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Office of Inspector General
Office of Audits and Inspections**

AUDIT REPORT

National Nuclear Security Administration's
Management of the B61-12 Life Extension
Program

DOE-OIG-16-15

August 2016



Department of Energy
Washington, DC 20585

August 18, 2016

MEMORANDUM FOR THE SECRETARY

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FROM: Rickey R. Hass
Acting Inspector General

SUBJECT: INFORMATION: Audit Report on the “National Nuclear Security Administration’s Management of the B61-12 Life Extension Program”

BACKGROUND

The primary mission of the National Nuclear Security Administration’s (NNSA) Defense Programs is to ensure the safety, reliability, and performance of the Nation’s nuclear weapons stockpile. One of the oldest nuclear weapon systems in the stockpile is the B61. NNSA has raised serious concerns regarding its future reliability. To address these concerns, in 2012, the Nuclear Weapons Council approved the refurbishment of the B61 through a life extension program (LEP), which extends the bomb’s life 20 years and consolidates several existing modifications of the B61 into one modification. The current total estimated cost for the B61-12 LEP is \$8.1 billion, with a First Production Unit by March 2020.

To help ensure delivery of the updated weapon within cost and schedule, NNSA Defense Programs identified the B61-12 LEP as a pilot program through which it sought to change its approach to LEP management. This added several enhanced project management tools to the suite of tools already required for the management of nuclear weapon refurbishments. Specifically, NNSA Defense Programs required its sites to use a program-wide earned value management system (EVMS) that uses standard scheduling software. The EVMS is used to integrate project and program management elements required for effectively planning, organizing, and controlling the work performed in order to complete the LEP in a cost-effective and timely manner. Program officials stated that this change provided early information about potential problems, and they have used this information to take action to keep the LEP on schedule and under budget. According to B61-12 LEP management, the program has met every major milestone in nearly 4 years of development work.

In addition, the B61-12 LEP required the sites to implement a risk management plan to minimize the likelihood of an adverse event affecting the program’s ability to meet cost, schedule, and reliability requirements. Further, the sites were required to conduct a robust cost estimate that included management reserves to ameliorate impacts from risks or cost uncertainties. Given the critical national security mission, as well as the significant cost of the project, we initiated this audit to determine whether NNSA was effectively managing the B61-12 LEP.

RESULTS OF AUDIT

The B61-12 LEP has overcome significant challenges in implementing several enhanced project management tools. Some of these challenges include developing eight resource-loaded site schedules for development and production activities occurring across NNSA sites, all with different management systems, processes, and cultures. In addition, the B61-12 LEP team had to develop a new system of control accounts and a process not only to integrate earned value data, but also to integrate the different site resource-loaded schedules into an NNSA Integrated Master Schedule. While these accomplishments are noteworthy, we also identified issues within the tools that, in our view, if not corrected, could make it more difficult for the B61-12 LEP to proactively ensure that its mission and functions are properly executed. Specifically, we found program management issues in the following significant areas:

- Master and Site Schedules - B61-12 LEP master and site schedules contained multiple scheduling issues that limited the full potential of the program's EVMS to provide program management with the ability to confidently validate the B61-12 LEP's critical path and earned value calculations. This affects the program's ability to effectively ensure that its mission and functions are properly executed without using additional tools. Specifically, our review identified cases where the master and site schedules were not aligned, master and site schedules did not contain accurate links between tasks, site schedules did not comply with the sequence established in NNSA Defense Program's 6.X process, and schedules did not have a specific and measurable means of gauging progress.¹
- Risk Management - Although the B61-12 LEP implemented a risk management system, we determined that risk mitigation activities could be improved to minimize risk exposure to the B61-12 LEP. Specifically, we identified cases where mitigation actions developed to manage and reduce risks to the B61-12 LEP were not integrated with the site schedules. We also observed cases where risks did not have approved mitigation actions that were specific and executable. In addition, in some cases, schedule and cost impacts of realized risks could not be identified, and half (24 of 48) of the risk mitigation actions in the B61-12 LEP risk database for Sandia National Laboratories (SNL) and Los Alamos National Laboratory were behind schedule.
- Quality Assurance - Quality assurance activities, in some cases, did not provide documented assurance that redesigned B61-12 LEP components would fully address prior safety and reliability concerns. Specifically, SNL officials were unable to provide documented assurance that redesigns to multiple components would address issues identified in unresolved significant finding investigations (SFIs). In response to our audit work, SNL made changes to its design review process to include reviews of open SFIs. According to NNSA, since the time of our review, design reviews have been conducted, and SNL was able to provide documented evidence that prior issues were being addressed with redesigned components.

¹ The 6.X process manages weapons system refurbishments from concept to full-scale production.

- Technically Justifiable Management Reserves - Site management reserve estimates were not technically justifiable, potentially constraining the B61-12 LEP's ability to absorb cost impacts of realized risks. However, according to NNSA, after nearly 4 years of development work, management reserve has been sufficient to absorb the cost impact of all realized risks.

Many of the issues we identified were also identified in B61-12 LEP Integrated Baseline Reviews of the site schedules that took place from August 2014 to September 2015. According to B61-12 LEP officials, the program was ensuring that the sites are working to correct these issues. According to B61-12 LEP management, followup reviews by NNSA officials to ensure these issues have been addressed are scheduled for fiscal year 2016.

Scheduling and risk management conditions existed because NNSA Defense Programs had not institutionalized requirements for prior LEPs to use a program-wide EVMS with standard scheduling software. NNSA Defense Programs did not require the B61-12 LEP to use one until December 2012, which was after the Phase 6.3 authorization, the Development Engineering portion of the 6.X process. Accordingly, when the B61-12 LEP was initiated in 2012, the B61-12 LEP did not initially require the sites to use a program-wide EVMS with standard scheduling software, and it did not explicitly require that the risk management system be integrated into its scheduling system. The B61-12 LEP has since begun to use EVMS.

While the B61-12 LEP required the examination and documentation of unresolved SFIs to be included as a part of design reviews for nonnuclear components, at the time of our review, SNL had not incorporated this requirement into its site design review procedures. Furthermore, although the B61-12 LEP developed a cost estimate guide based on the *GAO Cost Estimating and Assessment Guide*, a B61-12 LEP official told us that the sites' capability to conduct the required probability-based analysis of risk was immature at the time. This immaturity was due to a lack of overall requirements for probability-based analysis of risk for management reserve by NNSA Defense Programs. Therefore, when the B61-12 LEP attempted its cost estimate in accordance with the *GAO Cost Estimating and Assessment Guide*, NNSA sites were not fully equipped with proper resources to conduct the type of rigorous probability-based analysis of risk required to obtain justifiable management reserve estimates.

We recognize that the B61-12 LEP master and site schedule improvements have given the program the ability to correct site-to-site schedule alignment problems that were not available to past weapon programs. In addition, our review was performed 4 months after the program completed the new integrated baseline schedule. According to industry standards, the average time to implement an EVMS is 12–18 months, so we are encouraged by the improvements the program had made.

However, we believe without further improvement to its project management tools, it will be difficult for the program to proactively manage the costs, schedule, and risks of the B61-12 LEP to ensure it can deliver the First Production Unit within cost and meet its critical national security schedule. In addition, there is uncertainty whether the original cost estimate for the B61-12 LEP contains sufficient management reserve to allow the program to respond to the numerous risks

identified in the program. Finally, not having documented assurance that unresolved SFIs are a part of weapons design input significantly reduces management's ability to ensure that redesigned nuclear weapon components have addressed prior safety and reliability concerns.

According to a B61-12 LEP official, the program is continuously improving master and site schedule alignment to correctly reflect the planned work. The impact of this schedule alignment is currently unknown. Consequently, we made recommendations designed to improve program management controls over the B61-12 LEP, as well as other NNSA weapon system refurbishments.

MANAGEMENT AND AUDITOR RESPONSES

Management concurred with the recommendations and indicated that corrective actions have either already been completed or were planned to address the issues identified in the report. Management expressed concern that the audit activities largely concluded 1 year ago, and therefore, the information presented in the report did not adequately represent the current state of the B61-12 LEP. Management also was concerned that the report understated the significant accomplishments and increased management effectiveness associated with the B61-12 LEP.

We acknowledge that management had taken action to address many of the issues identified in our report. During the month that it took management to respond to the coordination draft and the 4 months to respond to the official draft report, we updated this report with the most current information available. We also made appropriate changes to the report as management provided additional information. We recognize the significant accomplishments and increased management effectiveness that have been achieved, and we applaud management for implementing tools, such as an EVMS. Management's comments and our responses are summarized in the body of the report. Management's formal comments are included in their entirety in Appendix 3.

Attachment

cc: Deputy Secretary
Administrator, National Nuclear Security Administration
Chief of Staff

NATIONAL NUCLEAR SECURITY ADMINISTRATION'S MANAGEMENT OF THE B61-12 LIFE EXTENSION PROGRAM

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NATIONAL NUCLEAR SECURITY ADMINISTRATION'S MANAGEMENT OF THE B61-12 LIFE EXTENSION PROGRAM

DETAILS OF FINDING

The Department of Energy's National Nuclear Security Administration (NNSA) Defense Programs and the Department of Defense share responsibility for all nuclear weapons through the Nuclear Weapons Council. The B61 gravity bombs are among the oldest nuclear weapon systems in the Nation's nuclear weapons stockpile. Our North Atlantic Treaty Organization allies rely on this system as part of the United States extended deterrent. NNSA Defense Programs has raised serious concerns regarding its future reliability. To address these concerns, the Nuclear Weapons Council approved the B61-12 life extension program (LEP) to extend the life of the bomb by 20 years. The current total estimated cost for the B61-12 LEP is \$8.1 billion, with a First Production Unit by March 2020.

NNSA Defense Programs uses the Nuclear Weapons Council's *Procedural Guideline for the Phase 6.X Process* to manage weapon system refurbishments from concept to full-scale production (see Figure 1).

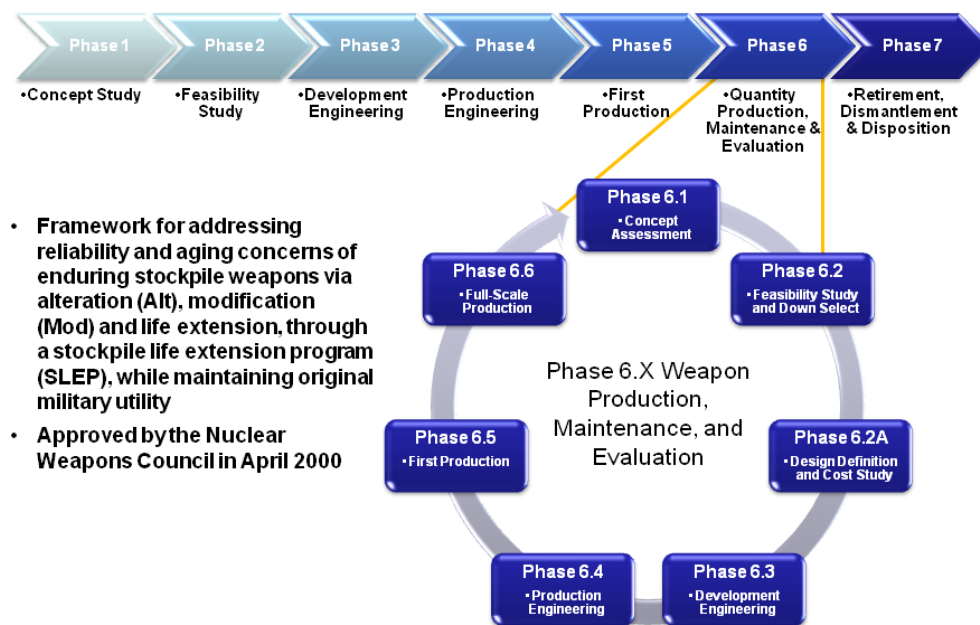


Figure 1: NNSA Phase 6.X Process

In 2012, the Nuclear Weapons Council approved entering Phase 6.3, Development Engineering, for the B61-12 LEP. The majority of design work for the B61-12 LEP is performed at the design agencies, Los Alamos National Laboratory (LANL) and Sandia National Laboratories (SNL). The approved scope consolidates several existing weapon modifications into one modification, the B61-12, and extends the life of the B61 bomb by 20 years. In addition to addressing the

critical aging of the nuclear and nonnuclear components, the B61-12 LEP also will increase limited life component exchange intervals and assure compatibility with current and future military aircraft.²

Historically, the Department and NNSA Defense Programs have had difficulties in meeting cost and schedule timelines for weapon system refurbishments due to issues in project management. For example, in our 2012 report *Follow-up Audit of the National Nuclear Security Administration's W76 Nuclear Warhead Refurbishment Program* (DOE/IG-0870, September 2012), we reported that the W76 LEP may have been unable to complete the full program scope within schedule and budget parameters, in part because the W76 LEP did not use a program-wide earned value management system (EVMS) to measure overall performance. Furthermore, in our 2006 report *W76 Life Extension Project* (DOE/IG-0729, May 2006), we reported that the W76 LEP had reduced scope and delayed work, in part because the W76 LEP did not ensure site schedules were consistent and integrated with the project master schedule, had not maintained effective control over project costs and baseline changes, and did not document risk mitigation activities. Similarly, in *The National Nuclear Security Administration's Refurbishment of the B61* (DOE/IG-0697, August 2005), we reported that NNSA did not have a valid estimate of total refurbishment costs for a prior B61 alteration and that inconsistencies and conflicts between site schedules had caused a program delay of at least 13 months.

To improve its program management of weapon refurbishments, in December 2012, NNSA's Deputy Administrator for Defense Programs directed the B61-12 LEP Federal program manager to pilot a program-wide EVMS using standardized scheduling software. Accordingly, in 2013, the program manager directed all sites involved in the B61-12 LEP to implement Primavera[®] software to construct new program baseline schedules. The sites completed their new baseline schedules in April 2014, and in May 2014, the B61-12 LEP used these schedules to set the current baseline for the program's master schedule. This baseline showed the program's First Production Unit being delayed from September 2019 to March 2020, with the total cost of the program estimated at \$8.1 billion.

By implementing a program-wide EVMS with standard scheduling software for the entire program, the B61-12 LEP forecast improved program management benefits. B61-12 program officials stated that this change provided early information about potential problems and they have used this information to make management decisions and implement changes necessary to keep the program on schedule and under budget. For example, in 2014, the B61-12 LEP schedule identified a component that could potentially delay the First Production Unit. Program officials evaluated the component's site schedule and negotiated changes to avoid negative schedule impacts to the program. According to B61-12 LEP management, the program has met every major milestone in nearly 4 years of development work.

The B61-12 LEP also required the sites to implement a risk management plan to minimize the likelihood of an adverse event affecting the program's ability to meet cost, schedule, and reliability requirements. Further, the program required the sites to conduct a robust cost estimate that included management reserves to manage impacts from risks or cost uncertainties.

² A limited life component is a weapon component that deteriorates in some respect over time and must be replaced periodically during the stockpile life of the weapon.

Program Management Tools

While the B61-12 LEP has implemented several enhanced project management tools, we identified issues within those tools that, in our view, if not corrected, could make it more difficult for the B61-12 LEP to proactively ensure that its mission and functions are properly executed.

Specifically, we found that the B61-12 LEP management tools, in some cases, were not adequately implemented in four significant areas:

- B61-12 LEP master and site schedules contained multiple scheduling issues that limited the full potential of the program's EVMS to allow program management to confidently validate the B61-12 LEP's critical path and earned value calculations;
- Risk management activities were not adequately managed to minimize risk exposure to the B61-12 LEP;
- Quality assurance activities, in some cases, did not provide documented assurance that redesigned B61-12 LEP components have fully addressed prior safety and reliability concerns; and
- Site management reserve estimates were not technically justifiable, potentially constraining the B61-12 LEP's ability to absorb cost impacts of all realized risks.

Program Management Schedules

Although the B61-12 LEP has implemented an EVMS with integrated schedules, we found that the master and site schedules were not sufficiently mature to confidently validate the critical path and predict potential schedule delays. Good earned value management relies on accurate scheduling, which provides program management with early indicators of future schedule delays. However, we identified issues with data accuracy in the master and site schedules that hinder the B61-12 LEP's ability to use the EVMS to consistently provide program management with accurate data to measure cost and schedule for useful management decisions. For example, in some cases, the master and site schedules were not aligned, schedules did not contain accurate links between tasks, site schedules did not comply with the sequence established in NNSA Defense Programs' 6.X process, and tasks were not specific and measurable. These issues could inhibit program management from using the EVMS to accurately measure progress of the B61-12 LEP and calculate the critical path without using additional tools.

Many of the schedule reliability issues we identified were also identified in the B61-12 LEP's Integrated Baseline Reviews of the site schedules that took place from August 2014 to September 2015. B61-12 LEP officials told us the sites are working to correct the schedule reliability issues and the program's schedules have improved enough that they are now providing useful management information. According to B61-12 LEP management, followup reviews by NNSA officials to ensure these issues have been addressed are scheduled for fiscal year (FY) 2016.

Master and Site Schedule Alignment

The master and site schedules were not, in some cases, aligned. Successful completion of the B61-12 LEP within cost and schedule relies on coordination between the B61-12 LEP management and the managers of the NNSA sites performing work. This coordination is especially important, as there are many instances where work at one site cannot begin until another site completes prerequisite work. For example, design agencies must complete a component design before production engineers can build the component. To coordinate these efforts, program management implemented a summary master schedule that consolidated schedule data from the site schedules. According to the B61-12 Project Controls System Description (PCSD), at a minimum, the milestone dates in the master schedule should be identical to those in the site schedules. This helps ensure that earned value data derived from the site schedules provides trending information that is relevant to the critical path data derived from the master schedule. In addition, the B61-12 PCSD requires feedback from the master schedule to site schedules for milestone activities between sites. This helps provide continued consistency between project and program milestones.

However, we determined that milestone dates in the September 2014 master schedule did not consistently match those in the site schedules. We examined the status of 29 milestones for Qualification Evaluation Release, which authorizes components for use, and found that seven (24 percent) of the milestones varied by more than 100 days between the design agency site schedules and the master schedule. For example, we identified a milestone date for LANL to qualify the primary main charge, a subcomponent of the nuclear explosive package, scheduled to be completed in the LANL site schedule 1.5 years (498 days) after the date shown in the master schedule (see Figure 2). LEP management was aware that the master and site schedules were not fully aligned. According to B61-12 LEP management, site action plans resulting from the B61-12 Integrated Baseline Reviews required Product Realization Teams and sites to agree on key milestones, and exchange hand-offs and engineering release matrices to a greater level of detail. However, this particular disconnect had not been corrected as of September 2015. Until the master and site schedules are brought into better alignment, it will be more difficult for LEP management to validate the critical paths for affected components.

After our review of the schedules, B61-12 LEP officials stated that due to differences in calendars used and scheduling environments, having identical schedules was an unachievable requirement. Consequently, the B61-12 LEP management changed the PCSD language to “aligned” versus “identical” in Revision 1 of the PCSD, indicating that the schedules should be close, but they do not have to be identical. However, as shown above, the master schedule was out of alignment with site schedules by more than 100 working days for 24 percent of the components developed at SNL and LANL.

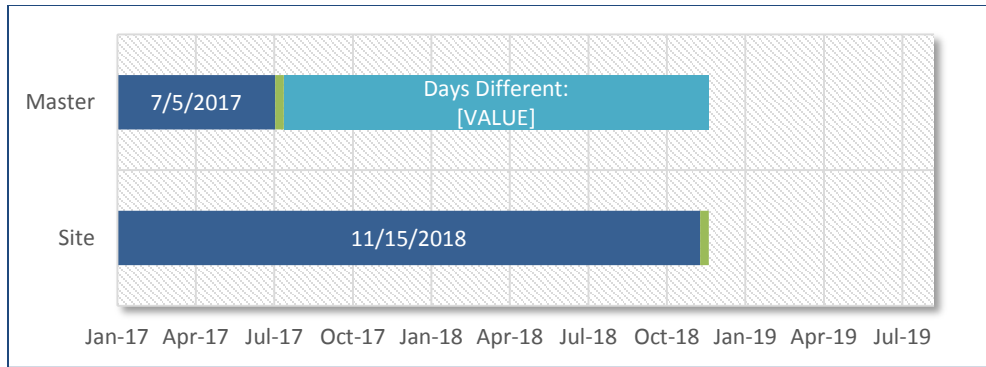


Figure 2: Primary Main Charge Qualification Milestone Dates

Master and Site Schedule Reliability

Unlinked Tasks

Master and site schedules did not, in some cases, contain logical or sequential links between tasks. This resulted in schedules that did not consistently give accurate data for calculating potential future program delays. For the schedules to provide this function, American National Standards Institute 748-B, guideline 6, states that any activities (tasks) that need to be performed in sequence should be linked to one another within the schedules. Accordingly, the NNSA B61-12 LEP PCSD required that all scheduled tasks in the master and site schedules have at least one predecessor and at least one successor. However, our review of the September 2014 master and site schedules showed that the schedules did not meet this requirement. Specifically, we reviewed discrete tasks that were either ongoing or not yet started at the time of our review and found the following:

- Master schedule tasks were missing either a predecessor or a successor for 1,002 of the 5,252 instances (19 percent);
- LANL schedule tasks were missing either a predecessor or a successor for 1,290 of the 13,476 instances (10 percent); and
- SNL schedule tasks were missing either a predecessor or a successor for 298 of the 29,537 instances (1 percent).

B61-12 LEP officials stated that links to other tasks may not always be possible for the site schedules because many tasks in the site schedules represent deliverables to or from other sites. However, many of the instances we observed were missing links within the same site schedule. For example, multiple joint tests were not linked to any subsequent tasks when NNSA stated they should have been linked to a report or review.

B61-12 LEP management performed their planned Integrated Baseline Reviews at LANL, SNL, and other sites to assess the sites' compliance with the LEP PCSD. These reviews identified similar and additional issues, providing recommendations to properly link all tasks in the

Integrated Site Schedules and communicate correct linkage to the master schedule. LEP officials informed us they have been working with the sites to correct these issues. When we reexamined the schedules in March 2015, 6 months after our initial review, we found that the number of tasks missing links to other tasks had dropped significantly in the site schedules but had increased slightly in the master schedule.

An LEP official also told us that NNSA Defense Programs is working to adopt a tailored method of assessing schedule health based on the methodology set forth in the Defense Contract Management Agency *Earned Value Management System Program Analysis Pamphlet*. This pamphlet contains several objective measures of schedule health, including a measure of tasks not linked to either preceding or subsequent tasks. NNSA Defense Programs' implementation of such a methodology would give future LEPs an objective way to measure the health of their schedule.

Incorrectly Linked Tasks

The master and design agency site schedules contained thousands of additional tasks in activity groupings that were incorrectly linked. These group's activities could be delayed for multiple years and the schedules would not reflect the impact on other relevant tasks. Specifically, we found 4,693 incorrectly linked tasks in the B61-12 LEP master and site schedules. For example, according to SNL's schedule, 12 component tests scheduled to be executed in 2014 or 2015 could have been delayed by 2,000 days without delaying the program, even though they are listed as tests supporting the weapon's Baseline January 2016 Design Review. As a result, the schedule did not communicate the true impact any potential delay to these tests would have. B61-12 LEP management also identified issues with incorrectly linked tasks in its Integrated Baseline Reviews and made recommendations to address and correct this issue. For example, B61-12 LEP management stated they have found, as part of their corrective action, that some of the schedule link problems were for work that is not directly needed for the project's First Production Unit, or for work that must be coordinated with Air Force work that was not fully baselined.

Improperly Sequenced Tasks

Design agency site schedules contained tasks that were not in the proper sequence for the production of a nuclear weapon. NNSA's Product Realization requirement R001 for conducting Phase 6.4, Production Engineering, identifies the sequence for developing a nuclear weapon and its components. For example, R001 states that Process Prove-In (PPI) builds must occur before Qualification builds. PPI builds are used to fine-tune the production process, while the Qualification builds actually certify that the production process is capable of yielding continuous war reserve components. It is essential that PPI builds occur in advance of Qualification builds so that process adjustments and corrective actions may be accomplished before qualification and full-scale production begins.

However, our review identified that SNL's schedule had multiple components with tasks that were not in the correct sequence for nuclear weapons component development. For example, SNL's schedule incorrectly showed weapon component Qualification builds beginning before

PPI builds for approximately 5 of 29 (17 percent) of their components. Most notable was SNL's schedule for developing electronic neutron generators that showed component Qualification builds beginning 1 year before PPI builds would be complete. While issues with out-of-sequence work for Qualification builds and PPI builds were the most common issue, other important activities were also out of order. A B61-12 LEP official told us the B61-12 LEP has been working with the sites to correct this issue in their component schedules. By March 2015, SNL corrected the sequencing of electronic neutron generator component activities, but four of the five other component sequences still needed to be corrected.

Specific and Measurable Tasks

Many of the tasks in the site schedules did not have a specific and measurable means of gauging progress. For a schedule to provide early indicators of future delays, progress against work tasks must be specific and measurable so that managers can accurately and objectively measure the work performed and predict a reasonable estimate for the cost and schedule at completion. American National Standards Institute guideline 10 requires authorized work to be done in measurable tasks, and the B61-12 LEP requires sites to report the status of performed work and to estimate cost and schedule at completion each month. However, the Integrated Baseline Reviews at both SNL and LANL found that their site schedules for design included many tasks that lacked specific and measurable interim deliverables because they were considered as level-of-effort, support-type tasks that are done to support other discrete work tasks. Using level-of-effort tasks when a discrete work task may be used can mask measurable progress for work being performed. In addition, the B61-12 LEP identified that there were many other tasks that were longer than 80 workdays without any specific and measurable interim deliverables against which to measure progress. The B61-12 LEP made recommendations to both sites intended to improve how objectively they measure performed work.

Similarly, we examined tasks in progress for LANL's and SNL's design schedules for interim deliverables that were longer than 6 months, as a conservative benchmark, and found it difficult to determine schedule performance. At the time of our review, LANL's design schedules contained 66 of 384 tasks (17 percent) longer than 6 months, but none of them included interim deliverables. Likewise, SNL's design schedule had 210 of 893 tasks (23 percent) longer than 6 months with no intermediate deliverables. This included 184 tasks coded as level-of-effort, even though the B61-12 LEP PCSD required level-of-effort tasks be kept to a minimum. According to the Integrated Baseline Review, SNL officials identified that many of the activities coded as level-of-effort could be separated into discrete activities with deliverables. In fact, the Integrated Baseline Review recommended reducing the number of activities coded as level-of-effort without specific and measurable deliverables, program management stated that they had to use other means to assess whether these tasks were ahead of or behind schedule or predict the extent or severity of delays in ongoing work. By March 2015, LANL's in progress tasks that contained no intermediate deliverables had increased to 33 percent. SNL's schedule remained the same at 23 percent.

Even though many of the schedule reliability issues we identified were also identified in subsequent B61-12 LEP Integrated Baseline Reviews of the site schedules, and corrective actions are being taken, as of May 2015, many of these reliability issues were still unresolved.

Risk Management

Although the B61-12 LEP implemented a risk management system, we determined that risk mitigation activities could be improved to minimize risk exposure to the B61-12 LEP. The identification of risks and the management of the risk's mitigation activities are essential to reducing the likelihood that a risk will have a significant impact on the cost, schedule, or performance of the B61-12 LEP. According to B61-12 LEP management, the B61-12 LEP has used an improved approach to risk management that is much more modern and more robust than the approach used by prior LEPs. Despite these improvements, our review found problems with the management of risks. Specifically, our review found that:

- Many risk mitigation actions were not integrated into the site schedules;
- Risks did not often have approved mitigation actions;
- Mitigation plans were not divided into specific, executable work actions;
- B61-12 LEP management did not, in some cases, identify the true impacts of realized risks to cost and schedule; and
- Half of the approved risk mitigation actions in the B61-12 risk database were behind schedule.

According to B61-12 LEP officials, many of these issues are being addressed to ensure that the program is capable of developing a cost estimate with justifiable management reserve amounts and more accurate discrete risk consequences for its upcoming Baseline Cost Report.

Schedule Integration of Risk Mitigation Actions

Many of the approved risk mitigation actions for significant risks to the B61-12 LEP were not included as tasks in the site schedules. In a high-risk program such as the B61-12 LEP, risk mitigation is crucial to help reduce significant risks to the program's cost and schedule. To accomplish this risk reduction, the B61-12 LEP Risk and Opportunity Management Plan requires NNSA sites to use the Active Risk Manager (ARM) to document, share, and retain in a single location, all risks identified for the program. Each risk in the ARM may be avoided, transferred, accepted, or mitigated. Our review focused on risks that management chose to mitigate. In cases where management's risk strategy is to mitigate the risk, specific executable actions must be developed, approved, and incorporated into the schedule as tasks in order to track and monitor these risk mitigation actions. Monitoring of these actions in the schedule improves schedule credibility and the chances that the action will be completed.

However, our review found that while the ARM usually contained actions intended to help reduce significant risks to the B61-12 LEP, most of those actions could not be found in the site schedules as tasks. Specifically, 19 out of 25 (76 percent) high to moderate SNL risks did not have mitigation actions included in the site schedule. Likewise, 3 out of 4 (75 percent) high to moderate LANL risks did not have mitigation actions included in the schedule. For example, a

LANL risk for not conducting flight tests with war reserve–like configurations could significantly increase the risk that LANL would not be able to determine if the components will perform as designed. The only approved mitigation action in the ARM for this risk is to obtain B61-12 LEP management agreement to use alternative components for conducting the flight tests. However, our review determined that this mitigation action was not in the LANL site schedule. Therefore, it is difficult to determine the status of the risk mitigation action and how it may affect the master schedule if not completed on time.

Since the time of our review, the B61-12 LEP has clarified requirements for risk management of the B61-12 LEP. Specifically, the B61-12 added to the PCSD that all work, including work planned to mitigate risk, is contained in work packages. According to the B61-12 LEP officials, the maturing of the B61-12 LEP risk management program is helping to ensure tasks are integrated into the master schedule, a practice which will allow the program to use earned value management performance to monitor risk mitigation plans.

Approved, Specific, and Executable Risk Mitigation Actions

Risks to the B61-12 LEP cost and schedule often did not have approved mitigation actions. Specifically, 5 out of 25 (20 percent) high to moderate SNL risks had no approved actions to address those risks. For example, according to SNL's ARM, if B61-12 LEP components developed during the qualification process cannot be used as war reserve for the First Production Unit, there is a potential delay of 40 weeks to the B61-12 First Production Unit until qualified components can be built. While the ARM states that it is SNL's intention to mitigate this risk, as of December 2014, there were no approved mitigation actions to reduce the likelihood of its occurrence or its potential 40-week delay, even though they identified this risk in May 2012.

In addition, approved risk mitigation actions were not, in many cases, specific or executable. A specific, executable risk mitigation action is a measurable action, such as performing an additional test to increase confidence in a design or changing a design to add additional margin to unknown design requirements. Of the four high to moderate LANL risks, only one had a specific executable risk mitigation action. For example, the B61-12 LEP will be exposed to new thermal environments that the B61 was never tested in. According to the ARM, there is a risk that exposure to such extreme hot and cold thermal environments will cause the nuclear explosive package to suffer a component failure and result in the B61-12 not meeting its new military requirements. To mitigate this risk, LANL plans to perform two additional thermal tests to increase the confidence that exposure to such thermal environments will not fracture the new high explosive charges for the B61-12. While we were able to find these risk mitigation tests in LANL's schedule, according to a LANL official, the other three LANL risks with mitigation actions in the ARM had not been adequately defined to be placed in the schedule and, as a result, measurement of their completion is difficult to determine. While the ARM stated that there is very little impact to the cost and schedule if any of LANL's risks were realized, it is still vital that specific executable risk mitigation actions be developed and completed. According to the ARM, the realization of any of LANL's risks could result in a significant degradation in the performance of the bomb, as key military requirements may not be met with the redesign of the B61-12.

Schedule and Cost Impacts of Realized Risks

B61-12 LEP management did not, in some cases, identify the true impacts of realized risks to cost and schedule. One of the primary purposes of the ARM is to analyze risks and determine the potential impact to cost and schedule that a risk may have. According to the NNSA change control process, a site realizing a risk should inform the B61-12 LEP of the actual cost and schedule impact through a change request. This process ensures that the program manager knows the actual cost, scope, and/or schedule impact to the program in order to take appropriate actions to keep the project on track.

In our review of the SNL- and LANL-realized risks found in the B61-12 LEP ARM, we could not, in many cases, determine the cost and schedule impacts. Specifically, as of October 2014, SNL had realized six risks to the B61-12 LEP, one of which was significant with a potential schedule impact of 78 weeks. In addition, LANL had two realized risks to the program, one of which was significant with a potential schedule impact of 100 weeks. However, in many cases, neither SNL nor LANL could show us what the actual schedule or cost impact was to the B61-12 LEP. At SNL, we were not able to locate the change request in the ARM for four of the six realized risks. Of the two change requests we did find, we identified the cost impact but could not determine the impact to the schedule. For example, SNL had originally planned to reuse the actuator and pulse battery assembly from existing B61 bombs. According to the ARM, the risk to the B61-12 LEP was that if reuse studies and environmental test data demonstrated that the battery assembly could not meet performance and service life requirements, then it would need to be redesigned. According to the ARM, the impact to schedule was 4-6 weeks, but the cost was potentially high at \$23-26 million. However, our review of change requests could not determine the actual impact this realized risk had to the schedule. Furthermore, using the same change requests, we found that the actual cost to the program was \$17 million for the redesign of the battery assembly. In response to our report, B61-12 LEP management stated that they fully understood the impact of risks realized on the program.

Similarly, at LANL, we could not locate change requests for its two realized risks. One of these risks was to the system qualification schedule of a detonator design. The ARM stated that the potential schedule impact of the realized risk was 100 weeks, with a cost of \$9.6 million. However, without locating the change requests, we could not determine what the actual schedule impact was to the B61-12 LEP. When we presented this issue to LANL, the responsible official could not demonstrate the impact the realized risk had to the program. In September 2015, a B61-12 LEP official stated that they were able to determine the LANL detonator redesign's actual impact of 33 weeks and \$2.6 million cost by working backwards from a change request submitted in March 2015.

Risk Mitigation Actions

At the time of our review, 50 percent of SNL's and LANL's unrealized risks with approved mitigation actions were listed as past due in the ARM. Although we found that the risk mitigation actions were not documented in the site schedules as tasks to be tracked and monitored, the ARM listed due dates for risk mitigation actions. Many of these mitigation actions are for significant risks to the program that can have impacts to the schedule of up to

52 weeks or costs up to \$32 million. For example, one of the risks to the B61-12 LEP was that the joint test assembly battery design would not meet requirements. To mitigate this risk, SNL developed an action to research and develop alternative cell technologies to reduce the time it would take to potentially redesign the joint test assembly battery. As of December 2014, this critical mitigation action was 6 months past due. Because the mitigation action was not included in the schedule, SNL could not show us the impact and may not have adequately reduced the likelihood that this risk will be realized or decreased its realized impact.

Furthermore, while performing followup work in this area, we identified that the planned completion dates for most of the risk mitigation actions had changed for those actions that were behind schedule. We decided to retest all the risk mitigation actions as of May 2015. With this updated testing, we discovered that none of the risk mitigation actions were late. Upon further review, we identified that many of the risk mitigation actions that were late in December 2014 had their planned completion dates pushed out, in some cases, 6 months to 1 year. We also identified that some of the risk mitigation action planned completion dates were changed to show that the action was completed ahead of schedule. For example, one risk mitigation action at SNL had a planned completion date of January 2015. According to the ARM, this action was completed in February 2015, approximately 1 month late. However, after this action had been completed, the planned completion date was changed to February 2015, appearing as if the risk mitigation action had been completed on time. The planned completion date was subsequently changed again to March 2015, making it appear as if the risk mitigation action was completed ahead of schedule. All these changes took place after the risk mitigation action had been completed.

As a result of changing the planned completion dates, B61-12 LEP management was unable to determine the actual status of a risk mitigation action because the ARM could no longer report the status of risk mitigation action against a baseline due date. Because the risk mitigation actions were not tied to site schedules, the B61-12 LEP no longer had a way to compare the current completion status dates against the original planned completion dates. This is significant because if only the ARM is used to determine the status of a risk mitigation action, the information will be misleading, as it will always appear that risk mitigation actions are on time. For example, as stated in this report, we were able to find five SNL risk mitigation actions in the ARM that tied directly to the SNL site schedule. We compared the baseline completion dates found in the September SNL site schedule to the planned completion dates found in the ARM for the same timeframe. While we found some of the dates were identical, there were others that showed the ARM completing risk mitigation actions either 7 months ahead of the SNL site schedule, or in other cases, 8 months late. Because most of the ARM risk mitigation actions are not tracked in the schedule, changing the planned completion date in the ARM can have a significant impact in determining whether an action is late, on time, or ahead of schedule, as all risk mitigation actions will constantly appear on time. An NNSA B61-12 program official stated that changes to the risk mitigation actions planned completion dates should not be happening and such an act further demonstrates the importance of having risk mitigation actions tied to the schedule.

Quality Assurance

The B61-12 LEP could not, in some cases, provide documented assurance that redesigned components fully addressed prior safety and reliability concerns. NNSA's weapons quality assurance plan requires weapons to be designed for reliability and safety, and design reviews should ensure design inputs are complete and correct. To address this, the B61-12 LEP required the examination of significant finding investigations (SFIs) to be documented as part of the design inputs of nonnuclear components. As of September 2014, multiple SFIs remained unresolved for B61 weapon components in the stockpile that were to be either redesigned or remanufactured for the B61-12 LEP. An SFI is a formal investigation to determine the cause of a weapon component anomaly and any impact it could have on the safety or reliability of a nuclear weapon system.

In the absence of documented evidence that open SFIs were reviewed, management lacks assurance that the redesigned component will address prior safety and reliability issues. For example, LANL is in the process of making necessary changes to the design of a nuclear component, the detonator cable assembly, to address reliability concerns as a result of an examination of both closed and unresolved SFIs. To LANL's credit, this examination was conducted even though the requirement to include unresolved SFIs as a design input did not extend to nuclear components. Had the unresolved SFI on the detonator cable assembly not been examined as part of the redesign, the reliability of the refurbished bomb may have been compromised because the redesigned detonator cable assembly would not have addressed the cause of this open SFI. According to LANL, this would leave the new B61-12 LEP vulnerable to the same reliability design issues that affected the current B61.

In contrast, despite being an NNSA B61-12 LEP requirement for nonnuclear components, SNL officials were unable to provide documented assurance that redesigns to multiple components will address issues identified in unresolved SFIs. In response to our audit work, SNL made changes to their design review process to include reviews of open SFIs. According to NNSA, since the time of our review, design reviews have been conducted, and SNL was able to provide documented evidence that prior issues are being addressed with redesigned components.

Management Reserves

While the B61-12 LEP office conducted a detailed cost estimate to determine program funding needed for planned work, LEP management could not justify whether program sites had sufficient reserve funds to respond to risks to the program. To ensure the B61-12 LEP has sufficient funds for successful program execution, the B61-12 program allocated management reserve to each site to help manage impacts from risks or uncertain costs that may occur during the program. To ensure that the site management reserve amounts were adequate, the program required each site to conduct a probability-based analysis of risks to the program as a part of the program cost estimate submitted in FY 2012. This process included identifying risks to the program, their potential impacts if realized, and the activities that would be affected if realized. However, site risk identification was immature at the time of the 2012 cost estimate, and consequently, the sites could not always follow the B61-12 LEP requirements for developing the

analysis to support their management reserve. As a result, the B61-12 LEP had low confidence in the management reserve estimates created by the sites and was forced to include additional funds in its contingency to accommodate the uncertainty.

In response to our review, B61-12 LEP management explained that while the management reserve was not technically justifiable, it believes it had adequate reserves based on nearly 4 years of development work. In addition, according to B61-12 LEP management, this is the first time that an LEP has used management reserves as part of the overall cost estimate, which they feel places them far ahead of prior LEPs. Furthermore, the B61-12 LEP has identified the importance of a justifiable management reserve and will require the sites to conduct a more rigorous analysis of their management reserve requirements when they prepare their submittals for the program's next major cost estimate in FY 2016. Notwithstanding, until B61-12 LEP management can fully justify the management reserve amounts developed for the program, it will be difficult to determine whether these amounts will be sufficient to respond to the impacts of realized risks or uncertain costs.

NNSA Life Extension Program Management Requirements

The identified issues occurred because NNSA Defense Programs generally lacked requirements for the conduct of LEPs using new project management tools and techniques. Specifically, NNSA Defense Programs had not previously required a program-wide EVMS with a standard scheduling system integrated with risk management, SFI reviews as part of the design process, or rigorous cost estimating for nuclear weapons programs. Further, NNSA Defense Programs did not require the B61-12 LEP to implement these tools until after the program had been authorized to begin design engineering.

Issues with implementation of the project schedule occurred because NNSA Defense Programs did not initially require a standard program-wide project management approach to building nuclear weapons. Specifically, NNSA Defense Programs did not require prior LEPs to use a program-wide EVMS with standard scheduling software, and NNSA Defense Programs did not require the B61-12 LEP to use one until December 2012, which was after the Phase 6.3 authorization. In May 2013, the B61-12 LEP developed the PCSD, which provides the project controls system requirements to be employed by the B61-12 LEP. The PCSD requirements include, among other things, EVMS, site schedules, and a master schedule. While NNSA Defense Programs is now developing requirements for weapons programs, NNSA Defense Programs is evaluating the B61-12 LEP's implementation of a program-wide EVMS and standard scheduling system to determine applicability for future LEPs. The B61-12 LEP is developing and implementing these standardized processes late in the program and without the benefit of NNSA-wide requirements.

In addition, to ensure master schedule milestone dates were identical to the site schedules, the PCSD requires that sites incorporate monthly feedback from the master schedule into their site schedules to show how one site's milestone completions have affected another site's milestone completions and the changes needed to reflect current status in a site's schedule.

However, we found that sites were not, in many cases, updating their schedules using the feedback from the master schedule to ensure alignment of their site schedules and proper sequencing of 6.X activities. For example, for one SNL component, the master schedule showed a substantially different completion date than the SNL site schedule for the Quality Engineering Release milestone. This was due to SNL not incorporating the feedback from the master schedule into its schedule. Specifically, SNL cannot complete a Quality Engineering Release until it has an actual component to qualify. According to B61-12 LEP officials, NNSA's Kansas City Plant was not planning on completing the component until the dates shown in the master schedule. NNSA B61-12 project officials stated the master schedule feedback identified this difference and should have prompted discussion between the sites to either push the SNL site schedule out for Quality Engineering Release, or have Kansas City develop the component earlier than shown in their schedule to align with SNL's Quality Engineering Release milestone. The B61-12 LEP has required the sites to correct schedule logic issues and refine the site schedules' alignment with the master schedule.

Risk management issues occurred because the B61-12 LEP did not explicitly require that the risk management system to be integrated into its scheduling system. Specifically, the B61-12 LEP PCSD stated that all work scope should be planned to completion, broken into discrete activities, and integrated into the baseline site schedules. While the B61-12 LEP has stated that the intent of the "all work scope" was to include risk mitigation actions, due to the lack of clarity, sites developed mitigation actions but did not always integrate those actions into the site schedules. As a result, many of the risk mitigation actions were being managed using level of effort rather than developing specific, executable actions. For example, according to B61-12 LEP management, there were hundreds of tests being run to mitigate risks for the detonator cable assembly. None of these tests were found in the sites schedules and were being managed using level of effort. If all work scope, including work to mitigate risk, is not broken down into discrete activities and integrated into the baseline site schedules, it will difficult for the B61-12 LEP to proactively manage these activities using earned value and critical path analysis.

In addition, many of the activities in the ARM existed before the B61-12 schedule baseline was developed. According to a B61-12 LEP official, these risk mitigation activities had been verified to exist in the prior B61-12 LEP schedule before the April 2014 baseline. B61-12 LEP management assumed that these activities were integrated into the new baseline schedule. Finally, B61-12 LEP management stated that changes in site personnel and the volume of ongoing work have caused the sites to not meet the risk management expectations of B61-12 LEP. Since the time of our review, the B61-12 LEP has made changes to their PCSD to clarify that all work performed by the project, including work planned to mitigate risk, is contained in work packages.

Weapon quality assurance issues occurred because although the B61-12 LEP had required the examination and documentation of unresolved SFIs to be included as a part of design reviews for nonnuclear components, at the time of our review, SNL had not incorporated this requirement into their site design review procedures. Rather, SNL site officials stated that they had assumed that product realization teams were using unresolved SFIs as inputs to their designs but could not provide us with any evidence to assure that redesigns were addressing prior safety and reliability issues. In addition, since our initial review, B61-12 LEP officials have stated that the redesigned

nuclear components were always required to include prior safety and reliability issues as design inputs, but they had not fully documented such a requirement in the actual B61-12 LEP requirements document.

Finally, the original B61-12 LEP cost estimate may not be sufficient because, while the B61-12 LEP developed a cost estimate guide based on the *GAO Cost Estimating and Assessment Guide*, a B61-12 LEP official told us that the sites' capability to conduct the required probability-based analysis of risk was at a very low level of maturity at the time. This low level of maturity was due to a lack of overall requirements for probability-based analysis of risk for management reserve by NNSA Defense Programs. Specifically, because there are no specific and comprehensive requirements for conducting a probability-based analysis of risk for management reserve for nuclear weapons LEPs, NNSA sites are not fully equipped with the proper resources to conduct the type of analysis required to obtain justifiable management reserve estimates. As a result, despite the B61-12 LEPs own requirements to obtain this type of a cost estimate, the NNSA sites could not realistically provide it. As a result, the initial management reserve estimates submitted by the sites were not consistent. While program management has stated its ability to analyze cost uncertainty has improved, the program will not be able to fully support a justifiable risk-based management reserve amount until it improves its processes for the tracking of risks.

Consequences

We recognize that the B61-12 LEP master and site schedule improvements have given the program the ability to correct site-to-site schedule alignment problems that were not available to past weapon programs. In addition, our review was performed 4 months after the program completed the new integrated baseline schedule in May 2014. According to industry standards, the average time to implement an EVMS is 12–18 months, so we are encouraged by the improvements the program made.

Further improvement to its project management tools should help the program to proactively manage the costs, schedule, and risks of the B61-12 LEP to ensure it can deliver the First Production Unit within cost and meet its critical national security schedule. As previously noted, prior Office of Inspector General reports have reported that similar program management issues caused delays in program execution. Specifically, previous reviews found that prior nuclear weapon refurbishment programs experienced delays as a direct result of not ensuring or validating that master schedules and site schedules were consistent; site schedules had activities that were scheduled out of sequence; risk mitigation activities were not well tracked and documented; or the program did not have a valid estimate of total refurbishment costs. While the project controls implemented by the B61-12 LEP are much more robust than those implemented by prior LEPs, these controls were not fully mature at the time of our review.

Without a well-integrated, accurate master schedule and cost estimate that incorporates the status of program risks, the B61-12 LEP lacks reliable information to make management decisions. The master schedule relies on master and site schedule accuracy to communicate the status of deliverables from one site to another and the status of its First Production Unit delivery commitment. Given the inaccuracies we identified and the lack of specific and measureable

tasks, it may be difficult for the B61-12 LEP to proactively ensure the sites' execution of the program's mission and functions. In addition, there is uncertainty whether original cost estimate for the B61-12 LEP contains sufficient management reserve to allow the program to respond to the numerous risks identified in the program. Finally, not having documented assurance that unresolved SFIs are a part of weapons design input significantly reduces management's ability to ensure that redesigned nuclear weapon components will address prior safety and reliability concerns.

RECOMMENDATIONS

As of March 2015, B61-12 LEP systems had improved in some areas but had declined or lost previous functionality in other areas. Both SNL and LANL reduced the number of incomplete activities without links to predecessor or successor activities. However, activities that can be delayed more than 2,000 days remain, and the misalignment between the master schedule and LANL's site schedule for the primary main charge approximately doubled. SNL corrected the sequencing of electronic neutron generator component activities, but other component sequences still needed to be corrected. According to a B61-12 LEP official, site maturity levels of the PCSD implementation vary by site, and more work is still needed.

Accordingly, we recommend that the Administrator of the National Nuclear Security Administration ensure that:

1. The B61-12 LEP continues to improve compliance with its PCSD, to include:
 - a. Improving alignment of the integrated master schedule and the site schedules;
 - b. Implementing baseline review recommendations in a timely manner;
 - c. Directing sites to include specific, discrete risk mitigation actions in their site schedules; and
 - d. Ensuring change requests include the actual impact to cost and schedule for realized risks;
2. The documented review of open significant finding investigations are a part of the design process for both nuclear and nonnuclear redesigned components and are implemented at B61-12 LEP sites, as appropriate;
3. LEP cost estimates include technically justifiable management reserve; and
4. NNSA Defense Programs complete the development of weapon systems program management processes and procedures and incorporate lessons learned from the B61-12 LEP.

MANAGEMENT RESPONSE

Management concurred with the recommendations and indicated that corrective actions have either already been completed or were planned to address the issues identified in the report. Management stated that corrective actions for two of the four recommendations have already been completed and corrective actions for the remaining two are slated to be completed by the end of FY 2016. Management expressed concern that the audit activities largely concluded 1 year ago, and therefore the information presented in the report did not adequately represent the current state of the B61-12 LEP as it prepared to enter Phase 6.4, Production Engineering. In addition, management was concerned that the report understated the significant accomplishments and increased management effectiveness associated with the B61-12 LEP.

AUDITOR COMMENTS

Management's comments and corrective actions were generally responsive to our recommendations. We acknowledge that management has taken actions to address many of the issues identified in our report since the completion of our fieldwork. During the month that it took management to respond to the coordination draft and the 4 months to respond to the official draft report, we updated this report with the most current information available. We also made appropriate changes to the report as management provided additional information. We recognize the significant accomplishments and increased management effectiveness associated with the B61-12 LEP. We applaud management for implementing project management tools, such as an EVMS based on integrated resource loaded schedules, and recognize that these tools take time to realize their full potential. Management's comments are included in Appendix 3.

OBJECTIVE, SCOPE, AND METHODOLOGY

Objective

To determine whether the National Nuclear Security Administration is effectively managing the B61-12 life extension program (LEP).

Scope

We conducted this audit between June 2014 and August 2016. The scope of the audit was limited to the B61-12 LEP. Our review included site visits to the National Nuclear Security Administration (NNSA) Albuquerque Complex and Sandia National Laboratories (SNL), located in Albuquerque, New Mexico, and Los Alamos National Laboratory (LANL), located in Los Alamos, New Mexico. This audit was conducted under the Office of Inspector General project number A14AL027.

Methodology

To accomplish the audit objective, we:

- Obtained and reviewed applicable Federal and Department regulations, policies, procedures and internal guidance related to the management of the B61-12 LEP;
- Reviewed the *GAO Cost Estimating and Assessment Guide* and Department of Defense Cost Assessment and Program Evaluation;
- Analyzed the NNSA Integrated Master Schedule, the SNL Design Agency Integrated Site Schedule, and the LANL Design Agency Integrated Site Schedule;
- Evaluated all Active Risk Manager high to medium risks at SNL and LANL;
- Examined all open significant finding investigations on the B61;
- Reviewed the original B61-12 cost estimate; and
- Interviewed NNSA and site B61-12 LEP officials.

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 objectives. We believe the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objective. Accordingly, we assessed internal controls and compliance with laws and regulations to the extent necessary to satisfy the audit objective. We assessed performance measures in accordance with *GPRA Modernization Act of 2010* and concluded that the Department has established performance measures related to the audit area. Because our review was limited, it would not necessarily have disclosed all internal

control deficiencies that may have existed at the time of our audit. We relied on computer processed data to satisfy our audit objective related to schedule management. We confirmed the validity of such data, as appropriate, by conducting interviews and performing data testing, and we determined the data was reliable for our use.

An exit conference was held with management on July 27, 2016.

PRIOR REPORTS

- Audit Report on [*Follow-up Audit of the National Nuclear Security Administration's W76 Nuclear Warhead Refurbishment Program*](#) (DOE/IG-0870, September 2012). The audit found that the National Nuclear Security Administration (NNSA) may be unable to complete the W76 life extension program (LEP) within established scope, cost, and schedule parameters, unless it adopts a more effective approach to reducing unit costs. This concern was exacerbated by the fact that the program was faced with a relatively flat budget over the next few years, even though its annual scope of work is projected to increase by 59 percent during the same period. The increase in production appears to be unsustainable given the projected funding. The goal of reducing the unit cost of W76 LEP production appeared to be one of the only paths to keeping the program on track without adversely affecting other NNSA programs. Although a senior NNSA official expressed confidence that NNSA would achieve the increased production rates within the out-year budget estimates, program officials could not provide plans detailing actions necessary to achieve the needed cost reductions.
- Audit Report on [*The National Nuclear Security Administration's B61 Spin Rocket Motor Project*](#) (DOE/IG-0740, September 2006). This audit found that there was a reasonable basis to be concerned about the aging and future performance of the Spin Rocket Motor, based on reported test anomalies and the fact that some versions of the motor had been in use for more than 30 years. However, the Department did not have conclusive information on the cause and impact of observed test anomalies nor of the cost of alternative options, both of which were needed to prioritize the development of a new motor in the context of competing weapons development requirements. Moreover, independent reviews conducted in 2002 suggested a range of expert opinion and different courses of action regarding motor aging and test anomalies. Further, Sandia National Laboratories' (SNL) cost estimates and assumptions used to support the decision to develop a new motor rather than to examine other options, such as refurbishing the existing motor, were not fully supported. We found that NNSA had not adequately validated key spin rocket motor data provided by SNL prior to approval of the new project. One senior NNSA weapons program official acknowledged that, due to staff reductions in the NNSA program, the information presented by SNL was accepted without question and had not been validated.
- Audit Report on [*W76 Life Extension Project*](#) (DOE/IG-0729, May 2006). This audit concluded that NNSA was at risk of not achieving the First Production Unit for the W76 refurbishment within the established scope, schedule, and cost parameters as detailed in the project plan. Specifically, we found delays in completing tests and production-related milestones, reductions in the scope of activities required to support final design and production decisions, unexplained variances in project cost data, and incomplete documentation of changes to the project cost baseline.
- Audit Report on [*The National Nuclear Security Administration's Refurbishment of the B61*](#) (DOE/IG-0697, August 2005). This audit found that NNSA was at risk of not achieving the First Production Unit for the B61 refurbishment within the original

schedule and scope specifications. NNSA experienced unforeseen technical problems, outside of its control, that delayed the design and testing of certain B61 components. However, other delays were avoidable had the proper internal control structure been in place. Furthermore, at the time of our review, NNSA did not have a valid estimate of total refurbishment costs. Specifically, a key component milestone had to be rescheduled at least 13 months later than originally planned because of inconsistent and conflicting production schedules among the participating sites. Receipt of essential production equipment was delayed as much as 9 months because project officials had not agreed on the appropriate delivery schedule. The program also experienced problems with the commercial vendor responsible for providing the production equipment in question. Further, NNSA's refurbishment baseline did not contain complete, consistent, and validated cost data. Finally, NNSA did not follow established procedures when making scope changes to the refurbishment project.

MANAGEMENT COMMENTS



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



MEMORANDUM FOR RICKEY R. HASS
ACTING INSPECTOR GENERAL

FROM: FRANK G. KLOTZ *F.Klotz 5/20/2014*

SUBJECT: Comments on the Office of Inspector General Draft Report Titled, *The National Nuclear Security Administration's Management of the B61-12 Life Extension Program* (2014-00334/A14AL027)

Thank you for the opportunity to review and comment on the subject draft report. The National Nuclear Security Administration (NNSA) agrees with the Office of Inspector General's four recommendations for further enhancing the application of project management principles to the B61-12 Life Extension Program (LEP). We note, however, the audit activities largely concluded a year ago, and therefore the information presented in the draft report does not adequately represent the current state of the B61-12 LEP as it prepares to enter Phase 6.4, Production Engineering. For example, the B61-12 Federal Program Office (FPO) has already completed corrective actions to address two of the four recommendations, and corrective actions for the remaining two are almost completed and are slated for closure by the end of fiscal year (FY) 2016.

NNSA also believes that the information presented in the draft report understates the significant accomplishments and increased management effectiveness associated with the B61-12 LEP. The B61-12 FPO implemented additional project control requirements in FY 2014 just as the Office of Inspector General began its audit. The early management reserve and contingency schedule maturation and risk management issues cited by the auditors were not unexpected and were already identified by the B61-12 FPO. Most of these issues have been corrected or are being addressed as part of Integrated Baseline Review (IBR) Corrective Action Plans and recent FPO initiatives.

The B61-12 LEP is the first program to implement program-level versus site-level risk management and establish an Earned Value Management System (EVMS) based on integrated resource loaded schedules in accordance with industry tested ANSI/EIA-748C standards. These tools take time to realize their full potential, but implementation of these self-initiated requirements and best practices are driving a dramatic cultural change across NNSA's nuclear security enterprise.

After establishing these new management requirements in FY 2014, the B61-12 LEP FPO initiated comprehensive IBRs at all eight production and design agencies from August 2014 to September 2015. The reviews evaluated these requirements using each site's integrated schedules, performance measurement baselines (PMBs), EVMS, and risk management



processes. The IBR team included world class experts including B61-12 management consultants and independent aerospace engineers. The B61-12 LEP has established action plans based on their observations and sites have corrected the majority of the deficiencies noted.

In addition to the IBRs, the B61-12 LEP has continued to self-identify and improve multiple areas throughout the program. A key focus area is improving integration between the new site schedules. Recently, the B61-12 FPO completed Integrated Schedule Reviews to assess alignment between site schedules and the NNSA Integrated Master Schedule (NIMS). The reviews validated site-to-site handoff and formalized new schedule logic diagrams and site hand-off tracking documents to improve schedule integration. The FPO also revised program management requirements to address lessons-learned as part of entry requirements into Phase 6.4, scheduled for June 2016. A major effort involved the rewrite of the B61-12 Baseline Cost Report to refine the 2012 Weapon Design and Cost Report cost estimate. The new requirements fully implement new NNSA Office of Defense Programs guidance and GAO best practices for cost estimating and development of risk based contingency and management reserves.

These positive improvements are reflected in the recent GAO report on B61-12 LEP Management (GAO-16-218). The GAO recognized the improvements made in B61-12 LEP federal management capability and authority, earned value management, integrated master schedules, and-integrated cost estimates, and concluded that, "The new management approach that the B61-12 LEP's program managers have implemented ... may help NNSA address the potential management challenges that NNSA officials and others have identified with previous LEPs." In the same report, the GAO also recognized that, "The B61-12 LEP's program management approach served as a model for many of the management practices and tools established in the Program Execution Instruction".

The B61-12 program recently completed the System Baseline Design Review and over 38 phased baseline design reviews across all major components verifying that technical and programmatic requirements are met. These reviews also assessed product realization schedules to ensure products are aligned and are meeting B61-12 first production unit (FPU) objectives. These reviews represent a significant accomplishment in demonstrating mature designs and support the decision to enter Phase 6.4 Production Engineering.

NNSA realizes that the implementation of program changes and enhancements during an audit creates challenges; however, the report should be balanced to accurately portray the success of the program and corrective actions to date, while still recognizing the areas for improvement as the program continues to mature. The attachment to this memorandum details the specific actions taken and planned to address all of the recommendations. NNSA has also provided comments under separate cover for your consideration to enhance the accuracy and balance 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

NATIONAL NUCLEAR SECURITY ADMINISTRATION
Response to Report Recommendations

Management of the B-61-12 Life Extension Program (A14AL027)

The Office of Inspector General (OIG) recommended NNSA:

Recommendation 1: Ensure the B61-12 LEP continues to improve compliance with its project Controls System Description (PCSD), to include:

- a) Improving alignment of the integrated master schedule and the site schedules;
- b) Implementing baseline review recommendations in a timely manner;
- c) Directing sites to include specific, discrete risk mitigation actions in their site schedules;
and,
- d) Ensuring change requests include the actual impact to cost and schedule for realized risks.

Management Response: The B61-12 LEP has continued to make progress in improving compliance with the PCSD since the May 2014 baseline.

- **Schedule Alignment:** In September 2015, NNSA led an Integrated Schedule Review to address schedule health and alignment issues. The initial observations were published in January 2016. Validation of corrections to site schedules and alignment of NNSA Integrated Master Schedule (NIMS) are to be completed by September 2016.
- **Implementing Baseline Recommendations:** Efforts to address recommendations from the Integrated Baseline Reviews conducted between August 2014 and September 2015 are in process.
- **Risk Mitigation:** Sites have been directed to include discrete risk mitigation actions in their site schedule as part of the revision to the Risk and Opportunity Management Plan (ROMP). This revision will clarify roles and actions to improve integration of discrete risk mitigation strategies with project controls and integrated site schedules (ISS). Additionally, the Risk Review Board (RRB) continues to focus efforts on defining actionable risk mitigation strategies and inclusion of the mitigation activities into the ISS to manage work as part of the performance management baseline (PMB).
- **Change Control:** The B61-12 has revised the Baseline Change Control procedure to address improvements in managing site management reserve and requests for NNSA contingencies, including assessment of cost and schedule impacts associated with realized risks.

The estimated completion date for all of the above actions is September 30, 2016, to allow for final validation of corrective actions.

Recommendation 2: Ensure the documented review of open significant finding investigations (SFIs) are a part of the design process for both nuclear and non-nuclear redesigned components and are implemented at B61-12 LEP sites, as appropriate.

Attachment

Management Response: NNSA completed all component baseline design reviews in December 2015. In all cases, the review confirmed that the performance concerns identified in the SFIs were either not relevant or addressed by the redesign. NNSA considers this closed based on actions already taken and planned.

Recommendation 3: Ensure LEP cost estimates include technically justifiable management reserve.

Management Response: LEP estimates are improving the technical basis for management reserve in accordance with the approach documented in the Weapon Design and Cost Report (WDCR) Guidance, Baseline Cost Report (BCR) Guidance, and NNSA Office of Defense Programs (DP) Cost Improvement Initiative (CII) Report, which was launched in October 2013. The resulting report provided a list recommended near-term actions and best practices based on collaboration across the Nuclear Security Enterprise cost estimating community.

In March 2014, DP issued high-level cost estimating guidelines consistent with industry and GAO best practices to facilitate uniform implementation. These guidelines provide details on creating clear program requirements, documenting a basis of estimate, and creating multi-year and total lifecycle profiles for planning & budgeting purposes. Cost estimating requirements for DP are currently under development and will be published in FY 2016 consistent with the recommendations and best practices in the CII Plan and the GAO Cost Estimating Guide.

GAO lauded DP for the CII, writing in GAO-15-29 published in November 2014: "...NNSA's Office of Defense Programs has taken steps to fill the existing gaps in the cost estimating framework for programs. For example, in 2011, Defense Programs established an Office of Cost Policy and Analysis to provide it with a cost analysis capability. In March 2014, NNSA's Office of Program Integration issued a cost estimating improvement plan, which includes proposed guidance for conducting cost estimate briefings to the Office of Defense Programs Assistant Deputy Administrator, establishing a defense programs database, and implementing various process improvements to improve cost accounting and performance." The B61-12 LEP Program used this framework to issue the BCR Guidance in 2015. The B61-12 LEP has incorporated lessons learned and has improved the technical basis and methodology to calculate management reserve. The management reserve that will be included in the BCR to be published by September 2016 will be calculated using this methodology.

The estimated completion date for these actions is September 30, 2016, consistent with publication of the B61-12 BCR.

Recommendation 4: Ensure NNSA Defense Programs completes the development of weapons systems program management processes and procedures and incorporates lessons learned from the B61-12 LEP.

Management Response: Over the past year, NNSA has been coordinating the creation of the DP PCSD, which provides complex-wide program management direction for all Defense

Attachment

Weapons Programs. The DP PCSD is heavily based on the lessons learned from both the B61-12 LEP and the W88 Alt. The W80-4, the next weapons program, is already moving forward under the direction of the PCSD. A lessons learned database, incorporating B61-12 among other programs, is being used by the W80-4 team. DP has also updated the program Execution Guidance (PEG) into the Program Execution Instruction (PEI) to further improve management processes.

The estimated completion date is December 31, 2016, to allow sufficient time to assess the need for future changes to the PCSD and other guidance.

FEEDBACK

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