



OFFICE OF INSPECTOR GENERAL

U.S. Department of Energy

AUDIT REPORT

DOE-OIG-18-42

August 2018

**THE SANDIA NATIONAL LABORATORIES
SILICON FABRICATION
REVITALIZATION EFFORT**



Department of Energy
Washington, DC 20585

August 9, 2018

MEMORANDUM FOR THE ADMINISTRATOR, NATIONAL NUCLEAR SECURITY
ADMINISTRATION

Michelle Anderson

FROM: Michelle Anderson
Deputy Inspector General
for Audits and Inspections
Office of Inspector General

SUBJECT: INFORMATION: Audit Report on "The Sandia National Laboratories
Silicon Fabrication Revitalization Effort"

BACKGROUND

The primary mission of the Department of Energy's National Nuclear Security Administration (NNSA) is to ensure the safety, reliability, and performance of the Nation's nuclear weapons stockpile. The NNSA's Sandia National Laboratories (Sandia) supports this mission through the development, design, and manufacturing of strategic radiation-hardened microelectronics at its Silicon Fabrication (SiFab) facility. The SiFab facility, constructed in 1988, reached its design end of life in 2013 and relies on fabrication tools configured for processing 6-inch silicon wafers to produce the radiation-hardened integrated circuits used in the stockpile. Commercial support for maintaining fabrication tools for 6-inch silicon wafers no longer exists. To address this problem, in 2012, Sandia began the Sandia Silicon Fabrication Revitalization (SSiFR) effort with the objective of reducing the risk of SiFab equipment failures through the replacement or refurbishment of tools and facility modifications. The SSiFR was originally scheduled to be completed in fiscal year 2018 with a Total Project Cost (TPC) of \$150 million.

The Department's principles for managing capital asset projects are set forth in Department Order 413.3B, *Program and Project Management for the Acquisition of Capital Assets*. These principles also apply to General Plant Project improvements.

Because of the importance of the SiFab to the nuclear weapons program, and the Department's long history with project management issues, we conducted this audit to determine whether Sandia had effectively managed the SSiFR project.

RESULTS OF AUDIT

Our review revealed that Sandia had managed the SSiFR project scope within the planned cost and schedule, but NNSA did not require Sandia to execute the project within Departmental

requirements. In addition, we found that Sandia had prioritized the replacement or refurbishment of SiFab equipment based upon the risk of equipment failure and regularly re-evaluated the risk ranking to account for changes in equipment condition. However, we identified issues that, if corrected, should improve Sandia's management of SSiFR and NNSA's oversight of SSiFR. Nothing came to our attention to indicate that Sandia will not continue to make progress in refurbishing or replacing silicon fabrication tools and facility modifications. Nevertheless, the issues we identified may contribute to problems in project execution in the future. We noted that Sandia had not:

- Generated reliable, accurate, and reasonable earned value data related to cost and completion estimates for managing SSiFR;
- Employed an earned value management system certified by the Department as compliant with established standards;
- Included NNSA in the baseline change approval process; and
- Established management reserve based on a formal risk analysis, and instead, determined management reserve as a percentage of remaining project costs.

These conditions occurred because NNSA Safety, Infrastructure, and Operations, the organization originally overseeing the SSiFR project, did not require Sandia to manage the SSiFR project in accordance with Department Order 413.3B¹. Following Department Order 413.3B would have required Sandia to use management practices that should have provided greater rigor in project execution. An NNSA Major Modernization Programs official told us that SSiFR was a replacement-in-kind project that was not acquiring new capabilities. NNSA Major Modernization Programs officials also stated that SSiFR was a severable portfolio of individual recapitalization projects, which they believed eliminated it from applicability to Department Order 413.3B. In addition, Sandia asserted that Department Order 413.3B did not apply to SSiFR for several reasons. For example, Sandia did not believe that SSiFR qualified as a capital asset project, nor was the project line item funded.

Despite NNSA's and Sandia's rationale, the management and operating contract requires Sandia's compliance with Department Order 413.3B. Department Order 413.3B provides the Department and NNSA with program and project management direction for the acquisition of capital assets with the goal of delivering projects within the original performance baseline, cost and schedule, and fully capable of meeting mission performance. Department Order 413.3B also implements Office of Management and Budget Circular No. A-11, Part 7, *Capital Programming Guide* (OMB Circular No. A-11), which prescribes requirements and leading practices for project and acquisition management and expands the explanation of the concepts not fully developed in the OMB Circular No. A-11 original publication.

¹ Subsequently, in August 2014, the responsibility for SSiFR was transferred from NNSA Safety, Infrastructure, and Operations to NNSA Defense Programs. Within NNSA Defense Programs, NNSA Major Modernization Programs oversees the NNSA Recapitalization Program Office which, along with the Sandia Field Office, provides Sandia with direction and oversight of SSiFR.

Managing the project under Department Order 413.3B would have required Sandia's implementation of key management controls that the Department has identified as critical to project management success. Based upon our assessment, implementation of these key controls should have provided SSiFR with increased visibility and involvement of the NNSA and Department to assist Sandia in meeting its mission requirements and reducing the risk of project failure. Without these key management controls, there is less assurance that NNSA's objectives will be met.

Earned Value Data

Sandia implemented a tailored Earned Value Management System (EVMS) for the management of SSiFR; however, we identified concerns with the reliability and accuracy of the earned value data for project management. Department Order 413.3B requires the use of an EVMS for all projects with a TPC greater than \$20 million² and compliance with the Electronic Industries Alliance (EIA)-748. Sandia officials reported to us that the tailored EVMS meets the general intent of the EIA-748 EVMS standards but allows the SSiFR manager flexibility in establishing thresholds, defining signature requirements, and eliminating redundant forms and templates. To its credit, Sandia included all activities within the SSiFR master schedule, and they appear to be logically sequenced and have logical dependencies. In addition, we found that the master schedule in the EVMS appears to include activities for approved scope as of May 2017. However, we noted earned value data errors in Sandia's Variance Analysis Reports that adversely impacted schedule. For example, several of the Variance Analysis Reports in fiscal year 2013 stated that because Sandia did not baseline and report project progress against a realistic plan, the schedule and cost variances generated were inaccurate. As such, Sandia could not determine the real schedule and cost variances or the impact these variances may have had on the affected scope or the project as a whole. In addition, our work revealed weaknesses in the EVMS data that called into question the reliability and accuracy of EVMS cost data and the reasonableness of the Estimate at Completion (EAC).

EVMS Cost Data Reliability and Accuracy

We analyzed 6 months of 2016 EVMS data and found anomalies in the EVMS data that Sandia used to manage the SSiFR. Anomalies are test results that fall outside the norm that require further investigation to determine whether actual problems exist. According to the Department's *Earned Value Management System and Project Analysis Standard Operating Procedure* (Procedure), earned value data is ultimately used to manage projects and make informed decisions and projections. As stated in the Procedure, an integral part of successful project management is the use of reliable and accurate information. In our review, we found numerous instances where SSiFR's EVMS data failed specific test criteria, which resulted in the anomalies. Specifically, we identified 373 anomalies in 130 control accounts. The control account is a subdivision of work in which planned value is established, earned value is assessed, and actual costs are collected. During our review, we found anomalies in 10 to 23 percent of the control accounts for the period of May 2016 through October 2016.

² During SSiFR project start, Department Order 413.3B (November 29, 2010) was mandatory for all capital asset projects having a TPC greater than or equal to \$50 million. In June 2015, the Order became mandatory for all capital asset projects with a TPC greater than or equal to \$10 million.

We evaluated the Cost Performance Index (CPI) for 6 months of data and found numerous anomalies. The CPI is an efficiency factor representing the relationship between the performance accomplished and the actual cost expended. An index of 1.00 or greater indicates that work is being accomplished at a cost equal to or below what was planned; generally, the work evaluated is under budget if the CPI is greater than 1.00. In the 6-month period (May 2016 through October 2016) reviewed, we found numerous (19) anomalies showing that the actual cost for each task was 10 times less than planned. Essentially, for every 1 dollar spent in these accounts, the SSiFR was receiving 10 dollars' value or more for the work performed. Although an index slightly above 1.00 may be considered good, the size of the variance (10 times less than planned cost) brings the reliability of the data into question, or it may indicate that the baseline was not accurately estimated. For example, in the account for the installation of a wafer sorter, the reported CPI fluctuated from 66.05 in May, up to 101.67 in July, and down to 4.37 in October. More specifically, the unreliability of the data creates uncertainty about whether the tasks were completed under budget. While the CPI eventually trended downwards for the installation of this wafer sorter during the period reviewed, we question whether the SSiFR actually received significantly more value than planned over a 6-month period for the installation of this tool.

In addition, we found 51 instances in the control accounts where Sandia's Work Breakdown Structure elements failed the test criteria for having earned value when there was no actual cost. When earned value is greater than zero, it signifies that the entity has performed work. Since work or materials must be paid for, it is not possible to earn value without incurring costs; therefore, actual costs should not be zero and the earned value for these instances were not accurate. According to the Procedure, further review of these anomalies is warranted to determine the extent and impact of issues in the EVMS data.

Reasonableness of Estimate at Completion

We also found numerous anomalies in the EVMS data that call in to question the EAC's reasonableness. According to the Procedure, an accurate EAC is vital, as it provides a dynamic estimate of the projected funding required to cover the costs to perform the work. The EAC is based on actual cost of work performed to date plus the estimate of the costs to complete the work. To assess the reasonableness of the EAC, we reviewed EVMS reports. Specifically, we analyzed 6 months of 2016 EVMS reports from May 2016 through October 2016 and found that the number of EAC anomalies that occurred ranged from 46 (or 14 percent) to 61 (or 19 percent). For example, one of the metrics we used to evaluate earned value data was a comparison of the CPI to the To Complete Performance Index. According to the Procedure, the two are compared to evaluate the realism of the contractor's EAC and to evaluate the reasonableness of using past efficiencies to predict future efficiencies. A mathematical difference of 5 percent or greater is used as an early warning indication that the contractor's forecasted completion cost could possibly be unrealistic, stale, or not updated recently. A larger difference of greater than or equal to 10 percent indicates that the EAC is not achievable based on current performance. For the 6-month period assessed, we noted that the number of anomalies (data greater than or equal to 10 percent) ranged from a high of 55 in May to a low of 33 in October. This means that the

contractor would have to increase its efficiency by over 10 percent in each of these Work Breakdown Structure accounts to meet the EAC, or, as the Procedure stated, the EAC is not achievable.

Certified Earned Value Management System for SSiFR

Sandia is not using an EVMS that had been certified to manage SSiFR. Although Sandia has an NNSA certified EVMS, they are using a tailored EVMS for the SSiFR project. As previously mentioned, Sandia officials reported to us that the EVMS was tailored to allow the SSiFR manager flexibility in establishing thresholds, defining signature requirements, and eliminating redundant forms and templates. Prior to the execution of a capital asset project with a TPC of \$100 million or greater, the Department Order 413.3B requires the certification of a contractor's EVMS by the Department's Office of Project Management Oversight and Assessments (Office of Project Management) organization to ensure that the system is in compliance with the EIA-748 EVMS standards. An Office of Project Management official stated that it may be problematic for Sandia to accurately track cost and schedule performance and make completion forecasts without an EVMS that has been specifically certified by the Office of Project Management. Furthermore, an EVMS should be certified by the Office of Project Management since there are no EVMS-like approved situations. Employing an EVMS certified for use on the SSiFR would provide additional assurance of the accuracy and reliability of the project's reported scope, schedule and cost, and estimate at completion data.

NNSA Not Included in the Baseline Change Approval Process

Sandia employs a baseline change approval process, but none of the project's baseline change proposals (BCPs) showed evidence of NNSA inclusion in the approval process. Department Order 413.3B requires the establishment of a performance baseline approved by the Secretarial Acquisition Executive or Acquisition Executive³ that clearly specifies the project's performance baseline, which includes the TPC, scope, and month and year of project completion. The intent of the SSiFR change control process was to have formal documentation that provided traceability, accountability, and transparency of changes to the project's scope, cost, and schedule. We reviewed 25 BCPs that had been executed for the project through December 2016. We noted that 8 of the 25 BCPs impacted SSiFR's schedule end-date by changes as much as a decrease of 25 days to an increase of 213 days. Many of the 25 BCPs addressed scope and schedule changes necessary to adjust project work within the constraints of SSiFR annual funding.

Our review also revealed that the 25 BCPs showed approvals were made only at the Sandia level. According to the SSiFR's Project Execution Plan, cost schedule, and technical baselines will be managed in accordance with established Baseline Change Control processes developed and jointly approved by the Department/NNSA/Sandia Field Office, and Sandia. However, in contrast to Department Order 413.3B, SSiFR did not have a performance baseline approved by a Department official such as a Secretarial Acquisition Executive or Acquisition Executive. A

³ In a May 2016 minor change to Department Order 413.3B, the terms of Secretarial Acquisition Executive and Acquisition Executive have been replaced with the Project Management Executive and Chief Executive for Project Management.

Sandia Field Office official stated that an Acquisition Executive was not assigned based upon the 2012 determination that SSiFR was not a capital asset project. For example, Sandia deleted planned scope to cover the cost of the replacement of three Chemical Mechanical Polisher tools in BCP 17-02. Sandia hoped that the deleted scope, and any additional Chemical Mechanical Polisher tool replacements, would be executed following the project completion with post-SSiFR funding. BCP 17-02 included approximately \$162,000 in design work scheduled to begin January 2, 2017. The total cost for the Chemical Mechanical Polisher equipment replacement was estimated at \$17.2 million. There was no indication on the BCP that NNSA approved the scope change.

Subsequently, Sandia told us that, as of December 2015, the NNSA Recapitalization Program Office funding SSiFR directed Sandia to enter project data into NNSA's Generation 2 Management Information System (G2), a custom software system to track project performance. Sandia also told us that a baseline change request was created in G2 that corresponded to the changes reflected in BCP 17-02 and that this request had been approved by the NNSA Recapitalization Program Office Federal Program Manager. However, during our review of G2, we found that the baseline change data entry corresponding with the SSiFR's BCP 17-02 had been created January 20, 2017 and approved by the NNSA Recapitalization Program Office Federal Program Manager on January 26, 2017, almost 2 months following Sandia's approval of BCP 17-02 in November 2016. Sandia explained that the lapse between Sandia's approval of BCP 17-02 and its corresponding entry in the G2 system occurred because Sandia was instructed by NNSA Defense Programs to update the G2 system quarterly. We question the NNSA Recapitalization Program Office Federal Program Manager approving a BCP after work associated with that BCP was scheduled to begin and so long after Sandia had processed the BCP. In addition, the NNSA Recapitalization Program Office Federal Program Manager told us that the G2 format provides financial and schedule changes but that he may not see specific scope changes within the BCPs. We found that the scope information and the rationale for scope, budget, and schedule changes were less detailed in G2 than in the BCPs processed by Sandia only. Sandia approved 19 BCPs prior to the December 2015 requirement to report project status in G2.

Management Reserve

We found that Sandia's use of management reserve was not based on formal risk analyses. Sandia calculates management reserve for SSiFR as 15 percent of the remaining project costs. According to Department Order 413.3B, management reserve is a budget amount withheld for management control purposes and is not part of the project's performance measurement baseline. The Earned Value Management Systems EIA-748-C Intent Guide states that project managers must realize that the performance measurement baseline planning process contains risks and opportunities, and should identify management reserve for unplanned events that may arise during the course of the project. Specifically, the management reserve budget should be commensurate with the level of risks identified by the project and must not be viewed as a source for added work scope. Additionally, according to Department Order 413.3B, part of management reserve is a budget amount withheld for management control purposes and is not the project's performance measurement baseline. The Department Guide 413.3-7A, *Risk Management Guide*, provides non-mandatory risk management approaches for implementing the

requirements of Department Order 413.3B. For example, Department Guide 413.3-7A provides a formal, four-step process that uses risk analyses for developing management reserve. The process includes: (1) risk identification (identification of threats and opportunities); (2) risk assessment (identify risk triggers and interdependencies, assign probabilities and consequences, and assign risk ratings); (3) risk handling (decide on a risk handling strategy for each threat and opportunity); and, lastly, (4) develop a risk assessment whereby the cost estimate and schedule impacts for risks are determined. In our opinion, calculating management reserve based upon the remaining project costs does not adequately consider SSiFR's potential risks and opportunities.

In its Project Execution Plan, SSiFR officials recognized scope identification, poor estimates, escalation, and material prices as project risks. Realization of these risks may make the budget assigned to the related work inadequate, thereby requiring either additional funding or a reprioritization and reduction of the SSiFR scope. Providing funding for these types of events is the purpose of management reserve. The SSiFR project management provided documents which indicate that management reserve was a combination of budget reserve and scope reserve. Scope reserve was defined by SSiFR personnel as tool and facility activities that might be removed, if needed. However, according to an NNSA official with the Office of Program Management Support, scope reserve is not a recognized method for planning management reserve. Further, the Earned Value Management Systems EIA-748-C Intent Guide does not recognize the term "scope reserve" or its use as a project management tool.

Management Practices to Improve Project Execution

If NNSA had required Sandia to follow Department Order 413.3B, then Sandia would have been required to use project management practices that should have added rigor to project execution. Specifically, the practices include the involvement of a Federal Project Director, the use of the critical decision process, and periodic external independent reviews. Department Order 413.3B states that a Federal Project Director is responsible and accountable for:

- The project's success in meeting cost, schedule, and performance targets;
- Development and implementation of key project documentation, such as the Project Execution Plan;
- Leading the Integrated Project Team;
- Evaluating and verifying reported progress; and
- Ensuring that construction, safety, security, and quality efforts performed comply with the contract and regulations.

NNSA has not designated a Federal Project Director for SSiFR. Department Order 413.3B notes that a Program Manager can serve as the Federal Project Director until a Federal Project Director is assigned. In fact, the NNSA Recapitalization Program Office Federal Program Manager, a Headquarters official, is serving as the SSiFR Program Manager with a Sandia Field Office official to provide operational awareness of the SSiFR project. The NNSA Recapitalization

Program Office Federal Program Manager reviews project performance and financial data input into G2 by the SSiFR project team. The Sandia Field Office official reported to us that he provided operational awareness by reviewing SSiFR weekly and quarterly reports prepared by Sandia and attending monthly project status meetings.

In addition, Sandia personnel prepared and approved SSiFR's Project Execution Plan, staffed all the positions on the Integrated Project Team, and were responsible for progress and compliance with the Management and Operating contract and Departmental regulations. However, the assignment of a Federal Project Director to the SSiFR project would benefit NNSA by providing a source of information, other than contractor personnel, to evaluate and verify reported progress. A Federal Project Director would also provide additional support in delivering the project to its NNSA customers that meets cost schedule and performance targets while ensuring compliance with the Sandia contract and regulations. Successful performance of Departmental and NNSA projects depends on professional and effective project management by the Federal Project Director. The Federal Project Director is certified under the Department's Project Management Career Development Program, accountable to the Acquisition Executive or Program Secretarial Officer for project execution, and knowledgeable of the day-to-day project operations.

NNSA Defense Programs did not require Sandia to use the critical decision (CD) process. The use of the CD process is required by the Department in the acquisition of capital assets similar to SSiFR. Projects typically progress through five successive CDs, from broadly stated mission needs to well-defined requirements, and authorization of each phase increases the Department's commitment of resources. Inclusive in the CD process is the requirement for projects to report project status into the Project Assessment & Reporting System, the Department's official "System of Record" for capital asset project performance information. The Project Assessment & Reporting System uses the same data as maintained in Departmental contractors' project management systems and provides transparency of project performance data to Department officials from the Federal Project Director's staff to the Secretary of Energy. Project Assessment & Reporting System reporting is required immediately following approval of Mission Need, the initial CD. NNSA Defense Programs did not require Sandia to use the CD process because of their determination that Department Order 413.3B was not applicable to SSiFR. In discussing Sandia's lack of use of the CD process, Sandia officials told us that they wanted the flexibility to manage SSiFR in this manner and that they believed it was the best way to manage the project. While Department Order 413.3B advocates using a tailored approach to fulfilling Department Order 413.3B requirements, the tailored approach does not mean that the omission of requirements is allowable. In our opinion, the use of the CD process would have provided higher confidence in completing SSiFR on time because it would have increased visibility of the project among Department officials, thereby potentially lessening the budget shortfall SSiFR experienced in fiscal year 2015, which was the cause for the project's schedule slippage.

Finally, according to Department Order 413.3B, reviews are an important project activity. For projects with a TPC greater than \$100 million, Department Order 413.3B requires the Office of Project Management to perform an External Independent Review to validate the performance baseline. Department Order 413.3B also required that annual project peer reviews be performed following the establishment of a performance baseline and continued through project construction, and that the contractor conduct an annual EVMS surveillance. Sandia provided us

with a 2011 Independent Cost Estimate, a 2012 Preliminary Design Document, and a 2013 Independent Cost Assessment of the 2011 Independent Cost Estimate. According to a Sandia Field Office official, the contractor (Sandia) had not performed annual surveillance of the EVMS since fiscal year 2013. However, during the audit, Sandia did perform a surveillance review from June through July 2016, which reported that basic Earned Value processes had been implemented but that improvements were necessary⁴. While Sandia's 2012 Preliminary Design Document may address topics similar to those evaluated in an External Independent Review conducted by the Office of Project Management, there is no assurance that the appropriate cost methodologies and databases were used and project elements were assessed in accordance with Office of Project Management standards. Sandia did not provide any other project reviews or audits and, according to the Sandia Field Office official, no other audits or reviews of the project occurred. As such, Sandia had not conducted EVMS annual self-assessments nor had NNSA ensured that independent reviews of SSiFR practices and execution were conducted, including the required annual project peer reviews, thereby missing opportunities to identify best practices and improvements in SSiFR execution.

Deviation from Directive Department Order 413.3B

In our opinion, these conditions exist because NNSA did not ensure that Sandia managed the project under Department Order 413.3B. Sandia officials told us that NNSA directed Sandia to execute the SSiFR as multiple capital equipment acquisitions, General Plant Project improvements, and expense projects. More specifically, NNSA decided to conduct SSiFR as a collection of specific Capital Equipment, General Plant Project, and expense projects funded through Readiness and Technical Base Facilities. In addition, Sandia officials told us that Sandia was directed to not manage the project per the Department Order 413.3B based upon a March 2012 email from the NNSA Director, Office of Facility Operations. However, the email stated that the Director had revalidated the approach of using Readiness and Technical Base Facilities operating funds for SSiFR. The email did not provide Sandia with explicit or formal direction to deviate from the requirements of Department Order 413.3B. Exemptions from Department Order 413.3B require Deputy Secretary approval memorialized in an action memorandum. Despite our inquiries, neither NNSA nor Sandia officials were able to provide documentation supportive of the decision to deviate from established requirements in Department Order 413.3B.

The former NNSA Readiness and Technical Base Facilities manager who held this position during SSiFR planning told us that SSiFR was a replacement-in-kind project, not subject to Department Order 413.3B. However, according to NNSA's Office of Infrastructure Planning & Analysis, it does not have a formal or unique definition of replacement-in-kind. Further, characterizing the SSiFR project as a replacement-in-kind project rather than as a capital asset is contrary to the definition of a capital asset according to OMB Circular No. A-11. The OMB Circular No. A-11 defines a capital asset as "...structures, equipment, and intellectual property, which are used by the Federal Government and that have an estimated life of more than 2 years.

⁴ National Technology and Engineering Solutions of Sandia (NTESS) assumed full management and operation of Sandia National Laboratories in May 2017. The Department's Office of Project Management has not yet certified an NTESS EVMS.

Capital assets include not only the assets as initially acquired but also additions, improvements, modifications, replacements, rearrangements and reinstallations, and major improvements (but not ordinary repairs and maintenance).” We did not find any reference to replacement-in-kind in OMB Circular No. A-11.

The former NNSA Readiness and Technical Base Facilities manager also told us that his decision was based on his understanding that the facility would not acquire new capabilities through the SSiFR. We disagree with this rationale because the work scope of SSiFR includes the replacement of tools (through capital expenditures) capable of enabling the conversion from 6-inch to 8-inch wafer processing. For example, Sandia purchased tools from British Aerospace Systems LTD. for \$824,000 in 2014 that will allow SSiFR to process 6-inch and 8-inch wafers.

NNSA Defense Programs officials also stated that SSiFR was a severable portfolio of individual recapitalization projects, which they believed eliminated it from applicability to Department Order 413.3B. However, a capital asset project can range from the construction of a simple facility to a group of closely-related projects managed in a coordinated way. As we stated previously, the SSiFR meets the definition of a capital asset and has a total project cost that exceeds the threshold of \$50 million—criteria that dictates the applicability of Department Order 413.3B. An Office of Project Management official confirmed our understanding that the applicability of Department Order 413.3B has nothing to do with the severability or interdependencies of the individual projects.

Sandia officials believed Department Order 413.3B was not applicable to SSiFR. When we asked Sandia officials why Department Order 413.3B was not followed, they explained that Department Order 413.3B was not applicable because SSiFR was not a line item and was a series of capital equipment acquisitions and General Plant Project improvements and expense projects for tools and facility modification. However, in addition to line item funded projects, Department Order 413.3B is applicable to other capital asset projects, such as major items of equipment and operating expense projects. Although an Office of Project Management official stated the SSiFR project meets the definition of capital assets consistent with OMB Circular No. A-11 and it should have been managed under Department Order 413.3B, the Office of Project Management organization has not formally declared a position on the subject. The Office of Project Management official also stated that a project does not need to be a line item for it to be a capital asset project.

In NNSA’s official response to our report, NNSA replied that, at this time, Sandia does not have a project subject to Department Order 413.3B (to which Earned Value Management is applicable) with a total project cost of \$100 million or more. However, as detailed in the above paragraphs, our audit work has shown that the SSiFR meets the definition of a capital asset project provided in OMB Circular No. A-11. Additionally, the SSiFR’s Total Project Cost of \$150 million significantly exceeds the \$100 million threshold established by Department Order 413.3B for requiring an EVMS certification by the Office of Project Management.

During the course of our review and in response to our *Management of the National Ignition Facility and the Advanced Radiographic Capability* (DOE-OIG-18-04, October 2017) audit, NNSA committed to implementing steps to assist program managers in identifying whether

activities are applicable to Department Order 413.3B. Specifically, NNSA will: (a) reemphasize program responsibility and accountability for identifying and categorizing capital assets as Department Order 413.3B management efforts, consistent with NNSA's operating procedure, *Project Management for the Acquisition of Capital Assets* (BOP-06.05); (b) clarify the program vetting process for making and documenting applicability determinations; (c) document the decision making authority within the agency to resolve applicability issues; and (d) identify circumstances under which issues should be elevated for resolution and corporate decision. NNSA's implementation of its planned actions should provide program managers with additional resources and information necessary to ensure program activities are executed within applicable requirements.

Implications

The SSiFR project has achieved successes (as noted below) and is on-going. Nonetheless, NNSA's failure to require Sandia to implement key project management controls in Department Order 413.3B reduces our confidence in Sandia's ability to achieve project goals in the future. To its credit, Sandia was able to save \$4.5 million in project costs through the acquisition of tools and intellectual property made available from the closure of a similarly operated silicon fabrication facility in 2014. This acquisition enabled Sandia to more quickly replace SSiFR tooling with well-maintained equipment capable of processing both 6-inch and 8-inch wafers. As of March 2018, the SSiFR project management reports that the project is approximately 77 percent complete and \$113 million of an expected total project cost of \$150 million. The project has refurbished or replaced 41 tools and completed 25 facility projects. Sandia also reports to have met production schedules in its delivery life extension parts during SSiFR project execution.

Compliance with Department Order 413.3B provides Department elements, including NNSA, with program and project management direction for the acquisition of capital assets with the goal of delivering projects within the original performance baseline, cost, and schedule, and fully capable of meeting mission performance. The methods within Department Order 413.3B have been identified by the Department as critical to project management success, and the adherence to those methods benefits NNSA and Sandia by fully engaging the Department's experts in project management related disciplines in support of Sandia's execution of SSiFR. We have made four recommendations that we believe, if fully implemented, should enhance the management of the SSiFR and other projects going forward.

Finally, the SSiFR investments extend the capability of the existing facility through 2025 and allow for the continued delivery of microelectronics technology needed for weapon systems and subsystems to stay safe, secure, and effective in a changing geopolitical environment. More specifically, the SSiFR investments will allow Sandia to cover production requirements for the B61-12, W88 Alt 370, and W80-4. The production schedules for these weapons do not appear to have been adversely impacted by SSiFR's \$20 million shortfall in funding during fiscal year 2015, which resulted in the SSiFR completion date being extended from 2018 to 2019. However, any further significant delays in completion of the SSiFR project, such as the 2015 funding shortfall, could affect the ability to deliver the planned technology consistent with current production requirement schedules. To satisfy the microelectronics needed for weapons

systems beyond 2025, NNSA had considered construction of a new facility to replace the SiFab. However, during the analysis of alternatives, NNSA commissioned an independent study of the SiFab that concluded that the useful life of SiFab could be extended to 2040 with periodic maintenance, repair, and recapitalization investments of approximately \$154 million. As of February 2018, NNSA planned to make the investments necessary to extend the life of the SiFab to 2040, provided that NNSA is able to validate the cost estimate.

RECOMMENDATIONS

To address the issues we identified, we recommend that the Administrator, National Nuclear Security Administration:

1. Direct the Acting Deputy Administrator for Defense Programs and the Manager, Sandia Field Office, evaluate the feasibility of bringing the SSiFR project into compliance with Department Order 413.3B and implement those requirements determined critical to the successful execution of SSiFR;
2. Direct the Manager, Sandia Field Office, to ensure that all ongoing and new Sandia capital asset projects are properly categorized and managed in accordance with Department Order 413.3B;
3. Request the Department of Energy, Office of Project Management perform a compliance certification review of National Technology and Engineering Solutions of Sandia's EVMS and provide input to Sandia management to strengthen SSiFR's EVMS; and
4. Ensure that program management decisions are documented in accordance with NNSA's planned process of identifying and resolving Department Order 413.3B applicability issues.

MANAGEMENT RESPONSE

Management detailed the specific actions taken and planned to address the report's recommendations. Specifically, NNSA has evaluated bringing SSiFR into compliance with Department Order 413.3B and determined that a change in direction at this point is not warranted. NNSA will reemphasize program responsibility and accountability for properly identifying and categorizing capital assets as Department Order 413.3B management efforts.

Management stated that EVMS certification by the Department's Office of Project Management is "triggered" to be performed by the presence of Department Order 413.3B capital asset project with a Total Project Cost of \$100 million or more. Further, management stated that, at this time, Sandia does not have a capital asset project under its new management and operation contract that would require an EVMS certification review by the Office of Project Management.

AUDITOR COMMENTS

Management's comments and proposed actions are generally responsive to our findings and recommendations. As stated in the "Deviation from Directive Department Order 413.3B" section of the report, our audit showed that the SSiFR meets the definition of a capital asset project and the SSiFR's Total Project Cost of \$150 million significantly exceeds the \$100 million threshold established by Department Order 413.3B for requiring an EVMS certification by the Office of Project Management.

Management's formal comments are included in Attachment 3.

Attachments

cc: Deputy Secretary
Chief of Staff

OBJECTIVE, SCOPE, AND METHODOLOGY

OBJECTIVE

We conducted this audit to determine whether Sandia National Laboratories had effectively managed the Sandia Silicon Fabrication Revitalization (SSiFR) project.

SCOPE

The audit was performed from April 2016 to August 2018 at Sandia National Laboratories in Albuquerque, New Mexico. The audit scope included SSiFR activities. We conducted this audit under Office of Inspector General project number A16LA036.

METHODOLOGY

To accomplish our audit objective, we:

- Reviewed applicable laws and regulations, and Department of Energy and National Nuclear Security Administration policies related to project management;
- Reviewed Sandia National Laboratories processes and procedures for the SSiFR project;
- Analyzed the SSiFR schedule and evaluated the baseline change proposals;
- Reviewed National Nuclear Security Administration's Generation 2 Management Information System for the SSiFR project;
- Toured the SSiFR facility;
- Interviewed key Department, National Nuclear Security Administration, and contractor personnel; and
- Analyzed 6 months of the SSiFR project's Earned Value Management System data reported from May 2016 through October 2016 to determine the validity and reliability of the cost data, and the reasonableness of the Estimate at Completion.

We conducted this performance audit 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 objective. We believe the evidence obtained provides a reasonable basis for our conclusions based on our audit objective. The audit included tests of internal controls and compliance with the laws and regulations to the extent necessary to satisfy the audit objective. Additionally, we assessed the Department's implementation of the *GPR Modernization Act of 2010* as it relates to our audit objective and found that the Department had established performance measures to execute key milestones in support of the National Nuclear Security Administration's Stockpile Stewardship Program.

Because our review was limited, it would not have necessarily disclosed all internal control deficiencies that may have existed at the time of our audit. We relied on computer-processed data on a limited basis to achieve our audit objective. Sandia National Laboratories officials provided documents that were generated from reporting systems and, in general, we found the data to be sufficiently reliable for the purposes of this audit. We have concerns with the reliability of the Earned Value Management System data, as detailed in the audit report.

An exit conference was held on July 12, 2018.

RELATED REPORTS

Office of Inspector General

- Audit Report on [Management of the National Ignition Facility and the Advanced Radiographic Capability](#) (DOE-OIG-18-04, October 2017). The audit found that while Lawrence Livermore National Laboratory has generally been successful in managing the National Ignition Facility to address National Nuclear Security Administration (NNSA), Department of Energy, and external needs, we found that Lawrence Livermore National Laboratory had not effectively managed the development and installation of the Advanced Radiographic Capability, a key National Ignition Facility diagnostic tool. Specifically, the Advanced Radiographic Capability was completed 5 years behind schedule, over budget, and with only half of the originally planned capability. In our opinion, the shortcomings in the Advanced Radiographic Capability's schedule, cost, and scope occurred because NNSA did not ensure Lawrence Livermore National Laboratory managed the Advanced Radiographic Capability as a separate project under Department Order 413.3B, *Program and Project Management for the Acquisition of Capital Assets*. During our fieldwork, NNSA technical experts confirmed that the Advanced Radiographic Capability meets the criteria of a capital asset. To address the issues identified, we recommended that NNSA ensure Lawrence Livermore National Laboratory manages the development of new diagnostics and other new capabilities with appropriate project management controls, as applicable, and as outlined in Department Order 413.3B, *Program and Project Management for the Acquisition of Capital Assets*.
- Audit Report on [Department of Energy Contractors' Implementation of Earned Value Management](#) (OAI-L-17-03, November 2016). To its credit, the Department's Office of Project Management Oversight and Assessments (Office of Project Management) has identified deficiencies with the contractors implementing Earned Value Management. While we observed that reviews of some contractors' Earned Value Management systems were delayed, we noted that Office of Project Management was taking corrective actions. We also noted that Office of Project Management was late in performing surveillance reviews for the Earned Value Management systems of six contractors with projects that had over \$100 million in total project costs. The Office of Project Management did not perform the reviews within the timeframes that were in effect at the time of our audit, as specified in Department Order 413.3B, *Program and Project Management for the Acquisition of Capital Assets*. However, in May 2016, the Department modified Department Order 413.3B, *Program and Project Management for the Acquisition of Capital Assets*, removing the requirement for reviews every 2 years and replacing the reviews with a "risk-based, data-driven" assessment. Office of Project Management officials stated that, in practice, they began implementing the risk-based, data-driven approach prior to the revision of Department Order 413.3B, *Program and Project Management for the Acquisition of Capital Assets*, consistent with a Secretarial policy direction issued in June 2015. Our report suggested that the Department ensure that all applicable projects with a total project cost at or above \$100 million are managed with a certified Earned Value Management System and that contractors update their project Estimate at Completion as appropriate.

- Audit Report on [*Sandia National Laboratories' Readiness in Technical Base and Facilities Program*](#) (OAS-L-13-13, September 2013). Nothing came to our attention to indicate that Sandia National Laboratories' Readiness in Technical Base and Facilities Subprogram was not effectively supporting Life Extension Program mission needs. We noted that Subprogram officials implemented performance monitoring controls, prioritized capital investments and management plans to mitigate risks, such as the needed recapitalization of aging and unsupported tools. The Readiness in Technical Base and Facilities Subprogram is facing challenges as it strives to meet the production and testing needs required for Life Extension Programs. According to Subprogram officials, current funding levels will likely not be sufficient to sustain the present operations level in the future. The Readiness in Technical Base and Facilities Subprogram and NNSA are aware of these challenges and are considering how best to address them.

Government Accountability Office

- [*High Risk Series: An Update*](#) (GAO-15-290, February 2015). The U.S. Government Accountability Office designated the Department's contract management—which includes both contract administration and project management—as a high-risk area in 1990 because the Department's record of inadequate management and oversight of contractors has left the Department vulnerable to fraud, waste, abuse, and mismanagement. In February 2013, the U.S. Government Accountability Office further narrowed the focus of the high-risk designation to the Department's Office of Environmental Management and NNSA's major contracts and projects, those with an estimated cost of \$750 million or more to acknowledge progress made in managing projects with an estimated cost of less than \$750 million. Since our 2013 high-risk update, the Office of Environmental Management and NNSA have continued to struggle with many of these projects. To address these issues, the Department must sustain the leadership commitment it has already demonstrated to address its contract and project management challenges, and ensure the corrective action plan and the initiatives needed to address underlying causes of contract and project management problems are up to date and address root causes.
- [*Project and Program Management: DOE Needs to Revise Requirements and Guidance for Cost Estimating and Related Reviews*](#) (GAO-15-29, November 2014). The Department of Energy's and its NNSA's cost estimating requirements and guidance for projects and programs do not fully reflect best practices for developing cost estimates. In regard to cost estimating requirements for projects, the Department's 2010 project management order requires 1 of the 12 cost estimating best practices—conducting an independent cost estimate—for larger projects at certain stages of development. In contrast, the Department's 2011 cost estimating guide describes recommended approaches for using 10 of 12 best practices and partially contains information about the other two. Furthermore, because the Department's cost estimating guide was issued in 2011—after the Department's 2010 project order was issued—it is not referenced in the order. As a result, users of the order may not be aware of the 2011 cost estimating guide's availability and may not benefit from its usefulness. In the absence of a requirement for using best practices, it is unlikely that the Department, NNSA, and their contractors will consistently develop reliable cost estimates.

MANAGEMENT COMMENTS

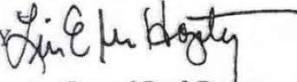


Department of Energy
Under Secretary for Nuclear Security
Administrator, National Nuclear Security Administration
Washington, DC 20585



June 1, 2018

MEMORANDUM FOR APRIL STEPHENSON
PRINCIPAL DEPUTY INSPECTOR GENERAL

FROM: LISA E. GORDON-HAGERTY 

SUBJECT: Comments on the Office of Inspector General Draft Report,
"The Sandia National Laboratories Silicon Fabrication
Revitalization Effort" (A16LA036)

Thank you for the opportunity to review and comment on the subject draft report. The National Nuclear Security Administration (NNSA) appreciates the Office of Inspector General's recognition of NNSA's success in managing the Sandia Silicon Fabrication Revitalization (SSiFR) effort within the planned cost and schedule to deliver tooling capable of meeting production milestones, while saving \$4.5 million. The auditors further stated they identified no issues to indicate that Sandia will not continue to make progress in refurbishing or replacing silicon fabrication tools.

The Office of Defense Programs did not require strict compliance with Department of Energy Order 413.3B, *Program and Project Management for the Acquisition of Capital Assets*, given the nature of the SSiFR effort. The attachment to this memorandum details the specific actions taken and planned to address the report's recommendations related to the chosen approach. Technical and general comments have also been provided by subject matter experts under separate cover for your consideration to further enhance the clarity and factual accuracy of the report. If you have any questions regarding this response, please contact Mr. Dean Childs, Director, Audits and Internal Affairs, at (301) 903-1341.

Attachment



Attachment

NATIONAL NUCLEAR SECURITY ADMINISTRATION
Response to Report Recommendations (A16LA036)

Sandia National Laboratories Silicon Fabrication Revitalization (SSiFR)
 Effort

The Office of Inspector General recommended NNSA:

Recommendation 1: Evaluate the feasibility of bringing the SSiFR effort into compliance with Department of Energy Order 413.3B (DOE 413.3B), *Program and Project Management for the Acquisition of Capital Assets*, and implement those requirements determined critical to the successful execution of SSiFR.

Management Response: Compliance with DOE 413.3B may be achieved by strict compliance to all of the technical requirements where appropriate and applicable, or by formally documenting and obtaining approval for a modified or tailored approach. As discussed in the response memorandum, the Office of Defense Programs did not require strict compliance with the Order, thus allowing Sandia to use a modified approach. While we agree the formal DOE 413.3B process for documenting and obtaining approval for a tailored approach was not followed, NNSA has evaluated bringing SSiFR into compliance with DOE 413.3B for the final year of this seven year effort, and does not believe a change in direction at this point is warranted, nor is there benefit to obtaining retroactive approval through the formal process.

Our conclusion is based on: 1) Successful SSiFR Management -The IG report notes the success of the effort under this modified approach and “identified no issues to indicate that Sandia will not continue to make progress in refurbishing or replacing silicon fabrication tools.” The report further demonstrates that Sandia employed critical principles of DOE 413.3B, and achieved \$4.5 million in resultant savings; and 2) Percent Complete - The SSiFR effort is over 70% complete and the fiscal year 2018 tools have been planned and are ready to be procured, to be followed by one final year of equipment upgrades in fiscal year 2019. While NNSA considers this recommendation closed as it relates to SSiFR, any similar efforts going forward will be subjected to DOE 413.3B where applicable.

Recommendation 2: Ensure all ongoing and new Sandia capital asset projects are properly categorized and managed in accordance with DOE 413.3B.

Management Response: The recommendation is consistent with NNSA’s self-identified need to facilitate consistent interpretation of whether potential activities meet the definition of a capital asset requiring the application of DOE 413.3B, consistent with our response to the OIG’s prior report (DOE-OIG-18-04). To address this recommendation, NNSA will reemphasize program responsibility and accountability for properly identifying and categorizing capital assets as DOE 413.3B management efforts. The estimated completion date for these activities is September 30, 2018.

Recommendation 3: Request the Department of Energy’s Office of Project Management (DOE PM) perform a compliance certification review of National Technology and Engineering

Attachment

Solutions of Sandia's EVMS and provide input to Sandia management to strengthen SSiFR's EVMS.

Management Response: EVMS certification by DOE PM is "triggered" to be performed by the presence of DOE 413.3B capital asset projects (to which EVM is applicable) with a total project cost of \$100M or more. At this time, Sandia does not have a project under the new contract triggering a DOE PM review. DOE PM will evaluate the Sandia EVMS upon request when a new project meeting their certification review criteria is undertaken. As this is a standing process with no clear timetable, NNSA considers this recommendation closed.

Recommendation 4: Ensure that program management decisions are documented in accordance with NNSA's planned process of identifying and resolving Department Order 413.3B applicability issues.

Management Response: NNSA's corrective actions in response to recommendation 2 will address documentation requirements. The estimated completion date for this action is September 30, 2018.

FEEDBACK

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Office of Inspector General (IG-12)
Department of Energy
Washington, DC 20585

If you want to discuss this report or your comments with a member of the Office of Inspector General staff, please contact our office at (202) 253-2162.