



NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Audit of the Geostationary Operational Environmental Satellite–R Series: Improvements in Testing, Contract Management, and Transparency Are Needed to Control Costs, Schedule, and Risks

FINAL REPORT NO. OIG-17-013-A

FEBRUARY 2, 2017

U.S. Department of Commerce
Office of Inspector General
Office of Audit and Evaluation

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February 2, 2017

MEMORANDUM FOR: Benjamin Friedman
Acting Under Secretary of Commerce for Oceans and
Atmosphere and NOAA Administrator

FROM: Allen Crawley
Assistant Inspector General for Systems Acquisition
and IT Security

A handwritten signature in cursive script, reading "Allen Crawley", is written over the printed name and title.

SUBJECT: *Audit of the Geostationary Operational Environmental Satellite—R Series: Improvements in Testing, Contract Management, and Transparency Are Needed to Control Costs, Schedule, and Risks*
Final Report No. OIG-17-013-A

Attached is our final audit report of National Oceanic and Atmospheric Administration's (NOAA's) Geostationary Operational Environmental Satellite—R Series (GOES-R) integration and test activities. Our objectives were to assess the adequacy of GOES-R development as the program completes system integration and test activities for the flight and ground segments in preparation for launch and data distribution, per NOAA and National Aeronautics and Space Administration (NASA) standards. We also monitored the program's progress in developing and reporting on flight and ground segment contracting actions and changes to minimize cost increases.

We found the following:

- *An unapproved test change damaged the satellite and exposed weaknesses in cost estimation that informed award fee determination.* We found that, prior to starting a 67-day continuous GOES-R thermal vacuum (TVAC) test, the contractor and project management personnel did not formally review and approve a change that altered the test equipment configuration. While the contractor completed the test on schedule, an unapproved test equipment configuration change caused an accident in the chamber that damaged the spacecraft and two of the instruments. Also, a delay in preparing spacecraft and instrument damage cost estimates that totaled more than \$1 million allowed award fees payment to the contractor of \$10.3 million, which we consider questioned costs, and made another \$3.9 million available to be earned on the final evaluation, which we consider funds put to better use. Lastly, we found that a lack of coordination in sharing evolving TVAC damage cost estimates restricted NASA's timely change of the mishap classification level—designed to ensure that appropriate activities and products are assigned to an investigation.

- *Delay in definitizing core ground system re-plan resulted in increased costs and risk.* The NOAA GOES-R contract office took nearly 2 years to negotiate a request for equitable adjustment proposal submitted in December 2013 by the contractor. As a result, the government had to pay the contractor \$9,586,935 for escalation and \$154,424 for proposal preparation costs, which we consider questioned costs. Moreover, prolonged delay resulted in NOAA and the contractor being unable to validate the core ground system's cost and schedule performance using earned value metrics during the undefinitized period.
- *Spacecraft project management reviews are not conducted in a transparent manner.* GOES-R contractors conduct regular project management reviews for both the flight and ground segments to inform the government on the project's technical and business status. These meetings are a contractual requirement; however, Office of Inspector General oversight was not permitted to observe the GOES-R spacecraft business meetings. The spacecraft business meetings are conducted as internal contractor meetings, with GOES-R project management attendance and participation. Additionally, no meeting minutes or action items are produced. Restricting OIG attendance, coupled with the lack of meeting minutes and action items, significantly limits oversight organizations' understanding of actions needed and taken to control cost increases and minimize schedule delays for the GOES-R flight project. As a result, we had limited insight into the business aspects of the most expensive part of the GOES-R program—the spacecraft.
- *The National Environmental Satellite, Data, and Information Service (NESDIS) does not consistently calculate or report geostationary satellite coverage gap probability.* NESDIS does not employ a consistent, transparent process for assessing the availability of geostationary satellite imagery for the eastern and western United States, in order to measure its performance against NOAA policy. The lack of a regular, detailed measurement of data gap probability makes it difficult to independently assess program performance compared to national geostationary imagery availability requirements for this primary mission essential function. While NESDIS does routinely report constellation health status on its website, we believe there are additional risk factors that should be considered when assessing the constellation's status.

In responding to the draft report, NOAA concurred with 10 of our 11 recommendations, partially concurred with 1 recommendation, and reported on activities it has or will take to implement the recommendations. We reaffirm our recommendation to modify the NOAA-funded spacecraft contract's performance evaluation plan through NASA, as NOAA's supporting acquisition agent. In addition, NOAA included general and editorial comments, and recommended factual and technical information, which we reviewed but did not include in our final report. We did update our final report to reflect NOAA's successful launch of GOES-R on November 19, 2016. We have summarized NOAA's response and included its entire formal response as appendix E.

The final report will be posted on OIG's website pursuant to sections 4 and 8M of the Inspector General Act of 1978 (5 U.S.C. App., §§ 4 & 8M), as amended.

In accordance with Department Administrative Order 213-5, please provide us your action plan within 60 days of this memorandum. The plan should outline the actions you propose to take to address each audit recommendation.

We appreciate the cooperation and courtesies extended to us by your staff during our audit. Please direct any inquiries regarding this report to me at (202) 482-1855, or Fred Meny, Director, Satellites and Weather Systems, at (202) 482-1931, and refer to the report title in all correspondence.

Attachment

cc: Stephen Volz, Assistant Administrator, NESDIS, NOAA
Mack Cato, Director, Office of Audit and Information Management, NOAA



Report In Brief

FEBRUARY 2, 2017

Background

NOAA's Geostationary Operational Environmental Satellites (GOES) provide the United States with meteorological data for weather observation, research, and forecasting. These satellites look for "atmospheric triggers" for severe weather conditions (e.g., tornadoes, flash floods, and hurricanes), monitor the development of storms, and track their movements.

The overall GOES-R program is managed by NOAA with two integrated NOAA/National Aeronautics and Space Administration (NASA) offices—the ground segment project and the flight segment project—and integrated supporting offices such as program systems engineering and program contracts. NOAA manages the acquisition and development efforts for the entire ground segment; software and hardware; and the remote unit for backup of mission-critical functions. NASA manages development and acquisition of the flight segment.

Why We Did This Review

Our objectives were to assess the adequacy of GOES-R development as the program completes system integration and test activities for the flight and ground segments in preparation for launch and data distribution, per NOAA and NASA standards. We also monitored the program's progress in developing and reporting on flight and ground segment contracting actions and changes to minimize cost increases.

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OIG-17-013-A

WHAT WE FOUND

An unapproved test change damaged the satellite and exposed weaknesses in cost estimation that informed award fee determination. Prior to starting a 67-day continuous GOES-R thermal vacuum (TVAC) test, the contractor and project management personnel did not formally review and approve a change that altered the test equipment configuration. An unapproved test equipment configuration change caused an accident in the chamber that damaged the spacecraft and two of the instruments. Also, a delay in preparing spacecraft and instrument damage cost estimates that totaled more than \$1 million allowed award fees payment to the contractor of \$10.3 million, which we consider questioned costs, and made another \$3.9 million available to be earned on the final evaluation, which we consider funds put to better use. Lastly, we found that a lack of coordination in sharing evolving TVAC damage cost estimates restricted NASA's timely change of the mishap classification level.

Delay in definitizing core ground system re-plan resulted in increased costs and risk. The NOAA GOES-R contract office took nearly 2 years to negotiate a request for equitable adjustment proposal submitted in December 2013 by the contractor. As a result, the government had to pay the contractor \$9,586,935 for escalation and \$154,424 for proposal preparation costs, which we consider questioned costs. Moreover, prolonged delay resulted in NOAA and the contractor being unable to validate the core ground system's cost and schedule performance using earned value metrics during the undefinitized period.

Spacecraft project management reviews are not conducted in a transparent manner. GOES-R contractors conduct contractually-required regular project management reviews for both the flight and ground segments to inform the government on the project's technical and business status. However, OIG oversight was not permitted to observe the GOES-R spacecraft business meetings. Additionally, no meeting minutes or action items are produced.

The National Environmental Satellite, Data, and Information Service (NESDIS) does not consistently calculate or report geostationary satellite coverage gap probability. NESDIS does not employ a consistent, transparent process for assessing the availability of geostationary satellite imagery for the eastern and western United States, in order to measure its performance against NOAA policy.

WHAT WE RECOMMEND

We recommend that the NESDIS Assistant Administrator

1. Direct NASA to ensure the spacecraft contractor's thermal vacuum procedural documents include adequate steps to account for configuration modifications on future GOES-R series satellites.
2. Direct GOES-R Program to establish a reporting mechanism that tracks mishap or damage costs.
3. Direct NASA to modify the spacecraft contract's performance evaluation plan to specify that both direct and indirect costs are used in determining a major breach of safety for future evaluation periods.
4. Direct GOES-R Program to provide timely mishap cost data to NASA.

We recommend that the NOAA Deputy Under Secretary for Operations

5. Determine whether the spacecraft contractor was entitled to receive award fee payment for period 12.
6. Direct NOAA Acquisition and Grants Office (AGO) to develop a policy on timely disposition of request for equitable adjustment (REAs).
7. Direct AGO to provide more detailed status of REAs and unpriced change orders (UCOs) for programs presented at Program Management Council (PMC) meetings that have been unresolved for over 6 months.
8. Direct AGO to develop a mechanism to regularly communicate status of REAs and UCOs that have been unresolved for over 6 months to senior NOAA leadership for programs not presented at PMC meetings.

We recommend that the Under Secretary of Commerce for Oceans and Atmosphere and the NOAA Administrator

9. Direct the GOES-R program to ensure that the business meeting portion of the spacecraft project management reviews allow independent government oversight attendance.

We recommend that the NESDIS Assistant Administrator

10. Ensures that (a) the GOES-R program captures meeting minutes for project management reviews identifying all action items, decisions, and significant points of discussion and (b) all future NESDIS funded contract meeting and review deliverables require minutes.
11. Create a documented, periodic, and consistent geostationary imagery gap probability summary for comparison with policy.

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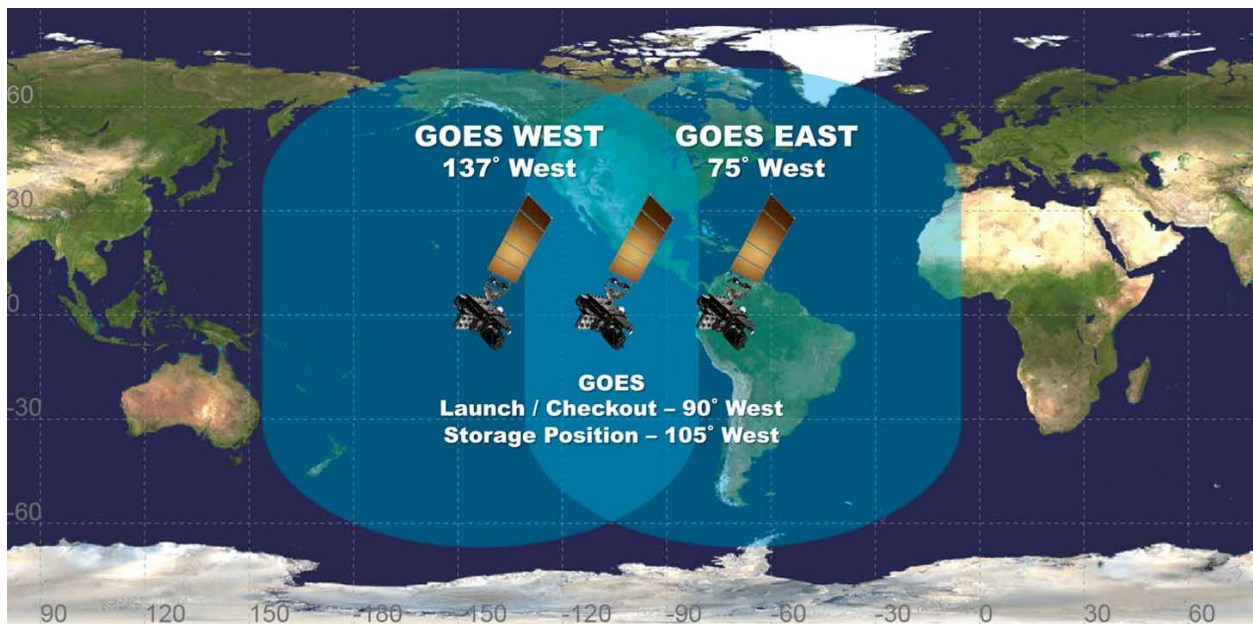
Introduction

One of the primary mission essential functions of National Oceanic and Atmospheric Administration's (NOAA's) National Environmental Satellite, Data and Information Service (NESDIS) is to acquire and manage the nation's operational environmental satellites. NOAA's Geostationary Operational Environmental Satellites (GOES) provide the United States with meteorological data for weather observation, research, and forecasting since 1975. These satellites look for "atmospheric triggers" for severe weather conditions (e.g., tornadoes, flash floods, and hurricanes), monitor the development of storms, and track their movements.

GOES constellation

NOAA's policy is to have three satellites on-orbit (see figure 1). NOAA simultaneously operates two primary GOES satellites, GOES-East and GOES-West, to maintain a constant view of the Earth from an approximate 22,300-mile orbit and one satellite in on-orbit storage in the event of a failure of one of the operational GOES satellites. Currently in orbit are GOES-13 (GOES-East) and GOES-15 (GOES-West), with GOES-14 as backup.

Figure 1. Location and Area of Coverage of the GOES Constellation^a



Source: NOAA, GOES-R program documentation

^a The GOES-R series will maintain the two-satellite system implemented by the current GOES satellites. However, the locations of the operational GOES-R series satellites will be 75° West and 137° West. The latter is a shift from current GOES location at 135° West.

The GOES-R series of satellites are lettered GOES-R, -S, -T, and -U until successfully reaching orbit, and then designations are converted to numbers. Table I gives the launch commitment dates¹ and corresponding number designations for each of the GOES-R series satellites.

Table I. GOES-R Series Designations and Launch Commitment Dates

Satellite Letter Designation	Launch Commitment Date	Satellite Number Designation ^a
GOES-R	1st qtr FY 2017	GOES-16
GOES-S	4th qtr FY 2018	GOES-17
GOES-T	3rd qtr FY 2019	GOES-18
GOES-U	1st qtr FY 2025	GOES-19

Source: OIG, adapted from GOES-R documentation

^a These are assuming each satellite achieves orbit; if one does not, the number designation would change.

These satellites will incorporate the first technological advance in GOES instrumentation since the launch of the GOES I–M series, which began in 1994. The primary instrument is the Advanced Baseline Imager (ABI), which will introduce new capabilities and improve on the existing products, providing data to generate more timely and accurate weather forecasts. The GOES-R satellites will also have a Geostationary Lightning Mapper (GLM) that will be the first lightning mapping instrument in geostationary orbit. It will provide early indication of growing, active, and potentially destructive thunderstorms, early warning of lightning ground strikes, and potentially improved tornado warning capability—as well as improved routing of commercial, military, and private aircraft over limited oceanic regions, where observations of thunderstorm intensity are scarce. For a full description of all the GOES-R instruments, see appendix B.

Cost estimate

In NOAA’s fiscal year (FY) 2017 Congressional budget justification, the GOES-R program life-cycle cost estimate decreased from \$10.8 billion to \$10.1 billion, after \$678 million was moved to the Operations, Research, and Facilities account to fund operational requirements through the projected GOES-R mission life. The GOES-R life-cycle cost estimate includes development and deployment of four satellites through FY 2036. GOES-R—along with NOAA’s other major satellite programs, the Joint Polar Satellite System and the Polar Follow-On—are the Department’s largest investments, together accounting for more than 16 percent of its \$9.7 billion FY 2017 discretionary budget request.

¹ This is the latest date the satellite would be available for launch.

Program structure

The overall GOES-R program is managed by NOAA with two integrated NOAA/National Aeronautics and Space Administration (NASA) offices—the ground segment project and the flight segment project—as well as integrated supporting offices such as program systems engineering and program contracts. NOAA manages the acquisition and development efforts for the entire ground segment, including the facilities; antenna sites; software and hardware for satellite command and control, as well as generating and distributing end-user products; and the remote backup unit for backup of mission-critical functions. NASA manages development and acquisition of the flight segment, which consists of the spacecraft, instruments, launch vehicle and services, and auxiliary communication payloads.

Ground segment

In our May 2015 report,² we specified that the core ground system development was in the midst of a second costly re-plan that started in 2013—because of past problems with flight and ground dependencies, technical communications between flight and ground engineers, and overly optimistic task durations. Since we issued our 2015 report, the GOES-R ground contracting officer has definitized \$190 million in costs for this re-plan. With this re-plan, and an earlier re-plan for \$89 million, the core ground system contract has increased by \$279 million for a total contract value of \$1.2 billion.³ This amount also includes \$12 million in costs because of the program changing the launch date from March 2016 to October 2016. The contract may incur further cost increases due to the most recent launch date change from October 2016 to November 2016. Also in our May 2015 report,⁴ we identified off-ramps⁵ that may be needed as a strategy to mitigate schedule delays. The ground project identified 58 off-ramps in total, all of which have either have been executed or passed. The core ground system was on schedule to meet the October 2016 launch date (see figure 2 on the next page) and remained on schedule to meet the November 2016 launch date.

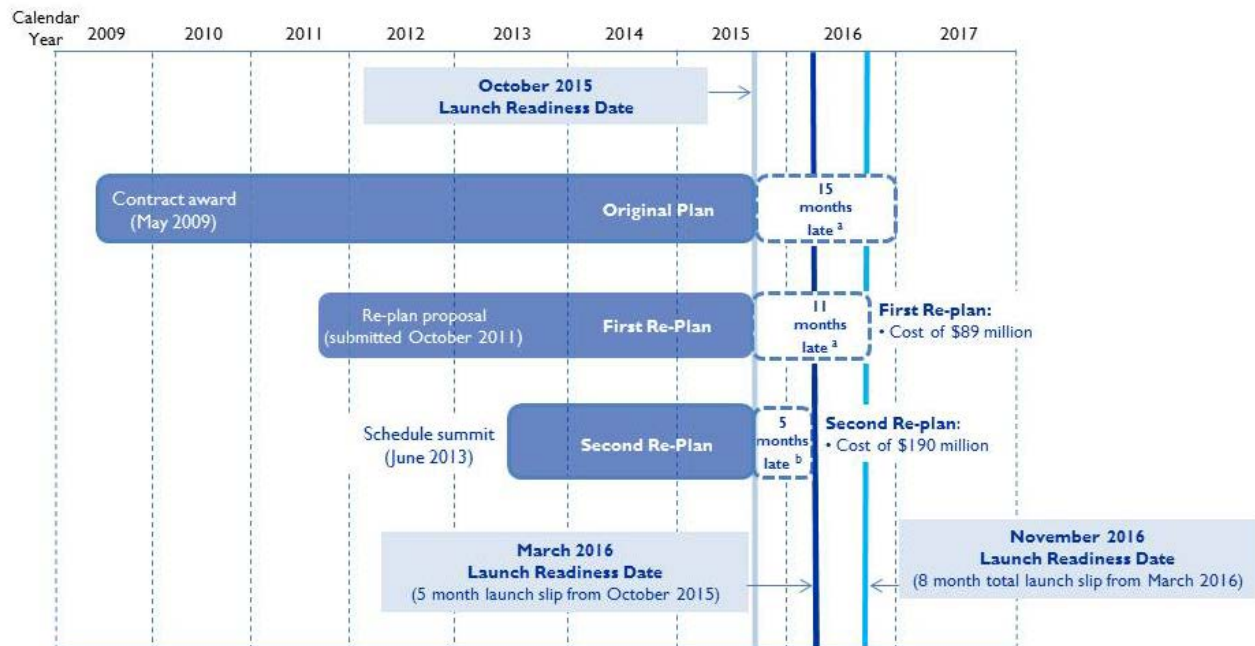
² U.S. Department of Commerce Office of Inspector General, May 28, 2015. *Audit of Geostationary Operational Environmental Satellite-R Series: Leadership Must Proactively Address Integration and Test Risks to Maintain Revised Launch Schedule*, OIG-15-030-A. Washington, DC: DOC OIG, 12.

³ As of July 2016, the \$1.2 billion includes costs for other changes to the core ground system contract not related to the re-plans.

⁴ See DOC OIG, OIG-15-030-A, 14.

⁵ Off-ramps defer or eliminate requirements.

Figure 2. OIG Estimate of the Core Ground System Completion Date, Based on Progress Made in Implementing Core Ground System Re-Plans



Source: OIG graphic analysis of NOAA data

^a This delay is calculated against the October 2015 launch date.

^b In March 2014, OIG estimated the core ground system to be 5 months behind schedule based on the launch readiness date of October 2015. OIG's projection of months remaining to develop the core ground system on October 2015 assumed (1) that the contractor would be able to start the second re-plan immediately when it was determined that development was 11 months behind schedule (at the June 2013 schedule summit) and (2) that development time could be regained at the same rate as was regained by the first re-plan (i.e., 4 months regained over 20 months' duration).

Flight segment

Since the spacecraft contract's 2008 award, the contractor has experienced a number of development issues that have resulted in schedule delays and cost increases. In our May 2015 report, we noted that—even with the delayed launch date of the first satellite in the GOES-R series, from October 2015 to March 2016—there were still significant challenges to the GOES-R flight segment development schedule.⁶

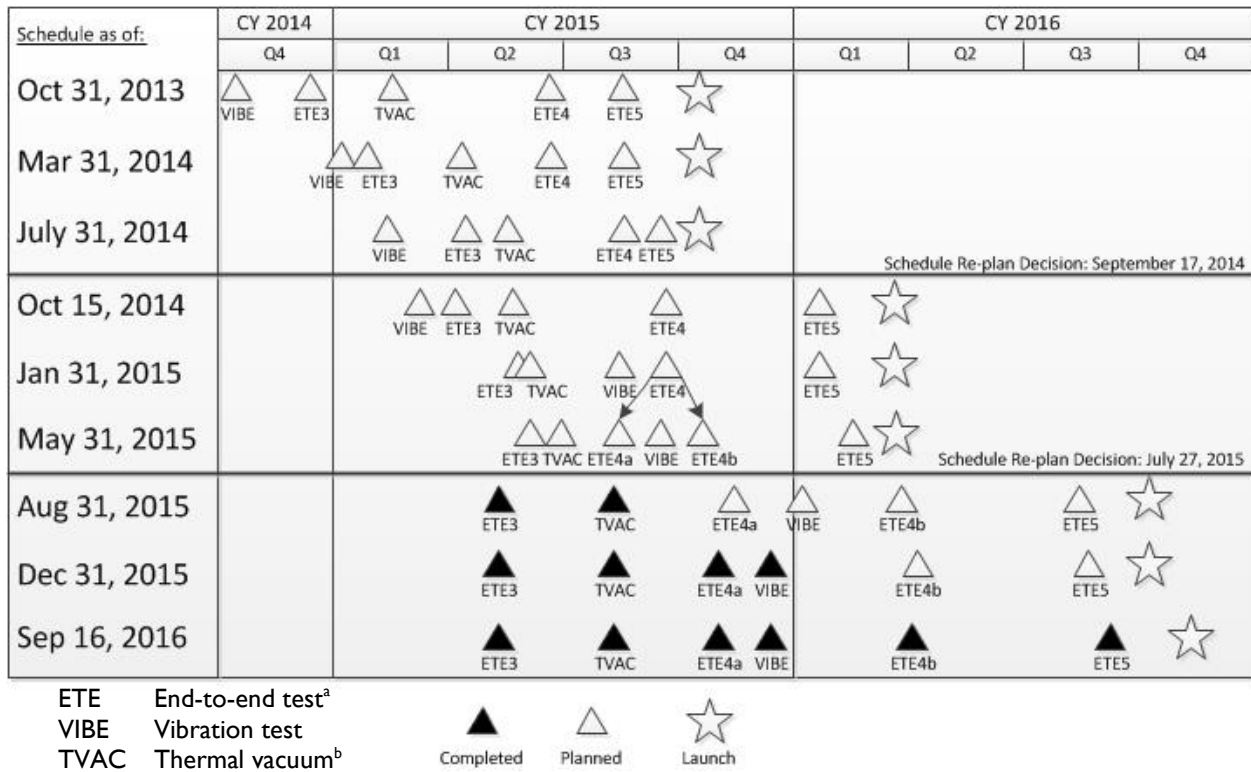
In April 2015, the spacecraft contractor's Integration and Test Manager was replaced; task durations were reassessed to be more realistic; and the launch date was eventually delayed from March 2016 to October 2016. According to GOES-R project management, the delay was due to the previous Integration and Test Manager's underestimation of task durations during

⁶ See DOC OIG, OIG-15-030-A, 3.

the integration and test phase,⁷ which caused schedule compression. Since this launch date change, schedule compression had been alleviated, but schedule pressure still existed to ensure that the program remained on track to make the October 2016 launch date.

In June 2016, the launch date was further delayed to November 2016 because of an issue with a United Launch Alliance’s Atlas V launch vehicle discovered during another satellite’s mission. Figure 3 illustrates launch schedule changes. Test schedule compression is shown prior to each schedule re-plan (i.e., schedule compression from October 31, 2013, to July 31, 2014, and October 15, 2014, to May 31, 2015). In some cases, test event order was changed, however schedule compression still occurred.

Figure 3. History of GOES-R Schedule Test Compression and Launch Changes



Source: OIG graphic analysis of GOES-R Integration and Test schedule history

^a End-to-end tests are tests in which the system is configured to run as closely as possible to its real-life application from beginning to end. Five end-to-end tests are planned before the launch of GOES-R.

^b The vibration test and thermal vacuum test are environmental tests that provide confidence that the design will perform when subjected to environments more severe than expected during the mission.

⁷ During this phase, the system components are assembled, integrated, and verified to meet system requirements. By the end of this phase, the system is ready to transition to launch and then operations.

In our 2013 report, we stated that the program expected spacecraft overruns to reach \$140 million.⁸ Since then, there have been approximately \$304 million in overruns, mainly due to the complexity of the spacecraft subsystems and technical issues. As of June 2016, the spacecraft contract is valued at \$1.8 billion, including approximately \$30 million for the change in launch date from October 2015 to October 2016. The entire cost of the flight segment is estimated to increase by an additional \$14 million for instruments and launch services, due to the change in launch date from March 2016 to November 2016.

The Constellation's Risk of a Coverage Gap

Despite the launch delay of the GOES-R satellite, NOAA assessed a chance of having an operational satellite coverage gap as lower than before the delay. But the underlying assumptions used to determine the probability are inconsistent due to a reassessment of the operational satellites' original design life. Also, if any of the on-orbit GOES satellites were to fail before GOES-R completes on-orbit checkout of approximately 1 year, NOAA could be without a backup satellite on orbit. In the past several years, GOES-13 failures have already necessitated a call-up of the backup satellite twice. Additionally, GOES-15 only has one operable star tracker⁹ remaining among its three onboard. If the final star tracker fails, GOES-15 will be unable to meet its mission requirements. The time frame of a potential data gap coincides with a transition to a new Administration and a new Congress, both of which will need to understand the status of risk to the continuity of geostationary observations.

⁸ DOC OIG, April 25, 2013. *Audit of Geostationary Operational Environmental Satellite—R Series: Comprehensive Mitigation Approaches, Strong Systems Engineering, and Cost Controls Are Needed to Reduce Risks of Coverage Gaps*, OIG-13-024-A. Washington, DC: DOC OIG, 13.

⁹ Star trackers are part of the spacecraft's navigation system, and are required in order to know which direction the satellite is pointing.

Objectives, Findings, and Recommendations

Our objectives were to assess the adequacy of GOES-R development as the program completes system integration and test activities for the flight and ground segments in preparation for launch and data distribution, per NOAA and NASA standards. We also monitored the program's progress in developing and reporting on flight and ground segment contracting actions and changes to minimize cost increases. (For further details regarding our objectives, scope and methodology, see appendix A. For a full description of all the GOES-R instruments, see appendix B.)

We found that (1) an environmental testing mishap damaged the satellite and exposed weaknesses in cost estimation that informed award fee determination, resulting in questioned costs and funds put to better use (see appendix C); (2) NOAA delayed definitizing a core ground system re-plan, resulting in additional questioned costs and risk to ground system development, (3) spacecraft project management reviews are not conducted in a transparent manner, and (4) NESDIS does not consistently calculate or report geostationary satellite coverage gap probability.

I. An Unapproved Test Change Damaged the Satellite and Exposed Weaknesses in Cost Estimation that Informed Award Fee Determination

We found that, prior to starting a 67-day continuous GOES-R thermal vacuum (TVAC) test,¹⁰ the contractor and project management personnel did not formally review and approve a change that altered the test equipment configuration. Since the contractor had already experienced schedule delays and launch date changes, there was pressure not to delay starting the TVAC testing to stay on track. While the contractor completed the test on schedule, an unapproved test equipment configuration change caused an accident in the chamber that damaged the spacecraft and two of the instruments.

Following the testing mishap, a delay in preparing accurate spacecraft, and instrument damage, cost estimates totaling more than \$1 million allowed \$10.3 million in questionable award fees paid to the contractor—and made another \$3.9 million available to be earned on the final evaluation—both of which we consider potential monetary benefits to the government (see appendix C). We also found that a lack of coordination in sharing evolving TVAC damage cost estimates restricted NASA's timely change of the mishap classification level—designed to ensure that appropriate activities and products are assigned to an investigation.

¹⁰ The satellite is tested inside a sealed chamber designed to simulate extreme hot and cold conditions of space, in order to assess performance in that environment.

A. *Lack of configuration control put GOES-R satellite at risk during test*

The GOES-R satellite was on a tight environmental test timeline due to inadequate task planning, which resulted in schedule compression. On August 24, 2015—at the completion of TVAC testing—the contractor opened the chamber and found damage to the satellite and support equipment. Per NASA requirements, Goddard Space Flight Center (GSFC) assembled a mishap investigation team to determine the root cause of the TVAC test failure.

In January 2016, NASA issued a mishap report on the incident, which provided recommendations and corrective actions for GOES-R program management. Specifically, the report noted that a design change to the TVAC test equipment was not fully reviewed and approved. Our assessment is that the configuration management process, required by the contract and configuration management plan, was not followed. The design change resulted in a molten copper discharge material that damaged some of the satellite instruments' shielding and thermal insulation. Without proper configuration management¹¹ of this change, there was a breakdown in the overall process to ensure that test equipment configuration control (i.e., analysis, review, and approval by proper technical and management experts) is maintained when changes are needed.

NASA's mishap report also noted that the contractor was under schedule pressure to finish the TVAC test, because another program's satellite needed to use the test chamber immediately following GOES-R testing. Project and contractor personnel confirmed that there was a lack of design review and process oversight. During our fieldwork, we determined that the spacecraft contractor had established procedures related to the initial configuration of test equipment used in the TVAC chamber; however, the contractor did not document modifications to change the existing configuration. As a result, there was no formal test or technical modification request or documentation related to the configuration change for either the contractor or project management personnel to review and approve.

Following our independent analysis of the ongoing mishap remediation, we noted that the program did not develop any deviation or residual risk¹² documentation that captured the effects of the instrument contamination resulting from the mishap. Although follow-on tests confirmed the contamination posed a minimal risk to future instrument performance, the program did not document the actions leading to this determination. If a problem occurs once the satellite is operational, these uncaptured actions will not be available to aid managers and engineers later during problem resolution efforts. For instance, the GLM instrument contractor had to remove copper discharge material that deposited onto the instrument baffle and determined that any

¹¹ *Configuration management* identifies the configuration of the product at various points in time; systematically controls changes of the product; maintains the integrity and traceability of the product; and preserves the records throughout its life cycle.

¹² *Residual risk* remains after all mitigation actions have been implemented or exhausted, in accordance with the risk management process.

remaining contamination was negligible. The ABI instrument contractor and NASA GSFC mishap investigation team also determined that any remaining contamination was an acceptable risk that would be further mitigated through pre-launch inspections. Neither of these was documented as a residual risk.

Further, the contractor indicated that, because it was using the GOES-R TVAC test equipment setup for the first time, a great deal of fine-tuning and adjustment to the design was required. We determined that these design changes necessitated a greater need for a documented and controlled configuration management process. A controlled process would not only reduce risk to this satellite but also establish steps taken for GOES-S, -T, and -U satellites. In particular, the changes made to the test configuration would incorporate the contract's requirement to ensure proper design reviews, controlled configuration changes, and overall configuration management. However, lacking configuration control, the GOES-R spacecraft was placed at significant risk due to modifications that lacked formally documented reviews and approval.

B. Low priority given to completing TVAC mishap cost estimate during award fee period led to a questionable award fee

The spacecraft contract's award fees are determined over multiple performance periods and are based on established evaluation criteria for technical, management, and cost performance requirements. Award fee determinations for each evaluation period are contractually required to be made within 45 days after the end of the period, and contractor payment is required no later than 60 days after end of the period.

The contract's performance evaluation plan¹³ sets forth criteria by which the contractor's work is reviewed, as well as conditions that would restrict award fee payment. In particular, the plan has a section that

The spacecraft contract's performance evaluation plan definition of a major breach of safety includes damage to equipment or property equal to or greater than \$1 million

discusses that the contractor will be evaluated on its ability to provide a safe work environment, including inspections and processes for accident and incident files, mishap reporting, and training. Further it states that—if a major breach of safety, which includes an accident, incident, or exposure results in damage to equipment or property equal to or greater than \$1 million—in no case will any award fee be paid and/or earned by the contractor in any interim evaluation period.

The TVAC mishap was discovered by the program on August 24, 2015, during the evaluation timeframe covering award fee period 12.¹⁴ We found that the program,

¹³ The performance evaluation plan covers the administration of the award fee provisions of Contract No. NNG09HR00C.

¹⁴ Award fee period 12 was from April 1 through September 30, 2015

despite having 82 days prior to making an award fee determination, took focus off developing a thorough mishap cost estimate. As a result, the program's initial cost estimate to repair and replace components damaged during the test did not serve as an accurate basis for the program's award fee determination.

We found that the lack of priority given to the development of the TVAC damages cost estimate was due to schedule pressure to repair damages and continue testing to stay on track for launch. In April 2016, the GOES-R flight segment project management provided us with an updated damages cost estimate of \$375,000, slightly higher than NASA's reported \$301,008 in January 2016. However, we found the program did not include a \$628,212 modification to the ABI contract that was issued in February for repair of damages. GOES-R flight segment management also informed us, in June 2016, that mishap cost estimates for the spacecraft and GLM instrument were still being accumulated—almost 1 year after the TVAC incident. At the end of our fieldwork in July 2016, the program provided an updated mishap cost estimate of \$1,124,532 (see table 2).

Table 2. GOES-R TVAC Mishap Related Cost

Contract	Costs of the Mishap
Spacecraft	\$476,400
ABI Instrument	\$628,212
GLM Instrument	\$19,920
Total	\$1,124,532

Source: OIG summary of GOES-R project estimation of costs

The program's slow development of the TVAC mishap cost estimate—and the lack of clear communication with the spacecraft contracting officer about the accumulating costs—resulted in the spacecraft contractor receiving \$10,299,050 in award fees¹⁵ for period 12, which we consider questioned costs because it violates the terms and conditions of the contract's performance evaluation plan. By not properly identifying the mishap as a major safety breach in accordance with the contract's performance evaluation plan, it also made the remaining \$3,943,450 of unpaid award fee for period 12 available to the contractor for the final award evaluation, which we consider as funds available to be put to better use (see appendix C).¹⁶ During an interview in May 2016 with the contracting officer for the GOES-R spacecraft and ABI instrument, we found that the contracting officer did not have a full understanding of how the program's

¹⁵ The contractor was provisionally awarded \$9,356,550 of the \$13,300,000 available award fee for period 12 with an overall rating of satisfactory. Also, the contractor was awarded \$942,500 of the \$1 million available award fee for post-delivery support for all mission operations activities.

¹⁶ The \$3,943,450 is the difference between the \$13,300,000 fee available and the \$9,356,550 fee paid. This amount would normally be carried forward except for periods in which a major breach of safety occurred.

estimated mishap costs were progressing. Specifically, the contracting officer informed us that a \$628,212 equitable adjustment modification was issued for ABI in February 2016 to repair and replace components because of TVAC testing. However, the spacecraft contracting officer was unaware that the spacecraft contractor was still determining cost estimates, and the GLM contractor (with a different contracting officer) had costs, about 10 months after the mishap occurred. Had the contracting officer known that the TVAC damage cost estimates were still being accumulated at the time award fee payment was made, other actions could have been considered by the government.

We believe that, because the total cost estimate of the TVAC mishap has exceeded \$1 million, the spacecraft contractor should not have received any portion of available award fees for period 12, per the performance evaluation plan for the contract. If a full accounting of the costs had been made in a timely, rigorous manner, it would have been apparent sooner to the contracting officer that the TVAC mishap damages had exceeded \$1 million, and this questioned award fee cost likely would have been avoided. In addition, the spacecraft contracting officer should have more insight into cost estimate maturity of other flight segment contracts, in order to account for all mishap costs and take timely contract actions.

After we notified the GOES-R program of our assessment in August 2016, it reduced its cost estimate to \$809,037 by removing \$315,502 of mishap-related indirect costs that it determined should not be included. From the program's perspective, only direct equipment damage costs should be included, as defined in NASA procedural requirements (NPR) for mishap investigations,¹⁷ even though that regulation is not referenced anywhere in the performance evaluation plan (i.e., the controlling agreement as to how a contractor performance is evaluated). In contrast, we believe the performance evaluation plan's safety and security clause is to be interpreted broadly in its damages calculation, consistent with the document's intent to direct how to administer award fee provisions.

Further, the performance evaluation plan and the NPR have different purposes. The purpose of the performance evaluation plan's safety and security clause is to protect government interests by determining total costs of the incident to hold contractors accountable for major safety and security breaches in a cost-plus type contract. In contrast, the NASA mishap investigation procedural requirement's purpose is to determine root cause, to avoid mishap reoccurrence, regardless of the costs—and NPR 8621.1C's description of its purpose indicates the NPR's damages calculation is meant to be limited to NASA accident investigations and Occupational Safety and Health Administration corrective actions, not a requirement on how damages are calculated for

¹⁷ NASA Procedural Requirement (NPR) 8621.1C Procedural Requirements for Mishap and Close Call Reporting, Investigating and Recordkeeping provides internal NASA requirements to report, investigate, and document mishaps, close calls, and any resulting corrective actions to prevent occurrence of similar work-related injury, property damage, or mission failure. The NPR does not apply to investigative procedures concerning civil, criminal, or administrative culpability or legal liability.

the performance evaluation plan in the contract. We determined, based on the language of the performance evaluation plan, that the clause is not limited to direct costs, since it contains no language reflecting an intent to limit the damage calculations.

C. Lack of cost estimate coordination restricts NASA's mishap classification level

Upon discovery of the TVAC test mishap in August 2015, NASA initiated their mishap response process,¹⁸ which is designed to analyze, report, and potentially prevent reoccurrence of a similar event in the future. The specific requirements of the process vary based on the estimated direct damage costs and/or level of injury to personnel according to a mishap classification. The difference in classification type is important because it generally determines the skillsets of officials assigned to the team, depth and breadth of investigation products, and reporting requirements. Type A and B mishaps are the most severe, as indicated in table 3.

Table 3. NASA Mishap Classification

Mishap Classification	Greater Than Or Equal To	Less Than
Level A	\$2,000,000	—
Level B	\$500,000	\$2,000,000
Level C	\$50,000	\$500,000
Level D	\$20,000	\$50,000
Close Call	—	\$20,000

Source: OIG adaptation of NASA Procedural Requirements for Mishap and Close Call Reporting, Investigating, and Recordkeeping

Based on the mishap and initial damage estimates provided by the program, NASA assembled the mishap investigation team and board members with a level C designation. As a level C mishap (compared to level A or B), the investigation process was not required to include or adhere to the following:

- Board Appointing Official role fulfilled, at a minimum, by a NASA Mission Directorate Associate Administrator
- development of publicly releasable investigation status reports every 30 workdays until the mishap investigation report is signed
- construction of causal factor tree or similar graphical representation of mishap
- description of all structured analysis techniques used and how they contributed to determine the findings
- determination of event sequence and conditions documented in a timeline

¹⁸ Ibid.

- ensuring resources are provided to submit the Mishap Summary to the NASA Lessons Learned Information System for entry
- access to a NASA Safety Center mishap investigation specialist
- inclusion of safety and human factors professionals as team members
- Corrective Action Plan closure statement to the GSFC safety office

As noted earlier, the initial damage cost estimate provided to NASA was \$301,008, based on the January 2016 NASA Mishap Investigation Board report. Then, in February, the contracting officer modified the ABI instrument contract for \$628,212 to repair and replace damaged components. NASA's mishap investigation team was not notified of this contract modification, or the additional cost estimates for the spacecraft and GLM instrument, until July. If this modification and estimated costs had been shared as they were developed or after they were finalized, the mishap classification would have been elevated to level B sooner than July 2016. The GOES-R program, as the responsible organization for the cost data according to NASA procedures, did not share timely cost information to NASA as required.

If NASA elevated the classification to a level B earlier, it could have added more resources, visibility, and additional analyses for lessons learned that could mitigate similar test risk to the remaining GOES-R series satellites moving forward. At completion of our fieldwork, the mishap investigation remains open pending the completion of corrective actions planned for closure in FY 2017.

Recommendations

We recommend that the NESDIS Assistant Administrator

1. Direct NASA to ensure the spacecraft contractor's thermal vacuum procedural documents include adequate steps to account for configuration modifications on future GOES-R series satellites.
2. Direct GOES-R Program to establish a reporting mechanism that tracks mishap or damage costs with appropriate contract management personnel.
3. Direct NASA to modify the spacecraft contract's performance evaluation plan to specify that both direct and indirect costs are used in determining a major breach of safety for future evaluation periods.
4. Direct GOES-R Program to provide timely cost data to NASA in order to achieve the proper mishap level of classification as early as possible.

We recommend that the NOAA Deputy Under Secretary for Operations

5. Determine whether the spacecraft contractor was entitled to receive award fee payment for period 12.

II. Delay in Definitizing Core Ground System Re-Plan Resulted in Increased Costs and Risk

The NOAA GOES-R contract office took nearly 2 years to negotiate a request for equitable adjustment proposal submitted in December 2013 by the contractor. As a result, the government had to pay for contractor preparation of several proposals and significant costs due to escalation.¹⁹ Moreover, prolonged delay resulted in NOAA and the contractor being unable to validate the core ground system's cost and schedule performance using earned value metrics during the undefinitized period.

A. NOAA's Acquisition and Grants Office does not have a policy for timely disposition of requests for equitable adjustment

NOAA's Acquisition and Grants Office (AGO) provides contracting support for the GOES-R core ground system contract. As such, the GOES-R ground contracting officer is required to follow AGO policy, which included Acquisition Alert (AA) 13-05, NOAA Implementation of Policy for Definitization of Unpriced Change Orders (UCO). AGO implemented AA 13-05 in April 2013, in response to a February 6, 2013, draft of our April 2013 GOES-R report.²⁰ According to the alert,

[a]n unpriced change order shall include a not-to-exceed amount and a definitization schedule that requires...definitization of an unpriced change order within 180 days of being issued; or...definitization of an unpriced change to occur on the date that the funds obligated under the change order is equal to more than 50 percent of the not-to-exceed price.

In April 2015, AGO incorporated AA 13-05 into the *NOAA Acquisition Manual* but clarified the language to indicate that definitization of a UCO shall occur at the "earlier of" the 180-day time limit or when funds obligated have exceeded 50 percent of the not-to-exceed amount.²¹

However, according to the GOES-R ground contracting officer, the latest re-plan was a request for equitable adjustment (REA), not a UCO. As a result, AGO's criteria for definitization of UCOs did not apply to the proposed REA that the core ground system contractor had submitted. Also the criteria did not apply to subsequent actions taken by the contractor and contracting officer leading up to definitization. In addition, there was

¹⁹ Escalation is the use of a price index to convert past to present prices or present to future prices, or an increase in price due to inflation and outlay rates.

²⁰ DOC OIG, April 25, 2013. *Audit of Geostationary Operational Environmental Satellite-R Series: Comprehensive Mitigation Approaches, Strong Systems Engineering, and Cost Controls Are Needed to Reduce Risks of Coverage Gaps*, OIG-13-024-A. Washington, DC: DOC OIG, 17.

²¹ NOAA AGO had changed from "50 percent of the not-to-exceed **price**" in the second condition in AA 13-05 to "50 percent of the not-to-exceed **amount**" (bold added by OIG for emphasis) in the second condition in the *NOAA Acquisition Manual* (NAM). Additionally, AA 13-05 previously allowed, and the NAM currently allows, the funding amount to be increased to no more than 75 percent of the not-to-exceed price (for AA 13-5) or amount (for NAM) if the increase is issued before 50 percent of funds have been obligated.

no UCO prior to submission of the REA. Nevertheless, NOAA had incrementally funded the work after the REA submission. As part of the incremental funding, NOAA increased the core ground system contract ceiling multiple times—and took almost 2 years to definitize cost for the re-plan (see table 4).²²

Also, when the government issued contract modification 076 with initial incremental funding and establishment of a contract ceiling for the re-plan, it stated that “issuance of incremental funding...does not represent a determination...[of] potential award fee.” Therefore, the government did not commit to how much of the re-plan cost would be eligible for award fee until negotiations were complete and settlement was reached. However, as we previously reported,²³ the government loses the opportunity to negotiate final cost of contract modifications while incrementally funding a contract during definitization delays—for the latest ground re-plan, this was approximately \$91 million from August 2014 through June 2015 because of these delays (see table 4).

Table 4. Incremental Funding, Contract Ceiling Increases, and Time to Definitization for Latest Ground Re-Plan (ETC-15)
(\$ in thousands)

Date	Core Ground System Contract Modification Number	Incremental Funding Amount	Cumulative Funding Amount	Contract Ceiling Increase Due to ETC-15	Time Since Submission of Initial Proposal (December 2013)
August 2014	076	\$31,000	\$31,000	\$54,419	8 months
September 2014	081	\$10,023	\$41,023	\$0	9 months
February 2015	091	\$20,000	\$61,023	\$20,000	14 months
April 2015	098	\$20,000	\$81,023	\$20,000	16 months
June 2015	0102	\$10,000	\$91,023	\$10,000	18 months
September 2015	0105 ^a	\$68,908	\$159,931	\$85,578	21 months
Total Contract Ceiling Increase Due to ETC-15				\$189,997	
Core Ground System Contract Value as of July 2016				\$1,249,584	

Source: OIG analysis of GOES-R program documentation

^a Re-plan definitized on September 3, 2015, with contract modification 0105.

Although AGO’s criteria are intended to prevent potentially increased costs and lack of contract performance assessment associated with UCO definitization delays, they do not currently address these same effects due to delayed disposition of REAs. During a meeting with the GOES-R program, the ground contracting officer expressed concern with implementing a policy for timely resolution of REAs because the Federal Acquisition Regulation is silent on this matter. However, we remain concerned that the lack of a policy for REA disposition could result in increased cost and risk to NOAA’s

²² The initial REA proposal was referred to as Estimate to Complete 15 or ETC-15 and NOAA AGO definitized its cost in September 2015.

²³ See DOC OIG, OIG-13-024-A, 17.

programs. Without a developed policy, NOAA is challenged to improve its internal control to the timely disposal of equitable adjustment requests.

B. Prolonged delay in definitizing re-plan resulted in added cost and increased risk to core ground system development

The contractor submitted several re-plan proposals resulting in additional cost for contractor proposal preparation, as well as additional time it took for the government to perform evaluations. Additionally, both the government and contractor had to account for substantial increased cost due to escalation because of a lengthy period to complete negotiations. At settlement in September 2015, the government included \$9,586,935 for escalation and \$154,424 for proposal preparation, which we consider questioned costs due to prolonged delay in definitizing the re-plan (see appendix C), as part of the total re-plan's cost of \$190 million. While it became necessary for the government to pay these costs, they were the result of the protracted delay in definitizing the re-plan, and this delay was not covered by policy in the *NOAA Acquisition Manual* timeline for definitization of UCOs. Additionally, the delay in definitizing the re-plan while incrementally funding it reduced the government's opportunity to negotiate its final cost.

Along with additional cost caused by the lengthy delay in definitization, the government and contractor were not able to use earned value metrics to measure the core ground system development's cost and schedule performance. According to GOES-R ground segment project officials, in order to determine whether or not the contractor was executing in accordance with its re-plan baseline, the cost portion of the contractor's proposal needed to be finalized. This concern was also highlighted by the contractor during its monthly project management reviews with the government. This placed the government at risk, because cost and schedule performance could not be accurately determined during the re-plan's undefinitized period. Also, the contractor took on risk by continuing to perform work based on re-plan changes prior to knowing what total funding the government would provide.

Thus, we believe that NOAA should provide more focused attention on timely disposition of unresolved REAs, given

- increased cost to government for both contractor proposal preparation and escalation due to delay in definitizing re-plan;
- the cost of the re-plan, representing 15 percent of the cost of the core ground system as of July 2016; and
- increased risk to government and contractor during prolonged undefinitized period.

Recommendations

We recommend that the NOAA Deputy Under Secretary for Operations

6. Direct NOAA AGO to develop a policy on timely disposition of REAs.
7. Direct AGO to provide more detailed status of REAs and UCOs for programs presented at NOAA/NASA Program Management Council meetings that have been unresolved for over 6 months (e.g., how long they have been unresolved or undefinitized, plan for resolution or definitization, and estimated value).
8. Direct AGO to develop a mechanism to regularly communicate status of REAs and UCOs that have been unresolved for over 6 months to senior NOAA leadership for programs not presented at NOAA/NASA Program Management Council meetings (e.g., how long they have been unresolved or undefinitized, plan for resolution or definitization, and estimated value).

III. Spacecraft Project Management Reviews Are Not Conducted in a Transparent Manner

GOES-R contractors conduct regular project management reviews for both the flight and ground segments to inform the government on the project's technical and business status. These meetings are a contractual requirement; however, OIG oversight was not permitted to observe the GOES-R spacecraft business meetings. The spacecraft business meetings are conducted as internal contractor meetings, with GOES-R project management attendance and participation. Additionally, no meeting minutes or action items are produced. Restricting OIG attendance, coupled with the lack of meeting minutes and action items, significantly limits oversight organizations' understanding of actions needed and taken to control cost increases and minimize schedule delays for the GOES-R flight project. As a result, we had limited insight into the business aspects of the most expensive part of the GOES-R program—the spacecraft.

A. *Spacecraft business reviews are conducted as internal contractor meetings, resulting in a lack of transparency to independent oversight bodies*

Bi-monthly spacecraft business meetings are required by contract. We requested to attend these meetings to observe the manner in which management decisions and actions are made to control project costs. However, OIG staff was denied access because we were told that the meetings are conducted internally by the contractor. When we inquired further, the GOES-R program management office informed us that these meetings were originally held as a separate government meeting but are now conducted internally by the contractor with GOES-R project management in attendance. While GOES-R program management invited us to observe a different meeting that focused on a subset of the internal contractor business information, these meetings did not provide the full context of decisions and actions we would have expected to occur during the contractually required meeting.

In accordance with the Inspector General Act of 1978,²⁴ the Inspector General is authorized to request such assistance as may be necessary for carrying out the duties and responsibilities of the Act. Independent oversight is important to ensure that costs are understood, particularly for the spacecraft project that has had substantial cost growth and multiple schedule slips. As of June 2016, the spacecraft contract is valued at \$1.8 billion, which includes a number of development issues that resulted in approximately \$304.8 million in cost overruns since April 2013, as well as schedule delays. Appendix D provides a summary of the contract cost overruns, the timeframes in which they occurred, and the costs associated with each.

Because we were denied access to observe the contractually required spacecraft business meetings, we requested minutes and action items from previous meetings, in order to determine the manner in which management works to control project costs. The flight project manager provided us with presentations from previous meetings; however, these did not contain any context related to the meetings' discussions. In addition, the contractor informed us that no meeting minutes or action items are produced as a result of these meetings. As a result, we were not able to gain any insight related to the manner in which project management works to control costs during the GOES-R spacecraft project business meetings as we were with the ground system.

We believe that conducting GOES-R spacecraft business meetings as internal contractor meetings and restricting access to independent oversight personnel reduces the project's transparency. In order to mitigate these issues, independent oversight personnel should be permitted to attend and observe these meetings. Also, minutes and action items should be well documented and available for NOAA and NASA leadership, as well as independent oversight organizations, to capture decisions being taken to control costs and schedule.

B. Spacecraft contract lacks project management review best practices

The GOES-R spacecraft contract requires the contractor to prepare monthly project management review data packages and conduct meetings bi-monthly, similar to the ground segment contract. However, the spacecraft contract does not require project management review meeting minutes or action items, though it does require minutes for other meetings (i.e., teleconferences, technical interchange meetings, working groups, and peer reviews).

Without capturing meeting minutes and actions for spacecraft project management reviews, flight project management and contractor personnel lack documentation related to the topics discussed and decisions agreed upon at these meetings. As a result, decisions and action items are not tracked and may never be completed. This limits traceability and contractor accountability to ensure that decisions and actions items are completed. In addition, there is a lack of transparency.

²⁴ Inspector General Act of 1978 as amended, 5 U.S.C. App. § 6(a)(3).

By comparison, the GOES-R core ground system contract requires the contractor to prepare and conduct monthly project management reviews²⁵ for the purpose of reviewing both the technical (e.g., issues and concerns, project risks, and schedule changes) and business aspects (e.g., open contract items, outstanding proposals, and financial summaries) of the project. In addition, unlike the spacecraft contract, the core ground system contract requires meeting minutes, including action items for identifying decisions and significant discussion points.

The Office of Management and Budget requires program and project managers for major acquisition programs, such as GOES-R, to have a Federal Acquisition Certification (FAC).²⁶ Moreover, OMB notes that the Project Management Institute (PMI) project management professional certification satisfies FAC requirements. PMI is accredited by the American National Standards Institute and provides globally recognized standards for project management. A guide produced by the PMI²⁷ states that the results of discussions should be documented with meeting minutes and action items as a best practice.

Meetings should be prepared with well-defined agendas, purposes, objectives, and time frames—as well as documented with meeting minutes and action items.

Source: OIG adaptation of Project Management Institute, 2013. *A Guide to the Project Management Body of Knowledge*, 5th ed.

Recommendations

We recommend that the Under Secretary of Commerce for Oceans and Atmosphere and the NOAA Administrator

9. Direct the GOES-R program to ensure that the business meeting portion of the spacecraft project management reviews are conducted in a transparent manner by allowing independent government oversight attendance.

We recommend that the NESDIS Assistant Administrator

10. Ensures that (a) the GOES-R program captures meeting minutes for project management reviews identifying all action items, decisions, and significant points of discussion and (b) all future NESDIS funded contract meeting and review deliverables require minutes.

²⁵ The core ground system contract refers to these meetings as Project Management Status Reviews (PMSRs); however, the terms are used interchangeably.

²⁶ See OMB, April 25, 2007. *The Federal Acquisition Certification for Program and Project Managers*. Washington, DC: OMB.

²⁷ This primary publication of PMI is the global standard for project management and provides best practices for conducting meetings. See Project Management Institute, 2013. *A Guide to the Project Management Body of Knowledge*, Fifth Edition, Section 4.3.2.3, page 84.

IV. NESDIS Does Not Consistently Calculate or Report Geostationary Satellite Coverage Gap Probability

NESDIS does not employ a consistent, transparent process for assessing the availability of geostationary satellite imagery for the eastern and western United States, in order to measure performance against NOAA policy.²⁸ The lack of a regular, detailed measurement of data gap probability makes it difficult for stakeholders to independently assess program performance compared to national geostationary imagery availability requirements for this primary mission essential function. While NESDIS does routinely report constellation health status on its website, we believe there are additional risk factors that should be considered when assessing the constellation's status.

A. *Reported status of the GOES constellation altered by new satellite lifetime assumptions*

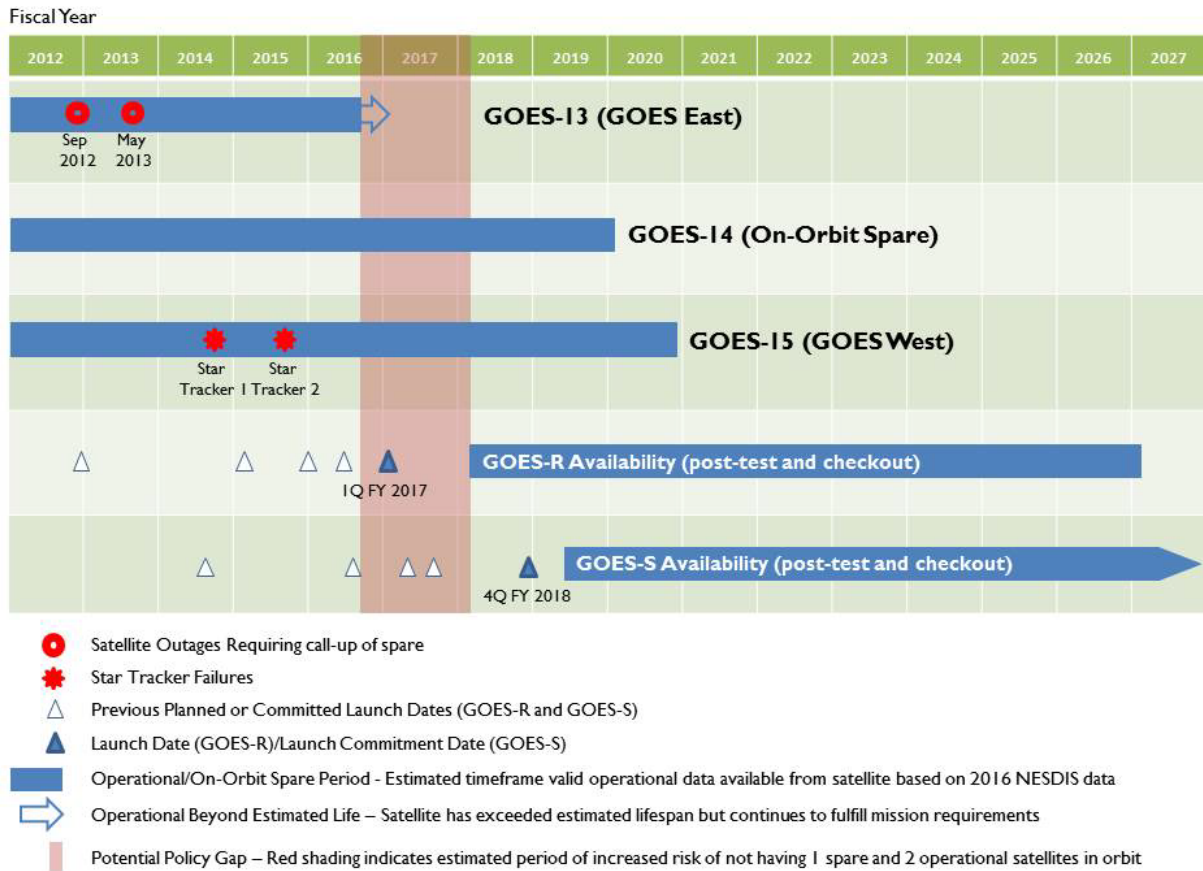
As part of two assessments for the GOES-R Standing Review Board in 2014 and 2015, the program calculated the probability of having a geostationary imagery gap based primarily on two factors: (1) projected lifetimes of satellites already in orbit and (2) proposed launch dates for GOES-R series satellites. Using projected geostationary satellite lifetimes and proposed launch dates,²⁹ the status of the constellation is shown in figure 4 (next page). The satellite lifetimes (blue horizontal bars) reflect an April 2015, NESDIS decision to double the operational lifetime estimates for the GOES-13, -14, and -15 satellites from 5 years to 10 years.³⁰

²⁸ NESDIS, November 16, 2011, *NOAA Satellite and Information Service: Geostationary Satellite Launch and Spare Call-Up Policy*, 1.

²⁹ Based on June 2016 *NOAA Geostationary Satellite Programs Continuity of Weather Operations* chart.

³⁰ This decision was not formally announced or documented by NESDIS at the time, but its rationale was explained about 7 months later in a response to Congressional questions in November 2015, and later during separate Congressional testimony in December 2015.

Figure 4. Policy Gap Risk^a Using NOAA’s New Satellite Lifetime Estimates



Source: OIG graphic analysis of NESDIS documentation

^a NOAA policy requires having two operational satellites and one spare in orbit.

Based on the new satellite lifetimes and launch dates, the effect of the lifetime extension is to reduce the potential time period when only two operational satellites would be in orbit (e.g., GOES-13 failure that leaves GOES-14 and GOES-15 operating without a spare). This period is between the end of GOES-13’s projected operational life³¹ and the start of GOES-R’s operational readiness (see red shaded area). However, while NESDIS has three fully operational satellites in orbit, we noted there are additional factors that add risk to the operational status (see figure 4):

1. GOES-13 failures have already necessitated a call-up of the backup satellite (GOES-14) twice.
2. GOES-15 has only one operable star tracker remaining among its three onboard. If the final star tracker fails, GOES-15 will be unable to meet its mission requirements.

³¹ GOES-13 continues to operate in a fully mission capable status and has surpassed the 10 year lifetime expectation (it was launched April 2006). Thus, the beginning of the policy gap risk period in red is only realized as a policy gap if GOES-13, -14, or -15 fail before GOES-R is operational.

3. Several launch date changes have occurred, as indicated by the previous launch targets (open triangles in figure 4) for GOES-R and GOES-S.

Overall, a mission failure of GOES-13 or GOES-15, or another delay to the GOES-S projected launch date is reasonably possible based on the history, and these factors are an important part of assessing the status of the geostationary constellation.

B. NESDIS gap calculations do not adequately inform stakeholders

To assess proposed launch schedule changes for the GOES-R series, the program calculated two separate estimates for the probability of a gap in imagery coverage from either of the two operational satellites, GOES-West or GOES-East. NOAA policy requires 20 percent or less chance of a gap in imagery for either of those two satellites.

In August 2014, the program calculated that a March 2016 launch of GOES-R would leave the GOES satellite constellation susceptible to a 43 percent chance of not having required imagery in either the western or eastern United States (i.e., not meeting the NOAA policy; see table 5). Following the GOES-R program's inability to meet its March 2016 commitment with an acceptable level of risk, the launch date was delayed to October 2016.

In August 2015, the program recalculated the coverage gap probability as part of its assessment of the new October 2016 launch date. Even though the GOES-R launch date was delayed 7 months, the program's estimated probability of a gap decreased from 43 percent (not compliant with NOAA policy³²) to 15 percent (compliant).

Table 5. Two-Imager Gap Probability Calculation Changes

Date of Estimate	Based on GOES-R Launch in:	GOES-13, -14, -15 Lifetime Estimate	Program's Calculation of Gap Probability (goal ≤20%)
August 2014	March 2016	5 years	43%
August 2015	October 2016 ^a	10 years	15%

Source: GOES-R presentation slides to Standing Review Board

^a At the time of the estimate, the proposed launch date was October 2016.

NESDIS's more optimistic April 2015 operational life assumption for GOES-13, -14 and -15 was decided just before the GOES-R launch slip decision was considered. This change to the calculation input had a correspondingly optimistic impact on the program's calculation of gap probability in August 2015. However, it lacked detail to independently assess the reliability of the results.

³² NOAA Geostationary Satellite Launch and Spare Call-Up Policy, 1.

Similarly, stakeholders have expressed concern in understanding NOAA's geostationary satellite constellation status. In October 2015, the U.S. House of Representatives' Committee on Science, Space, and Technology requested information on the GOES-N series changes, followed by a hearing in December 2015 with the NESDIS Assistant Administrator. Additionally, the United States Senate's Commerce, Science, and Transportation committee wrote to the NOAA Administrator with concern about the "posture and status regarding potential gaps and future funding needs," on August 15, 2016.³³ In the same letter, the Senate committee also conveyed that it was crucial for NOAA to "consistently identify changes in operational lifespan" for the GOES constellation.

We believe the agency's approach to measuring its compliance with NOAA policy on geostationary imager gap probability lacks sufficient detail and transparency. Specifically, there is no periodic requirement to compare the constellation's expected performance to the policy or to make comparisons of calculations using a consistent set of inputs. Furthermore, the results are not routinely reported for stakeholder awareness, nor are methodologies documented for independent review, which has contributed to a lack of stakeholder understanding on this topic.

Recommendation

We recommend that the NESDIS Assistant Administrator

11. Create a documented, periodic, and consistent geostationary imagery gap probability summary for comparison with policy.

³³ Letter from Hon. John Thune, Chairman, Senate Committee on Commerce, Science, and Transportation, and Hon. Bill Nelson, Ranking Member, S. Comm. on Commerce, Sci., and Transp., to Hon. Kathryn D. Sullivan, Administrator, NOAA, August 15, 2016, 4.

Summary of Agency Response and OIG Comments

In responding to our draft report, NOAA concurred with 10 of our 11 recommendations, partially concurred with 1 recommendation, and reported on activities it has or will take to implement the recommendations. NOAA also included general and editorial comments, as well as recommended factual and technical information, which we reviewed but did not include in our final report. We did update our final report to reflect NOAA's successful launch of GOES-R on November 19, 2016. NOAA's complete response to our draft report is in appendix E.

In partially concurring to recommendation 3, NOAA noted that it has concerns directing NASA to modify the spacecraft contract's performance evaluation plan to specify that both indirect and direct costs will be used in determining a major breach of safety for future award fee evaluation periods. The agency stated that it will work with NASA to clarify its guidelines for NASA's anomaly investigation, assessment, and reporting process. However, NOAA does not identify whether it will direct NASA to modify the NOAA-funded spacecraft contract's performance evaluation plan. As we report in finding I, part B, the purpose of the spacecraft contract's performance evaluation plan's safety and security clause is to protect government interests—by determining the total cost of the incident, to hold contractors accountable for major safety and security breaches in a cost-plus type contract. OIG's interpretation of the performance evaluation plan, which is based on the plan's language, is that the clause is not limited to direct costs because it contains no language reflecting an intent to limit the damage calculations. We reaffirm our recommendation to the agency to modify the NOAA-funded spacecraft contract's performance evaluation plan through NASA, which serves as NOAA's supporting acquisition agent.

In NOAA's general comment, it recommended including additional language to the introduction specifying that task underestimation was not done by a single person and delays were also caused by numerous technical issues that arose. However, as we report, after the spacecraft contractor replaced its Integration and Test Manager, task durations were reassessed to be more realistic.

In NOAA's recommended factual and technical information for finding II, it recommended changing different forms of the term "definitize" to forms of "negotiate." However, we believe that "definitize," as it applies to the core ground system re-plan, is the correct term. As our report identifies, the core ground system re-plan proposal, which was a request for equitable adjustment (REA), was also known as Estimate to Complete 15 (ETC-15) that was definitized in contract modification 0105. Furthermore, while definitization applies to unpriced change orders (UCOs) per the *NOAA Acquisition Manual*, the government had incrementally funded work after the REA submission, as it often does with UCOs.

Additionally, NOAA asserted that earlier settlement of ETC-15 would not have prevented escalation from occurring. However, documentation provided by the ground contracting officer stated that escalation was added to account for rate increases since 2014.

In NOAA's editorial comments, it states that the report is misleading regarding the report's statement on the government's loss of opportunity to negotiate final cost of the re-plan during incremental funding of a contract during definitization delays. However, as we report in finding II, part A, the government had incrementally funded approximately \$91 million from August 2014 through June 2015—half of the total re-plan's cost of \$190 million—and had not yet determined what costs would be eligible for award fee, which we believe weakened NOAA's negotiation position prior to definitization in September 2015.

Appendix A: Objectives, Scope, and Methodology

Our objectives were to (1) assess the adequacy of GOES-R development as the program completes system integration and test activities for the flight and ground segments in preparation for launch and data distribution, per NOAA and NASA standards, and (2) monitor the program's progress in developing and reporting on flight and ground segment contracting actions and changes to minimize cost increases.

To accomplish our first objective, we did the following:

- interviewed GOES-R program (NOAA and NASA) personnel and assessed documentation regarding costs associated with the flight segment re-plan, and the integration and test schedule, including anomalies during this phase,
- interviewed contractor personnel and analyzed documentation regarding staffing, plans to keep original launch date, and the integration and test phase, including procedures and anomalies during this phase,
- assessed the thermal vacuum test mishap by analyzing associated reports and interviewing government and contractor personnel who were involved—including members of the mishap investigation board that included a safety representative from NASA Safety and Mission Assurance Directorate (GSFC Code 300),
- obtained outside perspective of spacecraft contract language and actions from Goddard Space Flight Center Procurement Operations Office (GSFC Code 210),
- interviewed Defense Contract Management Agency personnel regarding GOES-R spacecraft prime contractor and sub-contractor oversight,
- interviewed Kennedy Space Center and other NASA personnel and analyzed policy and contractual documents to obtain an understanding of the launch manifest process,
- assessed the integrated master schedule prior to and after the flight segment re-plan for any changes in the testing approach by reviewing monthly schedules,
- identified root cause for the loss of schedule margin after the release of the March 2016 launch date by analyzing schedule burn down rate data, monthly schedule margin usage, and issues impacting the schedule,
- analyzed the 2014 and 2015 gap probability assessments and interviewed program and NESDIS personnel to evaluate the probability of a two-imager gap,
- assessed NOAA's Satellite and Information Service Geostationary Satellite Launch and Spare Call-Up Policy for meeting national geostationary environmental imagery requirements, as well as compared the agency's Congressional correspondence with existing policy, and

- obtained GOES-R program updates by observing program monthly status reviews for the flight and ground segments, as well as monthly program management council meetings.

To accomplish our second objective, we did the following:

- interviewed GOES-R program (NOAA and NASA) regarding contract liability and assessed estimates and proposals related to the change in launch date,
- evaluated spacecraft award fee letters for contractor scoring in relation to performance reported and criteria stated in the spacecraft contract performance evaluation plan,
- assessed spacecraft modifications for cost responsibility changes and problems during integration and test,
- interviewed program officials and reviewed the spacecraft contract for program management review requirements, as well as compared flight segment reviews to ground segment reviews and contract requirements,
- reviewed Federal Acquisition Regulation, NASA Federal Acquisition Regulation Supplement, and *NOAA Acquisition Manual* (NAM) for policies on disposition and definitization, and
- analyzed the impact of time required to definitize ETC-15 by using criteria stated in NAM and Acquisition Alert 13-05 NOAA Implementation of Policy for Definitization of Unpriced Change Orders.

We reviewed controls significant within the context of the audit objective by interviewing NOAA and NASA officials, as well as contractor personnel; examining policies and procedures; and reviewing documentation for evidence of internal control. We found that corrective actions are needed to improve some controls. These issues are discussed in the findings of this report. Although we did not independently verify the reliability of computer-processed information we collected, we compared the data to supporting documents to verify completeness, accuracy, and reasonableness. Based on our efforts, we believe that the information we obtained is sufficiently reliable for this report.

We performed our fieldwork at the GOES-R program office in Greenbelt, Maryland; NOAA headquarters in Washington, DC; and a contractor facility in Littleton, Colorado. We conducted this audit under the authority of the Inspector General Act of 1978, as amended, 5 U.S.C. App., and Department Organization Order 10-13, dated April 26, 2013. We conducted our audit from August 2015 through July 2016 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence that provides 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.

Appendix B: GOES-R Suite of Instruments

Instrument	Functional Purpose
Advanced Baseline Imager (ABI)	As the primary instrument, the ABI will enable forecasters to use the higher resolution images to track the development of storms in their early stages; it will offer a wide range of applications related to weather, oceans, land, climate, and hazards such as fires, volcanoes, hurricanes, and storms that cause tornadoes.
Geostationary Lightning Mapper (GLM)	The GLM will provide early indication of storm intensification over land and ocean areas, severe weather events, and improved tornado warning lead time of up to 20 minutes or more, as well as data for long-term climate variability studies. NOAA anticipates that the GLM will have immediate applications to aviation weather services, climatological studies, and severe thunderstorm forecasts and warnings.
Space Environment In-Situ Suite (SEISS)	The SEISS sensors will monitor the proton, electron, and heavy ion fluxes at geosynchronous orbit; assess radiation hazard to astronauts and satellites; and provide warnings of high flux events which will mitigate damage to radio communications.
Solar Ultraviolet Imager (SUVI)	The SUVI will allow users to observe the sun in the extreme ultraviolet (EUV) wavelength range, characterizing complex active regions of the sun, and solar flares and eruptions—space weather that could disrupt power utilities, communication and navigation systems, and potentially damage orbiting satellites and the International Space Station.
Extreme ultraviolet/X-ray Irradiance Sensor (EXIS)	The EXIS will monitor solar flares that can disrupt communications and degrade navigational accuracy, affecting satellites, astronauts, high latitude airline passengers, and power grid performance.
Magnetometer (MAG)	The MAG will provide measurements of the space environment magnetic field that controls charged particle dynamics potentially dangerous to spacecraft and human spaceflight. In addition, it will provide alerts and warnings to many customers, including satellite operators and power utilities.

Source: OIG adapted from GOES-R program documentation

Appendix C: Potential Monetary Benefits

Description	Questioned Costs	Funds to Be Put to Better Use
Questioned spacecraft award fee period 12 payment (finding I.B)	\$10,299,050	\$3,943,450
Escalation cost due to prolonged delay in definitizing ground system re-plan (finding II.B)	\$9,586,935	\$0
Proposal preparation cost due to prolonged delay in definitizing ground system re-plan (finding II.B)	\$154,424	\$0
Total	\$20,040,409	\$3,943,450

Source: OIG adaptation and analysis of NOAA and NASA documents

Appendix D: Summary of Spacecraft Contract Cost Overruns Since April 2013

Modification Number	Date Issued	Total Associated Overrun Cost (\$ in millions)
103	April 25, 2013	\$162.8
129	July 7, 2014	\$48.0
139	December 9, 2014	\$33.4
151	November 27, 2015	\$11.5
154	December 16, 2015	\$49.1
Total		\$304.8

Source: OIG, adapted from GOES-R Spacecraft Contract Modifications

In 2013, a major cost overrun was recognized at \$162.8 million and attributed to the unanticipated complexity of the spacecraft's subsystems. This was partly due to the GOES-R program's use of the contractor's commercial communications spacecraft that was not designed for remote environmental sensing. The overrun has led to complex and under-planned assembly, integration, and testing activities unique to GOES-R. Also, prior to the 2013 cost overrun, the spacecraft schedule reserve had significantly decreased, causing a schedule re-plan.

From 2012 through 2014, the spacecraft contractor faced numerous technical issues—including problems with subsystem production and subcontracts—that led to two additional overruns. In November 2015, the project sustained another cost overrun in order to extend staff for integration and testing as the GOES-R launch was delayed to October 2016. During the integration and test phase, there was additional cost growth and schedule delays, leading to the most recent contract overrun in December 2015.


Appendix E: Agency Response



UNITED STATES DEPARTMENT OF COMMERCE
The Deputy Under Secretary for Operations
Washington, D.C. 20230

JAN 11 2017

MEMORANDUM FOR: Allen Crawley
Assistant Inspector General for Systems Acquisition
and IT Security

FROM: Benjamin Friedman 
Deputy Under Secretary for Operations

SUBJECT: *Audit of the Geostationary Operational Environmental Satellite-R Series: Improvements in Testing, Contract Management, and Transparency are Needed to Control Costs, Schedule, and Risks.*
Draft Report

Thank you for the opportunity to comment on the Office of the Inspector General's draft report evaluating the Geostationary Operational Environmental Satellite-R Series. Thank you also for granting the extension, which allowed time to coordinate among various offices to finalize a response.

Our specific comments on the report's findings and recommendations are attached, which includes a description of ongoing and future actions to address recommendations.

If you have questions, please contact Mack Cato, Director, Audit, Internal Control, and Information Management on (301) 628-0949.

Attachment



Department of Commerce
National Oceanic and Atmospheric Administration
Comments to the OIG Draft Report Entitled
“Audit of the Geostationary Operational Environmental Satellite-R Series:
Improvements in Testing, Contract Management, and Transparency
Are Needed to Control Costs, Schedule, and Risks”
(November 2016)

The National Oceanic and Atmospheric Administration (NOAA) appreciates the opportunity to review and comment on the Office of Inspector General (OIG) draft report. The response to each recommendation is provided below. NOAA recommends factual and technical changes to the report, which are also provided below.

General Comments

Page 4, last paragraph:

The following statement in the draft report is not correct: “According to GOES-R project management, the delay was due to the previous Integration and Test Manager’s underestimation of task durations.” Task underestimation was not done by a single person and delays were also caused by numerous technical issues that arose. We suggest that the OIG include this information in the report.

Recommended Changes for Factual/Technical Information

Pages 14-16, Section II:

There are repeated references throughout Section II that refer to “definitization”, “definitizing”, or “definitized” as it relates to a large cost overrun. See specifically page 14, last paragraph, 2nd sentence; page 15, second sentence top of page, and first paragraph, last sentence; page 15, table 4 title and asterisk note; page 16, Title B, as well as first paragraph, 3rd and 4th sentences; and last paragraph, bullets 1 and 2. It is recommended that these references be revised to reflect “negotiation”, “negotiating” or “negotiated” as the meaning of definitization is applicable to Unpriced Change Orders (UCOs) and not Requests for Equitable Adjustments (REAs). The requested revision is due to the fact that the cost overrun is considered to be an REA and not a UCO within the meaning of the NOAA Acquisition Manual (NAM) 1330-43.204(b) or Acquisition Alert 13-05.

Page 16, Section II B:

It is accurate that subsequent proposals were received during the interim period between December 2013 and final settlement in September 2015 that resulted in escalation. Since this a cost reimbursement type contract, these costs reflected future costs based on impact of the schedule re-plan and the proposal was submitted as an Estimate to Complete (ETC). As such, it is expected that escalation would have occurred in the out-years. Earlier settlement of the cost overrun would not have prevented this escalation and most likely would have resulted in an additional cost overrun REA. This is proven by current earned value management statistics that indicate cost is running in accordance with the current plan with the Cost Performance Index (CPI) and Schedule Performance Index (SPI) at 1.00 cumulatively which indicates perfect performance. In addition, as the original Variance at Completion (VAC) proposal submitted in December 2013 was for \$197 million and settlement was ultimately reached at \$192 million (amounts are inclusive of estimated award fee), the delay in settlement did not have a significant impact on the outcome.

Editorial Comments

Page 15, Section II A, first full paragraph, last sentence:

The sentence states that “the government loses the opportunity to negotiate final cost of contract modifications while incrementally funding a contract during definitization delays”. This statement is misleading as incremental funding of non-definitized contract actions is necessary to permit continuation of essential work to meet mission and schedule requirements without requiring the contractor to perform at risk. During analysis of any contractor proposals, the contracting officer has the latitude to determine if any of the proposed costs are unallowable, unallocable, or unreasonable and require that the contractor provide a credit to the Government for these costs as part of the negotiated settlement. This is the case even after payment has been made. In addition, for all actions that exceed the cost and pricing data threshold, the contractor is liable for the penalties associated with providing defective cost or pricing data.

NOAA Response to OIG Recommendations**Recommendations for the NESDIS Assistant Administrator**

Recommendation 1: Direct NASA to ensure the spacecraft contractor’s thermal vacuum procedural documents include adequate steps to account for configuration modifications on future GOES-R series satellites.

NOAA Response: Concur. The NESDIS AA will direct the GOES-R Program, in accordance with the governance model, to ensure the spacecraft contractor’s thermal vacuum procedural documents include adequate steps to account for configuration modifications on future GOES-R series satellites. Of note, the GOES-R series program has already worked with the spacecraft contractor to apply the lessons learned from the GOES-R thermal vacuum chamber mishap to ensure a similar issue does not occur in the future.

Recommendation 2: Direct GOES-R Program to establish a reporting mechanism that tracks mishap or damage costs with appropriate contract management personnel.

NOAA Response: Concur. NOAA will review the existing reporting and cost accounting mechanisms employed by the contractors and the GOES-R Series program. If necessary, NOAA will update processes to ensure that program/project management procedures are consistent with applicable NASA and NOAA guidelines and are adequate to ensure management and contracting personnel are aware of the technical, cost and schedule impacts associated with issues including mishaps.

Recommendation 3: Direct NASA to modify the spacecraft contract’s performance evaluation plan to specify that both direct and indirect costs are used in determining a major breach of safety for future evaluation periods.

NOAA Response: Partially-Concur. NOAA will work with NASA to clarify its guidelines for accounting for costs in NASA’s anomaly investigation, assessment, and reporting process, but has concerns with directing another Federal Agency, which has significant expertise in this area, to change its legally approved contracting methods.

Recommendation 4: Direct GOES-R Program to provide timely cost data to NASA in order to achieve the proper mishap level of classification as early as possible.

NOAA Response: Concur. In this instance, the GOES-R program sought to provide mishap cost estimates on the schedule defined by the NASA mishap procedure. Timeliness of cost data transfer to NASA will be reviewed and process improvements made where necessary.

Recommendations for the NOAA Deputy Under Secretary for Operations

Recommendation 5: Determine whether the spacecraft contractor was entitled to receive award fee payment for period 12.

NOAA Response: Concur. NOAA will review its process to determine whether the spacecraft contractor was entitled to receive award fee payment for period 12.

Recommendation 6: Direct NOAA AGO to develop a policy on timely disposition of REAs.

NOAA Response: Concur. AGO will issue new or update existing policy/guidance to support the goal of negotiating REA's as timely as possible.

Recommendation 7: Direct AGO to provide more detailed status of REAs and UCOs for programs presented at NOAA/NASA Program Management Council meetings that have been unresolved for over 6 months (e.g., how long they have been unresolved or undefinitized, plan for resolution or definitization, and estimated value).

NOAA Response: Concur. AGO currently provides a Contract Actions Executive Summary for the GOES-R Ground Segment Program to the NOAA/NASA Agency Program Management Council (APMC) which includes a separate accounting for Unpriced Change Orders (UCOs) which are pending definitization and limited explanation of status of outstanding actions shown. This summary will be modified to add information on actions that have been forwarded to the Senior Bureau Procurement Official (SBPO) for approval to extend definitization dates beyond 6 months in accordance with Acquisition Instruction 16-01.

Recommendation 8: Direct AGO to develop a mechanism to regularly communicate status of REAs and UCOs that have been unresolved for over 6 months to senior NOAA leadership for programs not presented at NOAA/NASA Program Management Council meetings (e.g., how long they have been unresolved or undefinitized, plan for resolution or definitization, and estimated value).

NOAA Response: Concur. Note that AGO Acquisition Instruction (AI) 16-01, issued 21 June 2016, requires SBPO review and approval of requests for extension of definitization dates beyond 6 months for all UCOs. This includes a new schedule for definitization. AGO will also issue new or update existing policy/guidance to strengthen notification and tracking requirements to ensure appropriate visibility of REAs.

Recommendations for the NOAA Under Secretary of Commerce for Oceans and Atmosphere and the NOAA Administrator

Recommendation 9: Direct the GOES-R program to ensure that the business meeting portion of the spacecraft project management reviews are conducted in a transparent manner by allowing independent government oversight attendance.

NOAA Response: Concur. NOAA will direct the GOES-R program to ensure that the business meeting portion of the spacecraft project management reviews are conducted in a transparent manner by allowing independent government oversight attendance and will work with the IG to ensure that the free flow of information is maintained.

Recommendations for the NESDIS Assistant Administrator

Recommendation 10: Ensure that (a) the GOES-R program captures meeting minutes for project management reviews identifying all action items, decisions, and significant points of discussion and (b) all future NESDIS funded contract meeting and review deliverables require minutes.

NOAA Response: Concur. NOAA will ensure that the GOES-R program captures meeting minutes for project management reviews identifying all action items, decisions, and significant points of discussion. Additionally, NOAA will ensure that future NESDIS-funded contract meetings and reviews will have minutes.

Recommendation 11: Create a documented, periodic, and consistent geostationary imagery gap probability summary for comparison with policy.

NOAA Response: Concur. NOAA has generated a draft policy which is under agency review. The policy will go into effect once the policy has been approved.

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