CONTINUED OVERSIGHT OF THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION'S GEOSTATIONARY WEATHER SATELLITE SYSTEM

HEARING

BEFORE THE

SUBCOMMITTEE ON ENERGY AND ENVIRONMENT

COMMITTEE ON SCIENCE AND TECHNOLOGY

HOUSE OF REPRESENTATIVES

ONE HUNDRED ELEVENTH CONGRESS

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CONTENTS

April 23, 2009

	Page
Witness List	2
Hearing Charter	3

Opening Statements

Statement by Representative Brian Baird, Chairman, Subcommittee on Energy and Environment, Committee on Science and Technology, U.S. House of Representatives	8
Written Statement	9
Statement by Representative Bob Inglis, Ranking Minority Member, Subcommittee on Energy and Environment, Committee on Science and Technology, U.S. House of Representatives	9
Written Statement	10
Prepared Statement by Representative Jerry F. Costello, Member, Subcommittee on Energy and Environment, Committee on Science and Technology, U.S. House of Representatives	11
Prepared Statement by Representative Eddie Bernice Johnson, Member, Subcommittee on Energy and Environment, Committee on Science and Technology, U.S. House of Representatives	11

Witnesses:

Mr. David A. Powner, Director, Information Technology Management Issues, U.S. Government Accountability Office	
Oral Statement	12
Written Statement	15
Biography	21
Ms. Mary E. Kicza, Assistant Administrator for Satellite and Information Services, National Environmental Satellite, Data, and Information Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce	
Oral Statement	21
Written Statement	23
Biography	26
Mr. George W. Morrow, Jr., Director, Flight Projects, Goddard Space Flight Center, National Aeronautics and Space Administration	
Oral Statement	27
Written Statement	28
Biography	31
Discussion	
Budget Overruns	32
Program Expectations	35
Incorporating Recommendations and Preventing Future Problems	37
The Need for Better Cost Estimates	38
Meeting Budgets and Deadlines	41
The Partnership of NASA and NOAA	42
Program Funding	43
Complying With Recommendations and the Responsibilities of NOAA and NASA	44
The Role of Congress	45
Benefits of GOES–R	46

Page

Closing 47

Appendix: Answers to Post-Hearing Questions

Ms. Mary E. Kicza, Assistant Administrator for Satellite and Information Services, National Environmental Satellite, Data, and Information Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce 50

Mr. George W. Morrow, Jr., Director, Flight Projects, Goddard Space Flight Center, National Aeronautics and Space Administration (NASA) 56

CONTINUED OVERSIGHT OF THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION'S GEOSTATIONARY WEATHER SATELLITE SYSTEM

THURSDAY, APRIL 23, 2009

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

The Subcommittee met, pursuant to call, at 10:04 a.m., in Room 2318 of the Rayburn House Office Building, Hon. Brian Baird [Chairman of the Subcommittee] presiding.

BART GORDON, TENNESSEE
CHAIRMAN

RALPH M. HALL, TEXAS
RANKING MEMBER

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Hearing on

Continued Oversight of the National Oceanic and Atmospheric Administration's Geostationary Weather Satellite System

Thursday, April 23, 2009
10:00a.m. – 12:00p.m.
2318 Rayburn House Office Building

Witness List

Mr. David Powner
Director
Information Technology Management Issues
Government Accountability Office (GAO)

Ms. Mary Ellen Kicza
Assistant Administrator for Satellite and Information Services
National Oceanic and Atmospheric Administration (NOAA)

Mr. George Morrow
Director of Flight Projects Directorate
Goddard Space Flight Center
National Aeronautics and Space Administration (NASA)

HEARING CHARTER

SUBCOMMITTEE ON ENERGY AND ENVIRONMENT
COMMITTEE ON SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

Continued Oversight of the National Oceanic and Atmospheric Administration's Geostationary Weather Satellite System

THURSDAY, APRIL 23, 2009
10:00 A.M.—12:00 P.M.
2318 RAYBURN HOUSE OFFICE BUILDING

Purpose

The Government Accountability Office (GAO), at the request of the Committee, has submitted its latest report on the progress of the new GOES–R series of geostationary weather satellites being developed by the National Oceanic and Atmospheric Administration (NOAA). On April 23, 2009, the Subcommittee on Energy and Environment will take testimony from GAO, NOAA and the National Aeronautics and Space Administration (NASA) on the status of the program and the GAO's findings and recommendations.

Witnesses

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

Mr. Powner is the head of the GAO team that has supported the Subcommittee's oversight of NOAA's major satellite programs for the past five years. He will discuss the findings and recommendations on NOAA's management of the GOES–R satellite program in the report it will release at the hearing.

Ms. Mary Ellen Kicza, Assistant Administrator for Satellite and Information Services, NOAA

Ms. Kicza leads the National Environmental Satellite, Data, and Information Systems (NESDIS) at NOAA, operating the geostationary weather satellites and leading the development of the new GOES–R series. A former NASA official, Ms. Kicza assumed responsibility for NOAA satellite development in November 2006. She will describe the current status of the GOES–R program and give NOAA's response to the GAO report.

Mr. George Morrow, Director of Flight Projects Directorate, Goddard Space Flight Center, National Aeronautics and Space Administration

Mr. Morrow's office is currently managing the development or implementation of 40 space and Earth science missions at Goddard. Before a short stint in the private sector, he oversaw technical management of the Hubble Space Telescope and served as Project Manager for the Aqua satellite. Morrow has held his current position since September 2007.

Background

Western Hemisphere Weather Sentinels

NOAA depends on its GOES satellites to detect and track weather systems affecting the Western Hemisphere. The satellites hold position in geosynchronous orbit (22,300 miles above the Earth) where their speed matches the Earth's rotational velocity. The Severe Storm Center uses GOES to track tornadoes, hailstorms and other weather events threatening life and property over land. For the Hurricane Center, GOES shows developing storms in the areas of the oceans where there are no other observational sensors.

A prototype satellite was launched in 1974; the first GOES satellite went into orbit in 1975. Today, normal practice has two GOES satellites in orbit simulta-

neously, with one focused on each of the U.S. coasts (GOES–11 and GOES–12). A third (GOES–13) is also kept in space as a spare to assure uninterrupted coverage.

GOES—The Recent Chronicle

The current GOES–R development program is the third major procurement for GOES satellites since NOAA assumed responsibility for funding its own geostationary operational satellites in 1982. In the previous instances, NOAA purchased five GOES–Next satellites in the period from 1985–2001, and then contracted for four GOES–N satellites for the years 1998–2001. The first GOES–N model launched in May 2006 to be the on-orbit spare,[1] GOES–O is awaiting launch next month and GOES–P has been completed and is in storage. GOES–Q was canceled in 2002 because the existing satellites were performing well past their expected lifetimes.

In the original plan for the GOES–R program NOAA intended to spend **$6.2 billion** for the life cycle period 2007–2020. This would purchase **four satellites.** It would also fund development of two new major instruments, the Advanced Baseline Imager (ABI) and the Hyperspectral Environmental Suite (HES), as well as upgraded models of the space weather sensors. The first satellite would be launched in **2012**.

The Committee became concerned about the progress of the GOES program when NOAA's other satellite development effort, the National Polar-Orbiting Operational Environmental Satellite System (NPOESS), was forced to undergo a Nunn-McCurdy recertification. The GAO team studying NPOESS was asked to determine if GOES was proceeding down a similar path. By September 2006, as GAO made its first report, there were important changes announced. Estimated cost grew to **$11.4 billion.** NOAA reacted by **eliminating two satellites and the HES instrument,** and **pushing first launch back to December 2014.** The President's FY 2008 budget request now listed the life cycle cost estimate reflected in the President's FY 2008 budget request as **$6.96 billion** for the years 2003–2028.

The Subcommittee heard from NOAA at its hearing in October 2007 that an independent review team (IRT) felt changes needed to be made in the agency's plan for managing the program. NOAA had intended to assume overall responsibility for procurement of the entire satellite system, including the spacecraft, instruments, ground systems and integration. The IRT questioned NOAA's ability to do this. Instead it recommended that NOAA divide the program. NASA would manage the space segment (which included the spacecraft bus and launch vehicle) and NOAA would do the same for the ground segment (communications, satellite control and data management). The IRT argued that this would allow NOAA to benefit from the expertise in both agencies. To reflect these changes, NOAA and NASA had signed a Memorandum of Understanding in June 2007, and would agree on a Management Control Plan in December 2007.

For the instruments, NASA would manage their development for NOAA and provide the finished devices as government equipment to the space segment contractor. NASA would also handle the integration of the instruments with the spacecraft. ABI was the first contract awarded (September 2004), as it was expected to involve numerous technical challenges. By the time of the hearing, the three space weather sensors had been awarded. Selection of the contractor for the Geostationary Lightning Mapper (GLM) followed in December 2007.

Since that hearing, there have been some additional significant changes. In its FY 2009 budget request, NOAA said that launch of GOES–R had slipped to **April 2015** because the FY 2008 Omnibus Appropriation had reduced funding below the level NOAA expected. In the *Major Satellite Program Annual Report* for FY 2009, NOAA provided a new program baseline cost estimate of **$7.672 billion.** The award for the space segment contract was made to Lockheed Martin, in December 2008, but work came to a halt when Boeing protested the award. Currently, NASA is reconsidering the proposals. The ground system Request for Proposals was released in May 2008, with NOAA hoping to make an award by June. GAO's new report indicates that some of the expected performance standards in the ground segment contract have been reduced. Further discussion appears below.

GAO's GOES–R Snapshot

There are two major facets in GAO's new report on GOES–R. GAO credits the program with progress in many areas listed as concerns in previous reports. Even

[1] While on the ground, GOES satellites have a letter designation based on the order in which they were built. After launch, checkout and acceptance testing in orbit, it is changed to a number. Therefore, GOES–N is now identified as GOES–13.

so, GAO identifies items of risk in program controls and management of the instruments where the program continues to fall short of best practices.

Over the course of the GOES–R program, the expected capabilities of the satellites have been reduced as the increasing costs of the program led to elimination of one major instrument (HES) and other changes in scope. The Subcommittee asked GAO to evaluate the effect of these changes on NOAA's ability to produce the products expected by its users. In the second part of this report, GAO finds that the plan for restoring the lost capability is stalled and that GOES–R may fall short of user expectations.

I. Continuing Cost Risks

GAO, in its previous testimony, indicated that the GOES–R program office was projecting the life cycle cost for the two-satellite program was $6.9 billion, while an independent estimate projected it would ultimately be $9.3 billion. By the time the estimates were reconciled, GAO believed, there would be an increase in the estimate. This has indeed occurred; NOAA completed reconciliation of the two estimates and now states the baseline is $7.6 billion—very close to GAO's prediction.

However, in Section 112(f) of the 2008 *Consolidated Appropriations Act,* the Appropriations Committees established a statutory baseline for the GOES–R program of **$6.96 billion.** Thus, there has been a ten percent growth in the baseline, half of the growth necessary to trigger a report to Congress and a set of reviews leading to an action plan responding to the increased costs, a report on alternatives and their associated costs and a report on the impact of the cost growth on other NOAA programs. In such a situation, NOAA is likely to reduce the capabilities of the satellites yet again.

GAO notes in its report that the primary instrument—the imager—is only half-completed after five years, has been showing cost growth ($30 million) and a delay in some scheduled work. NOAA indicates that this can be accommodated by the instrument project, as they had considered the contractor's proposal optimistic and so provided an increased budget in the program plan. In the three years since GAO first began reporting these variances, the cost variance has grown by $24 million and the schedule variance by $8 million. These are discouraging trends.

The ABI has already been re-baselined once for cost and schedule (February 2007) and again for schedule in March 2008. Yet GAO's report indicates that the ABI integrated baseline review failed to consider significant items such as schedule milestones or the contractor's management processes. In its first recommendation, GAO urges NOAA to add these to future reviews before any subsequent re-baselinings. NOAA agreed to do so. Again, GAO raised similar concerns on these program control issues three years ago.

GAO goes on to fault NOAA for lack of documentation regarding the cost and schedule variances reported on the imager and the lightning mapper. NOAA responded that they were reviewing the variances with the contractors, but not recording the information. Of course, the lack of information on the decisions resulting from these conversations might be crucial in resolving later technical problems. NOAA agreed with GAO's second recommendation to be more diligent in documenting information on variances.

GAO lists the ABI as a continuing cost risk, while it considers GLM a high schedule risk.

II. The Boeing Protest and Schedule Risk

On December 2, 2008, the Lockheed Martin proposal won the contract for the GOES–R space segment. Following agency debriefings, however, the Boeing Company filed a protest with GAO, asserting that they had a superior offer. Further action to finalize the contract, as well as initial work, was suspended pending GAO's decision. On February 17, 2009, NASA informed GAO that it had decided to reconsider the proposals and GAO dismissed the protest. The source evaluation board has reviewed the bids to make a new recommendation, with the intent to issue an award next month. Because this continues to be an active procurement, NASA and NOAA will sometimes be limited in their responses in order to shield "source selection" and other proprietary information protected by law and regulation. GAO also placed a protective order on information related to the protest, and it appears that elements of the order remain in force. This may also affect what information the agencies may provide.

However, the Subcommittee's immediate concern is the effect of the protest on the GOES–R program schedule. In March 2008, the IRT was already concerned that the lack of contracts for the space and ground segment ". . . has impacted potential schedule margins," and there was a "[n]eed to move forward without delay to get

Flight and Ground Segment procurements underway."[2] NOAA noted in June that the proposals for both segments had been issued and that the anticipated award dates preserved adequate schedule margin, assuming no budget problems.[3] With the protest, however, the current first launch in April 2015 now threatens to slip. Should a delay materialize, the risk increases that NOAA will violate its current operational requirement for a spare satellite in orbit around 2015.

The GOES–R program now has to assume that NASA's coming decision on the space segment contract will face a new protest. Should the original choice of Lockheed Martin be sustained, Boeing can be expected to renew its challenge. Changing to Boeing will likely draw complaints from an aggrieved Lockheed Martin. Risks of a protest after the ground segment contract award may have also increased. This will create more pressure on the program.

III. Disappearing Capabilities

As the GOES–R program has progressed, the improvements users expected in its performance have been eroding. The 2006 decision to drop the HES sensor to help restrain the projected $5 billion cost growth in program estimates, contributed a great deal to the loss of 13 products (from 81 to 68) GOES–R was expected to produce. It also meant that GOES–R would not retain at least the same level of atmospheric sounding data now flying on the current satellites.

The Subcommittee asked GAO to evaluate NOAA's efforts to mitigate these losses and to find alternate means to provide the reduced capabilities. In this report, GAO describes the initial plan to use the ABI—with other data sources—to supply sounding products equivalent to the existing capability. This will require some tradeoffs; the ABI should produce more data faster, but the readings in four product categories will not be as precise as the current instrument.

Having developed the plan, NOAA briefed the proposal to parts of its user community. According to GAO, these users were willing to accept the alternative, but this appeared to rest on NOAA's assurance that the data would be updated ("refreshed") much more often than it is today. Yet GAO also states that these "refresh rates" were among the requirements that became optional requests as NOAA readied the ground segment Request for Proposal in 2007. NOAA stated that the users were informed as this change was made. It is unclear whether users understand all the ramifications of the change.

GAO also notes that NOAA also has reduced the number of products now expected from GOES–R by half, to 34. Despite declaring that the lost products remain priorities for the agency, GAO reports ". . . NOAA has not defined plans or a timeline for implementing any of the options or for addressing the requirements for advanced products. Further, agency officials were unable to estimate when they would establish plans to fulfill the requirements." As a result, the report's third recommendation urges NOAA to establish such a plan and process. Again, NOAA has agreed with the recommendation.

NOAA states that planning is underway to prepare some kind of improved sounder that could be flown aboard two future satellites, the GOES–T and –U satellites. However, these two satellites are not part of the current procurement and budgets have not been developed or approved for them within the GOES–R program. Preliminary steps to provide resources for that development may be included in the FY 2011 budget request. This was first offered as an option in April 2007 in the wake of HES's cancellation. The competitors for the HES instrument at the same time also argued that enough progress had been made to consider flying a prototype of the next-generation sounder aboard GOES–S, but NOAA declined.

This situation raises a question: just how well does NOAA work with its user communities when setting priorities among the many competing requirements that affect design of its satellite instruments? In his 2006 written statement to the Committee, former Administrator Launtenbacher described:

> ". . . a group consisting of the NOAA users of the satellite data . . .. 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

[2] *Geostationary Operational Environmental Satellite Series-R (GOES-R) Key Decision Point (KDP) C/D Readiness Report by GOES–R Independent Review Team (IRT),* March 18, 2008, p. 5.

[3] *Ibid.,* p. 20.

finalizing sensors and the satellite system to ensure GOES–R will meet NOAA's requirements for data and products . . .."[4]

GAO's discussion of NOAA's user interactions does not appear to be referring to this group. Without the continuing contributions of users knowledgeable about the evolution of the GOES–R space and ground systems, it is possible that the increased investment in GOES–R may produce satellites little advanced from current models. GAO hopes to examine this in greater detail in its next assignment.

[4] U.S. Congress. House. *GAO Report on NOAA's Weather Satellite Program.* Hearing Before the Committee on Science. 109th Congress; Serial 109–66. September 29, 2006; p. 19.

Chairman BAIRD. Good morning. Our hearing will come to order.

We are pleased to have everybody here today on a topic which we in the Committee think is of tremendous importance to the country and we have some outstanding witnesses today to give us information on the status of this program. Today we are going to meet to receive GAO's latest report on the Geostationary Operational Earth Satellite System, so-called GOES. From their stations above the equator, the GOES system tracks weather across the Western Hemisphere. It is one of two major satellite programs now underway at NOAA.

Development of the satellite and instruments for this series, the GOES–R, is a NASA responsibility. The GOES program has from the outset depended on cooperation between the two agencies, NASA and NOAA. It has not, however, always been a happy partnership. The troubles in the polar satellite program are a stark warning of the dangers of interagency friction, and so the Subcommittee has asked NASA to participate today to allow discussion of its critical contribution to the GOES–R success.

While the GOES program has not suffered from the same mismanagement and mistakes that have plagued the polar satellite replacement program, it has not been a model of excellence either. In our previous hearings we have learned that the preliminary cost estimates for these satellites had doubled and as a result NOAA found it necessary to cut the number of satellites to be ordered by half. And so, or even so, as GAO forecasted, the program cost has again gone up.

At the same time, the GOES satellites lost the new instrument that would expand our ability to sample atmospheric conditions at more levels. NOAA found the technical challenges too great given the time and money it had. The Subcommittee asked our GAO team to review NOAA's plan for providing these lost capabilities, and they report today that "NOAA has not defined plans or a timeline for implementing any of the options for addressing the requirements for advanced products." I look forward to hearing both the GAO and NOAA's testimony on this subject.

Just to put this into context, I asked staff to give me a list of some examples of where this satellite data has been useful, and wherever you are virtually in the United States of America we have examples of that. My own district was hit by severe flooding in January of 2009. GOES satellite imagery was relied upon heavily. Part of its monitoring of water vapor imagery helped predict the amount of rainfall, and it was an epic flood. I was in the middle of it and I can tell you we lost property and it was a very difficult experience. It continues to be so. I was just there last week dealing with the aftereffects of the flood.

The Oklahoma-Texas wildfires of January 2006 and April 2009—Mr. Inglis will find this interesting as well. Here is a GOES picture, a satellite photo from April 21, 2009, showing the smoke from the fires in Texas just two days ago now; and the Mount Redoubt volcano in Alaska March 2009, GOES satellite imagery detected, monitored and tracked volcanic ash eruptions critical for a variety of things, even aviation safety as we try to understand where planes should or shouldn't fly. Hurricane Katrina, we have heard of that. Mr. Jindal might take note of this if he wants to attack

earmarks in the future, but we will just say that GOES satellite image was particularly important in helping forecast Katrina. What many people don't know is the Katrina forecast was pretty darn good. They hit its magnitude, arrival and location very, very precisely. The problem was on the ground, people didn't prepare, but you folks did your job, those who were involved with this. But all of the aforementioned and countless other uses could fall in jeopardy if we don't get this right, and that is what today's hearing is about. We are afraid we are not going to get it right and we want to, we want to get it right, meaning on time, on budget, which we are already off, but we don't want more cost overruns and we certainly don't want a big gap in reliability, and I think there is reason to question whether we are going to achieve that goal. But I highlight all these applications, Mr. Inglis and my friends on the panel, because I think the American people need to understand, this is not small, irrelevant, abstract issues that we are dealing with. This is something very, very consequential to public health, life, safety, economic benefits, et cetera.

So with that, I will again thank the witnesses and recognize Mr. Inglis for his opening remarks.

[The prepared statement of Chairman Baird follows:]

PREPARED STATEMENT OF CHAIRMAN BRIAN BAIRD

Good morning and welcome. The Subcommittee is meeting today to receive GAO's latest report on the Geostationary Operational Environmental Satellite system (GOES). From their stations above the equator, the GOES system tracks weather across the Western Hemisphere. It is one of two major satellite programs now underway at NOAA.

Development of the satellites and instruments for this series, GOES–R is a NASA responsibility. The GOES program has from the outset depended on cooperation between the two agencies, NASA and NOAA. It has not always been a happy partnership. The troubles in the polar satellite program are a stark warning of the dangers of interagency friction, and so the Subcommittee has asked NASA to participate today to allow discussion of its critical contributions to GOES–R success.

While the GOES program has not suffered from the same mismanagement and mistakes that have plagued the polar satellite replacement program, it has not been a model of excellence either. In our previous hearings we have learned that the preliminary cost estimate for these satellites had doubled and as a result NOAA found it necessary to cut the number of satellites to be ordered in half. Even so, as GAO forecasted, the program cost has again gone up.

At the same time, the GOES satellites lost the new instrument that would expand our ability to sample atmospheric conditions at more levels. NOAA found the technical challenges too great given the time and money it had. The Subcommittee asked our GAO team to review NOAA's plan for providing those lost capabilities; they report today that ". . . NOAA has not defined plans or a timeline for implementing any of the options or for addressing the requirements for advanced products." I look forward to hearing both GAO and NOAA's testimony on this subject.

I would like to thank our witnesses for their testimony today, and I recognize the Ranking Member, Mr. Inglis, for his remarks.

Mr. INGLIS. Thank you, Mr. Chairman. Getting it right is very important in this case because it is very important that we be able to take these pictures and the potential loss of redundancy by not getting these satellites up in time could mean that a significant part of our observation goes dark. I mean, what if one of them goes out and it is all dark on that side of the Earth and we are not able to see the hurricanes coming, we are not able to predict weather for commerce. It is just a—it is a very important matter, and I am sure that no one on this panel wants to be here right now because what a disaster have we got in the works.

So, you know, a year and a half ago we were here having a hearing on this. In that hearing, the GAO told us that the program was over budget, behind schedule and running the risk of discontinuity, and that is the thing I am expressing great concern about. Discontinuity here would be a huge practical impact. So GAO made some recommendations how to proceed and how to avoid further cost overruns while ensuring that the technological development stays on schedule.

And now we are here with a GAO report in hand entitled *"Acquisition has increased cost, reduced capabilities and delayed schedules."* That is a pretty sorry title. I mean, those are all bad things. The price tag is up from $670 million since we last met, even though the program has now been down-sized from 81 products on the satellites to 32. There is still the threat of launch delays, and even if we get two new satellites in the air, we are now not sure if there will be orbit backup, so that means that one mishap with the new instruments and we could lose our eyes on half the world or all the world.

So the question for us today is, how do we fix this? I thought we were learning about what was wrong here. Now we are back in the same spot so I hope we can figure out how to fix it from here. Is it a matter of poor management? Should NOAA continue to be charged with supervision of this program or does Congress need to give the reins to some other agency entirely? How are we prioritizing the instruments we put on the satellites to make sure we get what we really need on those satellites? So those of us responsible for this program, Congress, NOAA, NASA, cannot lightly risk delays and cost overruns. GOES–R today is a $7.7 billion program for two satellites. That is a lot of taxpayer money and we expect that investment to provide a series of weather satellites that are launched on time and that provide data to ensure the most accurate possible weather forecasting and modeling.

So I look forward to hearing some solutions today and hopefully not repeating this a year and a half from now. Thank you, Mr. Chairman.

[The prepared statement of Mr. Inglis follows:]

PREPARED STATEMENT OF REPRESENTATIVE BOB INGLIS

Good morning. Thank you, Chairman Baird, for holding this hearing about the Geostationary Operational Environmental Satellites–R series (GOES–R). This hearing continues close oversight of this vital weather satellite program, oversight that started under Republican leadership of this committee.

Exactly one year and a half ago, to the day, this subcommittee held a hearing on the GOES–R program. In that hearing, GAO informed us that the program was over budget, behind on schedule, and running a risk of discontinuity in valuable forecasting data. GAO also made recommendations on how to proceed so as to avoid any further cost overruns while ensuring that technological development stays on schedule.

Now we're here, with a GAO report in hand entitled, *"Acquisition Has Increased Costs, Reduced Capabilities, and Delayed Schedules."* The price tag is up $670 million since we last met, even though the program has now been down-sized from eighty one products on the satellites to thirty-two. There is still a threat of launch delays, and even if we still get two new satellites in the air, we're now not sure if there will be an in orbit backup. That means that one mishap with the new instruments, and we could lose our forecasting eyes on half the world.

So the question before us today is: What are we going to do to fix this problem? We obviously can't go back, but we can't afford to show up a year and half from now only to find that the future of our weather forecasting is even more off track.

Is this a matter of poor management? Should NOAA continue to be charged with supervision over this program, or does Congress need to give the reins to another agency entirely? And how are we prioritizing the instruments we put on the satellite to make sure we get the necessary equipment in place so that we don't experience any discontinuity in valuable forecasting data?

Those of us responsible for this program, Congress, NOAA, and NASA, cannot lightly risk delays and cost overruns. GOES–R today is a $7.7 billion program for two satellites. That is a lot of taxpayer money. We expect that investment to provide a series of weather satellites that are launched on time and provide data to ensure the most accurate possible weather forecasting and modeling.

I look forward to hearing from our witnesses today and yield back the balance of my time.

Chairman BAIRD. Thank you, Mr. Inglis. We have been joined by Ms. Edwards. Thank you for joining us, Mr. Neugebauer, as well. As is the custom of this committee, we will proceed now. If any other Members have opening remarks, they may submit them for the record.

[The prepared statement of Mr. Costello follows:]

PREPARED STATEMENT OF REPRESENTATIVE JERRY F. COSTELLO

Good Morning. Thank you, Mr. Chairman, for holding today's hearing on the oversight of the NOAA's geostationary weather satellite system.

Geostationary weather satellite systems are important in identifying and anticipating extreme weather conditions before as they approach the U.S. My Congressional District in Southern Illinois frequently faces extreme weather conditions, including tornadoes and ice storms that can destroy property, take out electricity for long periods of time, and even take lives. I appreciate the efforts of NOAA and NASA to continually update and improve the technology of these satellite systems to increase warning times for extreme weather events.

However, I remain concerned about the continued delays and cost increases associated with the GOES–R program. In the face of these challenges, NOAA has reduced the capabilities of these satellites and delayed their deployment. While I appreciate the efforts of NOAA and NASA to adopt the recommendations of the GAO and remain transparent in their contracting negotiations, I have concerns about the impact of these delays and decreased capacities.

I would be interested in hearing from our witnesses today what impact they see the GAO recommendations and the increasing cost of the satellites having on their deployment date and capacity. Specifically, if GOES–R will be able to achieve the goals set forth by NOAA, including significant improvements in warning time for extreme weather and if any further delays are expected leading to a gap in satellite coverage?

I welcome our panel of witnesses, and I look forward to their testimony.

[The prepared statement of Ms. Johnson follows:]

PREPARED STATEMENT OF REPRESENTATIVE EDDIE BERNICE JOHNSON

Good morning, Mr. Chairman.

The ability to track the Earth's weather and to predict storms is of great national importance. Weather satellites make that possible.

The American public relies on the Geostationary Operational Environmental Satellites (GOES) to accomplish this goal.

These satellites, which rotate around the Earth at a synchronous velocity as the that of the Earth, are used to track tornadoes, hailstorms and other weather events.

The National Oceanic and Atmospheric Administration (NOAA) is primarily responsible for developing the newest of these satellites, in cooperation with the National Aeronautics and Space Administration.

Today, the Committee will be interested to hear comments on a recent report by the Government Accountability Office on the progress of the new GOES–R satellites that are in development.

In summary, the GAO report recommends that the program take steps to "improve management and oversight and determine whether and how to recover certain capabilities that were removed from the program."

Our witnesses, from GAO, NOAA, and NASA will discuss why the project has had continued escalating costs.

The Subcommittee will also want to know why a major instrument, the Hyperspectral Environmental Suite (HES), is planned be eliminated.

The Hyperspectral Environmental Suite is designed to provide high-resolution hemispheric observations, large-scale examinations of severe weather systems, and imaging of coastal waters.

It will also provide temperature and moisture measurements and can be applied to examine cloud-top information, winds, and ozone.

The Science Committee has held hearings in the past to assess other NOAA/NASA satellite development endeavors.

It is this committee's responsibility to provide oversight to ensure the timely and appropriate development of this project.

Budget estimates that are substantially larger than first predicted and delays in deliverables should be communicated to the Committee and our citizens, who provide the funding for these endeavors.

Mr. Chairman, this project is very important and should be supported by the Committee.

A first-rate weather satellite program will benefit every citizen in this nation.

NOAA weather satellites provide pictures of weather from around the United States or the world.

The data from these satellites are used to measure the temperature of the ocean, which is a key indicator of climate change.

Satellite information is used to monitor coral reefs, harmful algal blooms, fires, and volcanic ash.

Monitoring the Earth from space helps us understand how the Earth works and affects much of our daily lives.

Again, I want to emphasize the importance of this project to the American people.

Also, I would like to welcome today's witnesses.

We appreciate the work that you are doing and hope that we can facilitate a smooth transition to new, high-quality satellites as soon as possible.

Chairman BAIRD. We will now proceed to hear from the panel. You will each be asked to speak for about five minutes and then we will follow up with questions. Let me introduce the panel at this point. Mr. David Powner is the Director of Information Technology Management Issues at the Government Accountability Office, Ms. Mary Ellen Kicza is the Assistant Administrator for Satellite and Information Services at the National Oceanic and Atmospheric Administration, and Mr. George Morrow is the Director of the Flight Projects Directorate at the Goddard Space Flight Center at the National Aeronautics and Space Administration. Thank you all for being here.

Mr. Powner, please proceed.

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

Mr. POWNER. Chairman Baird, Ranking Member Inglis and Members of the Subcommittee, we appreciate the opportunity to testify this morning on our GOES–R report completed at your request.

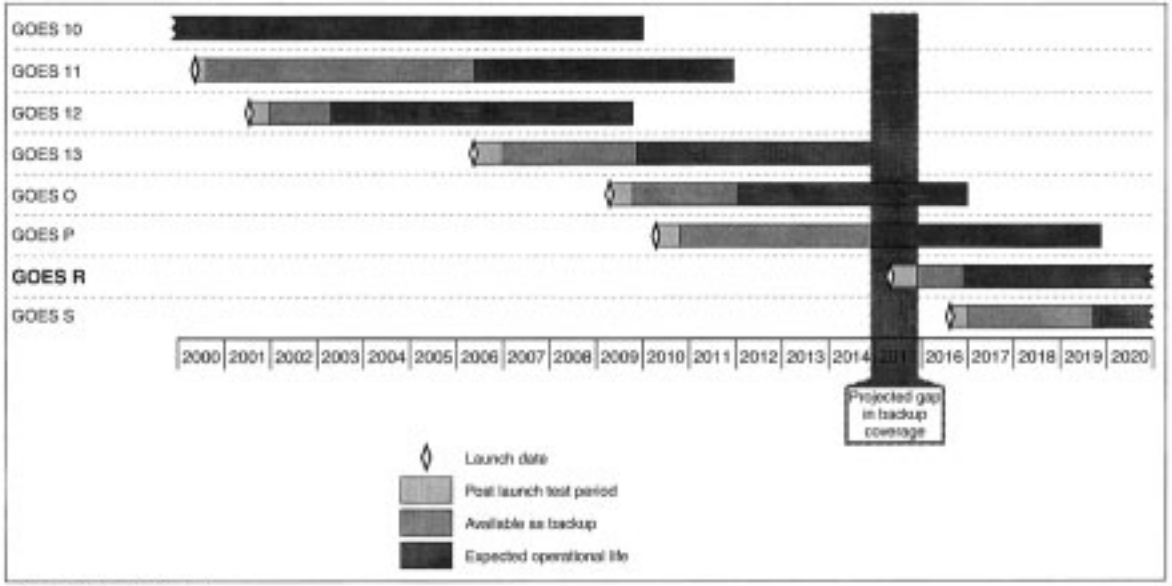
This subcommittee's early oversight, Mr. Chairman, has been essential to ensure that NOAA is effectively planning for this critical satellite acquisition. Since the Subcommittee's last hearing, NOAA has made progress on this acquisition, awarding development contracts for five instruments and plans to award contracts for the spacecraft and ground segments this summer. NOAA has also made good progress implementing our recommendations, specifically has improved its risk management processes and increased oversight of its contractors. Today, as requested, I will provide an update on GOES–R's current cost and schedule estimates and how

this affects continuity of satellite coverage, key reductions in satellite capability and recommendations going forward.

Starting with cost and schedule, the new cost estimate is nearly $7.7 billion, an increase of $670 million from the prior estimate. Several key issues could affect this estimate. First, the estimate will be revisited after the spacecraft and ground segment contracts are awarded in May and June of this year. In addition, the Imager and Lighting Mapper costs are reported as high risk by the program and delivering these instruments could cost more than originally estimated.

Turning to schedule and continuity of satellite coverage, NOAA has delayed several GOES–R program milestones, including issuing requests for proposals and contracts for the spacecraft and ground segments by 12 and 10 months, respectively. In fact, the spacecraft contract was already awarded and protested last December which led to NASA deciding to reevaluate the proposals. These delays have pushed the date when the first satellite will be launched by four months and it is now targeted for April 2015, as this chart throughout the hearing room displays.

Projected Gap in GOES Satellite Coverage



Source: GAO analysis of NOAA data.

I would like to also note too that this date could be later than April 2015. These delays in the launch of the first GOES–R satellite run counter to NOAA's policy of having a backup satellite in orbit at all times and could lead to gaps in coverage as displayed by the portion of the graphic that is in red throughout the hearing room. If NOAA experiences a problem with these two operational satellites before GOES is in orbit, it will need to rely on older satellites that are well beyond their expected operational lives.

It is important to note, Mr. Chairman, that the cost increases and schedule delays just discussed would be greater if NOAA were not reducing program capabilities. Back in September 2006, the GOES–R acquisition went from delivering 81 products to 68 when it dropped the technically complex sensor HES, a state-of-the-art sounder, to control costs. More recently to keep costs down, the program has once again eliminated the number of products GOES–R is expected to deliver from 68 to 34, a 50 percent reduction. These products include those associated with aircraft icing and turbulence. Program officials told us that the products dropped are not currently being produced by legacy GOES satellites.

In addition to eliminating products from the program, NOAA users will not get critical data as quickly as planned. Such drastic reductions in functionality raise questions concerning how much better the GOES–R program will be when compared to legacy GOES products. Program officials claim as good or better but our analysis of the capabilities expected after HES was removed shows that some are less than GOES legacy capabilities. These are clearly laid out in our detailed report and are tied to product accuracy.

We are making several recommendations to NOAA to control future costs and schedule growth including performing a detailed review of the most critical and expensive instrument, improving oversight of contractor performance and developing a plan that articulates which dropped capabilities will be restored since this could affect the program's cost and schedule. In addition, given the magnitude of the capabilities dropped from this program and the severity of the potential gaps in satellite coverage, we also recommended that NOAA inform this subcommittee of any further reductions in plan capabilities and of contingency plans to address the potential gaps in satellite coverage.

In summary, Mr. Chairman, it is important that these recommendations be addressed to control future costs and schedule growth to ensure that capabilities are not reduced to a point that they are no longer meeting user needs and to assure that our nation mitigates the potential gap in satellite coverage.

This concludes my statement. Thank you for your oversight of this important acquisition.

[The prepared statement of Mr. Powner follows:]

PREPARED STATEMENT OF DAVID A. POWNER

Mr. Chairman and Members of the Subcommittee:

Thank you for the opportunity to participate in today's hearing on our nation's Geostationary Operational Environmental Satellite–R (GOES–R) series. 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 2014. 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, this statement summarizes our report being released today that (1) determines the status of the program, (2) evaluates whether plans for the GOES–R acquisition address problems experienced on similar programs, and (3) determines whether National Oceanic and Atmospheric Administration's (NOAA) plan to address the capabilities that were planned for the satellites, but then removed, will be adequate to support current data requirements.[1]

In preparing this testimony, we relied on our work supporting the accompanying report. That report contains a detailed overview of our scope and methodology. In addition, we updated factual information on satellite launch schedules as warranted. All of our work for this report was performed in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

NOAA operates GOES as a two-satellite system that is primarily focused on the United States. These satellites are uniquely positioned to provide timely environmental data about the Earth's atmosphere, its surface, cloud cover, and the space environment to meteorologists and their audiences. 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.

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). NOAA's policy is to have two operational satellites and one backup satellite in orbit at all times.

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	1998-2010	13, O, P, Q[c]
GOES-R	2008-2016	R, S

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.

Four GOES satellites—GOES–10, GOES–11, GOES–12, and GOES–13—are currently in orbit. Both GOES–11 and GOES–12 are operational satellites, with GOES–12 covering the east and GOES–11 the west. GOES–13 is currently in an on-orbit storage mode. It is a backup for the other two satellites should they experience any degradation in service. GOES–10 is at the end of its service life, but it is being used to provide limited coverage of South America. The others in the series, GOES–O and GOES–P, are planned for launch over the next two years.[2] NOAA is also planning the next generation of satellites, known as the GOES–R series, which are planned for launch beginning in 2015.

[1] GAO, *Geostationary Operational Environmental Satellites: Acquisition is Under Way, but Improvements Needed in Management and Oversight,* GAO–09–323 (Washington, D.C.: April 2, 2009).

[2] 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.

GOES–R Program—An Overview

NOAA plans for the GOES–R program to improve on the technology of prior series, in terms of both system and instrument improvements. The system improvements are expected to fulfill more demanding user requirements by updating the satellite data more often and providing satellite products to users more quickly. The instrument improvements are expected to significantly increase the clarity and precision of the observed environmental data. NOAA originally planned to acquire six different types of instruments.

In September 2006, however, NOAA decided to reduce the scope and technical complexity of the GOES–R program because of expectations that total costs, which were originally estimated to be $6.2 billion, could reach $11.4 billion.[3] Specifically, NOAA reduced the minimum number of satellites from four to two, canceled plans for developing a critical instrument—the Hyperspectral Environmental Suite (which reduced the number of planned satellite products from 81 to 68), and divided the Solar Imaging Suite into two separate acquisitions. The agency estimated that the revised program would cost $7 billion. In addition to the reductions in scope, NOAA also delayed the launch of the first satellite from September 2012 to December 2014.

NOAA is solely responsible for GOES–R program funding and overall mission success. However, since it relies on the National Aeronautics and Space Administration's (NASA) acquisition experience and technical expertise to help ensure the success of its programs, NOAA implemented an integrated program management structure with NASA for the GOES–R program. Within the program office, there are two project offices that manage key components of the GOES–R system—the flight and ground segment project offices. The flight project office, managed by NASA, is responsible for awarding and managing the spacecraft segment contract, delivering flight-ready instruments to the spacecraft segment contractor for integration onto the satellites, and overseeing the systems engineering and integration. The ground segment project office, managed by NOAA, oversees the ground contract, satellite data product development and distribution, and on-orbit operations of the satellites.

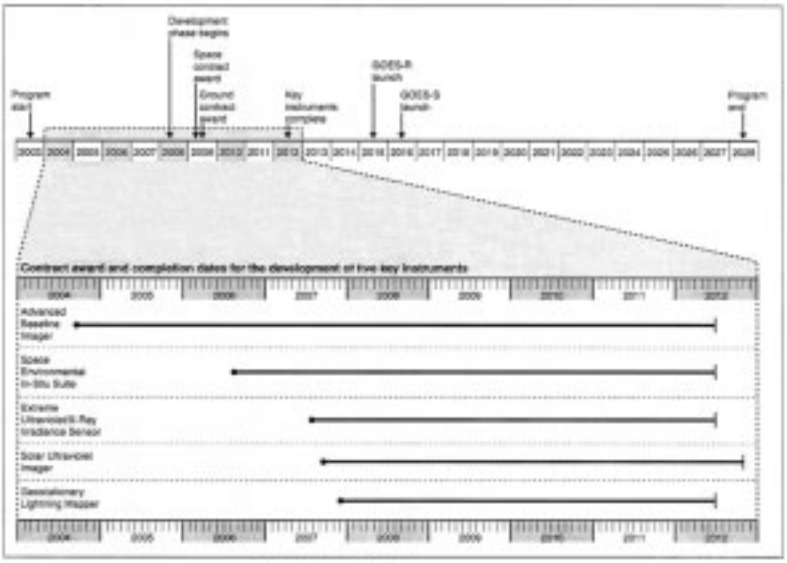
GOES–R Is in Development, But Costs Have Increased, Envisioned Functionality Has Been Reduced, and Schedules Have Been Delayed

NOAA and NASA have made progress on the GOES–R program. In January 2008, NOAA approved the program's move from the preliminary design and definition phase to the development phase of the acquisition life cycle. This approval also gave the program the authority to issue the requests for proposals for the spacecraft and ground segment projects—which it did in January 2008 and May 2008, respectively. The program office plans to award the prime contract for the spacecraft segment in May 2009 and the contract for the ground segment in June 2009. In addition, between September 2004 and December 2007, the GOES–R program awarded contracts for the development of five key instruments.[4] These instruments are currently in varying stages of development. Figure 1 depicts the schedule for both the program and key instruments.

[3] GAO, *Geostationary Operational Environmental Satellites: Additional Action Needed to Incorporate Lessons Learned from Other Satellite Programs,* GAO–06–1129T (Washington, D.C.: Sept. 29, 2006) and *Geostationary Operational Environmental Satellites: Steps Remain in Incorporating Lessons Learned from Other Satellite Programs,* GAO–06–993 (Washington, D.C.: Sept. 6, 2006).

[4] A sixth instrument, the Magnetometer, is to be developed as part of the space segment contract.

Figure 1: Planned Schedule for GOES-R Program and Key Instruments



Source: GAO analysis of NOAA data.

GOES–R Cost Estimate Has Increased, Envisioned Functionality Has Been Reduced, and Key Milestones Have Slipped

NOAA has made several important decisions about the cost, scope, and schedule of the GOES–R program. After reconciling the program office's cost estimate with an independent cost estimate, the agency established a new program cost estimate of $7.67 billion, an increase of $670 million from the previous estimate. Agency officials plan to revisit this cost estimate after the spacecraft and ground segment contracts are awarded but stated that it was developed with a relatively high level of confidence and that they believe that any adjustments would be well within the $7.67 billion program budget.

To mitigate the risk that costs would rise, program officials decided to remove selected program requirements from the baseline program and treat them as options that could be exercised if funds allow. These requirements include the number of products to be distributed, the time to deliver the remaining products (product latency), and how often these products are updated with new satellite data (refresh rate). Specifically, program officials eliminated the requirement to develop and distribute 34 of the 68 envisioned products, including aircraft icing threat, turbulence, and visibility. Program officials explained that these products are not currently being produced by legacy GOES satellites; they are new products that could be produced from the advanced GOES–R instruments. In addition, the program slowed planned product latency on the remaining products by as much as 10 minutes for hurricane intensity and six minutes for volcanic ash detection and height. It also reduced the refresh rates on these products by as much as 55 minutes for sea surface temperatures, cloud top observations, and vertical moisture profiles in the atmosphere. Program officials included the restoration of the products, latency, and refresh rates as options in the ground segment contract—items that could be acquired at a later time.

NOAA also delayed GOES–R program milestones including the dates for issuing the requests for proposals by up to six months and awarding the contracts for the spacecraft and ground segments by 12 and 10 months, respectively. The dates when the satellites would be available for launch have also slipped by four months, with the first satellite launch now scheduled for April 2015. Program officials attributed these delays to providing more stringent oversight before releasing the requests for

proposals, additional time needed to evaluate the contract proposals, and funding reductions in fiscal year 2008.

Recent events have raised doubts about the feasibility of the GOES–R launch date. Specifically, after the spacecraft segment contract was awarded and then protested in December 2008, NASA decided to re-evaluate the proposals. NASA now plans to re-award the contract in May 2009. Because NASA has agreed to a 72-month development cycle for the spacecraft segment (from contract award date to launch readiness), the launch date of GOES–R will likely be delayed until at least May 2015.

Any delays in the launch of the first GOES–R satellite run counter to NOAA's policy of having a backup satellite in orbit at all times and could lead to gaps in satellite coverage. This policy proved useful in December 2008, when NOAA lost communication with GOES–12, but was able to use GOES–13 as an operational satellite until communication was restored. However, beginning in November 2014, NOAA expects to have two operational satellites in orbit (O and P), but it will not have a backup satellite in place until GOES–R is launched. If NOAA experiences a problem with either of its operational satellites before GOES–R is in orbit, it will need to rely on older satellites that are beyond their expected operational lives and therefore may not be fully functional.

The GOES–R Program Office Has Taken Steps to Address Lessons Learned From Other Satellite Programs, But Important Actions Remain

GOES–R has taken steps to address lessons from other satellite programs. These actions include ensuring sufficient technical readiness of the spacecraft and ground segments prior to awarding the contracts. However, key risks remain and important actions remain to be completed in selected areas. Specifically, key technology risks remain—affecting both the ground segment and the instruments. While the hardware that is to be used for the ground segment is mature, key components have not previously been integrated. In addition, the program office has identified the Advanced Baseline Imager and the Geostationary Lightning Mapper instruments as having a high level of risk associated with cost due in part to the technical challenges posed by each instrument. Program officials reported that they have sufficient management reserves to address these risks.

To manage such risks, NOAA uses earned value management,[5] a proven means for measuring progress against cost and schedule commitments and thereby identifying potential cost overruns and schedule delays early, when the impact can be minimized. Two key aspects of this process are (1) conducting comprehensive integrated baseline reviews to obtain agreement from stakeholders on the value of planned work and validate the baseline against which variances are calculated and (2) using monthly variance reports to provide information on the current contract status, the reasons for any deviations from cost or schedule plans, and any actions taken to address these deviations.

To its credit, the GOES–R program office is using earned value management to oversee the key instrument contracts and plans to use it on the spacecraft and ground segment contracts. To date, the program office has performed integrated baseline reviews on the instruments and obtains and reviews variance reports for each of the instruments. However, the program's integrated baseline review for the Advanced Baseline Imager did not include a review of schedule milestones, the adequacy of how tasks are measured, and the contractor's management processes. Further, the variance reports for two instruments—the Advanced Baseline Imager and the Geostationary Lightning Mapper—do not describe all of the significant variances. Program officials explained that they meet with the contractor on a monthly basis to discuss all of the variances, but they were unable to provide documentation of these discussions or the reasons for, impact of, or mitigation plans for the variances. As a result of these shortfalls, the program office has less assurance that key instruments will be delivered on time and within budget, and it is more difficult for program managers to identify risks and take corrective actions.

NOAA Has Not Developed Plans for Meeting Requirements for Advanced Products

Before it was canceled in September 2006, the Hyperspectral Environmental Suite was originally planned as part of the GOES–R satellite series to meet requirements for products that are currently produced by GOES satellites as well as new tech-

[5] Earned value management is a project management approach that, if implemented appropriately, provides objective reports of project status, produces early warning signs of impending schedule delays and cost overruns, and provides unbiased estimates of a program's total costs.

nically-advanced products not currently produced by GOES satellites. NOAA still considers these requirements to be valid, and NOAA and the science community still have a need for the advanced products.

NOAA had planned to use the new sounding products to improve its performance goals, such as helping to increase the lead times associated with severe thunderstorm warnings from an average of 18 minutes in 2000 to as much as two hours by 2025, and helping to increase the lead times associated with tornado warnings from an average of 13 minutes in 2007 to as much as one hour by 2025.[6] In addition, NOAA had planned to use the new coastal waters imaging products to provide more accurate and quantitative understanding of areas for which NOAA has management responsibilities.[7] In particular, the coastal water imaging products could have been used to predict and monitor the growth, spread, severity and duration of harmful algal blooms. Recent studies suggest that harmful algal blooms are occurring more frequently because of climate change.

NOAA, NASA, and the Department of Defense assessed alternatives for obtaining advanced sounding and coastal water imaging products from a geostationary orbit. The results of the analysis recommended that NOAA work with NASA to develop a demonstration sounder to fly on an as-yet undetermined satellite and to evaluate other options for coastal waters imaging. NOAA plans to assess the technical feasibility of various options and to have the National Research Council make recommendations on long-term options for coastal water imaging.

However, NOAA has not defined plans or a timeline for addressing the requirements for advanced products. Further, agency officials were unable to estimate when they would establish plans to fulfill the requirements. Until a decision is made on whether and how to provide the advanced products, key system users will not be able to meet their goals for improving the lead times or accuracy of severe weather warnings, and climate research organizations will not obtain the data they need to enhance the science of climate, coastal, environmental, and oceanic observations.

Implementation of Recommendations Could Improve Management and Oversight

In our report, we are making three recommendations that, if implemented, could improve the management and oversight of the GOES–R acquisition. These are: ensuring that any re-baselining of a key instrument includes an assessment of milestones, adequacy of resources, task and technical planning, and management processes; ensuring that reasons for cost and schedule variances are fully disclosed and documented; and, if feasible, developing a plan and timeline for restoring the advanced capabilities removed from the program.

In written comments on a draft of this report, the Department of Commerce agreed with our findings and recommendations and outlined steps it is taking to implement them. The department also provided technical comments on the report, which we incorporated as appropriate.

In summary, NOAA has made repeated and continuing efforts to learn from problems experienced on other satellite programs. The GOES–R satellite series is now in development, but program costs have increased, the scope of the program has been reduced, and schedules have been delayed. Further, unless the program exercises contract options, key benefits in terms of new products and faster data updates will not be realized. Of particular concern are the three years of launch delays since 2006. In addition, recent events make it likely that the launch of GOES–R will continue to slip, which increases the risk of having gaps in satellite coverage. Until NOAA and NASA act to address this risk, the United States' ability to maintain the continuity of data required for weather forecasting is in jeopardy. In addition, NOAA has not yet developed a plan or a timeline for recovering the advanced capabilities that were removed. Until such decisions and plans are made, the geostationary user community may not be able to make significant improvements in their severe weather forecasts, or their ability to monitor our coastal environments.

Mr. Chairman and Members of the Subcommittee, this concludes our statement. We would be pleased to respond to any questions that you or other Members of the Subcommittee may have at this time.

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[6] In addition to advanced sounding, other activities such as improvements in radar technologies are expected to help improve lead times.

[7] While current and future satellite systems provide selected coastal waters images, they lack the resolution, sampling frequency, and spectral information (field of vision) needed to monitor coastal areas and estuaries.

Staff Acknowledgments

Other key contributors to this testimony include Colleen M. Phillips, Assistant Director; Carol Cha; William Carrigg; Neil Doherty; Franklin Jackson; Kaelin Kuhn; Lee McCracken; and Eric Winter.

BIOGRAPHY FOR DAVID A. POWNER

Dave is currently responsible for a large segment of GAO's information technology (IT) work, including systems development, IT investment management, and cyber critical infrastructure protection reviews. He has nearly 20 years of both public and private information technology-related experience. In the private sector, he held several executive-level positions in the telecommunications industry, including overseeing IT and financial internal audits, and software development associated with digital subscriber lines (DSL). At GAO, he has led reviews of major IT modernization efforts at Cheyenne Mountain Air Force Station, the National Weather Service, the Federal Aviation Administration, and the Internal Revenue Service. These reviews covered many information technology areas including software development maturity, information security, and enterprise architecture. Dave has an undergraduate degree from the University of Denver in Business Administration and is a graduate of the Senior Executive Fellows program at Harvard University's John F. Kennedy School of Government.

Chairman BAIRD. Thank you, Mr. Powner.

Ms. Kicza.

STATEMENT OF MS. MARY E. KICZA, ASSISTANT ADMINISTRATOR FOR SATELLITE AND INFORMATION SERVICES, NATIONAL ENVIRONMENTAL SATELLITE, DATA, AND INFORMATION SERVICE, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, U.S. DEPARTMENT OF COMMERCE

Ms. KICZA. Chairman Baird, Ranking Member Inglis, distinguished Members and staff, I am pleased to join Mr. Powner of GAO and Mr. Morrow of NASA to discuss the GOES–R program, NOAA's next generation geostationary satellite system. I am pleased to report that our current GOES satellites are providing data 24 hours a day, seven days a week. We are preparing the GOES–O satellite for launch later this year and completing development of the GOES–P satellite.

As you said, NOAA's geostationary satellites are best known for creating hurricane pictures that you see on television. They provide data to help forecast the weather and are critical to detecting and tracking severe weather. The value of GOES data was recently demonstrated during the wildfires in Oklahoma and Texas, as you have just shown.

I would like to review briefly the status of the GOES program. We have made significant progress to address the cost, schedule and technical risks the program faced. I addressed this when I testified in front of this subcommittee nearly two years ago. The program will certainly face further risks during the course of this development, but we have established rigorous processes and reporting thresholds to provide early warning of risks so that we can promptly address them. In collaboration with NASA, we have developed an acquisition strategy that takes advantage of the strengths of each agency. NOAA has program management and funding responsibilities for the program. NASA manages the flight project which includes the instruments, the spacecraft and procuring a launch vehicle. NOAA manages the ground system project which includes ground station and weather products development. This places the government in direct oversight and control of each

of the key elements of the program. NASA plans to award the spacecraft contract in May of this year. NOAA plans to award the ground system contract in June of this year. Awarding these contracts are important milestones for the program.

We have encountered some issues during instrument development thus far. That is why we build prototype models of the most complex sensors to resolve the issues before the final flight instruments are built to fly in a satellite. We have addressed all of these issues within the existing budget. The current budget supports development and operations for the GOES–R and –S satellites through 2028. Subject to availability of funds in future fiscal years, we anticipate exercising contract options to procure and operate two additional satellites, GOES–T and –U.

I would like to turn to the GAO report. I want to say that we value—we greatly value the insight provided by GAO. We are pleased that the GAO has recognized the program's progress since they began to review this program, especially recently our strides implementing sound cost estimating methodologies.

I would like to address the report's recommendations. The GOES–R program office recently modified the Advanced Baseline Imager contract to more closely align its schedule with the planned schedule for spacecraft development and we have adjusted the earned value metrics accordingly. GAO's first recommendation states that with the changes of this nature, the program should conduct a formal integrated baseline review. We agree with this recommendation and expect to complete one by the end of this year. In the interim, the program will continue to closely manage the ABI development.

The second recommendation directed the agency to improve its ability to oversee contractor performance by ensuring the reasons for cost and schedule variances are fully disclosed and documented. We agree with this recommendation. The program has been receiving information on all costs and schedule variances. The practice has been for our major instrument development, ABI, that the contractor submit detailed analysis on the top five cost and schedule variances. The program then meets with each of the contractors monthly to discuss any additional variances that require additional clarification. From this point forward we will formally document the results of those meetings and track any resulting actions.

The next recommendation calls for a plan and timeline if feasible and justified for recovering the advanced capabilities that were removed from the program when the Hyperspectral Environmental Suite was canceled. We agree with the recommendation. The user requirements for the HES advanced capabilities are documented. While the capabilities are not currently a part of the GOES–R program, the ability to accommodate them in the future has been retained. The measurements which had originally been planned for HES remain important to a wide range of users and my office is examining how to best bring these capabilities to bear in the future. We are seeking information on capabilities that the U.S. private sector can contribute and we are actively exploring the potential of international collaboration to bring the capabilities to bear. As the efforts mature and given they are deemed of high priority

in comparison to other NOAA observational needs, we will request funds to support the capabilities on our satellite platforms.

I want to take the opportunity to once again thank Mr. Powner and his staff for the recommendations offered. We agree with them and we are responding to them. I want to thank Mr. Morrow. We value the expertise that NASA provides for GOES–R. We have a strong NOAA–NASA partnership in GOES–R and our team is fully committed to its success.

I appreciate the Committee's interest in our satellite programs and I am happy to answer any questions you may have.

[The prepared statement of Ms. Kicza follows:]

PREPARED STATEMENT OF MARY E. KICZA

Introduction

Mr. Chairman and Members of the Subcommittee, I am Mary E. Kicza, Assistant Administrator of the National Environmental Satellite, Data, and Information Service (NESDIS). NESDIS is part of the National Oceanic and Atmospheric Administration (NOAA), within the Department of Commerce. NOAA's mission is to understand and predict changes in Earth's environment and conserve and manage coastal and marine resources to meet our nation's economic, social, and environmental needs.

I appreciate the opportunity to discuss with you today NOAA's environmental satellite programs and to highlight their importance to our hurricane and other severe weather forecasting and warning capabilities. NOAA has made significant progress in the development of the next generation Geostationary Operational Environmental Satellites R Series (GOES–R) program since the last hearing on this topic on October 23, 2007.

NOAA's satellite acquisitions are complex and difficult development efforts. I will be the first to acknowledge that it is a challenge to build the complex satellites that are required to meet the requirements of our customers and users. However, NOAA has implemented several changes to strengthen the program control processes within our satellite development programs in response to lessons learned from programs including the National Polar-orbiting Operational Environmental Satellite Systems (NPOESS) and from the recommendations of outside reviewers, such as the U.S. Government Accountability Office (GAO).

What Are Geostationary Satellites?

NOAA has operated geostationary operational environmental satellites (GOES) since the 1970s. These satellites are located more than 22,000 miles above the equator and provide near continuous 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 the data to help forecast the weather and are critical to detecting and tracking severe weather.

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 in space that can be repositioned and brought out of storage to take the place of a failed satellite. Given the importance of the data from these satellites, continuity of operations remains our highest priority.

Status of the Current GOES Constellation (GOES I–M and GOES–N Series)

Individual GOES satellites have a letter designation through their development until they are launched, placed in orbit, and have completed a rigorous checkout procedure. They are then given numeric designations for their operational lifetimes. The operational satellites in space now, GOES–11 and GOES–12, are the last two satellites of the GOES I–M series.

The next series of geostationary satellites is called GOES–N, and this series consists of the same instruments as the GOES I–M series. The first of the GOES–N series satellites was launched in May 2006 and is currently serving as the on-orbit spare. The final two satellites from this series are GOES–O and GOES–P, with GOES–O scheduled to launch later this year.

What Is the GOES–R Series?

GOES–R is a joint development and acquisition effort between NOAA and the National Aeronautics and Space Administration (NASA) as documented in a jointly signed Memorandum of Understanding and Management Control Plan. The GOES–R series will replace the GOES–N series and extend geostationary capabilities through FY 2028.

GOES–R will provide forecasters and scientists with a new suite of improved instruments. These new instruments will enhance our current capability to track and monitor severe weather on Earth with improved imagery and scan rates. Additionally, solar environmental monitoring instruments will provide advances for space weather forecasting. GOES–R will provide more timely and accurate weather forecasts and improve the detection and observations of severe weather events that directly affect public safety, protect property, and, ultimately support the country's economic health and development.

Under a multi-contract acquisition strategy, NASA will procure the space segment (including spacecraft and instruments) and NOAA will procure the ground segment (including the ground system that will conduct satellite operations and environmental product generation and distribution) for the GOES–R program. The GOES–R planned launch is April 2015; however, delays in the spacecraft procurement may impact the launch date. The GOES–R program will analyze the impact to planned launch dates once the spacecraft and ground contracts are awarded and underway.

The GOES–R program is budgeted for two satellites and a supporting ground system and has unfunded options for two additional satellites. GOES–R instruments include an Advanced Baseline Imager (ABI), the main imaging sensor for the satellite; solar instruments, including the Extreme Ultraviolet and X-ray Irradiance Suite (EXIS) and Solar Ultraviolet Imager (SUVI); a Space Environment In-Situ Suite (SEISS); and a new Geostationary Lightning Mapper (GLM), which will monitor lightning strikes to enhance severe weather prediction. The spacecraft will also host a magnetometer.

The imagery improvements provided by the ABI and the addition of the GLM to the GOES instrument suite will lead to improved observations, forecasts, and warnings for a host of environmental hazards, including severe thunderstorms, tornadoes, hurricanes, lightning, flash floods, winter storms, fog, forest fires, and poor air quality.

The ABI Prototype Model (a model built to test the design of the sensor before the first instrument for flight is assembled) is now being integrated by the instrument contractor, ITT Corporation (ITT). Testing of the prototype model will proceed through the end of the year, while ITT begins development of the first flight model during the next year.

The GLM instrument contract was awarded to Lockheed Martin Advanced Technologies Corporation in December 2007. The instrument's Preliminary Design Review was successfully conducted earlier this year, and the instrument is now in its detailed design phase. The remaining instruments have all had successful Preliminary Design Reviews and are also in the detailed design phase. (Appendix 1 includes additional information about instrument development.)

Status of GOES–R Spacecraft Acquisition

On December 4, 2008, the GOES-R program awarded the spacecraft contract to Lockheed Martin Space Systems Company to build two spacecraft for the GOES–R program. The total estimated value of the basic contract including the two options is $1.09 billion. The basic contract is for two spacecraft with two unfunded options that each provide for one additional spacecraft.

On December 15, 2008, Boeing Satellite Systems filed a protest with GAO against the GOES–R spacecraft contract award to Lockheed Martin Space Systems Company. On February 17, 2009, NASA requested GAO dismiss the protest based on NASA's decision to re-evaluate the proposals and make a new award decision. On February 19, 2009, GAO dismissed the protest. After the protest was dismissed, the Source Evaluation Board (SEB) reconvened to re-evaluate the proposals of Lockheed Martin and Boeing. The contract remains suspended until a new award decision is announced, which is currently planned for May.

Status of GOES–R Ground Systems Acquisition

The GOES–R Program Office is working toward awarding the GOES–R ground segment contract in June 2009. The ground segment will maximize use of well proven technologies for its systems. Scientific algorithm development to develop new environmental products from GOES–R series satellite data will be performed by an ex-

perienced NOAA science team partnered with university-based cooperative institutes and NASA scientists.

Ongoing GAO Review of the GOES–R Program

GAO has provided regular reviews of our GOES–R Series acquisition for many years and we appreciate the perspective the GAO professionals provide. We have met with GAO and provided information and feedback on its most recent report. I will summarize this information for you today.

I am pleased the GAO report recognizes we have taken steps to apply the lessons learned from other satellite programs to the procurement of GOES–R. I understand we have more work to do to improve the overall management of these complex and high risk programs, and the joint NOAA/NASA team is fully committed to making these improvements.

Specifically, the GAO provided three recommendations:

Recommendation number one: *As part of any effort to re-baseline the cost and schedule of the Advanced Baseline Imager, perform an integrated baseline review and ensure the review includes an assessment of key schedule milestones, the adequacy of resources, task and technical planning, and management processes.*

NOAA agrees with this recommendation. NOAA will perform an integrated baseline review on the Advanced Baseline Imager as part of any effort to re-baseline its cost and schedule. The integrated baseline review will include assessment of the technical scope of the work, key schedule milestones, the adequacy of resources, task and technical planning, and management processes. There is no near-term plan to re-baseline ABI at this time.

Recommendation number two: *Improve the agency's ability to oversee contractor performance by ensuring the reasons for cost and schedule variances are fully disclosed and documented.*

NOAA agrees with this recommendation. GOES–R contractors submit monthly Cost Performance Reports with itemization of all variances. The GOES–R program office will ensure these cost and schedule variances reported by the contractor are elaborated upon as needed for full understanding and disclosure. Also, the GOES–R program office will fully document the actions taken to address significant cost and schedule variances, along with the reasons for and impact of those actions.

Recommendation number three: *If feasible and justified, develop a plan and timeline of recovering the advanced capabilities that were removed from the program when the Hyperspectral Environmental Suite was canceled.*

NOAA agrees with this recommendation. NOAA will identify and validate user requirements, evaluate the priority of addressing those requirements against the technical feasibility of meeting those requirements, and determine the most appropriate methods to meet them.

Conclusion

I appreciate the Committee's continued interest in NOAA's satellite programs. It is widely acknowledged satellites are very complicated and difficult systems to design, build, and operate. However, their capabilities play a role in NOAA's mission to observe and predict the Earth's environment and to provide critical information used in protecting life and property.

We are making significant strides in developing a better process for designing and acquiring our satellites. We have fully functioning operational satellites with backup systems in place, and we are working on the next generation that will provide significant improvements in our ability to forecast the weather and other environmental phenomena. I would be happy to answer any questions you may have.

Appendix 1

GOES–R Instrument Status

- **Advanced Baseline Imager (ABI)**
  - — Implementation phase
  - — Contractor: ITT Corporation, Ft. Wayne, IN
- **Space Environmental In-Situ Suite (SEISS)**

— Implementation phase
— Contractor: Assurance Technology Corporation, Carlisle, MA

- **Extreme Ultra Violet/X-Ray Irradiance Sensor (EXIS)**
  — Implementation phase
  - Contractor: Laboratory for Atmospheric and Space Physics, Boulder, CO
- **Solar Ultra Violet Imager (SUVI)**
  - Implementation phase
  - Contractor: Lockheed Martin Advanced Technology Corp, Palo Alto, CA
- **Magnetometer**
  — To be procured as part of spacecraft contract
- **Geostationary Lightning Mapper (GLM)**
  - Implementation phase
  - Contractor: Lockheed Martin Advanced Technology Corp, Palo Alto, CA

BIOGRAPHY FOR MARY E. KICZA

Mary E. Kicza is the NOAA Assistant Administrator for Satellite and Information Services. NOAA Satellite and Information Service is dedicated to providing timely access to global environmental data from satellites and other sources to promote, protect, and enhance the Nation's economy, security, environment, and quality of life. In this role, Ms. Kicza leads the acquisition and operation of the Nation's civil operational environmental satellite system. She also leads efforts for research and development of products and programs to archive and provide access to a variety of Earth observations via three national data centers.

Ms. Kicza is a leader in the international Earth observation community, serving as Chairman of the Committee on Earth Observation Satellites Strategic Implementation Team. In this capacity, she leads efforts to coordinate global satellite-based observations among international space agency partners to further the development of a Global Earth Observation System of Systems. In addition, Ms. Kicza serves as the Co-Chairman of the NOAA Observing Systems Council, a group which coordinates observing systems requirements and provides resource recommendations for NOAA's observation platforms. She is also a member of the NOAA Executive Council, NOAA's executive decision-making body.

Before coming to NOAA, Ms. Kicza was the Associate Deputy Administrator for Systems Integration at the National Aeronautics and Space Administration (NASA). As a senior leader within NASA, she was responsible for assuring that the mission and mission support elements were effectively aligned and integrated. She served previously as the Associate Administrator for Biological/Physical Research, the Associate Center Director for Goddard Space Flight Center, the Assistant Associate Administrator for Space Science, and the Deputy Director of the Solar System Exploration Division. Ms. Kicza began her career as an engineer at McClellan Air Force Base in California, before joining NASA in 1982 as a lead engineer supporting the Atlas Centaur and Shuttle Centaur launch vehicles.

Ms. Kicza has served with distinction in a variety of technical, managerial, and leadership posts, supporting the development, launch, and operation of satellite systems as well as multi-faceted research and development programs. She has significant experience in building and maintaining effective relationships with the Office of Management and Budget, the Office of Science and Technology Policy, the Defense Department, Congress, the aerospace industry, and a diverse research community. Ms. Kicza has earned two SES Meritorious Service Awards, NASA's Distinguished Service and Scientific Achievement Medal, and numerous other awards.

Ms. Kicza received her Bachelor's Degree in Electrical and Electronics Engineering from California State University and a Master's Degree in Business Administration from the Florida Institute of Technology.

Chairman BAIRD. Thank you, Ms. Kicza.

Mr. Morrow.

STATEMENT OF MR. GEORGE W. MORROW, JR., DIRECTOR, FLIGHT PROJECTS, GODDARD SPACE FLIGHT CENTER, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Mr. MORROW. Mr. Chairman, Members of the Subcommittee, thank you for the opportunity to be here today to discuss NASA's role in support of NOAA for the GOES–R series. NASA Goddard Space Flight Center in Greenbelt, Maryland has a long history in weather satellite development, having developed and launched the world's first weather satellite in 1960 called the Television Infrared Observation Satellite, or TIROS for short.

Today NASA and NOAA share a 39-year partnership in designing, developing and launching GOES and POES environment satellites. These spacecraft provide our nation with meteorological data for the weather observations, research, forecasting and storm warnings that we have all come to rely on every day.

Today my testimony outlines the steps NOAA and NASA are taking to minimize costs, schedule and performance risks on GOES–R. In addition, I would like to highlight the ways NASA continues to fill the Agency's commitment to providing complete transparency to its program management activities to ensure the successful and timely delivery of GOES–R. Effectively managing costs, schedule and performance risks requires the up-front identification of the most vulnerable program areas. For the GOES–R program, NASA and NOAA identified the following areas together: requirements definition, instrument development, instrument interfaces and contract oversight. NOAA and NASA took exceptional steps up front to fully define all the requirements for GOES–R. We capitalized on the lessons learned from other major similar satellite programs and employed Goddard's own internal lessons learned and rules. As a result, the GOES–R set of requirements represents the best-defined requirement set of any previous GOES mission.

The GOES–R series spacecraft, as you know, includes six key instruments. In 2001, NASA and NOAA issued preliminary design contracts as an initial step to mitigating risk associated with GOES–R instrument development activities. Implementing that phased-type approach provided for an initial study period where technology maturation and vulnerabilities were assessed and rigorous requirements evaluations were completed before contracting for the implementation and development phases for the instruments. Interfaces between the instruments and the spacecraft are another area and a development challenge for any complex satellite acquisition. NASA engaged in a number of risk reduction activities, including developing and qualifying the instrument-to-spacecraft communications interface, and these risk reduction activities are directly applicable to the GOES–R mission and serve to reduce risk. Demonstrating responsible cost and schedule performance demands that NASA and NOAA develop a robust programmatic cost and schedule baseline and to closely monitor contract performance, maintaining contract oversight. All of the instrument and spacecraft contracts for GOES–R are managed as separate entities within the GOES–R flight project, not as one large prime contract, thereby assuring that the government has authority to implement changes necessary to ensure the success. For each of those contracts, we have dedicated managers and contracting officers and

engineering oversight and each effort is afforded the attention required to stay on top of developments, issues and risks. In addition, as you well know, we have fully implemented our value management and review the data with the GOES–R NOAA Program Office on a monthly basis.

You are also aware that the GOES–R spacecraft contract is in source selection process. Lockheed Martin was awarded the GOES–R spacecraft contract in December of last year. December 15, Boeing Satellite Systems filed a bid protest with GAO. As a result of the protest, the contract with Lockheed Martin was suspended and on February 19, GAO dismissed the protest. NASA's Source Evaluation Board reconvened to reevaluate the proposals of Lockheed Martin and Boeing and a new contract award is scheduled to be accomplished in May. Please note that the government is not at liberty to provide details concerning the GAO bid protest proceedings at this point since those are subject to the protective order issued by GAO. In addition, since new contract award has not yet been made, NASA is unable to disclose information concerning the reevaluation as it is source selection sensitive.

In the meantime, NASA is taking all possible steps to minimize schedule risk. Instrument contracts are being held to their original delivery dates and not being allowed to slip. The delayed award of the spacecraft contract could also result in instrument accommodation risk or interface risk and we at the Goddard Space Flight Center are acting in that interface role with the instrument contractors in the absence of a spacecraft contractor.

NASA and NOAA took very great steps to be an integrated program at the beginning of this. We have a NOAA program office colocated at the Goddard Space Flight Center with the NASA Flight Project and the NOAA ground project. There are over 100 NOAA civil servants and contractors located on site. We are intimately involved with NOAA and the program office there, and the NOAA program office and program folks have full access to all contract deliverables and reporting requirements and we are in lockstep with them. It is a very close partnership.

In closing, I am glad to be here. I want to answer any further questions you have and I hope that you will become confident that we are successfully managing this program. Thank you.

[The prepared statement of Mr. Morrow follows:]

PREPARED STATEMENT OF GEORGE W. MORROW, JR.

Mr. Chairman and Members of the Subcommittee, thank you for the opportunity to appear today to discuss NASA's role and support to the National Oceanic and Atmospheric Administration (NOAA) for the Geostationary Operational Environmental Satellites R Series (GOES–R). The NASA Goddard Space Flight Center (GSFC) in Greenbelt, Maryland developed and launched the world's first weather satellite in 1960 called the Television Infrared Observation Satellite (TIROS). Designed to test experimental television techniques that would lead to a worldwide meteorological information system, TIROS demonstrated the benefits of studying Earth's weather systems from space. Today, NASA and NOAA share a 39-year partnership designing, developing and launching the GOES weather satellites. The GOES and Polar Operational Environmental Satellite (POES) series provide our Nation with the meteorological data for the weather observations, research, forecasting, and storm warnings that we have come to rely on. Through this partnership, NOAA and NASA are now implementing plans for the design, development and launch of the next generation geostationary weather satellite, the GOES–R series. These next-generation spacecraft will further improve our ability to observe and predict weather

events and provide a means for the identification of severe storm conditions such as hurricanes and tornadoes.

NASA recognizes the importance of delivering missions on cost and on schedule, and developing clear and stable baselines. Developing scientific instruments, spacecraft, and new launch systems often requires that the Agency redefine state-of-the-art. Often, NASA is pushing the technology boundaries and must venture beyond our past experience and into an environment of uncertainty and higher risk. The GOES–R satellite series is a major improvement over the previous system and therefore it does come with some risk. Today my testimony outlines the steps NOAA and NASA are taking to minimize cost, schedule and performance risk on the GOES–R program and how NASA continues to fulfill the Agency's commitment to providing complete transparency to its program management activities to ensure the successful and timely delivery of the GOES–R series spacecraft.

Minimizing Cost, Schedule and Performance Risk

Effectively managing cost, schedule and performance risk requires the identification of the most vulnerable program areas. For the GOES–R program, NASA and NOAA identified the following areas: 1) requirements definition; 2) instrument development; 3) instrument interfaces; and, 4) contract oversight.

Developing well-defined mission requirements is the critical first step to any major system acquisition. NOAA and NASA took exceptional steps to fully define all requirements for the GOES–R space and ground segments. This included defining performance, interface, testing, quality assurance, and deliverable requirements. During the formulation phase, NASA worked with NOAA to define and refine the instrument performance requirements. These requirements flow down to NASA from NOAA through the Mission Requirements Document (MRD). NASA then allocated the NOAA performance requirements to the individual instruments within the GOES–R payload suite. During the Program Definition and Risk Reduction phase (PDRR), NASA worked with the prospective spacecraft and ground system providers to refine the spacecraft specification. Capitalizing on lessons learned from other major spacecraft programs, and employing the GSFC Goddard Open Learning Design[1] (GOLD) Rules, NOAA and NASA developed specifications, mission assurance requirements, and statements of work to fully define the mission requirements. Thus, the GOES–R set of requirements represents the best defined requirements set of any previous GOES mission, and an excellent baseline from which to proceed with development of the Nation's next generation geostationary weather satellite.

The GOES–R series spacecraft includes five key instruments: the Advanced Baseline Imager (ABI); the Space Environmental In-Situ Suite (SEISS); the Extreme Ultra Violet and X-ray Irradiance Sensor (EXIS); the Solar Ultra Violet Imager (SUVI); and, the Geostationary Lightning Mapper (GLM). A sixth instrument, the magnetometer, will be developed as part of the spacecraft contract. In 2001, NASA and NOAA issued preliminary design (or formulation) contracts as an initial step to mitigating risk associated with the GOES–R instrument development activities. Implementing a "phased-contract" approach provided for an initial study period where technology maturity and vulnerabilities were assessed and rigorous requirements evaluations were completed before contracting for the implementation and development phases. The first instrument formulation contract awarded was for the ABI. Considered the most complex instrument development activity, ABI will monitor and track severe weather and provide images of clouds to support forecasts. Awarding the ABI development effort early and employing the phased contract approach allowed the GOES–R program sufficient time to work through all of the issues that arise during the development of a state-of-the-art instrument and ensures that the performance of the ABI instrument meets our customer's requirements. Subsequently, study and implementation contracts were awarded for each of the remaining four GOES–R instruments. ABI has completed its critical design review (CDR) and the prototype model instrument is currently being integrated. The remaining four instruments have all completed their preliminary design reviews (PDR) and are working towards their CDRs.

Interfaces between instruments and spacecraft present the next greatest development challenge for the GOES–R program. NASA has engaged in a number of risk reduction activities to reduce the risk on the GOES–R program. These include developing and qualifying the instrument to spacecraft communications interface (e.g., SpaceWire communications protocol). Other risk reduction activities include Global Positioning System (GPS) at Geostationary (GEO) receiver development, Field-Programmable Gate Array (FPGA) life testing, Electrical, Electronic, and

[1] *http://askmagazine.nasa.gov/issues/22/22_enhancing_day.php*

Electromechanical (EEE) parts radiation testing, loss-less compression chip development, solar-blind detector development, dual circular-polarization receiver testing, and thermal radiator (white paint) coatings qualification. All of these activities are directly applicable to the GOES–R mission and serve to reduce risk for flight hardware contractors.

Demonstrating responsible cost and schedule performance demands that NASA closely monitor contract performance, maintaining contract oversight to ensure the delivery of quality and timely products. All instrument and spacecraft contracts are managed as separate entities within the GOES–R Flight Project—not as one large prime contract—thereby assuring that the Government has the authority to implement any actions necessary to ensure success. With dedicated managers, contracting officers and engineering oversight, each effort is afforded the attention required to stay on top of developments, issues, and risks. NASA performs in-depth contract reviews and has implemented the necessary insight and oversight into the contractors' efforts. NASA has fully implemented earned value management on all flight hardware contracts and reviews the data with the GOES–R Program Office on a monthly basis. With GSFC's 50-year history in managing spacecraft development efforts (with skills in engineering, procurement, mission assurance, and mission management), NASA is in a position to apply all necessary resources to the GOES–R Program to reduce risk and ensure success.

Space Segment Contract Award

By way of background, Lockheed Martin Space Systems Company (LMSSC) was awarded the GOES–R spacecraft contract on December 4, 2008. On December 15, 2008, Boeing Satellite Systems (BSS) filed a bid protest with the Government Accountability Office (GAO) against the GOES–R spacecraft contract award to LMSSC. As a result of the protest, the contract and any associated work were suspended. On February 17, 2009, NASA requested that the GAO dismiss the protest as a result of the Agency's decision to re-evaluate the proposals of Lockheed Martin and Boeing, and make a new selection decision. On February 19, 2009, the GAO dismissed the protest. After the protest was dismissed, the NASA Source Evaluation Board (SEB) reconvened to re-evaluate the proposals of Lockheed Martin and Boeing. A new contract award is planned for May 2009. Please note that the Administration is not at liberty to provide details concerning the GAO bid protest proceedings, since those are subject to the protective order issued by GAO. In addition, since a new contract award has not yet been made, the Administration is unable to disclose information concerning the re-evaluation, as it is source selection sensitive.

Once NASA has selected a spacecraft contractor and NOAA has selected a ground system contractor, NOAA will establish a new launch readiness date. In the meantime, NASA is taking all possible steps to minimize schedule risk. Instrument contracts are being held to their original delivery dates and not being allowed to slip.

The delayed award of the spacecraft contract may result in additional instrument accommodations risk. This risk is defined as the possibility of incompatible interfaces between the spacecraft and instruments. However, to mitigate this risk NASA's Flight Project Office continues to perform as the spacecraft integrator in the absence of a spacecraft contractor. Overcoming this challenge is not new to NASA, where frequently instrument development efforts are initiated very early in the systems acquisition process given their long-lead development requirements. NASA has established resource allocations on the GOES–R program for the instruments and spacecraft, holding sufficient margins against both. In addition, NASA has established and documented firm interface requirements for the instruments and spacecraft, which are on all contracts.

NASA Program Management Transparency

NASA continues to fulfill its commitment towards complete transparency in the execution of the Flight Project within the GOES–R Program. Starting early in the GOES–R program formulation, NASA and NOAA made the decision to co-locate the GOES–R Program Office and Ground Project at GSFC. Employing a centrally located GOES Program Office is a first for the long-term NOAA/NASA relationship. The co-located office enables daily interaction between the respective project elements and fosters closer working relationships. Approximately 100 NOAA employees and contractors supporting GOES–R reside and work at GSFC. Within the NASA Flight Project, the Deputy Project Manager (DPM) is a NOAA employee and three of the Instrument Managers are NOAA employees. Within the NOAA Ground Project, the DPM is a NASA employee as is the Systems Manager. Within the NOAA Program Office, the Assistant System Program Director is a NASA employee

and within the Program Systems Engineering Office, the lead Program Systems Engineer is a NASA employee, and the Deputy is a NOAA employee. From a personnel standpoint, the GOES–R Program is totally integrated.

The NASA Flight Project reports directly to the NOAA Program Office. So, all of the typical staff meetings, board meetings, etc. that occur on a routine basis within a Program Office are attended by the Flight Project and reported to the NOAA Program Office. Conversely, NOAA Program Office personnel attend all NASA flight hardware contractor reviews and internal technical meetings. All deliverable contractor data is stored electronically and the NOAA Program Office has access to all data. Finally, all earned value analysis for the Flight Project is performed by the NOAA Program Office.

External reporting is handled similarly. The GOES–R Management Control Plan (MCP) outlines the overall reporting requirements. Both GOES–R Projects engage in the standard reporting processes that are implemented for Projects at GSFC. Both Projects report status on a monthly basis to the Director of Flight Projects and then again to the GSFC Center Management Council (CMC) at Monthly Status Review (MSR) meetings. The GOES–R Program Office attends both of these reviews and is invited to present status as well. Additionally, NOAA/National Environmental Satellite, Data, and Information Service (NESDIS) personnel attend the MSR and sit at the table with the GSFC CMC in review of the GOES–R Projects. The same is true with the NOAA Program Management Council (PMC). The GOESR Program presents monthly to the PMC, along with other NASA/NOAA Programs—GOES–N/P, POES, NPP, and NPOESS. Sitting on the PMC, along side of NOAA, are representatives of senior leadership from GSFC. These include the GSFC Deputy Center Director and the NASA Chief Engineer. NOAA senior leadership hears exactly the same thing as NASA management, sitting side-by-side at two different monthly reviews of the GOES–R Program.

In summary, NOAA has access to all contract documentation and attends all contract reviews. NOAA attends and participates in all Flight Project reporting to NASA management, and NASA participates in NOAA PMC meetings. NOAA performs all of the earned value analysis on the Flight Project contracts, so there is no misunderstanding of any cost or schedule performance issues. There is unprecedented transparency between NASA and NOAA on the GOES–R Program.

Conclusion

In closing, NASA remains committed to minimizing cost, schedule and performance risk on the GOES–R program and fulfilling our commitment to providing transparency in our project management activities. Building on the strength of our partnership with NOAA and its predecessor organizations since 1958, along with NASA's successful history of spacecraft and instrument development, we are looking forward to the successful completion and launch of the GOES–R series.

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

BIOGRAPHY FOR GEORGE W. MORROW, JR.

George Morrow is the Director of Flight Projects at NASA/Goddard Space Flight Center and has served in this position since September 2007. He is responsible for the day-today management of the more than 40 Space and Earth Science missions in formulation or implementation at Goddard as well as the coordination of the Earth Science Technology Office and the Advanced Concepts and Technology Office.

Mr. Morrow began his career at Goddard in 1983 in the Space Power Applications Branch as the Lead Spacecraft Battery Systems Engineer. He led the design, fabrication, and test efforts for flight battery systems for all Goddard projects including the Earth Radiation Budget Satellite, LandSat, the Cosmic Background Explorer, the Gamma Ray Observatory, the Upper Atmosphere Research Satellite, and the Hubble Space Telescope (HST).

From November 1988 to April 1994, Mr. Morrow served in various increasingly responsible systems engineering and observatory management positions in the HST program in support of the first HST Servicing Mission. From April 1994 until May 1997, he was the Deputy Project Manager of the HST Flight Systems and Servicing Project. He oversaw all activities within or outside NASA which affected program cost, technical reliability, and schedule. Mr. Morrow served as the Deputy Associate Director of Flight Projects for HST from May 1997 until January 1998.

In January 1998, Mr. Morrow was assigned as the Earth Observing System (EOS) PM (later named Aqua) Project Manager. He was responsible for all aspects of the development, test, and launch of the $900M EOS PM Observatory, which included

direct management of eight complex science instruments—two of which were contributions from foreign entities (Japan and Brazil).

In February 2001, Mr. Morrow left government service to become the Vice President and Division Manager of the Aerospace Engineering Division at Jackson and Tull, a privately held aerospace company in the Washington metro area. He returned to Goddard in March 2003 as the Deputy Director of Flight Projects but served until April 2004 as the Acting Associate Director of Flight Programs and Projects for EOS. In this acting capacity, he was responsible for the management of six complex missions in development and 11 operating missions.

Mr. Morrow received the NASA Exceptional Service Medal in 1994 and the NASA Outstanding Leadership Medal in 2006. In addition, he is the recipient of numerous NASA and Goddard Group Achievement and Special Act awards. Mr. Morrow received a Bachelor of Science degree in Chemical Engineering from the University of Virginia and a Masters of Engineering Administration degree from George Washington University.

DISCUSSION

Chairman BAIRD. Thank you very much. We have been joined by Mr. Ehlers. Dr. Ehlers, thank you for joining us here. I will recognize myself for five minutes and then we will proceed and alternating with sides.

If one had not listened closely to Mr. Powner's testimony or read the GAO report and one then listened to our friends from NOAA and NASA, one might say it sounds like the program is going pretty great. The problem seems to be that we are substantially over budget. We have cut by more than half the numbers of instruments that were expected to be placed up. The data is to come to us slower and we are very much delayed and at some significant risk of having a gap in coverage that my colleague Mr. Inglis alluded to. I therefore feel sort of a conundrum because on the one hand, I am inclined to say what the heck happened, how did we get here, and I think someone needs to ask that. At the same time, I also want to focus on where we go from here, and my problem is, the second question, I have lack of confidence in the answer because the first question is so problematic, and I also am told by Committee staff—as you know I am new to this committee, I served on it before but not chaired it—that we tend to get this information of things not going well only when the Committee asks GAO and GAO reports, that it has not been the practice of NOAA and NASA to come to the Committee proactively and say we are having some troubles and here is what we are doing about it. I will tell you, I would like that to change. If you were having difficulties, we need to know about it, and if you are having discussions about changes in direction of the partnership or the mission, we want to know about it. We don't want to hear about it secondhand. We don't want to have to send the GAO out to follow up on this and we want to know about that, and I want that to be for the record and I will insist on that.

BUDGET OVERRUNS

Mr. Inglis said quite rightly, this is a lot of taxpayer money. Taxpayers put it in common sense and they say look, if I go to the car dealer and the car dealer says I am going to sell you a car for a certain price and you can pick it up tomorrow and these are the features and you come tomorrow and the car dealer says it will be ready actually a year from now, maybe, and the features we agreed

on won't be there and the price has doubled but write the check, the taxpayer says are you kidding me, expletives left out purposefully. Why shouldn't the taxpayer say that? Why shouldn't the taxpayer say how is it that we keep writing checks for projects that come in late, that cut the services and don't meet their expectations?

I want to start with that question because that is what I think the taxpayer would want to know. That is not an easy question. I acknowledge that.

Ms. KICZA. I would like to take that one on if I——

Chairman BAIRD. Good for you. I admire that.

Ms. KICZA. What I would like to start with is a discussion of cost growth that is overruns and contracts versus changes in cost estimates. Now, in the charter for the hearing you saw three different cost estimates and I would like to talk about at what time those cost estimates were made and what was the status of the program at that time, you know, recognize at this point, we don't even have the spacecraft or the ground system contractor on board. In 2004, we had an initial estimate for the GOES–R system of $6.2 billion. At that point we had just completed 11 low-cost concept studies. We were looking at a potential architecture of anywhere from three to eight satellites so we were very early in the stages of formulating the GOES–R architecture. In the NASA parlance, it is like phase A concept studies. So at that point you have, 2004, a $6.2 billion estimate for the GOES–R program. We provided a second estimate in 2006. At that point it was $6.96 billion, and by that time we had completed three more in-depth studies with three different contractors and we were solidifying what the architecture would actually look like and we were beginning to see more realistically what the costs of the architecture would be, what the requirements of the system were and having a sense of what kind of budget was affordable. So that is 2006 we were at $6.96 billion.

When we came to the Congress with that number, we said this is where we are right now and here is what we have yet to do. We have to complete a program estimate and subject it to independent cost analysis. In 2007, we came to the Congress with an estimate of $7.67 billion. That was the estimate after we had subjected the program to thorough independent review, then a bottoms-up program estimate and subjected that to independent analysis and did a reconciliation process. That was in 2007 at $7.67 billion. That is where we currently are right now and that cost estimate reflects the most probable cost. So when you refer to cost overruns, when I think of cost overruns I think of contracts awarded, cost overruns happening that we had estimated and we were wrong on. For the GOES–R program, we are still at the beginning and we are trying to solidify what is the right cost estimate, and as——

Chairman BAIRD. Okay, but if you come to us and say we are working on a package and we work with you and we say this is what the package ought to entail, this is the instrumentation, these are the dates, and you give an estimate and then you come back—I understand estimates are not an easy business but if the estimate is so far off, off in time, off in budget and off in instrumentation, I mean, the problem is you are saying oh, well, you know, yes, our

estimate has gone up but so to your capacity has gone vastly down and your timeframe——

Ms. KICZA. Yes, sir, yes, I acknowledge that, and when we were doing that we were communicating it. We were communicating the fact that we needed to——

Chairman BAIRD. But my question is, how does such stuff happen? How do you miss it by so much? I want to say it is not rocket science. It is rocket science. We have a rocket scientist on this committee, two of them, but——

Ms. KICZA. I think what I am trying to explain is, it is a normal process that you go through from early concept studies, moving to more detailed concept studies and preliminary designs and you begin to understand where the key risks are and you begin to reduce risk, which is what we have done in order to bring the program in at a cost which we believe is the most probable cost and one which we can deliver in the timeframe that we have indicated.

Chairman BAIRD. I am going to recognize my colleague, Mr. Inglis. In a little bit I will get back to this issue and I want to hear Mr. Powner's take on this and give Mr. Morrow a chance to speak but I want to respect the time.

Mr. INGLIS. Well, thank you, Mr. Chairman, and I think it is very interesting. Your question shows us where we are with our constituents, doesn't it? On the whole financial mess we are in. You want to pound on what happened but you also want to pound on what is the solution so we are in the same spot, aren't we? Ms. Kicza, you have just helped me to understand a little bit better where we might be. It is sort of like, you know, if you are building a building, once you have got a contract, there are some costs that can change and usually contracts will allow the contractor to get more money if there is an unexpected increase in metal prices, let us say, or something like that. Otherwise the contractor eats it and they just lose profit and maybe lose their shirt on the building. But in the concept phase, what I am trying to figure out is, so we don't have a contract, I guess what I am hearing you say. We really don't have—and using the analogy of building a building, we don't have a contract yet.

Ms. KICZA. Right now we do not have the spacecraft contractor selected and we do not have the ground system contractor selected. That is to happen in May and June of this year, respectively.

Mr. INGLIS. So tell me how it works. I think this is all affected by NPOESS, you know, I mean we are all sort of here but we are thinking NPOESS and so therefore we are worried about all that, and so you know, when you are building a building and using that analogy, sometimes the architect comes in with a dream building, unbelievably beautiful, and I guess it is just the strategy of the architect can either do that or show you the bare bones and then get you up basically sort of bait and switch you up or get you down. How does it work in government contracting? I mean, do people generally come and say gee, listen, we can build this super-duper thing for X billion dollars and then they walk you down from there or do they walk you up? What I am concerned about is we typically get walked up.

Ms. KICZA. Okay. I am going to try to answer that although I am not quite sure. I think that when we laid out the requirements for

GOES–R, we laid out a pretty aggressive scope for the program, and the contractors in their analysis designed and did preliminary costs on the scope that we asked for. At the same time, we were all learning the lessons of NPOESS and understanding where we were seeing significant cost growth in complex instruments. So it was a combination of understanding how much the scope that we were asking for actually would cost, given more detailed studies, and understanding how painful it can be if your technology is not mature enough to be moving towards flight. So both of those things were occurring. We reduced our scope, although I will tell you in nearly every case the GOES–R system that we are developing is superior to the GOES–N/O/P system that is current in terms of the resolution, in terms of the scope of view and in terms of how fast the products are going to be made available to our user community, how fast the data is coming down, much superior to the current systems of today. So I don't want to lead you to that it is just the same thing. It is actually vastly improved, and in fact, there are some geostationary lightning capabilities planned for GOES–R that we have not yet had which will provide significant advances in our ability to forecast extreme weather events. So it is a combination of recognizing how much the scope we were asking for cost and recognizing how much risk was involved in some of the more complex instruments that caused us to say we have to—we can't afford that much scope, we are going to reduce scope in order to make it affordable and we are going to reduce capabilities because it is too high risk and we cannot afford to not deliver these satellites on time.

PROGRAM EXPECTATIONS

Mr. INGLIS. Our church recently built a building and the guy that was in charge of it said don't show a picture because once you show a picture, everybody is going to have in mind that that is what it looks like, and then what you realize is, you can't afford that and so then you reduce it and everybody has in mind that architect's rendering of the building and then they are disappointed. Is that what we are dealing with here, that you can have——

Ms. KICZA. Yes, I think that——

Mr. INGLIS.—a really beautiful picture. I mean——

Ms. KICZA. I think that we are very good at creating expectations and then when we realize, you know, what we can actually afford and what we actually build, it is less than what we had set out in terms of expectations, but I will again say it is more, it is more than what we are currently providing today with the GOES–N/O/P series.

Mr. INGLIS. Mr. Powner, do you agree with that kind of line that basically we are getting a lot better than what we have got now, we maybe showed the pictures too soon?

Mr. POWNER. I think clearly there is some information that will be quicker, that we are getting products quicker and there is some capabilities that it is better, but however, if we step back, we have reduced a lot here, okay, and let us start with the HES instrument, okay? And this is, the original scope of this thing was too large and that was flawed to start with that approach. HES, for instance, was going to provide things like this: Tornado warning lead time

is very important. Currently it is 13 minutes on average. We were going to then have warning lead times up to an hour. That was the leap that we were going to take with GOES–R. Well, then HES went away, okay, to control costs, it was complex and all that so we are not going to get those warning lead times. So although there are some improvements, we have reduced a lot of capability here. That was the one sensor going away. Then we went from 68 products down to 34. There is a fundamental question, you know, how much better is it than legacy GOES and I think you are approaching legacy GOES capability in order to control costs. So the bottom line here is, we are spending $7.6 billion for two satellites, for something that is better than what we currently have but likely not much better, and we haven't awarded contracts yet so the key here going forward, there is still a lot of schedule and cost risk without having awarded the space and ground contracts.

Mr. INGLIS. Ms. Kicza, do you want to respond to that?

Ms. KICZA. Yeah, what I would like to do is talk about the improvements with this imager capability with GOES–R. In terms of the imager, the Advanced Baseline Imager, four times the resolution, five times the coverage, twice the number of bands that we have with the current imaging capability and more coverage simultaneously. That is, we can look at the full disc and look at a picture of the disc, a smaller portion. With lightning detection, we now will—we will have continuous coverage of total lightning flash over land and water from the space looking down as opposed to from a single spot on the ground looking up. In solar and space monitoring, we will have a better imager and improved heavy ion detection and we are also adding low-energy electrons and protons, both very important for space weather prediction, and also for unique payload services of bent pipe services, getting information from buoys and tracked animals and such, higher data rates for environmental data relay and also to support search and rescue capabilities. So across the board our instrument capability is more robust. Yes, we have reduced capability in order to reduce risk and to bring the project in on time. I don't deny that. But in terms of the capability that we are bringing to bear, it is improved. Now, for the demanifested HES instrument, we worked very closely with the community to examine whether or not we should put a legacy sounder on versus using the ABI, and in fact, we brought over 50 representatives from a broad range of the community to discuss that and the various benefits or disadvantages of that and we collectively came to the conclusion that delivering the sounding products from the ABI was the better way to go. It did reduce some capabilities in some areas but the consensus of the community was that it more than made up in other areas because we were getting higher temporal sampling rates. So the decisions were made in order to be able to reduce risk, to deliver the system within the projected budget that I have discussed previously and to bring that to bear as rapidly as we can.

Mr. INGLIS. Thank you, Mr. Chairman.

Chairman BAIRD. Ms. Edwards.

INCORPORATING RECOMMENDATIONS AND PREVENTING FUTURE PROBLEMS

Ms. EDWARDS. I think what I would like to focus on is not just kind of where we are but what prevents us from doing this all over again. I mean, we have essentially a doubling, almost a doubling in the projected cost of these satellites, and so in addition to knowing what the improved capabilities are with the reduced system, I want to know what are the capabilities that we lose because it seems to me that at some period of time we are going to need those capabilities and then we are not getting them in this next phase. I also—I am also very interested in looking at the lessons learned in the contracting process because essentially cost plus contracts have been awarded, were awarded for the instrumentalities and yet the technology that we get suggests that we could have done a fixed price contract and gotten more bang for the buck, and so for me that is perhaps a lesson learned. In terms of the GAO recommendations, I want to know the three key recommendations, where the two agencies are in terms of meeting those recommendations going forward because I think it is tough to argue—not to argue to the public about the great benefit of the work that you do and the need because I think there is no one on this panel that doesn't believe that we need the kind of satellite coverage for weather projection and prediction that is important to saving lives and preserving commercial interests and protecting communities. But we can't do it at any cost and especially in this kind of environment. And so if you could please address those concerns, and I am going to be one on this panel who says we understand that with science there is a lot out there that we don't know and that with technology development that things can happen but, you know, $7 billion to $11 billion, that is a lot of stuff happening, and so it raises a concern for this Member that we have to get better at communicating along the way so that it doesn't feel like a surprise attack when we have gone to such severe cost overruns, and I do think that there are cost overruns and it may have to do with the way that these contracts are broken up and the stages at which you evaluate so that you are essentially not—you know, you don't think that you are buying the Cadillac when in turns out that you are getting a Ford. The Ford is going to run, it will be just fine but not when you thought you were buying a Cadillac and the price is reasonable.

Ms. KICZA. I am going to address the responses to the recommendations and I will hand it to George to talk about fixed price versus cost plus. In terms of the recommendations, the GAO recommended that we conduct an integrated baseline review when we make significant changes to our instrument development. In particular, they were concerned that we had not done an IBR on the ABI when we moved a segment of the work to the right. In fact, we have done two integrated baseline reviews on this instrument in the past in 2004 and 2007 and we expect to do another one this fall and have it completed before the end of the year. The GAO was concerned about our formal evaluation of cost variances against the instrument contracts, and I discussed the process we have had to date and the fact that we will be changing that process. So we see

all the variances, both cost and schedule. We talk specifically about those that need further clarification and going forward we will document the results of those regularly scheduled monthly discussions as well as any actions going out of it so that we see the long-term trends relative to the variances that are occurring. And then the third one was with respect to plans for reinstating the advanced capabilities, and as I have discussed for the HES activities, we are actively going through a request for quote process to solicit private industry on what capabilities they can bring to bear and we are exploring the possibility of international collaboration with our partners in Europe who are also looking at advanced sounding capabilities. We may be bringing their capabilities to bear, and what we will be doing is documenting our plans in a formal transition planning document to transition that new capability into an operational capability. So I hope that answers the questions relative to your concerns about the GAO recommendations and I will turn it over to Mr. Morrow to talk about fixed price contracts versus cost plus.

Mr. MORROW. I think as you know, we have used fixed price contracting in many areas where the complexity of the system allowed that to occur or where we were rebuilding sensors or spacecraft bus requirements that were very similar to what we had done on a previous mission and those types of things. Also, we use fixed price contracting where the instrument-to-spacecraft interfaces are very well known and aren't technologically pushing the state-of-the-art. GOES–R is a case where the instruments, the primary instrument, ABI, is very much advanced beyond the imager that was on the legacy GOES–N/O/P series. The detector systems, the optic systems are much advanced and there was a lot of technical development that needed to be done there, and that is why on ABI, and in fact, the other instruments on GOES–R, we have prototype model development as part of the basic contract. Also, because the instrument capability and the instrument data rates and the communication data rates between GOES–R and the ground and the ground and GOES–R are much greater than what had been there in the previous series. The spacecraft bus was, while many components were like what we would fly on another mission, the spacecraft bus architecture was a very much new development and the interface to the instruments was a new development.

Ms. EDWARDS. My time has expired, and so Mr. Chairman, I don't know if our panelists would please put the responses to those questions in the record and respond to the Committee. I would appreciate it.

Chairman BAIRD. We will probably have another round as well, Ms. Edwards. If you can stay for that, we will certainly give you an opportunity to follow up.

Mr. Neugebauer would be next but he is not here, so Dr. Ehlers is recognized.

THE NEED FOR BETTER COST ESTIMATES

Mr. EHLERS. Thank you, Mr. Chairman. Sitting here, I developed a bad case of dejá vu, largely because I used to chair the rough equivalent of this committee, subcommittee, and we went through much the same thing as NPOESS to the point where the Chairman of the Committee called a number of Committee Members in and

we ended up with a rather marvelous shouting match. But we saw the danger signs far before NOAA did and eventually it ended up that it got so bad that there had to be a recertification process which slowed everything down but should never have happened. But what really concerns me first of all, we are hearing essentially the same thing and I had hoped that NOAA would have learned something from that and not made the same mistakes.

Secondly, the satellites are marvelous, they are wonderful and I deeply appreciate all the information we get. I almost get addicted to the Weather Channel. I look at it every time I go to fly somewhere and correlate the weather with my trip in deciding whether I want to move a day ahead or a day back or whatever. They are all very good stuff. But what really concerns me, in NPOESS they had a number of detectors which I thought were outstanding and they were removed because we could no longer afford them, and I think the capability of NPOESS is severely hindered or hampered by removing those. Now I see us doing the same thing and I wondered in the case of NPOESS and I wonder about this, can't we come up with better cost estimates? Can't we as a Congress come up with a better method of funding projects such as this so that we keep tabs on it? If we are going to have to spend more money, we put that in the next year's budget as rapidly as we can and so forth. I think it is a shared fault here. I don't think NOAA has handled it properly but I also think we do not handle the appropriation process properly for these major projects. If this were part of the military budget, of course, there is no problem because everyone votes for more money for the military. Not everyone will vote for more money for the weather satellites, unfortunately. So this—I have got to get this dejá vu off my chest. What is wrong with NOAA? Why can't they get it right the first time? Why remove systems? You should have known what they cost to begin with? And why go through this charade of going to all the trouble of saying we are going to put this on, then designing it and part-way through you just say sorry, we can't afford it, jerk it out. Comments from anyone?

Mr. POWNER. Congressman Ehlers, I think we can start with both NPOESS and GOES that were too optimistic with the leap forward. If you look at NPOESS and the one instrument there that is still causing all the problems is VIIRS. That thing is still in testing. That is why schedules are being pushed out. It is still the major driver of NPOESS. You know, here I think what the NOAA folks are attempting to do is to reduce that complexity so we don't have another VIIRS issue on GOES, okay, and that is probably a good thing to reduce the complexity but we just need to be realistic too with now what we are delivering at what cost.

Mr. EHLERS. Well, I guess as a scientist I would respond and say I was always delighted when I had complex experiments to do because it meant I was going to learn more, and I don't think you should be afraid of complexity. It seems to me that any good engineering program would take care of that and give you the same reliability as a less complex system if you built it right and use it right.

Ms. Kicza.

Ms. KICZA. Yeah, I am afraid I have to take issue with you because you are saying GOES–R is NPOESS all over again and it most certainly is not. What we have done is, we have incorporated the lessons learned from NPOESS. We took stock of the effort, and you have to realize, NPOESS is several years down the line from where GOES–R is now and we are making the tough decisions now, and the work that has been done in the last two years to not only put in a rigorous cost estimate to make scope and budget align with one another, that is done before we ever start the major contract efforts. That was not done with NPOESS, okay? It is very different.

And then secondly, over the course of GOES–R we have maintained a rigorous independent review process that are outside of the program who are coming in on an annual basis to evaluate where we are and whether or not we are doing the right thing and challenging us. With GOES–R, we have established a budget reserve that is the most probable cost—again, before we ever start the major contracts. We have completely restructured the acquisition strategy for GOES–R. We were on a track to have it much like NPOESS where we would have a prime contractor who would be doing the instruments. We completely restructured that and have put the government in charge of every major element in the system, the spacecraft, the ground system, all of the instruments and in fact the government is doing the systems integration. It is very different from NPOESS and I challenge the fact that we are saying that it is NPOESS all over again. Thank you, sir.

Mr. EHLERS. Well, I am pleased for that clarification but the point I was trying to make is that removing functionality after investing quite a bit of money in it is, I don't think, good. First of all, you build expectations in the user community and the scientific community about what they are going to be able to do with the information, and secondly, it is the wasted effort at NOAA, and perhaps at some other agencies. I am basically trying to make the same point Mrs. Edwards made about that we are deeply concerned about the loss of functionality. If we are going to spend that much money sending something out there, let us make sure what we send up there is really going to do the job that we wanted done in the first place.

Ms. KICZA. I respect that, sir, and what I had indicated is that in developing the spacecraft, we are designing it in such a way that we can add capability if and when we think we are ready to and so the ability to put an advanced sounder on the GOES–R system when we are convinced that the technology is ready and we have the funding to do so, then we will be able to do that.

Mr. EHLERS. I yield back.

Chairman BAIRD. Thanks, Mr. Ehlers—Dr. Ehlers.

Mr. Powner, there has been a number of comments made and I wonder if you have a desire to respond. One particular question is that it sounded like an earlier statement made about the willingness of the review group to suggest that while we will sacrifice one instrument in favor of another in exchange for more rapid download rates, and yet we are also hearing that the download rates may themselves also be compromised. Is that of concern?

Mr. POWNER. Yes, there is several concerns that I think our report laid out. There was some concerns about the accuracy of products not being comparable to legacy but I do acknowledge what Ms. Kicza is saying. There is certain products that will be better. A couple things going back to your original question on, you know, whether we have a contract or whether we have a cost estimate and whether we are overrunning or whether we are changing estimates. This is all semantics. I mean, what we are getting into here is whether you have got an active contract and you overrun, it costs the government more money, where you have an estimate and you are increasing it. We are not going to spend less than that estimate. That has never happened. So the bottom line is, we are spending more money so let us just acknowledge that. I think the key thing going forward on the fixes is that we get better estimates. I mean, that was the basis of some of our recommendations where we have very detailed reviews of the baselines of these programs because that is your basis for your estimate going forward. Now, we are dealing with the instruments right now and we hope that that discipline that the program is instilling on some of those instruments, following some of our recommendations, will then be applied to the larger spacecraft and ground segments. That is what we really need going forward. We need that discipline where we have sound estimates and then on top of that many of our recommendations, we are in the weeds here on some of these, but what it is all about is, it is really staying on top of the contractor. So when we see a slip on cost and schedule, we are on them and we are effectively managing those risks. So that is really where we are trying to go to be helpful with this program moving forward.

Chairman BAIRD. Do you feel like the kind of changes Ms. Kicza has acknowledged in response to Mr. Ehlers' question addressed those issues you just raised?

Mr. POWNER. Yes, I think her—the way they are planning to address those recommendations, if in fact there is follow-through on that, we feel comfortable with that.

Chairman BAIRD. I should say parenthetically, Mr. Ehlers, I serve in the Coast Guard Committee as well and we have the Deepwater program there which was certainly not a model of procurement, to say the least.

MEETING BUDGETS AND DEADLINES

So we have talked a little bit about how we got here maybe. The next question is, where do we go, and the two fundamental questions is, how are we going to afford this, where does it fit into the budget, the NASA budget and the NOAA budget, and two, are we going to hit the mark in terms of time? Because we are in a bit precarious situation.

Ms. KICZA. Okay. In terms of the budget, the budget that the Congress has approved is the budget that we believe is the most probable cost and so we have confidence in our ability to bring the system in within that budget. In terms of the planned launch date, with the spacecraft protest it does have implications for our launch. Nominally—I should let George answer this. Nominally, it is 72 months for a spacecraft development of this complexity. If we stick to that nominal timeline as we move to the right from a planned

April award, we move to the right on the projected launch date and so we are definitely concerned about that. Both NOAA and NASA are aware of the implications and are working to address that as effectively as we can through the contract award process.

Chairman BAIRD. Let me drill down a little bit on the nominally question. There is a bunch of research in countless areas of engineering that people are overly optimistic and set dates. We have seen this obviously with the budget on this project to some extent with the timeline. Does "nominal" mean based on real-world actual practice experience, we are within somewhere in the middle of the normal curve there, that is our most probable estimate or is it some optimistic thing that we are then going to hear?

Mr. MORROW. So let me comment on that. Mary mentioned the nominal 72 months for a spacecraft development of this type, so we at NASA have gone back into our actual, you know, what it actually took database on similar projects, and the 72-month agreement between NASA and NOAA on the spacecraft development comes from that database. We may find when we actually award the spacecraft contract and go to an integrated baseline review that the spacecraft contractor and the contract schedule may be somewhat less than 72 months and this goes to the point of creating baseline—adequate baselines. What we want to do at NASA and in conjunction with NOAA on GOES–R is to conduct integrated baseline reviews for each of our contracted efforts that are not optimistic but hold the contractor's feet to the fire to perform efficiently. In addition to that, we want to come back using our historical database and independent cost estimates from outside entities outside of NASA and NOAA to develop a program baseline that allows us the latitude for unforeseen things that occur in the contract development, and so that part of what we have really worked closely together on GOES–R to do, is to develop that program baseline that allows that margin between, you know, what we actually are signing up to deliver the system for and on what schedule and the margin between that and what the contractors have signed up to do so we can hold their feet to the fire, monitor their performance and keep things moving.

THE PARTNERSHIP OF NASA AND NOAA

Chairman BAIRD. Two more very quick questions. One, is it your feeling that the partnership now as it exists between NASA and NOAA on this project is now functioning properly and is likely to continue in a constructive manner?

Ms. KICZA. From a NOAA perspective, absolutely yes.

Mr. MORROW. And from my perspective, yes, that is—some of my points were that we have a lot of NOAA people on site at Goddard and we are working arm and arm with each other.

Chairman BAIRD. I have had a lot of relatives in my house before. That doesn't mean it is always——

Mr. MORROW. No, no, no, it is not the same thing here.

Chairman BAIRD. Mr. Powner.

Mr. POWNER. You know, last—October of 2007 was the last hearing the Subcommittee held and I think we raised that issue about the working relationship. We see that improved based on our attendance at certain meetings and those things.

Chairman BAIRD. Finally, I don't have enough time to have you answer it but I do not understand why Moore's Law doesn't apply here. I mean, I can get a 20-megabyte digital camera now whereas three years ago it was about a two-megabyte camera. The capacity of a Nikon D3 blows your mind in terms of what it can do. Anyway, it is a separate issue. But I understand it is a different—it is a bit apples and oranges but the capacity of what we can do electronically and in imaging systems in the commercial realm is remarkably improving, and what we are saying here is that we don't seem to have much comparable. You are tempted to send a Canon G9 into space and say send us back the pictures and you get some pretty good resolution.

Mr. Inglis, is he coming right back or—okay. Then I will recognize Dr. Ehlers and then we will——

PROGRAM FUNDING

Mr. EHLERS. Thank you. I just want to pursue one thing here. As we are pointing fingers, I am interested in how many fingers should be pointed at the U.S. Congress. Did Congress provide sufficient funding in that 2009 Omnibus bill for you to continue your work on this at the appropriate pace? Is lack of funding going to slow down the project and create other problems? And I am interested in—well, I think you have already answered that question. I was curious about some of the details of the original GOES–R program and how it is being proposed now. So if you an answer the first part and then say a few words about the last.

Ms. KICZA. I will say that for the 2009 budget, we are very appreciative and that will allow us to proceed on the pace that we had anticipated proceeding on and so we are very thankful for the Congress's support for the 2009 budget.

Mr. EHLERS. Let me just interrupt you there. Do you think it would be beneficial if we changed our budgeting system for these major projects, and it is not just satellites, it is not just rockets, it is things such as the new accelerators that we built, particle accelerators we build occasionally. Wouldn't it be better if we——

Ms. KICZA. If it wasn't year to year as more of a——

Mr. EHLERS. Continuing budget.

Ms. KICZA. The stability would be beneficial, yes, sir.

Mr. EHLERS. I have always felt that way but it is pretty hard to persuade people around here.

Ms. KICZA. Yes, sir.

Mr. EHLERS. Okay.

Ms. KICZA. And in terms of the second request and that is sort of a chronology of the changes in the GOES–R program, I would be happy to take that question for the record and provide you a brief synopsis of what has occurred over the last two to three years and the rationale for the changes that were made.

Mr. EHLERS. Okay. And jumping back to the first question, what about for fiscal year 2008?

Ms. KICZA. In fiscal year 2008, we sustained a budget cut of about $44 million, if I recall, and we as a result of that delayed the planned launch date for the GOES–R, the first GOES–R by approximately three months.

Mr. EHLERS. And when you delay that way, do you really save a lot of money or is there——

Ms. KICZA. No, it does not save money in the long run because when you move everything to the right, your life cycle cost increases.

Mr. EHLERS. Yeah, that is what I thought. So it doesn't help you at all when we mess up the budget process?

Ms. KICZA. That is correct, sir.

Mr. EHLERS. Maybe I can get that in writing and show it to my colleagues. I will yield back at this point. Thank you.

Chairman BAIRD. Mr. Ehlers, I will think out loud in a dangerous way here but there might be some merit to pursuing precisely that in a joint hearing with the Appropriation Committee and the Science Committee at some point where we talk about this. There are these major projects that span decades in some cases and we give you this incredible uncertainty and then when we miss our appropriations date, as we do almost always now, it is fun for us to sit here and hammer you guys because you don't make your dates but unfortunately you are not able to ask us why we didn't make our dates, but that is another topic. But we might want to pursue that very issue of some form of more reliable and longer term project appropriations. I think it makes an awful lot of sense.

Ms. Edwards.

Ms. EDWARDS. Well, Mr. Chairman and Dr. Ehlers, I certainly share that view.

COMPLYING WITH RECOMMENDATIONS AND THE RESPONSIBILITIES OF NOAA AND NASA

Let me just follow up again, Mr. Powner, just to be clear that you are in agreement that NOAA and NASA Goddard are on the process now in terms of complying with some of the recommendations that have been made by GAO?

Mr. POWNER. Yes, I believe they have agreed to address the recommendations. I think a couple things here. One are these baseline reviews. The more rigor we can get in the baseline reviews where they are very detailed, they will ultimately result in better estimates so it is not only just on the ABI instrument that we are interested in but that is something we will be looking forward to ensure that these detailed baseline reviews are done on the, you know, overall spacecraft and ground segment contracts. So we are hopeful. I mean, they need to still follow through on that.

The other item is, we have seen much improvement with the use of earned value metrics to oversee contractors' performance so that we see variances where they are not—you know, what is delivered isn't matching up to what we are paying for, you know, those types of metrics. And the more we can really stay on the contractors with those metrics, you are going to be able to monitor performance and hopefully stay closer within those estimated costs and schedules.

Ms. EDWARDS. Great. Thank you. And then I am just—I am curious as to whether given where we are right now and what I think is, you know, sort of improved kind of management oversight relationship between NOAA and NASA that we shouldn't have concerns—I guess I am asking, we shouldn't have concerns about the

relative split between NOAA and NASA in terms of its management functions for the project?

Ms. KICZA. I don't think so. I think that what we have done is, we are capitalizing on each others' strengths and so we are applying our competencies to what we do best, and that is reflected in the organizational construct for the GOES–R program.

Mr. MORROW. And I fully agree. I mean, I think we have done that very well here.

Ms. EDWARDS. And then let me just inquire as to what will then be a gap in coverage that has been identified by GAO. What is the work-around plan for that?

Ms. KICZA. Actually there are a couple of work-arounds in the event that we do have a gap. Recognize that right now, you know, it may turn out that the operational satellites last longer than they are designed for so we could have continued operation there. If we didn't, we can fall back to the older satellites because we eke out of the older satellites every bit of instrument capability that we can, and then we have beyond that a contingency plan where we can call on European capabilities in the event that we have a gap and then can apply their own orbit spare to help support our gap issues.

Ms. EDWARDS. And is there ongoing work in terms of developing and refining this contingency plan? Because it does—I mean, we should be realistic here. You know, there is probably going to be a gap.

Ms. KICZA. There is—there are existing agreements in place and in fact just last week the Director of EUMETSAT[1] and I spoke to this about this—the fact that these agreements are in place and used, so they are active.

Ms. EDWARDS. Thank you. And then lastly, without going into the details of the spacecraft contract, have these contractors been asked to take—potential contractors asked to take into consideration the fact that they are going to get the award, the award is going to be made in April and what does that mean to their projections about the timeline?

Mr. MORROW. In our reevaluation process, we went back through the contractors' proposals. The contractors themselves have not yet been engaged in that process by the way the process is designed and so once we get to the point of making that selection and award, then we will go into those discussions with the contractors. Now, the contractors have extended their proposals. They have been asked to extend their proposals to accommodate the process that we are in and they have done that.

Ms. EDWARDS. All right. Thank you, Mr. Chairman.

Chairman BAIRD. Thank you, Ms. Edwards.

THE ROLE OF CONGRESS

I want to give you the opportunity to follow up on the line of questioning that Dr. Ehlers was pursuing, and that is, what does Congress or the Administration need to do differently to help make this a success? We want this mission to succeed. We don't want to have a hearing some time from now with a huge gap and signifi-

[1] EUMETSAT: European Organization for the Exploitation of Meteorological Satellites.

cant risks and costs and that is no fun. I mean, it gets you press coverage but who cares. What I want to hear is what we can do to make this work. How do we do that? What can we do better?

Mr. POWNER. Even more frequent oversight hearings such as this. There was a comment made that there is action on GAO reports. I will tell you, there is a lot more action when there is an accompanying hearing with the GAO report, a lot more.

Ms. KICZA. I will say that my immediate thought when you asked the question was simply do the job that you have been entrusted to do and that is to provide oversight, to work with the Congress to appropriate funds in a timely manner.

Mr. MORROW. I really agree with Mary. I think that is the most important. That stable baseline to us is very important.

Chairman BAIRD. Ms. Kicza, you mentioned earlier, I think, or maybe Mr. Morrow about an annual review of, it sounded like an independent board of advisors, if I remember. Is annual enough, given the complexity of it and how things——

Ms. KICZA. Well, it is actually more than that. We employ independent review at all levels of the program, at the technical level, at the mid-management level and at the most senior level.

Chairman BAIRD. So that is ongoing?

Ms. KICZA. That is ongoing. At the most senior levels, we tag up annually and in advance of major decision milestones.

BENEFITS OF GOES–R

Chairman BAIRD. One last question for me and then I will recognize Dr. Ehlers and Mr. Inglis if he returns. It is a substantial cost to the public. What is the benefit of having this instrument?

Ms. KICZA. Well, I think you said it most effectively in your opening remarks. It literally impacts every American every day. It is critical to predicting severe weather, oftentimes rapid onset of severe weather. It is absolutely essential to predicting hurricane tracks. So it is an essential element in our observational suite of capabilities.

Chairman BAIRD. Has anyone put a dollar estimate on the value of this?

Ms. KICZA. Yes, sir, we do have analyses about the economic impact that the geostationary capability brings to bear and I can take that question for the record and provide you additional information.

Chairman BAIRD. I think that is really essential because at some point on the one hand we want to do everything we can to stop cost overruns or inaccurate estimates. We will quibble about the semantics separately but we want to hit the mark in terms of what our budget is. But we also need to understand that there is benefit to the public from this instrument, not just abstract academic benefit but practical, real world. Is your loved one going to arrive safely on the airplane, will your crops be pelted by hailstones or not, will your home be flooded, will you be safe taking that camping trip, you know, all of that comes from this. I am told that a Member of Congress was—maybe this story applies to you, Dr. Ehlers, and I should let you hear this. The Accu-Weather story, is that your story? I was told that someone was asking about why we need to put these weather satellites up, can't we just rely on Accu-Weather.

The joke, of course, is that Accu-Weather gets its information from these weather satellites, and we don't want to go back to the *Farmer's Almanac* and that's what a dark period in the lack of these—I mean, we will obviously have better stuff than that, but the point is, this is very important. We want to work with you to solve this.

Does Mr. Inglis or Mr. Ehlers have any further questions or comments? I will recognize Dr. Ehlers.

Mr. EHLERS. Thank you, Mr. Chairman. First of all, in light of your comments, as an addict of the Weather Channel, I certainly agree with your comments about the value of what we do, but for me it is just my convenience in traveling and settling traveling plans. There are a lot of other people who use this for many very important reasons, industries, businesses, et cetera. So there is no question about the value. I am just curious, what other nations put up weather satellites and what capability do they engineer into theirs?

Ms. KICZA. Well, the Europeans put up weather satellites, the Japanese put up weather satellites, the Chinese have weather satellites. It is fairly prevalent. Our capabilities are roughly comparable, and in fact, for the European satellite system, we in fact deliver many instruments that they employ on their satellite capabilities. So yes, there is a very prevalent weather satellite capability throughout the world and the community is very closely linked.

Mr. Baird, I would also like to provide an additional comment relative to the return on investment. One of my staff provided me a note. One-third of the U.S. GDP is impacted by the weather and climate sensors that NOAA brings to bear.

Chairman BAIRD. So we need to get this right, and we appreciate your work on that.

Mr. EHLERS. Maybe that is the third that I have investments in. There is some reason it is going down.

CLOSING

Chairman BAIRD. With that, I want to thank our witnesses and my colleagues on the Committee. The record will remain open for the customary two weeks so that people can offer additional comments and I thank the witnesses for their expertise and their hard work. We will have further oversight hearings of this to monitor your progress and the achievements and look forward to watching this bird launch on schedule with the most capable package possible at the moment.

Thank you very much, and the hearing stands adjourned.

[Whereupon, at 11:24 a.m., the Subcommittee was adjourned.]

Appendix:

Answers to Post-Hearing Questions

ANSWERS TO POST-HEARING QUESTIONS

Responses by Mary E. Kicza, Assistant Administrator for Satellite and Information Services, National Environmental Satellite, Data, and Information Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce

Questions submitted by Chairman Brian Baird

Q1. During the hearing, we discussed the importance of identifying a monetary value of the GOES–R program in light of its substantial cost to the taxpayer. Please provide these analyses of economic impact that the GOES–R capabilities will provide.

A1. A number of studies have been conducted to identify the economic benefits of GOES and GOES–R. Summaries of the economic benefits and links to the supporting studies are available at *http://www.economics.noaa.gov/?goal=weather&file=obs/satellite/goes*. Two reports that address the benefits associated with improvements from GOES–R are:

- "An Investigation of the Economic and Societal Value of Selected NOAA Data and Products for Geostationary Operational Environmental Satellites (GOES)" conducted by Centrec Consulting Group LLC, available on-line at: *http://www.centrec.com/climate_weather.htm*
- *Economic Statistics for NOAA,* April 2006, Fifth edition, available on-line at: *http://www.publicaffairs.noaa.gov/pdf/economic-statistics-may2006.pdf*

The GOES–R series of satellites will provide a greater range of data at a higher resolution than NOAA's current geostationary satellites. GOES–R will also provide additional societal and economic benefits including:

- enhanced hurricane predictions to mitigate disaster losses;
- lightning mapping to predict conditions that may lead to severe storms, providing earlier warnings to the public;
- improved monitoring of thunderstorm and fog development to augment the safety of surface, air and marine transportation;
- more frequent and accurate information for commercial transportation to enable them to avoid adverse weather conditions resulting in reduced energy consumption;
- improved precipitation forecasts to enable more efficient water management and agricultural decision-making; and
- enhanced monitoring of climate change and variability in the oceans, atmosphere, and on land.

The 2007 Centrec study presented the following about the value of the GOES–R satellite system:

- In 2015, the combined annual value added from the information from GOES–R series satellites for the aviation, energy and agriculture industries, as well as recreational boating, is expected to exceed $1.2 billion. Since GOES–R is expected to be in operation from 2015–2027, the value of the estimated combined benefits approaches $7 billion over the on-orbit life of the program's satellites.
- In addition, the enhanced information from GOES–R satellite observations is expected to improve NOAA tropical cyclone forecasting. This will enable more efficient evacuation and protection of property in advance of storms, which is expected to be valued at $450 million in 2015 (average of $130,000 per U.S. coastline mile from Maine to Texas), for a total of $2.4 billion from 2015 to 2027 (average of $690,000 per U.S. coastline mile from Maine to Texas).

These valuations do not capture all of the sectors in society that would receive direct and indirect benefits of enhanced GOES–R data, but provides examples of how the GOES–R series of satellites is both important and beneficial to the Nation's social welfare, scientific advancement, and economic efficiency.

The study, titled *Opportunities and priorities in a new era for weather and climate services,* by John Dutton[1] and cited in the 2006 NOAA Economic Statistics report identified that weather and climate sensitive industries, both directly and indirectly,

[1] Dutton, John A., Opportunities and priorities in a new era for weather and climate services, *Bulletin of the American Meteorological Society,* September 2002, volume 83, no. 9, pp. 1303–1311.

account for about one-third of the Nation's GDP, $4 trillion in 2005 dollars, ranging from finance, insurance, and real estate to services, retail and wholesale trade and manufacturing. GOES–R will continue and enhance the current GOES capabilities for weather forecasting, storm detection and tracking, and warning by providing over twenty times more environmental information; a two-fold increase in image clarity; and, a fourfold increase in frequency of new observation data of the constantly changing atmosphere.

The GOES–R Geostationary Lighting Mapper (GLM) instrument is the first ever operational satellite lighting detection system aboard a geostationary satellite. The GLM detects severe weather by mapping lighting strikes, both cloud to ground and for the first time, cloud-to-cloud. Mapping cloud-to-cloud lighting strikes can be helpful in early prediction of severe weather systems. The 2006 NOAA Economic Statistics report indicates that lightning activity causes $4 to $5 billion in losses each year in the civilian sector and that lightning has consistently been one of the top three causes of weather-related deaths in the country. Lightning kills between 50 and 70 people and injures hundreds more each year. By having the GLM capability on GOES–R, NOAA will be able to provide warnings that will save lives from lightning hazards.

GOES–R will also carry a number of the solar/space monitoring instruments that will provide significantly improved images and detection of approaching space weather hazards. These space storms endanger billions of dollars worth of commercial and government satellite systems by causing power surges in sensitive electronics that can impact system performance (e.g., degrade communication capabilities) or even end the life of the satellite, or threaten the lives of astronauts space walking. These storms also impact ground-based power grids. Geomagnetic storms caused by energetic streams of particles and fields that originate from the sun impact the Earth's magnetic field, interact with the long wires of the power grid, and cause electrical currents to flow in the grid. These currents cause imbalances in electrical equipment, reducing its performance and leading to dangerous overheating. The power grid operators respond to warning by modifying the way the power grid is operated to maintain adequate power quality for customers and reserve capacity to counteract the effects of space weather. A geomagnetic storm in 1989 caused a "black out" of the power distribution system for Quebec, Canada, and left six million people without electricity for nine hours at a cost of $300 million. With these solar/space monitoring instruments on GOES–R, NOAA's Space Weather Prediction Center will be able to significantly improve space weather forecasts for government and commercial satellite operators and for the communications and power generation industries.

Questions submitted by Representative Donna F. Edwards

Q1. In response to program difficulties as identified in the 2006 GAO report, including a near doubling of projected program costs, NOAA made several key changes to the program as a whole. The newest GAO report identifies several program improvements since that time, but NOAA also eliminated two satellites and the Hyperspectral Environmental Suite (HES) program and pushed back the first launch date to December 2014.

Q1a. What are the key improved capabilities the GOES–R program has with reduced system?

A1a. The restructured GOES–R system represents a significant improvement in technical capabilities over the GOES–I/M and GOES–N series satellites. GOES–R will enhance our ability to advance weather forecasting, storm detection, tracking, and warnings.

The GOES–R Advanced Baseline Imager (ABI) will:

- Improve the current GOES geographic coverage rate by five times. A GOES–R full-Earth disk (the Earth as seen from a geosynchronous orbiting satellite) can be imaged in five minutes, compared to a 26 minute duration for the current GOES–I/M and GOES–N Series Imagers. This will improve the timeliness of the data being used for weather detection and forecasting.
- For regions facing severe weather, new images of key areas will be available every 30 seconds, as opposed to four minutes, 43 seconds with the current GOES rapid scan operations. This will improve not only the timeliness of the data for areas being impacted by severe weather, but also the fidelity of the data, which helps improve forecasting accuracy.

- Improve horizontal resolution by four times (0.5 km resolution for GOES–R vs. one km for the current GOES for visible wavelengths), which improves the accuracy of forecasts and warnings.
- Increase spectral resolution by three times (16 GOES–R ABI channels vs. five channels for the current GOES imager) which provides added information to support more accurate forecasts.

The GOES–R Geostationary Lighting Mapper (GLM) instrument is the first ever operational satellite lighting detection system aboard a geostationary satellite. The GLM detects severe weather by mapping both cloud to ground and cloud-to-cloud lighting strikes. Lightning activity causes $4 to $5 billion in losses each year in the civilian sector and lightning has consistently been one of the top three causes of weather-related deaths in the country. It kills between 50 and 70 people each year and injures hundreds more. By having the GLM capability on GOES–R, NOAA will be able to provide more accurate severe weather warnings that save lives. In addition, research has shown that cloud-to-cloud lightning typically begins before cloud-to-ground lightning (which can be more dangerous) as severe weather systems first develop. Monitoring this information closely will allow for longer lead times for severe weather warnings.

GOES–R will also carry solar/space monitoring instruments that will provide significantly improved images and detection of approaching space weather hazards. These space storms endanger billions of dollars worth of commercial and government satellite systems by causing power surges in sensitive electronics, which can impact system performance (e.g., degrade communication capabilities) or even end the life of the satellite. These storms also impact ground-based power grids. Geomagnetic storms caused by energetic streams of particles and fields that originate from the sun impact the Earth's magnetic field, interact with the long wires of the power grid, and cause electrical currents to flow in the grid. These currents cause imbalances in electrical equipment, reducing its performance and leading to dangerous overheating. The power grid operators respond to warning by modifying the way the power grid is operated in order to maintain adequate power quality for customers and reserve capacity to counteract the effects of space weather. With these solar/space monitoring instruments on GOES–R, NOAA's Space Weather Prediction Center will be able to significantly improve space weather forecasts for government and commercial satellite operators and for the communications and power generation industries.

Q1b. What specific capabilities will we lose with the two satellites and the HES program?

A1b. Two satellites: No specific capabilities would be lost, but having two instead of four satellites means that the overall expected life of the series will be shorter.

To meet the Nation's weather data needs, the GOES system requires two operational satellites and a spare satellite on-orbit at all times. Two GOES satellites in orbit, one in the East and one in the West are required to maintain visual coverage of the entire Nation and the adjacent ocean areas where weather activity, especially storms, often originates. A single GOES spacecraft cannot simultaneously monitor a hurricane in the Atlantic and wildfires in Southern California and can do neither mission while closely monitoring tornado and thunderstorm activity in Texas. Having only one operational GOES satellite would greatly hinder weather forecasting for the United States. To ensure this continuity, a backup GOES needs to be available on orbit in case one of the operational GOES fails.

By the GOES–R system having only two satellites, rather than the originally planned four, the overall expected life of the series will be shorter, requiring a new series of satellites to be developed earlier. The originally planned GOES–R four-satellite constellation would be expected to provide coverage through 2036. The current two-satellite GOES–R series constellation will provide coverage through 2028.

The GOES–R spacecraft and instrument contracts have options to support the acquisition of two additional satellites (GOES–T and GOES–U) beyond the initial two satellites. The decision to exercise the contract options for the additional satellites will be addressed through the NOAA budget process. The initial GOES–R contract enables the purchasing of key parts for all four satellites as well as spares, which may eliminate some future costs associated with purchasing duplicates of parts in the future.

Hyperspectral Environmental Suite (HES): From initial planning and development of HES, it became clear that HES would be a highly capable sensor, but very complex and expensive to develop. Although the HES capabilities (hyperspectral sounder and coastal waters imaging) would greatly improve NOAA's ability to characterize the atmosphere and the coastal environment, NOAA had to weigh the ad-

vantages of an improved sounder against the risk that the sensor development would delay the launch of the GOES–R series, creating risk to continuity of operations. After careful consideration by NOAA and its users, informed by independent assessment, the technical and cost risk associated with a complex new instrument was considered too high for an operational mission such as GOES–R. NOAA will continue to provide products similar to the sounding based products currently provided by the GOES–N Series sounder with data from the Advanced Baseline Imager (ABI) instrument.

The HES had promised the ability to measure fine disturbances in the atmosphere that can occur hours before severe storms develop. These measurements could have extended the lead times for severe weather warnings. The HES also could have provided fine scale observations of the oceans and coastal waters allowing coastal zone managers to monitor changes in the surface of those environments.

The restructure of the GOES–R architecture allowed NOAA to ensure uninterrupted GOES data availability while incrementally achieving technological advances.

Q1c. How will the additional delay impact costs and satellite services?

A1c. With respect to costs, the projected life cycle costs of $7.7 billion for the GOES–R system has remained constant through the last two Administration budget requests. The additional schedule delay reduces the probability of having two operational satellites in orbit in April 2015 by a few percent. The GOES–R program is monitoring this risk closely.

Q1d. Please expound on the potential gap in service coverage as identified by GAO.

A1d. To meet the Nation's weather data needs, the GOES system requires two operational satellites and a spare satellite on-orbit at all times. Two GOES satellites in orbit, one in the East and one in the West are required to maintain visual coverage of the entire Nation and the adjacent ocean areas where severe weather activity, especially storms, often originates. A single GOES spacecraft cannot simultaneously monitor a hurricane in the Atlantic and wildfires in Southern California and can do neither mission while closely monitoring tornado and thunderstorm activity in Texas. Having only one operational GOES satellite would greatly hinder weather forecasting for the United States. To ensure this continuity, a backup GOES needs to be available on orbit in case one of the operational GOES fails.

In April 2015 when the first GOES–R satellite is scheduled to launch, internal projections indicate a 65 percent probability that NOAA will have both a GOES–West and GOES–East satellite in operations. Both NOAA and GAO have noted this as a concern since a 35 percent risk of only one operational GOES at that time could put forecasts at risk.

To mitigate this risk, NOAA is planning ahead to maximize the use and lifetime of all existing NOAA GOES satellites by carefully monitoring the performance of GOES–14 and GOES–P (once on orbit as GOES–15). As a further risk reduction measure, NOAA has in place existing agreements with European and Japanese governments that also operate GOES-type satellites. If necessary, NOAA would borrow or request re-positioning of one or more foreign satellites, contingent on availability, to assist NOAA in meeting U.S. data needs.

Q2. During the hearing, Mr. Morrow described his perspectives on funding project contracts. Please discuss any of your own lessons learned from the contracting process thus far. What are the appropriate occasions for fixed-price contracting versus cost-plus?

A2. In general, a fixed price contract provides for a set price for goods or services including profit. A cost plus contract provides for the reimbursement of the contractor's costs and an amount of fees. For both types of contracts, the profit and fees can vary. The principal determinate for picking fixed price or cost plus is the customer's ability to specify what goods and services are required and what level of risk will be involved in delivering the goods and services.

If the customer can describe the goods or services required with sufficient implementation detail to allow a good estimate of the effort and materials required and their costs, and there is little technology, schedule, or other risk involved in accomplishing the effort, then a fixed price contract is the best option. A good example of an appropriate fixed price contract is a later satellite in a series with limited changes from the early satellites and where the risks of manufacturing are very well known based on prior experience.

However, if there are substantial uncertainties associated with the effort related to development and engineering issues, availability of properly skilled and experienced staff, and schedule challenges, then a cost-plus contract is more appropriate.

A good example of this is the development of a new satellite or ground system like GOES–R. The uncertainties and risks related to engineering and schedule translate into uncertainties and risks associated with the budget that both government and contractor are willing to commit to the contract.

The cost-plus contracts NOAA has in place, through ongoing partnership with NASA, have been effective contract vehicles to work through the design of the GOES–R instruments to date.

Question submitted by Representative Vernon J. Ehlers

Q1. Please provide a chronology of the changes in the GOES–R program over the last two to three years including a rationale for the changes that were made.

A1. The following is a chronology of the changes to the GOES–R Program from January 2004 to the present.

FY 2004 (January 2004–October 2004): NOAA developed the first working estimate for GOES–R of $6.2 billion.

- Estimate was derived from 11 concept studies, including architecture options that ranged in size from three to nine spacecraft.
- Cost estimate was used at the beginning of the Program Definition and Risk Reduction (PDRR) phase of the program.

FY 2006 to FY 2007 (October 2005–April 2007): Program Definition and Risk Reduction (PDRR) Phase, consisting of three firm-fixed-price contracts to three different contractors.

The GOES–R PDRR phase included the following steps:

- Defined an end-to-end system architecture, including more detailed concept designs and cost estimates.
- Conducted system and subsystem level trade studies to identify and mitigate risk.
- PDRR ended with each contractor presenting a System Concept Review (SCR).
- Based on the information in the SCR, NOAA developed the second working cost estimate of $6.96 billion, which consisted of two satellites and the removal of the Hyperspectral Environmental Suite (HES). Internal studies concluded that the HES instrument (including hyperspectral sounder and coastal waters imaging) was too technologically challenging to build within the available budget and schedule. NOAA demanifested the HES from GOES–R.

FY 2007 to FY 2008 (May 2007–December 2007): NOAA acquisition planning period.

- June 2007: The NOAA/NASA Memorandum of Agreement for management and acquisition of the GOES–R system was signed.
- Based on the recommendations of a high-level Independent Review Team (IRT), NOAA changed the management and contract structure from a single prime contract to separate space and ground systems contracts with the government responsible for systems engineering and integration of the system.
- December 2007: The Under Secretary of Commerce for Oceans and Atmosphere certified readiness to proceed into the acquisition and operations phase of the program. The components of the program approved included:
  - The $7.58 billion budget;
  - The two-contract acquisition strategy: NASA responsible for space segment and NOAA responsible for the ground segment and operations; and
  - Deliverables consisting of two spacecraft with an option for two additional spacecraft.

FY 2008 Omnibus Appropriations Act—Reduced funding for the program by $44 million.

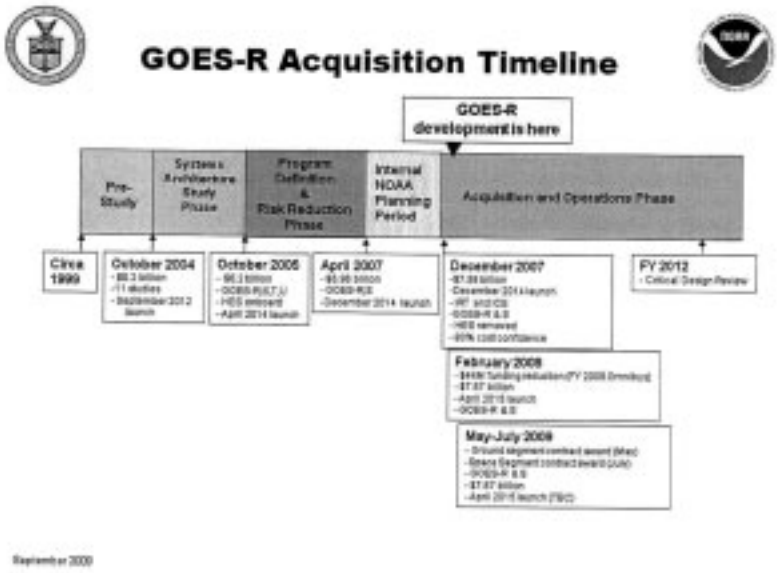
- Funding reduction forced an adjustment to the acquisition schedule.
- Launch readiness date changed from December 2014 to April 2015.

FY 2009 President's Budget request based on $7.67 billion cost estimate.

- Spacecraft program provides two spacecraft with an option for two additional spacecraft, which are unfunded.

- NOAA developed a program office cost estimate, conducted an independent cost estimate, and resolved differences between the two cost estimates. The resulting budget and schedule was at the 80 percent confidence level (to allow for sufficient reserves to address potential technical problems during development, per the recommendation of the IRT).
- October 2008: Pursuant to Public Law 110–161, the Under Secretary of Commerce for Oceans and Atmosphere certified readiness to Congress to proceed into the acquisition and operations phase of the program. The components of the program approved included:
  - The $7.67 billion budget;
  - The two-contract acquisition strategy: NASA responsible for space segment and NOAA responsible for the ground segment and operations; and
  - Deliverables consisting of two spacecraft with an option for two additional spacecraft.

FY 2010 President's Budget request retained the $7.67 billion cost estimate.



ANSWERS TO POST-HEARING QUESTIONS

Responses by George W. Morrow, Jr., Director, Flight Projects, Goddard Space Flight Center, National Aeronautics and Space Administration (NASA)

Question submitted by Chairman Brian Baird

Q1. During the hearing, we discussed the importance of identifying a monetary value of the GOES–R Program in light of the substantial cost to the taxpayer. Please provide these analyses of economic impact that the GOES–R capabilities will provide.

A1. NASA and NOAA share a 39-year partnership designing, developing and launching the GOES and Polar Operational Environmental Satellite series. While NASA is implementing the flight segment of the GOES–R Program, program responsibility resides with NOAA. This question is best answered by NOAA in their role as the program manager.

Questions submitted by Representative Donna F. Edwards

Q1. In response to the program difficulties as identified in the 2006 GAO report, including a near doubling of projected program costs, NOAA made several key changes to the program as a whole. The newest GAO report identifies several improvements since that time, but NOAA also eliminated two satellites and the Hyperspectral Suite (HES) program and pushed back the first launch date to December 2014. What are the key improved capabilities the GOES–R program has with the reduced system? What specific capabilities will we lose with the two satellites and the HES program? How will the additional delay impact costs and satellite services? Please expound upon the potential gap in service coverage as identified by GAO.

A1. NASA and NOAA share a 39-year partnership designing, developing and launching the GOES and Polar Operational Environmental Satellite series. While NASA is implementing the flight segment of the GOES–R Program, program responsibility resides with NOAA. This question is best answered by NOAA in their role as the program manager.

Q2. During the hearing, Ms. Kicza described NOAA's progress toward implementation of GAO's three major recommendations for GOES–R. Please explain how NASA is approaching these goals and what progress has been made so far at reaching them.

A2. GAO Recommendation (1): As part of any effort to re-baseline the cost and schedule of the Advanced Baseline Imager, perform an integrated baseline review and ensure the review includes an assessment of key schedule milestones, the adequacy of resources, task and technical planning, and management processes.

NASA expects to complete the re-baselining of the ABI instrument contract later this year. As part of that re-baseline activity, we will conduct a comprehensive Integrated Baseline Review (IBR). The ABI contractor is currently updating their new program management baseline. Once that is complete, NASA and NOAA will conduct the IBR.

GAO Recommendation (2): Improve the agency's ability to oversee contractor performance by ensuring the reasons for cost and schedule variances are fully disclosed and documented.

All five NASA GOES–R instrument contractors submit monthly Cost Performance Reports that includes cost and schedule earned value metrics and the itemization of all related variances. These cost variances are reviewed by both NASA and NOAA personnel within the GOES–R program office on a monthly basis to ensure that the cost and schedule variances reported by the contractor are fully understood. All cost and schedule metrics, variances, impacts and mitigation plans (as appropriate) are reported on a monthly basis to the GOES–R program, NASA Goddard Space Flight Center staff, as well as NOAA and the Department of Commerce. Once the spacecraft contract is awarded, identical cost and schedule reporting processes will be utilized for reporting and documentation.

GAO Recommendation (3): If feasible and justified, develop a plan and timeline of recovering the advanced capabilities that were removed from the program when the Hyperspectral Environmental Suite was canceled.

As NOAA's flight hardware implementing partner, NASA continues to provide NOAA with the requisite engineering support necessary to evaluate options. In the event that NOAA elects to pursue an advanced sounding instrument to meet their

user needs, then NASA will ensure that the proper systems engineering is performed to ensure GOES–R mission success.

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