



March 3, 2011

TO: Elizabeth Robinson
Chief Financial Officer
American Recovery and Reinvestment Act Senior Accountable Official

Julie Pollitt
Recovery Act Implementation Executive

FROM: Jim Morrison 
Assistant Inspector General for Audits

SUBJECT: NASA's Use of Recovery Act Funding for the James Webb Space Telescope Project (Report No. IG-11-014; Assignment No. A-09-009-09)

The American Recovery and Reinvestment Act of 2009 (Recovery Act) provided funding to the NASA Office of Inspector General (OIG) for oversight and audit of NASA's use of Recovery Act funding. Among other projects, we conducted a review of the \$75 million in Recovery Act funds allocated to the James Webb Space Telescope (JWST) Project to assess NASA's compliance with Recovery Act mandates and adherence to Office of Management and Budget (OMB) guidelines.

The overall objective of our review was to determine whether management used Recovery Act funds appropriately and met Recovery Act goals and requirements. To conduct our assessment, we analyzed the statements of work for each JWST Recovery Act contract action, reviewed progress reports and other related documentation, reviewed the Agency's Recovery Act program and project plans, and spoke with JWST Project staff to determine whether goals were achieved and funds were used for intended purposes.

Executive Summary

Following multiple schedule delays and substantial cost growth, in 2009 the JWST Project received \$75 million in Recovery Act funding intended to sustain the Project's workforce at a consistent level and maintain the baseline schedule for key development activities. We found that in using these funds, the JWST Project adequately addressed the requirements of the Recovery Act and related OMB guidance and delivered measureable outcomes consistent with Agency program and project plans and the goals of the Act. Specifically, we found that the \$75 million in Recovery Act funds enabled 454 jobs to be retained on the JWST Project in the fourth

quarter of FY 2009 and 149 jobs in the first quarter of FY 2010.¹ In addition, we identified 40 JWST tasks funded by the Recovery Act, of which 34 were completed on schedule – between July 11, 2009, and September 30, 2009; by November 6, 2009; or upon exhaustion of Recovery Act funds, depending upon the contract modification covering the given task. According to NASA officials, all of the critical path tasks were completed on schedule.² Significant progress was also made on the other 6 tasks, which were subsequently fully completed using non-Recovery Act funding. Based on our review of the final performance reports from the involved contractors and discussions with NASA officials, we concluded that the performance results on the JWST Recovery Act activities fulfilled the intent of the Recovery Act, and for tasks that were not completed within the planned period of performance, delays were justified appropriately.

Background

The JWST is projected to be the premier space-based observatory of the next decade, serving thousands of astronomers worldwide. It is a unique, deployable infrared telescope designed to study every phase in the history of our universe, ranging from the first luminous glows after the Big Bang to the formation of solar systems capable of supporting life on planets like Earth to the evolution of our own solar system. The capabilities of the JWST are intended to differ from and far exceed those of the Hubble Space Telescope (Hubble). Specifically, the JWST will primarily look at the universe in infrared and has a much larger mirror, which will allow it to look farther back into time than Hubble. Further, the JWST will travel deeper into space than Hubble – 1.5 million kilometers for the JWST versus 570 kilometers for Hubble.

Over the course of its development, the JWST has encountered technical challenges that have resulted in multiple schedule delays and cost growth. Moreover, because its annual budget is a substantial portion of the Science Mission Directorate Astrophysics Division's budget, schedule delays and cost overruns on the JWST significantly impact the Division's overall performance.³

Early in FY 2009 it became apparent that due to a number of major technical difficulties, including problems with the fabrication and polishing of JWST's design-critical mirrors, the JWST Project would run out of FY 2009 funding well before the end of the fiscal year. In light of this projected funding shortfall, JWST Project management and contractor representatives drafted plans to stop work on the Project before the end of the FY 2009, which they projected would lead to the temporary loss of a significant number of contractor jobs associated with the Project.

According to OMB, agencies should use Recovery Act funds to “support projects that have, among other things and to the greatest extent, a demonstrated or potential ability to deliver programmatic results; optimize economic activity and the number of jobs created or saved in

¹ Jobs retained data as reported by Northrop Grumman and the University of Arizona via federalreporting.gov. We confirmed that the appropriate NASA contract specialist validated the reported data.

² Critical path tasks must be completed on schedule to avoid a delay in the overall Project schedule.

³ JWST was managed by the Science Mission Directorate's (SMD's) Astrophysics Division until December 2010, when JWST was made a separate organizational element within SMD.

relation to the Federal dollars obligated; and achieve long-term public benefits.” In addition, OMB directs agencies to ensure that:

- funds are used for authorized purposes and that instances of fraud, waste, error, and abuse are mitigated;
- projects funded under the Act avoid unnecessary delays and cost overruns; and
- project goals are achieved, including specific project outcomes and improved results on broader economic indicators.

NASA received a total of \$1 billion in Recovery Act funds, of which \$75 million was directed to the JWST Project. The Project used this money to fund 40 discrete tasks intended to help sustain the workforce at a consistent level and maintain the baseline schedule for key development activities. Specifically, the Project paid Northrop Grumman Aerospace Systems (Northrop Grumman) \$65 million for 28 tasks related to the design and development of the ground- and space-based portions of the JWST Observatory and the remaining \$10 million to the University of Arizona for 12 tasks related to the construction of the near-infrared camera (NIRCam), the imager for JWST.

OIG Review of the Project’s Use of Recovery Act Funds

We found that the JWST Project used Recovery Act funds in accordance with the requirements and goals of the Act to prevent cost growth associated with the planned stop-work orders; prevent the temporary loss of a significant number of contractor jobs; accelerate work related to 40 specific tasks; and mitigate significant technical risks identified at the beginning of FY 2009. Moreover, the 40 tasks that used Recovery Act funds were tasks that had to be completed in FY 2009 in order to avoid additional schedule delays. Without the infusion of Recovery Act funding, these tasks could not have been completed in a timely manner. For example, without Recovery Act funding, fabrication of the secondary combustion augmented thruster would have been delayed. According to management officials, such a delay could have further postponed JWST’s launch and further increased the overall cost of the Project.

Of the 40 tasks that were funded, 34 were fully completed within the planned period of performance; i.e. by September 30, 2009, November 6, 2009, or upon exhaustion of Recovery Act funds, depending upon the contract modification covering the given task. Although significant progress was made on the remaining 6 tasks within the performance period, they were completed after the period of performance using non-Recovery Act funds. However, the delay in completion of 4 of these tasks had no impact on the overall JWST schedule. The delay in completion of the remaining 2 tasks resulted in a 1 month delay in development and fabrication of the NIRCam but had no impact on the overall JWST schedule (see list of incomplete tasks below). In addition, use of Recovery Act funding prevented further delays to the overall JWST schedule by providing funding necessary to advance work on the project.

Specifically, NASA awarded \$65 million in Recovery Act funds to Northrop Grumman to advance the JWST Project toward its mission Critical Design Review (CDR). The CDR certifies that the maturity of the JWST program design is appropriate to support proceeding with full-

scale fabrication, assembly, integration, and testing of the mission elements leading to launch. Project management identified 28 individual tasks for Northrop Grumman that needed to be completed to advance toward the CDR. We found that 24 of these tasks were completed within the planned period of performance and that progress was made on the remaining 4 prior to the end of FY 2009. In addition, we confirmed with the Recovery Act Implementation Executive that all 4 tasks had since been completed using non-Recovery Act funding. We did not perform any additional review of these 4 tasks.

In addition, NASA awarded \$10 million in Recovery Act funds to the University of Arizona for construction of the JWST NIRCcam. Project management identified 12 individual tasks that needed to be completed by the University to advance toward CDR. Of those 12 tasks, 10 were completed within the Recovery Act planned period of performance and progress was made on the two remaining tasks prior to the end of FY 2009. In addition, we confirmed with the Recovery Act Implementation Executive that both tasks were completed with non-Recovery Act funding. We did not perform any additional review of these 2 tasks.

Listed below are the tasks that were not completed within their respective Recovery Act performance periods as well as the responsible contractor, the JWST design element affected, the reasons the task was not timely completed, and the ultimate resolution of the task. To compile this list, we reviewed the JWST Monthly Status Report submitted by Northrop Grumman Aerospace Systems to NASA on November 5, 2009, and the JWST NIRCcam Final Report Update, dated January 4, 2010. Details were also provided during our discussion with NASA JWST Project management on January 5, 2010.

JWST Observatory: Northrop Grumman

Task 1. Space Vehicle: Secondary Combustion Augmented Thruster Fabrication

The fabrication of the secondary combustion augmented thruster was not completed on schedule because staff discovered defects in 0.092 inch and 0.062 inch feed tubes. These feed tubes had to be replaced before the secondary combustion augmented thruster could be completed. This work was finalized on December 9, 2009.

Task 2. Optical Telescope Element: Critical Design of the Actuator Drive Unit Hardware and Flight Software

Northrop Grumman completed the flight software design on September 24, 2009, within the scope of the Recovery Act statement of work, as evidenced by a successful Critical Design Audit (CDA) completed on September 24, 2009. The worst-case analysis segment of the hardware design was not completed within the planned period of performance because personnel with the skills and capabilities to perform this analysis were not available when this portion of the design process was scheduled to be conducted. Once the requisite personnel became available, the worst-case analysis was performed and completed on December 9, 2009.

Task 3. Optical Telescope Element: Isolator Design

At the time when this Recovery Act funded task was initiated, it was believed that all of the necessary design parameters for the isolator were well-understood and that Minus-K, the subcontractor selected by Northrop Grumman to design the isolator, would therefore be able to complete the isolator design on schedule. The international agreement specified after the JWST Recovery Act statement of work was finalized that additional ballast mass would be needed to ensure the proper storage balance. The design completion was deferred to ensure Minus-K, the subcontractor selected by Northrop Grumman to design the isolator, had all the design parameters before completing their design, including an increase in ballast mass to improve the system performance. The task was completed shortly after the Recovery Act period.

Task 4. Systems Engineering: Update Modeling and Analysis Plan

Partial progress was made toward completing the Critical Design Review (CDR). The modeling and analysis Technical Interchange Meeting was held; however, the Modeling and Analysis Plan was not completed due to prioritization of the integrated modeling cycle for the OTE CDR. Progress was scheduled to continue through February 2010 in preparation for an April mission CDR. The Modeling and Analysis Plan has since been completed.

University of Arizona: NIRCam

Task 5. Advance NIRCam toward ETU Delivery and Flight Unit Assembly: Short Wave Engineering Test Unit (ETU) Integration

This milestone could not be completed during the Recovery Act period of performance due to unexpected engineering design flaws. Upon delivery to the University of Arizona, staff discovered that the cable harnesses needed to complete the ETU integration, which were built and supplied by NASA (Goddard Space Flight Center), were inadequately shielded. The ETU Integration has since been completed.

Task 6. Advance NIRCam toward ETU Delivery and Flight Unit Assembly: Singlet Assembly Integration and Testing

Assembly of the NIRCam design and fabrication depended on the delivery of the optical lens, which required a coating necessary for proper lens function. The University of Arizona had subcontracted the work to Lockheed Martin, but Lockheed Martin could not perform the work and subcontracted the job to JDS Uniphase. This subcontractor had demonstrated to Lockheed Martin their ability to properly coat the telescope lens; however, the lens was delivered to Lockheed Martin with defects. Lockheed Martin subsequently conducted a quality audit at JDS Uniphase and generated a number of action items for follow-up. A resolution plan was established by Lockheed Martin and corrective actions were implemented at JDS Uniphase. In mid-January 2010, JDS Uniphase once again successfully demonstrated its ability to perform the required lens coating. The singlet assembly integration and testing has since been completed.

Based on our review of the final performance reports from Northrup Grumman and the University of Arizona, as well as discussions with JWST officials, we concluded that the performance results for JWST Recovery Act activities fulfilled the intent of the Recovery Act, and for tasks that were not completed within the planned period of performance, delays were appropriately justified. In addition, NASA and JWST contractors took appropriate steps to continue and complete these remaining tasks.

Although comments were not required, technical comments provided by NASA management were incorporated into this memorandum, as appropriate. We appreciate the courtesies extended during our review. If you have any questions or need additional information, please contact Laura B. Nicolosi, Director, at 202-358-2562, or John Apker, Project Manager, at 202-358-2978, of the Office of Audits, Mission Support Directorate.

cc:

Michael C. Wholley
NASA General Counsel

Terry Bowie
Deputy Chief Financial Officer

Scope and Methodology

We performed this review from November 2009 through February 2011 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform our work to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on the objectives. We believe that the evidence obtained during this review provides a reasonable basis for our findings and conclusions based on our objectives.

We reviewed the 40 JWST tasks funded by the Recovery Act. To perform this work, we visited NASA Headquarters, the JWST Project facility and Goddard Space Flight Center and visually inspected various modules of the JWST. We also interviewed JWST Project Management personnel and Recovery Act officials. In addition, we reviewed the following documentation:

- American Recovery and Reinvestment Act of 2009, February 17, 2009
- Updated Implementing Guidance for the American Recovery and Reinvestment Act of 2009, April 3, 2009
- NASA's American Recovery and Reinvestment Act Program and Project Plans as submitted to OMB on May 15, 2009
- Procurement Information Circular (PIC) 09-06D, Contracting with Recovery Act Funds, October 14, 2009
- JWST Northrop Grumman and University of Arizona contract modification documents and the related Statements of Work for the Recovery Act funded activities.
- JWST Project progress, status reports, invoices, and financial reports submitted by Northrop Grumman and the University of Arizona

Computer-Processed Data. We did not use computer-processed data to perform this review.

Review of Internal Controls. We reviewed NASA's policies, procedures, and internal controls that address the JWST Project's compliance with the requirements of the Recovery Act as identified in the "Updated Implementing Guidance for the American Recovery and Reinvestment Act of 2009" issued by OMB on April 3, 2009, and did not note any issues. We also reviewed the JWST Project's compliance with NASA Procurement Information Circular (PIC) 09-06D, "Contracting with ARRA Funds," date October 14, 2009, by obtaining and reviewing technical progress reports, financial reports, invoices, and other project deliverables; we did not note any issues.

Prior Coverage. During the last 5 years, the Government Accountability Office has issued 3 reports related to the JWST Project, listed below. We reviewed these reports and determined that the recommendations contained in these reports did not impact our review.

“NASA’s James Webb Space Telescope: Knowledge-Based Acquisition Approach Key to Addressing Program Challenges” ([GAO-06-634](#), July 14, 2006)

“NASA: Assessments of Selected Large-Scale Projects” ([GAO-09-306SP](#), March 2, 2009)

“NASA: Assessments of Selected Large-Scale Projects” ([GAO-10-227SP](#), February 1, 2010)