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Office of Audits and Inspections

AUDIT REPORT

The National Nuclear Security Administration's Neutron Generator Activities

OAS-L-14-11

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Department of Energy
Washington, DC 20585

August 20, 2014

MEMORANDUM FOR THE MANAGER, SANDIA FIELD OFFICE

FROM: David Sedillo
Director, Western Audits Division
Office of Inspector General

SUBJECT: INFORMATION: Audit Report on "The National Nuclear Security Administration's Neutron Generator Activities"

BACKGROUND

Neutron generators (NG) are nuclear weapon components that have a limited lifetime due to their use of tritium, a radioactive gas which decays over time. Periodic replacement of these components is necessary to sustain weapon system functionality and is an on-going process managed by the National Nuclear Security Administration (NNSA) and the Department of Defense. NNSA's Sandia National Laboratories (SNL) carry out NG design and production through Limited Life Component Exchanges (LLCE) and weapon refurbishment activities such as Life Extension Programs (LEP). SNL has been responsible for these agency missions since the early 1990s and has been producing NGs since Fiscal Year (FY) 2002. SNL's NG Enterprise performs activities related to planning, developing, qualifying and sustaining NGs for all weapon systems.

The NG Enterprise currently has two product families in production. The first, which has been in production since 2002, is the large NG. The second is the small NG, which was introduced into production in September 2013. The main difference between the two product families is the size and configuration of the neutron tubes (a miniature linear accelerator). The neutron tubes represent a large portion of the NG development and production effort. SNL is also developing a new product family, the electronic NG, which uses the same neutron tube as the small NG and is scheduled to begin production in FY 2018.

Due to the importance of the NG Enterprise's mission, we initiated this audit to determine whether NNSA is effectively managing NG activities for weapon systems.

RESULTS OF AUDIT

Our review disclosed that NNSA and SNL face a number of challenges and risks with NG design and production activities. Specifically, we noted that SNL will need to significantly increase NG

production over the coming years to meet LLCE and LEP requirements. Other challenges and risks include those associated with developing, producing and testing new NG designs, maintaining a quality vendor base, mitigating work stoppages resulting from equipment failures and working within budget constraints. In addition, we noted that SNL had not established a costing methodology that consistently included a fair share of infrastructure costs to ensure full cost recovery for NG units to be built for the United Kingdom (UK). To its credit, SNL recognized that its costing methodology had been inconsistent and initiated an improvement activity to update both the NG product cost and the basis for the product cost calculation so that it was more representative of actual NG production costs. This resulted in a significant increase to the NG product cost estimate. As a consequence, NNSA retracted the proposed cost estimate provided by SNL and asked SNL to review their cost model to ensure appropriate cost methodologies are used. NNSA and SNL are taking actions to address these challenges and risks.

NG Production

As the NG production agency for NNSA, SNL is striving to meet significant increases in LLCE and LEP requirements over the coming years. In FY 2013, SNL produced close to 600 units; however, it needs to ramp up production to achieve a total production level of 900 units per year to meet FY 2016 requirements. Currently, SNL is producing NGs to meet the LEP requirements for the W76 weapon system and the LLCE requirements for the W78 and W87 weapon systems. Additional LLCE requirements in the coming years will add to SNL's workload. Specifically, to meet future LLCE requirements, SNL will need to begin production of NGs for the W80, B83, B61-11, B61-12, and W88 between FY 2015 and 2019. Further, SNL will also produce partially built NG units for development purposes, which assist with NG qualification and validation of production processes. Although some weapon systems share a common type of NG (i.e., large, small and electronic), the testing and qualification requirements are different. Below is a list of weapon systems showing the associated NG type and planned first production year.

Weapon System	NG Type	Begin Production
W76	Large	Underway
W78	Large	Underway
W87	Small	Underway
W80	Small	2015
B83	Electronic	2018
B61-11	Electronic	2019
B61-12	Electronic	2019
W88	Small	2019

To achieve increases in the NG production schedule, SNL has invested resources and expended a high level of effort to improve efficiencies in producing the small neutron tube, and has demonstrated the ability to achieve the needed neutron tube production level over a three week period. Specifically, in FY 2013, SNL demonstrated the ability to achieve 40 tube starts per week (up from 24 in FY 2012), while maintaining a 66 percent average production yield of useable neutron tubes (up from 25 percent in FY 2012). However, it is not certain whether SNL

can sustain that production-level and yield over an extended period of time. We noted that as of May 2014, SNL was producing at an average rate of 12 tube starts per week, which would not meet the planned production schedules. SNL officials stated that the production level was down to 12 tube starts due to budgetary constraints. To ensure that it meets production requirements, SNL plans to increase its start rate to 24 tubes per week in late FY 2014 and to over 30 starts per week in FY 2015. In addition, although neutron tube production yields have improved since FY 2012, they have not been consistent. For example, early in FY 2014, the yields were 33 to 49 percent of neutron tube production starts due to unidentified quality issues with one lot of material which had met inspection and drawing requirements.

SNL plans to mitigate risks in meeting the increased NG production requirements by gaining production efficiencies; and, by increasing expenditures (dependent on funding) for materials and components, machining and tooling, and additional staffing. For example, SNL optimized equipment usage by repairing and requalifying equipment and testers to be utilized as backups. To their credit, NNSA and SNL created annual and long-term schedules to meet production and shipping requirements, and established project milestones and related performance measures for the NG Enterprise.

SNL is also addressing challenges and risks associated with developing, producing and testing new NG designs, maintaining a quality vendor base for materials and components, and work stoppages resulting from equipment failures. For example, because increased testing of new NG designs may create bottlenecks for product acceptance activities, SNL is developing a plan with the Product Acceptance and Supplier Quality Organization that includes increased resources and shortened production processing times. Further, to maintain a quality vendor base, SNL monitors vendor performance, including quality and timeliness of deliveries. If a vendor begins to show deterioration in these categories, SNL may proactively reassess a vendor's performance ahead of the 3-year rating requirement to ensure that the vendor continues to meet quality and timeliness requirements. Finally, SNL plans to build up a finished goods inventory to help meet long-term NG production requirements and to mitigate any down time due to equipment failures and any other issues that may arise.

We also noted that in response to revised Air Force requirements and FY 2014 budget constraints, SNL plans to revise W87 NG production builds to better align with Air Force requirements and minimize costs. This action will include a partial drawdown of the finished neutron tube inventory to meet the annual production requirements for the W87. SNL also plans to take further actions to minimize the risk posed by the drawdowns of finished neutron tube inventories on its ability to meet future NG requirements.

NG Costing Methodology

SNL had not established a costing methodology that consistently included a fair share of infrastructure costs to ensure full cost recovery for NG units to be built for the UK. To its credit, SNL recognized that its costing methodology had been inconsistent and initiated an improvement activity to update both the NG product cost and the basis for the product cost calculation so that it was more representative of actual NG production costs. This resulted in a significant increase to the NG product cost estimate. As a consequence, NNSA retracted the proposed cost estimate

provided by SNL and asked SNL to review their cost model to ensure appropriate cost methodologies are used. We noted that changes in costing methodology have contributed to price fluctuations for NG units sold to the UK. SNL is working towards designing an improved cost tracking method that will allow it to more accurately track the variable costs and overhead costs associated with all units produced, including the UK units.

Specifically, in August 2013, in preparation for delivering NG units to the UK in FY 2015, SNL developed an estimated cost per unit of $146,000. The unit cost was based on the actual number of W76 NGs completed in FY 2013, and was derived using SNL's Oracle Manufacturing software system to apportion a fair share of FY 2013 infrastructure costs that provided a benefit to the NG production, such as engineering labor, manufacturing supervision, supply chain management, and infrastructure support. SNL briefed this cost estimate to the UK Program Working Group in February 2013. In September 2013, NNSA sent a memo to the UK retracting the $146,000 estimated unit cost and replacing it with an estimate of $97,000. The memo stated that further review of the cost model by SNL indicated several inconsistencies and noted that SNL will continue to work internally and consult with the NNSA's Kansas City Plant (a production plant with experience manufacturing weapon components for entities other than NNSA) to implement appropriate costing methodologies. NNSA officials noted that the $97,000 estimate was used as a placeholder, pending SNL's implementation of appropriate costing methodologies. The revised cost estimate was derived by inflating the FY 2011 actual unit cost that was charged to the UK for 2 years. According to the SNL officials, the FY 2013 estimate included more infrastructure costs (such as failure analysis, and tester maintenance and replacement) than the FY 2011 estimate. Additionally, it is important to note the revised unit cost of $97,000 is an estimated cost and that SNL has until the UK shipments begin in FY 2015 to generate its final cost per unit.

Full cost recovery is required when Department facilities are used to provide goods or services to non-federal customers. While Federal Policy and Department Orders state that full cost recovery shall include all direct and allocable costs, they do not provide an exact definition of these costs. However, due to SNL's inconsistent cost methodology, there is a risk that NNSA may not be fully compensated for the cost of building NG units for the UK. As noted above, SNL is working towards designing an improved cost tracking system that will allow it to more accurately track costs associated with all units produced, including the UK units.

PATH FORWARD

Given SNL's ongoing actions to address NG production issues and costing methodology, we are not making any recommendations. However, in light of the importance of meeting the NG production requirements, we suggest that the Manager, Sandia Field Office direct SNL to:

1. Remain vigilant to ensure that required NG production deliverables are achieved; and

2. Continue evaluating unit costing methodologies to ensure full cost recovery of the NGs produced for the UK.

Attachment

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

OBJECTIVE, SCOPE AND METHODOLOGY

OBJECTIVE

The objective of this audit was to determine whether the National Nuclear Security Administration (NNSA) is effectively managing neutron generator (NG) activities for weapon systems.

SCOPE

We performed this audit from November 2013 to August 2014, at Sandia National Laboratories (SNL) in Albuquerque, New Mexico and the NNSA Albuquerque Complex in Albuquerque, New Mexico. The audit was conducted under Office of Inspector General Project Number A14AL006.

METHODOLOGY

To accomplish the objective, we:

- Reviewed Departmental criteria and SNL policies, procedures, functions and responsibilities for performance of NG development and production activities;
- Interviewed key Federal and contractor personnel associated with the NG program;
- Toured NG facilities at SNL, including design and production areas;
- Reviewed prior assessments and reports related to NG activities; and
- Evaluated NNSA policies, procedures and staffing for oversight of NG activities.

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 that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objective. Accordingly, the audit included tests of controls and compliance with laws and regulations to the extent necessary to accomplish the objective. We considered the *GPRA Modernization Act of 2010* as necessary to accomplish the objective and determined that performance measures related to the NG program were established as required. 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 did not rely on computer-generated data to satisfy our objective.

Management waived an exit conference.

FEEDBACK

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