjourned.]

Appendix 1:

Biographies, Financial Disclosures, and Answers to Post-Hearing Questions

BIOGRAPHY FOR GREGORY W. WITHEE

Mr. Withee is the Assistant Administrator for NOAA's Satellite and Information Services. He leads the U.S. civil operational environmental satellite program which supplies the Nations weather and environmental satellite data; and also leads three National environmental data centers which archive and make accessible climate, ocean, and geophysical data and products.

Mr. Withee was first employed in the private sector with the Lockheed Ocean Laboratory. After serving for some years as the chief oceanographer for the NOAH Data Buoy Office, he served as a senior specialist for the UN World Meteorological Organization. He then worked as a senior oceanographer for an applications group at the Applied Physics Laboratory of John Hopkins University. In 1983, after leading an ocean products effort for the National Weather service, he was appointed Special Assistant to the Administrator of NOAH for Ocean Service Centers. From 1986 to 1991, Mr. Withee was Director of the National Oceanographic Data Center. For the next six years, he served as Deputy Assistant Administrator for NOAA's Satellite and Information Service.

Mr. Withee has received numerous awards and has been cited for special recognition both in Government and industry. He has received two Presidential Rank Awards for extraordinary performance in the Senior Executive Service. Mr. Withee has authored more than 100 publications and reports and has lectured at a wide variety of conferences and symposiums. Mr. Withee received his undergraduate degree in Physics from Pomona College and a Master of Science in Oceanography from the Scripps Institution of Oceanography.

ANSWERS TO POST-HEARING QUESTIONS

Responses by Gregory W. Withee, Assistant Administrator for National Environmental Satellite Data and Information Service (NESDIS), National Oceanic and Atmospheric Administration

Questions submitted by Democratic Members

Q1. In response to Chairman Ehlers' question, Mr. Powner of GAO stated that the current 21-month delay in the NPOESS program is due to the funding reductions announced in 2003 and proposed for 2004 and beyond. Mr. Powner further stated a concern that schedule and cost buffers are being used this early in the program.

Q1a. Does the Administration anticipate at this time (e.g., FY05 budget request) any further reductions in the funding path for the NPOESS program?

A1a. The Administration is currently developing the President's FY 2005 Budget Request which will be presented to Congress in February 2004. At that time, the Administration will lay out the planned funding requirements for the NPOESS Program. As stated by Undersecretary Teets and Assistant Administrator Withee, the Departments of Defense and Commerce are working closely to address the program's funding requirements.

Q1b. What assurance can you provide to us that the current re-baselining effort will provide a firm commitment of base funding levels for the NPOESS funding path for FY05 and forward?

A1b. The current re-baselining establishes a new, executable schedule and supporting budget, although with a delivery 21 months later than planned at contract award in August 2002. We believe the program is on a sound fiscal footing and there seems to be strong support in the Department of Commerce (DOC) and Department of Defense (DOD) for maintaining the schedule and hence the budget.

However, the budget is reviewed each year against Administration targets and the enacted Congressional budget and there are many competing pressures. While NPOESS is extremely important, it must be annually judged against these competing pressures.

Q2. What is the status of the test launch program, the NPOESS Preparatory Project (NPP)? Will the key sensors that need to be tested be ready to meet the planned launch date in 2006? How are the sensor development, NPP launch, and NPOESS launch schedules related to one another? Does a delay in one part of this sequence automatically translate into a similar delay in the other schedules?

A2. The NPOESS Preparatory Project (NPP) is currently scheduled for launch in October 2006. To meet this date, the following are required:

NASA Provided	**NPOESS Provided**
• Launch vehicle	• Visible/Infrared Imaging Radiometer Sensor (VIIRS)
• Satellite bus	
• Advanced Technology Microwave Sounder Sensor (ATMS)	• Cross-track IR Sounder (CrIS)
	• Ozone Mapping/Profiling Sensor (OMPS)
	• Command, Control, Communications
	• Data Processing

The current status for our deliverable items meets the NPP need date:

Instrument	Planned dates	Required
VIIRS	Nov 05 [1]	Nov 05
CrIS	Oct 05 [1]	Oct 05
OMPS	Feb 05 [1]	Feb 05
Command, Control, Communication	Dec 05	Apr 06
Interface Data Processing System at NOAA	Dec 05	Apr 06

[1] These dates include between 30 and 60 days of margin against the required date. To create satellite integration and test margin, we plan to deliver the engineering development unit (EDU) sensors in the spring of 2005. This will allow the NPP contractor to perform mechanical and electrical integration much earlier than planned, greatly reducing risk. The flight sensors will then be installed for environmental test.

The sensor developments of VIIRS, CrIS, OMPS, and ATMS for NPP are the first NPOESS program sensor deliveries to reduce both development and manufacturing risk and demonstrate orbital performance. By doing this early for NPP, it should greatly reduce NPOESS risk.

The sensors are the pacing items for the NPP launch. If the NPP sensors slip past the required dates, this could slip the NPP launch. These slips in NPP, however, will not slip the NPOESS launch. NPP is intended to verify performance of the complete NPOESS ground and data processing systems. With an NPOESS ground readiness need date of February 2009, we have margin between the NPP launch and the NPOESS need date.

Q3. Has NOAA explored the possibility of negotiating a contingency clause with Lockheed Martin (the primary contractor for the current POES program) to supply an additional POES satellite(s) in the event that NPOESS is further delayed or that the final POES fails upon launch as a way to ensure there are no gaps in data delivery?

A3. Yes. NOAA has conducted a thorough analysis of the transition between POES and NPOESS and does not believe that an additional POES spacecraft can be built in time, or cost-effectively, to fill any gaps between the launch of the last POES (NOAA–N') and the availability of the first NPOESS satellite (C–1). NOAA's analysis indicates that it is more cost effective to fully fund the FY 2004 President's Budget Request and minimize any additional gaps in backup capability.

A major concern is the availability of instruments. Several of the contractors completed delivery of their last POES hardware quite some time ago, and others have been acquired by other companies and it is not a certainty that they would bid on such future work.

Even with the assumption that all of the principal POES vendors will be capable of responding to such a new requirement, there is a schedule problem. The amount of time from turn on to get delivery of the instruments are:

* Advanced Very High Resolution Radiometer (AVHRR): 51 months
* Advanced Microwave Sounding Unit - A (AMSU-A): 39 months
* Solar Background Ultra-Violet sensor (SBUV): 31 months
* Space Environment Monitor (SEM): 51 months

The time required to integrate and test the satellite is estimated to be 37 months. The time from integration to launch is estimated at 6 months. Therefore, it would take approximately 94 months (51 + 37 + 6) to build and launch a NOAA–N'—well into 2011 and long after a backup to NOAA–N' is required, i.e., March 2008.

In addition, this timeline is based on the assumption that the Delta-2 launch vehicle for which the NOAA POES spacecraft are designed and tested will be available in 2011 for this task. However this is an old launch vehicle and there are no projected launches that far out in time. If the Delta-2 is unavailable, a costly and time-consuming modification of the spacecraft to use a more modern launch vehicle would be necessary.

BIOGRAPHY FOR PETER B. TEETS

Peter B. Teets is Under Secretary of the Air Force, Washington D.C. Within the Air Force, Mr. Teets is responsible for all actions of the Air Force on behalf of the Secretary of the Air Force and is acting secretary in the secretary's absence. In that capacity, he oversees the recruiting, training and equipping of more than 710,000 people, and a budget of approximately $68 billion. Designated the Department of Defense Executive Agent for Space, Mr. Teets develops, coordinates and integrates plans and programs for space systems and the acquisition of all DOD space major defense acquisition programs. Also the Director of the National Reconnaissance Office, Mr. Teets is responsible for the acquisition and operation of all U.S. space-based reconnaissance and intelligence systems. This includes managing the National Reconnaissance Program where he reports directly to the Secretary of Defense and the Director of Central Intelligence.

Mr. Teets is the retired President and Chief Operating Officer of Lockheed Martin Corp., a position he held from 1997 through 1999. He began his career with Martin Marietta, Denver, Colo., in 1963, as an engineer in flight control analysis. In 1970, he began managing the inertial guidance system to the Titan IIIC launch vehicle until 1975, when he became Program Manager for the company's Transtage Project and Director of Space Systems. Five years later, Mr. Teets became Vice President of Business Development for Martin Marietta Denver Aerospace; and in 1982, he joined its Strategic and Launch Systems Division as Vice President and General Manager. Following two years in these positions, Mr. Teets became President of Martin Marietta Denver Aerospace, and in 1993, President of the company's Space Group.

After the Lockheed Martin merger in 1995 and until 1997, Mr. Teets served as President and Chief Operating Officer of the Information and Services Sector.

EDUCATION

1963 Bachelor of science degree in applied mathematics, University of Colorado, Boulder

1965 Master of science degree in applied mathematics, University of Colorado, Denver

1978 Master of science degree in management, Massachusetts Institute of Technology, Cambridge

CAREER CHRONOLOGY

1. 1963–1970, engineer for flight control analysis, Martin Marietta, Denver, Colo.

2. 1970–1975, Manager, Titan IIIC inertial guidance system, Martin Marietta, Denver, Colo.
3. 1975–1980, Program Manager, Transtage Project, and Director of Space Systems, Martin Marietta, Denver, Colo.
4. 1980–1982, Vice President of Business Development, Martin Marietta Denver Aerospace, Denver, Colo.
5. 1982–1985, Vice President and General Manager, Aerospace Strategic and Launch Systems Division, Martin Marietta Denver Aerospace, Denver, Colo.
6. 1985–1993, President, Martin Marietta Denver Aerospace, Denver, Colo.
7. 1993–1995, President, Martin Marietta Space Group, Bethesda, Md.
8. 1995–1997, President and Chief Operating Officer, Lockheed Martin Information and Services Sector, Bethesda, Md.
9. 1997–1999, President and Chief Operating Officer, Lockheed Martin Corp., Bethesda, Md.
10. 2001–present, Undersecretary of the Air Force, Washington, D.C.

AWARDS AND HONORS

Sloan Fellow

1990 Honorary Doctor of Science Degree, University of Colorado

PROFESSIONAL MEMBERSHIPS AND ASSOCIATIONS

Fellow, American Institute of Aeronautics and Astronautics

Fellow, American Astronautical Society

National Academy of Engineering

ANSWERS TO POST-HEARING QUESTIONS

Responses by Peter B. Teets, Under Secretary of the Air Force and Department of Defense Executive Agent for Space

Test Launch Program

Q1. What is the status of the test launch program, the NPOESS Preparatory Project (NPP)? Will the key sensors that need to be tested be ready to meet the planned launch date in 2006? How are the sensor development, NPP launch, and NPOESS launch schedules related to one another? Does a delay in one part of this sequence automatically translate into a similar delay in the other schedules?

A1. The NPOESS Preparatory Project (NPP) is currently scheduled for launch in October 2006. To meet this date, the following; deliverables are required: from NASA—Launch vehicle; Satellite bus; Advanced Technology Microwave Sounder Sensor (ATMS). From NPOESS—Visible/Infrared Imaging Radiometer Sensor (VIIRS); Cross-track IR Sounder (CrIS); Ozone Mapping/Profiling Sensor (OMPS); Command, Control, Communications; Data Processing.

Delivery of the key sensors for NPP has been planned for early FY06, with 30 to 60 days of margin included against the NPP required delivery date. To create satellite integration and test margin, we plan to deliver the engineering development unit (EDU) sensors in the spring of 2005. Early delivery of the EDU sensors will allow the NPP contractor to perform mechanical and electrical integration much earlier than planned, greatly reducing risk. The flight sensors will then be installed for environmental test. The delivery of VIIRS, CrIS, OMPS, and ATMS for NPP will reduce both development and manufacturing risk, and demonstrate orbital performance. By doing this early for NPP, it should greatly reduce NPOESS risk.

The sensors are the pacing items for the NPP launch. If the NPP sensors slip past the required dates, this could slip the NPP launch. Such slips would increase NPOESS schedule risks; risk reduction efforts necessary to validate sensors that will be flown on the first operational NPOESS satellite could be impacted. NPP is intended to verify performance of the NPOESS ground and data processing systems. With an NPOESS ground readiness need date of February 2009, we have margin between the NPP launch and the NPOESS need date.

NPP is needed to maintain the climate continuity record between NASA's earth observing satellite Terra and NPOESS. With an expected end of life of Terra in 2006, a five-year NPP lifetime, and a requirement for overlap between NPP and NPOESS, there is very little margin for NPOESS slips. NPP slips hurt the environmental record continuity on the front end (Terra-to-NPP) but aid continuity on the back end (NPP-to-NPOESS).

BIOGRAPHY FOR DAVID A. POWNER

U.S. General Accounting Office (GAO); Director (Acting), Information Technology Management Issues

Dave is currently responsible for a large segment of GAO's information technology (IT) work, including systems development and IT investment management reviews. He recently returned to GAO after spending several years with Qwest Communications where he held several positions, including director of internal audit responsible for information technology and financial audits, and director of information technology responsible for Qwest's digital subscriber line (DSL) software development efforts. Previously at GAO he has worked at both the Denver and Washington D.C. offices where he led reviews of major IT modernization efforts at Cheyenne Mountain Air Force Station, the National Weather Service, and the Federal Aviation Administration. These reviews covered many information technology areas including software development maturity, information security, and enterprise architecture. Dave has an undergraduate degree from the University of Denver in Business Administration and is a graduate of the Senior Executive Fellows program at Harvard University's John F. Kennedy School of Government.

BIOGRAPHY FOR WES BUSH

Wes Bush was appointed President of Northrop Grumman Space Technology in January 2003. In this position, he holds complete general management responsibilities for the company's Space Technology business.

Prior to the acquisition of TRW by Northrop Grumman, Mr. Bush had served since 2001 as President and CEO for TRW Aeronautical Systems.

Mr. Bush joined TRW in 1987 as a systems engineer and has held a series of increasingly responsible roles. In 1996 he was named program manager of a defense satellite program for the Defense Systems Division, responsible for management of the satellite and ground segment developments, launch services, and operations and maintenance.

He became Vice President of TRW Space & Electronic's Planning & Business Development in 1998, where his duties included managing the organization's planning, resource management, and strategic development initiatives.

Beginning in 1999, Mr. Bush was Vice President and General Manager of the Telecommunication Programs Division. In this position he was responsible for managing the development and production of telecommunication systems and products with an emphasis on advanced satellite and terrestrial wireless communications.

From 2000 to 2001, he served as Vice President and General Manager of TRW Ventures, an organization focused on leveraging TRW's advanced technologies to create new business opportunities in commercial markets.

Prior to joining TRW, Mr. Bush held engineering positions with both the Aerospace Corporation and Comsat Labs.

He earned a Bachelor's degree and a master of science degree in electrical engineering from the Massachusetts Institute of Technology. He also is a graduate of UCLA's Executive Management Program.

Northrop Grumman Corporation is a $25 billion global defense enterprise, with worldwide headquarters in Los Angeles, Calif. Northrop Grumman provides technologically advanced, innovative products, services and solutions in defense electronics, systems integration, information technology, nuclear and non-nuclear shipbuilding, and space technology. With approximately 120,000 employees and operations in all 50 states and 25 countries, Northrop Grumman serves U.S. and international military, government and commercial customers.

Wes Bush
President

Space Technology
One Space Park
Redondo Beach, California 90278
Telephone 310-814-2837

Northrop Grumman Space & Mission Systems Corp.

NORTHROP GRUMMAN
Space Technology

July 11, 2003

The Honorable Vernon J. Ehlers
Chairman
Subcommittee on Environment, Technology, and Standards
House of Representatives
Committee on Science
Suite 2320 Rayburn House Office Building
Washington, DC 20515 - 6301

Dear Chairman Ehlers:

Thank you for your invitation to testify during a hearing conducted by the Environment, Technology, and Standards Subcommittee of the U.S. House of Representatives' Committee on Science entitled "NOAA Satellites: Will Weather Forecasting Be Put At Risk?" on Tuesday, July 15. As is required by the House rules, I submit the financial information below to disclose Northrop Grumman's sources and amounts of federal funding which directly support the subject matter on which I will be testifying. The table lists funds Northrop Grumman received during the current fiscal year and the two preceding fiscal years to perform work on the NPOESS program.

NPOESS FUNDING	FY 01	FY 02	FY 03	Total
DOC	2,650,000	75,456,000	110,359,941	188,465,941
DoD	10,397,632	22,804,000	226,162,414	259,364,046
Total	13,047,632	98,260,000	336,522,355	447,829,987

I look forward to seeing you at the hearing and discussing the important issues surrounding NOAA's satellite programs.

Sincerely,

Wes Bush

BIOGRAPHY FOR RONALD D. MCPHERSON

Ronald D. McPherson became the Executive Director of the American Meteorological Society (AMS) January, 1999. The AMS is a nonprofit scientific and professional organization with a membership of over 11,000, representing the university, governmental and private sectors of the atmospheric, oceanographic and related sciences.

Prior to that he served for nearly 40 years with the National Weather Service, ending his career with eight years as the Director of the National Centers for Environmental Prediction (NCEP). His responsibilities there included overall management of the nine centers comprising NCEP, including scientific and technical leadership, budget issues, personnel and policy.

Earlier, Dr. McPherson served as Deputy Director for the National Weather Service. The National Weather Service is responsible for providing weather and flood warnings and forecasts for the United States and its coastal and offshore waters. The Weather Service employs approximately 5,000 people in more than 300 locations throughout the United States and its territories.

Dr. McPherson has been extensively published in scientific journals including *Journal of Applied Meteorology, Monthly Weather Review* and *Bulletin of American Meteorological Society*.

He earned the Department of Commerce Silver Medal and the Presidential Rank Award as an outstanding executive. He was elected Fellow of the AMS in 1981.

Dr. McPherson holds a Bachelors degree in Meteorology, a Masters degree in Environmental Engineering and a Ph.D. in Atmospheric Sciences from the University of Texas at Austin.

The American Meteorological Society is the Nation's leading professional society for scientists in the atmospheric and related sciences. Founded in 1919, the Society promotes the development and dissemination of information on atmospheric, oceanic, and hydrologic sciences. The Society publishes nine well-respected scientific journals, sponsors scientific conferences and policy discussions, and supports public education programs across the country. Additional information on the AMS is available on the Internet at http://www.ametsoc.org/ams.

AMERICAN METEOROLOGICAL SOCIETY
HEADQUARTERS: 45 BEACON STREET, BOSTON, MASSACHUSETTS 02108-3693 U.S.A.
RONALD D. MCPHERSON, EXECUTIVE DIRECTOR
RICHARD E. HALLGREN, EXECUTIVE DIRECTOR EMERITUS
KENNETH C. SPENGLER, EXECUTIVE DIRECTOR EMERITUS

July 15, 2003

The Honorable Vernon J. Ehlers
Chairman
Environment, Technology
and Standards Subcommittee
Science Committee
U.S. House of Representatives
2319 Rayburn House Office Bldg.
Washington, D.C. 20515
Attn.: Elyse Stratton

Dear Chairman Ehlers,

I am writing in connection with the testimony I will be providing to the Environment, Technology and Standards Subcommittee of the House Science Committee on Tuesday, July 15 at a hearing entitled "NOAA Satellites: Will Weather Forecasting Be Put at Risk?" As per your request, and per the Rules of the House of Representatives, please consider this letter a statement of financial disclosure by myself, as well as on behalf of the American Meteorological Society, of which I am the Executive Director.

Please note that neither I nor the American Meteorological Society receives any federal funding which directly supports the subject matter on which I will be testifying before the Subcommittee at the July 15 hearing.

I hope and trust this letter will adequately serve the financial disclosure requirements of the Rules of the House of Representatives for those testifying before Congressional Committees. Of course, if you have any questions on this matter, please do not hesitate to contact me.

Finally, thank you for inviting me to testify before your Subcommittee on this most important subject.

Sincerely,

Ronald D. McPherson

Ronald D. McPherson
Executive Director

cc: Doug Stone
AMS Government Relations Representative