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GAO REPORT ON NOAA'S WEATHER SATELLITE PROGRAM

HEARING

BEFORE THE

COMMITTEE ON SCIENCE
HOUSE OF REPRESENTATIVES

ONE HUNDRED NINTH CONGRESS

SECOND SESSION

SEPTEMBER 29, 2006

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GAO REPORT ON NOAA'S WEATHER SATELLITE PROGRAM

FRIDAY, SEPTEMBER 29, 2006

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE,
Washington, DC.

The Committee met, pursuant to call, at 10:03 a.m., in Room 2318 of the Rayburn House Office Building, Hon. Sherwood L. Boehlert [Chairman of the Committee] presiding.

COMMITTEE ON SCIENCE
U.S. HOUSE OF REPRESENTATIVES

GAO Report on NOAA's Weather Satellite Program

September 29, 2006
10:00 a.m. to 12:00 p.m.

2318 Rayburn House Office Building

Witness List

Vice Admiral Conrad C. Lautenbacher, Jr. (Ret.)
Under Secretary of Commerce for Oceans and Atmosphere
National Oceanic and Atmospheric Administration

David A. Powner
Director, Information Technology Management Issues
Government Accountability Office

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HEARING CHARTER

COMMITTEE ON SCIENCE
U.S. HOUSE OF REPRESENTATIVES

GAO Report on NOAA's Weather Satellite Program

FRIDAY, SEPTEMBER 29, 2006
10:00 A.M.—12:00 P.M.
2318 RAYBURN HOUSE OFFICE BUILDING

Purpose

On September 29, 2006 at 10:00 a.m., the House Science Committee will hold a hearing about the status of a critical weather satellite program, the National Oceanic and Atmospheric Administration's (NOAA) Geostationary Operational Environmental Satellite (GOES) system. NOAA is beginning the process of purchasing the next generation of the GOES system, which has been designated GOES–R. Cost estimates for the system have escalated, and NOAA has already announced the elimination of one new sensor that was to be part of the satellite. The Government Accountability Office (GAO) recently completed a report about GOES–R, "Geostationary Operational Environmental Satellites: Steps Remain in Incorporating Lessons Learned from Other Satellite Programs." The GAO report will be officially released at the hearing. (An *embargoed* copy of the Executive Summary of the report is attached as Appendix I.)

Geostationary satellites maintain a fixed position above the Earth and provide a constant view of weather conditions. NOAA operates a two-satellite geostationary system to provide continuous and complete coverage of the continental Unites States. This system provides vital real-time data for NOAA's weather forecasting and warning operations.

Government satellite programs have a history of technical problems and major cost overruns. Most recently, NOAA and its government partners (the Department of Defense and the National Aeronautics and Space Administration) have experienced massive cost overruns on another weather satellite program, the National Polar-orbiting Operational Environmental Satellite System (NPOESS). In June, government officials testified to the Science Committee that the NPOESS program needs to be completely restructured, resulting in delays, higher costs, and more limited capabilities than were originally planned for the satellite.

The GOES–R program is at a much earlier stage than NPOESS is at this point. NOAA has nearly completed the preliminary design of GOES–R. The GOES–R satellite series is intended to maintain the continuity of weather forecasting data through 2028 and provide the first major technical advance in geostationary instrumentation since 1994. Original estimates for GOES–R placed the total cost at $6.2 billion, but as of May 2006 the program office estimated costs could be as high as $11.4 billion. In an effort to lessen these costs, NOAA is currently looking at options to reduce the scope and capabilities of GOES–R.

The GAO report, requested by the Committee, examines the status of the GOES–R program and reasons for the cost increases and problems to date, and identifies program management actions NOAA should take to ensure past problems with satellite programs are not repeated with GOES–R. GAO identified four major lessons from previous satellite programs and found that, while NOAA has some plans to address those lessons, actions remain for NOAA to fully implement the lessons and decrease the risk of future cost overruns and technical problems.

Witnesses:

Vice Admiral Conrad C. Lautenbacher (ret.), Administrator, National Oceanic and Atmospheric Administration

Mr. David Powner, Director of Information Technology Management Issues, U.S. Government Accountability Office

Background About GOES–R

The GOES–R satellites are designed to maintain a fixed position at high altitude above the Earth and provide a constant view of weather conditions in the United

States. They orbit at the same speed as the Earth rotates, and so appear to hover above a set position on the ground. They complement other weather satellites (polar-orbiting satellites) that circle the Earth at low altitude and provide global coverage of weather and climate conditions. NOAA has flown geostationary satellites since 1970.

GOES–R satellites are being built to carry instruments, or sensors, to measure a number of atmospheric features important to real-time detection and tracking of severe weather such as thunderstorms and hurricanes. GOES satellites are also important for NOAA's daily and hourly weather forecasts. Original plans for GOES–R included four satellites, each carrying five sensors, described in detail below. GOES–R will be the first major technical upgrade for NOAA's geostationary satellites since 1994. (New GOES satellites have been launched since 1994, but they have not been more advanced than their predecessors.)

Originally Planned GOES–R Sensors

Original plans for GOES–R, developed in 2003, included three sensors for weather forecasting and two for detecting solar flares that can interfere with communications and other electrical systems. The key sensors for weather data are the Advanced Baseline Imager (ABI) and the Hyperspectral Environmental Suite (HES). ABI will provide images of the Earth's surface, atmosphere and cloud cover that help track severe weather and support regular weather forecasts. ABI will provide higher resolution and faster coverage than the current capabilities. For example, current GOES satellites provide updated pictures every 25 minutes and ABI is to provide updated images every five minutes.

HES was supposed to provide significantly advanced "sounder" information compared to capabilities on current satellites. Sounders like HES provide three-dimensional vertical profiles of atmospheric temperature and humidity. These profiles are fundamental information for the computer models used to provide daily weather forecasts. Original GOES–R plans also called for HES to provide images of coastal waters to help scientists monitor events like harmful algal blooms or assist in fisheries management.

Earlier this month, NOAA decided HES was too complicated and the technology was not mature enough to include it on GOES–R. NOAA is currently examining other options to provide sounder capabilities on GOES–R.

The third weather forecasting sensor on GOES–R will be the Geostationary Lightning Mapper (GLM). In the past, the government has flown lightning mappers on polar-satellites for research purposes, but GOES–R will be the first time the U.S. flies a lightning mapper on a geostationary satellite for operational purposes. NOAA expects that the GLM will provide improved capabilities for tracking thunderstorms and severe weather events.

The other two sensors planned for GOES–R are the Space Environmental In-Situ Suite (SEISS) and the Solar Imaging Suite (SIS). Together these sensors will detect solar storms and track dangerous solar flares that come towards the Earth. NOAA forecasts and warns about solar storms because the storms can: cause damage to communication satellites, electric transmission lines and electric transformers; interfere in ground-based communications with airline pilots; be fatal to astronauts on space flights and in the International Space Station; and potentially harm airplane passengers flying polar routes.

GOES–R Management, Timeline, and Budget

GOES–R is the first time NOAA is taking on primary responsibility for managing the procurement of a major weather satellite. In the past, NOAA relied on NASA to procure and launch the GOES satellites. For GOES–R, NOAA is responsible for the overall satellite, while NASA will assist in procuring individual instruments.

NOAA expects the current GOES satellites to last at least until 2016. Current plans for GOES–R will launch the first satellite in 2014, leaving two years for calibrating the new satellite before it needs to be fully operational. This timeline is consistent with how NOAA typically schedules geostationary satellite launches and calibration.

NOAA began internal design of and planning for GOES–R in 2003. In October 2005, NOAA awarded three contracts for the preliminary design phase of GOES–R. During this phase of the program, the three private contractors develop detailed technical, schedule and cost plans for the overall GOES–R system based on the original design described above. The preliminary design phase ends in December 2006. Based on work performed during the preliminary design phase, NOAA will issue a Request for Proposals for system acquisition and operations and then will make a final decision on the prime contractor for GOES–R.

However, results thus far from the preliminary design phase indicate that NOAA underestimated the cost and technical complexity of the GOES–R satellites and sensors. The original cost for a series consisting of four satellites and five sensors was estimated at $6.2 billion. However, more recent and more detailed cost estimates indicate that costs would be close to $12 billion. Also, based on preliminary design work, NOAA decided earlier this month that HES was too complicated and the technology was not mature enough to include it on GOES–R. Given the rising cost estimates and technical challenges, NOAA is currently examining options for scaling back the GOES–R program. NOAA is looking at options that include building only two satellites, and removing HES and providing less advanced sounder capabilities.

Originally, NOAA planned to select the prime contractor by July 2007. The process of re-designing the satellite will delay that selection until May 2008.

In addition to selecting a prime contractor, NOAA will also issue contracts for the individual sensors on GOES–R. NOAA has already selected a contractor for building ABI and for SEISS, and expects to select the contractor for SIS in spring 2007. By starting work on key sensors now, NOAA hopes to allow plenty of time to mitigate any technical problems that may occur while developing the equipment.

Lessons Learned from Past Problems with Government Satellites

Government satellite programs have a history of technical problems and major cost overruns. GAO examined four major satellite procurement programs and identified key lessons learned from those procurements that it recommends NOAA apply to the GOES–R procurement.

Lesson #1: Establish Realistic Cost and Schedule Estimates

Many experts have found that satellite acquisition programs tend to produce unrealistically low cost and schedule estimates. Contractors have incentive to come in with low estimates to make their bids more competitive, and agencies have incentive to produce low estimates to make the programs appealing to budget reviewers and the Congress.

For GOES–R, NOAA has commissioned three costs estimates (one by GOES–R officials, one by NOAA's budget office, and one by an independent cost estimating group), but currently has no firm plans for how to reconcile the government and independent life-cycle cost estimates once the program requirements are completed. Thus, GAO recommends NOAA establish a formal process for objectively evaluating and reconciling the government and independent life cycle cost estimates for the program.

Lesson #2: Ensure Sufficient Technical Readiness of the System's Components Prior to Key Decisions

Satellite programs are technically complex and often experience problems as equipment is being built. To mitigate the technical risk, managers establish key decision points to make sure the technology meets certain requirements before moving on in the program. However, in past programs adequate requirements were not always established for key decision points. For example, for the most problematic sensor in the NPOESS program (VIIRS), a key decision point known as the critical design review proceeded with officials reviewing only a paper design for the sensor. Most experts agree that normally a critical design review should include building a model unit, not just reviewing designs on paper.

NOAA has performed preliminary studies of some of the GOES–R technologies but GAO recommends much more extensive reviews by technical experts before sensors go into production. In particular, GAO is concerned about the Advanced Baseline Imager (ABI). ABI is similar to VIIRS and is based on the same legacy NASA sensor (MODIS). ABI will cost $360 million and has already experienced technical problems that led to cost overruns of $6 million, so far. GAO projects those overruns could reach as high as $23 million if NOAA does not put in place more rigorous technical and management review milestones for ABI.

Lesson #3: Provide Sufficient Management at Government- and Contractor-Levels

Another problem systemic in satellite procurement is poor management. On the government side, this can mean inadequate expertise in systems engineering and project management, inappropriate contractor award fees, inadequate reserve funds, and lack of close oversight of the contractor.

For GOES–R, NOAA plans to increase the number of resident systems engineers and project management experts and to place government staff at each of the contractors' locations to more closely oversee day-to-day program management. Additionally, NOAA intends to structure the award fee process for GOES–R in a manner consistent with recommendations from a recent report by the Department of Commerce Inspector General and other experts.

The GAO report commends NOAA for the management action taken to date, but points out that, especially since GOES–R marks the first time NOAA is taking on a major satellite acquisition by itself, NOAA may need more technical experts than it currently plans to hire.

Lesson #4: Perform Adequate Senior Executive Oversight to Ensure Mission Success

Timely and informed decisions from senior officials are vital to successful satellite programs. GAO and others have stated that the lack of timely decisions by senior management in the NPOESS was a major factor in the large cost overruns and schedule delays for that program. With GOES–R, NOAA has established a council of high-level officials who meet monthly to review the program. GAO recommends that this council closely review the results of all preliminary studies and independent assessments of the program.

Witness Questions:

The witnesses were asked to address the following questions in their testimony.

Vice Admiral Conrad C. Lautenbacher (ret.), Administrator, National Oceanic and Atmospheric Administration

1. What new processes for satellite procurement has NOAA implemented as a result of lessons learned from previous programs, such as the National Polar-orbiting Operational Environmental Satellite System?
2. Do you agree with the following recommendations from the Government Accountability Office (GAO)'s report, *"Geostationary Operational Environmental Satellites: Steps Remain in Incorporating Lessons Learned from Other Satellite Programs?"*
   a. Develop a process to evaluate and reconcile the independent and program cost estimates once final program decisions are made.
   b. Develop a process to validate the level of technical maturity and contractor management procedures achieved on the Advanced Baseline Imager prior to critical design reviews.
   c. Determine the appropriate level of resources needed to adequately track and oversee the GOES–R program.
   d. Ensure that the NOAA Program Management Council reviews all preliminary studies and independent assessments on technical maturity of the system and its components so that an informed decision can be made about the level of technical complexity it is taking on when proceeding past key decision milestones.
3. What specific steps have you taken and will you take to address each of GAO's recommendations listed in question two?

Mr. David Powner, Director of Information Technology Management Issues, Government Accountability Office

1. Please outline the major findings and recommendations of your report, *"Geostationary Operational Environmental Satellites: Steps Remain in Incorporating Lessons Learned from Other Satellite Programs."*
2. Given its current schedule and procedures, what are the greatest risks facing the GOES–R program as it moves ahead?
3. What information should Congress and the public have to ensure the GOES–R program remains on track?

Appendix I: Executive Summary from GAO Report

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Highlights

Highlights of GAO-06-993, a report to the Subcommittee on Environment, Technology, and Standards, Committee on Science, House of Representatives

Why GAO Did This Study

The National Oceanic and Atmospheric Administration (NOAA) plans to procure the next generation of geostationary operational environmental satellites, called the Geostationary Operational Environmental Satellites-R series (GOES-R). This new series is considered critical to the United States' ability to maintain the continuity of data required for weather forecasting through the year 2028. GAO was asked to (1) determine the status of and plans for the GOES-R series procurement, and (2) identify and evaluate the actions that the program management team is taking to ensure that past problems experienced in procuring other satellite programs are not repeated.

What GAO Recommends

We are making recommendations to the Secretary of Commerce to direct its NOAA Program Management Council to establish a process for reconciling the government and independent cost estimates; perform a comprehensive review of a key instrument prior to moving it into production; and to evaluate the appropriate levels of resources needed at the program office to oversee the contractor's performance in meeting cost and schedule targets. In written comments, the Department of Commerce agreed with the recommendations and identified plans for implementing them.

www.gao.gov/cgi-bin/getrpt?GAO-06-993.

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

September 2006

GEOSTATIONARY OPERATIONAL ENVIRONMENTAL SATELLITES

Steps Remain in Incorporating Lessons Learned from Other Satellite Programs

What GAO Found

NOAA is nearing the end of the preliminary design phase of its GOES-R system—which was estimated to cost $6.2 billion and scheduled to have the first satellite ready for launch in 2012. It expects to award a contract in August 2007 to develop this system. However, according to program officials, NOAA's plans for the GOES-R procurement could change in the near future. Recent analyses of the GOES-R program cost— which in May 2006 the program office estimated could reach $11.4 billion—have led the agency to consider reducing the scope of requirements for the satellite series. NOAA officials estimated that a decision on the future scope and direction of the program could be made by the end of September 2006.

NOAA has taken steps to implement lessons learned from past satellite programs, but more remains to be done. Prior satellite programs—including a prior GOES series, a polar-orbiting environmental satellite series, and various military satellite programs—often experienced technical challenges, cost overruns, and schedule delays. Key lessons from these programs include the need to (1) establish realistic cost and schedule estimates, (2) ensure sufficient technical readiness of the system's components prior to key decisions, (3) provide sufficient management at government and contractor levels, and (4) perform adequate senior executive oversight to ensure mission success. NOAA has established plans to address these lessons by conducting independent cost estimates, performing preliminary studies of key technologies, placing resident government offices at key contractor locations, and establishing a senior executive oversight committee. However, many steps remain to fully address these lessons (see table). Until it completes these activities, NOAA faces an increased risk that the GOES-R program will repeat the increased cost, schedule delays, and performance shortfalls that have plagued past procurements.

Key Lessons Learned and the Activities Taken or Remaining to Fully Address Them

Lesson learned	Actions taken or under way	Actions remaining
Establish realistic cost and schedule estimates	• Obtaining multiple independent cost estimates • Conducting risk analysis of schedule estimates	• Ensuring objectivity when reconciling alternative estimates
Ensure sufficient technical readiness of the system's components prior to critical decisions	• Conducted preliminary studies of key technologies and components	• Ensuring sufficient technical maturity before proceeding to production
Provide sufficient management of contractors and subcontractors	• Increased presence at contractor sites • Plan to increase number of system engineers • Plan to hire three specialists in earned value	• Assessing the number of earned value specialists needed commensurate with increased acquisition activities
Perform effective executive-level oversight	• NOAA's program management council meets regularly to oversee project	

Source: GAO analysis.

United States Government Accountability Office

Chairman BOEHLERT. The hearing will come to order. Just let me outline what we expect this morning. We will probably just get through a couple of opening statements, mine and Mr. Gordon's, and then the bells will ring. So it is going to be a hectic morning, and Admiral and Mr. Powner, you understand how this place operates, and this is the getaway day. It may be 30 hours in length, but in any event it is going to be a rather hectic day, so with your indulgence we will try to proceed in an orderly manner. The Speaker doesn't really accede to our wishes all the time, and we would go forward without any interruption.

This may well be the last hearing for me as Chairman, and for the Committee in this session because we are due to complete our business today and then go off back to the districts and then come back for what is affectionately referred to as a lame duck session, and so we are unlikely to have hearings then. But I want to take the privilege of the Chair at the last hearing to thank our very capable professional staff led by the Chief of Staff, Mr. David Goldston, and Mr. Chuck Atkins, the Chief of Staff for the minority. These guys and their entire team have been absolutely magnificent.

And I think, Admiral, you would have to acknowledge that while they are persistent in their probing but they are just so professional in their daily conduct, and I think all of us owe them a debt of gratitude. And then I am sorry that it is so hectic because usually we have a full complement here, but we don't today because everybody is scattered to the wind and doing a lot of last minute things before departing the Nation's Capitol. But I want to say to Mr. Gordon, I could not have had a better partner in this endeavor, and I think this Science Committee has done itself proud. And I am fond of saying, and many of you have heard me say this, that when legislation is reported out of this committee, and significant legislations has year after year, I take pride in saying the fingerprints of just about everybody is all over the legislation.

We listen to our Democrat colleagues. We don't always agree but we always listen and we always have a dialogue, and so I couldn't be prouder than I am as I begin to take leave from this institution of their performance of all Members of this committee, Republican and Democrat alike. Mr. Gordon, I thank you.

Mr. GORDON. Mr. Chairman, if you would, just allow me just a moment. As usual, I often times concur with your remarks, and I once again concur with them today, but also to let you know that there was a rumor that this meeting called on the last day of our session was potentially an attempt to continue the goodbye tour for additional accolades, and I am sure this goodbye tour is not going to be over with any time soon but you will be less staffed.

And so what I wanted to do, I am glad that Mary Ann is here today because I know she is going to be staffing the Sherry's goodbye tour, and this is for the road staff. So if you would take that over to Mary Ann, we would appreciate that.

Chairman BOEHLERT. Thank you very much, and thank you for acknowledging my bride who is, I tell everyone, my biggest booster and most constructive critic. Ladies and gentlemen, let me proudly present the First Lady of the Science Committee. Mary Ann, you are being introduced. Thank you very much. With that, let us get

right on to the business as is the usual in this committee. I want to welcome everyone here for what may very well be the final hearing of my tenure, and we picked a vital and future-looking subject for this hearing, the procurement of the next generation of weather satellites known as GOES–R.

As I think everyone knows, our past hearings on weather satellites have not been very happy occasions for everybody. The polar satellite program, NPOESS, was entirely to use a description of one of my grandsons, out of whack, over budget, behind schedule, losing capability, and, quite honestly, we have to concede grossly mismanagement, and there is shared blame all the way around. One reason the NPOESS program got that way was inadequate oversight, and that includes inadequate oversight by the leadership at the National Oceanic and Atmospheric Administration, and inadequate oversight by those of us who have the responsibility in the Congress.

In the case of NPOESS, we are now getting monthly updates from NOAA, and I hope the Committee will have periodic hearings to keep the NPOESS procurement process transparent, the public informed, and the agency and its contractors on its toes. And now early on in the procurement process, we are going to inaugurate that same open continued oversight approach for GOES–R. This should be the first of many hearings on this critical weather satellite program. The GOES–R hearings ought to go better than NPOESS hearings have so far. I am happy to say that it now appears that NOAA has indeed been learning from past mistakes, and I want to compliment Admiral Lautenbacher for that, his openness, his willingness to interact with us, his providing of vital information so that we can assess it in a timely fashion.

With GOES–R, NOAA is trying to evaluate its technology assumptions early and trying not to overreach. NOAA has put together stellar independent cost review teams and what looks like an appropriate senior management team. Once again, congratulations. Neither of these steps was taken in the case of NPOESS, and NOAA is taking action now for GOES–R precisely to avoid repeating past mistakes and that is reassuring. At the same time, there are some red flags already for us. The budget estimates for GOES–R are already close to doubling. Now this is very early in the process exactly when NOAA can make design changes to control costs in the end but still it is not comforting that the estimates were so far off so early.

Also, NOAA is already dropping an advanced sensor. Again, this in many ways might be a good thing. Untried, problematic technology shouldn't be used on operational satellites but it means that GOES–R may represent much less of a technical advance than had been hoped. So one of our tasks today is to get a clear fix on the current status of GOES–R, its cost and capabilities, with the understanding that this information will continue to change. But our most important task is to set up a system of congressional oversight. That is our responsibility, and, quite frankly, we have not measured up to the task in the past with respect to NPOESS, and we must concede that.

We have got to make sure that NOAA has set up a system of internal oversight to prevent future problems. The very helpful Gov-

ernment Accountability Office study that is being released today should guide NOAA and this committee as we insure that NOAA has taken all the steps necessary to increase the chances of success, and as we determine what information Congress and the public need as the project moves ahead. The data from weather satellites have become features of our every day lives and they help protect life and property, but we need to be sure that we are getting the best satellite feasible for the lowest possible cost. That is our responsibility. That requires constant vigilance and today we start that oversight. Mr. Gordon.

[The prepared statement of Chairman Boehlert follows:]

PREPARED STATEMENT OF CHAIRMAN SHERWOOD L. BOEHLERT

I want to welcome everyone here for what may very well be the final hearing of my tenure. And we picked a vital and future-looking subject for this hearing—the procurement of the next generation of weather satellites, known as GOES–R.

As I think everyone knows, our past hearings on weather satellites have not been very happy occasions for anybody. The polar satellite program, NPOESS, was entirely out of whack—over budget, behind schedule, losing capability and grossly mismanaged.

One reason the NPOESS program got that way was inadequate oversight—and that includes inadequate oversight by the leadership at the National Oceanic and Atmospheric Administration (NOAA) and inadequate oversight by us. We are asking NOAA to learn from its mistakes, and we're going to try to do the same.

In the case of NPOESS, we are now getting monthly updates from NOAA, and I hope the Committee will have periodic hearings to keep the NPOESS procurement process transparent, the public informed and the agency and its contractors on their toes. And now, early on in the procurement process, we are going to inaugurate that same open, continual oversight approach for GOES–R. This should be the first of many hearings on this critical weather satellite program.

The GOES–R hearings ought to go better than NPOESS hearings have so far. I am happy to say that it appears that NOAA has indeed been learning from its mistakes, and I want to compliment Admiral Lautenbacher for that.

With GOES–R, NOAA is trying to evaluate its technology assumptions early and not overreach. NOAA has put together stellar independent cost review teams and what looks like an appropriate senior management team. Neither of these steps was taken in the case of NPOESS, and NOAA is taking action now for GOES–R precisely to avoid repeating past mistakes. That's reassuring.

At the same time, there are some red flags already for us. The budget estimates for GOES–R are already close to doubling. Now, this is very early in the process—exactly when NOAA can make design changes to control costs in the end. But still, it's not comforting that the estimates were so far off so early. Also, NOAA is already dropping an advanced sensor. Again, this is in many ways a good thing—untried, problematic technology shouldn't be used on operational satellites. But it means that GOES–R may represent much less of a technological advance than had been hoped.

So one of our tasks today is to get a clear fix on the current status of GOES–R—its costs and capabilities—with the understanding that that information will continue to change. But our more important task is to set up a system of Congressional oversight and to make sure that NOAA has set up a system of internal oversight to prevent future problems.

The very helpful Government Accountability Office (GAO) study that is being released at today's hearing should guide NOAA and this committee as we ensure that NOAA has taken all the steps necessary to increase the chances of success, and as we determine what information Congress and the public need as the project moves ahead.

The data from weather satellites have become features of our everyday lives, and they help protect life and property. But we need to be sure that we are getting the best satellites feasible for the lowest cost possible. That requires constant vigilance, and today we start that oversight.

Mr. Gordon.

Mr. GORDON. Thank you, Mr. Chairman. As usual, you have well set forth that this morning's hearing is to hear testimony on

NOAA's plans to require the next series of Geostationary Environmental Satellites, a series known as GOES–R. The satellite pictures are a familiar site to anyone viewing a weather forecast. These satellites are essential to monitoring the development of severe storms. Whenever a hurricane is threatening our coastal areas it is the GOES image that we see the eye and the rotating clouds of the storm. We simply must insure continuity of this satellite information to maintain our ability to accurately forecast this weather.

We are still at a very early stage of this program. We have an opportunity to take steps to avoid problems with this acquisition such as the problems you put forth and that we experienced with the polar satellite procurement or NPOESS. We simply cannot afford to repeat the mistakes of the polar program. The Administration has taken initial steps to obtain realistic cost estimates and to determine the degree of technical difficulty associated with the planned sensors for this system. The Administration has also taken steps to hire technical experts and to establish an executive oversight committee for this program.

I commend you, Admiral Lautenbacher, for these actions. However, Mr. Powner of the Government Accountability Office will testify this morning additional steps must be taken to limit risk of cost and schedule overruns. We expect to see a realistic cost assessment for this program before the system contract is awarded. We expect a realistic assessment of the technical challenges associated with the development of the sensors and adequate reserves to be able—or be put aside to deal with the problems that will inevitably arise.

Finally, we expect the Executive Committee overseeing this program to pay attention to its development and to act decisively and expeditiously when problems are identified. Again, I would like to thank Mr. Powner and members of the GAO team for his fine work and assistance to the Committee in our oversight of NOAA's satellite programs. The Committee will continue to watch the development of this program closely over the next few years. I hope we can work cooperatively to achieve our common goal of delivering important and improved weather forecasting information. Thank you.

[The prepared statement of Mr. Gordon follows:]

PREPARED STATEMENT OF REPRESENTATIVE BART GORDON

We are here this morning to hear testimony on NOAA's plans to acquire the next series of geostationary environmental satellites—the series known as GOES–R.

The GOES satellite pictures are a familiar sight to anyone viewing a weather forecast. These satellites are essential to monitoring the development of severe storms. Whenever a hurricane is threatening our coastal areas, it is the GOES images that we see of the eye and the rotating clouds of the storm.

We simply must ensure continuity of this satellite information to maintain our ability to accurately forecast the weather.

We are still at a very early stage of this program. We have an opportunity to take steps to avoid problems with this acquisition such as the problems we are experiencing with the polar satellite procurement—NPOESS. We simply cannot afford to repeat the mistakes of the polar program.

The Administration has taken initial steps to obtain realistic cost estimates and to determine the degree of technical difficulty associated with the planned sensors for this system. The Administration has also taken steps to hire technical experts and to establish an executive oversight committee for this program.

I commend you, Admiral Lautenbacher, for these actions.

However, as David Powner of the Government Accountability Office will testify this morning, additional steps must be taken to limit risks of cost and schedule overruns.

We expect to see a realistic cost estimate for this program before a system contract is awarded. We expect a realistic assessment of the technical challenges associated with the development of the sensors and adequate reserves to be put aside to deal with the problems that will inevitably arise.

Finally, we expect the Executive Committee overseeing this program to pay attention to its development and to act decisively and expeditiously when problems are identified.

I would like to thank David Powner and the member of his GAO team for their fine work and assistance to the Committee in our oversight of NOAA's satellite programs. The Committee will continue to watch the development of this program closely over the next few years. I hope we can work cooperatively to achieve our common goal of delivering improved weather forecasting to the Nation.

Chairman BOEHLERT. Now for the distinguished Chairman of the Subcommittee, Dr. Ehlers.

Mr. EHLERS. Thank you, Mr. Chairman. I am very pleased that the Committee is holding this hearing today on another of the Nation's critical weather satellite programs, the next generation of the National Oceanic and Atmospheric Administration's Geostationary Operational Environmental Satellite, known as GOES–R. But first, Mr. Chairman, on this occasion of your presumably last hearing as Chair, I want to thank you from the bottom of my heart for the incomparable leadership you have given this committee. Your unwavering support for science and technology has warmed the cockles of my scientific heart, and with your easy manner and open-minded approach to every issue you tackle, you have served this committee, this Congress, and the American people well, and I thank you for it.

The fact that the last hearing of Chairman Boehlert's tenure is on this satellite program should help us focus our attention on the importance of GOES–R, and how seriously we need to take our role in ensuring its success. NOAA has operated geostationary weather satellites since the 1970s. It is not hyperbole to say that these satellites save lives, many lives. They help the National Weather Service to better understand and monitor severe weather events such as tornadoes and hurricanes and of course the resultant floods, and they are critical to the timely delivery of the alerts and warnings that lead people to safety before disaster strikes.

I am frequently reminded of my childhood in Minnesota where we had the storms, we called them cyclones at that time, but the tornadoes, the storms, came up unexpectedly. The only warning was to look at the sky and see what was happening. We had a number of lives lost in the communities I have lived in simply because there was no warning system. People had to use their own eyes and ears and often could not reach shelter in time. Today, we don't have. The ongoing problems with other satellite programs have made it clear that we in Congress must take our oversight responsibilities seriously. Failure to do so can cost our communities dearly. Therefore, I look forward to hearing what the Government Accountability Office will tell us about the state of GOES–R and how NOAA is applying lessons to learn from past satellite programs.

I also look forward to hearing from NOAA about what they see as the biggest challenges to the success of GOES–R, and, most importantly, how they will address these challenges. I am particularly

concerned about how NOAA will move the program forward in light of the recent cancellation of HES, the Hyperspectral Environmental Suite. The way NOAA fills the gap left by this instrument will affect how our nation observes and forecasts weather for the next two decades, so it is critical that we get this right.

I believe that NOAA is earnest. They are trying to get this program right and I applaud their efforts. However, good intentions are not enough. We all have to work on this together. I expect this hearing to be the beginning of an ongoing dialogue with NOAA, the GAO, and our committee as we all work together as one to ensure the success of this important program. I thank out witnesses for being here. I would love to stay. Unfortunately, I have to go and dedicate the new botanic garden with Ms. Bush, but I will return as soon as I can, and perhaps I could even persuade to come along and enjoy the rest of the hearing with us.

[The prepared statement of Mr. Ehlers follows:]

PREPARED STATEMENT OF REPRESENTATIVE VERNON J. EHLERS

Thank you Chairman Boehlert. I am pleased the Committee is holding this hearing today on another of this nation's critical weather satellite programs: the next generation of the National Oceanic and Atmospheric Administration's Geostationary Operational Environmental Satellite, known as GOES–R.

But first, on the occasion of his last hearing as Chair, I thank my friend, Sherry Boehlert, for his incomparable leadership of our committee. His unwavering support for science and technology, along with his easy manner and open-minded approach to every issue he tackles, has served this committee, this Congress, and the American people well.

The fact that the last hearing of Chairman Boehlert's tenure is on this satellite program should help focus our attention on the importance of GOES–R, and how seriously we need to take our role in ensuring its success. NOAA has operated geostationary weather satellites since the 1970's. It is not hyperbole to say these satellites save lives—they help the National Weather Service to better understand and monitor severe weather events such as tornadoes and hurricanes and are critical to the timely delivery of the alerts and warnings that lead people to safety before disaster strikes.

The ongoing problems with other satellite programs have made it clear that we in Congress must take our oversight responsibilities seriously—failure to do so can cost our communities dearly. Therefore, I look forward to hearing what the Government Accountability Office will tell us today about the state of GOES–R, and how NOAA is applying lessons learned from past satellite programs. I also look forward to hearing from NOAA about what they see as the biggest challenges to the success of GOES–R, and—most importantly—how they will address those challenges. I am particularly concerned about how NOAA will move the program forward in light of the recent cancellation of HES, the Hyperspectral Environmental Suite. The way NOAA fills the gap left by this instrument will affect how our nation observes and forecasts weather for the next two decades, so it is critical that we get this right.

I believe that NOAA is earnest—they are trying to get this program right and I applaud their efforts so far. However, good intentions are not enough. I expect this hearing to be the beginning of an ongoing dialogue between NOAA, the GAO, and our committee as we all work to ensure the success of this important program.

I thank our excellent witnesses for being here, and I yield back the balance of my time.

Chairman BOEHLERT. Dr. Ehlers, don't go too far. We are advised that in five to seven minutes a vote will start on the Floor, so we are going to get right to the opening statements. Before doing so, I want to acknowledge something that is going to happen. The Nation has been well served by a very distinguished government employee, Max Mayfield, who at the end of this year has announced his intention to retire. He is the Director of the National Hurricane Center in Miami, one of the true stars in the otherwise sorry saga

of Hurricane Katrina. Just an absolutely able, committed, professional public servant. And, Admiral Lautenbacher, you know how good he is. And very dependent on weather satellites.

And my wife reports to me, and she knows, that he is also a matinee idol because all over America during Hurricane Katrina the TV sets were on and people were glued to it, and the most credible information came from this dedicated and able guy, and we thank him. With that, Admiral, you are up.

[The prepared statement of Mr. Wu follows:]

PREPARED STATEMENT OF REPRESENTATIVE DAVID WU

Thank you, Mr. Chairman, for calling this hearing today.

The GOES program has provided us with vital weather forecasting information for the past four decades. The last significant technological improvements to GOES were adopted in 1994. It is reasonable to expect that we could consider expanding our capabilities for an expected launch of the GOES–R series in 2012.

We all realize that increased capabilities come at a price—in the case of satellite systems at a significant price. I am in agreement with Ranking Member Gordon that we must have realistic cost estimates and technology assessments of any upgraded sensor capabilities so that we can make an informed judgment about how much technological improvement we need and can afford. Expanded technological capabilities require not only improvements to satellite instrumentation, but expanded ground systems and data management and analytical capabilities to get full value for our money.

In all of these considerations, continuity of service must be the top priority.

I encourage you, Admiral Lautenbacher, to heed the recommendations included in the GAO report we are releasing today. I also encourage you to maintain open, frank communication with this committee as the program moves forward.

Mr. Powner, I would also like to express my thanks to you and your team for this report and for the other fine work you have done for us on NOAA's satellite programs.

I thank the witnesses for appearing before us today and I look forward to your testimony.

[The prepared statement of Mr. Costello follows:]

PREPARED STATEMENT OF REPRESENTATIVE JERRY F. COSTELLO

Good morning. I want to thank the witnesses for appearing before our committee to discuss the National Oceanic and Atmospheric Administration (NOAA)'s next generation Geostationary Operational Environmental Satellite Program, known as GOES–R.

Since the 1960s, NOAA has operated geostationary satellites that provide images and data on atmospheric, oceanic, and climatic conditions over the continental United States and Hawaii. These satellites are best known for creating the hurricane pictures you see on television and the data to help forecast the weather. Providing our communities with accurate and timely information to predict and track weather and natural disasters is critical to our economic security and national safety.

This past summer, my congressional district suffered from severe thunderstorms and rain, causing damage and destruction throughout our communities. I know how beneficial weather forecasts and warnings to help communities prepare for a natural disaster. However, these predictions are not perfect and there are instances when the scale and magnitude of some storms are not accurate. I am pleased NOAA continues to take steps to implement lessons learned from past satellite programs, and acknowledges that more remains to be done.

Today's hearing focuses on NOAA's plan for the GOES–R program to replace the current series of satellites before they reach the end of their usefulness by approximately 2012. Chairman Boehlert and Ranking Member Gordon requested the Government Accountability Office (GAO) to determine the status of and plans for the GOES–R series procurement and identify and evaluate the actions that the program management team is taking to ensure that past problems experienced in procuring other satellite programs are not repeated.

I look forward to hearing from GAO on its findings and recommendations to the Secretary of Commerce. Thank you Mr. Chairman.

STATEMENT OF VICE ADMIRAL CONRAD C. LAUTENBACHER, JR. (RET.), UNDER SECRETARY OF COMMERCE FOR OCEANS AND ATMOSPHERE, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Admiral LAUTENBACHER. Thank you very much. Chairman Boehlert, Ranking Member Gordon, distinguished Members of the Committee and staff, I appreciate the opportunity to engage in a discussion of GOES–R and to report on our progress. Before I start talking about the satellite programs, allow me to express my appreciation to the Chairman for his leadership and his conduct of hearings and oversight of NOAA in the past during his tenure. We have gone through the tenure together. At the time that I started was about the time when I started with CORE. Chairman Boehlert was coming on line. I appreciate the truly bipartisan nature of the hearings and the interest in our programs, and I appreciate your leadership. On behalf of all of NOAA, we thank you for your interest in our programs and their value to the country.

I also want to thank Chairman Ehlers before he goes to the botanical gardens. His personal leadership allowed the passing of a NOAA Organic Act on the House floor, truly a historic occasion. Congressmen have been trying for years to do that, and we thank you. As the Committee knows if there is any one piece of legislation that I believe would help us to manage better and to release and unleash the power of the NOAA concept is an Organic Act agreed to by Congress. So thank you very much. We appreciate your leadership. You have been a great inspiration to those of us in the agency.

Because of the bipartisan nature and because I really believe this, I want to thank Congressman Gordon and Congressman Wu as well for the partnership because if you didn't care about these programs they wouldn't get any air time at all, so I am very pleased to be here with you and to discuss these and have the future laid out and work on the best solution for the country, so thank you.

As mentioned in the opening statements, the Committee is familiar with the NPOESS program. We have had several hearings on it. This is a discussion on the next generation Geostationary Operational Environmental Satellite Program. It is called GOES–R. We name them by letters as they—before they are launched, and when they are launched and successful they become numbers so if you hear the numbers when they are in orbit they become numbers. These satellites, remember, are geo positioned. They are 23,000 miles above the equator. We have two of them that are constantly looking at the Atlantic and the Pacific, and they do give you these spectacular pictures that you see of hurricanes. They also help us to provide information for forecasts and warnings for severe weather, as mentioned, such as thunderstorms and beginning of the fronts that can create tornadoes and that sort of thing.

Now we are in the early stages of the acquisition process for the next generation of GOES satellites called GOES–R. So we are about five years ahead of where we were on NPOESS, and this is the opportunity that we have to have this discussion at this point to define the system to make sure it is the best possible system technologically for the cost and the money that the Nation is will-

ing to pay for it so I appreciate this opportunity. We have made significant changes to our GOES–R program management, as I hope to demonstrate as I go through here. Because of the direction from this committee, the reviews from the GAO, and the DOC inspector general, the reason recent Nunn-McCurdy certification process and our own internal reviews.

We have made those changes not because of today's hearing necessarily but because we believe they are right, and we have been doing them for the past several years as the lessons have been coming out. We have been modifying our approach to GOES–R and trying to incorporate in a very timely manner the right way, the best way, to manage these programs for the future. Should I stop? Go ahead? All right.

Chairman BOEHLERT. Go right ahead.

Admiral LAUTENBACHER. There are bells ringing, and just to make sure. Some of the changes that we have made include the creation of a NOAA program management council. This is something that NOAA has not had before. This is to back stop our normal chain of command process, which I am sure you are aware of, but this is a senior management council. It is made up of our senior NOAA personnel, the leaders that are responsible for cost, schedule and performance technically budgetarily and administratively. It also includes NASA experts who meet. They come, we meet—have this council meet monthly to review this program. We have also created a group of users of satellite data, a broad-based group, which developed the initial recommendation for the requirements and they also meet regularly to assess the preliminary design.

My deputy and I meet regularly to discuss the recommendations from these two groups, and we make decisions based on these recommendations. We provide the Department of Commerce with quarterly briefings on the program, and I brief the Deputy Secretary and the Secretary of Commerce as needed. In fact, there is a schedule to brief them very shortly on the current status. We are using the full capabilities and processes at NASA for the development of the GOES–R system, including their independent technical and engineering reviews, and also NASA will manage the sensor contracts. We have hired teams of independent satellite experts and independent cost estimators to provide periodic reviews and address the concerns raised by NOAA senior leadership.

We have also hired a highly competent and respected former NASA program manager for the GOES–R program. The program office is increasing staff to support robust systems engineering and oversight of the contractors, which will include on site representatives at the contractor and major subcontractors. Presently, we have three contractor teams developing preliminary designs and identifying program risks. When they are finished, NOAA and the Department of Commerce will decide on a system design and award a contract. Our three contractor teams and our independent review team have provided feedback on preliminary design concepts, and they are three in nature.

First of all, to realize and actually build this concept that we had been working on for GOES–R would be much more expensive and much riskier than we had first thought. Number two, one of the

proposed sensors of the five that are on this—projected to be on this satellite, the HES or Hyperspectral Environmental Suite, is not technically mature enough that would impact the spacecraft, the ground systems, and it would jeopardize a launch in 2014, which is the right time to launch for continued continuity. And, third of all, based on our conversations with GAO and our continued internal review, we can make further improvements in the way the acquisition will be managed, and we are doing so.

We are revising our plans to insure we have a program that maintains data continuity, allows for technical advances, and is affordable. Regarding the cost, preliminary cost estimates, and there were rough cost estimates that were created before we had full requirements in line, increased from a number of roughly $6.2 billion to a potential of $11.4 billion, learned from these studies that the contractors are doing for us. Most of this increase in required budget was because we revised inflation assumptions in our cost models. Cost models at inflation which was well out of date, that is about $2.6 billion of the increase as inflation changes. The revised estimate also would provide for $800 million for increased management reserves based on expert recommendations and lessons learned from NPOESS.

In addition, the cost of the spacecraft ground system and sensors from the technological complexity increased by about $1.5 billion. That was the rough orders of magnitude of the issues that we are tacking at this point. In response to those increased cost estimates, the program office assembled a team of experts to develop multiple program options to reduce cost and risk and to look at a optimal solution. The team provided information to the program management council and the user group, which examined the option and provided me with recommendations. We are still in that process but to date the following items have been accomplished.

While the Hyperspectral Environmental Sensor potentially could have provided a major improvement in our ability to characterize the atmosphere and the coastal environment we have decided not to award a contract to build the HES sensor at this time for this satellite. It does not mean we are giving up on HES. It means we are deferring it and trying to build the proper technological base before it can be instituted and put on an operational satellite.

[The prepared statement of Admiral Lautenbacher follows:]

PREPARED STATEMENT OF VICE ADMIRAL CONRAD C. LAUTENBACHER, JR.

Introduction

Chairman Boehlert, Ranking Member Gordon, and Members of the Committee, I am Conrad C. Lautenbacher, Under Secretary for Oceans and Atmosphere at the Department of Commerce (DOC) and head of the National Oceanic and Atmospheric Administration (NOAA).

Before I talk about satellites, I would like to thank Chairman Boehlert for his thoughtful leadership and friendship over the past several years. I truly appreciate the bipartisan manner in which you conduct the Science Committee and your strong support for NOAA. You and your staff have been good to work with—always thorough and fair. We will miss your leadership and wish you the best in retirement. I also want to thank Chairman Ehlers who, although he is not retiring, will no longer be our Subcommittee Chairman in the next Congress. Chairman Ehlers has invested a considerable amount of time and effort into learning our issues and become quite an expert on our agency. I personally appreciate your leadership and efforts to pass a NOAA Organic Act. By passing the Organic Act on the House Floor last week, you accomplished something many Members had tried and failed to do

over the last 20 years. It was a testament to your dedication and your abilities, and I thank you.

What are geostationary satellites?

While the Committee is familiar with NOAA's next generation polar-orbiting environmental satellite program (NPOESS), I am here to discuss NOAA's next generation Geostationary Operational Environmental Satellite Program, known as GOES–R. NOAA has operated geostationary satellites since the 1970s. These satellites—located more than 22,000 miles above the equator—provide images and data on atmospheric, oceanic, and climatic conditions over the continental United States and Hawaii. These satellites are best known for creating the hurricane pictures you see on television, but they also provide data to help forecast the weather and provide warnings for severe weather such as thunderstorms. We operate two geostationary satellites, one over the east coast and the other over the west coast. To protect against a loss of satellite coverage, we maintain a spare satellite on-orbit that can be repositioned to take the place of a failed satellite.

What is GOES–R?

The final two GOES satellites in the current GOES–N series have been built. We are in the early stages of the acquisition process for the next generation of GOES satellites, called GOES–R. Given the long lead time needed for satellite development, acquisition work is required now to ensure continuity of satellite coverage.

At first, we envisioned GOES–R as a satellite series that would contain significant technological advancements. We looked at ways to expand the use of GOES data for other NOAA missions, such as ocean and coastal observations that support fisheries management and marine research. The 2003 preliminary system design concept was for a combination of the five sensors to be flown on as many as eight satellites. The preliminary cost estimate of $6.2 billion identified in the GAO report was developed in 2004 and presented in the FY 2006 President's Budget. This figure has been revised over time as the program has moved forward.

The five sensors included an advanced imager, a hyperspectral suite, two solar weather sensors, and a lightning mapper. The Advanced Baseline Imager (or A–B–I) is the main sensor which fulfills NOAA's critical mission requirements. This sensor will provide significant advancements over current GOES imagers by taking pictures five times faster and have the ability to zoom in to view specific severe weather events, while at the same time continue to look at the rest of the United States. We currently do not have this capability and must constantly make decisions about what to focus on, which impacts our ability to forecast weather. The Hyperspectral Environmental Suite (HES) was conceived as an advanced sounder and coastal water imager that would provide a profile of atmospheric temperature and moisture content used in weather forecasting and take images of coastal areas for water quality monitoring and coastal hazard assessment. The Solar Imaging Suite (SIS) will provide pictures of the sun to detect solar flares, while the Space Environmental in-Situ Suite (SEISS) will measure the space radiation environment. The Geostationary Lightning Mapper (GLM) will help us better detect lightning and improve our capabilities to forecast and track severe weather.

The planned launch readiness date—based on the projected life expectancy of current satellites and the requirement to preserve continuity of the imaging mission—was projected to be in 2012. NOAA reevaluates the need date for GOES–R based on the performance of the operational satellites; this analysis has led to revisions of the GOES–R launch date. Continuing analyses of our current satellites indicates that the on-orbit GOES satellites are lasting longer than predicted and a 2014 launch readiness date is now warranted.

As noted earlier, GOES–R is still in the design phase and we have yet to award a prime contract for acquisition of this satellite series. Presently, three contractor teams are developing preliminary designs and identifying program risks, and when they are finished, NOAA and the Department of Commerce will decide on the system design and award a contract. The ABI instrument is under contract and being developed, and the contract for development of the SEISS instrument was just signed. NASA is managing all of our sensor contracts and is providing technical guidance and support for the whole program.

Lessons Learned from NPOESS and Other Reviews

NOAA is applying lessons learned from the NPOESS program and other recent reviews of space systems. We are implementing these lessons into our management and acquisition strategy. We have made significant changes to our GOES–R program management and oversight based on direction from this committee, reviews from the Government Accountability Office (GAO), the DOC Inspector General, the recent NPOESS Nunn-McCurdy certification process, and our own internal reviews.

I created a NOAA Program Management Council chaired by my Deputy, which is made up of senior NOAA and NASA personnel and meets monthly to review the program. This group assesses the technical, budget, and schedule performance of the program. It reviews proposed new activities and/or changes in scope of the program to ensure risk and budget impacts to existing programs are understood and realistic. This group provides recommendations on whether the program should move forward at all major milestones, such as contract award, critical design reviews, test readiness reviews and launch readiness. The PMC can also recommend alternative actions including terminations. During these monthly meetings members openly question the program director and can request further information or actions the program office must fulfill. Each meeting begins with a review of any open action item.

In addition, I have a group consisting of the NOAA users of the satellite data, which also reports to my Deputy. As we designed the original concept for GOES–R, the user group developed the initial requirements and meets regularly to assess the extent to which the preliminary designs meet the requirements. This group is critical as we move forward with finalizing sensors and the satellite system to ensure GOES–R will meet NOAA's requirements for data and products.

As both of the groups report to my Deputy, it is his job to arbitrate any differences of opinions between the two groups. My Deputy and I meet regularly to discuss the recommendations from the groups and I make decisions based on these recommendations. We provide the Department of Commerce with quarterly briefings on the program and I brief the Deputy Secretary and Secretary as needed.

We have co-located the GOES–R program office at NASA Goddard Space Flight Center and are using the full capabilities and processes at NASA for the development of the GOES–R system. This includes NASA's processes for independent technical and engineering reviews. The program reports on a monthly basis to a NASA Program Management Council which is chaired by the Goddard Deputy Director.

We hired a team of independent satellite experts to provide periodic reviews and address specific concerns raised by NOAA senior leadership. We also hired two cost estimating teams to independently develop the program estimates. One will work for the GOES–R program office and develop the Program Office Estimate. The other cost estimating team works for the NOAA Chief Financial Officer, who reports to my Deputy, to provide an Independent Cost Estimate. Our goal is to ensure that the program will have a realistic and executable budget in place that provides sufficient reserves to handle development issues that arise. NOAA also hired a highly competent and respected former NASA program manager, Anthony Comberiate, for the GOES–R program. The GOES–R program has increased staff to support robust systems engineering and oversight of the contractors, including on-site representatives at the prime contractors and at major subcontractors.

What did we learn about GOES–R?

As we proceed through the preliminary design phase, our three contractor teams and our Independent Review Team have provided feedback on our design concepts:

1. To actually build our concept for GOES–R would be much more expensive and riskier than we first thought;
2. One of the proposed sensors, the Hyperspectral Environmental Suite (HES) is not technologically mature enough, would impact the spacecraft and the ground systems, and would not allow us to launch in 2014; and
3. Further improvements could be made in the way the acquisition will be managed.

Based on this information we are revising our plans to ensure we have a program that maintains data continuity, allows for technical advances, and is affordable. The good news is that this is the right time to make changes to the plans—before we let a contract to build the satellites.

Why have the cost estimates increased so much?

The preliminary cost estimates to build this new system went from $6.2 billion to around $11.4 billion. Most of the increase was because we revised the inflation assumptions in our cost models, which added about $2.6 billion to the total. The estimates were also revised to provide for increased management reserves/margins based on expert recommendations and lessons learned from NPOESS. This added an additional $800 million. The cost of spacecraft, ground system and sensors increased about $1.5 billion. The remaining increase covers the launch, operation and support segments of GOES–R. This increase in the life cycle cost estimate reflects new inputs from NASA and others.

In response to the increasing cost estimates for the program, the program office assembled a team of cost and technical experts and developed multiple program op-

tions to reduce cost and risk. The team provided information to the PMC and the user group, which examined the options and provided me with recommendations. These recommendations are being considered and decisions will be incorporated in the FY 2008 President's Budget.

Why not build HES?

One decision we have made is not to award a contract to build the HES sensor given its risks and technological challenges. HES is a large and complex instrument. The combination of instrument development challenges, magnitude of required spacecraft accommodations, and ground product implications, provided a high level of risk. Given input from the Program Management Council, input from the program office, the contractor and the independent review team, I determined HES created too much risk for the GOES–R program. While HES potentially could have provided a major improvement in our ability to characterize the atmosphere and the coastal environment, we did not think it was prudent to accept that much risk in an operational satellite for an acquisition program. We are examining alternate ways to maintain today's sounding capability for GOES–R. While not including the HES on GOES–R we are going to complete the HES preliminary design and risk reduction work that is currently under contract. This work will be of value to the user group which is actively working this issue with the program office as I have also asked the program office to look at alternatives to add a HES-like instrument on research satellites or future GOES satellites. Fulfilling the coastal waters component of the sounder capability remains a NOAA priority. NOAA has initiated a separate analysis of alternatives to examine possible future approaches for providing hyperspectral sounding and coastal waters imaging.

In addition to architectural changes, we have decided to provide the sensors to the prime contractor as Government Furnished Equipment. This will ensure more direct Government oversight of these critical developments allowing the prime contractor to focus on the spacecraft, ground system, and integration. We are also examining the division of labor between NOAA and NASA. In the past, NOAA has provided the funding and NASA managed the contract for NOAA. We are discussing with NASA whether this model is the most appropriate one for the GOES–R Program.

The GAO Report

We have also provided information to the GAO about GOES–R, which is why we are here today. I am pleased the GAO report recognizes we continue to incorporate the lessons learned from problems of other satellite programs into the GOES–R procurement. I realize more remains to be done and I am committed to doing it.

Specifically, the GAO provided three recommendations:

Recommendation number one: *Once the scope of the program has been finalized, establish a process for objectively evaluating and reconciling the government and independent life cycle cost estimates.*

We will establish a process to reconcile the cost estimates, and I will ensure this process is reviewed by our Independent Review Team. We will examine how NASA and the Department of Defense reconcile cost estimates and tailor a process that is most appropriate for NOAA.

Recommendation number two: *Perform a comprehensive review of the Advanced Baseline Imaginer Sensor (called A–B–I) before it enters production.*

The report highlights the problems the contractor is experiencing with ABI, the one sensor in actual development. This sensor fulfills our mission critical imaging requirements. NOAA and NASA are working closely to ensure performance of the instrument meets these requirements. We believe we understand the current technical problems and the contractor has a realistic plan to develop the sensor. Given the importance of this instrument and lessons learned from the NPOESS Visible/Infrared Imager/Radiometer Suite (VIIRS) sensor, I agree with GAO that we need to ensure we are technologically ready to move forward through the critical milestones of development and production. NASA has several reviews of the sensor planned by government experts outside of the program, and NOAA will have independent experts regularly assess the progress of the sensor development at critical phases along with reviews by the NOAA PMC. GAO was also concerned about the potential for ABI cost overruns and schedule delays. We agree with GAO and we have budgeted for additional cost and schedule contingencies in line with GAO estimates to cover these challenges. We believe these actions will ensure the sensor will be ready to fly in 2014.

Recommendation number three: *Seek assistance from an independent review team to determine the appropriate level of people and resources needed to track and oversee the contractor's performance using specific metrics.*

We agree with GAO about the importance of monitoring critical metrics that help illuminate the cost and schedule performance of the contractors. NOAA is hiring at least three additional people to aid in the implementation of Earned Value Management program management. As the program grows, we will adjust accordingly while seeking input and advice from NASA experts and our Independent Review Team.

What are NOAA's next steps?

Given the analysis that our preliminary concepts for GOES–R are significantly riskier and more expensive than previously thought and would likely not be ready for a 2014 launch, NOAA and DOC are reevaluating the GOES–R program. As we evaluate and attempt to balance cost, schedule, risk, and performance, our number one priority is to ensure continuity of existing imagery data.

We are providing the three contractor teams developing the preliminary designs for GOES–R three additional months. We want them to refine their designs by removing the HES sensor and providing at least existing sounding capability. We instructed them to develop a system that will have the remaining four sensor suites on each satellite, thus reducing the minimum number of satellites needed from three to two. We expect to have the preliminary design proposals at the end of this year. Then the program office, the PMC and the user group will provide me with recommendations on the final design for GOES–R, which will include the cost, schedule, performance and risk for the program. I will then provide my recommendations to the Secretary who will decide whether to move forward with a contract. It will then be about one year to develop and award a contract, which would occur in the summer of 2008.

Conclusion

As I have said before, satellites are very complicated and difficult machines to build. But, their capabilities are critical to NOAA's mission to predict the Earth's environment. I believe we are making significant strides in developing a better process for designing and acquiring our satellites. My goal is to have a process in place that will provide my successors with the best information to make the best decisions.

Once again, I appreciate the efforts of the Committee, in particular Chairman Boehlert, in working with us as we develop this process. I would be happy to answer any questions you may have.

BIOGRAPHY FOR VICE ADMIRAL CONRAD C. LAUTENBACHER, JR.

A native of Philadelphia, Pa., retired Navy Vice Admiral Conrad C. Lautenbacher, Ph.D., is serving as the undersecretary of commerce for oceans and atmosphere. He was appointed Dec. 19, 2001. Along with this title comes the added distinction of serving as the eighth Administrator of the National Oceanic and Atmospheric Administration. He holds an M.S. and Ph.D. from Harvard University in applied mathematics.

Lautenbacher oversees the day-to-day functions of NOAA, as well as laying out its strategic and operational future. The agency manages an annual budget of $4 billion. The agency includes, and is comprised of, the National Environmental Satellite, Data and Information Services; National Marine Fisheries Service; National Ocean Service; National Weather Service; Oceanic and Atmospheric Research; Marine and Aviation Operations; and the NOAA Corps, the Nation's seventh uniformed service. He directed an extensive review and reorganization of the NOAA corporate structure to meet the environmental challenges of the 21st century.

As the NOAA Administrator, Lautenbacher spearheaded the first-ever Earth Observation Summit, which hosted ministerial-level representation from several dozen of the world's nations in Washington July 2003. Through subsequent international summits and working groups, he worked to encourage world scientific and policy leaders to work toward a common goal of building a sustained Global Earth Observation System of Systems (GEOSS) that would collect and disseminate data, information and models to stakeholders and decision makers for the benefit of all nations individually and the world community collectively. The effort culminated in an agreement for a 10-year implementation plan for GEOSS reached by the 55 member countries of the Group on Earth Observations at the Third Observation Summit held in Brussels February 2005.

He also has headed numerous delegations at international governmental summits and conferences around the world, including the U.S. delegation to 2002 Asia-Pacific

Economic Cooperation Ocean Ministerial Meeting in Korea, and 2002 and 2003 meetings of the World Meteorological Organization and Intergovernmental Oceanographic Commission in Switzerland and France, as well as leading the Commerce delegation to the 2002 World Summit on Sustainable Development in South Africa.

Before joining NOAA, Lautenbacher formed his own management consultant business, and worked principally for Technology, Strategies & Alliances Inc. He was president and CEO of the Consortium for Oceanographic Research and Education (CORE). This not-for-profit organization has a membership of 76 institutions of higher learning and a mission to increase basic knowledge and public support across the spectrum of ocean sciences.

Lautenbacher is a graduate of the U.S. Naval Academy (Class of 1964), and has won accolades for his performance in a broad range of operational, command and staff positions both ashore and afloat. He retired after 40 years of service in the Navy. His military career was marked by skilled fiscal management and significant improvements in operations through performance-based evaluations of processes.

During his time in the Navy, he was selected as a Federal Executive Fellow and served at the Brookings Institution. He served as a guest lecturer on numerous occasions at the Naval War College, the Army War College, the Air War College, The Fletcher School of Diplomacy, and the components of the National Defense University.

His Navy experience includes tours as Commanding Officer of USS HEWITT (DD–966), Commander Naval Station Norfolk; Commander of Cruiser-Destroyer Group Five with additional duties as Commander U.S. Naval Forces Central Command Riyadh during Operations Desert Shield and Desert Storm, where he was in charge of Navy planning and participation in the air campaign. As Commander U.S. Third Fleet, he introduced joint training to the Pacific with the initiation of the first West Coast Joint Task Force Training Exercises (JTFEXs).

A leader in the introduction of cutting-edge information technology, he pioneered the use of information technology to mount large-scale operations using sea-based command and control. As Assistant for Strategy with the Chief of Naval Operations Executive Panel, and Program Planning Branch Head in the Navy Program Planning Directorate, he continued to hone his analytic skills resulting in designation as a specialist both in Operations Analysis and Financial Management. During his final tour of duty, he served as Deputy Chief of Naval Operations (Resources, Warfare Requirements and Assessments) in charge of Navy programs and budget.

Lautenbacher lives in Northern Virginia with his wife Susan who is a life-long high school and middle school science teacher.

Chairman BOEHLERT. Admiral, under the circumstances that is a good place to stop. And I applaud that last statement, and all of your statement. Here is what we plan to do. We are going to give Mr. Powner an opportunity for his full five-minute statement, and then we are going to recess, go over and answer the call at the House. There are two votes. We should be back in about 20 minutes or so, and then we will have some limited questioning because we have your full statements. And we have the open dialogue back and forth and so we will follow it up with that open dialogue and some written questions. Mr. Powner.

STATEMENT OF MR. DAVID A. POWNER, DIRECTOR, INFORMATION TECHNOLOGY MANAGEMENT ISSUES, GOVERNMENT ACCOUNTABILITY OFFICE

Mr. POWNER. Chairman Boehlert, Ranking Member Gordon, and Members of the Committee, we appreciate the opportunity to testify this morning on our GOES–R report completed at your request. The next generation of geostationary environmental satellites is critical for future weather forecasting and tracking severe weather. NOAA is currently early in the acquisition cycle as the prime contract is expected to be awarded in 2008. Your early oversight, Mr. Chairman, has been essential to insure that NOAA is establishing a management team and processes that will help to avoid repeating

the problems recently experienced on NPOESS and other major satellite acquisition

Today, as requested, I will summarize three key points starting with the current cost and schedule estimate of GOES–R, lessons learned from previous satellite acquisitions and recommendations going forward. GOES–R acquisition is the fourth series of GOES satellites that have been acquired since 1970. As originally planned, this acquisition is to consist of four satellites that would each contain five sensors that are expected to significantly increase the amount and precision of environmental data. NOAA has three vendors currently working on preliminary designs and plans to award a contract to one of them in May, 2008.

NASA is responsible for the sensors having awarded final contracts on two of the five and preliminary design contracts on the remaining three. The first GOES–R satellite is expected to be launched in 2014, and the final one is to provide coverage through 2028. Regarding costs, Mr. Chairman, when we began our review for you the life cycle cost was reported at 6.2 for four satellites. During our review, we learned that the cost could be in the $11 billion to $12 billion range, double the original estimate. We concluded our review last month with the future scope and direction in limbo, and a commitment from NOAA that a decision would be made by the end of this month. NOAA last week told us that the GOES–R life cycle cost could be close to the original $6.2 billion range, but now it only includes two satellites, and we dropped one of the technically complex sensors, HES.

Although the cost per satellite is not good news, NOAA's early attention to reducing this acquisition's technical complexity and more fully understanding its requirements prior to awarding the prime contract is. Our review also showed that NOAA's management team is taking into consideration key lessons learned from the recent NPOESS and prior GOES experiences, but that even more attention to past problems is needed. Past problems experienced with these acquisitions include poor cost and schedule estimates, technical complexity that exceeds the contractors' and government's abilities to deliver, insufficient contract oversight, and ineffective executive involvement.

NOAA has established plans to address many of the past problems that focus on conducting independent cost estimates, performing preliminary studies of key technologies, placing resident government offices at key contractor locations and establishing a senior executive oversight committee. However, additional actions are needed to better position NOAA for success. We made a number of recommendations to address these actions that include establishing processes to insure that NOAA has an accurate independent life cycle estimate, performing a comprehensive review of one of the critical sensors to fully understand the level of technical complexity and having an independent review team assess the adequacy of key resources needed to oversee the contractor's performance.

In summary, Mr. Chairman, NOAA's attention to requirements and this acquisition's technical complexity prior to contract award is commendable but recent direction still leaves our government with an extremely costly and complex acquisition that is essential for our nation's warning and forecasting operations through nearly

2030. Key risks facing this program include obtaining an accurate cost estimate and realistic schedule, balancing the pressure to increase the level of technical complexity to advance science with budget realities and the need to control costs and schedules, securing adequate systems engineering expertise to oversee contractor performance, and having early and frequent executive level involvement that holds both contractor and government personnel accountable.

There is also additional risk in that NOAA is for the first time responsible for managing a satellite acquisition instead of NASA. Given this, it will be important to leverage NASA's expertise and to aggressively and continuously manage the risks that always seem to plague these large satellite acquisitions. This concludes my statement. Chairman Boehlert, thank you for your many years of service to our nation.

[The prepared statement of Mr. Powner follows:]

PREPARED STATEMENT OF DAVID A. POWNER

GEOSTATIONARY OPERATIONAL ENVIRONMENTAL SATELLITES

ADDITIONAL ACTION NEEDED TO INCORPORATE LESSONS LEARNED FROM OTHER SATELLITE PROGRAMS

Why GAO Did This Study

The National Oceanic and Atmospheric Administration (NOAA) plans to procure the next generation of geostationary operational environmental satellites, called the Geostationary Operational Environmental Satellites-R series (GOES–R). This new series is considered critical to the United States' ability to maintain the continuity of data required for weather forecasting through the year 2028.

GAO was asked to summarize and update its report previously issued to the Subcommittee on Environment, Technology, and Standards—Geostationary Operational Environmental Satellites: Steps Remain in Incorporating Lessons Learned from Other Satellite Programs, GAO–06–993 (Washington, D.C.: Sept. 6, 2006). This report (1) determines the status of and plans for the GOES–R series procurement, and (2) identifies and evaluates the actions that the program management team is taking to ensure that past problems experienced in procuring other satellite programs are not repeated.

What GAO Recommends

In our report, we make recommendations to the Secretary of Commerce to improve NOAA's ability to effectively manage the GOES–R procurement. In written comments, the Department of Commerce agreed with the recommendations and identified plans for implementing them.

What GAO Found

At the time of our review, NOAA was nearing the end of the preliminary design phase of its GOES–R system—which was estimated to cost $6.2 billion and scheduled to have the first satellite ready for launch in 2012. It expected to award a contract in August 2007 to develop this system. However, recent analyses of the GOES–R program cost—which in May 2006 the program office estimated could reach $11.4 billion—have led the agency to consider reducing the scope of requirements for the satellite series. Since our report was issued, NOAA officials told GAO that the agency has made a decision to reduce the scope of the program to a minimum of two satellites and to reduce the complexity of the program by canceling a technically complex instrument.

NOAA has taken steps to implement lessons learned from past satellite programs, but more remains to be done. Prior satellite programs—including a prior GOES series, a polar-orbiting environmental satellite series, and various military satellite programs—often experienced technical challenges, cost overruns, and schedule delays. Key lessons from these programs include the need to (1) establish realistic cost and schedule estimates, (2) ensure sufficient technical readiness of the system's

components prior to key decisions, (3) provide sufficient management at government and contractor levels, and (4) perform adequate senior executive oversight to ensure mission success. NOAA has established plans to address these lessons by conducting independent cost estimates, performing preliminary studies of key technologies, placing resident government offices at key contractor locations, and establishing a senior executive oversight committee. However, many steps remain to fully address these lessons (see table). Until it completes these activities, NOAA faces an increased risk that the GOES–R program will repeat the increased cost, schedule delays, and performance shortfalls that have plagued past procurements.

Key Lessons Learned and the Activities Taken or Remaining to Fully Address Them

Lesson learned	Actions taken or under way	Actions remaining
Establish realistic cost and schedule estimates	• Obtaining multiple independent cost estimates • Conducting risk analysis of schedule estimates	• Ensuring objectivity when reconciling alternative estimates
Ensure sufficient technical readiness of the system's components prior to critical decisions	• Conducted preliminary studies of key technologies and components	• Ensuring sufficient technical maturity before proceeding to production
Provide sufficient management of contractors and subcontractors	• Increased presence at contractor sites • Plan to increase number of system engineers • Plan to hire three specialists in earned value	• Assessing the number of earned value specialists needed commensurate with increased acquisition activities
Perform effective executive-level oversight	• NOAA's program management council meets regularly to oversee project	

Source: GAO analysis.

United States Government Accountability Office

Mr. Chairman and Members of the Committee:

We appreciate the opportunity to participate in today's hearing on the planned Geostationary Operational Environmental Satellites-R (GOES–R) program. The GOES–R series is to replace the current series of satellites which will likely begin to reach the end of their useful lives in approximately 2012. This new series is expected to mark the first major technological advance in GOES instrumentation since 1994. It is also considered critical to the United States' ability to maintain the continuity of data required for weather forecasting through the year 2028.

As requested, our testimony summarizes and updates a report we previously issued to your subcommittee that (1) determines the status of and plans for the GOES–R series procurement, and (2) identifies and evaluates the actions that the program management team is taking to ensure that past problems experienced in procuring other satellite programs are not repeated.[1] In preparing for this testimony, we relied on our work supporting the accompanying report. That report contains a detailed overview of our scope and methodology. All the work on which this testimony is based was performed in accordance with generally accepted government auditing standards.

Results in Brief

The National Oceanic and Atmospheric Administration (NOAA) is nearing the end of the preliminary design phase of its GOES–R system, which was initially estimated to cost $6.2 billion and scheduled to have the first satellite ready for launch in 2012. At the time of our review, NOAA had issued contracts for the preliminary design of the overall GOES–R system to three vendors and expected to award a contract to one of these vendors in August 2007 to develop the satellites. In addition, to reduce the risks associated with developing new instruments, NOAA issued contracts for the early development of two instruments and for the preliminary designs of three other instruments. The agency plans to turn these instrument contracts over to the vendor that is awarded the contract for the overall GOES–R program. However, recent analyses of the GOES–R program cost—which in May 2006 the program office estimated could reach $11.4 billion—have led the agency to consider

[1] GAO, *Geostationary Operational Environmental Satellites: Steps Remain in Incorporating Lessons Learned from Other Satellite Programs,* GAO–06–993 (Washington, D.C.: Sept. 6, 2006).

reducing the scope of requirements for the satellite series. At the time of our review, NOAA officials estimated that a decision on the future scope and direction of the program could be made by the end of September 2006. Since then, NOAA officials told us that the agency has made a decision to reduce the scope and complexity of the GOES–R program by reducing the number of satellites and canceling a technically complex instrument.

NOAA has taken steps to implement lessons learned from past satellite programs, but more remains to be done. Prior satellite programs—including a prior GOES series, a polar-orbiting environmental satellite series, and various military satellite programs—often experience technical challenges, cost overruns, and schedule delays. Key lessons from these programs include the need to (1) establish realistic cost and schedule estimates, (2) ensure sufficient technical readiness of the system's components prior to key decisions, (3) provide sufficient management at government and contractor levels, and (4) perform adequate senior executive oversight to ensure mission success. NOAA has established plans to address these lessons by conducting independent cost estimates, performing preliminary studies of key technologies, placing resident government offices at key contractor locations, and establishing a senior executive oversight committee. However, many steps remain to fully address these lessons. Specifically, NOAA has not yet developed a process to evaluate and reconcile the independent and government cost estimates. In addition, NOAA has not yet determined how it will ensure that a sufficient level of technical maturity will be achieved in time for an upcoming decision milestone, nor has it determined the appropriate level of resources it needs to adequately track and oversee the program using earned value management.[2] Until it completes these activities, NOAA faces an increased risk that the GOES–R program will repeat the increased cost, schedule delays, and performance shortfalls that have plagued past procurements.

To improve NOAA's ability to effectively manage the GOES–R procurement, in our accompanying report,[3] we made recommendations to the Secretary of Commerce to direct its NOAA Program Management Council to establish a process for objectively evaluating and reconciling the government and independent life cycle cost estimates once the program requirements are finalized; to establish a team of system engineering experts to perform a comprehensive review of the Advanced Baseline Imager instrument to determine the level of technical maturity achieved on the instrument before moving the instrument into production; and to seek assistance in determining the appropriate levels of resources needed at the program office to adequately track and oversee the contractor's earned value management data. In written comments, the Department of Commerce agreed with our recommendations and provided information on its plans to implement our recommendations.

Background

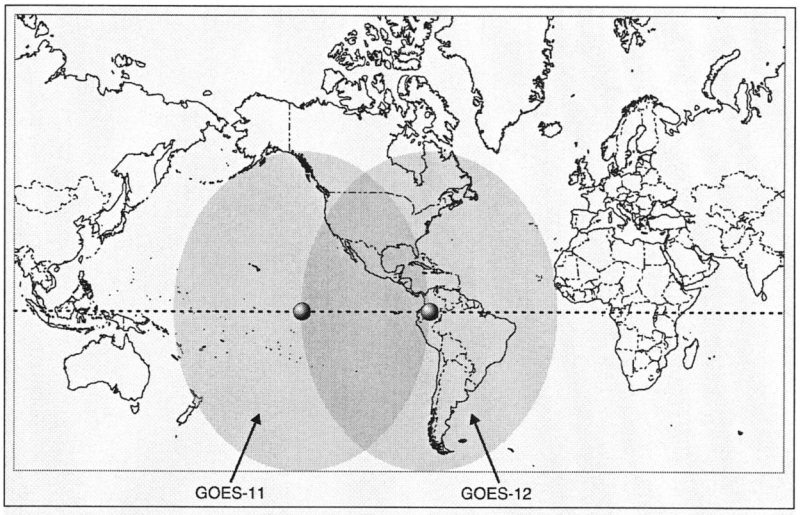
Since the 1960s, geostationary and polar-orbiting environmental satellites have been used by the United States to provide meteorological data for weather observation, research, and forecasting. NOAA's National Environmental Satellite Data and Information Service (NESDIS) is responsible for managing the civilian geostationary and polar-orbiting satellite systems as two separate programs, called GOES and the Polar Operational Environmental Satellites, respectively.

Unlike polar-orbiting satellites, which constantly circle the earth in a relatively low polar orbit, geostationary satellites can maintain a constant view of the earth from a high orbit of about 22,300 miles in space. NOAA operates GOES as a two-satellite system that is primarily focused on the United States (see Fig. 1). These satellites are uniquely positioned to provide timely environmental data to meteorologists and their audiences on the earth's atmosphere, its surface, cloud cover, and the space environment. They also observe the development of hazardous weather, such as hurricanes and severe thunderstorms, and track their movement and intensity to reduce or avoid major losses of property and life. Furthermore, the satellites' ability to provide broad, continuously updated coverage of atmospheric conditions over land and oceans is important to NOAA's weather forecasting operations.

[2] Earned value management is a method that compares the value of work accomplished during a given period with that of the work expected in that period.

[3] GAO–06–993.

Figure 1: Approximate GOES Geographic Coverage



Sources: NOAA (data), MapArt (map).

To provide continuous satellite coverage, NOAA acquires several satellites at a time as part of a series and launches new satellites every few years (see Table 1).

Table 1: Summary of the Procurement History of GOES

Series name	Procurement duration[a]	Satellites
Original GOES[b]	1970–1987	1, 2, 3, 4, 5, 6, 7
GOES I-M	1985–2001	8, 9, 10, 11, 12
GOES-N	1998–2011	13, O, P, Q[c]
GOES-R	2007–2020	R, S, T, U

Source: GAO analysis of NOAA data.

[a]Duration includes time from contract award to final satellite launch.

[b]The procurement of these satellites consisted of four separate contracts for (1) two early prototype satellites and GOES-1, (2) GOES-2 and -3, (3) GOES-4 through -6, and (4) GOES-G (failed on launch) and GOES-7.

[c]NOAA decided not to exercise the option for this satellite.

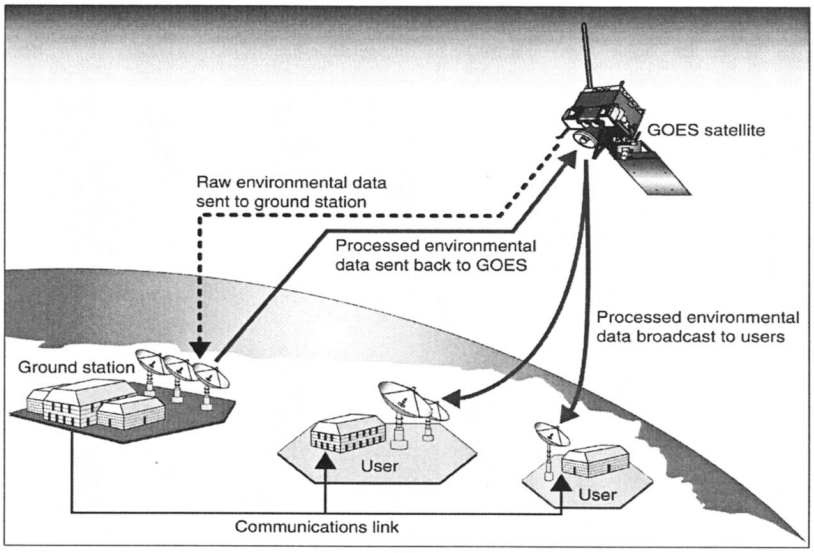
Three satellites—GOES–11, GOES–12, and GOES–13—are currently in orbit. Both GOES–11 and GOES–12 are operational satellites, while GOES–13 is in an on-orbit storage mode. It is a backup for the other two satellites should they experience any degradation in service. The others in the series, GOES–O and GOES–P, are planned for launch over the next few years.[4] NOAA is also planning a future generation of satellites, known as the GOES–R series, which are planned for launch beginning in 2012.

Each of the operational geostationary satellites continuously transmits raw environmental data to NOAA ground stations. The data are processed at these ground stations and transmitted back to the satellite for broadcast to primary weather services both in the United States and around the world, including the global research

[4]Satellites in a series are identified by letters of the alphabet when they are on the ground and by numbers once they are in orbit.

community. Raw and processed data are also distributed to users via ground stations through other communication channels, such as dedicated private communication lines and the Internet. Figure 2 depicts a generic data relay pattern from the geostationary satellites to the ground stations and commercial terminals.

Figure 2: Generic GOES Data Relay Pattern



Source: GAO analysis of NOAA data.

GOES–R Program—An Overview

NOAA is planning for the GOES–R program to improve on the technology of prior GOES series, in terms of both system and instrument improvements. The system improvements are expected to fulfill more demanding user requirements and to provide more rapid information updates. Table 2 highlights key system-related improvements GOES–R is expected to make to the geostationary satellite program.

Table 2: Summary of Key GOES-R System Improvements

Key feature	GOES-N (current)	GOES-R
Total products	41	~152
Downlink rate of raw data collected by instruments (from satellite to ground stations)	2.6 Mbps	132 Mbps
Broadcast rate of processed GOES data (from satellite to users)	2.1 Mbps	17–24 Mbps
Raw data storage (the length of time that raw data will be stored at ground stations)	0 days	30 days

Source: GAO analysis of NOAA data.

The instruments on the GOES–R series are expected to increase the clarity and precision of the observed environmental data. NOAA plans to acquire five different types of instruments. The program office considered two of the instruments—the Advanced Baseline Imager and the Hyperspectral Environmental Suite—to be most

critical because they would provide data for key weather products.[5] Table 3 summarizes the originally planned instruments and their expected capabilities.

Table 3: Expected GOES-R Series Instruments, as of June 2006

Planned instrument	Description
Advanced Baseline Imager	Expected to provide variable area imagery and radiometric information of the earth's surface, atmosphere, and cloud cover. Key features include • monitoring and tracking severe weather, • providing images of clouds to support forecasts, and • providing higher resolution, faster coverage, and broader coverage simultaneously.
Hyperspectral Environmental Suite	Expected to provide information about the earth's surface to aid in the prediction of weather and climate monitoring. Key features include • providing atmospheric moisture and temperature profiles to support forecasts and climate monitoring, • monitoring coastal regions for ecosystem health, water quality, coastal erosion, and harmful algal blooms, and • providing higher resolution and faster coverage.
Space Environmental In-Situ Suite	Expected to provide information on space weather to aid in the prediction of particle precipitation, which causes disturbance and disruption of radio communications and navigation systems. Key features include • measuring magnetic fields and charged particles, • providing improved heavy ion detection, adding low energy electrons and protons, and • enabling early warnings for satellite and power grid operation, telecom services, astronauts, and airlines.
Solar Imaging Suite	Expected to provide coverage of the entire dynamic range of solar X-ray features, from coronal holes to X-class flares, as well as estimate the measure of temperature and emissions. Key features include • providing images of the sun and measuring solar output to monitor solar storms and • providing improved imager capability.
Geostationary Lightning Mapper	Expected to continuously monitor lightning activity over the United States and provide a more complete dataset than previously possible. Key features include • detecting lightning strikes as an indicator of severe storms and • providing a new capability to GOES that only previously existed on polar satellites.

Source: GAO analysis of NOAA data.

GOES–R Program Office Structure

The program management structure for the GOES–R program differs from past GOES programs. Prior to the GOES–R series, NOAA was responsible for program funding, procurement of the ground elements, and on-orbit operation of the satellites, while NASA was responsible for the procurement of the spacecraft, instruments, and launch services. NOAA officials stated that this approach limited the agency's insight and management involvement in the procurement of major elements of the system.

Alternatively, under the GOES–R management structure, NOAA has responsibility for the procurement and operation of the overall system—including spacecraft, instruments, and launch services. NASA is responsible for the procurement of the individual instruments until they are transferred to the overall GOES–R system contractor for completion and integration onto the spacecraft. Additionally, to take advantage of NASA's acquisition experience and technical expertise, NOAA located the GOES–R program office at NASA's Goddard Space Flight Center. It also designated key program management positions to be filled with NASA personnel. These positions include the deputy system program director role for advanced instrument and technology infusion, the project manager for the flight portion of the system, and the deputy project manager for the ground and operations portion of the system. NOAA officials explained that they changed the management structure for the GOES–R program in order to streamline oversight and fiduciary responsibilities, but that they still plan to rely on NASA's expertise in space system acquisitions.

Satellite Programs Often Experience Technical Problems, Cost Overruns, and Schedule Delays

Satellite programs are often technically complex and risky undertakings, and as a result, they often experience technical problems, cost overruns, and schedule delays. We and others have reported on a historical pattern of repeated missteps in the procurement of major satellite systems, including the National Polar-orbiting Operational Environmental Satellite System (NPOESS), the GOES I–M series, the

[5] After our report was issued on September 6, 2006, NOAA officials told us that the agency has decided to cancel its plans for the development of the Hyperspectral Environmental Suite but expects to explore options that will ensure continuity of data provided by the current GOES series.

Space Based Infrared System High Program (SBIRS–High), and the Advanced Extremely High Frequency Satellite System (AEHF).[6] Table 4 lists key problems experienced with these programs.

Table 4: Key Problems Experienced on Selected Major Space Systems

Problem	NPOESS	GOES I-M	SBIRS–High	AEHF
Insufficient technical readiness prior to critical decision points				
Inadequate preliminary studies prior to the decision to award a development contract	X	X	X	
Insufficient technical maturity prior to the decision to move to production	X	X	X	X
Unrealistic cost and schedule estimates				
Optimistic assumptions including:				
• savings from heritage systems	X	X	X	
• readiness of technology maturity	X	X	X	X
• constant and available industrial base			X	
• no weight growth	X		X	X
• no requirements growth				X
• savings from lot buys versus single-unit purchase			X	
• overly aggressive schedule	X	X	X	X
Poor program and contractor management				
Quality and subcontractor issues	X	X	X	X
Inadequate systems engineering capabilities	X	X	X	X
Inadequate earned value management capabilities	X		X	X
Insufficient management reserve	X			X
Ineffective contract award fee structure	X	X	X	
Poor senior executive level oversight				
Infrequent meetings	X			
Inability to make timely decisions	X			
Other				
Unstable funding stream	X		X	X
Unstable requirements			X	X

Source: GAO analysis of NOAA and DOD data.

GOES–R Procurement Activities Are Under Way, but System Requirements and Cost Estimates Are Changing

At the time of our review, NOAA was nearing the end of the preliminary design phase on its GOES–R program and planned to award a contract for the system's development in August 2007. However, because of concerns with potential cost growth, NOAA's plans for the GOES–R procurement are changing. To date, NOAA has issued contracts for the preliminary design of the overall GOES–R system to three vendors and expects to award a contract to one of these vendors to develop the system. In addition, to reduce the risks associated with developing new instruments, NASA has issued contracts for the early development of two instruments and for the preliminary designs of three other instruments.[7] The agency plans to award these contracts and then turn them over to the contractor responsible for the overall GOES–R program. However, this approach is under review and NOAA may wait until the instruments are fully developed before turning them over to the system contractor. Table 5 provides a summary of the status of contracts for the GOES–R program.

[6] GAO, *Defense Acquisitions: Space System Acquisition Risks and Keys to Addressing Them,* GAO–06–776R (Washington, D.C.: June 1, 2006); *Polar-orbiting Operational Environmental Satellites: Cost Increases Trigger Review and Place Program's Direction on Hold,* GAO–06–573T (Washington, D.C.: Mar. 30, 2006); *Polar-orbiting Operational Environmental Satellites: Technical Problems, Cost Increases, and Schedule Delays Trigger Need for Difficult Trade-off Decisions,* GAO–06–249T (Washington, D.C.: Nov. 16, 2005); *Polar-orbiting Environmental Satellites: Information on Program Cost and Schedule Changes,* GAO–04–1054 (Washington, D.C.: Sept. 30, 2004); *Defense Acquisitions: Despite Restructuring, SBIRS High Program Remains at Risk of Cost and Schedule Overruns,* GAO–04–48 (Washington, D.C.: Oct. 31, 2003); *Military Space Operations: Common Problems and Their Effects on Satellite and Related Acquisitions,* GAO–03–825R (Washington, D.C.: June 2, 2003); *Defense Acquisitions: Assessments of Major Weapon Programs,* GAO–03–476 (Washington, D.C.: May 15, 2003); *Weather Satellites: Action Needed to Resolve Status of the U.S. Geostationary Satellite Program,* GAO/NSIAD–91–252 (Washington, D.C.: July 24, 1991). Defense Science Board/Air Force Scientific Advisory Board Joint Task Force, *Report on the Acquisition of National Security Space Programs* (May 2003).

[7] The development contract for the Space Environmental In-Situ Suite instrument was issued after we completed our review.

Table 5: Status of GOES-R Program Contracts, as of September 6, 2006

Contract item	Date contract was awarded for design	Planned date contract will be awarded for development
Instruments		
Advanced Baseline Imager	May 2001	September 2004 (actual)
Space Environmental In-Situ Suite	December 2004	August 2006 (actual)
Solar Imaging Suite	September 2004	September 2006
Hyperspectral Environmental Suite	June 2004	June 2007
Geostationary Lightning Mapper	February 2006	August 2007
GOES-R System		
Acquisition and Operations	October 2005	August 2007

Source: NOAA.

According to program documentation provided to the Office of Management and Budget in 2005, the official life cycle cost estimate for GOES–R was approximately $6.2 billion (see Table 6). However, program officials reported that this estimate was over two years old and under review.

Table 6: GOES-R Program Life Cycle Cost Estimate, as of June 2006

Major cost category	Dollars in millions
System level	$533
Space segment	2,494
Ground segments	729
Launch segment	686
Operations and support	1,147
Government program office	637
Total	**$6,226**

Source: NOAA.

At the time of our review, NOAA was planning to launch the first GOES–R series satellite in September 2012.[8] The development of the schedule for launching the satellites was driven by a requirement that the satellites be available to back up the last remaining GOES satellites (GOES–O and GOES–P) should anything go wrong during the planned launches of these satellites. Table 7 provides a summary of the planned launch schedule for the originally planned GOES–R series.

[8] After our report was issued on September 6, 2006, NOAA officials told us that the planned launch schedule was being delayed. The expected launch of the first GOES–R series satellite is now planned for December 2014.

Table 7: GOES-R Program Schedule, as of September 6, 2006

Milestone	Planned date
GOES-O launch[a]	April 2008
GOES-P launch[a]	October 2009[b]
GOES-R satellite available for launch	September 2012
GOES-S satellite available for launch	April 2014
GOES-T satellite available for launch	October 2015
GOES-U satellite available for launch	April 2017
End of operations and maintenance	2028

Source: NOAA.

[a]GOES-O and GOES-P are not part of the GOES-R series program. Their launch dates are provided because of their relevance to the GOES-R series satellite schedules.

[b]Because GOES satellites have been operating longer than expected, NOAA is considering moving the planned launch of the GOES-P satellite to July 2011.

However, NOAA's plans for the GOES–R procurement are changing because of concerns with potential cost growth. Given its experiences with cost growth on the NPOESS acquisition, NOAA asked program officials to recalculate the total cost of the estimated $6.2 billion GOES–R program. In May 2006, program officials estimated that the life cycle cost could reach $11.4 billion. The agency then requested that the program identify options for reducing the scope of requirements for the satellite series. Program officials reported that there were over 10 viable options under consideration, including options for removing one or more of the planned instruments. The program office also reevaluated its planned acquisition schedule based on the potential program options. Specifically, program officials stated that if there was a decision to make a major change in system requirements, they would likely extend the preliminary design phase, delay the decision to proceed into the development and production phase, and delay the contract award date. At the time of our review, NOAA officials estimated that a decision on the future scope and direction of the program could be made by the end of September 2006.

Recent NOAA Decision on the Direction and Scope of the GOES–R Program

In mid-September 2006, NOAA officials reported that a decision on the future scope and direction of GOES–R had been made—and involved a reduction in the number of satellites and in planned program capabilities, a revised life cycle cost estimate, and the delay of key programmatic milestones. Specifically, NOAA reduced the minimum number of satellites to two. In addition, plans for developing the Hyperspectral Environmental Suite—which was once considered a critical instrument by the agency—were canceled. Instead, the program office is exploring options that will ensure continuity of sounding data currently provided by the current GOES series.[9] NOAA officials reported that the cost of the restructured program is not known, but some anticipate it will be close to the original program estimate of $6.2 billion. The contract award for the GOES–R system has been pushed out to May 2008. Finally, the planned launch date of the first satellite in the GOES–R series has been delayed until December 2014.

The GOES–R Program Office Has Taken Steps to Address Past Lessons Learned, But Significant Actions Remain

NOAA has taken steps to apply lessons learned from problems encountered on other satellite programs to the GOES–R procurement. Key lessons include (1) establishing realistic cost and schedule estimates, (2) ensuring sufficient technical readiness of the system's components prior to key decisions, (3) providing sufficient management at government and contractor levels, and (4) performing adequate senior executive oversight to ensure mission success. NOAA has established plans designed to mitigate the problems faced in past acquisitions; however, many activities remain

[9] The Hyperspectral Environmental Suite was intended to be the successor to the sounder instrument on-board the current GOES series. The sounder measures radiated energy at different depths (altitudes) and also records surface and cloud-top temperatures and ozone distribution.

to fully address these lessons. Until it completes these activities, NOAA faces an increased risk that the GOES–R program will repeat the increased cost, schedule delays, and performance shortfalls that have plagued past procurements.

Efforts to Improve Reliability of Cost and Schedule Estimates are Under Way, But Key Steps Remain in Reconciling Cost Estimates

We and others have reported that space system acquisitions are strongly biased to produce unrealistically low cost and schedule estimates in the acquisition process.[10] Our past work on military space acquisitions has indicated that during program formulation, the competition to win funding is intense and has led program sponsors to minimize their program cost estimates. NOAA programs face similar unrealistic estimates. For example, the total development cost of the GOES I–M acquisition was over three times greater than planned, escalating from $640 million to $2 billion. Additionally, the delivery of the first satellite was delayed by five years.

NOAA has several efforts under way to improve the reliability of its cost and schedule estimates for the GOES–R program. NOAA's Chief Financial Officer has contracted with a cost-estimating firm to complete an independent cost estimate, while the GOES–R program office has hired a support contractor to assist with its internal program cost estimating. The program office is re-assessing its estimates based on preliminary information from the three vendors contracted to develop preliminary designs for the overall GOES–R system. Once the program office and independent cost estimates are completed, program officials intend to compare them and to develop a revised programmatic cost estimate that will be used in its decision on whether to proceed into system development and production. In addition, NOAA has planned for an independent review team—consisting of former senior industry and government space acquisition experts—to provide an assessment of the program office and independent cost estimates for this decision milestone. To improve its schedule reliability, the program office is currently conducting a schedule risk analysis in order to estimate the amount of adequate reserve funds and schedule margin needed to deal with unexpected problems and setbacks. Finally, the NOAA Observing System Council[11] submitted a prioritized list of GOES–R system requirements to the Commerce Under Secretary for approval. This list is expected to allow the program office to act quickly in deleting lower priority requirements in the event of severe technical challenges or shifting funding streams.

While NOAA acknowledges the need to establish realistic cost and schedule estimates, several hurdles remain. As discussed earlier, the agency was considering—during the time of our review—reducing the requirements for the GOES–R program to mitigate the increased cost estimates for the program. Prior to this decision, the agency's efforts to establish realistic cost estimates could not be fully effective in addressing this lesson. In addition, NOAA suspended the work being performed by its independent cost estimator. Now that the program scope and direction is being further defined, it will be important for the agency to restart this work. Further, the agency has not yet developed a process to evaluate and reconcile the independent and program office cost estimates once final program decisions are made. Without this process, the agency may lack the objectivity necessary to counter the optimism of program sponsors and is more likely to move forward with an unreliable estimate. Until it completes this activity, NOAA faces an increased risk that the GOES–R program will repeat the cost increases and schedule delays that have plagued past procurements.

Preliminary Studies Are Under Way, But Steps Remain in Determining Components' Technical Maturity

Space programs often experience unforeseen technical problems in the development of critical components as a result of having insufficient knowledge of the components and their supporting technologies prior to key decision points. One key decision point is when an agency decides on whether the component is sufficiently ready to proceed from a preliminary study phase into a development phase; this decision point results in the award of the development contract. Another key decision point occurs during the development phase when an agency decides whether the compo-

[10] GAO, *Space Acquisitions: Stronger Development Practices and Investment Planning Needed to Address Continuing Problems,* GAO–05–891T (Washington, D.C.: July 12, 2005). Defense Science Board/Air Force Scientific Advisory Board Joint Task Force, *Report on the Acquisition of National Security Space Programs* (May 2003).

[11] NOAA's Observing System Council is the principal advisory council for NOAA's Earth observation and data management activities. It includes members from each NOAA line office, other relevant councils, and program offices. The Assistant Administrator for Satellite and Information Services and the Assistant Administrator for Weather Services serve as the co-chairs of the council.

nent is ready to proceed from design into production (also called the critical design review). Without sufficient technical readiness at these milestones, agencies could proceed into development contracts on components that are not well understood and enter into the production phase of development with technologies that are not yet mature.

In 1997, NOAA began preliminary studies on technologies that could be used on the GOES–R instruments. These studies target existing technologies and assessed how they could be expanded for GOES–R. The program office is also conducting detailed trade-off studies on the integrated system to improve its ability to make decisions that balance performance, affordability, risk, and schedule. For instance, the program office is analyzing the potential architectures for the GOES–R constellation of satellites—the quantity and configuration of satellites, including how the instruments will be distributed over these satellites. These studies are expected to allow for a more mature definition of the system specifications.

NOAA has also developed plans to have an independent review team assess project status on an annual basis once the overall system contract has been awarded. In particular, this team will review technical, programmatic, and management areas; identify any outstanding risks; and recommend corrective actions. This measure is designed to ensure that sufficient technical readiness has been reached prior to the critical design review milestone. The program office's ongoing studies and plans are expected to provide greater insight into the technical requirements for key system components and to mitigate the risk of unforeseen problems in later acquisition phases.

However, the progress currently being made on a key instrument currently under development—the Advanced Baseline Imager—has experienced technical problems and could be an indication of more problems to come in the future. These problems relate to, among other things, the design complexity of the instrument's detectors and electronics. As a result, the contractor is experiencing negative cost and schedule performance trends. As of May 2006, the contractor incurred a total cost overrun of almost $6 million with the instrument's development only 28 percent complete. In addition, from June 2005 to May 2006, it was unable to complete approximately $3.3 million worth of work. Unless risk mitigation actions are aggressively pursued to reverse these trends, we project the cost overrun at completion to be about $23 million.

While NOAA expects to make a decision on whether to move the instrument into production (a milestone called the critical design review) in January 2007, the contractor's current performance raises questions as to whether the instrument designs will be sufficiently mature by that time. Further, the agency does not have a process to validate the level of technical maturity achieved on this instrument or to determine whether the contractor has implemented sound management and process engineering to ensure that the appropriate level of technical readiness can be achieved prior to the decision milestone. Until it does so, NOAA risks making a poor decision based on inaccurate or insufficient information—which could lead to unforeseen technical problems in the development of this instrument.

Efforts to Strengthen Government and Contractor Management Are Under Way, But Significant Work on Program Controls Remain

In the past, we have reported on poor performance in the management of satellite acquisitions.[12] The key drivers of poor management included inadequate systems engineering and earned value management[13] capabilities, unsuitable allocation of contract award fees, inadequate levels of management reserve, and inefficient decision-making and reporting structure within the program office.

NOAA has taken numerous steps to restructure its management approach on the GOES–R procurement in an effort to improve performance and to avoid past mistakes. These steps include:

- The program office revised its staffing profile to provide for government staff to be located on-site at prime contractor and key subcontractor locations.
- The program office plans to increase the number of resident systems engineers from 31 to 54 to provide adequate government oversight of the contrac-

[12] GAO–06–573T, GAO–06–249T, GAO/NSIAD–91–252, *Defense Acquisitions: DOD Has Paid Billions in Award and Incentive Fees Regardless of Acquisition Outcomes,* GAO–06–66 (Washington, D.C.: Dec. 19, 2005), and *Weather Satellites: Cost Growth and Development Delays Jeopardize U.S. Forecasting Ability,* GAO/NSIAD–89–169 (Washington, D.C.: June 30, 1989).

[13] Earned value management is a method, used by DOD for several decades, to track a contractor's progress in meeting project deliverables. It compares the value of work accomplished during a given period with that of the work expected in that period. Differences from expectations are measured in both cost and schedule variances.

tor's system engineering, including verification and validation of engineering designs at key decision points (such as the critical design review milestone).

- The program office has better defined the role and responsibilities of the program scientist, the individual who is expected to maintain an independent voice with regard to scientific matters and advise the program manager on related technical issues and risks.
- The program office also intends to add three resident specialists in earned value management to monitor contractor cost and schedule performance.
- NOAA has work under way to develop the GOES–R contract award fee structure and the award fee review board that is consistent with our recent findings, the Commerce Inspector General's findings, and other best practices, such as designating a non-program executive as the fee-determining official to ensure objectivity in the allocation of award fees.
- NOAA and NASA have implemented a more integrated management approach that is designed to draw on NASA's expertise in satellite acquisitions and increase NOAA's involvement on all major components of the acquisition.
- The program office reported that it intended to establish a management reserve of 25 percent consistent with the recommendations of the Defense Science Board Report on Acquisition of National Security Space Programs.[14]

While these steps should provide more robust government oversight and independent analysis capabilities, more work remains to be done to fully address this lesson. Specifically, the program office has not determined the appropriate level of resources it needs to adequately track and oversee the program and the planned addition of three earned value management specialists may not be enough as acquisition activities increase. By contrast, after its recent problems and in response to the independent review team findings, NPOESS program officials plan to add 10 program staff dedicated to earned value, cost, and schedule analysis. An insufficient level of established capabilities in earned value management places the GOES–R program office at risk of making poor decisions based on inaccurate and potentially misleading information. Finally, while NOAA officials believe that assuming sole responsibility for the acquisition of GOES–R will improve their ability to manage the program effectively, this change also elevates NOAA's risk for mission success. Specifically, NOAA is taking on its first major system acquisition and an increased risk due to its lack of experience. Until it fully addresses the lesson of ensuring an appropriate level of resources to oversee its contractor, NOAA faces an increased risk that the GOES–R program will repeat the management and contractor performance shortfalls that have plagued past procurements.

NOAA Has Established a Senior Executive Committee to Perform Oversight Role

We and others have reported on NOAA's significant deficiencies in its senior executive oversight of NPOESS.[15] The lack of timely decisions and regular involvement of senior executive management was a critical factor in the program's rapid cost and schedule growth.

NOAA formed its program management council in response to the lack of adequate senior executive oversight on NPOESS. In particular, this council is expected to provide regular reviews and assessments of selected NOAA programs and projects—the first of which is the GOES–R program. The council is headed by the NOAA Deputy Undersecretary and includes senior officials from Commerce and NASA. The council is expected to hold meetings to discuss GOES–R program status on a monthly basis and to approve the program's entry into subsequent acquisition phases at key decision milestones—including contract award and critical design reviews, among others. Since its establishment in January 2006, the council has met regularly and has established a mechanism for tracking action items to closure.

The establishment of the NOAA Program Management Council is a positive action that should support the agency's senior-level governance of the GOES–R program. In moving forward, it is important that this council continue to meet on a regular basis and exercise diligence in questioning the data presented to it and making difficult decisions. In particular, it will be essential that the results of all preliminary studies and independent assessments on technical maturity of the system and its

[14] Defense Science Board/Air Force Scientific Advisory Board Joint Task Force, *Report on the Acquisition of National Security Space Programs* (May 2003).

[15] GAO–06–573T; Department of Commerce Office of Inspector General, *Poor Management Oversight and Ineffective Incentives Leave NPOESS Program Well Over Budget and Behind Schedule,* OIG–17794–6–0001 (May 8, 2006).

components be reviewed by this council so that an informed decision can be made about the level of technical complexity it is taking on when proceeding past these key decision milestones. In light of the recent uncertainty regarding the future scope and cost of the GOES–R program, the council's governance will be critical in making those difficult decisions in a timely manner.

Implementation of GAO Recommendations Should Improve NOAA's Efforts to Implement Lessons Learned

To improve NOAA's ability to effectively manage the GOES–R procurement, in our accompanying report,[16] we recommended that the Secretary direct its NOAA Program Management Council to take the following three actions:

- Once the scope of the program has been finalized, establish a process for objectively evaluating and reconciling the government and independent life cycle cost estimates.
- Perform a comprehensive review of the Advanced Baseline Imager, using system engineering experts, to determine the level of technical maturity achieved on the instrument, to assess whether the contractor has implemented sound management and process engineering, and to assert that the technology is sufficiently mature before moving the instrument into production.
- Seek assistance from an independent review team to determine the appropriate level of resources needed at the program office to adequately track and oversee the contractor's earned value management. Among other things, the program office should be able to perform a comprehensive integrated baseline review after system development contract award, provide surveillance of contractor earned value management systems, and perform project scheduling analyses and cost estimates.

In written comments, Commerce agreed with our recommendations and provided information on its plans to implement our recommendations. In particular, Commerce intends to establish a process for evaluating and reconciling the various cost estimates and to analyze this process and the results with an independent review team comprised of recognized satellite acquisition experts. The agency is also planning to have this independent review team provide assessments of the Advanced Baseline Imager's technical maturity and the adequacy of the program management's staffing plans.

In summary, the procurement of the next series of geostationary environmental satellites—called the GOES–R series—is at a critical juncture. Recent concerns about the potential for cost growth on the GOES–R procurement have led the agency to reduce the scope of requirements for the satellite series. According to NOAA officials, the current plans call for acquiring two satellites and moving away from a technically complex new instrument in favor of existing technologies. While reducing the technical complexity of the system prior to contract award and defining an affordable program are sound business practices, it will be important for NOAA to balance these actions with the agencies' long-term need for improving geostationary satellites over time.

While NOAA is positioning itself to improve the acquisition of this system by incorporating the lessons learned from other satellite procurements including the need to establish realistic cost estimates, ensure sufficient government and contractor management, and obtain effective executive oversight, further steps remain to fully address selected lessons and thereby mitigate program risks. Specifically, NOAA has not yet developed a process to evaluate and reconcile the independent and government cost estimates. In addition, NOAA has not yet determined how it will ensure that a sufficient level of technical maturity will be achieved in time for an upcoming decision milestone or determined the appropriate level of resources it needs to adequately track and oversee the program using earned value management. Moreover, problems that are frequently experienced on major satellite acquisitions, including insufficient technical maturity, overly aggressive schedules, inadequate systems engineering capabilities, and insufficient management reserve will need to be closely monitored throughout this critical acquisition's life cycle. To NOAA's credit, it has begun to develop plans for implementing our recommendations. These plans include, among other things, establishing a process to evaluate and reconcile the various cost estimates and obtaining assessments from an independent review team on the technical maturity of a key instrument in development and the adequacy of the program management's staffing plans. However, until it addresses these lessons, NOAA faces an increased risk that the GOES–R program will repeat

[16] GAO–06–993.

the increased cost, schedule delays, and performance shortfalls that have plagued past procurements.

Mr. Chairman, this concludes my statement. I would be happy to answer any questions that you or Members of the Committee may have at this time.

DISCUSSION

Chairman BOEHLERT. Thank you. And as evidence of the high degree of professionalism we have come to expect from GAO, you finished exactly on the five-minute mark. And so I want to thank you for your testimony, and I want to thank you and your colleagues at the GAO for the outstanding work you do. Now we are going to recess. We have for the benefit of my colleagues three minutes and fifteen seconds to get over to the floor. We will get back as soon as we can. Thank you very much.

[Recess.]

ESTIMATED COST OF GOES–R PROGRAM

Chairman BOEHLERT. We will resume. Admiral, right to you. Based on NOAA's scrub of program requirements, what is the estimated cost for the restructured GOES–R program? Are you trying to stay near the original $6.2 billion estimate, and, if so, are you sacrificing technical capability or advances to stay within this number?

Admiral LAUTENBACHER. We are trying to look at a range of options so that we can provide enough information for the Secretary and for OMB, for the decision-makers with the Administration, as well as Congress in oversight role to insure that we have the best program that is technologically risk—levels of risk that we can live with, that the cost is reasonable. We are trying to obviously look for options that are less than the full cost of the 11—roughly $11.2 or $0.4 billion that——

Chairman BOEHLERT. Is it closer to $6.2 billion or are you just giving us a broad range of $5 billion——

Admiral LAUTENBACHER. I am, and we are at a point where it is hard to sit here and say that. If you ask me personally what I am trying to do, I am trying to keep it within about seven to nine. I would like to at least have a range in there for us to discuss as we go through the process as to what is reasonable based on what I know about the program now.

Chairman BOEHLERT. Do you have some feel of the time table of when this analysis might be concluded?

Admiral LAUTENBACHER. We have to conclude this analysis in the spring time because we expect to get the concept studies—we have extended the contractors for three months so that we can get more information based on the fact—based on this cost information. Then we will do the independent cost estimates and set up a program base line. There is no program base line for this. And then go to the Secretary of Commerce for a decision this summer, June to July of 2007. So that is the time frame.

CONGRESS' CONTINUING OVERSIGHT ROLE

Chairman BOEHLERT. Let me ask Mr. Powner, what questions should this committee and Congress as a whole continue to ask

about GOES–R as the program moves forward to insure it remains on track?

Mr. POWNER. Well, first of all, with that cost estimate, I think there is a fundamental question when we start throwing out numbers how many satellites we are considering. That is the first thing that I think we want to get clear in terms of whether it is four satellites, two satellites, are we at eleven or are we at six or are we at the seven to nine range, so that is quite unclear right now. Going forward, I think there are a couple of things that we need to make sure. We have a number of recommendations in our report that talks about reconciling different cost estimates. We need a real clear independent cost estimate that is real and that is realistic and not optimistic, so that is the first thing.

The other thing we need going forward is to insure that we have adequate systems engineering on this program. This is a program that is going to compete with resources with the NPOESS program. The NPOESS program still doesn't have that management team build out, so that is going to be real key when we start holding contractors' fee to the fire from a technical perspective. One other thing to consider going forward is the arrangement with NASA. NASA right now is responsible for the sensors. In terms of what NASA's role is going forward that is still being negotiated, and given NOAA's lack of experience in acquiring these large satellite acquisitions, it would make sense for NASA to stay on board as long as possible and help NOAA in this endeavor.

Chairman BOEHLERT. Admiral, what do you say in response to that?

Admiral LAUTENBACHER. I agree with everything that has been said. I think that we should be able to do all the things that he has asked and——

Chairman BOEHLERT. So the two of you are on the same wave length?

Admiral LAUTENBACHER. I believe we are on the same wave length, and we appreciate the independent view, and we got another team of independent experts and we want the independent view so that we are doing the most logical thing that we can do to make this program come in.

Chairman BOEHLERT. So you will continue to let the GAO report be a guide for you?

Admiral LAUTENBACHER. Oh, absolutely. Absolutely.

Chairman BOEHLERT. Any further recommendations, Mr. Powner, that were not contained in your recommendations?

Mr. POWNER. A couple other things to consider. If you look at what has happened with dropping the HES satellite, you know, historically DOD has gone to this approach where they are moving more to an incremental development with satellites. That is something that is very common in the technology world where you deploy lesser chunks of functionality more quickly. That hasn't been well accepted or associated with satellite acquisitions because typically the acquisition cycle is so long. But what we ought to consider is taking—we always talk about these leaps in technology. We ought to consider smaller steps advancing the technology, and maybe that would be more realistic going forward.

One other thing, Mr. Chairman, I think that is important to consider is with NOAA not having much experience leading acquisitions in the satellite world there are critical design reviews throughout the process that are extremely important when we go from preliminary design to development or from development into production modes, and it would be very important that there is clear criteria that they follow at all those key meetings and if that is done with rigor, it ought to go on in a forward basis.

Chairman BOEHLERT. Thank you very much. Mr. Gordon.

RISK OF NOAA'S SOLE PROCUREMENT RESPONSIBILITIES

Mr. GORDON. Mr. Powner, you and your colleagues serve a great function for our country and Congress, and I want to thank you. You have talked, I guess, generally about this but just specifically what do you believe are the greatest risks associated with NOAA's decision to take on sole procurement responsibilities and what information should Congress and the public have to insure that GOES program remains on track?

Mr. POWNER. A couple of key risks going forward. One, I think it starts with executive level involvement. We have a good structure in place right now. It will get more difficult going forward because as the bad news goes up the chain typically that bad news isn't escalated well. So that executive level involvement will need to be in place and we will need to hold both government and contractor personnel accountable, so that is one of the key risks is maintaining that involvement throughout.

Another key area is continuing to keep the technical complexity within the bounds that are doable. I think we have seen that on the HES sensor but there would also be other technical issues coming up with the other sensors. In terms of what the public needs, what the Congress and the public needs going forward, I think information coming out of these monthly executive meetings, we can start with that. We have looked at some of that information. There is clear identification of risks, what is being done to mitigate those risks.

Mr. GORDON. Excuse me. Are you copied on those? Do you get pretty much those minutes of those reviews?

Mr. POWNER. Yes, we get those and as part of our reviews we request those and get those key minutes.

Mr. GORDON. Is it pretty much the same time or is it—how much lag time?

Mr. POWNER. Usually there is some lag time but it differs. I mean if we look at the NPOESS program, we actually get invited now to those executive meetings where we are in attendance and that is a step in the right direction where we get timely information that we share with your staff.

PRICE ESTIMATES

Mr. GORDON. And we talked a little bit earlier about NPOESS and since you got an understanding in this area, I am a little skeptical of the estimate of the $11.4 billion. What is your feeling on that number now?

Mr. POWNER. We have very little details behind the 11.4. I think these numbers that are being thrown out, the 6.2, the 11.4, the seven to nine, I mean there are rough order of magnitudes right now, and we don't have detailed information behind those so we don't have great confidence in those numbers.

Mr. GORDON. Again, thank you for your service.

Chairman BOEHLERT. Mr. Gutknecht.

Mr. GUTKNECHT. Thank you, Mr. Chairman. I also serve on the Government Reform Committee, and yesterday we had what amounted to our seventh hearing on some of the waste and mismanagement in terms of the contracting relative to reconstruction efforts in Iraq. And so compared to those hearings this is like a walk in the park, but nonetheless it seems to me that this committee has a special obligation to see that America's taxpayers are well served and we get fair value for the amount of money that we pay for these things. Admiral Lautenbacher, let me ask you a fairly simple question but I hope you can give us a fairly sophisticated answer.

IMPROVEMENTS OVER NPOESS PROGRAM

What assurances do we have that senior executive reviews of the GOES–R will be better than we experienced with the NPOESS project?

Admiral LAUTENBACHER. I think that we have put in place much more auditable processes, and that we have a flow of information which is, first of all, there are duplicate channels of information coming up. The flow is much faster. And we have minutes, and we are having reportable types of events so it is not trust me that we are doing this. So these will be there for people to see. We will continue to work with the GAO, the IG in the Department of Commerce, and to make sure that what we have is open and available and it can be part of a dialogue to insure that everybody is comfortable with doing the best we can.

Mr. GUTKNECHT. Mr. Powner, let me come back to something, and I think this is really about overall management. Essentially what GAO says is that the performance of the senior executive council was really not up to par, and maybe I am being a little harsh on that. What assurances can you give us that they will now figure out how to better manage this project and the money that they are given?

Mr. POWNER. Well, we clearly had those findings related to the NPOESS acquisition. Concerning the GOES acquisition, we are early in the acquisition cycle, and what we have seen on GOES is there is a program management council made up of key executives, and they report to the Admiral. The frequency of those meetings and the makeup of that team, we have actually been complimentary to date of the structure. I think there are many lessons learned from the NPOESS experience so we are actually—we have not been critical of the executive level oversight on GOES to date.

Mr. GUTKNECHT. Thank you.

Mr. SCHWARZ. [Presiding] The gentleman from Oregon, Mr. Wu.

Mr. WU. Thank you, Mr. Chairman. I would like to enter my original opening statement into the record.

Mr. SCHWARZ. Without objection.

CONCERNS ABOUT GOES–R AND SIMILARITIES TO NPOESS

Mr. WU. And I would like to just make a few comments based on what I have read about GOES–R, what I have been briefed on about GOES–R, and our prior experiences with NPOESS. And the chairman, Ranking Member Gordon, Vern Ehlers, and I, have worked very, very hard to try to understand what happened with NPOESS, not so much with the rear view mirror perspective of who to blame but primarily looking out the windshield to try to find what we are to learn from the NPOESS experience and how to apply that to future acquisition programs. And from that perspective, I remain concerned. I remain very, very concerned. The GAO report and other materials seem to indicate that some of the problems which occurred with NPOESS continue to plague GOES–R.

Some of those very, very important ones are that the level of risk in some of the primary instruments, to mention ABI for one, is very, very high, that some of the instrument development and the contracts are being let before a prime contractor is selected, and that puts the prime contractor sometimes in a position of accepting what people assure them will happen with the instruments and their compatibility and their interference with each other, and that was a problem with NPOESS and that seems to be repeated here with GOES–R. The primary instrument is already demonstrating cost overruns as is the overall program, and I have yet to see a layout of what the probability of success is, whether we are facing an S-shaped curve, a flat curve or a very steep linear curve and whether these cost estimates, which have already moved on us, whether they are at the 50 percent point, at the 20 percent point or the 80 percent point, and the determination of the shape of that curve should guide us as to whether some of these contracts should be fixed cost contracts or whether they should be cost plus contracts.

And I for one have not been privy to any of that information. To the extent that this committee has not been briefed in to that information, I would very much like to see that and I would like to turn it over to Mr. Powner and Administrator Lautenbacher for your comment and answer.

Admiral LAUTENBACHER. You touched on a lot of subjects, and remind me, I probably will not remember all that you brought up, but let us talk about the GFE versus CFE. What we learned on NPOESS, first of all, we did try to start the contracts on the instruments in NPOESS early enough. It turns out it wasn't early enough to meet the schedule given the technological underestimation that was made at the time when people thought they could build these instruments, so we have started the instruments. Actually there is more time for the GOES–R instruments to be developed based on NPOESS. Now the issue of the prime contractor being able to manage this subcontractor is a huge one, and it is a huge problem we had with NPOESS.

The concept at this point, and I won't say—it could change because we are still in the preliminary design phase, is that these instruments will be GFE. They will be managed by the technical experts in NASA and they will have government oversight clearly on

them and we will not be reliant on contractors to do all of that work which has not turned out well in the case of NPOESS. So the concept is to go in that direction. As far as the cost goes, these are preliminary estimates. We are still—there is no cost overrun in the sense there is no baseline yet and nobody is committed to spending money that is overrunning. So we can decide that now. We are in that debate. We are in that formative phase and we want to work with you and provide you as much information as we can so we can have your thoughts on that.

Mr. WU. Well, thank you very much, and I will take as many of your responses as you can in writing. The red light is on already. But I am deeply concerned about this because you all are going to try to do this on your own, and, you know, when I stepped into medical school the dean in the medical school said, you know, the only true reward for hard work and success is a harder job. What he didn't say is if you screw up one patient or damage one patient, you get to work on the President of the United States next. Now your track record with NPOESS has been less than dramatically successful, and you are asking us to trust you with a larger project in essence.

I, for one, have my deep concerns at this point in time, but I look forward to staying closely in the loop, as I am sure you do, to closely manage this project and this committee to exert the proper oversight.

Admiral LAUTENBACHER. I agree with you, and this is a big project, and we will do everything we can to make it successful. Thank you.

Mr. WU. Thank you.

Mr. SCHWARZ. The gentleman's recollection of medical school is a little different than my own. I spent four years trying assiduously to avoid the dean. The gentleman from Texas, Mr. Neugebauer.

NEW TECHNOLOGIES AND INCREASING COSTS

Mr. NEUGEBAUER. Thank you, Mr. Chairman. I want to back up to Mr. Wu's testimony—the thing that I think concerns me is I have looked back over the track record and history here is the number of satellites keeps going down and the number—the cost keeps going up. What kind of benchmarks, number one, are you putting in place, and, secondly, are we trying to make this a Cadillac when a Chevrolet will do? In other words, how much incremental benefit are we getting of striving for these new technologies over what the current technologies are?

Admiral LAUTENBACHER. We are absolutely not trying to make it a Cadillac, and that is why we have taken a decision to defer one of these instruments that we know now. I mean we have—at least I am convinced that it is just too much of a step forward without the proper development being done so we need to go back and do more development. I am going to work with NASA on trying to get more development. In terms of the number of satellites, the concept is service on orbit so the contractor can give us options as to having more satellites that have less reliability or fewer satellites that have greater reliability and coverage. And part of that is what we are trying to figure out now. That is what these three teams of contractors are doing. They are coming in with ideas on what should

the number of satellites be. Our concept is for a coverage of a certain number of years.

We want to maintain coverage, full coverage, of the United States for severe weather and our weather models for a certain period of time. And so some contractors say, well, we can make our satellites last longer and it is cheaper to us. We need to examine that when they come in there with their proposals, so we are not trying to predetermine the number of satellites. We are trying to predetermine the level of service to the United States.

CONTRACTORS ROLE IN THE GOES–R PROJECT

Mr. NEUGEBAUER. Well, and it does nothing—I guess the question is as you look at the different models maybe a smaller number, better coverage, at what point in time will there be one contractor that will then provide all of those satellites or are you looking at saying here are some long-term solutions, here are short-term solutions, where are you headed?

Admiral LAUTENBACHER. The way this usually operates, and I am not saying it can't be changed or shouldn't be changed necessarily but we have a series of contractors that compete at a preliminary design stage to come in with the best concept, the best idea, and then we take that information, put our independent review teams on it, cost teams, technical experts, and come up with an RFP to come in for people to—and they will then compete for one contract. That has been the model in satellites that has worked most efficiently rather than having saying two manufacturers that are producing satellites. The business isn't big enough to do that so we end up necking down to one contractor for a series which may last for 16 to 20 years of coverage and then you go on to the next one.

Mr. NEUGEBAUER. And in that process, what kind of criteria are you looking for, in other words, one, ability to develop the product that you ordered but secondly the track record of that company's ability to deliver that. Particularly you deliver it within the budget constraints or the price. And I think the question, and I didn't hear you answer that, whether that was going to be a fixed price or if that was going to be a cost plus.

Admiral LAUTENBACHER. In terms of the contract for the RFP that we will put out have not been set yet so our contracting experts or acquisition experts will sit down and look at it. Previous contracts have been cost plus because of the technological increases in this. We have had a fixed price contract for the current series that is up there now that goes in which we are just starting to launch. Unfortunately, the contractor lost money on that and there was some long discussion about how to deal with that. So we have—all of the concepts are in play for either fixed price. A contractor won't take on huge leaps in technology obviously for a fixed price. My opinion again. We are still in the early part of it, but most of the time these have been cost plus types of contracts.

Mr. NEUGEBAUER. Mr. Powner, is that right, I'm sorry, what is the GAO's experience in that arena of your recommendation fixed price versus cost plus?

Mr. POWNER. Well, I think it depends on the circumstances. Whenever you can push for a fixed price, you clearly want to do

that. And there is a question here in terms of how well defined the technical complexity is going forward on these sensors in the program, whether it allows for a fixed price, or whether there is some unknowns that the contractors aren't going to be real receptive to accepting a fixed price consistent with what the Admiral mentioned.

Mr. NEUGEBAUER. Thank you.

Mr. SCHWARZ. The gentleman from Texas, Mr. Green.

Mr. GREEN. Thank you. And I thank the Ranking Member and the Chairman. And, if I may, I would like to make a special presentation on behalf of the Members on my side of the aisle who are here today, and with the consent of my Ranking Member. It has been a preeminent privilege for me to serve on this committee under the leadership of Chairman Boehlert, and I would like to as a small expression of appreciation present to him this certificate and it has a flag with it, and I shall read what the certificate bears.

It reads, "This flag was flown over the United States Capitol and presented to the Honorable Sherwood Boehlert, Chairman of the U.S. House of Representatives Committee on Science in recognition of his outstanding service to his country and his leadership in the advancement of science and technology." We do this for several reasons. One, of course, is that he has served us well. Yesterday was his birthday, as I understand it, his 30th for the second or third time, but also because he is leaving us. And he has been a real uniter. I have admired the way he and my Ranking Member, soon to be Chairman, how they have worked well together. And I am just so honored to be here and to do this, and so I would like to present this to his staff member at this time in his absence. And I trust that wherever you are, sir, you will remember that there are those of us who will be here, and we will try to as best we can carry on your good work, and I thank you very much. I yield back the balance of my time.

DATA CONTINUITY

Mr. SCHWARZ. Mr. Green yields back. Thank you, Mr. Green. That is a very kind gesture on your part. My understanding is that neither Mr. Inglis nor Mr. Diaz-Balart have any questions. For the record, I don't want to imply by asking these questions that I have any extraordinarily sophisticated knowledge of this topic. I am on the learning curve. But for the record, I have a couple of questions, Admiral Lautenbacher, if you don't mind. First, what options are being explored to insure data continuity for the cancelled sensor? Are you considering still providing improvements over current capabilities, just maybe not as much of an improvement as you had hoped for?

Admiral LAUTENBACHER. And the answer to that is yes. We want as an absolute minimum continuation of the current capability and data. We have begun a study of alternatives to look to see what is possible for improvements that will be within the ability of the technical community to deliver at a cost and schedule. So we are doing a complex study or complete study analysis of alternatives so we can get somewhere in between hopefully.

Mr. SCHWARZ. And the next question has to do with the users of the data that is produced. How will you involve the user group in the analysis of alternatives for the new GOES–R program scope? Please be specific about the process you will use to get input from all users of geostationary satellite data.

Admiral LAUTENBACHER. We have a users group which includes all the users of geostationary satellite data. It has a leader and a chairman, co-chairman, and a process to collect the information. The information is reported to my deputy who then brings it into the program office and with our program management council. The requirements will be then bounced against the studies that come in from the contractors, and we will look at the best arrangement of requirements versus cost and schedule and performance in that arena.

Mr. SCHWARZ. Thank you. Mr. Gordon, any further comments? Before we bring the hearing to a close, I want to thank our panelists, Admiral Lautenbacher, Mr. Powner, for testifying before the committee today in the stead of Chairman Boehlert. If there is no objection, the record will remain open for additional statements from the Members and for answers to any follow-up questions the Subcommittee may ask of the panelists. Without objection, so ordered. The hearing is now adjourned.

[Whereupon, at 11:30 a.m., the Committee was adjourned.]

Appendix:

Answers to Post-Hearing Questions

ANSWERS TO POST-HEARING QUESTIONS

Responses by Vice Admiral Conrad C. Lautenbacher, Jr. (Ret.), Under Secretary of Commerce for Oceans and Atmosphere, National Oceanic and Atmospheric Administration

Questions submitted by Chairman Sherwood L. Boehlert

Q1. In past Geostationary Operational Environmental Satellite (GOES) procurements, the National Aeronautics and Space Administration (NASA) has managed the procurement on the National Oceanic and Atmospheric Administration's (NOAA) behalf. In the past, for GOES–R you have stated that NOAA will manage the procurement, but your testimony for this hearing states that NOAA is still discussing the procurement model with NASA.

Q1a. Does this mean you are considering returning to having NASA manage the entire procurement?

A1a. No. Previous GOES acquisition and operations programs included both NOAA and NASA contracts for the end-to-end space and ground systems. For the GOES–R program, NOAA and NASA agree that we must leverage the unique expertise of each organization. We are also in general agreement that the chosen management approach must include a stronger NOAA system program management role than in prior GOES procurements. However, as part of managing program risks, the acquisition strategy is one of the things being discussed with NASA and reviewed by our Independent Review Team.

Q1b. What options are you reviewing concerning the assignment of specific tasks to NOAA and NASA?

A1b. NOAA and NASA have agreed in principle on a framework in which NOAA retains overall program management authority. As noted in our testimony, the spacecraft instruments will now be treated as Government Furnished Equipment (GFE) and NASA will continue to manage those procurements. The options under consideration with NASA and the Independent Review Team involve management structure and acquisition strategy. Any recommendations resulting from this process will need to be reviewed by NOAA senior management, the Department, and NASA policy officials before any decisions are made.

Q1c. When do you expect the Memorandum of Understanding (MOU) between the agencies to be completed and signed?

A1c. We are working to get the Interagency Agreement in place as soon as possible.

Q1d. If the details of the MOU are already generally in place, please clarify the relationship between NOAA and NASA with regard to the GOES–R procurement by specifically explaining each agency's responsibility for each component of the program, including the overall procurement, and provide specific details regarding the proposed MOU between the agencies that will govern the relationship.

A1d. The proposed MOU will be signed by the NOAA Deputy Under Secretary and the NASA Deputy Administrator and will govern all managerial and acquisition aspects of the NOAA/NASA GOES–R relationship. Its content is very similar in scope to NOAA/NASA MOUs governing the current NOAA/NASA relationship for existing operational environmental satellite programs.

Specific roles and responsibilities of NOAA and NASA will be delineated and formally documented. While specific details are being negotiated, it is agreed that NOAA will provide the overall System Program Director (SPD), who will be responsible for overall program management. NASA will provide key project leads supporting the SPD. The MOU outlines funding responsibilities, agreement on payment of NASA administrative fees, and in-kind provisions such as sufficient office space at the Goddard Spaceflight Center for the GOES–R program office.

In addition to the MOU, NOAA and NASA will complete lower-level management plans that will implement the MOU.

Q2. Did you ask for feedback from users or contractors prior to making the decision not to let the contract for the Hyperspectral Environmental Suite (HES)? If so, what was the process and timeline for soliciting feedback from users or contractors? What specific reaction to the decision, if any, did you receive from the users and contractors?

A2. The process we used to address the GOES–R affordability issue this spring and summer included user representation at every step. Government users were represented on the NOAA/NASA Team that developed and analyzed the baseline program and possible alternatives. The review process for the results of the Team effort included the GOES–R Operational Requirements Working Group (GORWG) and NOAA Observing Systems Council (NOSC). Contractor data regarding the technical risks and costs of HES and reduced capability alternatives, such as the removal of the coastal waters requirements, was utilized in the assessment of the costs and benefits of the GOES–R alternatives.

The users strongly endorsed having advanced sounding capabilities like HES but also endorsed the decisions regarding HES in the context of the GOES–R requirements priorities, resources available, associated risks, and the programmatic alternatives available. The contractors were disappointed with the decision and have expressed interest in supporting efforts to continue advanced sounding efforts.

Q3. Did you consider making minor changes to the HES requirements instead of outright cancellation? If so, why didn't those minor changes work to reduce the risk and expense?

A3. During the on-going HES Program Definition and Risk Reduction (PDRR) phase a number of studies were conducted looking at ways to reduce the cost of HES including changes and/or reductions. However, the core requirements for the sounding and coastal waters capabilities results in an instrument architecture with a certain size and technical complexity. This instrument complexity along with the spacecraft accommodations and ground processing to produce the associated products resulted in a risk that was inconsistent with NOAA's operational requirements.

Q4. One of the GOES–R independent review teams has been looking at HES and is due to report to about it this fall. Also, the contractors competing to build HES have until December 2006 to complete their preliminary design concepts for the instrument. You made the decision to cancel this sensor before the independent review team gave you their final report and before the contractors completed their preliminary design concepts for the instrument.

Q4a. When you made the decision to cancel HES, what information did you consider with respect to cost, schedule and technical issues and minimum user requirements?

A4a. We assessed the technical, cost and schedule risks associated with the entire HES system, which included the instrument, spacecraft integration and ground data processing risks. Assessment participants included the full range of GOES–R program participants: NOAA and NASA government personnel, the Program Definition and Risk Reduction (PDRR) contractor teams, and in-house support contractors. We considered the schedule for HES, which did not support the first GOES–R launch date. Our conclusion was that the technical maturity of the HES design was not sufficient enough to be flown on an operational spacecraft. We retained the requirement to maintain sounding capability equivalent to that of the present GOES spacecraft. Together with our users, we are presently assessing alternative technical solutions to meet these requirements. This assessment is on-going and is in the initial stages. When completed in February 2007, it will allow NOAA to determine what alternatives might go forward for further study. Mechanisms for external agencies to provide input is through the GOES–R Operational Requirements Working Group (GORWG), the NOAA Observing Systems Council (NOSC), various NOAA Goal Teams, as well as the NOAA Cooperative Institutes at the University of Wisconsin, Colorado State University, and Oregon State University.

Q4b. Why didn't you wait until the independent review and the final designs were available to make your decision about HES?

A4b. Concerns about HES technical, cost, and schedule risks became apparent following the PDRR System Requirement Reviews (SRRs) which occurred in the spring of 2006. Each of the three contractor teams expressed concerns about the HES and recommended that the GOES–R program office make a decision about HES as soon as possible. The Independent Review Team had also begun its work at that time and had also raised concerns about the HES risks. Subsequent work in-house and with the contractors refined those initial concerns. We used this information to make the decision to remove HES from GOES–R.

By making the decision in the late summer, we minimized impacts on the PDRR contracts and were able to provide direction to the contractors to modify their concepts to reflect the re-scoping decisions. The timing of our decision took into account

detailed technical analysis that confirmed earlier concerns, minimized impacts to the PDRR contracts and overall program schedule.

Q4c. Did you seek the input of this independent review team and/or the contractors in making that decision?

A4c. Following the first two Independent Review Team reviews of the GOES–R program, the IRT expressed concern about the HES risks and suggested that development risks for HES exceeded those of an operational satellite system. Concurrently, our program definition and risk reduction (PDRR) prime contractor competitive teams had each expressed concern about HES development risk. Both of these inputs weighed heavily in our decision.

Q5. In your testimony you mentioned that one of the reasons for not building HES is that it will affect the ground system. Please provide specific examples of how HES would affect the GOES–R ground system and why this led to your decision to not build the sensor.

A5. The magnitude and complexity of the additional software and hardware required to produce the HES sounder and coastal waters products was one of several factors influencing our decision to eliminate the HES. By taking an overall systems approach to the HES decision, we were able to make a system-level determination of HES risks. GOES–R ground system experts determined that eliminating HES-related algorithms and supporting computer hardware and software accounted for an approximate 40 percent decrease in ground system complexity. In addition to nonrecurring development costs, recurring costs which required periodic upgrade and maintenance of the ground system were proportionally reduced.

Q6. In your testimony you stated that the GOES–R User Group meets regularly to review the program.

Q6a. Please supply a list of members of the User Group.

A6a. The primary User Group is the GOES Operational Requirements Working Group (GORWG); membership consists of:

- Senior Representative from primary user National Weather Service (Chair)
- GOES–R Senior Scientist
- Senior representatives from the four Major NOAA Goal Teams:
  - Weather and Water
  - Climate
  - Commerce and Transportation
  - Ecosystems
- Senior representatives from NOAA HQ staff elements and Operating Branches:
  - Program Planning and Integration
  - Programs, Analysis, and Evaluation

The GORWG reports to the NOAA Observing Systems Council (NOSC). The NOSC consists of:

- Assistant Administrator (AA) for Weather Services (Co-Chair)
- Assistant Administrator for Satellite and Information Services (Co-Chair) and senior staff members
- Senior Representatives from NOAA Line Offices and staffs:
  - Chief Information Officer
  - Office of Marine and Aviation Operations
  - National Marine Fisheries Service
  - National Ocean Service
  - National Weather Service
  - Office of Oceanic and Atmospheric Research
  - Programs, Analysis, and Evaluation
  - Plans, Programs, and Integration

Q6b. How often does the User Group meet?

A6b. Currently the GORWG meets every two weeks. The NOSC meets monthly or as necessary.

Q6c. What type of information does the User Group review?

A6c. The GORWG reviews information at all phases of the GOES–R program.

- Requirements Identification Phase: Reviews higher-level user observational requirements for possible allocation to geostationary satellite systems such as GOES–R.
- Program Definition and Design Risk Reduction (PDRR) Phase: Reviews system alternatives proposed by the GOES Program Office (GPO) to assure requirements are satisfied.
- Acquisition and Operations (A&O) Phase: Will monitor and assess the program during manufacturing and test to assess the ability of the program to meet requirements.

Q6d. Is there a standard procedure in place for the GOES–R program office to seek the input of the User Group regarding possible modifications to user requirements if the GOES–R program encounters cost, schedule or technical problems going forward?

A6d. Yes. The primary senior management decision-making body for GOES–R is the NOAA Program Management Council (PMC). Many of the same organizations who have members on the NOSC, also have members on the PMC. The NOAA Deputy Under Secretary (DUS) is the PMC chair.

GOES–R issues surfacing at the PMC meetings requiring user input are assigned as action items to the NOSC, which evaluates all user-specific concerns and makes a recommendation to the DUS. The DUS brings the recommendation to the PMC for a decision. Similarly, issues arising through the NOSC affecting GOES–R are sent to the PMC for resolution.

Q6e. Is there a process for the User Group to submit grievances about GOES–R program decisions? If so, what is this procedure? If not, do you think such a procedure would benefit the program?

A6e. Yes, a process exists. Users can independently raise issues about GOES–R decisions through the GORWG and NOSC if consensus cannot be reached at the working level. The decision authority is the NOAA Administrator (Under Secretary of Commerce for Oceans and Atmosphere).

Q6f. Does the User Group operate under the Federal Advisory Committee Act?

A6f. No. The NOSC and GORWG were organized by direction and authority of the NOAA Administrator. These groups are not required to be established under FACA since their members are all federal employees.

Q7. What has NOAA done to identify a minimum set of requirements for Advanced Baseline Imager (ABI) and other critical sensors on GOES–R? If you run into serious technical problems with ABI, will you consider scaling back the requirements for the sensor? If so, do you have a strategy choosing which requirements will be reduced or eliminated?

A7. NOAA has identified GOES–R top-level system requirements in the GOES–R Level 1 requirements document which is presently in draft form. Following completion of the PDRR phase of the GOES–R acquisition program, the Deputy Under Secretary (DUS) will approve the Level 1 requirements document in its final form after NOSC formal review and concurrence. If we consider reducing ABI requirements in the future, we would follow the same procedures as we did for the HES, which would result in a coordinated approach presented to the DUS for approval.

Q8. In your testimony you explained that a group of senior NOAA officials, the NOAA Program Management Council, meets monthly to review GOES–R.

Q8a. What kind of information does the Council review?

A8a. The NOAA Program Management Council (PMC) provides the forum for regular review and assessment of selected NOAA programs and projects. The PMC is a decision-making body which is chaired by the Deputy Under Secretary.

The PMC is briefed on monthly assessments of performance versus plan in the following areas:

- Technical Performance—actual versus planned performance, risk identification and mitigation strategies
- Budget Performance—actual versus planned costs (Earned value), status of funds, budget threats, budget reserves posture

- Schedule Performance—critical path analysis, changes since last month, schedule threats, schedule reserves posture

Additional responsibilities include:

- Reviewing proposed new activities and/or scope to ensure risk, schedule, integration and budget impacts to existing programs are understood and realistic
- Commissioning independent assessments as needed, and reviewing both the results of the independent assessment and reviewing and approving the program/project's proposed response plan
- Recommending alternative actions, including termination of programs/projects or activities within programs/projects, when appropriate.

Q8b. The Government Accountability Office (GAO) recommends this group review the results of all preliminary studies and independent assessments on technical maturity of the satellite instruments. Will the Council review those studies and assessments? If not, why not?

A8b. NOAA agreed with the GAO recommendation and noted that the PMC has already addressed GOES–R schedule, technical and cost issues. Instrument design and acquisition status is reviewed at every PMC.

Q9. In your testimony you say that you meet regularly with your Deputy to discuss GOES–R. How often do these meetings occur? What materials do you review at these meetings? For example, do you review the independent review team reports and cost estimates, or do you review summaries of the reports and cost estimates?

A9. The NOAA Deputy Under Secretary (DUS) is in charge of the Program Management Council (PMC), which oversees management of the GOES–R Program at its monthly meetings. The DUS and Under Secretary of Commerce for Oceans and Atmosphere meet weekly to discuss a range of issues, including GOES–R. In these meetings, they discuss information from the PMC, as well as available updated information. The Under Secretary also holds meetings on key GOES–R related topics—such as on information from the independent review team or regarding the restructure of the GOES–R program—as often as necessary. The Under Secretary has had discussions directly with Tom Young, the Chair of the Independent Review Team, twice. Monthly satellite-related meetings are being formalized where the Assistant Administrator for Satellite and Information Services can brief the Under Secretary and the DUS on current issues pertaining to NOAA's satellite programs.

Q10. In the National Polar-orbiting Operational Environmental Satellite System (NPOESS) program, the critical design review (CDR) for the Visible Infrared Imager Radiometer Suite was conducted without building a full engineering design unit. Now GAO has expressed concern about inadequate plans for technical review of the key GOES–R sensor, the ABI, especially at important decision points. Will a full engineering design unit be built prior to CDR's of the GOES–R sensors, in particular of ABI? If not, why not and in that case what specific steps will be taken to ensure that the CDR's are sufficiently rigorous?

A10. Yes, for GOES–R, more rigorous design reviews are already incorporated.

Additionally, we are applying NASA Goddard Space Flight Center (GSFC) Office of Systems Safety and Mission Assurance Systems Review Office guidelines, and have adopted all NASA and NASA GSFC technical, management, safety, and mission assurance processes into the GOES–R program management structure and processes.

The decision to build an engineering development unit (EDU) is tied to the instrument's complexity and cost. The Advanced Baseline Imager (ABI) development contract includes a requirement for an EDU, as well as additional engineering models of critical components. EDUs will also be developed for each instrument in the Solar Imaging Suite (SIS) and the Space Environment In-Situ Suite (SEISS).

Because the final instrument, the Geostationary Lightning Mapper (GLM), is still in the formulation phase, we have not yet determined if complexity, cost and technical risk requires an EDU.

Q11. In your testimony you say you have hired a team of independent satellite experts to provide periodic reviews of GOES–R.

Q11a. How often will the independent team review the program? On a regular basis or just at key decision points?

A11a. NOAA has established a GOES–R Independent Review Team (IRT) comprised of senior industry and government space acquisition experts. This group will support four review tasks:

1) adequacy of current activities to support GOES–R objectives,
2) readiness of program to proceed into development phase,
3) annual progress reviews during development phase, and
4) review of major development milestones.

The IRT will meet and provide advice to support all major program decisions. Additionally, the IRT Chairman has held one-on-one meetings with senior Department of Commerce officials, and the Under Secretary of Commerce for Oceans and Atmosphere and the Deputy Under Secretary.

Q11b. What aspects of GOES–R will the independent team review—i.e., the entire program, specific issues or sensors?

A11b. The independent reviews will address the entire GOES–R program and consider, as appropriate, technical, programmatic, and management areas to highlight risks and recommend actions.

Q11c. What type of products will the independent team provide to NOAA?

A11c. The IRT will produce recommendations that will be presented to NOAA and NASA management through their respective Program Management Councils.

Q12. In May 2006 you testified to this committee about an Inspector General report on NPOESS. As part of that report, NOAA is required to develop a Corrective Action Plan about how it will implement the IG recommendations. That plan, required by July 11, is still not complete. When do you expect to finish the Corrective Action Plan for NPOESS and why has it been delayed?

A12. The original action plan was transmitted from the NOAA Administrator to the Department of Commerce Inspector General on July 7, 2006. The plan was modified and resubmitted for IG approval on September 29, 2006. The revision was necessary to clarify details in the action plan.

Q13. GOES–R was originally estimated to cost $6.2 billion. During the hearing, you attributed the cost estimate growing to roughly $11 billion to (1) a $2.6 billion inflation cost, (2) $800,000 for management reserve, and (3) $1.58 billion more for sensor development. Also, you said that now NOAA is restructuring the program and that you expect costs of the restructured program to be between $7–$9 billion. Since the three growth factors (inflation, management reserves, and complex sensor development) are likely to still be factors under the restructured program, what, if any, cost reduction on these factors do you expect by restructuring the program?

A13. The restructured program resulted in the elimination of the HES and a reduction in the number of spacecraft. The reduction in satellites, and instruments, impacted costs for ground operations and life cycle support costs. The $11 billion figure was a preliminary estimate for one potential system configuration. The restructuring addresses not only configuration changes, but also the assumptions used in the preliminary cost estimate. While inflation and management reserve costs are likely to still be growth factors under the restructured program, improvements in the cost assumptions could result in reductions from the preliminary estimate.

Q14. NOAA's restructured program reduces the numbers of satellites purchased from four to two. Since the Nation will still need those later two satellites, isn't this exercise simply deferring the costs in order to come up with an acceptably low cost estimate? What are the benefits of purchasing two instead of four satellites, other than reducing the program's overall cost?

A14. No. Given the longer on-orbit design life planned for the GOES–R series satellites, the two satellites are designed to provide continuous GOES operational coverage for a period comparable to that expected of the GOES–N series with three satellites. Two is considered a minimum number of satellites for the initial buy. The second satellite must be in production and available in case there is a problem with the launch of the first satellite. This approach supports our initial acquisition needs and provides an opportunity for performance based decisions associated with the procurement of additional satellites.

Questions submitted by Representative Bart Gordon

Q1. NOAA had an option with the current GOES series contractor to purchase an additional satellite—Q—in the current series.

Q1a. Why did NOAA choose not to exercise the option to build this satellite?

A1a. The following considerations influenced NOAA's decision to not exercise the option on the GOES–N series contract for a GOES Q satellite:

- The GOES I–M series of satellites were lasting longer than originally planned. NOAA wanted to delay launching the GOES N series satellites, but given the fixed price contract for these satellites, delaying launches would have required renegotiating the contract with Boeing and would have increased the costs of the satellites.
- During this same timeframe, Boeing approached the government with an offer to upgrade the GOES N series launch vehicles from Delta III's to the newer Delta IV's in exchange for not exercising the GOES Q option. The switch to the larger launch vehicle was attractive to the government—the larger launch vehicle was able to accommodate a heavier satellite with more fuel. The additional fuel would allow us to extend the on-orbit life of each of the GOES N, O and P satellites by three to four years. This would have allowed us to launch each satellite as contracted for, but to store them longer and put them in to operation only when they were needed—when the GOES I series satellites were failing. Moving to the Delta IV, although more expensive, was overall more advantageous to the GOES program, and the on-orbit life of the satellites.

Given these considerations, NOAA decided to accept the offer to move the GOES–N series to the larger launch vehicle in exchange for not exercising the Q option.

Q1b. What was the incremental cost for the additional satellite?

A1b. The cost to exercise the GOES Q option in the GOES–N series contract was $185 million. This option is no longer available to be exercised.

Q1c. How many more years would the current GOES series have extended had NOAA bought GOES–Q? Given the large initial cost for any new satellite series, why shouldn't we purchase more satellites in a series to achieve some economy of scale?

A1c. Based on a detailed technical and parametric analysis of actual and projected spacecraft lifetime, the final spacecraft in the GOES–N series (GOES–P) was predicted to reach its end of life in approximately the spring of 2019. The option to purchase and launch an additional GOES–N class spacecraft would provide an additional five years of design life, but since there are two operational spacecraft at a time it would extend the projected end of the GOES–N class constellation lifetime only slightly more than two years, requiring a GOES–R launch readiness date of April 2016. In addition, extending the GOES–N series by exercising the option on GOES Q would have delayed the opportunity to introduce new technology in the next series, such as the improved imaging capability of the ABI.

Q2. Weather forecasting can be improved with improved observations and data collection—essentially by building more advanced satellite systems—but we can also improve weather forecasting by using the data we already collect in new ways through improvement of our forecast models.

Q2a. How do these different investments compare in terms of their cost effectiveness?

A2a. Investments in geostationary satellite observations have shown value in both numerical weather prediction and nowcasting (forecasting based on satellite analysis and interpretation). In order to continue with this level of improvement, new satellites with increased capabilities are needed to meet requirements of the user community.

Unfortunately, we are not aware of any study conducted to quantify the percentage of improvements in weather forecasting expected from the improved data (resolution, quality and speed of transmission) as satellite technology has advanced (e.g., as we transition from the GOES–I series to the GOES–N series).

Q2b. How much improvement in forecasting could we achieve with more investment in data analysis and forecast modeling?

A2b. Targeted investments, as we have made over the years, have improved forecast accuracy as reflected in our improving performance measures. These are published annually by the Department in NOAA's annual performance plan that is inte-

grated with the President's Budget submission. Much of the improvement has come from investments in human resources to support data analysis and modeling as well as investments in better observation systems.

Q2c. What is NOAA's estimate of improvements in weather forecasting from the technological advancements incorporated into GOES–R?

A2c. GOES–R will provide increased and more rapid area coverage with improved resolution and additional spectral coverage using Advanced Baseline Imager (ABI) and provide lightning data from the GOES Lightning Mapper (GLM). These improved capabilities provide more frequent, accurate and timely products supporting:

- two to ten percent improvement in hurricane track forecast
- Ability to track severe storms while simultaneously maintaining coverage of the entire hemisphere

Q2d. How much has NOAA invested in research on model improvement during the past decade?

A2d. During the period 1997 to 2006, NOAA invested the following in operational weather model improvements:

1997 to 2006 (dollars in millions)

Model research	$ 62
Computing	$162
Total	$224

In the FY 2007 President's Budget, NOAA investment in operational weather model improvements is as follows:

FY 2007 (dollars in millions)

Model research	$ 9
Computing	$26
Total	$35

Q3. The development and incorporation of new sensors into an operational system assumes some demonstration of their feasibility through research and development programs. What is the state of these research and development programs? Exactly how much does heritage design inform the development of each new sensor for GOES–R?

A3. The Advanced Baseline Imager (ABI) provides significantly improved and new capabilities and contains the majority of the GOES–R technical risk. The technical risk for ABI derives from the specific engineering applications of the proven space-qualified components that have flown before. For example, the technology for critical ABI elements such as detectors and high data rate interfaces, have been used before in space instruments.

The Solar Environmental in Situ Suite (SEISS) and Solar Imaging Suite (SIS) represent evolutionary extensions of prior SEISS and SIS instruments with modest enhancements.

The GOES Lightning Mapper (GLM) is based on instruments that have flown previously in polar-orbits. We will not be able to determine the extent to which heritage design can be used until the completion of the GLM formulation phase in 2007.

Q4. How are changing priorities in earth science programs at NASA affecting NOAA's ability to improve sensor design, given NOAA's reliance on NASA's technical support in GOES satellite development, and the use of NASA missions to test prototype sensor performance?

A4. One benefit GOES–R received from previous NASA Earth science missions is data from those missions incorporated into algorithms and computer simulations in order to predict performance of GOES–R instruments and to assess design options.

In addition, NOAA and NASA have been working together to develop a Geosynchronous Imaging Fourier Transform Spectrometer (GIFTS) Engineering Development Unit (EDU) to validate key technologies and algorithms for potential use in advanced weather observing systems, including GOES–R; this GIFTS EDU activity was intended, in part, to provide risk reduction for the GOES–R Hyperspectral Environmental Suite (HES) acquisition. While originally designed as a full flight mission, the project had to be rescoped following the withdrawal from the program of the U.S. Navy. A NOAA–NASA/Langley Research Center Interagency Agreement to build and test the GIFTS EDU was signed in late 2004. All activities associated with the GIFTS EDU should be completed by the end of December 2006. The first-ever Decadal Survey in Earth Science by the National Research Council is nearing completion. When released, this decadal survey will provide the U.S. Earth science community's priorities for the next decade. Any impact of those priorities on the development of sensors for geostationary operational satellites will not be known until after the Decadal Survey is released and the resulting missions are fully understood and integrated into NASA's long-range planning.

Q5. Your testimony stated that NOAA has decided to provide individual sensors to the prime contractor as Government Furnished Equipment (GFE). What are the benefits of this type of arrangement? What are the risks associated with this type of arrangement?

A5. GOES–R instruments are being delivered to the future prime contractor as government-furnished equipment. The dominant major benefit is direct government visibility of instrument design status and technical issues that would not be readily available if the prime contractor was delivering instruments through subcontracts.

The resulting risk to the GFE approach is that the government must possess the necessary level of expertise to perform technical oversight. The capabilities and existing resources of the NASA Goddard Space Flight Center to perform this function mitigate this risk.

ANSWERS TO POST-HEARING QUESTIONS

Responses by David A. Powner, Director, Information Technology Management Issues, Government Accountability Office

Questions submitted by Representative Bart Gordon

Q1. Admiral Lautenbacher's testimony indicated that NOAA has decided to provide individual sensors to the prime contractor as Government Furnished Equipment What are the benefits of this type of arrangement? What are the risks of this type of arrangement?

A1. An arrangement in which critical components are provided to the prime contractor as Government Furnished Equipment (GFE) is designed to provide the government with a better view into the development of those components. If executed properly, this arrangement could be an effective and efficient approach for NOAA to take and could help the agency avoid several of the key management problems experienced on the National Polar-orbiting Operational Environmental Satellite System (NPOESS). Specifically, on the NPOESS program, the prime contractor had the lead responsibility for overseeing subcontractors' development of critical sensors and the government had limited insight into important acquisition management and program control functions, including the execution of the master schedule, earned value management system, and independent cost estimating. A GFE arrangement could improve NOAA's role in the timely identification and resolution of emerging technical and schedule problems, management of reserve funds, and decision making processes.

While the potential benefits of a GFE arrangement are significant, there are also risks associated with this approach if the government does not have sufficient technical capacity and skills. In particular, NOAA needs to have adequate and effective program control capabilities in the areas of systems engineering and earned value management in order to effectively oversee contractor performance in the development of the sensors.

Q2. NOAA is proposing to reduce the number of satellites in the GOES–R series and simplify them. However, the current unofficial estimate appears to be in the range of the original estimate for four satellites with more advanced sensors (over $6 billion). This estimate appears to be high for two satellites. What factors do you believe are driving the costs of these systems up to these levels?

A2. Senior NOAA officials stated that they are unable to provide a current unofficial estimate of the restructured GOES–R program, noting that they need more analysis to determine this cost. Thus, the factors that affect the cost of the system are still being determined. However, based on discussions with the agency, we believe the original estimate of $6.2 billion (for four satellites) was low because of optimistic assumptions made on the technical complexity of the system's components, including key sensors.

Q3. Your testimony included several things that NOAA still needs to do to implement the lessons learned from other satellite programs. One of these is that NOAA needs to determine how to ensure that a sufficient level of technical maturity will be achieved in time for a decision milestone. Are there particular methods, processes or other steps NOAA should take to address this issue?

A3. Our work on lessons learned from other satellite acquisitions noted the importance of fully understanding the technology before awarding a contract to develop that technology, and ensuring that there has been sufficient design work and technical maturity prior to deciding to move the technology into production. The processes that should be taken to ensure a sufficient amount of technical readiness[1] include the review of engineering hardware design, development approach, and test results for the development phase, and the subsequent assessment of technical maturity that has been achieved for the production phase. In moving forward, it will be important for NOAA to ensure that the exit criteria for key decision milestones—called the preliminary and critical design reviews, respectively—include these processes and are clearly defined and measurable. NOAA has taken positive steps to address this lesson by obtaining the services of an independent review team to verify

[1] The GOES–R program office uses a tool known as Technology Readiness Levels (TRL) to measure the level of technical maturity of technologies that reside in key satellite components. The levels of maturity range from 1 to 9 based on the demonstrated performance of these technologies-from paper studies to proven performance on the intended product.

and validate program office decisions on technical maturity. However, NOAA should also ensure that there is effective executive oversight of what is accomplished at key decision points. In particular, it is important that the executive leadership exercise diligence in questioning program office data associated with these areas.

Q4. One of the problems within the NPOESS program was resistance to reducing requirements even in the face of escalating costs, schedule slips, and serious technical problems with sensor development. Has NOAA set up a better decision process for addressing his type of issue?

A4. In our testimony statement, we credited NOAA with its decision to review requirements and to restructure the scope of the program as the GOES–R system's technical complexity became better understood. However, we did not assess NOAA's decision process—including what analysis has been done, which users are involved, or what alternatives were considered leading to its decision to reduce the scope of the program—because it was outside the scope of our review. Until this information is available and a baselined set of validated requirements is developed, it remains to be seen whether this is an improved decision process.

Q5. How can we ensure that the process of reconciling the different cost estimates for this program will be objective and result in a realistic cost estimate for GOES–R? How confident should we be that the cost models employed, both by the program office and by the independent estimator, provide accurate and complete estimates given the recurring problems with cost estimation in NOAA's previous programs?

A5. In our statement, we recommended that NOAA establish a process for objectively evaluating and reconciling the government and independent life cycle cost estimates once the scope of the GOES–R program has been finalized. To ensure this process will be objective, it is important that this process be transparent to all affected entities—from the program office up to all oversight organizations. In addition, NOAA should use realistic assumptions, a high confidence factor, and that same confidence factor across all cost estimates for an even comparison.

Given that the GOES–R system is still in the preliminary design phase and requirements are still being finalized, the cost estimates for this program will be somewhat imprecise. The accuracy of the cost estimates are contingent on the cost models and the comprehensiveness of the independent cost estimator's analysis. We plan to further evaluate the completed cost estimates by the independent estimator and program office in a follow-on review.

In responding to these questions, we relied on previously reported information on GOES–R and other satellite programs, as well as agency documentation describing GOES–R management responsibilities. We performed our work in accordance with generally accepted government auditing standards during October 2006.

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