National Aeronautics and Space Administration

Office of Inspector General
Washington, DC 20546-0001

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TO: Woodrow Whitlow
Associate Administrator for Mission Support

FROM: Jim Morrison
Assistant Inspector General for Audits

SUBJECT: Audit of NASA's Facilities Maintenance (Report No. IG-11-015; Assignment No. A-09-002-00)

The Office of Inspector General (OIG) examined NASA's facilities maintenance program to evaluate the Agency's efforts to prioritize and fund maintenance activities, including whether NASA accurately captured costs associated with its maintenance and repair activities in a consistent manner and reported such costs to NASA management and relevant Federal agencies. We also reviewed internal controls as they related to the overall objective. The details of our scope and methodology are set forth in the enclosure.

Many of NASA's facilities are in degraded condition and its maintenance backlog continues to grow each year.[1] NASA's deferred maintenance estimate for all its facilities increased from $1.90 billion in fiscal year (FY) 2005 to $2.55 billion in FY 2010. Continued deferral of facility maintenance could result in unsafe working conditions and higher annual maintenance costs. From FY 2005 through FY 2009, deferred maintenance as a percentage of current replacement value increased, indicating that NASA's facilities were deteriorating. Although the overall deferred maintenance estimate in FY 2010 increased by approximately $6 million, deferred maintenance as a percentage of current replacement value decreased, indicating a slight improvement in the condition of NASA's facilities.[2] This occurred due to NASA's efforts to replace or refurbish aged facilities.

Problems associated with NASA's ability to maintain its facilities and associated infrastructure have been widely reported for more than 2 decades. In 1990, the Government Accountability Office (GAO) reported that many of NASA's facilities were in degraded condition and had not

[1] NASA defines maintenance backlog or deferred maintenance as the essential but unfunded work necessary to bring its Centers up to required facilities maintenance standards.

[2] The NASA-wide Facility Condition Index (FCI) is rated on a scale from 5 (excellent) to 1 (non-functional). According to this tool, NASA's facilities have generally remained stable at 3.6 from FY 2006 to FY 2010. However, deferred maintenance as a percentage of current replacement value is a more precise indicator of whether the condition of NASA's facilities are improving or deteriorating.

been adequately maintained.[3] GAO found that Centers had not based their maintenance budgets on actual needs or accurately accounted for all maintenance expenditures because NASA had not previously required Centers to report all maintenance costs or conduct regular assessments of the condition of its facilities to develop their total maintenance needs. In 2008, GAO issued a report on deferred maintenance at six Federal Agencies, including NASA, and found that all six agencies periodically assess the condition of their assets to identify needed repairs. However, the agencies use different methods to define and estimate their repairs and maintenance backlogs.[4] Further, the 2008 report noted that information provided by NASA Centers identified a deferred maintenance estimate of about $1 billion, which is far lower than the $2.3 billion in deferred repair and maintenance backlog NASA reported for FY 2007. The GAO report stated that NASA officials' reason for the difference was that "the centers include only the most important projects that they believe should receive funding, instead of all projects to address their backlog as estimated in NASA's annual deferred maintenance assessment report." According to NASA facilities officials, Center facilities resources are reviewed by Headquarters as part of the annual budget development. NASA Centers assign priorities to maintenance and repair activities using Center prioritizing systems.

More recently, the Aerospace Safety Advisory Panel (ASAP) expressed concern about the safety of NASA's infrastructure. ASAP's Annual Report for 2010 stated that "(a)lthough the Field Centers appear to be doing a good job in identifying facilities that have deficiencies that could pose a safety risk to employees or missions, the Agency still has not presented a systematic approach to prioritizing facilities and laboratories requiring safety-related repairs and harmonizing funding across the Agency to facilitate those repairs in the most effective manner." In addition, a 2010 National Research Council assessment reported that NASA must invest more in maintaining and upgrading its basic research laboratories if it wants to meet major mission goals.[5]

Based on our work for this audit, we believe that the OIG needs to review additional aspects of NASA's efforts to reduce deferred maintenance and manage its real property. For example, during the course of our audit, we found that much of NASA's construction of facilities (CoF) funding is for major repair work. This could indicate that maintenance and repair funding is insufficient at the Centers. However, we did not assess CoF funding as a part of this review.[6] Further, the 2008 NASA Authorization Act included a directive requiring the Agency to develop a plan that would reduce its deferred maintenance by 50 percent over the next 5 years. Following the completion of our fieldwork, NASA submitted its plan to reduce deferred maintenance to Congress. Congress subsequently passed the FY 2010 Authorization Act that called for NASA to rescope its facilities and, as appropriate, downsize to fit current and future missions and

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[3] GAO, "NASA Maintenance: Stronger Commitment Needed to Curb Facility Deterioration (GAO/NSIAD-91-34)," December 1990. [Note: Prior to July 7, 2004, the GAO was known as the General Accounting Office.]

[4] GAO, "Federal Real Property - Government's Fiscal Exposure from Repair and Maintenance Backlogs is Unclear (GAO-09-10)," October 2008.

[5] National Research Council, "Capabilities for the Future: An Assessment of NASA Laboratories for Basic Research" (Washington, DC: National Research Council, 2010).

[6] CoF includes funds for construction of new facilities as well as refurbishment, and major repair projects. Between 2006 and 2010, NASA spent approximately $1.90 billion on CoF projects.

expected funding levels. Specifically, the Act directs the Administrator to undertake a comprehensive study that carefully examines NASA's institutional assets and pays particular attention to identifying and removing unneeded or duplicative infrastructure. Given these factors and in lieu of issuing a report detailing the full extent of our work to date, we are expanding our efforts in the area of NASA's facilities and infrastructure management and plan to conduct a series of in-depth reviews, including reviews of facility utilization and the management of CoF funding.

In light of our planned work and the requirement that NASA report to Congress regarding its facilities utilization, we are issuing this memorandum to summarize our concerns regarding NASA's ability to plan and budget for maintenance and repair needs. In short, we found that because maintenance requirements were not fully communicated to Headquarters during the budgeting process, it has been difficult for NASA to make informed budgeting decisions regarding Agency-wide facility maintenance needs.

Determining NASA's Annual Funding Dedicated to Maintenance and Repair Is Challenging

NASA's ability to plan for and achieve a reduction in its maintenance backlog depends on having reliable facilities maintenance cost data. However, at the time of our fieldwork, NASA used multiple and inconsistent mechanisms for capturing costs associated with facilities maintenance work. Without accurate, complete, and consistent maintenance cost data, NASA is unable to evaluate the maintenance and operation cost of its facilities and make informed sustainment/repair/replacement decisions.

NASA collected information from the Centers on annual maintenance and repair costs through three different mechanisms: (1) NASA's accounting system; (2) the facilities maintenance metrics reports; and (3) the Real Property Inventory database. In addition, each of the Centers we visited used varying reporting methodologies for each of these reporting mechanisms. Further, four Centers reported using funds from non-maintenance and repair accounts, including programmatic funds, on maintenance activities in their metrics reporting (see Table 1). These inconsistencies make it difficult to identify all maintenance costs across the Agency. We examine each of these mechanisms below.

1. **NASA's Accounting System.** Individual Centers did not consistently align cost reporting with work breakdown structures in NASA's accounting system as required by NASA guidance.[7] A work breakdown structure uses numerical codes to divide the program/project into manageable pieces of work, with increasing levels of detail, to facilitate planning and control costs and schedule. While Headquarters officials issued guidance to the Centers in March 2007 to better align contractor cost reporting with the work breakdown structure, 5 Centers (Ames, Goddard, Kennedy, Langley, and Marshall) did not develop adequate plans to do so. According to the former Deputy Director of the Office of Program and Institutional Integration (OPII), OPII did not mandate the use of

[7] NPR 9501.2D, "NASA Contractor Financial Management Reporting," effective May 23, 2001.

the specific work breakdown structure codes because doing so might have required contract modifications and resulted in additional costs.[8] In addition, the Centers' Offices of the Chief Financial Officer did not adequately communicate to the Centers' facility management offices the requirement to align costs with the work breakdown structure. As a result, 2 (Kennedy and Marshall) of the 5 Centers entered into new multi-year contracts for maintenance and repair services in 2008 without aligning contractor reported costs with the work breakdown structure. Because the maintenance costs recorded in the accounting system at these Centers did not accurately reflect the types of work that had been performed, decision makers could not rely on the data. Without reliable cost data, it is difficult for NASA Headquarters to facilitate accurate, requirements-based planning Agency-wide. Subsequent to our fieldwork, NASA conducted a study (The Baseline Services Study) in FY 2010 that confirmed a common work breakdown structure for budgeting starting in FY2011.

2. **Facilities Maintenance Metrics Reports.** The Facilities Engineering and Real Property Division (FERP) at NASA Headquarters did not issue adequate reporting guidance to the Centers to ensure consistency among the methodologies the Centers used to report maintenance and repair costs. NASA Centers are required to compile data about Center-specific facilities maintenance performance metrics and submit the data to FERP annually.[9] This data is compiled into a report that encompasses metrics such as actual annual maintenance and repair funding, cost of scheduled work, and the cost of unscheduled work and breakdown repair. We found that the data sources used by the Centers differed, as did whether they included service requests, grounds care, custodial services, user funds, and mission directorate funds in their maintenance cost data (see Table 1).

According to FERP personnel, this report is used to identify trends within the individual Centers – e.g., trends in the cost of maintenance and repair activities and comparing the amount of scheduled work to the amount of unscheduled work performed annually. Further, this metrics report is used to ensure that the individual Centers were being consistent in the manner in which they developed and presented their data. FERP personnel did not consider consistency among the various Centers to be an issue. However, our review of these reports found that FERP rolled up the metrics data from the Centers and used the combined number internally to track trends from year to year. Unfortunately, without consistent data across the Centers, FERP officials cannot obtain an accurate NASA-wide view of facility maintenance and repair trends, which hampers the Agency's ability to evaluate and plan for its facility maintenance needs.

[8] At the time of our review, the officials we spoke to were part of the Office of Program and Institutional Integration (OPII). As of February 23, 2010, OPII became part of the Mission Support Directorate.

[9] NPR 8831.2E, paragraph 3.11.5.10.

Table 1. Differences in Sources and Inclusions in Maintenance Cost Data from Eight Centers, by Center

NASA Center	Source of Cost Data	Included in the Cost Data: Service Requests	Grounds Care	Custodial Services	User Funded[a]	Mission Directorate Funded[b]
Ames	CMMS[c]	Yes	Yes	No	Yes	No
Glenn	CMMS[c]	Yes	Yes	No	Yes	Yes
Goddard	Accounting system	Yes	No	No	Yes	No
Johnson	Separate work order tracking system	No	No	No	No	No
Kennedy	Unknown[d]	Unknown	No	No	Unknown	Yes
Langley	Accounting system	No	Yes	No	No	No
Marshall	CMMS[c]	No	No	No	No	No
Stennis	Accounting system	No	No	Yes	No	Yes

[a] Maintenance and repair work performed by the Facilities Maintenance Management office but paid for through the NASA user's budget.

[b] Program contracts separate from the Centers' institutional contracts.

[c] Computerized Maintenance Management System (CMMS) used to track status and cost of maintenance activities.

[d] The person who compiled the metrics for Kennedy retired and, at the time of our review, no one was able to identify where the data came from.

3. **Real Property Inventory Database.** FERP officials did not provide the Centers with guidance on the methodology to use to calculate the maintenance costs in NASA's Real Property Inventory database. According to a February 2004 Executive Order, each Executive Branch agency is required to provide the General Services Administration with descriptive information about its real property holdings. In response, NASA directed the Centers to manage their real property (land and facilities) to ensure that it is available for NASA to use in support of accomplishing its mission.[10] To help Centers meet this requirement, NASA maintains the Real Property Inventory database, which provides an Agency-wide data system for tracking real property and serves as an automated method for maintaining and reporting real property data. NASA uses the Real Property Inventory data to compile, analyze, and report on real property to NASA Headquarters, FERP, and the General Services Administration and to support NASA management on budgeting and analysis of deferred maintenance. Because FERP did not provide the Centers guidance on the methodology to use to calculate the maintenance costs in the Real Property Inventory database, the Centers used variations of direct costs and allocations to

[10] NASA Policy Directive 8800.14D, "Policy for Real Estate Management," effective July 15, 2004.

determine their maintenance data. Because the source data were inconsistent, NASA management and the General Services Administration did not receive reliable and valid maintenance cost data in the Real Property Inventory database. In October 2010, NASA converted to a new database, the Real Property Module, which is part of NASA's accounting system. However, the Real Property Inventory data was migrated into the new database, and cost data was still being entered at the Centers.

Having multiple and inconsistent mechanisms for reporting the cost of maintenance activities limits the usefulness of the data because the amounts contained in the different systems are not comparable. Specifically, the inconsistencies in reporting limits the usefulness of the data for Headquarters budgeting decision makers, and prevents NASA from determining the total amount of funds used annually for maintenance and repair activities. In FY 2010, NASA conducted a comprehensive review of all center maintenance and operations costs, including facilities maintenance and operations. Common definitions and accounting codes were issued to the Centers for use in FY 2011. The OIG did not review that study as a part of this audit.

Facilities Maintenance Planning Documents Are Underutilized

NASA requires Centers to develop both an annual work plan and a 5-year plan to articulate their maintenance needs. However, we found that none of the Centers we visited had annual work plans that fully justified their budget requests or 5-year maintenance plans that provided data for budget forecasting. Without proper preparation and use of planning documents, NASA maintenance managers could not effectively assess anticipated maintenance needs across the Agency or effectively compete for funding of facilities maintenance activities with other Center support services.

NASA procedural guidance requires facilities maintenance managers to develop both an annual work plan and a 5-year maintenance plan to identify all maintenance needs and ensure that the highest priority work is scheduled and not overlooked in the budgeting process.[11] We describe each of these plans below.

Annual Work Plan. The annual work plan is used to justify funding for the maintenance and repair of facilities and to ensure that the Centers use resources effectively. According to NASA policy, the annual work plan provides Centers with a vehicle to display long- and short-range facility requirements by articulating their needs based on mission impact and the most probable facility availability outcomes under varying budget scenarios. The policy further states that the annual work plan should be prepared at the start of the fiscal year, incorporate work that is necessary but unfunded, and remain flexible to incorporate changes throughout the year to accommodate changes to requirements that cannot wait for the next budget cycle.

Five-Year Plan. The 5-year maintenance plan provides information for budget forecasting and initial planning and preparation of the annual work plan. NASA policy

[11] NPR 8831.2E, "Facilities Maintenance and Operations Management," effective November 18, 2008.

> requires that the annual work plan evolve from a multi-year plan derived from a complete and continuously updated list of facilities requirements. The 5-year maintenance plan is based on the total maintenance requirements, which in turn are based on mission, criticalities, and established standards. Developing a 5-year maintenance plan that provides a complete and continuously updated list of facilities requirements ensures that the highest priority of maintenance work is scheduled and not lost in the budgeting process. The plan should also provide for management of deferred maintenance.

Because Center budget offices did not require facility managers to submit these planning documents to justify their maintenance and repair budget requests, Center facilities management personnel did not develop adequate annual work plans and 5-year maintenance plans. As shown in Table 2, three Centers (Goddard, Langley, and Marshall) developed annual work plans, but these plans did not meet all NASA policy requirements. Specifically, the annual work plans did not include a risk assessment, routine maintenance costs, and budget justification information as required.[12] In addition, two of the Centers' (Langley and Marshall) annual work plans focused primarily on how the contractor was to perform its requirements under the maintenance contract and not on Center priorities.

Although not all of the Centers fully developed these formal planning documents, all of the Centers did develop lists of projects they planned to complete. However, similar to the annual work plans developed, the lists did not include routine maintenance costs or budget justification information and generally did not include adequate risk assessments. Five Centers (Glenn, Goddard, Johnson, Kennedy, and Stennis) had a formal process to document those risk assessments. However, only two of the five Centers (Goddard and Kennedy) maintained project lists that identified the risk of not completing the projects.[13]

[12] Goddard's annual work plan did include a risk assessment, but did not include routine maintenance costs or other budget justification information.

[13] Officials at Glenn maintained a list of projects that included a risk assessment they anticipated being funded; however, they did not include other vital projects for which they did not anticipate receiving funding.

Table 2. Differences in Center-Developed Maintenance Planning Documents

Center	Annual Work Plan	5-Year Maintenance Plan	Formal Risk Assessment Process
Ames	No	No	No
Glenn	No	No	Yes, but not complete
Goddard	Yes, but did not meet requirements	Yes, but did not address routine maintenance	Yes
Johnson	No	No	Yes, but not complete
Kennedy	No	No	Yes
Langley	Yes, but did not meet requirements	Yes, but did not address routine maintenance and had not been updated since 2004	No
Marshall	Yes, but did not meet requirements	Yes, but developed by contractor and not used by Center facilities officials	No
Stennis	No	No	Yes, but not complete

In addition, according to facility maintenance personnel at each of the Centers we visited, the annual work plan is not particularly helpful because even if projects are planned for completion during the year, many do not end up being funded because the Centers use available funding to cover unplanned repairs. Facility management personnel at some Centers noted that they often struggled to find funding for critical safety-related work and therefore could not often accomplish work that would result in future cost savings or early detection of failing systems.

Nevertheless, without proper planning, NASA maintenance managers could not effectively compete with other support services at their Centers for funding of facilities maintenance. The Centers' annual work plans and 5-year maintenance plans should support the development of their respective Program Analysis and Alignment Reports, which are used to develop the Center Management and Operations budget request and describes some specific, mission-critical projects that the Center facilities offices reported as the highest priority. However, Headquarters officials did not require the Centers to fully justify their budget requests in the Center Program Analysis and Alignment reports and left it to the Centers to determine what information they wanted to convey. As a result, Centers varied in the amount of detail included in the reports, making it difficult to analyze needs across the Agency.

Conclusion

Without better planning and budgeting information, it will be difficult for NASA to evaluate the maintenance and operation cost of its facilities, make informed sustainment/repair/replacement decisions across all NASA Centers, and accurately report progress toward reducing its deferred maintenance. Therefore, NASA's efforts to reduce its deferred maintenance projects may be hindered, thereby increasing the risk that facilities will not be available for future use to support the Agency's missions.

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

Enclosure

cc: Olga M. Dominguez
Assistant Administrator, Strategic Infrastructure

Frank T. Bellinger
Director, Facilities Engineering and Real Property Division

Simon P. Worden
Director, Ames Research Center

Ramon Lugo
Director, Glenn Research Center

Robert D. Strain
Director, Goddard Space Flight Center

Michael L. Coats
Director, Johnson Space Center

Robert D. Cabana
Director, Kennedy Space Center

Lesa B. Roe
Director, Langley Research Center

Robert M. Lightfoot
Director, Marshall Space Flight Center

Patrick E. Scheuermann
Director, Marshall Space Flight Center

Scope and Methodology

We performed our audit from December 2008 through February 2011 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

We concentrated our review on FY 2008 because, at the start of our audit, it was the most current complete reporting period available. We performed work at NASA Headquarters, including the FERP Division and the former OPII, as well as the following eight NASA Centers:

- Ames Research Center
- Glenn Research Center
- Goddard Space Flight Center
- Johnson Space Center
- Kennedy Space Center
- Langley Research Center
- Marshall Space Flight Center
- Stennis Space Center

We selected a statistical sample of 40 facilities and reviewed the maintenance projects for those facilities completed in FY 2008 for compliance with applicable laws, regulations, and policy. We reviewed each Center's FY 2008 annual work plan, five-year maintenance plan, and performance indicators such as deferred maintenance to evaluate the effectiveness of the maintenance activities. In addition, we reviewed NASA's Deferred Maintenance Reduction Plan, June 2010, to determine whether the plan met the requirements of the NASA Authorization Act of 2008. We interviewed representatives from the FERP Division to identify and discuss implementation of NASA's primary maintenance management guidance, NPR 8831.2E. We also interviewed representatives from each Center's facility management office, contract representatives, and budgeting officials to gain an understanding of each Center's process for selecting and funding maintenance activities.

Use of Computer-Processed Data. We used computer-processed data to perform this audit. Each Center records their maintenance cost data in NASA's accounting system and the Real Property Inventory database at the end of the fiscal year. However, NASA Headquarters did not provide adequate guidance as to what maintenance costs should be included, which resulted in inconsistent and incomplete cost data. Therefore, we do not have reasonable assurance that the maintenance cost data reported through NASA's accounting system or the Real Property Inventory database were reliable as we discussed in this report.

In addition, each Center uses a computerized maintenance management system to maintain their individual maintenance projects conducted on each facility. However, the Centers did not all use the same software or versions of the software. To review the maintenance projects completed in FY 2008 on the 40 sampled facilities, we discussed the maintenance projects with each Centers' facility management office and project managers. We believe that we received complete and accurate project information, and, therefore, our audit work, findings, and conclusions were not affected.

Review of Internal Controls

We reviewed and evaluated the internal controls associated with developing the required maintenance planning documents, selecting and funding maintenance projects, and determining the maintenance costs reported in NASA's accounting system, the annual facilities maintenance metrics, and the Real Property Inventory database. Our review included a review and evaluation of the oversight and guidance provided by the FERP Division, to the Centers for these areas. We also reviewed the internal controls associated with selecting a contract type for maintenance activities. We found deficiencies in these areas, as discussed in this report.

Prior Coverage

The Government Accountability Office (GAO) and NASA have issued three reports of particular relevance to the subject of this report. Unrestricted reports can be accessed over the internet at http://www.gao.gov (GAO) and http://oig.nasa.gov/audits/reports/FY09 (NASA).

Government Accountability Office

"Federal Real Property - Government's Fiscal Exposure from Repair and Maintenance Backlogs is Unclear" (GAO-09-10, October 2008)

"NASA Maintenance: Stronger Commitment Needed to Curb Facility Deterioration" (GAO/NSIAD-91-34, December 1990)

National Aeronautics and Space Administration

"NASA Should Reconsider the Award Evaluation Process and Contract Type for the Operation of the Jet Propulsion Laboratory" (IG-09-022, September 25, 2009)