



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

July 13, 2022

Robert J. Duncan

**REQUEST FOR FINAL ACTION – EVALUATION 2021-17270 – GROUNDWATER AT TVA NUCLEAR PLANTS**

The Tennessee Valley Authority (TVA) operates three nuclear plants capable of generating 7,800 megawatts of electricity. Groundwater contamination can result from routine nuclear plant activities such as wet storage of spent fuel, leaks from liquid waste pipelines and tanks, and leaks of contaminated cooling water. TVA Nuclear Power Group (NPG) Standard Programs and Processes (SPP) 05.15, *Fleet Groundwater Protection Program*, establishes a long-term groundwater-monitoring program with the purpose of minimizing the potential for inadvertent releases to the environment from plant activities. Due to risks associated with potential groundwater contamination, we performed an evaluation to determine if TVA Nuclear has taken actions to address issues related to groundwater at nuclear plants, identified during fiscal years (FY) 2017 through 2021, in internal assessments, external assessments, consultant reports, and condition reports (CR).<sup>1</sup>

We determined TVA Nuclear has taken actions, or no further actions were needed, to address the majority of issues and/or recommendations made. However, two recommendations from 2015 have not been addressed and likely affected TVA's corporate insurance premiums.<sup>2</sup>

We recommend the Senior Vice President, Engineering and Operations Support, complete actions to address long-standing groundwater recommendations.

In response to our draft report, TVA management agreed with our recommendation and stated immediate corrective actions have been taken and other actions are in progress to fully address the two recommendations from 2015. See the Appendix for TVA management's complete response.

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<sup>1</sup> A CR is a mechanism used to document an issue (undesired condition, problem, or concern) raised by personnel.

<sup>2</sup> Although the recommendations were originally made in 2015, they were also included in reports issued from FY 2017 through 2021.

## **BACKGROUND**

TVA operates three nuclear plants capable of generating 7,800 megawatts of electricity. Groundwater contamination can result from routine nuclear plant activities such as wet storage of spent fuel, leaks from liquid waste pipelines and tanks, and leaks of contaminated cooling water. Water containing tritium and other radioactive materials is normally released from nuclear power plants under controlled, monitored conditions the Nuclear Regulatory Commission mandates to protect public health and safety. NPG-SPP-05.15 implements the requirements specified in Nuclear Energy Institute<sup>3</sup> 07-07, Industry Groundwater Protection Initiative – Final Guidance Document, Revision 1. The SPP establishes a long-term groundwater-monitoring program with the purpose of minimizing the potential for inadvertent releases to the environment from plant activities. The primary elements of the groundwater protection program are prevention, early detection, and mitigation of impacts associated with potential subsurface and/or groundwater contamination. The American Nuclear Insurers (ANI), Nuclear Energy Institute, Electric Power Research Institute (EPRI),<sup>4</sup> Nuclear Regulatory Commission, and others, conduct periodic reviews, self-assessments, and audits of TVA's groundwater protection program. NPG-SPP-05.15 requires addressing issues identified during those reviews.

ANI is a joint underwriting association that acts on behalf of member companies. ANI writes nuclear liability insurance for nuclear facilities in the United States. ANI's Engineering Ratings Factor (ERF) program is used to redistribute the nuclear liability insurance premium according to ANI's perception of risk. ERF has multiple subfactors, one of which is ANI rated liability recommendations. ERF is computed annually and uses the most recent 3 years of data. The ERF subfactors have varying impacts on the rating and ultimately TVA's insurance premiums.

Due to risks associated with potential groundwater contamination, we performed an evaluation of groundwater at TVA nuclear plants.

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

The objective of this evaluation was to determine if TVA Nuclear has taken actions to address issues identified and/or recommendations made related to groundwater at nuclear plants. The scope of our evaluation included internal assessments, external assessments, consultant reports, and CRs from FY 2017 through 2021. To achieve our objective, we:

- Reviewed internal, external, and consultant reports<sup>5</sup> related to nuclear groundwater and identified 120 issues and recommendations.

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<sup>3</sup> The Nuclear Energy Institute is the policy organization of the nuclear technologies industry.

<sup>4</sup> EPRI conducts research, development, and demonstration projects for the benefit of the public in the United States and internationally. EPRI focuses electricity generation, delivery, and use in collaboration with the electricity sector to enhance the quality of life by making electric power safe, reliable, affordable, and environmentally responsible.

<sup>5</sup> Examples of reports reviewed include ANI inspections, TVA Quality Assurance assessments, EPRI self-assessments, Site Risk Analysis for Systems, Structures and Components, and peer-review reports.

- Reviewed associated CRs and work orders<sup>6</sup> from Maximo (TVA's work management system) and interviewed nuclear-site personnel to determine if actions were taken for the 120 identified issues and/or recommendations.
- We judgmentally selected 20 of 111 CRs<sup>7</sup> related to leaks or possible groundwater contamination at nuclear plants, to determine if actions were taken.

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

## **FINDINGS**

We determined TVA Nuclear has taken actions, or no further actions were needed, to address the majority of issues identified in internal assessments, external assessments, consultant reports, and CRs related to groundwater at nuclear plants. Specifically, we determined actions had been taken, or no further actions were needed, for 89 of 120 issues and recommendations identified in internal, external, or consultant reports reviewed. Of the remaining 31 issues and/or recommendations, 30 have actions planned, or in progress, which have not exceeded the scheduled finish date in Maximo.<sup>8</sup> However, the two oldest recommendations have been open since 2015 and likely affected TVA corporate insurance premiums.

- Sequoyah Nuclear Plant (SQN) ANI LR 15-02 recommended TVA establish a spent fuel pool tell-tale<sup>9</sup> drain-monitoring program. In 2021, ANI found no forward progress had been made on related CRs to address the recommendation and stated the open recommendation is reflected in ANI's ERF program. A TVA Corporate Insurance employee stated that generally there is a \$40,000 to \$90,000 increase to premiums annually for a recommendation factored into the ERF. The scheduled finished date, according to the CR related to this recommendation, is November 2022.
- WBN ANI LR 15-01 recommended TVA establish a formal inspection program for performing internal tank inspections on refuel water tanks. TVA created CRs in 2015 and 2016 to address the issue; however, the actions taken did not resolve ANI's concern. ANI currently classifies the recommendation as pending<sup>10</sup> and it is not impacting WBN's ERF at this time, but did in 2020. According to TVA Corporate Insurance, this change occurred because of TVA's higher level of engagement with ANI on the issue and additional responses provided by TVA. While it is not currently impacting WBN's ERF, it could in the future if not addressed. According to WBN Site

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<sup>6</sup> A work order is a record that requests maintenance or modifications activities be performed.

<sup>7</sup> We initially identified 263 CRs based on a keyword search. We then removed CRs (1) deemed not relevant to the project and (2) related to internal, external, and consultant reports already identified.

<sup>8</sup> As a result of our evaluation, TVA Nuclear issued a draft CR, on June 3, 2022, to address the Watts Bar Nuclear Plant (WBN) ANI liability recommendation (LR) 15-01.

<sup>9</sup> According to a TVA system engineer, a tell-tale drain is a valve and associated drain line used to indicate if there is a leak.

<sup>10</sup> According to a TVA Corporate Insurance employee, pending refers to a recommendation that, while not rising to the level of "rated" in ANI's current view, it could be in the future based on changing conditions/situations or TVA responses/actions taken (or not taken) with regard to the recommendation.

Licensing, this activity will not be performed until after 2025 as part of the WBN Unit 1 license renewal.

In addition, we determined actions had been taken, or no further actions were needed, for 18 of the 20 CRs related to leaks or possible groundwater contamination at nuclear plants we reviewed. The 2 remaining CRs are still in progress or have work orders to address them and have not exceeded the scheduled finish date in Maximo.

### **RECOMMENDATION**

We recommend the Senior Vice President, Engineering and Operations Support, complete actions to address the long-standing ANI liability recommendations.

**TVA Management's Comments** – In response to our draft report, TVA management agreed with our recommendation and stated actions were implemented immediately or are in progress to address the ANI liability recommendations. Specifically, management stated immediate actions have been taken to implement additional sampling criteria and improve record management of tracking tell-tale leak rates at SQN. Additionally, for SQN ANI Liability Recommendation 15-02, TVA will develop guidance documentation and perform an extent of condition of tell-tale monitoring. Regarding WBN ANI Liability Recommendation 15-01, TVA will continue to seek a mutual understanding of best practices for tank inspection and make a final decision to perform internal tank inspections.

**Auditor's Response** – We concur with TVA's planned actions for the recommendation.

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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 the report issuance.

If you have any questions or wish to discuss our observations, please contact Kristin S. Leach, Senior Auditor, at (423) 785-4818 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)

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cc: TVA Board of Directors  
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OIG File No. 2021-17270



Tennessee Valley Authority, 1101 Market Street, Chattanooga, Tennessee 37402

July 6, 2022

David P. Wheeler – WT 2C-K

**RESPONSE TO REQUEST FOR COMMENTS OIG – 2021-17270 - GROUNDWATER AT TVA NUCLEAR PLANTS**

Tennessee Valley Authority (TVA) Nuclear appreciates the efforts taken by the audit team in conducting this groundwater evaluation. The TVA Nuclear enterprise values the feedback and agrees with the recommendations provided in this report to ensure sustained margin from the vulnerabilities associated to the groundwater program with American Nuclear Insurer's (ANI) assessments. Actions are in progress to fully address the ANI liability recommendations, as described below, and immediate actions were implemented to address the recommendations:

**ANI Liability Recommendation 1:**

Sequoyah Nuclear Plant (SQN) ANI Liability Recommendation 15-02 recommended TVA establish a spent fuel pool tell-tale drain monitoring program. In 2021, ANI found no forward progress had been made on related Condition Reports (CR) to address the recommendation and stated the open recommendation is reflected in ANI's Engineering Rating Factor (ERF) program. The TVA Corporate Insurance referenced that generally there is a \$40,000 to \$90,000 increase to annual premiums for recommendation factored into the ERF. The scheduled finish date, according to the CR related to this recommendation, is November 2023.

**Management Actions to Address:**

Actions to address the recommendation are set forth in CR 1718645 with an expected resolution by December 30<sup>th</sup>, 2022. The resolution of the action in December will satisfy ANI's concerns prior to the next assessment in late January of 2023. The actions included in the CR are as follows:

- Develop an Overall Procedural Guidance Document on the Fuel Transfer Canal/Spent Fuel Pool/ and Cold Leg Accumulator (FTC/SFP/CLA) Liner Leakage Tell-Tale System.
- SQN personnel will create a formal program or guidance document similar to the Davis Besse "Leak Chase Monitoring Program document" (NG-EN-00387) for the monitoring of SQN's FTC/SFP/CLA tell-tale drains and the surrounding concrete structure. This provides a single reference that gathers together the site's response to this tell-tale leakage and references other site procedures that deal with aspects of the issue. The program includes the establishment of a cross-disciplinary team to periodically meet and evaluate and ensure SQN personnel

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understand any potential problems with the SFP liner and/or concrete structure around the FTC/SFP/CLA including potential discharge points or potential release to the environment. Flow rate and critical chemistry parameters from the SFP tell-tale drain system will be used as a monitoring tool by engineering and groundwater personnel to determine the integrity of the spent fuel pool, transfer canal, and underlying structures. Consideration for any additional actions or chemistry analyses during SFP and transfer canal operations during refueling outages are included.

- The program includes the identification of the appropriate stakeholders for such a team (e.g., civil engineering, chemistry, environmental, and/or system engineering).
- TVA Nuclear Engineering will perform an extent of condition and incorporate the lessons learned of tell-tale monitoring associated with the groundwater program in the nuclear fleet by November 18th, 2023.

**Immediate corrective actions taken:**

- Implemented additional sampling criteria, such as iron monitoring, to better understand material degradation via the tell-tale drains in accordance with 0-TI-CEM-000-005.0 (Groundwater Monitoring and Sampling) - CR 1718638.
- Improved record management of tracking tell-tale leak rates into station chemistry's database (Nuclear IQ) to strengthen collaboration on monitoring between chemistry and engineering, CR 1718652.

**ANI Liability Recommendation 2:**

Watts Bar Nuclear Plant (WBN) ANI Liability Recommendation 15-01 recommended TVA Nuclear establish a formal inspection program for performing internal tank inspections on refueling water tanks. TVA Nuclear created condition reports in 2015 and 2016 to address the issue; however, the actions taken did not resolve ANI's concern. ANI currently classifies the recommendation as pending and it is not impacting WBN's ERF at this time but did in 2020. According to TVA Corporate Insurance, this change occurred because of TVA's higher level of engagement with ANI on the issue and additional responses provided by TVA. While it is not currently impacting WBN's ERF, it could in the future if not addressed. According to WBN Site Licensing, this activity is not currently scheduled until after 2025 as part of the WBN Unit 1 License renewal.

**Management Actions to Address:**

TVA Nuclear will continue to seek a mutual understanding of best practices for tank inspections and make a final decision to perform internal tank inspections by October 1, 2023. TVA Nuclear

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has performed external tank inspections which would identify the most probable degradation mechanisms per industry operating experience in accordance with Nuclear Regulatory information notice 2013-18. This reduces the risk of ground water to an acceptable risk level. For example, interim actions have been implemented and managed with six (6) preventative maintenance opportunities that visually inspect the subject tank piping, connections, and the welds at the tank wall to floor plate and the grout base to floor plate for any evidence of appreciable signs of degradation.

The TVA license renewal team, by process, will evaluate longer term risk, such as refueling water storage tank integrity, and determine needed inspections for life extension. Currently, internal inspections present mid to low with a high cost of internal inspection (~1 million dollars/inspection).

Forward any questions on responses to recommendation 1 and 2, to James A. Cross, 423.751.2359 / [jacross@tva.gov](mailto:jacross@tva.gov).

Sincerely,



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