NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

The Joint Polar Satellite System: Further Planning and Executive Decisions Are Needed to Establish a Long-term, Robust Program

FINAL REPORT NO. OIG-16-026-I

APRIL 26, 2016

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

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UNITED STATES DEPARTMENT OF COMMERCE
Office of Inspector General
Washington, D.C. 20230

April 26, 2016

MEMORANDUM FOR: Dr. Kathryn D. Sullivan
Under Secretary of Commerce for Oceans and Atmosphere
and NOAA Administrator

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

SUBJECT: *The Joint Polar Satellite System: Further Planning and Executive Decisions Are Needed to Establish a Long-term, Robust Program*
Final Report No. OIG-16-026-I

Attached is our final report on NOAA's Joint Polar Satellite System (JPSS). Our objectives for this evaluation were to (1) determine the progress of Polar Follow-On (PFO) planning, (2) monitor ongoing JPSS acquisition and development (i.e., JPSS-1 and JPSS-2 missions), and (3) assess the potential for data gaps.

We found the following:

- **PFO plans needed further development to support the establishment of program cost, schedule, and performance baselines.** In reviewing PFO planning efforts, we found that the program had to postpone formulation milestones that will support the establishment of cost, schedule, and performance baselines. Until such baselines are established, the ultimate cost and schedules of the JPSS-3 and JPSS-4 missions will remain uncertain. Further, the program had not yet coordinated with the Department on the process and decision authority for establishing baselines. Additionally, the program was planning to evolve the JPSS ground system and faced a significant management challenge in transitioning its management from National Aeronautics and Space Administration (NASA) to NOAA.
- **Satellite and ground system development challenges posed risk to the JPSS-1 launch schedule.** Our monitoring of ongoing JPSS development efforts found that the JPSS-1 mission had maintained its schedule to meet its launch commitment date of no later than March 2017. However, the satellite will be completed later than planned and must undergo final environmental testing. Further, a major upgrade of the ground system has been delayed, and as a result, satellite compatibility testing may either be compromised or cause a schedule slip. As a result, there is risk to the mission schedule that requires the continued attention of senior management.
- **The potential for polar satellite data gaps requires leadership's sustained attention.** Until JPSS-1 is operational, NOAA will not have full backup capabilities for those provided by Suomi National Polar-orbiting Partnership (NPP) and is therefore at

risk of a data gap. Our updated assessment found that the potential data gap between Suomi NPP and JPSS-1 has decreased to a period of 7–10 months, beginning in November 2016. Beyond this near-term condition, we found that the long-term plans for the JPSS program (including PFO) would notionally meet NOAA's criteria for a robust satellite architecture for only a 10-year period within its life cycle, which extends to 2038. However, the program's ability to launch a satellite within 1 year of an on-orbit failure is uncertain and its criteria for a robust architecture are not supported by NOAA policy. Further, NOAA lacks plans for managing the development of, and integrating, new satellite technology.

We have summarized NOAA's response to our draft report and included its entire formal response as appendix H. The final report will be posted on OIG's website pursuant to section 8M of the Inspector General Act of 1978, 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 recommendation.

We appreciate the cooperation and courtesies extended to us by your staff during our audit. If you have any questions or concerns about this report, please contact 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: Bruce Andrews, Deputy Secretary
Ellen Herbst, Chief Financial Officer and Assistant Secretary for Administration
Ben Friedman, Under Secretary for Operations, NOAA
Stephen Volz, Assistant Administrator, National Environmental Satellite, Data, and Information Services, NOAA
Harry Cikanek, JPSS Program Director, NOAA
Mack Cato, Director, Office of Audit and Information Management, NOAA

Report In Brief

APRIL 26, 2016

Background

NOAA's Joint Polar Satellite System (JPSS) program is planning two additional missions, JPSS-3 and JPSS-4. Introduced in NOAA's fiscal year (FY) 2016 budget submission as the Polar Follow-On (PFO) program, the missions would be integrated with and extend the JPSS program from 2025 out to 2038. Meanwhile, the program is working to complete the JPSS-1 satellite, a major upgrade of its ground system, and launch by end of March of 2017. The program has also begun acquisitions of instruments and a spacecraft for JPSS-2, which is slated to launch in 2021.

In late 2013, the (then-Acting) NOAA Administrator and Director of the National Weather Service together issued a statement that concluded "that a lack of JPSS-quality data" from the afternoon polar orbit "would erode everyday weather forecasts and expose the nation to a 25 percent chance of missing extreme event forecasts that matter most." An independent review team (IRT) recommended that NOAA establish, as a national priority, a robust JPSS program.

Why We Did This Review

The objectives of this review were to (1) determine the progress of Polar Follow-On program planning, (2) monitor ongoing JPSS acquisition and development (i.e., JPSS-1 and JPSS-2 missions), and (3) assess the extent of potential data gaps. We have conducted oversight of the JPSS program since its inception; this is our fourth report on the program and related activities.

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

The Joint Polar Satellite System: Further Planning and Executive Decisions Are Needed to Establish a Long-term, Robust Program

OIG-16-026-I

WHAT WE FOUND

We found that

PFO plans needed further development to support the establishment of program cost, schedule, and performance baselines. In reviewing PFO planning efforts, we found that the program had to postpone formulation milestones that will support the establishment of cost, schedule, and performance baselines. Until such baselines are established, the ultimate cost and schedules of the JPSS-3 and JPSS-4 missions will remain uncertain. Additionally, the program was planning to evolve the JPSS ground system and faced a significant management challenge in transitioning its management from National Aeronautics and Space Administration (NASA) to NOAA.

Satellite and ground system development challenges posed risk to the JPSS-1 launch schedule. Our monitoring of ongoing JPSS development efforts found that the JPSS-1 mission had maintained its schedule to meet its launch commitment date of no later than March 2017. However, the satellite will be completed later than planned and must undergo final environmental testing. Further, a major upgrade of the ground system has been delayed, and as a result, satellite compatibility testing may either be compromised or cause a schedule slip. As a result, there is risk to the mission schedule that requires the continued attention of senior management.

The potential for polar satellite data gaps requires leadership's sustained attention. Until JPSS-1 is operational, NOAA will not have full backup capabilities for those provided by Suomi National Polar-orbiting Partnership (NPP) and is therefore at risk of a data gap. Our updated assessment found that the potential data gap between Suomi NPP and JPSS-1 has decreased to a period of 7–10 months, beginning in November 2016. Beyond this near-term condition, we found that the long-term plans for the JPSS program (including PFO) would notionally meet NOAA's criteria for a robust satellite architecture for only a 10-year period within its life cycle, which extends to 2038. However, the program's ability to launch a satellite within 1 year of an on-orbit failure is uncertain. Further, NOAA lacks plans for managing the development of, and integrating, new satellite technology.

WHAT WE RECOMMEND

We made the following recommendations to NOAA leadership:

1. Coordinate with the Deputy Secretary to determine who will be Milestone Decision Authority for establishing PFO program cost, schedule and performance baselines, and plan activities supporting a PFO baseline establishment key decision point.
2. Ensure the program's transition plan framework is subjected to expert, independent review.
3. Direct the JPSS program, on a regular basis, to report trends of schedule metrics for ground system development and JPSS-1 mission preparations to provide insight into issues, sufficiency of resources, and mission readiness.
4. Direct the completion of a study of JPSS Block 2.0 common ground system development to capture lessons learned and apply them to plans for the Segment3.0/Block 3.0 system and NOAA's Ground Enterprise Architecture System development.
5. Ensure that NWS completes its contingency plan for JPSS-1 data assimilation and communicates it to users and stakeholders by end of the third quarter of FY 2016.
6. Provide Department, OMB, and Congressional stakeholders with a list of key activities for operationalizing JPSS-1 data that NOAA will undertake during the potential data gap.
7. Provide stakeholders with the results of its study of launch-on-need versus launch-on-schedule strategies, as well as the implications for PFO plans.
8. Incorporate NOAA's robust architecture criteria into formal NOAA policy.
9. Include new satellite technology insertion as part of NOAA's strategic and tactical plans.

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Introduction

NOAA's Joint Polar Satellite System (JPSS) program is planning two additional missions, JPSS-3 and JPSS-4. Introduced in NOAA's fiscal year (FY) 2016 budget submission as the Polar Follow-On (PFO) program, the missions would be integrated with and extend the JPSS program from 2025 out to 2038.[1] Meanwhile, the program is working to complete the JPSS-1 satellite, a major upgrade of its ground system, and launch by end of March of 2017. The program has also begun acquisitions of instruments and a spacecraft for JPSS-2, which is slated to launch in 2021.

Microwave and infrared sounders on polar satellites provide important data for weather forecasts.[2] In late 2013, the (then-Acting) NOAA Administrator and Director of the National Weather Service together issued a statement that concluded "that a lack of JPSS-quality data" from the afternoon polar orbit "would erode everyday weather forecasts and expose the nation to a 25 percent chance of missing extreme event forecasts that matter most."[3] The statement was included with a report from an independent review team (IRT), which found that the JPSS constellation as then planned was fragile—one failure away from a gap occurring.

The review team recommended that NOAA establish, as a national priority, "a robust JPSS program" with additional missions and a *gap filler* capability.[4] In its FY 2016 budget justification for JPSS and PFO, NOAA defined a *robust architecture* for its polar satellite system as (1) two failures must occur to create a gap in microwave or infrared sounding data and (2) the ability exists to restore the constellation to a two-failure condition within 1 year.[5] To deliver this architecture, the JPSS program has made the following plans:

To make its constellation more fault-tolerant, the JPSS program intends to develop the capability to launch on need. The PFO satellites are planned to be launch-ready ahead of what would otherwise be a 5-year scheduled launch cadence to allow the program to respond to catastrophic failures of on-orbit missions (i.e., potential data gaps). If not otherwise needed, the JPSS-3 and JPSS-4 satellites would be kept in storage until their scheduled launch date (see table 1). Further, a JPSS-3 contingency mission has been conceived, whereby the satellite would be launched early with just its microwave and infrared sounders in response to early failures of JPSS-1 or JPSS-2. The contingency mission was chosen over a separate gap filler mission, which was deemed too costly.

[1] Figure 1 depicts a timeline of key events in the combined JPSS/PFO program.

[2] See appendix B, table B-1 for descriptions of JPSS instruments.

[3] See appendix B for a description of polar satellite constellations. Quoted material from JPSS Summary Rationale, included with NOAA National Environmental Satellite, Data, and Information Service Independent Review Team Report, "Assessment Update One Year Later," November 1, 2013: NESDIS IRT, 42.

[4] Its conception of a robust program included that, "multiple overlapping spacecraft [be] developed in a manner that allows downstream components and subsystems *to be used as spares* for the spacecraft being prepared for launch" (emphasis added). *Gap filler* refers to a satellite with just microwave and infrared sounders, providing data equivalent to ATMS and CrIS, that could be launched in time to "fill" a potential data gap due to a failure of an on-orbit satellite. See NESDIS IRT, 20.

[5] National Oceanic and Atmospheric Administration, *Budget Estimates, FY 2016, Congressional Submission,* Washington, DC: NOAA, NESDIS-43 and NESDIS-47.

Table 1. JPSS Satellite Launch Readiness and Scheduled Launch Dates (Including PFO Missions)

Mission		Launch Readiness Date[a]	Scheduled Launch Date[b]
JPSS	JPSS-1[c]	January 20, 2017	January 20, 2017
	JPSS-2	July 2021	July 2021
PFO	JPSS-3 Contingency (ATMS and CrIS only)	May 2023	N/A
	JPSS-3	January 2024	July 2026
	JPSS-4	April 2026	July 2031

Source: JPSS Program Multi-Mission Interim Briefing, July 21, 2015; JPSS Briefing to NOAA Program Management Council, February 17, 2016
[a] For PFO missions, this refers to the earliest accelerated launch date if needed to restore afternoon orbit to a two-failure condition (an accelerated launch, if needed, would take 12–24 months from call-up of satellite from storage); [b] refers to planned 5-year launch cadence. [c]In February 2016, the program announced that the launch readiness/scheduled launch date for JPSS-1 had been moved from December 2016 to January 20, 2017.

The PFO acquisition strategy involves block-buy procurements of JPSS-3 and JPSS-4 instruments. The PFO satellites, JPSS-3 and JPSS-4, will be copies of JPSS-2, with the same requirements and technical designs.[6] The instruments will be procured via modifications to the existing JPSS-2 instrument contracts. Two additional spacecraft have been negotiated under pre-priced options to the JPSS-2 spacecraft contract. We understand that this acquisition strategy was formalized through a series of discussions with NOAA, the Department, and the presidential administration in 2014.

Management reports indicated that the program had considered multi-mission procurements as early as 2012 but, at that time, NOAA chose to limit its polar satellite program to missions up to and including JPSS-2. In so doing, the program suffered from inefficiencies of a "buy one at a time" approach for JPSS-1 (the instruments for which, in some cases, had been started under the National Polar-orbiting Operational Environmental Satellite System, or NPOESS) and then JPSS-2, resulting in a lack of spare parts and cost savings from multi-unit purchases.[7, 8]

The JPSS program of record and PFO will be an integrated effort. While each will have separate budgets with their own cost, schedule, and performance baselines, NOAA—with its partner, National Aeronautics and Space Administration (NASA)—is planning to manage both under an integrated JPSS program.

Given that JPSS and PFO will have separate budgets, the program indicated that its general approach (subject to further refinement) will be to cover ground system operations, maintenance, sustainment, and development activities under the JPSS program of record budget

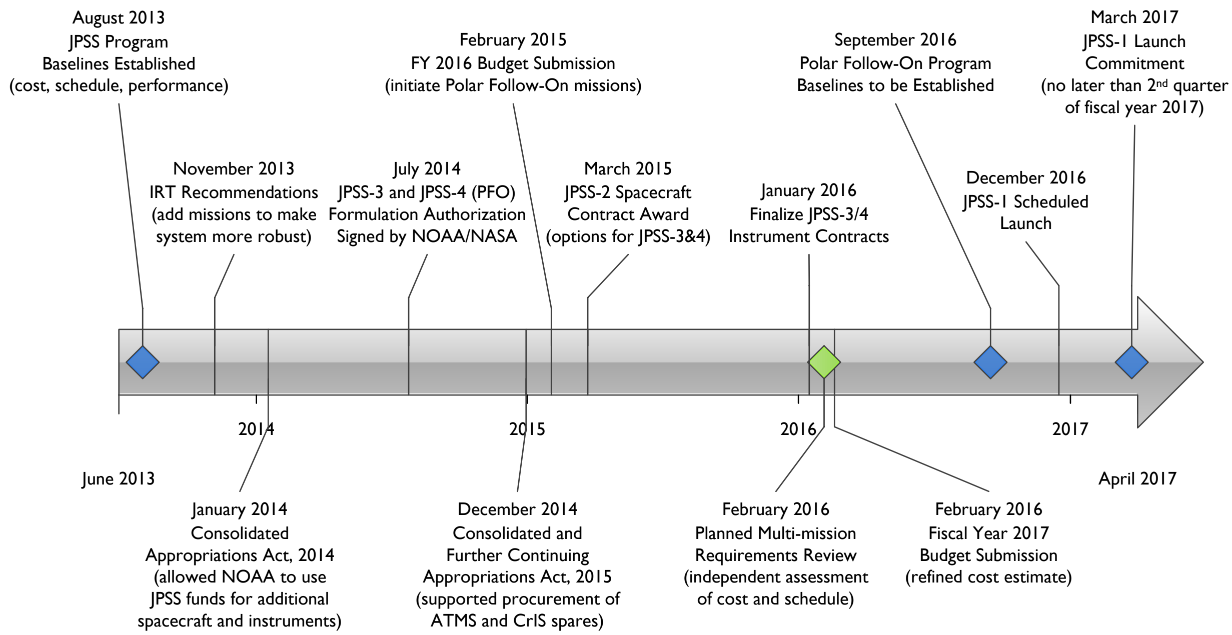
[6] See appendix D for changes to flight requirements from JPSS-1 to the JPSS-2/3/4 missions.

[7] National Polar-orbiting Operational Environmental Satellite System, the predecessor program to JPSS. See appendix B for more background information.

[8] In responding with technical comments to our draft report, NOAA management asserted that, because JPSS-1 instrument procurement had begun under NPOESS, its challenges with spare parts were independent of the decision to limit the program to just two satellites.

through FY 2025, after which the PFO budget would cover ground system costs. All program and flight project activities and infrastructure costs will be covered under the JPSS budget except the costs specifically attributable to the effort required for PFO.

Figure 1. Recent and Planned Key Events in Evolution of NOAA Polar Satellite Program



Source: OIG, adapted from JPSS program documentation
Dates as of August 31, 2015; IRT—Independent Review Team.

This is our fourth report on the JPSS program and related activities.[9]

[9] See appendix G for a list of OIG products related to NOAA satellite acquisitions.

Objectives, Findings, and Recommendations

Our objectives for this evaluation were to (1) determine the progress of PFO planning, (2) monitor ongoing JPSS acquisition and development (i.e., JPSS-1 and JPSS-2 missions), and (3) assess the potential for data gaps. To accomplish our objectives, we interviewed officials and project managers from NOAA's National Environmental Satellite, Data, and Information Service (NESDIS), the National Weather Service (NWS), and the JPSS program; reviewed program documentation; and observed multiple JPSS program management reviews between August 2014 and September 2015. See appendix A for a full discussion of our objectives, scope, and methodology.

We found that (1) PFO plans needed further development to support the establishment of program cost, schedule, and performance baselines, (2) satellite and ground system development challenges posed risk to the JPSS-1 launch schedule, and (3) the potential for polar satellite data gaps requires leadership's sustained attention.

I. Polar Follow-On Plans Needed Further Development to Support the Establishment of Program Baselines

In reviewing PFO planning efforts, we found that the program had to postpone formulation milestones that will support the establishment of cost, schedule, and performance baselines. Until such baselines are established, the ultimate cost and schedules of the JPSS-3 and JPSS-4 missions will remain uncertain. Further, NOAA had not yet coordinated with the Deputy Secretary in his role as the PFO milestone decision authority. The program was continuing to develop a life-cycle cost estimate of PFO missions. Procurements of PFO instruments were at risk due to the need for full and early funding. Finally, the program was planning to evolve the JPSS ground system and faced a significant management challenge in transitioning its management from NASA to NOAA.

A. Program formulation milestones were postponed in order to complete planning

PFO plans involve designing an efficient, multi-mission approach to the JPSS-2, -3, and -4 satellite acquisitions and evolving the ground system. The program undertook a significant amount of study and analysis towards baselining multi-mission requirements but postponed a requirements review from December 2015 to February 2016 in order to complete its work, and a key decision point to establish PFO program baselines was moved to September 2016.

In July 2014, NOAA and NASA officials approved a formulation authorization document to begin detailed planning of a PFO program of JPSS-3 and JPSS-4 missions, to be combined with the JPSS program. Since then, the JPSS program further developed a concept of operations to meet its criteria for a robust architecture. The program studied ways to manage and develop a more sustainable and simplified ground system and began planning a transition of responsibilities for the long-term sustainment of the

JPSS common ground system from NASA to NOAA.[10] And it had been tailoring its program and project management processes to account for the additional missions and maximize the efficiencies of a consistent design of the JPSS-2, -3, and -4 satellites. A need for additional time to complete trade studies and analyses led the program to delay a multi-mission requirements review from December 2015 until February 2016.

The time added to the PFO formulation schedule followed a July 2015 interim briefing to the JPSS standing review board, where multi-mission plans were presented. The review board made several suggestions to the program, which included

- developing materials to help Congress understand the impacts of alternate funding levels and the build-up of its cost estimate,
- assessing risks and a realistic date for transitioning common ground system management responsibilities from NASA to NOAA, and
- studying the tradeoffs between launch-on-schedule and launch-on-need strategies, and determining whether other programs have actually carried out a launch-on-need strategy and have lessons learned.

At the conclusion of our fieldwork, the program was still in the process of restructuring requirements and its technical baseline, management control plans, and other documentation of its multi-mission approach to JPSS-2, -3, and -4.[11]

Preliminary program plans indicated that PFO's life-cycle cost, schedule, and performance baselines would be established in September 2016, in conjunction with the JPSS-2 mission's Key Decision Point-C.[12] FY 2017 budget negotiations with the Office of Management and Budget (OMB) and Congress are likely to have a role in the process.

PFO baselines will be established in program commitment agreements for NOAA and NASA. The JPSS program-of-record baselines, established in 2013, will remain in effect. As a result, the integrated multi-mission JPSS program will implement two program baselines. Until NOAA establishes PFO baselines, however, the program's cost and schedules for JPSS-3 and JPSS-4 will remain uncertain.

[10] As discussed in finding I.E., below, sustainment could include considerable development work.

[11] The PFO formulation authorization document included a list of activities the program was expected to accomplish leading to the establishment of PFO cost, schedule, and performance baselines. A status of those activities is presented in appendix C.

[12] Performance baseline refers to the group of key performance parameters or metrics that define the program's operational capabilities.

B. Program had not yet coordinated with the Department on the process and decision authority for establishing baselines

Under the Department's acquisition program management policy,[13] the Milestone Decision Authority for high-profile programs[14] is the Deputy Secretary. The Deputy Secretary may delegate, in writing, with rationale, milestone decision authority and management of a high-profile program to the head of an operating unit.

Program officials initially told us that the NOAA Administrator was the Milestone Decision Authority for the establishment of PFO program-level cost, schedule, and performance baselines. According to the Department's Office of Acquisition Management, however, there had been no delegation of Milestone Decision Authority for PFO, nor had NOAA requested starting a milestone review (needed to establish PFO program baselines).

After we shared these findings, the program changed its response, indicating that the decision authority would be addressed as part of future planning. Who will serve as the PFO Milestone Decision Authority could have ramifications for the program's planning efforts and the activities necessary for establishing its baselines. For example, under the Department's policy, the Deputy Secretary would convene a milestone review board, hold formal reviews, and could even direct additional studies be undertaken. There would also need to be coordination among the Department, NOAA, and its program, to ensure that complete documentation is submitted in support of a review. A delegation of the decision authority to the NOAA Administrator would present a different set of information exchanges and timelines.

The Deputy Secretary served as the program-level Milestone Decision Authority for the JPSS program of record through Key Decision Point-I, the milestone that established that program's cost, schedule, and performance baselines. Under the Department's policy, the NOAA Administrator is the delegated decision authority for subsequent JPSS program and project-level milestones. However, the Office of Acquisition Management clarified that the delegation of JPSS decision authority did not apply to future programs (i.e., PFO, which, from a budget perspective, will be separate from JPSS).

Milestone decisions needed to establish PFO program baselines therefore remain under the authority of the Deputy Secretary. NOAA had to coordinate with the Department in order to sufficiently plan milestone reviews and provide needed information. Until then, a key management process for PFO had been left unplanned.

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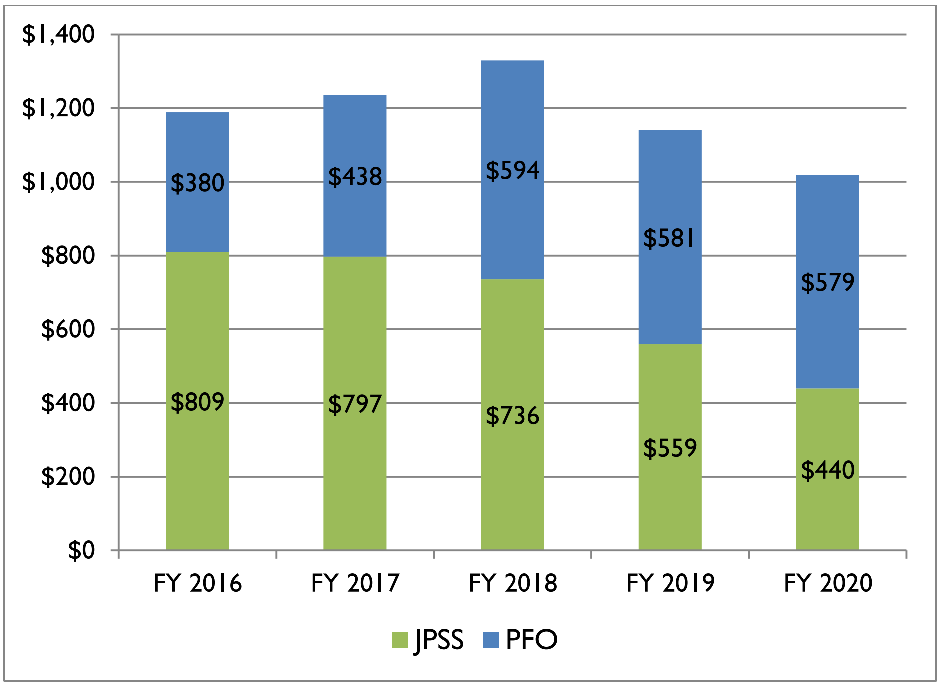
[13] Department Administrative Order 208-16 establishes the policy, procedures, and responsibilities for: implementing an "Acquisition Program and Project Management Framework" on all acquisition programs and projects and cost estimating and implementing independent cost estimates throughout the Department.

[14] High-profile programs are those that (1) warrant special attention or are deemed high risk, (2) entail expenditure of significant levels of resources, or (3) are nominated as a high-profile program by the Department's Milestone Review Board and approved as such by the Deputy Secretary. The PFO program, identified as the "Joint Polar Satellite System, J3 and J4," was included in the Department's FY 2015 list of high-profile programs.

C. Program had developed a preliminary life-cycle cost estimate of PFO

The July 2014 formulation authorization document for PFO, as well as budget briefings for Congress, included an initial formulation estimate of the life-cycle cost of PFO. However, that estimate—$8.2 billion over FYs 2016–2038—was not included in the NOAA FY 2016 Congressional budget submission, which only provided a 5-year funding profile.

Figure 2. Preliminary Combined NOAA JPSS/PFO Funding Profile (in millions)



Source: OIG adaptation of *NOAA Budget Estimates FY 2016, Congressional Submission*

This initial estimate for PFO was based on an extrapolation of costs from the JPSS program of record. The Department's Office of Acquisition Management reviewed the estimate as part of the FY 2016 budget process. It found that NOAA's initial estimate was reasonably well-modeled and that the eventual, formal life-cycle cost estimate for PFO should not increase to a significant degree. The program continued to revise and explore opportunities to reduce the estimate during 2015.

Program officials intend to provide stakeholders with greater insight into the breakdown of satellite system development costs versus operations and sustainment costs. In this regard, the life-cycle end date for a satellite program usually will not correlate with the actual end of a satellite mission, which could end sooner (e.g., due to some catastrophic event) or extend beyond its designed mission life (given sufficient health of the satellite and its value to the constellation). Further, program officials noted that operations and maintenance costs are enduring, relatively constant, level-of-effort functions and thus have no "end."

D. PFO procurement plans were at risk of delayed funding short of its full FY 2016 budget request

While the JPSS program was planning PFO missions and formulating the overall program, it initiated procurements of JPSS-3 and -4 instruments and spacecraft. However, the program's acquisition plans were contingent upon full and early receipt (in the first quarter) of FY 2016 funding—which was needed to avoid re-planning and renegotiations of instrument contracts.

The program was procuring PFO instruments via sole-source contract actions with the same performance and mission assurance requirements of JPSS-1 and JPSS-2 contracts. JPSS-3/4 instrument requests for proposals (i.e., block buys of two copies) were released between January and April 2015 and were based on the JPSS-2 specifications. The program planned to complete negotiations and make awards in early FY 2016 (see table 2). However, as negotiations were undertaken with the assumption of an early, fully-funded budget, a delayed appropriations law resulted in added risk to the viability of the procurement plans. The Consolidated Appropriations Act, 2016 provided the authorization and funding for PFO just within the program's need window of the first quarter of the fiscal year in order to proceed with instrument acquisitions.

Table 2. JPSS-3 and -4 Instrument Procurement Milestones

Procurement Step	Instrument[a] (two copies of each)			
	CrIS	ATMS	VIIRS	OMPS
Justification for Other than Full and Open Competition	July 2014	July 2014	July 2014	July 2014
Complete Requisition Package	November 2014	December 2014	January 2015	February 2015
Procurement Plan Approval	November 2014	November 2014	November 2014	November 2014
RFP Release	January 2015	February 2015	March 2015	April 2015
Proposals Receipt	April 2015	May 2015	June 2015	July 2015
Evaluations Complete	June 2015	July 2015	August 2015	September 2015
Negotiations Complete	August 2015	September 2015	October 2015	November 2015
Award[b]	October 2015	November 2015	December 2015	January 2016

Source: OIG, adapted from the JPSS-3 and -4 Instrument Acquisition Plan
[a] Instrument descriptions are provided in appendix B, table B-1. RBI is not shown here because that instrument is being acquired by a separate NASA project. [b] In response to our draft report, NOAA indicated that actual award dates had been delayed due to the enactment of the PFO appropriation in late December 2015.

Program justified its use of cost plus award fee contracts for instruments. In March 2015, the NOAA Assistant Administrator for Satellite and Information Services, in order to address questions raised by stakeholders, directed the program to reassess the decision to award cost plus award fee contracts for the JPSS-3/4 instruments. However, as described in the program's response, even if fixed-price contracts were a feasible option (according to the program, they were not), it was too late in the procurement process to realize cost savings. By that time, the program was 6 months into the procurement cycle and had released three of the four requests for proposals; revising the requests for proposals would have added more than 6 months to the procurement schedule. And, because three had been released, the government's negotiating position would have been compromised by changing the contract type.

Program staff asserted to us that to change from the existing cost plus award fee contracts (for JPSS-1 and -2 instruments) to fixed price contracts for JPSS-3/4 would have required significant technical and business changes to acquisition documents that would have been both time consuming and costly. And as JPSS-2 was to be the technical baseline for the JPSS-3 and JPSS-4 satellites, using the same contracting approach and documentation would enable the program to scale back the extent of design reviews needed. Further, cost plus-type contracts for the instruments provided the program more flexibility to manage risks due to the complexity and age of the instruments' designs.

Options for JPSS-3 and -4 spacecraft were included with JPSS-2 contract*:* NASA, as the program's flight systems acquisitions agent, awarded a firm fixed price delivery order contract for the JPSS-2 spacecraft, with pre-priced options for JPSS-3 and -4 spacecraft, to Orbital ATK on March 23, 2015. The options for JPSS-3 and JPSS-4 together are valued at approximately $217 million.

Under the terms of the contract, the option for the JPSS-3 spacecraft would need to be exercised in early November 2018 in order to support a contingency weather mission launch (if needed) in May 2023 as shown in table 1 above. The option for JPSS-4 could be exercised to support a launch as early as January 2026 (i.e., earlier than the planned JPSS-4 launch date shown in table 1), possibly sooner if mutually agreed upon.[15]

E. Plans for evolving the JPSS common ground system and transitioning responsibility for its sustainment presented challenges

An objective of the program's formulation of the multi-mission program was to plan a more sustainable and simplified ground segment that supports the JPSS fleet and a robust concept of operations.[16] Further, the program will attempt to align its ground segment, to the extent possible, with NOAA's enterprise architecture.[17] However, the extent to which the program can integrate with NOAA's enterprise architecture will be

[15] See appendix H for NOAA's comments about how these contract dates relate to its mission planning.

[16] See appendix E for anticipated ground system changes for JPSS-2/-3/-4 missions.

[17] See U.S. Department of Commerce Office of Inspector General, June 2015. *Cost Estimates, Long Term Savings, Milestones, and Enterprise Architecture Policy Are Needed for Common Satellite Ground System Program*, OIG-15-032-I. Washington, DC: DOC OIG.

constrained by the JPSS-2 launch schedule and a requirement to replace certain system hardware in FY 2019.

Program systems engineers indicated that requirements for JPSS-2 adaptations of the multi-mission common ground system would need to be fully defined in early 2016 in order for NASA to complete contract modifications to support the JPSS-2 launch schedule.[18] The requirements will also be driven by conditions of the sale of IBM's server business to Lenovo, which necessitate that the ground system's IBM x86 hardware be replaced by September 30, 2019. In July 2015, the program's standing review board disagreed with the program's presentation of the scope of future ground system changes as "minor"—the board found that it will likely require development work beyond typical sustainment activity. In August 2015, the program reported that it needed to complete further studies and was delaying its system requirements review.

In addition, the program was in the process of developing a framework for transferring responsibility of the common ground system contract (i.e., for its further development and sustainment) from NASA to NOAA, which is now targeted for February 2019, according to the program.[19] The program was also revising its review plan, so it was not yet documented whether the actual transition would be preceded by an independent review of the program's preparations for doing so.

Recommendations

In order to ultimately establish additional missions under the Polar Follow-On program, we recommend that the NOAA Administrator

1. Coordinate with the Deputy Secretary to determine who will be Milestone Decision Authority for establishing PFO program cost, schedule and performance baselines, and plan activities supporting a PFO baseline establishment key decision point.

In order to ensure a successful transition of responsibility for developing and sustaining the JPSS common ground system, we further recommend that the NOAA Administrator

2. Ensure the program's transition plan framework is subjected to expert, independent review.

II. Satellite and Ground System Development Challenges Pose Risk to JPSS-1 Launch Schedule

Our monitoring of ongoing JPSS development efforts found that the JPSS-1 mission had maintained its schedule to meet its launch commitment date of no later than March 2017.[20] The flight project overcame significant challenges to keep JPSS-1 development on schedule.

[18] This refers to the future version of the JPSS ground system that will support JPSS-2 and other missions.

[19] See appendix B, "JPSS component projects," for a description of NOAA and NASA responsibilities.

[20] A summary of JPSS-2 mission activities is presented in appendix F.

However, the satellite will be completed later than planned and must undergo final environmental testing. Further, a major upgrade of the ground system has been delayed, and as a result, satellite compatibility testing may either be compromised or cause a schedule slip. As a result, there is risk to the mission schedule that requires the continued attention of senior management.

A. Problems with a key instrument and other components added cost, schedule delay, and risk to JPSS-1 development

The JPSS flight project significantly revised the integration and testing sequence of the JPSS-1 satellite to accommodate the delayed completion of the Advanced Technology Microwave Sounder (ATMS) and gimbals for the satellite's two science mission data antennas. In so doing, project management kept the mission on schedule. However, while covered under the program's budgeted reserves, these challenges increased costs and delayed the study of expected satellite performance.

ATMS was significantly delayed by contaminated components. In early 2013, testing uncovered performance problems with intermediate-frequency (IF) amplifiers, ATMS subcomponents that were designed and built under the NPOESS program. Investigation ultimately revealed foreign-object debris contamination in the sealed parts and required significant corrective action. Complicated by the fact that the original supplier no longer produced them, the IF amplifiers had to be de-integrated from the assembled instrument, repaired, and then re-integrated.

Using flexibility provided in the spacecraft contract, flight project management re-sequenced the order in which JPSS-1 instruments were integrated with the spacecraft. After all of the other instruments[21] were integrated, the flight project chose to temporarily integrate the ATMS engineering development unit, in order to complete as much system-level testing as possible, and remain on schedule for launch readiness.

By September 2015, the ATMS flight unit had been re-assembled and the instrument was undergoing environmental testing. Delivery of the flight unit was scheduled for mid-November 2015 and its integration with the spacecraft was to be completed by the end of December. The satellite development schedule[22] retained 2.0 months of schedule reserve (compared with a minimum of 2.3 months of reserve it was required to have at that stage).

At the conclusion of our fieldwork, ATMS had been delayed 18 months and the instrument contract costs had increased by approximately $33 million. In addition, in order to accommodate additional late delivery of ATMS for integration with the JPSS-1 spacecraft, the program negotiated a modification, not to exceed $8 million, to the firm fixed price spacecraft contract.

[21] CrIS, VIIRS, OMPS, and CERES; see appendix B, table B-1 for instrument descriptions.

[22] As of September 30, 2015.

Delayed completion of antenna gimbals presented risk to spacecraft and instrument performance. The JPSS-1 spacecraft will have two gimbaled antennas for transmitting stored mission data, which is a change from the fixed antennas on Suomi National Polar-orbiting Partnership (NPP).[23] The gimbals have been delayed by nearly a year because of the supplier's transition to new ownership and strict technical specifications that make them difficult to manufacture. Without them, the ability of the flight project and spacecraft contractor to evaluate vibrational disturbances, or jitter, has been limited. In particular, the effects of jitter on CrIS performance are of concern.

B. Common ground system development delays added risk to JPSS-1 mission readiness

The JPSS ground project is leading a major upgrade of the JPSS common ground system, called Block 2.0, which will provide new hardware and software, capabilities for supporting JPSS-1, a full backup capability, additional ground antenna stations, and multiple operating environments. The upgrade will also include changes intended to significantly improve the system's security.[24] Block 2.0 was planned to be in operation to first support existing missions (Suomi NPP and partner satellites) and provide operators time to get experience with the system in advance of the JPSS-1 launch. However, the project encountered development and integration problems that delayed the completion of Block 2.0 and added risk to the JPSS-1 launch schedule.

A backlog of software problems delayed completion of the Block 2.0 system and put JPSS-1 mission preparations at risk. The problems have affected the overall stability of the system, required additional software development, and delayed completion of testing. As a result, the ground project's operational readiness review—which precedes the system's actual transition to operations—was twice rescheduled (see figure 3). Additional schedule changes may become necessary: at the conclusion of our fieldwork, the ground project reported that it had experienced problems during a dry run of a major test event.

The ground project had reported that, "conservatively," Block 2.0 needed to transition to operations at least 30 days before a compatibility test with the JPSS-1 satellite in order to meet full requirements for launch. By August 2015, however, the compatibility test had been rescheduled ahead of the operational readiness review, which suggested the project's ability to meet full requirements for launch was at greater risk.

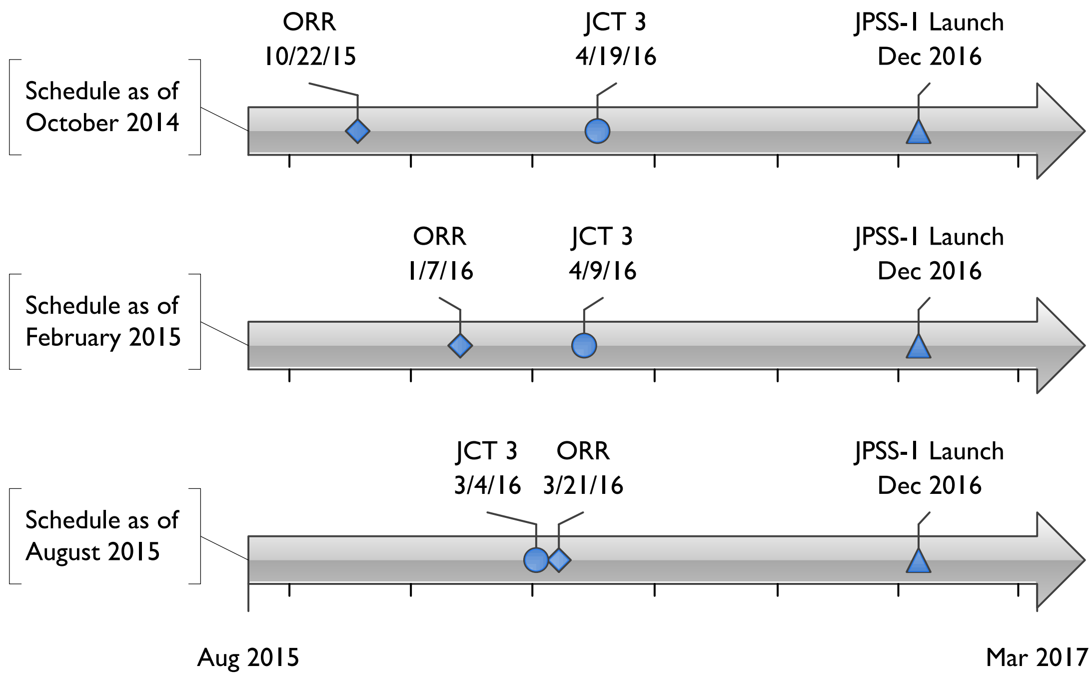
In October 2015, JPSS program management briefs indicated that the ground system contractor's extra work to address integration, testing, and other problems consumed 70 percent of the contract's life-cycle management reserves over the previous 13 months. And a key test preceding operational readiness had slipped 18 weeks past the contractual milestone. The ground project indicated that it was at risk of having

[23] Gimbal assemblies provide two-axes support and point antennas for ground and relay station data links.

[24] The common ground system contractor is Raytheon. See appendix B for an explanation of ground system project management. See DOC OIG, June 2015. *Expedited Efforts Needed to Remediate High-Risk Vulnerabilities in the Joint Polar Satellite System's Ground System–Final Memorandum*, OIG-14-027-M, Washington, DC: DOC OIG

insufficient reserves for the scope of work planned in FY 2016 and was working with the contractor to develop a new spend plan and reduce the risk of a stop work condition.

Figure 3. Common Ground System Block 2.0 Schedule Evolution



Source: OIG adaptation of JPSS Ground project schedule milestones
ORR—Operational Readiness Review (precedent to actual transition to operations); JCT 3—Joint Compatibility Test 3 (a JPSS-1 mission critical path test event for which Block 2.0 ground system site acceptance testing must be completed to support). In February 2016, the program announced the launch readiness/scheduled launch date for JPSS-1 had been moved from December 2016 to January 20, 2017.

New integration and test approach intended to preserve schedule also carried risk. To mitigate the schedule delays, the ground project adopted a new approach to system integration and testing that could result in lower-level system requirements being insufficiently tested. Further, problems that occur during test execution may be more difficult to isolate and understand. As a result, the delivered system may be unstable or have latent defects that will not be identified before the system is transitioned to operations. Such cases could require emergency patches, necessitate excessive operational workarounds, or even cause disruptions to on-orbit satellite operations.

The new, operations-based approach combined many requirements normally verified in a factory environment with those verified in the operations site-installed system. It was intended to be more efficient by eliminating duplicate procedures in the original test campaign, as well as to strengthen the verification methods. Further, the ground project wanted to take advantage of the fielded Block 2.0 system, which would run in parallel with the existing operational ground system (designated as Block 1.2), allowing the test campaign to use live mission data.

Parallel development activities posed a significant challenge for the program. The ground system development effort was also challenged by the number of parallel activities it involved. Because of the software problems, the completion of interface tests, flight simulators, and mission operation products were delayed. Coordination with other elements of the broader JPSS ground system, including those implemented by NOAA, was needed to ensure activities were appropriately supported. The program developed a schedule tool to resolve potential resource conflicts with the GOES-R program. The GOES-R mission's delay placed the launch readiness dates of both missions in fall 2016.

Program had not reported trends of ground system development metrics needed to provide insight into issues. In May 2015, the program's standing review board expressed concern with the lack of a detailed ground system development schedule, task burn down plans, and other metrics needed to demonstrate sufficient staffing and resources for planned activities. According to the program's director, these metrics were being examined within the program. However, we found that JPSS briefings to its Program Management Council lacked trending information for such metrics, which could provide insight into schedule performance and status as the program completes system integration, testing, and mission readiness activities.

Transition of ground system project management presents risks and opportunities. Earlier in this report, we discuss the transition of common ground system responsibilities from NASA to NOAA (see finding I.E). The transition of responsibilities from NASA carries personnel risk, as it will likely result in a loss of subject matter expertise. The program's lessons in developing the Block 2.0 common ground system could be instructive for future system development and sustainment, which will include a technical refresh and support for new spacecraft (i.e., supplied by Orbital ATK), changes in communication links, and security.[25] Further, the JPSS common ground system, which provides support to partner missions as well as JPSS missions, has aspects of enterprise architecture for polar satellites that may be extended to the broader NOAA satellite ground system enterprise.

Recommendations

In order to ensure that the progress of ground system development and JPSS-1 mission readiness is transparent, we recommend that the NOAA Assistant Administrator for Satellite and Information Services

3. Direct the JPSS program, on a regular basis, to report trends of schedule metrics for ground system development and JPSS-1 mission preparations to provide insight into issues, sufficiency of resources, and mission readiness.

[25] See appendix E.

In order to successfully guide future ground system development efforts, we recommend that the NOAA Assistant Administrator for Satellite and Information Services

4. Direct the completion of a study of JPSS Block 2.0 common ground system development to capture lessons learned and apply them to plans for the Segment3.0/Block 3.0 system and NOAA's Ground Enterprise Architecture System development.

III. Potential for Data Gaps Requires Leadership's Sustained Attention

Until JPSS-1 is operational, NOAA will not have full backup capabilities for those provided by Suomi NPP and is therefore at risk of a data gap. As Suomi NPP ages beyond its design life, the primary mitigation will be to launch JPSS-1 on time and complete activities necessary to use its data operationally. Our updated assessment, which accounts for these factors, found that the potential data gap between Suomi NPP and JPSS-1 has decreased to a period of 7–10 months, beginning in November 2016.[26] Beyond this near-term condition, we found that the long-term plans for the JPSS program (including PFO), would notionally meet NOAA's criteria for a robust satellite architecture for only a 10-year period within its life cycle, which extends to 2038. However, the program's ability to launch a satellite within 1 year of an on-orbit failure is uncertain and its criteria for a robust architecture are not supported by NOAA policy. Further, NOAA lacks plans for managing the development of, and integrating, new satellite technology.

A. The risk of a data gap is elevated while JPSS-1 data are not yet in operational use

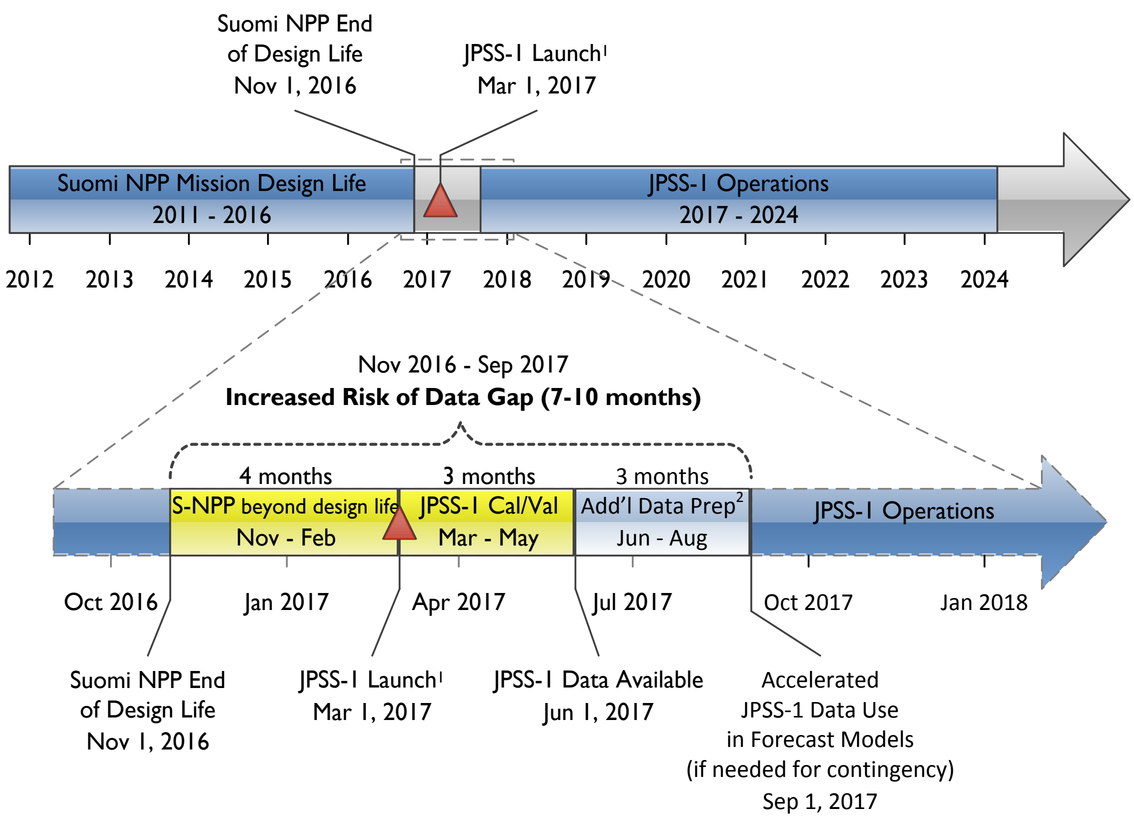
Suomi NPP continues to operate and the program has taken steps to extend its life. Among those, the program successfully tested and implemented an on-orbit mitigation designed to prevent the uneven wearing of the ATMS scan drive motor and prolong its operation. Conservatively viewed, however, as the satellite operates beyond its designed mission life, there is increased risk of a data gap until JPSS-1 is launched, its data are validated, and then operationally assimilated into NWS forecast models. Our current assessment indicates that this period of risk or "potential data gap" could last 7–10 months, beginning in November 2016 (see figure 4).

Given the risks remaining to the JPSS-1 schedule, our assessment used a conservative assumption of its launch date: March 1, 2017. This would be 4 months after Suomi NPP's mission design life expires. After JPSS-1 launch, a "checkout" period follows for the satellite. ATMS and CrIS data are calibrated and validated sufficiently for operational use, a period we estimate could take 3 months. Those periods together represent the lower bound of our assessment of 7 months of increased risk. We have also accounted for additional time (3 months, giving the 7–10 month range) for more calibration and validation work and activities that the NWS may need to perform in order to actually use the data in its numerical weather prediction forecast models, as discussed below.

[26] A data gap in this case is a loss of either ATMS or CrIS data for use in forecast models.

Our previous assessment of a potential data gap was 10–16 months.[27] The reduction in our current assessment is due to a shorter timeframe attributed to completing sufficient calibration and validation of ATMS and CrIS data for operational use, the plans for which benefit from Suomi NPP lessons learned.

Figure 4. Potential Data Gap between Suomi NPP and JPSS-1 Missions



Source: OIG analysis of Suomi NPP mission, JPSS-1 development, launch, and postlaunch calibration and validation schedules
[1] JPSS-1 launch date shown here is a conservative assumption—program is currently working toward a January 20, 2017 launch date; [2] this period allows for additional calibration and validation and preparations by the NWS that may be needed to incorporate JPSS-1 data into its forecast models.

The timeframe of this potential data gap coincides with a transition to a new Administration and a new Congress, who will need to understand the status of risk to the continuity of polar satellite sounder observations, including key activities leading to the operational use of JPSS-1 data (i.e., those leading up to and during the potential data gap).

The National Weather Service has not yet developed a contingency plan for accelerating the assimilation of JPSS-1 data into its forecast models. NWS does

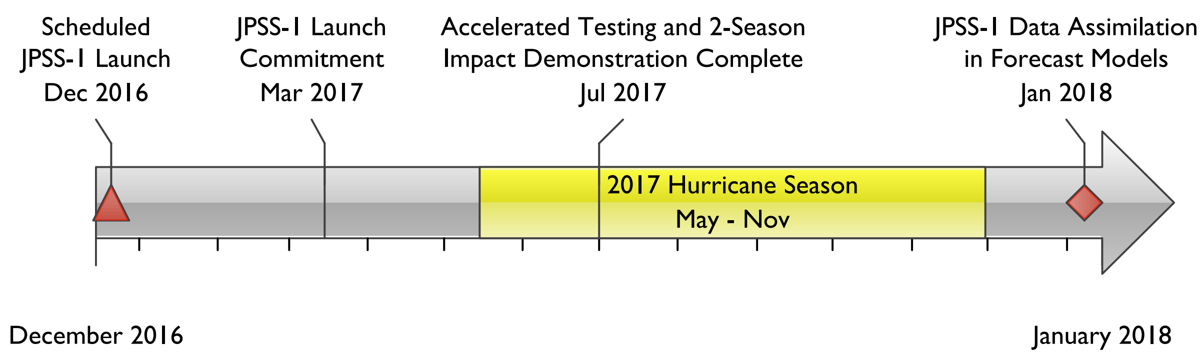
[27] See DOC OIG, June 2014. *Audit of Joint Polar Satellite System: To Further Mitigate Risk of Data Gaps, NOAA Must Consider Additional Missions, Determine a Strategy, and Gain Stakeholder Support*, OIG-14-022-A, Washington, DC: DOC OIG, 17.

not intend to use JPSS-1 data until it can fully assess the data's effect on forecast models for two seasons (e.g., winter, summer). Then the NWS will incorporate the data into a routine upgrade of its systems, in early 2018. NWS plans to complete contingency plans for assimilating JPSS-1 data sooner—in order to respond to an actual data gap—6 months before JPSS-1 launch.

Beyond the JPSS program-led calibration and validation of JPSS-1 data products, NWS will perform postlaunch experiments with JPSS-1 ATMS and CrIS data to ensure they provide a statistically neutral or better impact on forecast models. If the process goes according to plan (see figure 5), NWS will first use JPSS-1 data in its January 2018 upgrade of the Global Forecast System (GFS).[28] The assumptions that went into the NWS plan were

1. JPSS-1 will launch in December 2016;[29]
2. full accelerated testing and two-season impact demonstration of JPSS-1 data in the GFS will be completed by July 2017;
3. the next scheduled GFS upgrade will occur in January 2018; and
4. a polar satellite data gap—which the weather service defines as a loss of Suomi NPP ATMS or both CrIS and Aqua AIRS data—does not occur before that upgrade.[30] (This definition of a data gap differs from NESDIS' in that NWS considers AIRS and CrIS data to be equivalent in terms of their impact on forecast models.)

Figure 5. Timeline for Use of JPSS-1 Data in NWS Forecast Models



Source: OIG adaptation of NWS plans for JPSS-1

Should a data gap occur, the NWS told us that JPSS-1 data could be used operationally in as little as 3 months after launch, before the testing in its notional schedule is

[28] GFS is a weather forecast model for the entire globe. It provides a starting point for regional forecast models used to produce regional and local forecasts.

[29] In February 2016—after we had concluded our fieldwork—the program announced that the scheduled launch date for JPSS-1 had been moved to January 20, 2017. We did not assess how this change will affect the NWS plan.

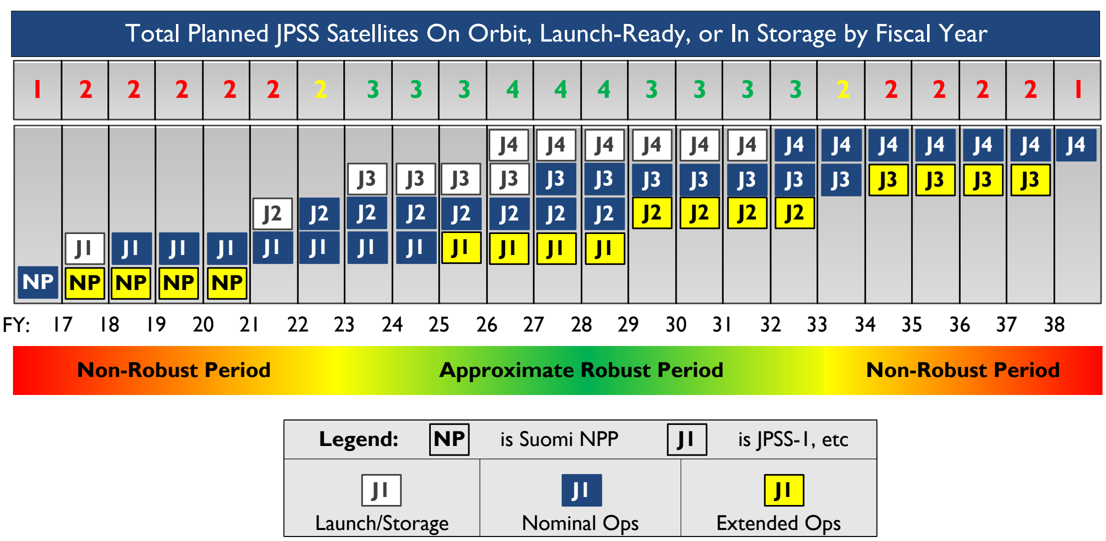
[30] AIRS is the Atmospheric Infrared Sounder aboard NASA's Aqua satellite, which was launched May 4, 2002.

completed. This would be contingent on ATMS and CrIS performing within specification and "if absolutely necessitated by a data gap." However, until its JPSS-1 data assimilation contingency plan is complete, guidance for how that decision should be made will not be available to stakeholders, including senior NOAA leadership who may have to make and communicate that decision. The 3-month, extended-range period of our potential data gap assessment (as depicted, previously, in figure 4) is intended to account for the uncertainty of the plans at this time (as well as provide additional time for calibration and validation).

B. Combined JPSS and Polar Follow-On program lacked a full understanding of launch-on-need capability and support of NOAA policy

NOAA's criteria for a robust satellite architecture require that (1) two failures must occur to create a gap in data from ATMS or CrIS and (2) the ability exists to restore the constellation to a two-failure condition within one year of an on-orbit failure. As currently planned, the combined program's delivered satellite constellation would notionally meet those criteria in FY 2023, with JPSS-1 and JPSS-2 on orbit, and JPSS-3 built and available for launch. This fault tolerant state would end in FY 2033 (see figure 6).

Figure 6. Fault Tolerance of NOAA's Planned Polar Satellite Constellation, FYs 2016–2038



Source: OIG analysis of Suomi NPP operations and JPSS mission launch readiness and launch schedules

The program's ability to launch on need within 1 year of an on-orbit failure was uncertain. The program's standing review board expressed concern over the program's ability to meet the second of its criteria for a robust architecture. A launch window may not be available on relatively short notice, given that there are likely to be other high-priority space missions utilizing the launch services and sites used for JPSS missions. The program was further studying its launch-on-need strategy, including exploring options to reduce uncertainty in meeting the within-1-year target. Given this uncertainty, stakeholders need clearer understanding of the results of the program's study, including the resulting risk to its constellation, when available.

Robust satellite architecture criteria are not formal NOAA policy. While used in the agency's FY 2016 budget justification, NOAA's criteria for a robust polar satellite architecture are not defined in formal agency policy. A lack of supporting policy leaves insufficient guidance for potential future decisions regarding on-orbit and early launch failure scenarios. For instance, decisions such as whether to store or accelerate launch of a fully or partially capable satellite are not currently guided by NOAA policy.

C. NOAA lacked plans for managing the development and integration of new satellite technology

NOAA lacked a formal strategy and plans for developing and integrating new satellite technology—beyond the current JPSS designs—into its environmental data processing architecture. Absent strategic and tactical technology insertion plans, NOAA risks not taking full advantage of opportunities to supplement its core satellite observation systems. New satellite technology could provide a more robust observing system architecture before the JPSS/PFO program life cycle ends. Further, small satellite technology insertion plans could be complementary to NOAA's efforts to develop its satellite ground system enterprise architecture, which should be done in short increments.[31] In 2014, a NESDIS Integrated Product Team conducted trade studies and produced a draft advanced technology roadmap before discontinuing the effort.

Recommendations

In order to ensure that the agency is prepared to address a potential data gap arising from a near-term loss of Suomi NPP data, we recommend that the NOAA Deputy Under Secretary for Operations

5. Ensure that NWS completes its contingency plan for JPSS-1 data assimilation and communicates it to users and stakeholders by end of the third quarter of FY 2016.

6. Provide Department, OMB, and Congressional stakeholders with a list of key activities for operationalizing JPSS-1 data that NOAA will undertake during the potential data gap.

[31] Small satellites may also be referred to as cubesats, microsatellites, or nanosatellites. Small satellites represent potentially cost-effective advances in technology. Trading shorter life spans for much lower costs and more rapid launch cycles, small satellites could provide increased flexibility for meeting space observation needs. See OIG-15-032-I, 8–9.

In order to guide and sustain the implementation of NOAA polar satellite observing systems, we recommend that the NOAA Deputy Under Secretary for Operations

7. Provide stakeholders with the results of its study of launch-on-need versus launch-on-schedule strategies, as well as the implications for PFO plans.

8. Incorporate NOAA's robust architecture criteria into formal NOAA policy.

9. Include new satellite technology insertion as part of NOAA's strategic and tactical plans.

Summary of Agency Response and OIG Comments

In response to our draft report, NOAA agreed with all of our recommendations and detailed actions it is taking, or plans to take, in response to each. While we will await NOAA's formal action plan, the responses were consistent with our recommendations. NOAA also provided a number of technical comments, which we incorporated into this final report as appropriate.

Appendix A: Objectives, Scope, and Methodology

The objectives of this review were to (1) determine the progress of Polar Follow-On program planning, (2) monitor ongoing JPSS acquisition and development (i.e., JPSS-1 and JPSS-2 missions), and (3) assess the extent of potential data gaps. We have conducted oversight of the JPSS program since its inception; this is our fourth report on the program and related activities.[32]

To meet our first objective, we reviewed trade studies and analyses, as well as interviewed JPSS senior managers and members of a NESDIS integrated product team responsible for determining a high-level strategy for a follow-on program to identify NOAA's rationale and approach for planning the PFO program. We also identified, in the PFO Formulation Authorization document, planning activities the JPSS program was expected to accomplish and compared those with what the program had accomplished by the end of our fieldwork. In addition, we compared NOAA's plans with requirements for establishing programmatic baselines in the Department's scalable acquisition framework. We assessed budget risks to PFO by evaluating JPSS-3/4 acquisition plans in relation to the status of FY 2016 appropriations. Our fieldwork included interviews of JPSS (NOAA and NASA) management and staff who participated in PFO planning, and the Department's Office of Acquisition Management. We reviewed extensive documentation including program management plans, acquisition plans, instrument and spacecraft contract information, available trade studies and analyses, preliminary cost estimates, management briefs, and interagency agreements to assess the reliability of program management information and the progress in PFO planning. Finally, we observed the program's multi-mission interim briefing to its standing review board, held on July 21, 2015, which was intended to solicit feedback and help the program refine its approach to incorporating PFO missions into the JPSS program—and compared the program's planning efforts at that point in time with its earlier stated milestones..

To meet our second objective, we assessed key risks to the JPSS-1 mission schedule by reviewing program and contractor monthly status reports and comparing them with NASA and GAO scheduling best practices, as well as NASA's practices for environmental testing. In addition, we reviewed monthly and weekly program status reports to monitor the status of instrument and spacecraft development and identified risks, potential schedule delays, and cost impacts. We also reviewed the JPSS-2 major contracts, interagency agreements, and other management information to identify key provisions and future decision dates (see appendix F). Finally, our findings were informed by our observations of multiple program management/technical life-cycle reviews, at which we discussed development issues with project managers.

To meet our third objective, we analyzed JPSS-1 schedule risk to update our assessment of a potential data gap, by accounting for Suomi NPP's mission design life, the JPSS-1 launch

[32] See appendix G for a list of OIG products related to NOAA satellite acquisitions.

schedule, and the plan for calibrating, validating, and incorporating JPSS-1 data into NWS forecast models. We also interviewed NWS officials to identify their timeline and contingency planning activities for assimilating JPSS-1 data after launch and evaluated the ramifications these could have for a potential gap. In addition, we compared NOAA's polar satellite program plan, with its stated criteria for a robust satellite architecture, and NOAA's polar satellite launch policy. We also interviewed NESDIS officials and reviewed documentation to assess progress in its efforts to update its polar satellite launch policy and its integrated product team's planning for new satellite technologies, as well as compared evidence of NOAA's new technology planning with best practices.

In addition, we assessed internal control significant within the context of our objectives. This included examining the design of program management controls as documented in program plans, NASA procedural requirements, and program schedules. We also assessed the implementation of internal control through document reviews and observations of program and project management life-cycle reviews to determine the program's adherence to its standards, procedures, and plans. In satisfying our objectives, we did not rely on computer-processed data; therefore, we did not test the reliability of NOAA and NASA information technology systems. The findings and recommendations in this report include our assessments of internal control.

Although we could not independently verify the reliability of all the information we collected, we compared it with other available supporting documents to determine data consistency and reasonableness. Based on these efforts, we believe the information we obtained is sufficiently reliable for this report.

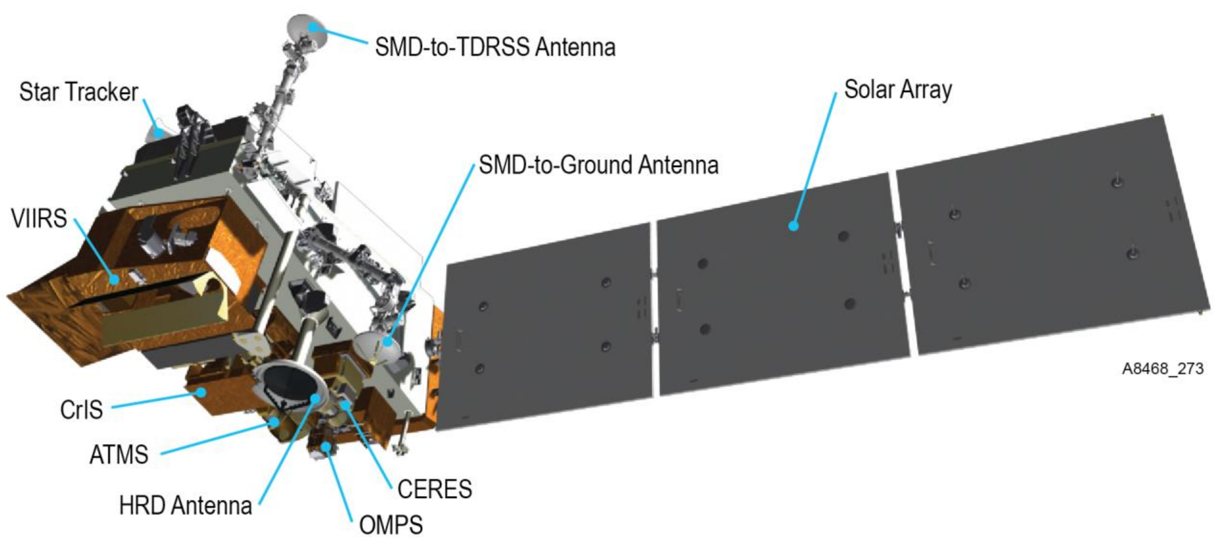
We performed our fieldwork at the JPSS program office in Lanham, Maryland, at NESDIS offices in Silver Spring, Maryland, and at contractor facilities in Aurora and Boulder, Colorado. We conducted this review under the authority of the Inspector General Act of 1978, as amended, and Department Organization Order 10-13, dated April 26, 2013. We conducted our fieldwork from August 2014 to September 2015 in accordance with the Quality Standards for Inspection and Evaluation (January 2012) issued by the Council of the Inspectors General on Integrity and Efficiency.

Appendix B: JPSS Background

Program origins and the risk of a gap: The Joint Polar Satellite System (JPSS) program was established in 2010 when the Administration chose to restructure the troubled National Polar-orbiting Operational Environmental Satellite System (NPOESS)—a tri-agency partnership among the Department of Defense, NOAA, and NASA—into separate civil and defense programs. JPSS currently supports the operation of one satellite (Suomi NPP) and is developing and launching two, next-generation polar-orbiting satellites (JPSS-1 and JPSS-2) with new, more capable instruments to replace NOAA's legacy polar satellites.

Given delays that began with NPOESS and the aging of NOAA's existing satellites, there is potential for a gap in polar satellite environmental data, some of which have been the most significant contributors to the accuracy of medium-range (3–7 day) forecasts produced by numerical weather prediction models. A degradation of such forecasts could inhibit NOAA's ability to provide emergency managers with information needed to adequately prepare for extreme weather events and protect lives and property.

Figure B-1. JPSS-1 Satellite, Including Instruments and Other Key Components



Source: Ball Aerospace & Technologies Corporation

The afternoon (polar) orbit: NOAA's polar satellites travel in sun-synchronous orbit—crossing a given latitude at the same time of day as the earth rotates underneath—which allows the satellites to collect data over the entire globe. NPOESS was originally intended to provide next-generation satellites for three different polar orbits, identified by the time of day they cross the equator: early morning, midmorning, and early afternoon. In 2006, as a result of NPOESS cost and schedule delays, European satellites were given responsibility for the midmorning orbit. With the restructuring in 2010, the Department of Defense was made responsible for the early morning orbit, and NOAA—partnering with NASA—became responsible for the afternoon orbit, considered the most important for operational weather forecasting.

Suomi NPP bridge mission: An early priority for JPSS was to successfully launch a NASA research and risk reduction satellite, NPOESS Preparatory Project or NPP. This satellite was built by NASA, with some instruments and the ground system largely built under NPOESS. NPP was originally intended to demonstrate the next generation of instruments for NPOESS and continue measurements of NASA's Earth Observation System. The ground system for NPP was not built with the redundancy and high-availability requirements of an operational weather satellite system. In order to prevent a gap in polar satellite data, however, the NPOESS executive committee decided that NPP data should be used operationally. After nearly 2 years of final preparations with the JPSS program, NPP was launched on October 28, 2011, and subsequently renamed Suomi NPP (National Polar-Orbiting Partnership). It has performed well, providing data for operational weather forecast centers and effectively mitigating a potential near-term gap that NOAA was confronting at the time.

JPSS missions: As Suomi NPP approaches the end of its 5-year mission design-life, NOAA's Joint Polar Satellite System (JPSS) program—a partnership with NASA—is working to complete a major upgrade of its ground system and launch JPSS-1, which is a near clone of Suomi NPP, by March of 2017. The JPSS program is also developing a second satellite, JPSS-2, which is slated to launch in July 2021. While JPSS satellites are designed for longer missions (7 years) than Suomi NPP, concern for the fault tolerance of NOAA's polar satellite constellation has led NOAA to begin planning two additional missions, JPSS-3 and JPSS-4. These "Polar Follow-On" missions would extend the JPSS program from 2025 out to 2038.

Legacy satellites: Older, legacy satellites (the last of which was launched in 2009) also continue to operate—in some cases at degraded levels—and provide data for numerical weather prediction models. The data from legacy satellites are generally not of the same quality as from Suomi NPP, however, and there is evidence[33] that some mid- or extended-range forecasts (i.e., 3+ days) could degrade should the satellite or its key instruments fail before a replacement is launched and operating.

JPSS capabilities: JPSS has four key performance parameters (system capabilities) that, if not met, "would compromise NOAA's weather mission to provide essential warnings and forecasts to protect lives and property, and would be cause for program reevaluation or cancellation,"[34] including

- Advanced Technology Microwave Sounder (ATMS) data,
- Cross-track Infrared Sounder (CrIS) data,
- Visible Infrared Imaging Radiometer Suite (VIIRS) imagery (in specified channels) for latitudes above 60 degrees North in the Alaskan region, and
- 96 minute data latency (the time period from satellite observation until the data or imagery are available to users at the distribution system) for ATMS, CrIS, and VIIRS key performance parameters

[33] *Impacts of assimilation of ATMS data in HWRF on track and intensity forecasts of 2012 four landfall hurricanes,* X. Zou, F. Weng, et al, Journal of Geophysical Research: Atmospheres, Vol 118,pp 558-576, October 28, 2013

[34] National Environmental Satellite, Data, and Information Service, June 27, 2013. *JPSS Level 1 Requirements Document–Final*, version 1.7. Silver Spring, MD: NESDIS, 8.

Table B-1. JPSS Instrument Descriptions

Instrument	Description
Advanced Technology Microwave Sounder (ATMS)	*Provides temperature and moisture sounding capabilities by hosting 22 microwave channels.* ATMS and CrIS together provide profiles of atmospheric temperature, moisture, and pressure. The combined ATMS/CrIS sensor suite is called the Cross-track Infrared and Microwave Sounder Suite (CrIMSS).
Cross-track Infrared Sounder (CrIS)	*Measures the three-dimensional structure of atmospheric temperatures, water vapor and trace gases.* CrIS provides over 1,000 infrared spectral channels at an improved horizontal spatial resolution.
Visible Infrared Imaging Radiometer Suite (VIIRS)	*Collects visible and infrared radiometric data of the Earth's atmosphere, ocean, and land surfaces.* Some of the data types include atmospheric parameters, clouds, Earth radiation budget, land/water and sea surface temperature, ocean color, and low light imagery.
Ozone Mapping and Profiler Suite (OMPS)	*Collects data to calculate the vertical and horizontal distribution of ozone in the Earth's atmosphere.* OMPS consists of separate nadir and limb sensors. Measurements from the nadir sensor are used to generate total column ozone measurements, while measurements from the limb sensor generate ozone profiles of the along-track limb scattered solar radiance.
Clouds and the Earth's Radiant Energy System (CERES) and Radiation Budget Instrument (RBI)	*Measures both solar-reflected and Earth-emitted radiation from the top of the atmosphere to the Earth's surface.* CERES is used to observe and understand the role of clouds and the energy cycle in global climate monitoring and prediction. JPSS-2 will host the next generation of this sensor, which will be called the Radiation Budget Instrument (RBI).

Source: JPSS program documentation

ATMS and CrIS data together combine to provide what is currently the most important type of data for numerical weather prediction models. VIIRS imagery is used in monitoring and forecasting Alaska weather, where there is a lack of other quality environmental data. The other instruments to be hosted on JPSS satellites are the Ozone Mapping and Profiler Suite (which includes a nadir sensor, designated OMPS-N, and a limb sensor, designated OMPS-L[35]), the Clouds and Earth's Radiant Energy System (CERES), and, on the second JPSS satellite, CERES' follow-on, the Radiation Budget Instrument (RBI). Beyond weather forecasting and situational awareness, JPSS data is used to monitor environmental conditions such as droughts, forest fires, volcanic ash, and ozone levels for treaty compliance. JPSS observations will also be used to monitor other climate variables, continuing more than 30 years of such polar satellite data.

JPSS component projects: The NASA component of the JPSS program currently consists of two interrelated projects: *flight* (responsible for developing the primary JPSS satellites and

[35] OMPS-L is flying on Suomi NPP but is not planned for JPSS-1. JPSS-2 will host OMPS-L if NASA can deliver in time for satellite integration and test need dates.

supporting Suomi NPP), and *ground* (responsible for developing the "common ground system" that commands and controls the primary satellites, processes their data, and collects and distributes data from partner organizations' satellites). NOAA is responsible for acquiring other ground system components that further process and distribute data to users. A third project, free flyer, was responsible for developing two smaller satellites that would fly climate, search and rescue, and in situ data collection instruments, but was transferred out of the JPSS program at the start of FY 2014. Flight is currently focused on JPSS-1 development and initial procurement activities for JPSS-2 while the ground project is planning upgrades to refresh, operationalize, and better secure the ground system for Suomi NPP and later, for JPSS satellites.

Program management and oversight: The JPSS program follows NASA's space flight program and project management requirements.[36] It must also meet the intent of the Department of Commerce's Scalable Acquisition Project Management Framework, which was instituted in November 2012 after a prolonged effort to improve the Department's management and oversight of acquisitions.[37] NASA revised its standards in August 2012 to emphasize program and project formulation activities. Notable benefits of formulation include the identification and mitigation of high technical, acquisition, cost, and schedule risks—which result in more realistic cost and schedule commitments as programs and projects are approved for implementation.

To help ensure the adequacy of JPSS program and project formulation and implementation, NOAA and NASA leadership are assisted by a standing review board which, with the program, conducts major life-cycle reviews to assess technical and programmatic status and health in advance of major decision points. Separately, NOAA has chartered an independent review team, which includes some members of the JPSS standing review board and aims to maximize the probability of success of NOAA's satellite portfolio through periodic reviews.

[36] National Aeronautics and Space Administration, August 2012. *Space Flight Program and Project Management Requirements w/Changes 1-10,* NPR 7120.5E. Washington, DC: NASA.

[37] See DOC OIG, November 2007. *Successful Oversight of GOES-R Requires Adherence to Accepted Satellite Acquisition Practices,* OSE-18291. Washington, DC: DOC OIG, as well as Inspector General letter to Honorable Darrell Issa on open and unimplemented recommendations, June 28, 2013.

Appendix C: Status of PFO Program Formulation Activities

Planned Activity	Status as of Multi-Mission Interim Briefing (MMIB), July 21, 2015
Develop a Formulation Agreement in response to the Formulation Authorization Document	In signature cycle
Develop satellite constellation concepts to improve robustness (fault tolerance), resiliency and acquisition efficiency, including evaluating production cadences and mission schedules	Presented at MMIB and ongoing
Develop satellite architectures consistent with above objectives and NOAA's current and planned enterprise infrastructure; and establish payload and launch vehicle risk classifications	Presented at MMIB and ongoing
Support evaluation of current JPSS ground architecture and propose changes to better support the PFO program	Ongoing
Conduct the Acquisition Strategy Meeting for JPSS-3 and JPSS-4 missions	Not conducted; according to NESDIS, the acquisition strategy for PFO was formalized through a series of discussions with NOAA and the Department through the winter and spring of 2014
Conduct a Mid-term or Interim Program Formulation Review (including a plan for the review of the program requirements), Program Implementation Review and Key Decision Point (KDP)-II for the JPSS Program, covering the status of the JPSS-1 and JPSS-2 missions, as well as the two new missions	MMIB conducted July 21, 2015 fulfilled requirement for mid-term or interim program formulation review KDP-C is planned for Q4 FY 2016
Propose a budget management and accounting structure to track the JPSS program of record and follow-on funds separately, including necessary transfers	Not presented at MMIB
Develop or update the program and mission documentation required to meet the KDP-II for the program, which includes the two new missions, including:	See status below
• NASA JPSS Flight Project Plan	To be revised for JPSS-3/4
• NASA JPSS Ground Project Plan	NASA will not revise due to plan to transition ground system responsibility to NOAA (NOAA status not reported at MMIB)
• JPSS Level-1 Requirements Document	Draft in review
• JPSS Level-1 Requirements Supplement	In process of being restructured to support multi-mission implementation
• Level-1 Program Implementation Document	Whether to be revised for JPSS-3/4 is to be determined
• Management Control Plan	Draft update in review
• NASA Program Commitment Agreement	To be revised for JPSS-3/4
• NOAA Program Commitment Agreement	To be revised for JPSS-3/4
• NASA JPSS Program Plan	Draft revision ready to be distributed for review
• NOAA JPSS Implementation Plan	To be revised for JPSS-3/4

Source: OIG analysis of program information

Appendix D: Changes to Flight Requirements for JPSS-2, -3, and -4 Missions

Parameter	JPSS-1	JPSS-2/3/4
Contingency mission	N/A	J2: N/A J3: Flight structural thermal models, early launch readiness date, satellite integration & test deltas J4: N/A
Launch-on-need	N/A	J2: N/A J3/4: Early LRD, extended ground storage
Launch vehicle	Delta II	Delta IV, Atlas V, or Falcon 9 compatible
Instrument suite[a, b, c]	ATMS, CrIS, VIIRS, OMPS Nadir, CERES	ATMS, CrIS, VIIRS, OMPS Nadir & Limb, RBI
Satellite integration & test ground system	Contractor unique, government converted procedures/databases	JPSS ground system, [common test tool]-based procedures/databases
Mission life	7 years	7 years
Mission orbit sustainment (propellant)	7 years	10.5 years
Stored mission data rate (for both to ground network and space network)	150 Mbps encoded	300 Mbps encoded
Stored mission data-to-space network link	Backup	Primary (enables new hybrid tracking and data relay satellite system/polar ground network concept of operations)
Direct broadcast rate	15 Mbps	15 or 30 Mbps (selectable)
On-board data storage	2.5 orbits	3 orbits required (~5 orbit capability specified)

Source: JPSS Multi-Mission Interim Briefing, July 21, 2015
[a] ATMS and CrIS provide key performance parameter data used in numerical weather prediction models; [b] VIIRS imagery of the Northern latitudes is also a key performance parameter for the JPSS program; [c] OMPS-Limb and RBI will be provided by NASA (i.e., separately funded) on an "accommodate-only" basis—interagency agreements reserve NOAA the option not to carry the instruments, if necessary, to preserve JPSS launch schedules.

Appendix E: Ground Segment Changes Anticipated for JPSS-2, -3, and -4 Missions

Topic	Current Baseline	JPSS-2/3/4 Multi-Mission Baseline
Data products	For SNPP/JPSS-1: JPSS program verification responsibility for Raw Data Records, Sensor Data Records, Key Performance Parameters, and Priority 2-4 data products (~60 in all)	For future baseline, the JPSS Program verification responsibility will only include mission unique (~15) data products versus NOAA enterprise responsible for all other enterprise data products (currently around 60 data products)
Stored mission data concept of operations	Polar ground station primary/TDRSS backup or contingency	Leverage international EUMETSAT/TDRSS capabilities; phased implementation to provide lower cost long-term with acceptance of some higher risk (availability)[a]
Mission operations support team and flight simulator responsibilities	Mission operation support team and end-to-end simulator responsibility is in ground project	Flight assumes responsibility for mission operations support team, integration and delivery of simulators for JPSS-2 – JPSS-4; some integration responsibility with ground segment for integration into NOAA satellite operations facility/consolidated back-up unit
Integrated ground segment	Bifurcated ground system elements and NOAA elements (NOAA data exploitation /product distribution and access), No trade space between systems (data processing)	Treat as integrated ground segment to meet key technical performance measures, JPSS program focus on mission unique data products, simplify interfaces, goal to reduce long term sustainment effort.
Security	NIST Special Publication 800-53 revision 3	NIST Special Publication 800-53 revision 4

Source: JPSS/PFO Multi-Mission Interim Briefing, July 21, 2015, section 3, page 20
[a] EUMETSAT—European Organisation for the Exploitation of Meteorological Satellites; TDRSS—Tracking and Data Relay Satellite System.

Appendix F: Summary of JPSS-2 Activities

Program plans to establish JPSS-2 mission cost and schedule baselines in 2016 and has begun acquisitions of a spacecraft and instruments

Cost and schedule baselines specific to the JPSS-2 mission will be formally set at its Key Decision Point-C, currently scheduled for September 2016. That milestone will also mark the project's transition to the final design and fabrication phase of its life cycle. NOAA has accelerated the JPSS-2 launch date by one quarter, to address concern for the constellation's fault tolerance. The program's current planned launch date is July 2021.

Spacecraft contract was restarted after award was upheld. Subsequent to the March 23, 2015, award of the JPSS-2 spacecraft contract to Orbital ATK, Ball Aerospace & Technologies Corporation, the Suomi NPP and JPSS-1 spacecraft vendor, protested the award. Contract performance was suspended while the protest was adjudicated. On July 16, 2015, GAO denied the protest. According to project management reports, there was an 80-day schedule loss as a result of the protest. The loss will be absorbed by the flight project's schedule reserve for the JPSS-2 mission.

Instrument acquisitions are underway. In the fall of 2014, NASA awarded sole source contract modifications for three JPSS-2 instruments: ATMS, CrIS, and OMPS. A VIIRS unit was put on contract in 2013. [38]

One interagency agreement for JPSS-2 accommodation of NASA-provided instruments was completed and another was under review. The RBI and OMPS-Limb are now NASA-funded instruments and will fly on JPSS-2 on a noninterference basis. Interagency agreements are needed to ensure RBI and OMPS-Limb pose no risk to the JPSS-2 mission.

In September 2014, NOAA and NASA officials signed an interagency agreement pertaining to RBI accommodation on JPSS-2. The agreement stipulates that NASA will develop and deliver RBI to the spacecraft vendor before the last scheduled instrument integration. If necessary, the instrument may be replaced with a suitable mass model or, if not fully tested, may fly in an "as is" state. As we concluded our fieldwork, a draft agreement for OMPS-Limb accommodation on JPSS-2 had been prepared but was still under review by both parties.

[38] See table F-1 for a summary of major contracts.

Table F-1. Orbital ATK JPSS-2 Spacecraft Contract (with options for JPSS-3 and JPSS-4)

Spacecraft	Period of performance	(In millions $)		
		Firm fixed price	Pre-priced changes[a]	Full value
JPSS-2	March 30, 2015–July 31, 2020	244.8	8.4	253.2
(Option 1) JPSS-3	Additional 4 years	119.8	10.4	130.2
(Option 2) JPSS-4	Additional 4 years	74.0	12.5	86.5
TOTAL	March 30, 2015–July 31, 2028	438.6	31.3	469.9

Source: NASA-Orbital ATK JPSS-2 Spacecraft Delivery Order
[a] The value of all pre-priced changes that may be invoked.

The contract includes spacecraft development, integration of the instruments, launch support, on-orbit commissioning, and postlaunch support. Also included are pre-priced costs for late delivery of instruments, additional testing, satellite storage and post-storage testing, and change of launch vehicle.

Table F-2. JPSS-2 Instrument Contracts

Contract Award Date	Instrument	Contractor	Contract Value[a] (in millions $)
October 2014	ATMS	Northrop Grumman Electronic Systems	121.6
September 2014	CrIS	Exelis, Inc., Geospatial Systems	220.8
September 2014	OMPS	Ball Aerospace and Technologies Corp.	115.0
June 2013	VIIRS	Raytheon Space and Airborne Systems	232.7

Source: JPSS instrument contracts and program management reports
[a] Includes total estimated cost, base fee, and maximum award fee.

These are sole-sourced, cost-plus-award-fee contracts with the Suomi NPP/JPSS-1 instrument vendors.

Appendix G: Related OIG Products

Date Issued	Document Number	Title
Oct 06, 2015	OIG-16-002	*Top Management Challenges Facing the Department of Commerce in FY 2016:* "Challenge 3. Ensure communities and businesses have the necessary information, products, and services to prepare for and prosper in a changing environment."
Jun 11, 2015	OIG-15-032-I	*Cost Estimates, Long-Term Savings, Milestones, and Enterprise Architecture Policy Are Needed for Common Ground System Satellite Program*
May 28, 2015	OIG-15-030-A	*Audit of NOAA's Geostationary Operational Environmental Satellite-R Series: Leadership Must Proactively Address Integration and Test Risks to Maintain Revised Launch Schedule*
Oct 16, 2014	OIG-15-002	*Top Management Challenges Facing the Department of Commerce in FY 2015:* "Challenge 3. Ensure communities and businesses have the necessary information, products, and services to prepare for and prosper in a changing environment."
Aug 21, 2014	OIG-14-027-M	*Expedited Efforts Needed to Remediate High-Risk Vulnerabilities in the Joint Polar Satellite System's Ground System–Final Memorandum*
Jun 17, 2014	OIG-14-022-A	*Audit of Joint Polar Satellite System: To Further Mitigate Risk of Data Gaps, NOAA Must Consider Additional Missions, Determine a Strategy, and Gain Stakeholder Support*
Mar 06, 2014	OIG-14-014-M	Memorandum to the Acting Under Secretary for Oceans and Atmosphere, *Audit of NOAA's Geostationary Operational Environmental Satellite–R Series Core Ground System Observations*
Nov 25, 2013	OIG-14-002	*Top Management Challenges Facing the Department of Commerce in FY 2014:* "Challenge 2. Strengthen Oversight of National Oceanic and Atmospheric Administration (NOAA) Programs to Mitigate Potential Satellite Coverage Gaps, Address Control Weaknesses in Accounting for Satellites, and Enhance Fisheries Management"
Apr 25, 2013	OIG-13-024-A	*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*
Nov 09, 2012	OIG-13-003	*Top Management Challenges Facing the Department of Commerce in FY 2013*: "Challenge 5. Reduce Risks of Cost Overruns, Schedule Delays, and Coverage Gaps for NOAA's Satellite Programs"
Sep 27, 2012	OIG-12-038-A	*Audit of the Joint Polar Satellite System: Continuing Progress in Establishing Capabilities, Schedules, and Costs Is Needed to Mitigate Data Gaps*
Oct 24, 2011	OIG-12-003	*Top Management Challenges Facing the Department of Commerce in FY 2012:* "Challenge 5. Manage the Development and Acquisition of NOAA's Environmental Satellite Systems to Avoid Launch Delays and Coverage Gaps"
Sep 30, 2011	OIG-11-034-A	*Audit of the Joint Polar Satellite System: Challenges Must Be Met to Minimize Gaps in Polar Environmental Satellite Data*
Jun 10, 2011	OIG-11-029-M	Memorandum to the Under Secretary of Commerce for Oceans and Atmosphere, *NOAA's Joint Polar Satellite System Audit Observations*
Dec 20, 2010	OIG-11-015	*Top Management Challenges Facing the Department of Commerce in FY 2011*: "Effectively Managing the Development and Acquisition of NOAA's Environmental Satellite Programs"
Nov 20, 2007	OSE-18291	*Successful Oversight of GOES-R Requires Adherence to Accepted Satellite Acquisition Practices*
May 08, 2006	OIG-17794-6-001	*Poor Management Oversight and Ineffective Incentives Leave NPOESS Program Well Over Budget and Behind Schedule*

Source: OIG

Appendix H: Agency Response

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

APR 01 2016

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

FROM: VADM Michael S. Devany
Deputy Under Secretary for Operations

SUBJECT: *The Joint Polar Satellite System: Further Planning and Executive Decisions Are Needed to Establish a Long-term, Robust Program*
Draft OIG Audit Report

Thank you for the opportunity to comment on the Office of the Inspector General's draft audit report evaluating the Joint Polar Satellite System (JPSS). We concur with all nine recommendations and our attached response describes both completed and planned actions to address each one. We will continue our efforts to fully implement those recommendations and work with the Department to close them.

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
"The Joint Polar Satellite System: Further Planning and Executive Decisions Are Needed to Establish a Long-term, Robust Program"
(March 2016)

General Comments

The Department of Commerce's National Oceanic and Atmospheric Administration (NOAA) appreciates the opportunity to review and comment on the Office of Inspector General (OIG) draft report on Polar Weather Satellites. NOAA has reviewed the report and agrees with all OIG recommendations. The response to each recommendation is provided below.

NOAA also recommends factual and technical changes to the report which are provided below our response to the recommendations, to ensure that the information presented is complete, accurate, and up-to-date.

Recommended Changes for Factual/Technical Information

Page 1 of the transmittal letter, First bullet, Line 7:
Change "NOAA had not yet determined the life-cycle cost of PFO missions" to "NOAA is continuing to refine and update the life-cycle cost of PFO missions to prepare a baseline consistent with rigorous standards." The statement: "NOAA had not yet determined the life-cycle cost of PFO missions." is not accurate. A preliminary estimate of life cycle cost has been determined, and communicated verbally to stakeholders. Per our rigorous program and project management process requirements and consistent with appropriations law and Federal budget process policy, JPSS will refine the life cycle cost estimate; reconcile it with an Independent Cost Estimate; subject requirements, plans, and cost estimates to independent review; and submit the results along with the recommended life cycle baseline commitment including life cycle cost, for formal Key Decision Point approval by the decision authority (Deputy Secretary unless delegated to the Under Secretary).

Page 1, first paragraph, line 5:
Change "…launch by March of 2017" to "…launch by end of March 2017." The Program Commitment is not by end of February 2017 as implied by the statement "by March."

Page 1, footnote 4, lines 3 and 4:
Between "…with just microwave and infrared sounders…." and "that could be…" add: "that provide data equivalent to ATMS and CrIS.." – a gap cannot be filled with inferior instruments. They must be at least as good as ATMS and CrIS. Inferior instruments can mitigate the impact of a gap.

Page 2, table 1:
Suggest that you may wish to update Launch Readiness and Scheduled Launch Dates to January 2017 to reflect current plans. While this may also become outdated it will be more aligned with actual dates at the time of the release of the report. Making this change will also require

updating the source document footnote under the table to add a source identifying the January 20th launch readiness date.

Page 2, first paragraph, Line 5:
Change the following text to capture discussions with the Administration. "We understand that this acquisition strategy was formalized through a series of discussion with NOAA, ~~and~~ the Department *and the Administration* in ~~the winter and spring of~~ 2014.

Page 2, second paragraph, Line 3:
Delete the parenthetical "(likely due to challenges with the overall agency budget)" because it is speculation.

Page 2, second paragraph:
Delete JPSS-1 as an example in "NOAA chose to limit its polar satellite program to missions up to and including JPSS-2." While it is true that the program suffered from inefficiencies of buy one at a time for JPSS-1, it was not by NOAA's choice. NOAA did not have a choice for JPSS-1 because the instruments were started under the National Polar-orbiting Operational Environmental Satellite System, or NPOESS. As stated in the report, the procurement for JPSS-1 was already underway by the time the JPSS program was initiated.

Page 4, third paragraph, line 5:
Change "NOAA had not yet determined the life-cycle cost of PFO missions" to "NOAA is continuing to refine and update the life-cycle cost of PFO missions to prepare a baseline consistent with rigorous standards." The statement: "NOAA had not yet determined the life-cycle cost of PFO missions." is not accurate. A preliminary estimate of life cycle cost has been determined, and communicated verbally to stakeholders. Per our rigorous program and project management process requirements and consistent with appropriations law and Federal budget process policy, JPSS will refine the life cycle cost estimate; reconcile it with an Independent Cost Estimate; subject requirements, plans, and cost estimates to independent review; and submit the results along with the recommended life cycle baseline commitment including life cycle cost, for formal Key Decision Point approval by the decision authority (Deputy Secretary unless delegated to the Under Secretary).

Page 4, third paragraph:
Change the last sentence to read "Finally, the program is looking to evolve the JPSS ground segment. Planning of the ground management transition from NASA to NOAA is in the early phases."

Page 4, fourth paragraph:
Recommend adding a sentence at the end that states: "These delays were driven by the 100 day protest of the JPSS-2 spacecraft contract award, and enactment of the FY16 budget."

Page 4, fifth paragraph, line 5:
Change the sentence by inserting the text *manage and* to read "The program studied ways to *manage and* develop a more sustainable and simplified ground system and began planning a

transition of responsibilities for the long-term sustainment of the JPSS..."

Page 5, second paragraph, second bullet:
Change the sentence by inserting the text *management of* to read "assessing risks and realistic date for transitioning *management* of common ground…"

Page 5, third paragraph:
Change: "…process of revising requirements and its technical baseline, management control plans and other documentation of its approach…." to "restructuring requirements and its technical baseline, management control plans and other documentation to align with a multi-mission approach… " – a reader may misinterpret revising requirements to include departing from the concept of making JPSS-3 and JPSS-4 copies of JPSS-2. We are not departing from that concept, but are restructuring to implement the concept in the most efficient manner possible.

Page 5, fourth paragraph, line 1:
Change: "Program Plans indicated that PFO's life-cycle cost, schedule and performance baselines would be established in September 2016, in conjunction…" to "Preliminary program planning indicates that PFO's life cycle cost schedule and performance will begin undergoing Key Decision Point Review as early as September 2016, in conjunction…." The Key Decision Point review process has several steps that cannot all be completed within 1 month. Afterward, a decision memo must be issued that approves the baseline and a report submitted to Congress. A schedule for the report to Congress has not been determined as of the date this report was written.

Page 5, fourth paragraph, line 3:
Change "FY 2017 budget negotiations with the Office of Management and Budget (OMB) and Congress are likely to have a role in the process." To "Establishment of the PFO baseline will be dependent upon continued Administration and Congressional support of the required budgets."

Page 5, fifth paragraph, lines 4-5:
Change "….exactly what capabilities the program will deliver, and for what cost, will remain uncertain." To "what cost and schedule the program will deliver JPSS-3 and JPSS-4 will remain uncertain." NOAA has never been uncertain about the capabilities for the PFO baseline, only on what cost and schedule they can be delivered.

Page 7, section header C:
Change: "C The life-cycle cost of PFO had not been determined" to "The life cycle cost of PFO had not been baselined." The statement: "The life-cycle cost of PFO had not been determined" is not accurate. A preliminary estimate of life cycle cost has been determined, and communicated verbally to stakeholders. Per our rigorous program and project management process requirements and consistent with appropriations law and Federal budget process policy, JPSS will refine the life cycle cost estimate; reconcile it with an Independent Cost Estimate; subject requirements, plans, and cost estimates to independent review; and submit the results along with the recommended life cycle baseline commitment including life cycle cost, for formal Key Decision

Point approval by the decision authority (Deputy Secretary unless delegated to the Under Secretary).

Page 7, second paragraph, line 7:
Delete reference to potential savings of $1 billion. Those estimates were targets based on initial estimates. Providing them in this report would create unrealistic expectations for the final LCC for PFO.

Page 8, table 2:
Recommend adding an asterisk to the last line, "Award," with a note that PFO appropriation enactment was in late December 2015, delaying award dates.

Page 9, second paragraph, 1st sentence:
Clarify the sentence to indicate that technical changes are required for acquisition documents, not the instruments, by adding the text *to acquisition documents*. The sentence should read: "Program staff asserted to us that to change from the existing cost plus award fee contracts (for JPSS-1 and -2 instruments) to fixed price contracts for JPSS-3/4 would have required significant technical and business changes *to acquisition documents* that would have been both time consuming and costly."

Page 9, fourth paragraph:
Change "Under the terms of the contract, the option for the JPSS-3 spacecraft would need to be exercised in early November 2018 in order to support a contingency weather mission launch in May 2023 as shown in table 1 above. The option for JPSS-4 could be exercised to support a launch as early as January 2026, possibly sooner if mutually agreed upon." to: "Under the terms of the contract, the option for the JPSS-3 spacecraft would need to be exercised in early November 2018 in order to support **the full JPSS-3 mission LRD of January 2024,** as shown in table 1 above. The option for JPSS-4 could be exercised to support a launch as early as **April 2026**, possibly sooner if mutually agreed upon." It is confusing to try to convey a small number of specific contract date details that are defined to support mission planning with margin. The mission planning is accurately portrayed in Table 1, and the contractual dates in the spacecraft contract support that mission planning. Also, the contingency mission capability can be called upon at any time up to instrument integration. Our plan is to implement the full mission, and only back off to the contingency mission if necessary. The preparations to fly without a full complement of instruments will be in place ahead of time to ensure readiness to conduct a contingency mission without schedule delay.

Page 9, fifth paragraph, last sentence:
Change "…requirement to replace system hardware…" to "…requirement to replace *certain* system hardware…" Not all hardware needs to be replaced in FY19, only a subset within the IDPS subsystem.

Page 10, first paragraph, 1st sentence:
Change "…indicated that requirements for the "Segment 3/Block 3.0" multi-mission common ground system would need to be defined…" to "…indicated that requirements for the JPSS-2 adaptations needed for the multi-mission common ground system would need to be defined…."

We have not yet precisely defined Segment 3/Block 3.0 vs Block 2.x and it is likely that the adaptations needed for JPSS-2 will go into a Block 2.x release. Also, not all modifications that might be grouped into a Segment 3/Block 3 are needed by the time the JPSS-2 adaptations are needed.

Page 10, second paragraph, 1st sentence:
Modify the following statement to capture the framework for transition planning "In addition, the program was in the process of developing a *framework* ~~transition plan~~ for transferring responsibility of the common ground system contract (i.e., for its further development and sustainment) from NASA to NOAA ~~approximately 1 year after JPSS-1 is launched~~.

Page 10, second paragraph, second sentence:
Change "In addition, the program was still revising its review plan, so it was not clear whether the actual transition would be preceded by an independent review of the program's preparations for doing so." to "Because the program was still revising its transition framework, it was not yet documented that the actual transition would be preceded by an independent review of the program's preparations for doing so." All the planning JPSS has done with OSGS for the transition has included independent review of the program's preparations and of the readiness, similar to the approach the program has taken for transition of satellite operations to OSPO.

Page 12, second paragraph, last sentence:
Change from "Nevertheless, the project struggled with development and integration problems that delayed the completion of Block 2.0 and added risk to the JPSS-1 launch schedule." to "However, development and integration problems resulted in delays to the Block 2.0 Operational Readiness and transition to operations for supporting the SNPP operations." "Struggle" could be mis-understood - meaning includes, forceful or violent efforts to get free of restraint or restriction; or difficulty handling or coping with, neither of which accurately portray the JPSS Ground Project situation. And, we have not yet connected ground delays to JPSS-1 launch schedule risk, because the flight system has always driven the critical path.

Page 12, Figure 3:
Include JPSS-1 Mission ORR milestone as context for JPSS-1 readiness. The latest Ground Project Schedule as of February 2016, has the JCT 3 in May 2016 and the Block 2.0 ORR on August 30, 2016. It should also be noted that the movement of some of these events was due to other issues outside the Ground Project purview.

Page 13, third paragraph, 3rd sentence:
Change last sentence from "The ground project indicated that it lacked sufficient reserves" to "The ground project indicated it was *at risk* of inadequate reserves…"

Page 13, fifth paragraph:
Change last sentence from "…existing operational common ground system (currently known as Block 1.2),…" to "…existing operational ground system (designated Block 1.2),…"

Page 13, sixth paragraph, Line 5:
Change from "…other elements of the larger JPSS ground segment..." to "…other elements of the broader JPSS ground segment…" The Ground Segment is the phrase that JPSS utilizes to refer to the whole ground capability required by the program. The Common Ground System is delivered by Ground Project under the Raytheon prime contract.

Page 13, last sentence (and continued on top of page 14):
Modify the sentence because the schedule tool was more limited in purpose than the original sentence indicates. The sentence should read "The program developed a schedule tool to help resolve potential resource conflicts with GOES-R. The delay of GOES-R placed the launch readiness of both missions in the Fall of 2016."

Page 14, first full paragraph:
Change "Program had not reported trends of ground system development metrics to provide insight into issues" to "Program had not reported trends for more specific detailed metrics than standard to provide insight into issues." Various ground project metrics showing ground system development trends have been provided including earned value management schedule and cost performance, critical milestone status for the next 12 months, cumulative trend analysis, risks and issues, and status of reserves.

Page 14, second paragraph:
Change "Transition of common ground system management presents risks and Opportunities" to "Transition of Ground System Project Management …" It is more than the common ground system that will transition.

Page 18, second paragraph, Lines 5-7:
Change "The program was further studying the feasibility of its launch-on-need strategy, including exploring options to reduce what is typically 2 years needed to ready a launch vehicle." to "The program was further studying its launch-on-need strategy, including exploring options to reduce uncertainty in meeting the within 1 year target." We have not identified any feasibility issues with launch-on need strategy. The only fundamental difference is between what we plan and routine strategy is that we plan to store the satellites in a flight ready condition, then bring them out of storage and prepare for launch. Launch Service Task Orders for JPSS 3/4 will include provisions for pre-priced launch delay periods to enable incremental reschedule from the earliest contingency date to the nominal mission launch date. Once a spacecraft is Launch ready there will be a Launch Delay until launch on need (LON) is needed or the planned launch date is reached. There will be a reset of the launch clock at L-6 months to L-12 months every 6 months as required until mission is ready to proceed to launch. The risk is the ability to secure the desired launch date following a reschedule based upon the priority of the JPSS-3/4 mission in the launch queue. The ability to do this has been demonstrated many times with satellites that slip their readiness dates for launch. Two years is not typical for recovery from a satellite launch delay caused by a slip in satellite readiness.

Editorial Comments
Page 11, second paragraph, Line 7 and seventh paragraph, Line 3:
Replace "science" with "stored" mission data antennas.

NOAA Response to OIG Recommendations

Recommendation 1: "Coordinate with the Deputy Secretary to determine who will be Milestone Decision Authority for establishing PFO program cost, schedule and performance baselines, and plan activities supporting a PFO baseline establishment key decision point."

NOAA Response: Concur. The National Oceanic and Atmospheric Administration (NOAA) is requesting the Deputy Secretary delegate the decision-making responsibility for the PFO baseline KDP, to the Under Secretary of Commerce for Oceans and Atmosphere.

There is precedence to delegating MDA to NOAA. In 2007, the Deputy Secretary granted MDA to the Under Secretary for the GOES-R Program. On September 18, 2012, Deputy Secretary Rebecca Blank issued a memo to retain MDA for JPSS Program of Record stating that "NOAA has work underway to identify options and associated independent cost estimates to ensure the JPSS program can execute with a high probability of success and efficiency while minimizing the probability of any gap in critical coverage. Until such time as these risks can be retired, the Key Decision Point authority for the Joint Polar Satellite System (JPSS) program will remain with the Deputy Secretary to ensure the highest levels of support to the program."

Since that 2012 memo from Deputy Secretary Blank, the JPSS Program of Record has demonstrated consistent performance against the plan, and has completed all performance milestones on time. The DOC Office of Acquisition Management completed an Independent Cost Estimate of the JPSS program in May 2013, and the JPSS program baseline was subsequently established in August 2013 at KDP-I/Milestone 2 and 3, with the Deputy Secretary as decision authority. JPSS continues to successfully manage to this baseline today.

Recommendation 2: "Ensure the program's transition plan is subjected to expert, independent review."

NOAA Response: Concur. The ground transition framework agreed between NOAA and NASA already plans for two independent reviews to assess: i) the maturity of transition planning and ii) the readiness for transition. Initial schedules for the reviews have also been identified in the framework.

Recommendation 3: "Direct the JPSS program, on a regular basis, to report trends of schedule metrics for ground system development and JPSS-1 mission preparations to provide insight into issues, sufficiency of resources, and mission readiness."

NOAA Response: Concur. JPSS reports trends on schedule metrics for ground system development and JPSS-1 mission preparations during the GSFC Center Management Council monthly status reviews and the NOAA-NASA Agency Program Management Council.

Recommendation 4: "Direct the completion of a study of JPSS Block 2.0 common ground system development to capture lessons learned and apply them to plans for the Segment3.0/Block 3.0 system and NOAA's Ground Enterprise Architecture System development."

NOAA Response: Concur. NOAA will study JPSS Block 2.0 common ground system development to capture lessons learned and apply them to plans for sustainment updates including Segment 3.0/Block 3.0 and NOAA's Ground Enterprise Architecture System development.

Recommendation 5: "Ensure that NWS completes its contingency plan for JPSS-1 data assimilation and communicates it to users and stakeholders by end of the third quarter of FY 2016."

NOAA Response: Concur. This recommendation is actually part of our development process. JPSS is working with NWS on finalizing a contingency plan to ensure that critical JPSS data are available to NWS within 90 days from the JPSS launch. This plan will be completed by the end of the third quarter of FY2016. The data will flow to NWS operations and ready to switch over to operational use in case of a data gap. In the case of no data gap, NWS will continue to validate and monitor the data through the formal validation period which is scheduled for launch plus six months and then implement the JPSS data to NWS operations when the next NWS scheduled system update takes place.

Recommendation 6: "Provide Department, OMB, and Congressional stakeholders with a list of key activities for operationalizing JPSS-1 data that NOAA will undertake during the potential data gap."

NOAA Response: Concur. Operationalizing JPSS-1 data consists of several key activities. This response will focus on the KPP products, which are the highest priority products for NESDIS and NWS operational users. The goal of these activities is to have everything possible in place prior to the launch of JPSS-1 so that as soon as the data starts flowing from the satellite, it can be made available to users in a timely manner. The timeline of data availability to users assumes that no major on-orbit anomalies occur during post-launch testing.

The science algorithms have already been implemented/integrated into the ground system. They are being testing during the JPSS-1 test activities that are continuing now through launch. For ATMS and CrIS SDR products, the data must be converted into BUFR format and be tailored for use by NWS. The BUFR converter software is planned to be delivered to the ground system at least 30 days prior to launch. Following launch, the science teams will check-out the quality of the data as soon as it is available. Once the quality meets minimum standards, OSPO can operationalize the data to key users such as NWS.

Recommendation 7: "Provide stakeholders with the results of its study of launch-on-need versus launch-on-schedule strategies, as well as the implications for PFO plans."

NOAA Response: Concur. The PFO strategy incorporates both launch on need and launch on schedule strategies and as those plans are refined through study and implemented, NOAA will keep stakeholders informed.

Recommendation 8: "Incorporate NOAA's robust architecture criteria into formal NOAA policy."

NOAA Response: Concur. NOAA's strategy is to be fault tolerant in the sense of maintaining a two-failures-to-a-gap posture and a return to that posture as soon as practicable when it is removed. NOAA's plan is to document the fault tolerant policy via the NESDIS Quality Management System (QMS) which is configuration controlled and maintained. The policy will be approved by the Deputy Under Secretary for Operations (DUSO).

Recommendation 9: "Include new satellite technology insertion as part of NOAA's strategic and tactical plans."

NOAA Response: Concur. From the tactical standpoint, the opportunities for the insertion of new satellite technology are limited due to the process for long term\detailed planning and budgeting of NESDIS programs, especially JPSS and GOES-R Series. Nevertheless, NESDIS has proposed in the FY17 program to initiate a dual purpose gap risk mitigation / technology demonstration mission called Earth Observing NanoSat – Microwave (EON-MW). EON-MW represents a disruptive technology implementation of microwave sounding in a very small size/weight/power form factor ("U-class"). The DUSO is the approving authority for all Level 1 requirements changes to NESDIS programs, of which any new technology insertion would be a part. The plans for funding EON-MW have been approved by the DUSO.

From the strategic standpoint, the Office of Projects, Planning and Analysis (OPPA) and the Office of Systems Architecture and Advanced Planning (OSAAP) are joined in planning to incorporate new technologies into the NESDIS future architecture. OSAAP is currently managing a NOAA Satellite Observing System Architecture (NSOSA) study which is expected to develop architecture options by the end of FY17 that will include the implementation of new technologies to be fully operational by the 2030 epoch. OPPA is prepared to fund (or co-fund with NASA or other partners) technology demonstrations in concert with the NSOSA findings. The DUSO is the approving authority to move forward on program changes including the future architecture.

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