



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

June 29, 2017

David W. Sorrick, LP 3K-C

**REQUEST FOR FINAL ACTION – EVALUATION 2016-15391 – GAS PLANT  
PREVENTIVE MAINTENANCE**

Attached is the subject final report 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 will 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 wish to discuss our findings, please contact Leslie A. Franks, Auditor, at (865) 633-7330 or E. David Willis, Director, Evaluations, at (865) 633-7376. We appreciate the courtesy and cooperation received from your staff during the evaluation.

David P. Wheeler  
Assistant Inspector General  
(Audits and Evaluations)  
ET 3C-K

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Attachment  
cc (Attachment):

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OIG File No. 2016-15391



Office of the Inspector General

# *Evaluation Report*

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To the Senior Vice  
President, Power  
Operations

## **GAS PLANT PREVENTIVE MAINTENANCE**

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Evaluation Team  
Leslie A. Franks  
Claire E. Blackstock  
David S. Shields

Evaluation 2016-15391  
June 29, 2017

## **ABBREVIATIONS**

CC	Combined Cycle
CR	Condition Report
CT	Combustion Turbine
EGD	Engineering Guideline Document
FPG	Fossil Power Group
MBO	Maintenance Basis Optimization
NERC	North American Electric Reliability Corporation
PdM	Predictive Maintenance
PM	Preventive Maintenance
PO	Power Operations
PRC	Protection and Control
SPP	Standard Programs and Processes
TVA	Tennessee Valley Authority

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MEMORANDUM DATED JUNE 21, 2017, FROM DAVID W. SORRICK TO  
DAVID P. WHEELER



# Evaluation 2016-15391 – GAS PLANT PREVENTIVE MAINTENANCE

## EXECUTIVE SUMMARY

### Why the OIG Did This Evaluation

Preventive maintenance (PM) consists of servicing and data collection activities carried out at predetermined intervals and is intended to reduce the likelihood of equipment failures. Due to the importance of PM to the reliable operation of the Tennessee Valley Authority's (TVA) generating assets and as a result of findings identified related to nuclear and coal PM in previous evaluations,<sup>i</sup> we initiated an evaluation of TVA's gas plant PM. The objective of our evaluation was to determine if PM had been performed in accordance with established schedules and, if not, what effect the deviations had.

### What the OIG Found

We determined PM regulated by the North American Electric Reliability Corporation (NERC)<sup>ii</sup> was performed in accordance with TVA's established schedules. However, we were unable to determine if non-NERC PM had been performed in accordance with established schedules due to unreliable dates and a lack of documentation in Maximo.<sup>iii</sup> We also determined that inadequate PM contributed to 11 equipment failures; 9<sup>iv</sup> of these failures resulted in forced outages.<sup>v</sup> Through interviews with plant personnel, we identified potential areas for improvement including: (1) predictive maintenance (PdM), (2) implementation support for new PM programs, (3) Maximo training and access, and (4) transition of coordinator responsibilities.

In an effort to optimize their gas plant PM strategy, TVA is implementing Maintenance Basis Optimization (MBO) in the gas fleet, which is an aspect of the Electric Power Research Institute's<sup>vi</sup> plant reliability optimization. MBO optimizes PM by evaluating causes and risk of failure and taking preventative measures to extend the life of the assets. According to TVA,

<sup>i</sup> Evaluation 2012-14845, Review of TVA's Nuclear Power Group Preventive Maintenance, September 24, 2013; and Evaluation 2014-15053, Coal Plant Preventive Maintenance, September 29, 2014.

<sup>ii</sup> NERC is a not-for-profit international regulatory authority whose mission is to assure the reliability and security of the bulk power system in North America.

<sup>iii</sup> Maximo is the work management system used by TVA to manage PM.

<sup>iv</sup> Six of the 9 equipment failures resulting in forced outages were failed starts, which occur when a unit is called on to run, but is unable to be brought online to produce power.

<sup>v</sup> A forced outage is an outage that requires immediate removal of a unit from service. This type of outage usually results from mechanical/electrical/hydraulic control systems trips and operator-initiated trips in response to unit alarms.

<sup>vi</sup> The Electric Power Research Institute conducts research, development, and demonstration projects for the benefit of the public in the United States and internationally, with a focus on electricity generation, delivery, and use.



# Evaluation 2016-15391 – GAS PLANT PREVENTIVE MAINTENANCE

## EXECUTIVE SUMMARY

the MBO initiative will enable TVA to focus available resources on critical maintenance tasks to ensure equipment and plant reliability.

### What the OIG Recommends

We recommend the Senior Vice President, Power Operations:

- Identify the root cause(s) of data inaccuracies and omissions in Maximo and take action to prevent future recurrence.
- Continue with MBO efforts to establish necessary PMs and implement appropriate PM frequencies.
- Develop processes to effectively implement PMs for future plant construction and acquisitions.
- Evaluate gas fleet PdM and determine if implementation of a programmatic approach to PdM is needed.
- Evaluate the process for new PM program implementation to determine if additional communication or support is necessary.
- Evaluate Maximo training and access needs for site personnel and provide training and access as appropriate.
- Clearly define PM roles and responsibilities at CT sites and provide training as needed to alleviate difficulties related to managing PM.

### TVA Management's Comments

TVA management generally agreed with our findings and recommendations and has planned actions to implement our recommendations. See the Appendix for TVA management's complete response.

## **BACKGROUND**

The Tennessee Valley Authority (TVA) operates 16 natural gas-fired plants throughout the Tennessee Valley. In fiscal year 2016, the gas fleet accounted for 18 percent of the total power produced by TVA. Due to the ability of gas units to quickly start up and shut down as needed, gas plants are utilized by TVA to provide reliability to the region, quickly meet peak power demand, reduce the need to purchase higher-priced power from external sources, and control costs while reliably meeting energy demands.

TVA performs preventive maintenance (PM), which consists of servicing and data collection activities carried out at predetermined intervals, to reduce the likelihood of equipment failures. In an effort to optimize their gas plant PM strategy, TVA is implementing Maintenance Basis Optimization (MBO) in the gas fleet, which is an aspect of the Electric Power Research Institute's<sup>1</sup> plant reliability optimization. According to TVA, an optimized PM strategy provides higher reliability at a lower cost through the efficient use of resources and the performance of scheduled maintenance, which is more cost effective than performing emergency maintenance. MBO optimizes PM by evaluating causes and risk of failure and taking preventative measures to extend the life of the assets.

TVA uses a work management system, Maximo, to manage (e.g., track, store, generate) PMs. According to TVA personnel, PM work orders are generated in Maximo, scheduled by maintenance coordinators or foremen, executed by maintenance craft personnel, and then closed out in Maximo. TVA's Power Operations (PO) Standard Programs and Processes (SPP) PO-SPP-06.000, Power Operations Conduct of Maintenance, requires the following information to be documented on work orders in Maximo upon completion of work: (1) the "as-found" and "as-left" condition of the equipment, component, or system including parts replaced and any recommendations for additional work; (2) notes for equipment history that accurately capture actual work performed; (3) information related to approved configuration changes; and (4) the appropriate work order reconciliation code.<sup>2</sup>

Some PMs performed by TVA are regulated by the North American Electric Reliability Corporation's (NERC)<sup>3</sup> Protection and Control (PRC) Standard PRC-005-6. NERC established this standard to implement a program for the maintenance of certain systems affecting the reliability of the Bulk Electric System so that they are kept in working order. According to PRC-005-6, generator owners shall establish a Protection System Maintenance Program,

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<sup>1</sup> The Electric Power Research Institute conducts research, development, and demonstration projects for the benefit of the public in the United States and internationally, with a focus on electricity generation, delivery, and use.

<sup>2</sup> The reconciliation code is used to code the work order as "completed as planned," "canceled," "completed on another work order," "work not needed," etc.

<sup>3</sup> NERC is a not-for-profit international regulatory authority whose mission is to assure the reliability and security of the bulk power system in North America.

which TVA has implemented through PO-SPP-09.021, NERC Generation Protection Systems and Sudden Pressure Relaying Maintenance Program. PMs governed by this SPP include activities such as certain battery inspections and relay testing.

Previous Office of the Inspector General evaluations of other operating areas<sup>4</sup> identified deficiencies related to PM. Due to the importance of PM to the reliable operation of TVA's generating assets, we initiated an evaluation of TVA's gas plant PM.

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

The objective of our evaluation was to determine if PM had been performed in accordance with established schedules and, if not, what effect the deviations had. The scope of our evaluation included PM and equipment failures at all 15<sup>5</sup> natural gas-fired plants in the TVA gas fleet between January 1, 2014, and September 30, 2016.

To achieve our objective, we:

- Reviewed the following procedures and guideline documents to obtain an understanding of PM processes and requirements:
  - Fossil Power Group (FPG) FPG-SPP-09.000, Conduct of Engineering
  - PO-SPP-06.000, Power Operations Conduct of Maintenance
  - PO-SPP-07.001, Power Operations Work Management
  - PO-SPP-09.021, NERC Generation Protection Systems and Sudden Pressure Relaying Maintenance Program
  - Engineering Guideline Document (EGD) EGD-09.022, Maintenance Basis
  - EGD-09.070.01, Predictive Maintenance Program
- Interviewed pertinent PO personnel to obtain information related to MBO, PM, and work management processes.
- Interviewed pertinent plant personnel throughout the gas fleet to obtain information related to the PM programs at the sites.
- Judgmentally selected 7 of the 15 plants in TVA's gas fleet for site visits to gain an understanding of the PM process, to identify potential best practices, and to identify areas for improvement related to PM at each site. To visit a geographically dispersed and representative sample of the gas fleet, we selected the following plants:
  - Ackerman Combined Cycle (CC)
  - Gallatin Combustion Turbine (CT)

<sup>4</sup> Evaluation 2012-14845, Review of TVA's Nuclear Power Group Preventive Maintenance, September 24, 2013; and Evaluation 2014-15053, Coal Plant Preventive Maintenance, September 29, 2014.

<sup>5</sup> At the time of our evaluation, TVA's gas fleet consisted of 15 gas plants. Subsequent to our evaluation, TVA added to its fleet Paradise CC gas plant, which began commercial operation on April 7, 2017.

- John Sevier CC
  - Johnsonville CT
  - Lagoon Creek CC
  - Lagoon Creek CT
  - Magnolia CC
- Randomly selected a statistical sample (using attribute sampling designed to provide a 95-percent confidence level) of 57 out of 1,215<sup>6</sup> gas PM work orders identified as NERC-related in Maximo with start dates between October 26, 2015, and September 30, 2016.<sup>7</sup> We reviewed 54 of the 57<sup>8</sup> work orders to determine if NERC-related PM had been performed in accordance with established schedules in Maximo.
  - Evaluated non-NERC PM work order data from Maximo for reliability and completeness. We identified 52,269 non-NERC PM work orders with start dates between October 26, 2015, and September 30, 2016. Based on our analysis of the work order data, we determined adherence to non-NERC PM schedules could not be confirmed due to a lack of documentation for non-NERC PM work orders and unreliable dates in Maximo.
  - Reviewed 236<sup>9</sup> condition reports (CR) in Maximo with reported dates between January 1, 2014, and August 31, 2016, to determine if inadequate PM contributed to equipment failures.

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

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<sup>6</sup> We identified 1,254 PM work orders coded as "NERC" in Maximo. However, we excluded 39 of these work orders from our population because they served as reminders for relay testing coming due, but the work was actually performed by the appropriate Power Service Operations Service Center rather than the gas plant.

<sup>7</sup> Reconciliation codes were not procedurally required until October 26, 2015. Due to this, we pulled work orders from that date through the end of fiscal year 2016.

<sup>8</sup> According to TVA, 2 of the work orders were incorrectly identified as NERC-related in Maximo and 1 work order was erroneously assigned to a gas plant rather than the Power System Operations group. Based on this information, we excluded them from further testing. Due to Maximo data inaccuracies, we determined projecting our findings to the population was inappropriate and therefore did not pull additional items for testing.

<sup>9</sup> We performed a summary word search on the term "fail." This search may not have included all CRs related to equipment failures, as the search function does not search the entire CR and there could have been equipment failure CRs entered by the site using different wording.

## **FINDINGS AND RECOMMENDATIONS**

We determined PMs identified as NERC-related had been performed in accordance with TVA's established schedules. However, we were unable to determine if non-NERC PM had been performed in accordance with established schedules due to unreliable dates and a lack of documentation<sup>10</sup> in Maximo. We also determined that inadequate PM contributed to 11 equipment failures; 9<sup>11</sup> of these failures resulted in forced outages.<sup>12</sup> Through interviews with plant personnel, we identified potential areas for improvement including: (1) predictive maintenance (PdM), (2) implementation support for new PM programs, (3) Maximo training and access, and (4) transition of coordinator responsibilities.

### **TVA'S ADHERENCE TO ESTABLISHED PM SCHEDULES**

We identified 53,523 gas PM work orders in our scope, 1,254 of which were identified as NERC-related in Maximo. We reviewed supporting documentation for a sample of the NERC-related work orders and determined they had been performed in accordance with TVA's established schedules. However, we were unable to determine non-NERC PM schedule adherence due to unreliable dates and a lack of documentation in Maximo.

#### **NERC-Related PM Schedule Adherence**

Based on our review of the 54 randomly selected work orders, we determined PM work orders identified as NERC-related in Maximo had been performed in accordance with TVA's established schedules. For each of the 54 work orders, documentation showed the PM was performed within the maximum maintenance intervals. We noted for several of the work orders reviewed, the dates written on the supporting documentation did not match the actual finish dates recorded in Maximo. Due to this, we relied on the dates recorded on the supporting documentation rather than the actual finish dates in Maximo to determine TVA's adherence to NERC-related PM schedules established by TVA.

In addition to noting inaccurate dates in Maximo, we also found other information was not being entered as required. TVA's PO-SPP-06.000, Power Operations Conduct of Maintenance requires the following to be documented in Maximo at work order closure: (1) the "as-found" and "as-left" condition of equipment, (2) notes for work performed, (3) information related to configuration changes, and (4) the appropriate reconciliation code. We noted none of the 54 NERC-related PM work orders reviewed complied with all 4 work order requirements as defined in PO-SPP-06.000. However, the supporting documentation attached to

<sup>10</sup> For the purpose of this report, "documentation" refers to supporting attachments, reconciliation codes, notes for work performed, and time charged or materials purchased under the work order.

<sup>11</sup> Six of the 9 equipment failures resulting in forced outages were failed starts, which occur when a unit is called on to run, but is unable to be brought online to produce power.

<sup>12</sup> A forced outage is an outage that requires immediate removal of a unit from service. This type of outage usually results from mechanical/electrical/hydraulic control systems trips and operator-initiated trips in response to unit alarms.

the work orders in Maximo contained detailed information documenting the work performed and other pertinent testing information.

### **Non-NERC PM Schedule Adherence**

We were unable to determine if non-NERC PM had been performed in accordance with established schedules due to:

1. **Unreliable Dates in Maximo** – We determined the actual start and actual finish dates recorded in Maximo were not necessarily indicative of when the work was performed. As stated above, PM work orders identified as NERC-related contained supporting documentation in Maximo. Our review of the documentation identified discrepancies between the dates recorded in Maximo and the dates written on the supporting documentation. Additionally, TVA personnel at one of the sites visited stated the actual finish date recorded in Maximo is often the date of work order closure rather than the date the work was actually performed and completed.
2. **Lack of Documentation for Non-NERC PM Work Orders** – TVA personnel indicated the evidence of work performed documented in Maximo for non-NERC PM would likely be the reconciliation code, since supporting documentation is not required. However, analysis of the 53,523 work orders identified found 41,079 (77 percent) did not contain a reconciliation code.

Due to the unreliable dates in Maximo and a lack of documentation for non-NERC PM work orders, we were unable to determine if non-NERC PM had been performed in accordance with established schedules.

**Recommendation** – We recommend the Senior Vice President, PO, identify the root cause(s) of data inaccuracies and omissions in Maximo and take action to prevent future recurrence.

**TVA Management's Comments** – TVA management stated (1) the data inaccuracies and omissions in Maximo have resulted from the lack of a singular, comprehensive effort to identify all areas where process steps can be performed consistently across the fleet, and (2) gaps in the work management process have emerged as a result of unclear requirements. TVA has initiated the Gas Fleet Alignment initiative to identify areas for improvement and develop process solutions until a complete, consistent work order management process is implemented in the gas fleet. See the Appendix for TVA management's complete response.

**Auditor's Response** – We concur with management's planned actions.

## INADEQUATE PM CONTRIBUTED TO EQUIPMENT FAILURES

Based on our review of gas plant CRs related to equipment failure, we determined inadequate PM contributed to 11 failures between January 1, 2014, and August 31, 2016. Nine of these failures resulted in forced outages. Eight of the 11 equipment failures were related to unestablished PMs and the remaining 3 were related to ineffective PM frequencies.

According to plant personnel, the lack of established PMs is due to:

1. **Ineffective Transitioning of Acquired Gas Plants Into the TVA Fleet** – Since 2006, TVA has purchased 6 gas plants that were already in operation. According to plant personnel at 2 of the acquired plants, the PMs established before TVA bought the plant were not transferred into Maximo. As a result, all PMs previously established were lost and plant personnel are working to recreate the PMs in Maximo.
2. **PMs Not Being in Place at the Time the Plant Began Commercial Operation** – Since 2006, TVA has built 3 new gas plants. According to PO management, PMs were not always developed and in place when the plants began commercial operation. As a result, plant personnel are still trying to identify and establish necessary PMs. We were also informed there are PMs being performed that are not in Maximo. Plant personnel at one site visited stated they have relied on personal knowledge and experience to perform the PMs necessary for maintaining the health of the assets. According to TVA personnel, this issue has improved with TVA's most recent plant constructions.

According to TVA, the MBO initiative will enable TVA to focus available resources on critical maintenance tasks to ensure equipment and plant reliability. The initiative utilizes the Electric Power Research Institute's criteria to identify each component's criticality and associated basis (i.e., the PM scope and frequency). MBO also includes a review of PM tasks on critical and noncritical components in an effort to optimize the scope and frequency of PM tasks.

**Recommendation** – We recommend the Senior Vice President, PO, (1) continue with MBO efforts to establish necessary PMs and implement appropriate PM frequencies and (2) develop processes to effectively implement PMs for future plant construction and acquisitions.

**TVA Management's Comments** – TVA management stated (1) the Gas Fleet Programs Team is piloting implementation of MBO at Ackerman CC to establish a process to be rolled out to all CC and CT sites, and (2) a revised integration procedure, PO-SPP-06.001, Gas Operations Site Integration from Construction or Purchase, was published in response to events related to PM program deficiencies at newly constructed sites as well as acquisitions. However, TVA management stated the statement in the report that "the PMs established before TVA bought the plant were not transferred into Maximo" may be inaccurate.

According to TVA management, all existing PMs at Ackerman CC were evaluated and the majority of existing PMs were transferred to Maximo. During that evaluation, it was determined that not all existing PMs were needed and those PMs were not transferred to Maximo. See the Appendix for TVA management's complete response.

**Auditor's Response** – As stated in the report, we determined ineffective transition of acquired sites into the TVA fleet resulted in a loss of PMs based on testimonial evidence from plant personnel. The information provided by plant personnel was consistent with a TVA Operational Assurance report,<sup>13</sup> which found that "TVA did not do an effective job of capturing the PMs that were already in place at the three Combined Cycle plants purchased by TVA." We concur with management's planned actions and actions completed to date.

## OTHER MATTERS FOR MANAGEMENT CONSIDERATION

Through interviews with plant personnel, we identified potential areas for improvement including: (1) PdM, (2) implementation support for new PM programs, (3) Maximo training and access, and (4) transition of coordinator responsibilities. We did not design testing to review these matters as part of this evaluation, but thought it prudent to include the information for management's consideration.

### **Predictive Maintenance**

PdM is an advanced PM technique that utilizes technology to determine the condition of equipment. PdM involves periodic equipment condition monitoring and diagnostics to (1) increase the availability of plant equipment, (2) reduce maintenance costs, and (3) increase personnel safety by detecting equipment deterioration condition and taking preventive action prior to failure.

Plant personnel at two gas sites raised concerns regarding the lack of a programmatic approach to PdM in the gas fleet. Gas PdM is governed by EGD-09.070.01, Predictive Maintenance Program, which contains recommendations for the implementation of a PdM program rather than requirements. Plant personnel provided a specific example of motor failures that could have been prevented through the utilization of vibration testing PdM activities.

The level of PdM performed at the sites varies throughout the gas fleet because PdM is not a required activity. The lack of a programmatic approach to gas plant PdM could contribute to equipment failures.

**Recommendation** – We recommend the Senior Vice President, PO, evaluate gas fleet PdM and determine if implementation of a programmatic approach to PdM is needed.

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<sup>13</sup> TVA Accountability Engagement, Combined Cycle Preventive Maintenance Program, dated April 14, 2015.

**TVA Management's Comments** – TVA management agreed that a programmatic approach to PdM would be beneficial and stated the PO Asset Management organization will develop and implement a more programmatic approach to PdM that aligns activities with resources. See the Appendix for TVA management's complete response.

**Auditor's Response** – We concur with management's planned actions.

### **Implementation Support for New PM Programs**

Plant personnel at six sites expressed concern and provided examples of new PM programs developed by Corporate that lacked implementation support at the sites. According to plant personnel, there is a lack of communication and support from TVA to implement new programs, as well as a lack of follow-up. Due to this, plant personnel indicated they are often unsure (1) what is expected of them in order to comply with the programs, (2) if they are meeting the intent of the programs, or (3) if they are providing the right information Corporate seeks to obtain through the programs. A lack of implementation support in the gas fleet for new PM programs could result in wasted resources if the intent of the programs is not being met.

**Recommendation** – We recommend the Senior Vice President, PO, evaluate the process for new PM program implementation to determine if additional communication or support is necessary.

**TVA Management's Comments** – TVA management stated Gas Operations is aware of deficiencies in overall TVA program implementation and the negative impact on PM compliance. As a result, Gas Operations staff is working with the Programs and Performance group to identify and address gaps in the change management process. See the Appendix for TVA management's complete response.

**Auditor's Response** – We concur with management's planned actions.

### **Maximo Training and Access**

Plant personnel raised concerns related to (1) a lack of Maximo training and (2) the limited number of site maintenance personnel with Maximo access needed to close work orders. Based on our interviews, the lack of Maximo training and access has led to completed work orders remaining open in Maximo until plant personnel with the knowledge or necessary access can close them. This results in a misleading PM work order backlog in Maximo, which can make it difficult for the plants to track which PMs still need to be performed and which have been completed but not yet closed in Maximo. This issue could also skew PM compliance metrics being developed by TVA as part of the MBO, making it appear that some plants are performing less PM work than they actually are.

**Recommendation** – We recommend the Senior Vice President, PO, evaluate Maximo training and access needs for site personnel and provide training and access as appropriate.

**TVA Management's Comments** – TVA management agreed there are Maximo knowledge gaps and stated the Gas Fleet Alignment initiative will include (1) Maximo training conducted at each site to address site-specific training gaps and (2) a review of site security roles in Maximo to ensure employees have the appropriate Work Management access. See the Appendix for TVA management's complete response.

**Auditor's Response** – We concur with management's planned actions.

#### **Ineffective Transition of Coordinator Responsibilities**

According to TVA, the gas fleet was reorganized in March 2016 to assign site leadership at each of the 9 CT plants. Prior to this, CT plants had regional managers overseeing multiple sites rather than a manager at each site. As part of the restructuring, the CT maintenance coordinator positions were eliminated. Maintenance coordinators were previously responsible for managing plant PM; however, according to plant personnel, site managers and foremen took on these responsibilities under the new structure. Plant personnel stated there was a lack of change management and guidance from Corporate, including assignment of the coordinator duties, knowledge transfer, and training to assist with the transition into these new roles. As a result, plant personnel stated this has led to an inability to effectively manage PM programs at the CT sites.

**Recommendation** – We recommend the Senior Vice President, PO, clearly define PM roles and responsibilities at CT sites, and provide training as needed to alleviate difficulties related to managing PM.

**TVA Management's Comments** – TVA management stated PO-SPP-07.001, PO Work Management Process, has been revised to define roles and responsibilities for the work management process, which includes execution of the PM Program. A "child" SPP is currently under development to establish specific gas positions responsible for each role in the work management process based on the CC and CT organizational structures. A comprehensive change management plan will be developed to ensure effective SPP implementation, including assessment of associated training needs. See the Appendix for TVA management's complete response.

**Auditor's Response** – We concur with management's planned actions.

June 21, 2017

David P. Wheeler, ET 3C-K

REQUEST FOR COMMENTS – DRAFT EVALUATION 2016-15391– GAS PLANT  
PREVENTIVE MAINTENANCE

We appreciate the opportunity to provide comments and details on the Office of Inspector General's (OIG) evaluation report of TVA's gas plant preventive maintenance (PM) program dated May 25, 2017.

***OIG Recommendations to the Senior Vice President, Power Operations:***

- *Identify the root cause(s) of data inaccuracies and omissions in Maximo and take action to prevent future recurrence.*
- *Continue with MBO efforts to establish necessary PMs and implement appropriate PM frequencies.*
- *Develop processes to effectively implement PMs for future plant construction and acquisitions.*
- *Evaluate gas fleet PdM and determine if implementation of a programmatic approach to PdM is needed.*
- *Evaluate the process for new PM program implementation to determine if additional communication or support is necessary.*
- *Evaluate Maximo training and access needs for site personnel and provide training and access as appropriate.*
- *Clearly define PM roles and responsibilities at CT sites and provide training as needed to alleviate difficulties related to managing PM.*

**Recommendation**

Identify the root cause(s) of data inaccuracies and omissions in Maximo and take action to prevent future recurrence.

**Response**

Power Operations (PO) believes it understands the root cause of the data inaccuracies and omissions in Maximo. Until recently PO had not implemented a singular, comprehensive effort that identifies all areas where process steps can be performed consistently across the fleet, and gaps in the work management process have emerged as a result of unclear requirements. Recognizing the need for systematically identifying opportunities for improvement and implementing process improvements and definition, the Gas Fleet Alignment initiative has been launched. On June 1, 2017, the first identified area, use of reconciliation codes and other information required at work order closure, was vetted and a process solution developed by a team of subject matter experts. The consensus was sent to key stakeholders for review and comment. Upon concurrence, an appropriate change management plan will be developed to ensure effective implementation and sustainability of the new process. The PO

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Work Management Senior Program Manager and team will continue to identify areas for improvement and develop process solutions until a complete, consistent work order management process is implemented in the gas fleet. Given the fairly large scope of work involved, target completion is end of FY18.

**Recommendations**

Continue with MBO efforts to establish necessary PMs and implement appropriate PM frequencies and develop processes to effectively implement PMs for future plant construction and acquisitions.

**Response**

PO believes the following statement in the report "the PMs established before TVA bought the plant were not transferred into Maximo" may be inaccurate. At Ackerman Combined Cycle (CC), all existing PMs were evaluated and the majority of existing PMs were transferred to Maximo. During that evaluation it was also determined that not all existing PMs were needed and as a result those PMs were not transferred to Maximo. As we implement our MBO process, additional PMs are also being created.

Recognizing improvement opportunities are present, and in response to events related to PM program deficiencies at newly constructed gas generating sites as well as acquisitions, a revised integration procedure was published on December 12, 2016. Where the previous document, GO-SPP-06.001, required Engineering to perform the task of developing a PM basis, the revised governance procedure, PO-SPP-06.001, accomplishes the following:

- For acquisitions,
  - Section 3.2.2.D.2 - Requires the Senior Manager, Regional Gas Operations and the Senior Manager, Plant Integration "to identify plant leadership candidates. As a minimum, this should include the Plant Manager, the Operations Manager, and the Maintenance Manager, as these positions are critical to a timely and successful integration."
  - Section 3.2.2.D.6 - Firmly establishes ownership and accountability of the PM Program with the site Maintenance Manager.
- For new construction,
  - Section 3.2.3.C - Requires the seated Plant Manager and Senior Manager, Plant Integration "to identify plant leadership candidates. As a minimum, this should include the Plant Manager, the Operations Manager, and the Maintenance Manager, as these positions are critical to a timely and successful integration."
  - Section 3.2.3.C.4 - Firmly establishes ownership and accountability of the PM Program with the site Maintenance Manager.
- Includes a note stating:
  - "A detailed written action plan shall be developed, specifying the actions necessary to transition from the existing Work Management System (WMS) to

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TVA's WMS. The action plan will be written from the point of the acquisition to the point where the WMS is fully assimilated into the TVA/PO standards."

Additionally, the MBO implementation process in gas has been improved over the past two years through a collaborative effort between TVA and EPRI. A new governance document is being created to replace Engineering Guidance Document, EGD-09.022, Maintenance Basis. The new Standard Programs and Processes (SPP) will establish:

- Roles and responsibilities for the Generation Engineering PM Program Manager, Generation Engineering, Responsible Manager, and other key personnel.
- The Gas Maintenance Manager and the Combustion Turbine (CT) Site Manager as the Responsible Manager for gas sites.

For all future acquisitions or new builds, PO will adhere to the new MBO SPP. Paradise CC has used the improved implementation process for MBO to develop their PM program and capture lessons learned for use at Allen CC. The Gas Fleet Programs Team is piloting implementation of MBO at Ackerman CC to establish a process to be rolled out to all CC and CT sites by the end of FY18.

**Recommendation**

Evaluate gas fleet PdM and determine if implementation of a programmatic approach to PdM is needed.

**Response**

PdM technologies are being leveraged across the gas fleet including bore scope inspections, chemistry analysis, lube oil/transformer oil analysis, vibration analysis, infrared monitoring, and audio detection.

PO does agree with the OIG recommendation that a more programmatic approach to PdM would be beneficial. Prior to the end of calendar year 2017, the PO Asset Management organization will have personnel dedicated to the development of a PdM program within its group. Asset Management will develop a more programmatic approach to PdM that aligns activities with resources and will be implemented using our change management process by the end of FY18.

**Recommendation**

Evaluate the process for new PM program implementation to determine if additional communication or support is necessary.

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Response

Gas Operations is aware of deficiencies in overall TVA program implementation and the negative impact on PM compliance. To address this, Gas Operations staff is working with the current Programs & Performance group to identify and address gaps in the change management process.

This improvement effort includes:

- Gas Senior Program Managers serving as program leads for Gas Operations, to include:
  - Reviewing all relevant change management plans and executive summaries during procedure stakeholder reviews to ensure they provide the necessary gas site- and role-specific information.
  - Cascading new and changing programmatic requirements and review requests across Gas Operations to drive effective communication.
- An upcoming, off-cycle revision to PO-SPP-01.001, PO Administration of Fleet SPPs to provide:
  - The framework for process improvements and help drive a more effective deployment process within Gas Operations.
  - Role clarity for stakeholders and change leaders across PO, including Gas Operations.
- Validating business cases and resource impacts for work impacting Gas Operations by adhering to the new PO Programs, Procedures and Initiatives (PPI) Streamlining process, which:
  - Established a sustainable framework for vetting new and existing PPIs and ensures effective change management across the impacted organizations.
  - Optimizes the PO business model.
  - Aligns PO activities with available resources.

Recommendation

Evaluate Maximo training and access needs for site personnel and provide training and access as appropriate.

Response

PO is aware there are gas sites with varying degrees of Maximo knowledge gaps. As part of the Gas fleet alignment initiative, Maximo training will be conducted at each site based on site-specific training gaps.

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Also, as part of the ongoing implementation, PO leadership will be reviewing site security roles in Maximo and updating them accordingly to ensure employees have the appropriate Work Management access. This review is currently underway at Ackerman CC and will expand to cover each gas site.

**Recommendation**

Clearly define PM roles and responsibilities at CT sites and provide training as needed to alleviate difficulties related to managing PM.

**Response**

PO-SPP-07.001, PO Work Management Process, has been revised to define roles, responsibilities, and GOES accountabilities for the Work Management process that encompasses execution of the PM Program. The procedure is currently under final review before publishing.

PO-SPP-07.001 does not, however, prescribe specific gas positions responsible for each role in the Work Management process because of PO's staffing variability in coal, gas, and hydro. PO Programs & Performance is currently developing a "child" SPP to specifically establish those roles and responsibilities based on the organization structures in place at CC and CT sites. The target date for completion of the new governance document is December 31, 2017.

A comprehensive change management plan will be developed to ensure effective "child" SPP implementation including assessment of associated training needs.

Please let us know if you have any other questions or need additional information.



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