National Aeronautics and Space Administration

**Office of Inspector General**
Washington, DC 20546-0001

December 2, 2013

TO: Charles F. Bolden, Jr.
Administrator

FROM: Paul K. Martin
Inspector General

SUBJECT: 2013 Report on NASA's Top Management and Performance Challenges

As required by the Reports Consolidation Act of 2000, this memorandum provides our views of the top management and performance challenges facing NASA for inclusion in the Agency's fiscal year (FY) 2013 Performance and Accountability Report.

In deciding whether to identify an issue as a top challenge, we consider its significance in relation to the Agency's mission; its susceptibility to fraud, waste, and abuse; whether the underlying causes are systemic in nature; and the Agency's progress in addressing the challenge. We previously provided a draft copy of our views to NASA officials and considered all comments received when finalizing this report.

Looking forward to 2014, we identified the following as the top management and performance challenges facing NASA:

- Considering Whether to Further Extend the Life of the International Space Station
- Developing the Space Launch System and Its Component Programs
- Securing Commercial Crew Transportation Services
- Maintaining Cost and Schedule for the James Webb Space Telescope
- Ensuring Continued Efficacy of the Space Communications Networks
- Overhauling NASA's Information Technology Governance Structure
- Ensuring the Security of NASA's Information Technology Systems
- Managing NASA's Infrastructure and Facilities
- Ensuring the Integrity of the Contracting and Grants Processes

Similar to last year, we noted that declining budgets and fiscal uncertainties have compounded the difficulty of meeting these and other NASA challenges. Finally, during FY 2014 the OIG will conduct audit and investigative work that focuses on NASA's continuing efforts to meet these challenges. Please contact us if you have questions.

Enclosure

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# NASA's Top Management and Performance Challenges
# November 2013

## Introduction

During the past fiscal year (FY), NASA's rover Curiosity explored the surface of Mars and celebrated the 1-year anniversary of its landing on the Red Planet; six NASA astronauts traveled to and from the International Space Station (ISS or Station); and the Agency continued to work with commercial partners Space Exploration Technologies Corporation (SpaceX), Orbital Sciences Corporation (Orbital), The Boeing Company (Boeing), and Sierra Nevada Corporation (Sierra Nevada) to develop cargo and crew transportation systems that would end the Agency's reliance on Russian and other international spacecraft. SpaceX made cargo deliveries to the ISS in October 2012 and March 2013 and Orbital flew a demonstration mission of its cargo delivery system to the Station in September 2013.

However, the Agency also faced a series of significant programmatic and budgetary challenges. Along with the rest of the Federal Government, NASA began FY 2013 under a 6-month continuing resolution that funded the Agency at FY 2012 levels. This was followed by a budget for the remainder of the fiscal year that reduced the Agency's enacted funding level of $17.5 billion by $626.5 million, or approximately 4 percent due to sequestration.

These financial pressures look to repeat themselves in FY 2014, with no annual budget in place at the beginning of the fiscal year and potential sequestration impacts that could reduce NASA's budget request of $17.7 billion by $1.5 billion to $16.2 billion. As the National Research Council noted in its 2012 report examining NASA's strategic direction and management, NASA's budget is "mismatched to the current portfolio of missions, facilities, and staff."[1] Accordingly, the principal challenge currently facing NASA leaders is to effectively manage the Agency's varied programs in this austere and uncertain budget environment.

In addition to this overarching challenge, NASA managers will continue to grapple with a myriad of individual Agency, project, and facility-related issues. This document identifies what we believe to be the top challenges facing the Agency in FY 2014:

1. Considering Whether to Further Extend the Life of the International Space Station
2. Developing the Space Launch System and Its Component Programs
3. Securing Commercial Crew Transportation Services
4. Maintaining Cost and Schedule for the James Webb Space Telescope
5. Ensuring Continued Efficacy of the Space Communications Networks
6. Overhauling NASA's Information Technology Governance Structure
7. Ensuring the Security of NASA's Information Technology Systems
8. Managing NASA's Infrastructure and Facilities
9. Ensuring the Integrity of the Contracting and Grants Processes

[1] National Research Council, "NASA's Strategic Direction and the Need for a National Consensus" (2012).

In deciding whether to identify an issue as a top challenge, we considered the significance of the issue in relation to the Agency's mission; its susceptibility to fraud, waste, and abuse; whether the underlying causes are systemic in nature; and the Agency's progress in addressing the challenge. We have not ranked the challenges summarized below in priority order.

## 1. Considering Whether to Further Extend the Life of the International Space Station

In the mid-1980s, the United States began negotiating with the Canadian, Japanese, and European space agencies to build and operate a space station in low Earth orbit, and the Russians joined the effort in 1993. Assembly of the ISS began in 1998 and was completed in 2011, with NASA expending approximately $100 billion ($60 billion for construction and $40 billion for associated Space Shuttle flights). Originally slated to be decommissioned in 2015, NASA requested and Congress authorized extending the life of the Station to 2020, and NASA's international partners agreed to support ISS operations and utilization until then. As this deadline approaches, NASA is once again facing the question of whether to request that Congress extend the life of the Station, this time to 2028.

*International Space Station*

As part of its effort to extend ISS operations to 2020, NASA contracted with Boeing, the primary contractor for the ISS, to determine which ISS subsystems required servicing or upgrading in order to maintain the Station for another 5 years. Although a Boeing representative recently stated that this study did not reveal any major structural issues that would prevent ISS operation beyond 2020, deciding whether to extend the life of the ISS another 8 years requires further study by both NASA and its partners. For their part, Russian engineers believe the Zarya cargo module, the oldest pressurized module on the Station, can last in orbit until about 2028 – twice its design service life.

The ISS currently costs approximately $3 billion a year to operate. Extending the Station beyond 2020 would likely require NASA to invest additional funds to service the structure and update its equipment. Consequently, some space policy experts have expressed concern that NASA will not have enough money to make the required upgrades and operate the Station while concurrently developing the Agency's other human exploration programs, including the Space Launch System (SLS) and the Orion Multi-Purpose Crew Vehicle (MPCV). At the same time, NASA needs to gauge the interest and ability of its international partners to assist in extending ISS operations another 8 years.

Given the high costs and extraordinary effort to build the ISS, national leaders have emphasized the importance of maximizing its scientific research capabilities. NASA's current research

aboard the ISS focuses on life and physical sciences, human research, exploration research and technology development, astrophysics, heliophysics, and planetary and Earth science. In addition to NASA-directed research, other Federal agencies, research scientists, and commercial companies have conducted research on the ISS in fields such as cancer treatment delivery systems and vaccine development.

In 2013, NASA's Office of Inspector General (OIG) examined NASA's efforts to maximize research on the ISS and found that although NASA has made progress towards maximizing the Station's research capabilities, opportunities exist for greater utilization.[2] In this report, we found that NASA has generally increased the level of activity for each of the three metrics it uses to assess utilization of ISS research capabilities: average weekly crew time, number of investigations, and use of allocated space. However, further progress depends on the ability of the Center for the Advancement of Science in Space, Inc. (CASIS), the nonprofit organization NASA contracted to manage non-NASA research on the Station, to attract private funding and encourage companies and other organizations to conduct self-funded research. Maximizing these capabilities also relies on the success of the Agency's Commercial Cargo and Crew Programs.

In August 2011, NASA signed a cooperative agreement with CASIS to manage non-NASA research on the ISS. Pursuant to the agreement, NASA provides CASIS $15 million annually to fund non-NASA research proposals. CASIS is expected to supplement these funds by raising additional money and to encourage companies and other organizations to conduct self-funded research on the Station. However, attracting private funding, matching investors with researchers, and fostering a market to conduct non-NASA research on the Station is difficult given that historically NASA has received little interest from private entities to conduct research on the ISS absent a substantial infusion of Government funds.

NASA's Commercial Cargo Program is essential to ensuring the capacity to ferry experiments and supplies to and from the Station and the vehicles currently under development as part of NASA's Commercial Crew Program are expected to make it possible to staff the ISS with a full complement of seven crew members (rather than the current six), thereby increasing the amount of crew time available for research. According to the ISS Program Office, a seventh crew member could add an average of 33 hours per week of crew research time – a 94 percent increase over current rates.

Conversely, if the operational life of the Station is not extended, commercial providers may be left without a Government market for their transportation systems. As discussed below, NASA's goal is to secure transportation for its astronauts to the ISS from a commercial company by 2017, and currently NASA is the only customer for these services. Even if commercial flights begin that year, absent an extension of the ISS beyond 2020, commercial companies will have relatively few opportunities to carry NASA crews to the Station.

The OIG initiated an audit in September 2013 to assess NASA's examination of the issues surrounding possible extension of the ISS beyond 2020.

[2] NASA OIG, "NASA's Efforts to Maximize Research on the International Space Station" (IG-13-019, July 8, 2013).

## 2. Developing the Space Launch System and Its Component Programs

In April 2013, NASA announced plans for a mission to identify, capture, and relocate an asteroid while emphasizing that Mars is its ultimate destination for beyond low Earth orbit human exploration. However, some members of Congress advocate landing on the Moon as a precursor to a Mars mission. Whatever the destination, successful development of NASA's new "heavy lift" rocket – the SLS – and accompanying MPCV capsule are critical to the overall success of NASA's current human exploration goals.

*Artist concept of SLS launch.*

The NASA Authorization Act of 2010 set a goal for NASA to achieve operational capability for the SLS and MPCV by December 31, 2016. NASA has reported that it will not meet this timetable and instead plans to launch an uncrewed test flight of the SLS and MPCV in 2017 followed by a crewed flight in 2021.

NASA is using the Space Shuttle's main engine – the RS-25 – on the SLS vehicle and designing it with an evolvable architecture that can be tailored to accommodate longer and more ambitious missions. Initial versions of the SLS will be capable of lifting 70-metric tons and use an interim cryogenic propulsion stage to propel the MPCV around the Moon on its first exploration mission. Later versions will be designed to lift 130-metric tons and incorporate an upper stage to travel to deep space.

The MPCV will be mounted atop the SLS and serve as the crew vehicle for up to six astronauts on missions beyond low Earth orbit. NASA is developing the MPCV using an existing contract with Lockheed Martin Corporation and is basing its design on requirements for the Orion Crew Exploration Vehicle that was part of NASA's defunct Constellation Program.

In addition to the SLS and MPCV, NASA's Ground Systems Development and Operations (GSDO) Program is modifying launch infrastructure at Kennedy Space Center formerly used for the Space Shuttle. The GSDO Program is refurbishing the crawler-transporter that will transport the SLS from Kennedy's Vehicle Assembly Building to the launch pad and modifying the mobile launcher platform and tower (originally built for the Constellation Program's Ares I rocket), the Vehicle Assembly Building, and launch pad 39B to support the SLS. The OIG initiated an audit in August 2013 to evaluate NASA's management of its launch infrastructure modernization efforts, including work performed by the GSDO Program.

NASA's challenge in this area will be to concurrently develop a launch system and crew vehicle and modify the necessary supporting ground systems while meeting the Administrator's mandate

that exploration systems be affordable, sustainable, and realistic. For example, integrating hardware and supporting equipment from other programs, specifically the Space Shuttle and Constellation, may prove challenging since each piece of equipment was designed and tested for a different launch vehicle. Moreover, achieving successful integration will require effective management of the Programs' integrated cost and schedule.

Looming over the daunting technical and schedule challenges for NASA's human exploration program is a foreboding budget scenario. For example, the MPCV Program anticipates receiving a flat budget of approximately $1 billion per year into the 2020s. Given this budget profile, NASA is using an incremental development approach under which it allocates funding to the most critical systems necessary to achieve the next development milestone rather than developing multiple systems simultaneously as is common in major spacecraft programs. Prior work by our office has shown that delaying critical development tasks increases the risk of future cost and schedule problems.[3] Moreover, NASA Program officials admit that this incremental development approach is not ideal, but contend that it is the only feasible option given current funding levels. Although we believe MPCV Program officials are managing the Program as efficiently as they can within their constrained budget, we are concerned about the future of the Program given the risks associated with incremental development.

Similarly, the Government Accountability Office (GAO) reported in its 2013 assessment of major NASA programs that the SLS Program has had to make adjustments to its development schedule to stay within its short-term funding projections.[4] Specifically, the Program has deferred work on the 130-metric ton vehicle until sufficient funding becomes available. At the same time, NASA may need to modify Space Shuttle heritage hardware such as the RS-25 main engines in order to meet performance requirements for the SLS. In addition, the Program is working to determine what human rating requirements will be required for the SLS and whether the existing SLS design will meet those requirements.

Even after the SLS and MPCV are fully developed and ready to transport crew, NASA will continue to face significant challenges concerning the long-term sustainability of its human exploration program. For example, unless NASA begins a program to develop landers and surface systems, NASA astronauts will be limited to orbital missions. In the current budget environment, however, it appears unlikely that NASA will obtain significant funding to begin development of this additional exploration hardware anytime soon, delaying such development into the 2020s. Given the time and money necessary to develop landers and associated systems, it is unlikely that NASA would be able to conduct any manned surface exploration missions until the late 2020s at the earliest.

## 3. Securing Commercial Crew Transportation Services

Since the conclusion of the Space Shuttle Program in July 2011, the United States has lacked a domestic capability to transport crew and, until recently, cargo to and from the ISS. Consequently, NASA has relied on a series of barter agreements with Japanese and European

[3] NASA OIG, "NASA's Challenges to Meeting Cost, Schedule, and Performance Goals" (IG-12-021, September 27, 2012), and "Status of NASA's Development of the Multi-Purpose Crew Vehicle" (IG-13-022, August 15, 2013).

[4] GAO, "NASA: Assessments of Selected Large-Scale Projects" (GAO-13-276SP, April 17, 2013).

partners to transport cargo to the Station and the Russian Soyuz program to transport its astronauts. Between 2012 and 2017, NASA is scheduled to pay Russia $1.7 billion to ferry 30 NASA astronauts and international partners to and from the ISS at prices ranging from $47 million to more than $70 million per round trip.

As discussed above, reliable cargo transportation to the ISS is essential to ensure that life-sustaining supplies can be delivered to support the Station's crews and to maximize its utilization as a research lab by delivering and returning experiment-related materials to Earth. Beginning in 2006, NASA entered into a series of Space Act Agreements with commercial partners to stimulate the U.S. industry's development of transportation systems capable of providing safe and reliable cargo and crew services to the ISS and low Earth orbit. NASA initiated two activities to manage its investments in this area: the Commercial Orbital Transportation Services (COTS) Program and the Commercial Crew Program.

For the COTS Program, NASA collaborated with and provided funding to two companies –$396 million to SpaceX and up to $288 million to Orbital – to assist in their development of spaceflight cargo capabilities.[5] SpaceX flew successful resupply missions in October 2012 and March 2013 and has a $1.6 billion contract with NASA for a total of 12 resupply missions. Orbital flew its demonstration mission in September 2013, and is scheduled to undertake the first of eight resupply missions under its $1.9 billion contract as early as December 2013. These flights took place after multi-year delays for both companies' spacecraft.

As of August 31, 2013, NASA has spent $1.1 billion on its commercial crew development efforts. The Agency is currently working with three companies – Boeing, SpaceX, and Sierra Nevada – using a combination of funded Space Act Agreements and more traditional contracts based on the Federal Acquisition Regulation (FAR) to develop commercial crew transportation capabilities. NASA's goal is to secure commercial transportation for its astronauts to the ISS by 2017. As of August 31, 2013, the Agency has provided $416 million to Boeing, $328 million to SpaceX, and $229 million to Sierra Nevada to work toward this goal. A fourth company, Blue Origin, is also conducting development work under an unfunded Space Act Agreement with the Agency.

NASA's Commercial Crew Program is entering a critical stage in its development with Boeing, SpaceX, and Sierra Nevada expected to complete their spacecraft designs within the next year. While the partners are responsible for developing the vehicles, they rely heavily on NASA funding. At the same time, NASA maintains responsibility for ensuring that the partners' launch systems, spacecraft, and related ground support will meet Agency safety and operational requirements. All three partners successfully achieved a state of maturity approximate to a

[5] Rocketplane Kistler also received $32.1 million in funding from NASA, but was terminated from COTS in 2007 after failing to meet financial and technical milestones.

Preliminary Design Review prior to NASA's award of the latest round of Space Act Agreements in 2012, and have set an optimistic schedule for achieving what amounts to a Critical Design Review of their systems by mid-2014.[6]

After completion of the initial two rounds of development using funded Space Act agreements, NASA originally planned a two-phased, FAR-based acquisition approach to develop commercial crew capabilities. Phase 1 was to consist of firm-fixed-price contracts to multiple companies for integrated design and early development to be followed by a second round of firm-fixed-price contracts for additional development, testing, evaluation, and certification of the contractors' crew transportation systems. Thereafter, NASA planned to enter into individual FAR-based contracts for each service provider. However, for FY 2012, NASA received $397 million for its commercial crew program, less than half its $850 million request. In light of this development, early in 2012 NASA revised its commercial crew acquisition strategy and has relied on funded Space Act Agreements rather than FAR-based contracts for the integrated design phase of the Program. The funding cuts have also resulted in NASA delaying the expected completion of the commercial crew development phase from 2016 to 2017.

NASA's use of funded Space Act Agreements rather than FAR-based contracts to develop new transportation capabilities has several potential benefits. First, because the partners share development costs and the agreements involve fewer regulations and require less oversight by NASA, there may be a reduction in the Agency's cost of acquiring these capabilities. Second, because NASA does not impose specific requirements on the companies as part of the agreements, the commercial partners are free to develop spacecraft designs that will support the needs of both NASA and other potential customers. Third, NASA officials said they believe the greater flexibility offered by Space Act Agreements promotes creativity and innovation.

However, NASA's use of Space Act Agreements also poses risks, most prominently limiting NASA's ability to dictate specific design and safety requirements during the development process. In addition, oversight of partners in a Space Act Agreement relationship is challenging because the Agreements do not allow NASA to place specific requirements on the companies. Taken together, these constraints make it harder to ensure that the companies will ultimately produce spaceflight systems that meet Agency requirements and that NASA can be confident of their ability to safely carry its astronauts to and from the ISS. To mitigate these concerns, in December 2011 NASA published baseline documents identifying the requirements and certification process for commercial transportation systems. A year later, NASA began the certification process by awarding Boeing, SpaceX, and Sierra Nevada FAR-based contracts that require them to submit key documents for NASA's review and approval.

In a November 2013 audit, we identified four challenges to NASA's commercial crew development program: (1) unstable funding; (2) integration of cost estimates with the Program

[6] Each company defined its own requirements for achieving Preliminary and Critical Design Reviews that were then negotiated with NASA before the Space Act Agreements were awarded. NASA defines a Preliminary Design Review as establishing the basis for proceeding with detailed design and demonstrates that the correct design option was selected, interfaces have been identified, and verification methods have been described. The Critical Design Review determines if the integrated design is appropriately mature to continue with final design and fabrication. Both reviews are important to demonstrate that a system meets all requirements with acceptable risk and within cost and schedule constraints. NASA funded Boeing and SpaceX to achieve a Critical Design Review, but due to its limited budget has not funded Sierra Nevada's completion of that milestone.

schedule; (3) challenges in providing timely requirement and certification guidance; and (4) spaceflight coordination issues with other Federal agencies.[7]

For the past several years, the Commercial Crew Program has received significantly less funding than NASA requested. The reduction in funds has resulted in delays of the expected completion of the commercial crew development phase until 2017 – only 3 years before the currently scheduled end of ISS operations. Further, experience has shown that reducing funding profiles when an increase in funding is required could result in cost increases, schedule delays, and performance problems later in a program's development.

Moreover, NASA has yet to project the total amount of funding required by year, which makes it difficult for NASA to manage its wider portfolio of spaceflight programs and reduces the transparency of the Program's budget submissions. Further, the process for providing timely guidance to partners for satisfying NASA's human rating and certification requirements could be improved. If NASA is unable to confirm design requirements and provide certification guidance in a timely manner, the companies could face costly and time-consuming redesign work late in system development. Finally, coordination of important safety issues with the Federal Aviation Administration (FAA) and the U.S. Air Force is progressing, but has yet to be fully resolved. Resolution of issues such as approval processes for in-flight changes and reentry and emergency diversions require formal agreement between NASA, the FAA, and the Air Force.

Failure to resolve the challenges facing NASA's Commercial Crew Program could significantly delay the availability of commercial transportation services and extend U.S. reliance on the Russians for crew transportation to the ISS.

## 4. Ensuring Continued Efficacy of the Space Communications Network

NASA's Space Communications and Navigation (SCaN) Program is responsible for providing communications, navigation, and delivery of scientific data to space flight missions. SCaN is comprised of three networks: (1) the Near Earth Network, which covers low Earth orbit and portions of geosynchronous orbit; (2) the Space Network, which controls the Tracking and Data Relay Satellites (TDRS) through a network of geographically diverse ground systems; and (3) the Deep Space Network, which covers NASA mission needs beyond geosynchronous orbit.[8] Without SCaN services, NASA could not receive data transmission from its satellites and robotic missions or control such missions from Earth, and space hardware worth tens of billions of dollars would be little more than orbital debris. While NASA has provided these services for over 30 years, many of its current satellite communications systems are aging and increasingly difficult to repair.

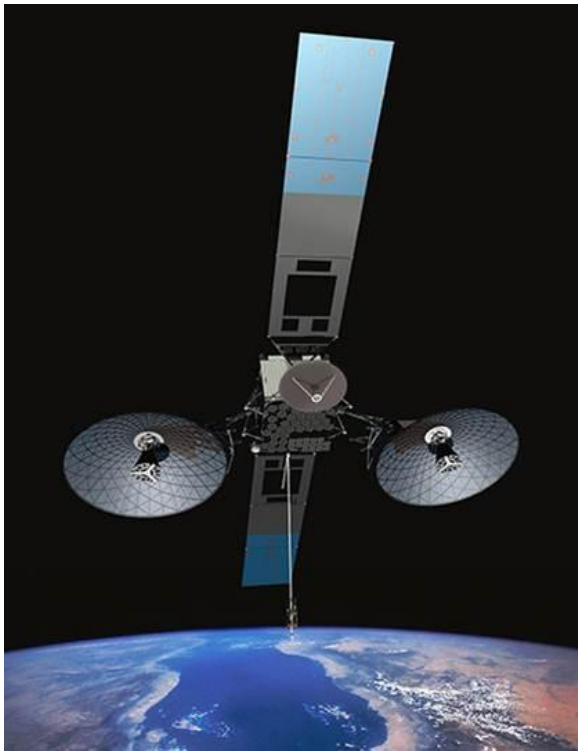
In 2006, NASA initiated the SCaN Program to create an integrated Agency-wide space communications and navigation architecture. The evolution of the integrated system will take place in phases. With a planned FY 2014 budget of $554 million, the Near Earth, Space, and Deep Space Networks initially will remain independent. In the interim, SCaN is adding new capabilities that extend the functionality of the networks and will be incorporated into the

[7] NASA OIG, "NASA's Management of the Commercial Crew Program" (IG-14-001, November 13, 2013).

[8] A geosynchronous orbit is one in which a satellite is always in the same position with respect to the rotating Earth.

integrated architecture. SCaN also manages the Spectrum Program for the Agency and is deeply involved in this issue with other space-faring nations. The Spectrum Management Program ensures that all NASA activities comply with national and international laws applicable to the use of the electromagnetic spectrum.

NASA has plans to upgrade its Space Network through an $860 million Space Network Ground Segment Sustainment (SGSS) Project. The purpose of the SGSS Project is to implement a modern ground station that will enable delivery of high quality services to the Space Network community while significantly reducing operations and maintenance costs. Without the upgrades, the ground system will become increasingly unreliable and more expensive to maintain. To complement the ground station, NASA maintains the TDRS fleet of satellites that transmit the tracking, data, voice, and video services from the ground station to the ISS, NASA's space and Earth science missions, other Federal agencies, and commercial users. The Space Network is in the process of upgrading and replenishing failing TDRS, many of which are operating well beyond their planned lives. The TDRS replenishment efforts are major components of maintaining Space Network capabilities.



*Artist concept of TDRS-K satellite.*

NASA is also upgrading the Deep Space Network. The Deep Space Network was established in 1963 to provide communications for all of NASA's robotic missions outside of Earth orbit, international spacecraft, as well as scientific investigations through radio astronomy, radio science, and radar activities. The Deep Space Network is run from three ground-based sites (Goldstone, California; Madrid, Spain; and Canberra, Australia) with one 70-meter antenna and multiple 34-meter antennas at each location for around-the-clock coverage. As part of the upgrade NASA will replace the aged 70-meter antennas at all three Deep Space Network sites with arrays of new 34-meter antennas by 2025 at an estimated cost of $369 million. The upgrades will support a greater number of missions and spacecraft as well as the increased complexity and data transfer requirements of those missions. For example, NASA projects that future deep space missions will require much faster data transmission than the current system can provide and that future robotic missions will require more precise spacecraft navigation for entry, descent, landing, and outer planet explorations, as well as to support manned missions to Mars.

The OIG is examining the SCaN Program through a series of audits, the first of which will focus on the Space Network to assess how NASA is identifying and adjusting capabilities to meet mission requirements; managing program, cost, schedule, and performance; and addressing key risks facing the Project. Future audits will examine the Deep Space Network, Near Earth

Network, and Spectrum Management, and conclude with a capping report on the entire SCaN Program.

## 5. Maintaining Cost and Schedule for the James Webb Space Telescope

The James Webb Space Telescope (JWST) – the successor to the Hubble Space Telescope – is anticipated to be the premier space-based observatory of the next decade. The telescope is designed to help understand the origin of the universe, the evolution of stars, and the formation of our solar system. JWST consists of a 25-square-meter mirror composed of 18 smaller mirrors, an integrated science instrument module that houses the telescope's 4 instruments, and a tennis court size sunshield. JWST's instruments are designed to work primarily in the infrared range of the electromagnetic spectrum, allowing the telescope unprecedented detection capability. NASA plans to launch the telescope aboard a European Space Agency Ariane 5 rocket in October 2018.

Unlike Hubble, which orbits relatively close to Earth (570 kilometers) and was refurbished by NASA five times since its 1990 launch, JWST will be positioned 1.5 million kilometers from Earth at the second Lagrange point (L2) and therefore unserviceable should it malfunction.[9]


*Hubble Space Telescope and JWST relative to Earth.*

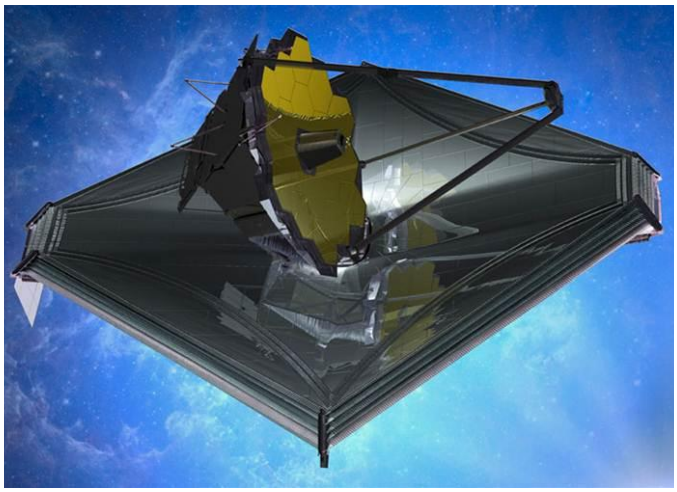
Like many NASA projects, JWST faces challenges meeting cost, schedule, and performance goals. In September 2012, we identified the Agency's optimistic culture, a tendency to underestimate technical complexity, and funding instability as major drivers of cost and schedule growth for its projects, including JWST.[10] Late 1990s and early 2000s cost estimates for the JWST Program ranged from $1 billion to $3.5 billion, with expected launch dates between 2007 and 2011. However, following a change in the launch vehicle and revisions to other requirements, NASA estimated life-cycle costs in 2005 at $4.5 billion with a launch date in 2013. A year later, an independent review team reported that although the Program was technically sound, contingency funding reserves were too low, phased too late in development, and did not support the complexity of the Program. The review team also reported that a 2013 launch date was not achievable. In 2009, NASA baselined JWST with a life-cycle cost estimate of $4.96 billion and a June 2014 launch date.[11]

[9] There are five Lagrange points where the gravitational forces and the orbital motion of the spacecraft, Sun, and Earth interact to create a gravitationally stable location. L2 is directly behind the Earth as viewed from the sun, approximately 1 million miles (1.5 million kilometers) away.

[10] NASA OIG, "NASA's Challenges to Meeting Cost, Schedule, and Performance Goals" (IG-12-021, September 27, 2012).

[11] A baseline defines the requirements, costs, schedule, and performance parameters of an acquisition program, and identifies milestones for measuring the program's progress.

Unfortunately, it soon became clear that neither the baseline cost estimate nor the launch date were attainable. At the request of Congress, NASA commissioned another independent review, and in October 2010 the Independent Comprehensive Review Panel reported that while technical performance was "commendable and often excellent" the budget and contingency funding reserve was severely understated and improperly phased, Program management was ineffective, and the Program could not meet its baselined cost and schedule commitments.[12] Subsequently, NASA restructured the JWST Program and in November 2011 established a revised baseline life-cycle cost estimate of $8.8 billion and an October 2018 launch date.



*Artist rendering of the James Webb Space Telescope.*

Although JWST Program management has made significant progress in the past 2 years, including completion of all 18 primary mirror segments, significant challenges remain for the Program to meet its revised baseline. In December 2012, the GAO reported that the Program's cost estimate could be improved, schedule reserve for required test and integration activities was limited, and two of four instruments had yet to be delivered.[13] The other two instruments – the Near-InfraRed Spectrometer and the Near-InfraRed Camera – were completed and received in September 2013. Program managers have had to continuously adjust the testing schedule to accommodate these delivery delays.

In addition, NASA has identified additional challenges related to the Program's budget. For example, having spent more than anticipated in the past year to address several unanticipated technical challenges, the Program's contingency reserves are less than planned and Headquarters-level reserves for the Program are limited in FY 2014.

As we stated in our September 2012 report, historically NASA has taken funds from other programs when highly visible flagship missions experience significant cost growth. Because JWST is the largest science project in NASA's portfolio, any future budgetary and programmatic challenges will reverberate throughout the Agency.

[12] Independent Comprehensive Review Panel, "James Webb Space Telescope (JWST) Independent Comprehensive Review Panel (ICRP): Final Report" (October 29, 2010).

[13] GAO, "James Webb Space Telescope: Actions Needed to Improve Cost Estimate and Oversight of Test and Integration" (GAO-13-4, December 3, 2012).

## 6. Managing NASA's Infrastructure and Facilities

NASA is the ninth largest Federal Government property holder, controlling approximately 4,900 buildings and structures with an estimated replacement value of more than $30 billion. More than 80 percent of the Agency's facilities are 40 or more years old and beyond their design life. Under its current policy, NASA is required to maintain these facilities either in an operational status or, if they are not being used, in sufficient condition so they do not pose a safety hazard. However, NASA has not been able to fully fund required maintenance for its facilities over the years and in 2012 estimated its deferred maintenance costs at $2.3 billion. Moreover, a 2012 NASA study estimated that the Agency may have as many as 865 unneeded facilities with associated maintenance costs of more than $24 million annually.

The OIG has conducted 10 audits over the past 4 years examining various aspects of NASA's efforts to manage its aging infrastructure.[14] Most recently, in February 2013 we released a report assessing NASA's efforts to reduce unneeded infrastructure and facilities. In that review, we identified 33 facilities, including wind tunnels, test stands, thermal vacuum chambers, airfields, and launch infrastructure at NASA Centers across the country the Agency was not utilizing or for which NASA officials could not identify a future mission use. These facilities cost the Agency more than $43 million to maintain in FY 2011 alone.

Historically, we found that efforts by NASA to reduce its underutilized facilities have been hindered by four longstanding and interrelated factors: (1) fluctuating and uncertain strategic requirements; (2) Agency culture and business practices; (3) political pressure; and (4) inadequate funding. We concluded that the combination of these forces has frustrated NASA's efforts over the years to make meaningful reductions in the size of its real property portfolio. Moreover, without sustained commitment by top NASA leaders and the authority from Congress to make the 'tough calls" when it comes to what facilities to close or consolidate, meaningful downsizing of the Agency's infrastructure will continue to be elusive.

The 33 facilities include:

- *Wind Tunnels*: At least 6 of NASA's 36 wind tunnels were underutilized or not needed for future missions. NASA's use of wind tunnels has declined in recent years due to a reduction in the Agency's aeronautics budget, fewer new aircraft developments by the Department of Defense and private industry, newer and more capable foreign testing facilities, and the advent of alternative testing methods such as computational fluid dynamics.

[14] NASA OIG, "NASA's Management of Energy Savings Contracts" (IG-13-014, April 8, 2013); "Review of NASA's Explosives Safety Program" (IG-13-013, March 27, 2013); "NASA's Environmental Remediation Efforts at the Santa Susana Field Laboratory" (IG-13-007, February 14, 2013); "NASA's Efforts to Reduce Unneeded Infrastructure and Facilities" (IG-13-008, February 12, 2013); "NASA's Plans to Modify the Ares I Mobile Launcher in Support of the Space Launch System" (IG-12-022, September 25, 2012); "NASA's Infrastructure and Facilities: An Assessment of the Agency's Real Property Leasing Practices" (IG-12-020, August 9, 2012); "NASA's Infrastructure and Facilities: An Assessment of the Agency's Real Property Master Planning" (IG-12-008, December 19, 2011); "NASA Infrastructure and Facilities: Assessment of Data Used to Manage Real Property Assets" (IG-11-024, August 4, 2011); "NASA's Hangar One Re-Siding Project" (IG-11-020, June 22, 2011); and "Audit of NASA's Facilities Maintenance" (IG-11-015, March 2, 2011).

- *Test Stands*: As many as 14 of the Agency's 35 rocket engine test stands were underutilized or not needed for future missions. NASA's use of test stands has declined in recent years primarily due to a lack of new, large-scale propulsion test programs. The ongoing development of the heavy-lift rocket associated with the SLS Program is not expected to alter this trend.

*A-3 Test Stand at Stennis Space Center*

- *Thermal Vacuum Chambers*: At least 4 of the Agency's 40 large thermal vacuum chambers were underutilized or not needed for future missions. NASA's use of the chambers has declined in recent years due to a lack of need by NASA programs and the poor condition of some chambers.
- *Airfields*: Two of the Agency's three airfields – Moffett Federal Airfield at Ames and the Shuttle Landing Facility at Kennedy – were underutilized or not needed for future missions. Moffett almost exclusively supports non-NASA entities while the Kennedy facility supports non-NASA space hardware deliveries. The Kennedy airfield was last used for a NASA mission in September 2012 by the plane carrying Space Shuttle Endeavour to its final home at the California Science Center.
- *Launch Infrastructure*: Seven of NASA's launch-related facilities at Kennedy were underutilized or not needed for future missions. These include solid rocket booster recovery facilities, a parachute refurbishment facility, a launch pad, and one Orbiter Processing Facility. NASA's need for this infrastructure ended when the Space Shuttle Program phased out, and timely decisions on their future is needed in light of the high costs associated with continuing their maintenance. To their credit, Kennedy managers have leased one Orbiter Processing Facility and are seeking commercial companies to lease several other sites, including launch pad 39A.

While NASA officials agreed that these 33 facilities are unused or at best underused, the consensus breaks down when searching for a way forward. In our audit, we identified four interrelated challenges that historically have hindered NASA's ability to comprehensively address its infrastructure problems.

First, changes to the Nation's space policy initiated by Congress, the President, and NASA have increased the difficulty of determining which facilities the Agency needs to accomplish its mission. For example, NASA's human exploration mission has transitioned from the Space Shuttle Program to the Constellation Program to the SLS in just 6 years. Because decisions of whether to retain, consolidate, or dispose of specific facilities depend heavily upon the missions NASA undertakes, frequent changes to those missions complicate the task of managing the Agency's infrastructure.

An example of this challenge is the Agency's experience with the A-3 test stand constructed at the Stennis Space Center to accommodate special testing requirements associated with NASA's Constellation Program. When Constellation was cancelled in 2010, the test stand was approximately 65 percent complete and NASA was directed by Congress to complete construction for at a total cost of nearly $350 million. However, because neither the SLS nor any planned NASA program requires the A-3's capabilities, NASA plans to mothball the test stand when construction is complete. At the time of our audit, NASA reported that the associated annual operations and maintenance costs of the mothballed stand could exceed $1.5 million.

Second, NASA has historically practiced a decentralized approach to managing its infrastructure that creates a rivalry between the Centers to compete for work from the Agency's major programs and rewards a "keep it in case you need it" philosophy. This culture has fostered a propensity for Centers to build or preserve facilities that duplicate capabilities available elsewhere in the Agency or lack an identified mission use. For example, NASA currently has 36 wind tunnels at 5 Centers, 35 rocket test stands at 6 sites, and 40 large thermal vacuum chambers at 7 locations.

Third, the political context in which NASA operates often impedes its efforts to reduce infrastructure. During our review, we noted several examples where political leaders intervened in plans to close or consolidate Agency facilities. For example, members of Congress opposed NASA's decision to consolidate the Agency's Arc Jet operations at Ames, directed completion of the A-3 test stand, and contested the Agency's decision to dispose of Hangar One. While input from Federal, state, and local officials is not unique to NASA, such pressure creates additional difficulties for the Agency as it seeks to manage its aging infrastructure.

Finally, demolishing or disposing of facilities that NASA no longer needs to fulfill its mission is not without cost. In many instances, NASA must conduct environmental remediation before it can dispose of a facility. For example, under the terms of its current agreement with California, NASA estimates that the environmental cleanup of its Santa Susana Field Laboratory will cost more than $200 million. Accordingly, the Agency's ability to reduce its real property footprint depends in large part on funding for cleanup and other costs associated with demolition and disposal. However, in this era of constrained Federal budgets, the amount of money dedicated to these activities is not likely to increase. In fact, although the Office of Management and Budget (OMB) supported NASA's facility strategy to reduce its infrastructure, for FYs 2013 through 2017 OMB only supported a budget request for approximately 50 percent of the resources required for the Agency's renewal strategy.

NASA officials readily acknowledge that the Agency has more infrastructure than it needs to carry out current and planned missions and the Agency has several promising initiatives underway to manage its infrastructure, including organizational changes, a new facilities strategy, an analytical framework for making infrastructure decisions, and improvements in managing its real property data. While we view these initiatives as positive steps, most are in the early stages of development and NASA has attempted infrastructure reduction initiatives in the past with limited success. Absent strong and sustained leadership to see its current efforts through and incorporate them into Agency policy, we are concerned that these latest efforts will meet a similar fate. Specifically, Agency leaders must ensure that these initiatives are institutionalized, coordinated, and communicated both inside and outside the Agency. In

addition, they must be willing to make the difficult decisions to divest unneeded infrastructure; effectively communicate those decisions to stakeholders; and withstand the inevitable pressures from Federal, state, and local officials.

Leasing unneeded facilities offers NASA another means to help address maintenance costs associated with its aging and underutilized facilities. However, Federal law and policy prohibit NASA from leasing facilities for which it has no current or future mission-related use. Instead, the Agency should consider other options for these facilities such as demolition or reporting the property to the General Services Administration for sale or transfer to another entity. The challenge for NASA is to use leasing when appropriate to generate revenue to offset facilities operations and maintenance costs while not using it as a way to hold on to facilities it does not need. An August 2012 OIG audit examined NASA's leasing practices and offered eight recommendations for improving the effectiveness of its efforts.

Given the disparity between the Agency's infrastructure and its mission-related needs, as well as the likelihood of continued constrained budgets, it is imperative that NASA move forward aggressively with its infrastructure reduction efforts. To achieve this goal, the Agency will need to move away from its longstanding "keep it in case you need it" mindset and overcome historical incentives for the Centers to build up and maintain unneeded capabilities. In addition, NASA officials need to manage the concerns of political leaders about the impacts eliminating or consolidating facilities will have on Centers' missions, their workforces, and the local communities. Moreover, abrupt changes in the strategic direction of the Nation's space policy by Congress, the President, and NASA will continue to add an element of uncertainty regarding the missions the Agency will pursue and therefore the facilities it will need to achieve those missions.

We acknowledge that NASA's best efforts to address these challenges may ultimately be insufficient to overcome the cultural and political obstacles that have impeded past efforts to eliminate Agency facilities. Accordingly, an outside process similar to the Department of Defense's Base Realignment and Closure Commission may be necessary to make the difficult but necessary infrastructure decisions.

## 7. Overhauling NASA's Information Technology Governance Structure

Information technology (IT) plays an integral role in every facet of NASA's operations. The Agency spends more than $1.4 billion annually on a portfolio of IT assets that includes approximately 500 information systems used to control spacecraft, collect and process scientific data, and enable NASA personnel to collaborate with colleagues around the world. Hundreds of thousands of individuals, including NASA personnel, contractors, members of academia, and the public, rely on these IT systems daily.

For more than 2 decades, NASA has struggled to implement an effective IT governance approach that appropriately aligns authority and responsibility commensurate with the Agency's overall mission. Since at least 1990, the OIG and the GAO have highlighted a series of challenges stemming from the limited authority of NASA's Chief Information Officer (CIO), decentralization of Agency IT operations, ineffective IT governance, and shortcomings in the Agency's IT security.

IT governance is a process for designing, procuring, and protecting IT resources. Because IT is intrinsic and pervasive throughout NASA, the Agency's IT governance structure directly affects its ability to attain its strategic goals. For this reason, effective IT governance must balance compliance, cost, risk, security, and mission success to meet the needs of internal and external stakeholders.

NASA's IT assets generally fall into two broad categories: institutional and Mission. The institutional systems support the day-to-day work of NASA employees and include networks, data centers, web services, desktop and laptop computers, mobile platforms, enterprise business applications, and other end-user tools such as e-mail and calendaring. The Mission systems support the Agency's aeronautics, science, and space exploration programs and host IT systems that control spacecraft, collect and process scientific data, and perform other critical Agency functions.

The Mission Directorates fund the IT assets on NASA's Mission networks, and funding for the IT investments associated with many NASA programs and projects is embedded in the funding for the underlying mission. In FY 2012, NASA spent 38 percent of its IT budget on institutional assets directly controlled by the Office of the Chief Information Officer (OCIO) or NASA Centers and the remaining 62 percent on assets controlled by the Mission Directorates.

Under NASA's current governance structure, the Agency CIO has little visibility into the Agency's Mission IT assets. Each Mission Directorate employs a CIO and IT security personnel who report through the Directorate's management chain rather than to the Agency CIO. The Mission Directorate CIO and IT personnel are responsible for security, risk determination, and risk acceptance for the Mission networks and associated IT assets. This organizational structure provides the Agency CIO with limited insight and control over the security of NASA's Mission IT assets.

Each NASA Center also employs a CIO and IT staff. For many years, Center CIOs reported to their respective Center Directors. In 2010, NASA revised this management structure so that the Center CIOs now report to the Agency CIO. The Agency CIO has delegated to the Center CIOs the responsibility, authority, and accountability for the Centers' IT portfolios. Center CIOs are responsible for ensuring that Center IT activities align with Federal and Agency requirements and for supporting the Agency CIO's review of Center IT investments. The Center CIOs receive their funding through each Center's budget, not through the OCIO. In addition to the CIOs, various boards and councils play a role in NASA's IT governance structure.

In a June 2013 audit, we examined whether NASA's OCIO has the organizational, budgetary, and regulatory framework needed to effectively meet the Agency's varied missions.[15] We found that the decentralized nature of NASA's operations and its longstanding culture of autonomy hinder its ability to implement effective IT governance. The Agency CIO has limited visibility and control over a majority of the Agency's IT investments, operates in an organizational structure that marginalizes the authority of the position, and cannot enforce security measures across NASA's computer networks. Moreover, the current IT governance structure is overly complex and does not function effectively. As a result, Agency managers tend to rely on

[15] NASA OIG, "NASA's Information Technology Governance" (IG-13-015, June 5, 2013).

informal relationships rather than formalized business processes when making IT-related decisions. While other Federal agencies are moving toward a centralized IT structure under which a senior manager has ultimate decision authority over IT budgets and resources, NASA continues to operate under a decentralized model that relegates decision making about critical IT issues to numerous individuals across the Agency, leaving such decisions outside the purview of the NASA CIO. As a result, NASA's current IT governance model weakens accountability and does not ensure that IT assets across the Agency are cost effective and secure.

With mission critical assets at stake and in an era of shrinking budgets, NASA must take a holistic approach to managing its portfolio of IT systems. To overcome the barriers that have resulted in the inefficient and ineffective management of the Agency's IT assets, we made a series of recommendations to NASA to overhaul its IT governance structure to centralize IT functions and establish the Agency CIO as the top management official responsible for its entire IT portfolio, including empowering the Agency CIO to approve all IT procurements over a monetary threshold that captures the majority of IT expenditures and making the Agency CIO a direct report to the NASA Administrator. We also recommended that the Administrator reevaluate the relevancy, composition, and purpose of NASA's primary IT governance boards in light of the changes made to the governance structure and require the use of reconstituted governance boards for all major IT decisions and investments. Finally, we suggested that the NASA Administrator reevaluate the resources of the OCIO to ensure that the Office has the appropriate number of personnel with the appropriate capabilities and skill sets.

To accomplish the fundamental changes recommended in our June 2013 report, strong leadership by the CIO and OCIO staff will be required. However, the CIO cannot make these changes alone. Rather, the NASA Administrator must be the driving force behind such sweeping organizational change.

## 8. Ensuring Security of Agency Information Technology Systems

NASA's high profile and the relatively large number of Agency networks coupled with its statutory mission to share scientific information present unique IT security challenges. The Agency's vast connectivity with outside organizations – most notably nongovernmental entities such as educational institutions and research facilities – offers cybercriminals a larger target than that of most other Government agencies.

In FYs 2012 and 2013, NASA reported 5,143 computer security incidents resulting in the installation of malicious software on or unauthorized access to its computers. These incidents spanned a continuum from individuals testing their skills to break into systems, to well-organized criminal enterprises hacking for profit, to intrusions that may have been sponsored by foreign intelligence services seeking to further their countries' objectives. These intrusions have affected thousands of NASA computers, caused disruption to mission operations, and resulted in the theft of export-controlled and otherwise sensitive data.

To protect the Agency against inevitable cyberattacks, NASA must ensure that its IT systems and associated components are regularly safeguarded, assessed, and monitored. For this critical effort, in FY 2014 OCIO dedicated an additional $10 million to fund a series of initiatives to address IT security concerns we reported. Planned projects for this initiative include:

- modernizing and expanding continuous monitoring and network penetration testing;
- deploying intrusion detection systems across mission, corporate, and research networks;
- increasing web application security scanning; and
- implementing intrusion prevention systems.

Over the past 5 years, the OIG has issued 20 audit reports containing 63 recommendations designed to improve NASA's IT security. For example, in a December 2011 report we identified several issues relating to NASA's transition from its previous "snapshot" approach for certifying the security of its IT systems to a continuous monitoring program in which maintains ongoing awareness of information security, vulnerabilities, and threats to support organizational risk management decisions.[16] We found that although NASA has made progress in transitioning to continuous monitoring, the Agency still needed to: (1) create and maintain a complete, up-to-date record of IT components connected to Agency networks; (2) define the security configuration baselines that are required for its system components and develop an effective means of assessing compliance with those baselines; and (3) use best practices for vulnerability management on all its IT systems. As of September 2013, these recommendations remained open.

In a July 2013 report, we examined the efficacy of NASA's efforts to adopt cloud-computing technologies.[17] We found that weaknesses in NASA's IT governance and risk management practices had impeded the Agency from fully realizing the benefits of cloud computing and potentially put NASA systems and data stored in the cloud at risk. For example, several NASA Centers moved Agency systems and data into public clouds without the knowledge or consent of the OCIO and on five occasions NASA acquired cloud-computing services using contracts that failed to fully address the business and IT security risks unique to the cloud environment.

We also examined the Agency's policies and procedures related to the acquisition of IT security assessment and monitoring tools in a March 2013 report and found that NASA's IT investment management process does not fully capture, assess, and consolidate IT security tool requirements across the Agency and therefore misses opportunities to capitalize on efficiencies and leverage purchasing power on critical IT security investments.[18] With improved awareness of its IT portfolio and visibility over its purchases, NASA could reduce its costs for IT security assessment and monitoring tools and potentially save millions of dollars annually in maintenance costs. We recommended that the CIO modify existing processes to capture detailed IT security requirements and enable greater visibility over existing inventory and planned acquisition of IT assessment and monitoring tools.

Currently, we are reviewing the security of NASA's publicly accessible websites and the Agency's efforts to reduce the number of these sites. NASA manages approximately 1,600 publicly accessible web applications and more than 130,000 unique Internet protocol

[16] NASA OIG, "NASA Faces Significant Challenges in Transitioning to a Continuous Monitoring Approach for Its Information Technology Systems" (IG-12-006, December 5, 2011).

[17] NASA OIG, "NASA's Progress in Adopting Cloud-Computing Technologies" (IG-13-021, July 29, 2013).

[18] NASA OIG, "NASA's Process for Acquiring Information Technology Security Assessment and Monitoring Tools" (IG-13-006, March 18, 2013).

addresses, representing roughly half of all publicly-accessible civilian Federal Government websites. The sheer scope of the Agency's web presence represents a significant security risk because each public-facing website provides a point of entry for unauthorized access to potentially sensitive information. For example, in September 2013 a number of NASA websites hosted by the Ames Research Center had to be taken offline after an international hacker posted political statements opposing U.S. policy.

In addition to our audit work, OIG investigators have conducted more than 120 investigations of breaches of NASA IT networks over the past 5 years, several of which have resulted in the arrests or convictions of foreign nationals in China, Great Britain, Italy, Nigeria, Portugal, Romania, Turkey, Venezuela, Australia, and Estonia. For example, in January 2013 a Romanian national who allegedly ran a "bulletproof hosting" service that enabled cyber criminals to distribute malicious software (malware) and conduct other sophisticated cybercrimes was indicted in New York on multiple conspiracy counts. Malware distributed by this hosting service infected more than one million computers worldwide, causing tens of millions of dollars in losses to the affected individuals, businesses, and government entities, including NASA. In another case, a Nigerian man was arraigned in a Nigerian court on charges he illegally accessed NASA and other U.S. Government e-mail accounts and used them to defraud victims worldwide.

NASA increasingly has become a target of a sophisticated form of attack known as advanced persistent threats (APT). APTs refer to those groups that are particularly well resourced and committed to steal or modify information from computer systems and networks without detection. The individuals or nations behind these attacks are typically well organized and funded and often target high-profile organizations like NASA. Moreover, even after NASA fixes the vulnerability that permitted the attack to succeed, the attacker may covertly maintain a foothold inside NASA's system for future exploits.

In FY 2011, NASA reported it was the victim of 47 APT attacks, 13 of which successfully compromised Agency computers. In FY 2012, NASA reported 55 APT attacks, 7 of which successfully compromised Agency computers. The OIG continues to work with its counterparts in both the law enforcement and the intelligence communities to help protect NASA's IT systems.

## 9. Ensuring Integrity of the Contracting and Grant Process

Approximately 80 percent of NASA's $17.7 billion FY 2012 budget was spent on contracts to procure goods and services and provide funding to grant and award recipients. Given the large amount of taxpayer funds NASA spends on contract awards, managers are constantly challenged to ensure that the Agency pays contractors in accordance with contract terms and receives fair value for its money. During the past year, the OIG continued to uncover fraud and other problems related to NASA contracts. For example:

- Six executives of two Virginia security firms were sentenced for fraudulently obtaining more than $31 million in Government contract payments set aside for disadvantaged small businesses. After becoming ineligible to participate in the disadvantaged small business program, the executives conspired to create a shell company to illegally obtain small business contracts from NASA and other Government agencies. The shell

company secured more than $31 million in Government payments, which generated more than $6 million in salary and other payments to the executives. The executives were sentenced to prison for up to 6 years, received fines totaling more than $1 million, and were ordered to make $7.8 million in restitution.

- The Department of Justice entered into a $3.6 million civil settlement with Crown Roofing Services, Inc., USS Engineering LLC, and company owners resolving claims that the companies violated the False Claims and Anti-Kickback statutes in connection with a NASA contract. An investigation by the NASA OIG found that the companies made illegal payments to two Johnson Space Center contracting officials. Both officials and the contractor previously pleaded guilty to related criminal charges.
- Gulf Cities Testing Laboratories, a Stennis Space Center contractor, was convicted for making false statements to NASA concerning testing of concrete used on a flight engine test stand. The company claimed to have completed the testing in compliance with industry standards when in fact it used faulty methods, uncalibrated or broken test equipment, or had not performed the testing at all.

One area that continues to be a challenge to protect from fraud is NASA's Small Business Innovation Research (SBIR) program. NASA awarded approximately $154 million to small businesses under this program during FY 2013 to stimulate technological innovation, increase participation by small businesses in federally funded research and development, and increase private sector commercialization of innovations derived from federally funded research and development efforts. In multiple investigations and audits over the years, the OIG has identified significant fraud, waste, and abuse in NASA's SBIR Program.

For example, this past year two executives of a scientific research company were indicted for wire fraud, conspiracy to commit wire fraud, and money laundering in California for defrauding NASA and the National Science Foundation by creating the false impression they had not applied for overlapping SBIR contracts with both agencies. In another case the OIG investigated jointly with other Federal agencies, the U.S. Air Force suspended 11 contractors and their company officers from directly or indirectly receiving SBIR contracts after finding that the contractors claimed research and development costs for components that had already been developed and sold commercially.

The OIG's audit work during the past year also identified weaknesses in NASA contract management. For example, a November 2013 audit examined whether NASA was effectively using award fees to motivate contractor performance and improve acquisition outcomes (an award fee is a pool of money a contractor may earn in whole or in part by meeting or exceeding pre-determined performance criteria).[19] We found that although NASA had implemented processes intended to improve contractor performance and acquisition outcomes, a number of questionable practices, including overly complex award formulas and a contract clause designed to hold contractors accountable for the quality of the final product that disregards interim performance evaluations, have diminished the effectiveness of award-fee contracts at the Agency. In addition, NASA failed to collect required data on award fee contracts, thereby reducing its ability to measure their effectiveness. Our report offered 12 recommendations

[19] NASA OIG, "NASA's Use of Award-fee Contracts" (IG-14-003, November 19, 2013).

aimed at improving NASA's efforts in this area, and while the Agency disagreed with 7, we are working to identify actions to bring those to resolution.

This past year we also examined whether NASA effectively monitored energy contracts to ensure that payments do not exceed the savings guaranteed in the contracts. An April 2013 audit found that the Johnson Space Center mismanaged a $42.7 million energy contract by not requiring the contractor to submit annual savings verification reports and accepting a flawed report for the first year, failing to consider the effect of renovations to or demolition of facilities on the guaranteed savings rate, and adding work to the contract without ensuring that energy savings would cover the additional costs.[20]

Apart from contracts, NASA awards approximately $500 million in grants annually to facilitate research and development projects; to fund scholarships, fellowships, or stipends to students and teachers; and to fund educational research performed by educational institutions or other nonprofit organizations. NASA faces the ongoing challenge of ensuring that these funds are administered appropriately and that recipients are accomplishing stated goals.

Over the past 5 years, the OIG conducted 30 grant fraud investigations resulting in 4 prosecutions and $13.2 million in restitution and recoveries and an additional $15 million in civil settlements. For example, a recent joint investigation with the Nuclear Regulatory Commission OIG culminated in the University of Florida agreeing to pay $422,000 to settle mischarging allegations. The investigation revealed that a former university professor had directed staff not conducting grant-related work to charge their time to the grants. In another case, a former principal investigator from Morehouse College was debarred from doing business with the Federal Government for a period of 5 years after a joint investigation by the NASA and National Science Foundation OIGs revealed that he had misused grant funds for personal travel and for equipment and services unrelated to the grants. Morehouse College agreed to pay $1.2 million to the Government in a civil settlement.

For both contracts and grants, NASA's award closeout process is the final step in ensuring taxpayer funds are accounted for properly. The process confirms that contractors and grantees have met the financial and reporting requirements of an award and allows NASA to redirect unused funds to other projects and priorities. We are currently examining whether NASA has procedures in place to ensure that award instruments are closed in a timely manner and in accordance with established requirements and that any unused funds are identified and de-obligated.

[20] NASA OIG, "NASA's Management of Energy Savings Contracts" (IG-13-014, April 8, 2013).