



**Memorandum from the Office of the Inspector General**

July 24, 2015

Michael A. Balduzzi, LP 3R-C

**REQUEST FOR FINAL ACTION – EVALUATION 2015-15273 – NUCLEAR OUTAGE PERFORMANCE**

This review was initiated to assess recent efforts of the Tennessee Valley Authority's (TVA) Nuclear Power Group (NPG) to improve outage performance. The objective of our review was to determine whether (1) the initiatives implemented by the NPG to improve outage performance have achieved planned results and (2) current improvement efforts can be improved.

We found cost structure development and controls initiatives have improved outage performance with respect to cost; however, outage duration and dose<sup>1</sup> continue to miss business plan goals. Additionally, we found outage performance initiatives have continually changed and excellence/improvement initiative plans do not include all planned actions. While some initiatives have been completed, others are ongoing and have rolled over to different plans, making it challenging to tie changes to measurable results.

We recommend the Senior Vice President, Operations, take steps to improve outage improvement plans by (1) clearly defining all initiatives in a central location with specific actions and measurable goals; (2) tracking planned initiatives through completion; and (3) reviewing all current plans to determine if they will achieve desired results for duration, dose, and budget.

TVA management generally agreed with the findings and recommendations. TVA provided additional information that we have evaluated and revised the report as appropriate. Please see the Appendix for TVA management's complete response.

The Office of the Inspector General concurs with TVA management's response.

**BACKGROUND**

TVA's three nuclear plants contribute about 6,600 megawatts of electricity, about 30 percent of TVA's power supply, to the power grid, making the NPG an integral part of the seven-state power system. According to TVA, as nuclear performance improves across the industry, TVA Nuclear's challenge is to continue its mission to ensure safe plant operations and achieve its vision of being the best multi-site, nuclear power operator in the world.

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<sup>1</sup> Dose (radiation) denotes the quantity of radiation or energy absorbed.

According to the International Atomic Energy Agency, the competitive environment for electricity has significant implications for nuclear power plant operations, including among others, the need of efficient use of resources and effective management of plant activities such as on-line maintenance and outages. Nuclear power plant outage management is a key factor for good, safe, and economic nuclear power plant performance. There are many aspects to outage management including plant policy, coordination of available resources, nuclear safety, regulatory requirements, technical requirements, etc. TVA's NPG has had recent initiatives aimed at improving outage performance. This review was initiated to assess recent efforts of the NPG to improve outage performance.

According to TVA's NPG Nuclear Operating Model Revision 4, issued in November 2012, emphasis will be placed on outage planning and execution as one of the five focus areas requiring additional attention and energy. The Nuclear Operating Model also states that to continue to move forward and help TVA be one of the nation's leading providers of low-cost and cleaner energy, the fleet must consistently meet, without exception, the highest standards of excellence and performance. The targets for fleet performance were developed by incorporating industry top quartile goals.

The main measures of outage performance include dollars, duration, and dose. TVA has established goals for outage performance. Current goals for refueling outages are to meet or exceed industry top quartile of less than 29.6 days duration and Operations and Maintenance (O&M) cost less than \$36 million. One of the improvement plans stated the Outage Management Process is not giving them the desired results expected of the process, although the process has been benchmarked and validated as consistent with standards of excellence. The plan states the gap in process implementation has resulted in variance in durations of outages compared to business plan and rev.0 schedules.

### **OBJECTIVE, SCOPE, AND METHODOLOGY**

This review was initiated to assess recent efforts of the NPG to improve outage performance. The objective of our review was to determine whether (1) the initiatives implemented by the NPG to improve outage performance have achieved planned results and (2) current improvement efforts can be improved. The scope of our review spans the last two refueling outages for each unit at the three nuclear plants, spanning February 2011–November 2014.

To achieve our objective, we:

- Interviewed key personnel, reviewed policies and procedures, and other pertinent documentation to determine (a) how outages performance is measured and (b) the status of past and current outage improvement initiatives.
- Reviewed outage performance metrics and compared the metrics against business plan goals to determine if outage performance is improving in reference to the established targets.
- Conducted interviews at the plants to determine status of outage performance improvement and identify current challenges.

This review was performed in accordance with the Council of the Inspectors General for Integrity and Efficiency's *Quality Standards for Inspection and Evaluation*.

## **FINDINGS**

We found cost structure development and controls initiatives have improved outage performance with respect to cost; however, outage duration and dose continue to miss business plan goals. Additionally, we found outage performance initiatives have continually changed and excellence/improvement initiative plans do not include all planned actions. While some initiatives have been completed, others are ongoing and have rolled over to different plans, making it challenging to tie changes to measurable results.

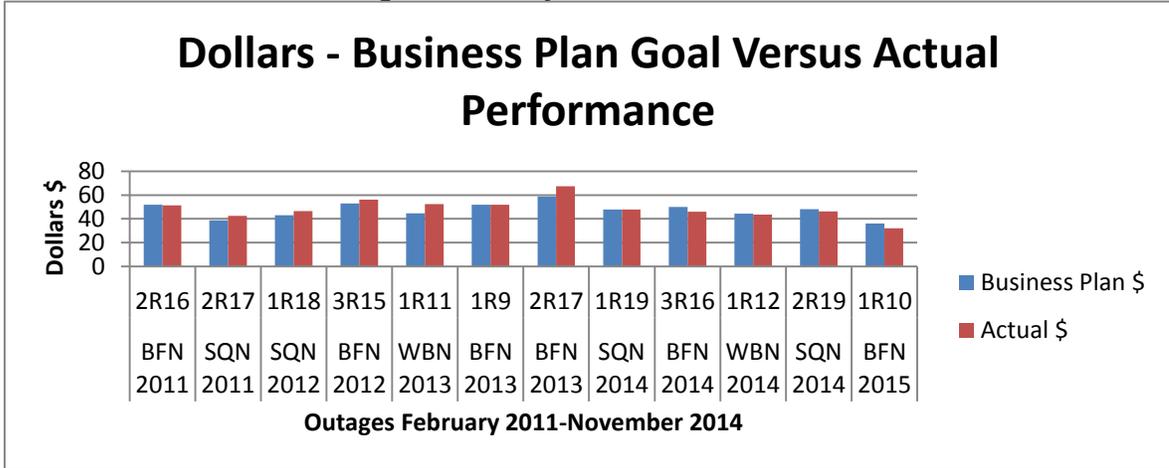
### **OUTAGE COST HAS IMPROVED WHILE DOSE AND DURATION ARE NOT CONSISTENTLY MEETING BUSINESS PLAN GOALS**

As part of the outage performance improvement initiatives, steps were taken to improve outage cost structure development. According to TVA, they lacked a standardized fleet approach to developing and controlling outage costs, and that hinders comparisons between TVA units and industry top performance. In order to help with this, TVA wrote procedure NPG-SPP-07.2.14, Outage Cost Management, issued in November 2013, to establish a fleet standard approach to outage O&M budget planning, allocation, and control. The purpose of the procedure is to define the methodology by which funds are allocated at the site and department level and to establish a control strategy to identify risks, opportunities, and offsets. In June 2014, the procedure was updated to add additional detail to the Near Term Budgeting process and specify outage O&M spend parameters. According to TVA management, the procedure specifies how costs should be split between capital and O&M. During and after the time frame of implementation of these improvements, outage performance with respect to cost has improved. The figure on the following page shows actual dollars spent versus business plan budget goals for the last two outages for each unit, spanning February 2011–November 2014.<sup>2</sup>

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<sup>2</sup> In the chart, the different outages (2R16, 2R17, etc.) are labeled according to their unit and "R" refueling outage cycle number.

**Figure 1: Dollars, Business Plan Goal Versus Actual Performance for Outages February 2011- November 2014**

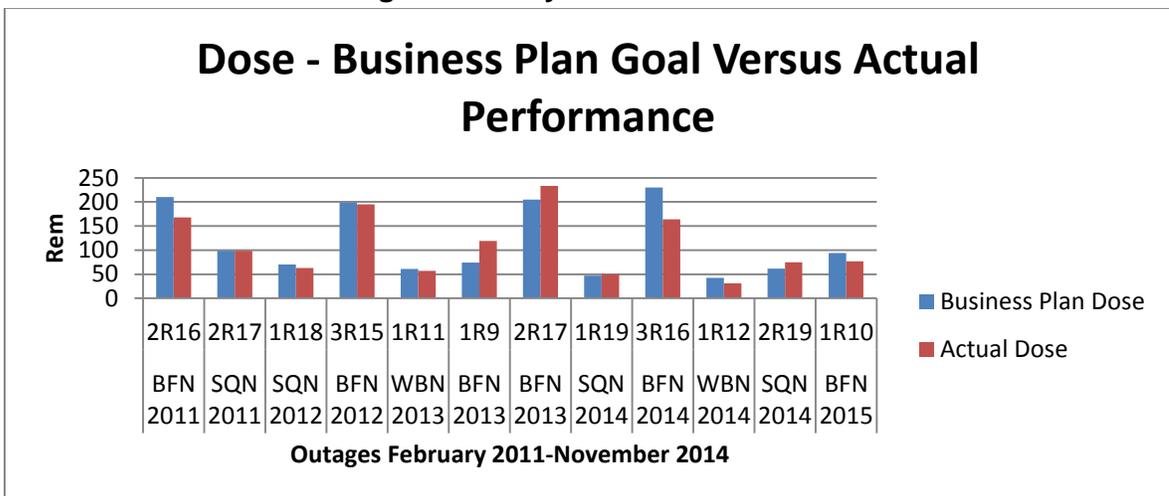


Source: Chart developed from TVA data on nuclear outages.

Five of the 12 outages cost more than business plan goals. Two of the outages hit on target and the other 5 outages came in under budget. Four of the 5 that came in under budget were 4 of the most recent outages in our scope. Six of the 7 outages that either came in at or under budget occurred in 2013 and 2014, and this indicates a trend of improving performance. While outage cost performance has recently improved, both dose and duration have not consistently met business plan goals.

The most recent outage, Browns Ferry Nuclear Plant (BFN) 1R10, completed in November 2014, excelled in meeting both dose and duration goals. The following figure shows actual versus business plan goals for dose for the last 2 outages for each unit, spanning February 2011–November 2014.

**Figure 2: Dose, Business Plan Goal Versus Actual Performance for Outages February 2011–November 2014**

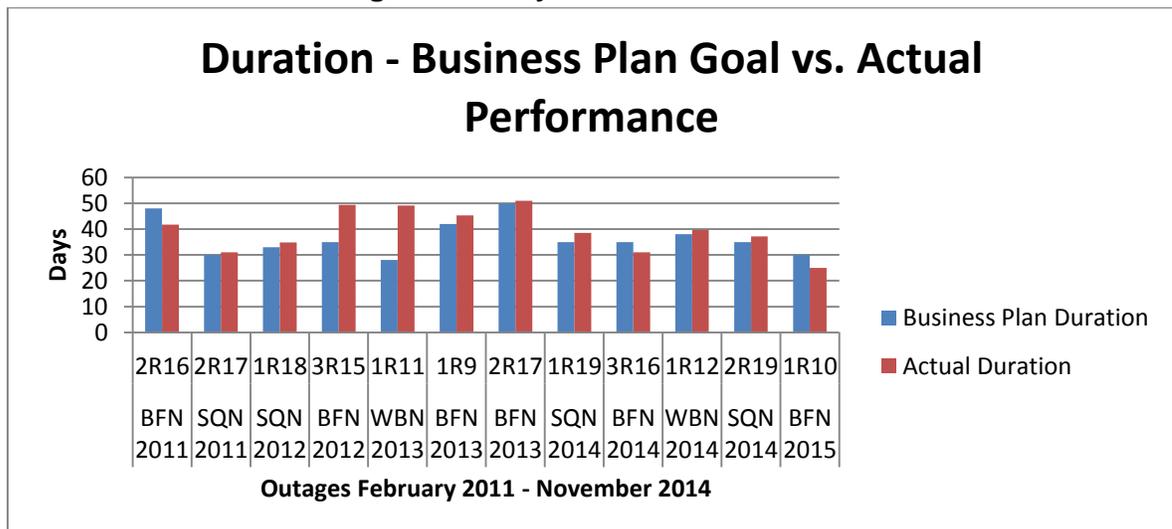


Source: Chart developed from TVA data on nuclear outages.

Four of the 12 outages exceeded their business plan dose goals, 7 came in under target, and one hit right at the goal. According to TVA, for the most recent outage, BFN 1R10, actual dose was the second lowest in the industry for a boiling water reactor outage. While outages have not been consistently meeting business plan goals, there is a slight trend of improvement as the last 3 of the 4 outages were below business plan goals. None of the initiatives we reviewed have actions designed to reduce dose. One plant personnel explained while they are always mindful of dose, they cannot always help dose issues.

Out of the 3 measures, performance related to duration has been the worst. The following figure details actual duration versus business plan goal for the last 2 outages for each unit, spanning February 2011–November 2014.

**Figure 3: Duration, Business Plan Goal Versus Actual Performance for Outages February 2011 – November 2014.**



Source: Chart developed from TVA data on nuclear outages.

Nine out of the 12 outages did not meet their business plan duration goals. One of the outages that did not meet its duration business plan goal finished less than a day off the duration goal. The most recent outage surpassed the business plan goal by 5 days. Of the nine outages that exceeded business plan duration goals, the range of differences off target was 2.0 to 75.6 percent and the average was 9.6 percent. No positive trend in outage duration performance was identified in this scope; however, the most recent outage was positive.

TVA management believes one main issue still facing outage performance is Long Range Outage Planning. This was confirmed by multiple site personnel we talked with, who also indicated challenges with planning. According to TVA, a lack of adequate Long Range Outage Planning has an adverse impact on scope selection, funding and preparations to execute a safe efficient outage. TVA currently has an excellence plan developed specifically to address their issues with Long Range Outage Planning. TVA plans to perform assessments at each site to develop specific action plans to address hardspots, optimize Long Range Outage Planning across the fleet, and review/enhance the existing

Long Range Outage Planning Governance. The assessments are scheduled to be completed by mid-2015.

**INITIATIVES HAVE CONTINUALLY CHANGED AND DO NOT INCLUDE ALL PLANNED ACTIONS**

Outage performance initiatives have continually changed and excellence/improvement initiative plans do not include all planned actions. While some initiatives have been completed, others are ongoing and have rolled over from one plan to the next, making it challenging to tie performance improvement to measurable results.

Over the past few years, there have been four different versions of outage performance improvement initiatives. The first one dates back into the 2012 time frame. The second plan was last updated in May/June 2014, and the third plan reflects the redesign that occurred in August 2014 and was a living document. Since the drafting of the August 2014 plan, governance and oversight for outage performance has been shifted entirely to Corporate, and execution responsibility has been pushed to the site level. During the course of our review, another round of initiatives dated January 2015 was developed. The following chart details the different versions of the initiatives and the focus areas for each.

<b>Initiatives</b>				
<b>Date</b>	<b>2012</b>	<b>May/June 2014</b>	<b>August 2014</b>	<b>January 2015</b>
<b>Title</b>	<b>Fleet Top Outage Improvement Initiatives</b>	<b>Performance Improvement Excellence Plan-Outage Execution</b>	<b>Excellence Plan-Outage Execution</b>	<b>Excellence Plan-Fleet Outage</b>
<b>Gaps, Initiatives, or Plans</b>	<ul style="list-style-type: none"> <li>• Long Range Outage Planning</li> <li>• Outage Cost Structure Development and Controls</li> <li>• PM Reduction</li> <li>• Schedule Quality/Level of Knowledge</li> <li>• Technology and Tools</li> <li>• Communication Tools</li> </ul>	<ul style="list-style-type: none"> <li>• Long Range Outage Planning</li> <li>• Outage Cost Structure Development and Controls</li> <li>• Schedule Quality and Level of Knowledge</li> <li>• Technology and Tools</li> <li>• Behaviors and Standards</li> </ul>	<ul style="list-style-type: none"> <li>• Scoping Process</li> <li>• Critical Maintenance</li> <li>• Outage Cost Control</li> </ul>	<ul style="list-style-type: none"> <li>• Station Outage Staffing and Development</li> <li>• Long Range Outage Planning</li> <li>• Outage Planning</li> </ul>

Due to the changes in plans and the time frame of those changes, we were unable to determine whether the different plans had achieved their intended results. Also, only the first initiative plan dates back late enough to have multiple outages that fall within our scope. The older initiative plan did not detail metrics or goals for measuring success. The plan lists problem statements and desired outcome, but no measurable goals. The second plan (May/June 2014) lays out specific metrics to demonstrate sustainability with

goal levels. The second plan was quickly replaced with the August 2014 plan, which has end-state standards (meet top quartile) and also lays out metrics for sustainability. The most recent excellence plans have more detailed end-state goals. Of the first two outage plans, some steps have been completed, while some were incorporated into the new plans and were in progress; others were cancelled with the redesign. TVA management stated tracking changes over the last few years could prove difficult because a lot had changed. With the first plan not having measurable goals and changing initiatives, it is challenging to tie any change to measurable results. Also, with the current excellence plan being a living document, new initiatives could become the focus rather than items not completed. As of March 2015, the third excellence plan (August 2014 version) is now complete.

Tracking of initiatives and actions are not centralized. In addition to the four versions of initiative plans, TVA provided other documentation showing actions taken or actions planned aimed at improving outage performance. A September 2014 document lists eight actions planned to achieve top quartile performance, some of which do appear to be included in the most recent initiative plan. Additionally, TVA has high impact teams set up working on tactical actions to reduce spending (including outage spending). Some of the actions include reducing (1) central in-processing training days, (2) outage contractor resource requirements, and (3) outage TVA labor cost practices. The work on these tactical actions is not part of the excellence plans. Without centralized tracking of initiatives and actions, it could be difficult to measure the results of certain initiatives and actions to determine if they improved performance.

## **RECOMMENDATIONS**

We recommend the Senior Vice President, Operations, take steps to improve outage improvement plans by (1) clearly defining all initiatives in a central location with specific actions and measurable goals; (2) tracking planned initiatives through completion; and (3) reviewing all current plans to determine if they will achieve desired results for duration, dose, and budget.

**TVA Management's Comments** – TVA management generally agreed with the findings and recommendations. TVA provided additional information that we have evaluated and revised the report as appropriate. TVA's "FY2016-FY2020 Nuclear Operations Support Business Plan-Outage Execution" contains all initiatives the Nuclear Executive Team has developed to achieve industry Top Quartile Outage Performance in the TVA Nuclear Fleet. These initiatives include Long-Range Outage Planning, Refueling Equipment Upgrades, Service Contracts, Scaffold Program Efficiency and Electronic Work Packages. Please see the Appendix for TVA management's complete response.

**Auditor's Comments** – The Office of the Inspector General concurs with TVA management's response.

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This report is for your review and final action. Your written comments, which addressed your management decision and actions planned or taken, have been included in the report. Please notify us when final action is complete. In accordance with the Inspector General Act of 1978, as amended, the Office of the Inspector General is required to report to Congress semiannually regarding evaluations that remain unresolved after 6 months from the date of report issuance.

Information contained in this report may be subject to public disclosure. Please advise us of any sensitive information in this report that you recommend be withheld. If you have any questions or need additional information, please contact Lucas W. Cotter, Auditor, at (423) 785-4826 or Gregory R. Stinson, Director, Evaluations, at (865) 633-7367. We appreciate the courtesy and cooperation received from your staff during the evaluation.



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(Audits and Evaluations)  
ET 3C-K

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cc: Joseph P. Grimes, LP 3R-C  
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TVA Board of Directors  
OIG File No. 2015-15273

June 30, 2015

Robert E. Martin – ET 3C-K

RESPONSE – REQUEST FOR COMMENTS – EVALUATION 2015-15273 – NUCLEAR OUTAGE PERFORMANCE

My staff and I have reviewed the draft Nuclear Outage Performance Evaluation dated 5/21/2015 and understand the findings/recommendations. Tennessee Valley Authority Nuclear appreciates the insights from the Office of the Inspector General (OIG) and is utilizing recommendations to strengthen our plans going forward. Tennessee Valley Authority Nuclear continues to strive to move to top quartile outage performance in duration, dose and dollars. The TVA vision is to be one of the Nation's leading providers of low cost and cleaner energy by 2020. The plans to achieve the vision are documented in the FY2016-2020 Nuclear Operations Support Business Plan for Outage Execution.

There have been numerous organizational changes in TVA Nuclear since the beginning of FY2014. These changes have had a positive impact on outage performance. The period of the evaluation was outages from FY2011-FY2014. The outage goals and accountability model is much improved due to the organizational changes that took place in FY2014. As a result, the three outages in FY2015 were at or below the TVA Nuclear Business Plan duration and the cumulative outage durations put TVA in the industry Top Quartile.<sup>1</sup>

Although outage durations have improved, meeting outage dose goals continues to be a challenge. A gap was identified with the timing of dose goal establishment. TVA Nuclear historically set the goal well before outage scope was clearly defined. Benchmarking determined that other utilities set outage dose goals three months prior to outage start, when scope is well defined. This change will be implemented by revising NPG-SPP-07.2.10 Milestone 28.<sup>2</sup> The established goal is intended to drive toward Top Quartile Performance for Collective Radiation Exposure (CRE), however, the final goal will be reflective of the actual outage work to be performed. Had we used this methodology for all FY2015 outages, it would have significantly reduced the dose goal gap.

The positive finding for outage cost control was attributed to the cost management procedure issued in FY2014. This has improved meeting individual department outage budgets and is standard throughout the Nuclear Fleet. We will continue to monitor/analyze budget performance and seek other cost saving initiatives. The actions are documented in the FY2016-2020 Nuclear Operations Support Business Plan Outage Execution. Cumulative O&M TVA Nuclear budget for the three FY2015 outages is three million dollars under budget which includes significant added cost due to additional outage scope for Sequoyah U1R20.

The OIG recommendations are to take steps to improve outage improvement plans by (1) clearly defining all initiatives in a central location with specific actions and measurable goals; (2) tracking planned initiatives through completion; and (3) reviewing all current plans to determine if they will achieve desired results for duration, dose and budget.

The response to the evaluation recommendations is the "FY2016-FY2020 Nuclear Operations Support Business Plan-Outage Execution" containing all initiatives the Nuclear Executive Team has developed to achieve industry Top Quartile Outage Performance in the TVA Nuclear Fleet.

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<sup>1</sup> Only one of the three FY2015 outages were covered in report.

<sup>2</sup> Condition Report 1045825 tracking revision

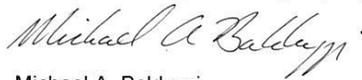
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These initiatives include Long-Range Outage Planning (LROP), Refueling Equipment Upgrades, Service Contracts, Scaffold Program Efficiency and Electronic Work Packages.

Each initiative has specific actions identified in "FY2016-FY2020 Nuclear Operations Support Business Plan-Outage Execution" plan with due dates. The Business Plan is a living document and will serve to track the progress of initiatives and help drive the TVA Nuclear Fleet to Top Quartile performance in duration, dose and dollars. The current version referenced and attached is likely to change based upon results and continuous re-evaluation of objectives.

Recent INPO (Institute of Nuclear Power Operation) outage performance indicators show TVA Nuclear on an improving trend. TVA Nuclear will continue to drive outage performance and achieve top quartile outage rating in all categories.

If you have any questions or wish to discuss our response, please contact John R. Garrity, General Manager of Outage Planning at (423) 751-7719.



Michael A. Balduzzi  
Senior Vice President, Nuclear Operations  
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MAB:JRG  
cc (Attachments): FY2016-2020 Nuclear Operations Support Business Plan for Outage Execution,  
TVA Nuclear Refueling Outage Results  
Lucas Cotter, EB 2G-C  
John R. Garrity, BR 3C-C  
Joseph P. Grimes, LP 3R-C  
Gregory R. Stinson, ET 3C-K