Memorandum from the Office of the Inspector General

May 16, 2024

Robert Bryan Williams

REQUEST FOR FINAL ACTION – EVALUATION 2023-17463 – QUALITY MANAGEMENT OF THE COLBERT COMBUSTION TURBINE EXPANSION PROJECT

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.

If you have any questions or wish to discuss our findings, please contact Andi R. McCarter, Senior Auditor, at (423) 785-4831 or Lisa H. Hammer, Director, Evaluations Projects, at (865) 633-7342. We appreciate the courtesy and cooperation received from your staff during the evaluation.

David P. Wheeler
Assistant Inspector General
(Audits and Evaluations)

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OIG File No. 2023-17463

Office of the Inspector General

Evaluation Report

To the Senior Vice President,
Generation Projects and
Fleet Services

QUALITY MANAGEMENT OF THE COLBERT COMBUSTION TURBINE EXPANSION PROJECT

Evaluation Team
Andi R. McCarter
Scott M. Norris

Evaluation 2023-17463
May 16, 2024

ABBREVIATIONS

CCT	Colbert Combustion Turbine
COQ	Cost of Quality
EPC	Engineering, Procurement, and Construction
OEM	Original Equipment Manufacturer
PMBOK	Project Management Body of Knowledge
PMP	Project Management Plan
PQM	Project Quality Manual
QA	Quality Assurance
QC	Quality Control
TVA	Tennessee Valley Authority

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Evaluation 2023-17463 – Quality Management of the Colbert Combustion Turbine Expansion Project

EXECUTIVE SUMMARY

Why the OIG Did This Evaluation

In August 2019, the Tennessee Valley Authority (TVA) Board of Directors granted approval for 1,500 megawatts of peaking gas replacement capacity at a total cost of just over $1 billion. In December 2020, TVA signed a fixed price engineering, procurement, and construction (EPC) contract for six new simple cycle[i] combustion turbines: three at TVA's Paradise reservation in Muhlenberg County, Kentucky, and three at TVA's Colbert reservation in Colbert County, Alabama. Construction activities began at Colbert in the summer of 2021 and commercial operation began in July 2023. Major Projects, a department within the Chief Operating Office's Generation Projects and Fleet Services organization, was responsible for management of the project. In their role, Major Projects provides support with front end project and site development, selection and oversight of the EPC contractor, and support for system turnovers, among other things.

TVA's Standard Programs and Processes 34.000, *Project Management*, provides the minimum requirements and guidance to enhance the probability for project success, which is measured by safely completing projects on budget and on schedule. One recommended project management functional area is quality management, which is used to provide confidence that activities affecting quality are accomplished in a manner that achieves compliance with preestablished objectives and criteria. For the Colbert Combustion Turbine (CCT) expansion project, TVA delegated quality management to the EPC contractor. The EPC contract required the EPC contractor to have a documented quality control (QC) program acceptable to TVA for all work, including (1) control of subcontractors and suppliers, (2) measuring and testing equipment, and (3) internal and supplier verification and reporting processes, among other things. The EPC contractor's responsibilities included inspecting equipment from the original equipment manufacturer (OEM) and verifying quality once it was delivered to the CCT site. The OEM was primarily responsible for the quality of the equipment during fabrication prior to site arrival.

We performed an evaluation to determine the effectiveness of TVA's quality management process for the CCT expansion project. Specifically, our objective was to evaluate whether TVA's quality management process for the CCT expansion project was accomplished in a manner to achieve compliance with quality objectives and acceptance criteria.

[i] Simple cycle systems consume natural gas in a single conversion system, such as a combustion turbine.

Evaluation 2023-17463 – Quality Management of the Colbert Combustion Turbine Expansion Project

EXECUTIVE SUMMARY

What the OIG Found

We determined quality management was accomplished by the EPC contractor in a manner to achieve compliance with quality objectives and acceptance criteria. Specifically, we (1) determined the EPC contractor's quality assurance (QA)/QC program included the elements required by TVA's Project Management Plan and (2) identified minimal risks in the EPC's QA/QC and turnover documentation. However, due to previously identified OEM related risks, we found TVA's oversight of the OEM's equipment during fabrication could have been improved.

What the OIG Recommends

We recommend the Senior Vice President, Generation Projects and Fleet Services, implement a process to determine the appropriate level of OEM oversight needed for future projects.

TVA Management's Comments

TVA management agreed there is an opportunity to do more oversight of OEMs and is working to add additional language to future contracts to provide clear expectations around on-site quality inspections. See the Appendix for TVA management's complete response.

Auditor's Response

We agree with TVA management's planned action.

BACKGROUND

In August 2019, the Tennessee Valley Authority (TVA) Board of Directors granted approval for 1,500 megawatts of peaking gas replacement capacity at a total cost of just over $1 billion. In December 2020, TVA signed a fixed price engineering, procurement, and construction (EPC) contract for six new simple cycle[1] combustion turbines: three at TVA's Paradise reservation in Muhlenberg County, Kentucky, and three at TVA's Colbert reservation in Colbert County, Alabama. Construction activities began at Colbert in the summer of 2021 and commercial operation began in July 2023. Major Projects, a department within the Chief Operating Office's Generation Projects and Fleet Services organization, was responsible for management of the project. In their role, Major Projects provides support with front end project and site development, selection and oversight of the EPC contractor, and support for system turnovers, among other things.

TVA's Standard Programs and Processes 34.000, *Project Management*, provides the minimum requirements and guidance to enhance the probability for project success, which is measured by safely completing projects on budget and on schedule. One recommended project management functional area is quality management, which is used to provide confidence that activities affecting quality are accomplished in a manner that achieves compliance with preestablished objectives and criteria. This includes the responsibilities of the project manager and project quality team.[2]

For the Colbert Combustion Turbine (CCT) expansion project, TVA delegated quality management to the EPC contractor. The EPC contract required the EPC contractor to have a documented quality control (QC) program acceptable to TVA for all work, including (1) control of subcontractors and suppliers, (2) measuring and testing equipment, and (3) internal and supplier verification and reporting processes, among other things. The EPC contractor's quality assurance (QA) and QC program included inspection and test plans to satisfy defined quality standards. The inspection and test plans include descriptions of (1) testing activities and applicable acceptance criteria, (2) documents generated during the scope of work, and (3) points where work should be inspected, witnessed, or held until authorized to proceed, among other things. The QA/QC program also refers to quality verification documents, which documents evidence that a product met the requirements of respective technical specifications. The EPC contractor's responsibilities included inspecting equipment from the original equipment manufacturer (OEM) and verifying quality once it was delivered to the CCT site. The OEM was primarily responsible for the quality of the equipment during fabrication prior to site arrival. The EPC contractor uses condition reports

[1] Simple cycle systems consume natural gas in a single conversion system, such as a combustion turbine.

[2] In November 2023, TVA revised Standard Programs and Processes 34.000, *Project Management.* Projects comparable in cost and complexity to the CCT expansion will now require (1) a quality management plan, (2) a quality audit procedure, and (3) quality hold points.

that are used to document conditions adverse to quality, resolve any current issues, and improve future results.

The contract provides that TVA may monitor the performance of the contractor, subcontractors, and suppliers with inspections and audits in order to determine compliance with various items, including product quality. TVA, in its oversight role, was responsible for ensuring contractors perform QA/QC in compliance with the contract and project-specific QA/QC plans.

The Project Management Institute is a global, nonprofit, project management membership organization that creates industry standards for project management, including the Project Management Body of Knowledge (PMBOK®). The PMBOK® outlines project management principles, such as those related to building quality into processes and deliverables. Guidance included in the PMBOK® pertains to methods for implementing quality management practices and activities, such as development of a quality management plan. Additional guidance includes methods for determining investment in quality prevention, such as utilizing cost of quality (COQ) methodology. COQ methodology considers all costs incurred over the life of the project to determine optimization of costs for a project or a single element of a project, such as a supplier.[3]

We performed this evaluation to determine the effectiveness of TVA's quality management process for the CCT expansion project.

OBJECTIVE, SCOPE, AND METHODOLOGY

The objective of this evaluation was to evaluate whether TVA's quality management process for the CCT expansion project was accomplished in a manner to achieve compliance with quality objectives and acceptance criteria. To complete the evaluation, we:

- Reviewed the Project Management Institute's PMBOK® (7th edition) to identify project management principles related to quality management.
- Reviewed TVA's contract and associated amendments with the EPC contractor, to identify contractually required quality management activities.
- Reviewed TVA's contract and associated amendments with an OEM to identify commitments between the OEM and TVA.
- Reviewed Major Projects' project management plan (PMP) for the CCT expansion to determine TVA's approach to managing the project specifically related to quality.
- Reviewed the EPC contractor's project quality manual (PQM), project execution plan (which describes how the contractor will manage and perform

[3] Determination of COQ includes costs spent on the front end to prevent quality issues and costs experienced on the back end when quality issues are identified. Optimization of these costs occur when the total cost to prevent quality concerns and the costs to remedy quality issues is as small as possible.

the work), and project-specific quality plan to identify the contractor's overarching approach to quality management.

- Visited the CCT site to gain further understanding of the expansion project.
- Conducted interviews with responsible TVA annual and managed task personnel, as well as EPC contractor staff to gain an understanding of the quality management activities of the expansion project.
- Obtained and reviewed evidence of TVA oversight of construction activities.
- Obtained the EPC contractor's inspection and test plans for various scopes of work at the CCT expansion to identify detailed quality management activities planned for the project.
- Selected a nonstatistical sample of 15 turnover packages, which are used in the transfer of systems from construction to operations, and compared the associated quality verification documents to the EPC contractor's project turnover plan to determine whether quality verification documents were completed.
- Examined evidence of factory acceptance testing for certain major components.
- Examined TVA lessons learned for the CCT expansion project, as of November 16, 2023, to identify any lessons learned related to quality.
- Consulted with Supply Chain personnel regarding contractor payments and warranty information.
- Examined condition reports entered into Maximo between July 25, 2023, the date of provisional acceptance, and January 20, 2024, to identify potential warranty issues.
- Examined documentation related to OEM incentives pertaining to meeting early provisional acceptance.
- Compared punch lists[4] in 60 system turnover packages to the final project punch list to determine if there were any exceptions.
- Reviewed TVA Standard Programs and Processes 34.000, *Project Management*, to gain an understanding of requirements and/or guidance for project and quality management.
- Reviewed Power Operation's Engineering Guidance Document 34.001, *Project Turnover Process Guidance,* to gain an understanding of the project turnover process.

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

[4] According to the Power Operation's Engineering Guidance Document 34.001, *Project Turnover Process Guidance*, punch lists capture items that have not been completed by the contractor to the satisfaction of TVA.

FINDINGS

We determined quality management was accomplished by the EPC contractor in a manner to achieve compliance with quality objectives and acceptance criteria. Specifically, we (1) determined the EPC contractor's QA/QC program included the elements required by TVA's PMP and (2) identified minimal risks in the EPC's QA/QC and turnover documentation. However, due to previously identified OEM related risks, we found TVA's oversight of the OEM's equipment during fabrication could have been improved.

EPC CONTRACTOR QUALITY PROGRAM

We determined the EPC Quality Program was established and executed to meet quality objectives. According to the EPC contract, the EPC contractor was required to have a documented QC program acceptable to TVA for all work. We obtained and reviewed the EPC contractor's PQM to understand the EPC contractor's quality management program. The purpose of this PQM was to confirm that project execution was performed to address drawings, specifications, codes, and applicable local, state, and federal standards. It also included an overview of the (1) project organization and responsibilities, (2) PQM documents, (3) condition reporting, and (4) turnover requirements, among other things related to the EPC's quality program. We noted the PQM outlined the process for how the EPC contractor would perform quality management, including inspection and testing, and oversight of subcontractor work execution. It also included the project quality procedures required to support the PQM.

Although quality management was delegated to the EPC contractor, TVA developed a PMP for the CCT expansion that defined certain elements that the EPC contractor's project-specific QA/QC plans should include or address. These elements included, but were not limited to (1) adhering to applicable industry requirements and standards, (2) identifying specific hold points, (3) specifying QA/QC to be performed, and (4) addressing QA/QC activities during the manufacturing process or factory component assembly and testing. We compared the EPC contractor's PQM to the PMP to verify all elements related to the QA/QC plans outlined in the PMP were included and identified no exceptions. We also confirmed that some of these elements were included in other documentation such as the EPC contractor's Project Execution Plan and QA/QC plans.

In addition, we obtained evidence of inspections and factory acceptance testing and performed a limited review of those documents. Specifically, we (1) found quality verification documents were generally included in turnover packages, and (2) confirmed factory acceptance testing was performed for 12 pieces of equipment. We also reviewed a September 2022 project health review provided by the project manager that stated, (1) they had indications that hold points were being utilized, (2) shop inspections of an OEM were being performed, and (3) a third-party review for specific generator transformers was conducted.

While we identified minimal concerns with QA/QC as performed by the EPC contractor, TVA personnel indicated concerns with the quality of equipment from an OEM. The EPC contractor was responsible for inspecting equipment and verifying quality once it was delivered to the CCT site, while the OEM was primarily responsible for the quality of the equipment during fabrication. We confirmed 158 entries in the EPC contractor's condition report log, several of which were related to the OEM, were closed, indicating issues related to the OEM equipment was documented during installation.

TVA QUALITY OVERSIGHT

Based on our review of project quality documentation, including witnessing of tests, TVA project personnel communication, and photographs, we determined oversight of the EPC was sufficient, but oversight of the OEM could have been improved. The PMP described how TVA, in its oversight role, will ensure that contractors perform QA/QC in compliance with the contract and project-specific QA/QC plans. To assess the oversight provided by TVA and managed task personnel, we requested documentation and received evidence of TVA's involvement in addressing issues identified during inspections. We also obtained records from TVA and managed task personnel that documented tests witnessed and indicated system walkdowns were performed.

In addition, we examined 12 lessons learned provided by TVA for the CCT expansion project and found TVA managed task personnel had identified a quality issue related to missing QA/QC hold points. When asked about the circumstances around this lesson learned, the TVA site construction manager indicated the EPC quality program contained hold points. Not all hold points were assigned to TVA personnel for review and signoff; however, the site construction manager indicated that TVA corrected the issues.

While we identified evidence of TVA's oversight of the EPC, we found issues with oversight of an OEM on the project. TVA's PMP established TVA's responsibility for oversight of the EPC contractor and suppliers. It states that Generation Projects and Fleet Services' QA requirements directly apply to suppliers, such as the OEM. While the EPC contractor was responsible for inspecting equipment and verifying quality once it was delivered to the CCT site, the OEM was primarily responsible for the quality of the equipment during fabrication.

According to the project manager, TVA performed some factory acceptance testing of the supplier equipment, but relies on suppliers to "do what is right." The project manager also indicated they did not establish quality metrics or perform any additional quality audits or reviews of the OEM, which could have assisted in mitigating the quality risk. The EPC provided TVA a report in August 2023 stating there were deficiencies and quality issues with the OEM. In addition, a TVA employee involved in the CCT expansion stated the site had more issues than expected with the equipment from the OEM, including software issues and small component failures that led to forced outages. There was also a warranty issue with the OEM soon after turnover, according to the site

manager. We identified 53 condition reports associated with the expansion project after provisional acceptance and 25 were quality issues related to the OEM. While warranties are designed to protect the recipient from receiving an item that contains a manufacturing defect, identifying issues earlier in the process can help ensure TVA receives quality equipment.

TVA has previously recognized risk with this particular OEM. In January 2021, prior to the CCT expansion construction start date, TVA's Corporate Credit and Insurance group identified credit risks and indicated concerns with performance of this OEM, which could impact product quality. According to Corporate Credit and Insurance personnel, letters of credit were obtained to secure the OEM's contractual obligations. Further, TVA's Power Operations organization, the asset owner for the finished CCT expansion project, has included a risk in its enterprise risk documentation, which includes this OEM since fiscal year 2021. Specifically, Power Operations noted the risk involved the quality of critical equipment and financial health of OEMs, including the OEM for the CCT expansion project.

The number of issues identified with the OEM equipment after construction raises concerns about the overall quality of the equipment provided. Previously identified risk related to the OEM for the CCT expansion project should have triggered additional oversight activities, such as development and evaluation of metrics, more TVA inspections, and/or implementation of quality audits or reviews, instead of relying on the vendor. Determining the appropriate level of oversight, such as using the COQ methodology discussed previously, can help prevent quality issues and ensure TVA receives quality equipment.

RECOMMENDATION

We recommend the Senior Vice President, Generation Projects and Fleet Services, implement a process to determine the appropriate level of OEM oversight needed for future projects.

TVA Management's Comments – TVA management agreed there is an opportunity to do more oversight of OEMs and are taking actions to address the recommendation. Specifically, Major Projects is working with Supply Chain to add additional language to future contracts to provide clear expectations around on-site quality inspections. TVA will generally use a risk-based approach in determining when to conduct factory inspections. See the Appendix for TVA management's complete response.

Auditor's Response – We agree with TVA management's planned action.

TENNESSEE VALLEY AUTHORITY

1101 Market Street, Chattanooga, Tennessee 37402

May 10, 2024

Mr. David P. Wheeler
Assistant Inspector General
Office of Inspector General
400 West Summit Hill Drive
Knoxville, Tennessee 37902

Dear Mr. Wheeler:

COMMENTS - DRAFT EVALUATION - 2023 -17463 - QUALITY MANAGEMENT OF THE COLBERT COMBUSTION TURBINE EXPANSION PROJECT

Thank you for the evaluation and opportunity to provide comments. I agree with the OIG that TVA has the opportunity to do more oversight to ensure OEMs are fully compliant with agreed upon quality management programs.

The Major Projects team is working with Supply Chain to add additional language to future contracts to provide clear expectations around onsite quality inspections. This language is currently in draft form and is presented below:

"*TVA may elect, at its sole discretion, to perform periodic factory visits before and after factory acceptance testing / or fabrication of components to inspect quality related operations which might result in defects which could cause quality issues upon delivery of components to TVA. Inspections may be scheduled or not and TVA or its third party inspector will be given access where safe and appropriate.*"

We believe that TVA will generally use a risk-based approach in determining when to conduct factory inspections, where components that could cause significant project schedule impacts, if defective upon delivery, would be inspected more frequently.

Thank you again for the opportunity to review and provide comments to this report.

Sincerely,

R. Bryan Williams
Senior Vice President
Generation Projects & Fleet Services