



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D.C. 20555-0001

September 28, 2022

Mr. James Barstow  
Vice President, Nuclear Regulatory  
Affairs and Support Services  
Tennessee Valley Authority  
1101 Market Street  
Chattanooga, TN 37402-2801

SUBJECT: SEQUOYAH NUCLEAR PLANT, UNITS 1 AND 2 – SUMMARY OF  
REGULATORY AUDIT FOR ALTERNATIVE REQUEST RV-02  
(EPID L-2021-LLR-0034)

Dear Mr. Barstow:

By letter dated March 15, 2022 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML22074A315), as supplemented by a letter dated June 28, 2022 (ML22179A357), Tennessee Valley Authority (TVA) submitted Alternative Request RV-02 to the U.S. Nuclear Regulatory Commission (NRC) for authorization under paragraph (z)(2) in Section 50.55a of Title 10 of the *Code of Federal Regulations* (10 CFR 50.55a(z)(2)) to implement an alternative to the Inservice Testing (IST) Program requirements specified in the American Society of Mechanical Engineers (ASME) *Code for Operation and Maintenance of Nuclear Power Plants* (OM Code), 2004 Edition through the 2006 Addenda, as incorporated by reference in 10 CFR 50.55a for specific pressure isolation valves (PIVs) at Sequoyah Nuclear Plant (Sequoyah), Units 1 and 2.

In the letter dated June 28, 2022, TVA indicated that a technical evaluation with specific stress calculations had been developed for the use of Alternative Request RV-02 at Sequoyah. To support its review of the request, the NRC staff conducted a virtual regulatory audit from August 10, 2022, through August 15, 2022, of the TVA technical evaluation. During the regulatory audit, the NRC staff reviewed the TVA technical evaluation and held discussions with members of TVA and its representatives. The regulatory audit summary is enclosed with this letter.

J. Barstow

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If you have any questions, please contact me at (301) 415-1383 or [Perry.Buckberg@nrc.gov](mailto:Perry.Buckberg@nrc.gov).

Sincerely,

***/RA – K. Green for/***

Perry H. Buckberg, Senior Project Manager  
Plant Licensing Branch II-2  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

Docket Nos. 50-327 and 50-328

Enclosure:  
Regulatory Audit Summary

cc: Listserv

OFFICE OF NUCLEAR REACTOR REGULATION

REGULATORY AUDIT SUMMARY

IN SUPPORT OF NRC REVIEW OF ALTERNATIVE REQUEST RV-02

TENNESSEE VALLEY AUTHORITY

SEQUOYAH NUCLEAR PLANT, UNITS 1 AND 2

DOCKET NOS. 50-327 AND 50-328

EPID L-2022-LLR-0034

1.0 BACKGROUND

By letter dated March 15, 2022 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML22074A315), as supplemented by a letter dated June 28, 2022 (ML22179A357), Tennessee Valley Authority (TVA) submitted Alternative Request RV-02 to the U.S. Nuclear Regulatory Commission (NRC) for authorization under paragraph (z)(2) in Section 50.55a of Title 10 of the *Code of Federal Regulations* (10 CFR 50.55a(z)(2)) to implement an alternative to the Inservice Testing (IST) Program requirements specified in the American Society of Mechanical Engineers (ASME) *Code for Operation and Maintenance of Nuclear Power Plants* (OM Code), as incorporated by reference in 10 CFR 50.55a, for specific pressure isolation valves (PIVs) at Sequoyah Nuclear Plant, Units 1 and 2 (Sequoyah Units 1 and 2). This request would apply for the remainder of the Fourth 10-Year IST Program interval at Sequoyah Units 1 and 2, with the current OM Code of record as the 2004 Edition through the 2006 Edition of the ASME OM Code, as incorporated by reference in 10 CFR 50.55a.

As described by TVA in its March 15, 2022, submittal, the proposed Sequoyah Alternative Request RV-02 would permit continued plant startup if a PIV within the scope of the request that failed its leakage test could be demonstrated to have acceptable seat leakage following mechanical agitation. The PIV would only be acceptable for normal operation for one refueling cycle and only if the final PIV seat leakage met the Technical Specification (TS) leakage criteria. This alternative would apply to the requirements of ASME OM Code, Subsection ISTC, "Inservice Testing of Valves in Light-Water Reactor Nuclear Power Plants," as incorporated by reference in 10 CFR 50.55a, in the following paragraphs: (1) ISTC-3630 as related to the use of additional closing force to achieve PIV closure before seat leakage testing, (2) ISTC-3630(f) as related to corrective action following a failed seat leakage test, (3) ISTC-5221(a)(1) as related to demonstrating that a PIV check valve disk will travel to its seat following cessation of flow, and (4) ISTC-5224 as related to retesting following any required corrective action before the valve is returned to service.

In responding to a request for additional information (RAI) in its supplement dated June 28, 2022, TVA stated that a technical evaluation had been developed for performing mechanical agitation on PIVs in support of Alternative Request RV-02. After reviewing the licensee's submittal and supplement, the NRC staff identified the need to review the specific calculations in the TVA technical evaluation supporting the proposed mechanical agitation process to complete its review of Sequoyah Alternative Request RV-02.

Enclosure

Information that the NRC staff relies upon to make the safety determination must be submitted on the docket. However, the NRC staff may review supporting information retained as records under 10 CFR 50.71 and/or 10 CFR 54.37, which, although not required to be submitted as part of the licensing action, would help the NRC staff better understand the licensee's submitted information. To support its review of the request, the NRC staff issued a regulatory audit plan on August 9, 2022 (ML22220A107). The purpose of the audit was to review the documentation related to the subject of Alternative Request RV-02 (e.g., calculations, technical evaluation, and reports) that were not submitted on the Sequoyah docket, to acquire additional understanding about the alternative request, and to determine whether additional information is needed to be docketed to complete the NRC staff's safety evaluation.

## 2.0 AUDIT ACTIVITIES

The NRC audit team established to review Sequoyah Alternative Request RV-02 consisted of the NRC staff members listed in the attachment to this audit summary. The TVA personnel interacting with the NRC staff during the audit are also listed in the attachment. The NRC audit team held a virtual entrance meeting for the regulatory audit with the licensee on August 11, 2022, and conducted the audit through August 15, 2022. In addition to reviewing documents submitted by TVA on the docket, the NRC audit team reviewed non-docketed information related to Sequoyah Alternative Request RV-02 that was made available by TVA through an internet-based portal.

During the audit videoconference with TVA personnel on August 11, 2022, the NRC audit team discussed the non-docketed information in the TVA electronic portal and provided audit questions to the TVA (ML22224A035). On August 15, 2022, the NRC audit team conducted another videoconference with TVA personnel to facilitate the technical discussions of the NRC staff questions according to the audit plan. The technical discussions were focused on the details of the mechanical agitation process to be applied to the PIVs within the scope of Alternative Request RV-02, and the calculations of the stress induced in the valve body and load on the valve body resulting from mechanical agitation of the applicable PIVs.

At the conclusion of the August 15, 2022, videoconference the NRC staff conducted a virtual exit meeting for the audit to provide a brief conclusion of the formal, virtual audit, including the audit objectives that were met and details on the path forward. There were no open items from audit discussions and no deviations from the audit plan.

## 3.0 TVA DOCUMENTS

The TVA documents reviewed by the NRC staff as part of this audit are as follows:

TVA Engineering Work Request EWR No. 22-DEC-063-050 (dated June 14, 2022), "CNL-22-024 SQN PIV Relief Request – Mechanical Agitation Allowance," provided on TVA internet-based portal

TVA Letter (dated March 15, 2022), "Sequoyah Nuclear Plant, Units 1 and 2, American Society of Mechanical Engineers Operation and Maintenance Code, Request for Alternative RV-02"

TVA Letter (dated June 28, 2022), "Response to Request for Additional Information Regarding Sequoyah Nuclear Plant, Units 1 and 2, American Society of Mechanical

Engineers Operation and Maintenance Code, Request for Alternative RV-02 (EPID L-2022-LLR-0034)”

#### 4.0 AUDIT DETAILS

In its supplement dated June 28, 2022, to Sequoyah Alternative Request RV-02, TVA stated that it had developed a technical evaluation to formally document the guidance for performing mechanical agitation of the PIVs within the scope of the alternative request. In developing this evaluation, TVA researched industry precedents and obtained copies of other nuclear power plant procedures and engineering evaluations related to similar safety-related valves. TVA stated that the applicable procedures will be revised to incorporate the technical evaluation prior to performing any mechanical agitation of the Sequoyah PIVs within the scope of the alternative request.

In the supplement, TVA described the specific mechanical agitation process to be applied to the PIVs within the scope of Sequoyah Alternative Request RV-02 that was assessed in its technical evaluation. TVA specified the proposed mechanical agitation process as follows:

- Following the failure of a PIV to meet the Sequoyah Technical Specification (TS) and ASME OM Code leakage testing requirements, mechanical agitation will be used to assist in troubleshooting the PIV failure.
- Mechanical agitation of PIVs assists in ascertaining the condition of the valve seat. Prior to using mechanical agitation, obtain as-found test results and apply other measures, where possible, such as varying pressure or venting, to seat the check valve.
- Mechanical agitation of two-inch check valves may be performed by tapping the valve body using a five-pound (maximum) rubber mallet or soft-faced dead blow mallet swung at a maximum of approximately 30 degrees about the elbow, without excessive use of the body to accelerate the hammer head. The surface to be agitated will not include bolting or flanges. The valve will be visibly inspected prior to and after the mechanical agitation to ensure that no physical external damage to the check valve has occurred.
- Mechanical agitation of six-inch, eight-inch, and ten-inch check valves may be performed by tapping the valve body using a 15-pound (maximum) soft-faced dead blow mallet, rubber mallet, or against a block of wood with a ten-pound (maximum) steel mallet, swung approximately 120 degrees about the elbow, without excessive use of the body to accelerate the hammer head. The surface to be agitated will not include bolting or flanges. The valve will be visibly inspected prior to and after the mechanical agitation to ensure that no physical external damage to the check valve has occurred.
- The technical evaluation includes an analysis that provides a reasonable determination that the above mechanical agitation process will not create damage to the PIV.
- During the next refueling outage following application of the mechanical agitation, disassemble and inspect the valve for damage and determine if agitation caused any adverse effects on valve performance.

Based on the TVA description of its mechanical agitation process in Alternative Request RV-02 and its supplement, the NRC staff determined that an audit review of the TVA technical

evaluation was necessary to confirm that the calculations demonstrate that the proposed mechanical agitation method would be performed without damage to the PIVs within the scope of the request nor would the method endanger plant staff performing the mechanical agitation of the specified PIVs and the piping system. In response to the NRC staff's request to audit the technical evaluation supporting Alternative Request RV-02, TVA made available Engineering Work Request (EWR) No. 22-DEC-063-050 (dated June 14, 2022), "CNL-22-024 SQN PIV Relief Request – Mechanical Agitation Allowances," in its internet-based portal for NRC staff's review.

The EWR indicates that its purpose is to provide approved methods and limitations for performing mechanical agitation of the PIVs within the scope of Alternative Request RV-02. The EWR also provides information for (1) how the licensee will perform mechanical agitation, and (2) maintenance and testing procedures to control the mechanical agitation of the specified PIVs. To provide reasonable assurance that the mechanical agitation method will not damage the valve, the EWR calculates the induced impact force and localized stress using an equation for a pendulum. Based on Section 16.4 of Roark's Formulas for Stress and Strain (7<sup>th</sup> Edition), the EWR assumes that the stress resulting from impact of a falling body is twice the stress produced by its weight applied as a static load. Therefore, the EWR assumes that a load factor of 2 would be appropriate for the relatively low hammer velocity occurring during the mechanical agitation method. However, due to probable variations in the hammer velocity, the EWR doubles the final calculated impact force on the valve to produce a conservative result.

The EWR calculates the load applied by a 5-pound (lb) weight hammer for a 2-inch check valve, and by a 15-lb weight hammer for the 6-inch, 8-inch and 10-inch check valves within the scope of Alternative Request RV-02. To estimate the induced localized stress while ignoring any dampening effects, the EWR uses Roark, Table 11.2, Case 17, to calculate the stress in a circular flat plate using a radius of the valve length and thickness equal to valve minimum wall thickness with an applied force. The EWR assumes this case to be conservative because the valve body is tubular with varying thicknesses, and the unsupported length is less than that of the total valve length. The EWR predicts that the resulting stress on the valve body for both the 5-lb weight hammer and 15-lb weight hammer will be much lower than the allowable stress. The EWR asserts that the induced stresses will not exceed the previously evaluated seismic stresses and that any localized stresses will be minimal. The EWR determined that mechanical agitation of the valves within the scope of the request is not of sufficient force to mask other performance-related issues, such as gross misalignment of the disk or major warpage of the valve body.

The EWR asserts that the mechanical agitation process for the valves within the scope of Alternative Request RV-02 is acceptable with the specified requirements. For example, the EWR specifies that a 5-lb maximum soft-faced dead blow mallet or rubber mallet will be used to mechanically agitate the 2-inch check valves. For the 2-inch valve, the valve body will be tapped using the mallet that is swung at a 30-degree angle about the individual's elbow. The EWR specifies that a 15-lb maximum soft-faced dead blow mallet or rubber mallet, or a 15-lb max steel mallet against block of wood, will be used to mechanically agitate the 6-inch, 8-inch and 10-inch check valves. For the 6-inch, 8-inch, and 10-inch valves, the valve body will be tapped using the mallet that is swung at a 120-degree angle about the individual's elbow. The EWR specifies that excessive force to accelerate mallet head by the individual will not be allowed. The EWR requires that the swing be about the arm without excessive use of the body to accelerate the mallet head. The EWR emphasizes that valve bolting and flanges shall not be contacted. After the mechanical agitation, the EWR specifies that the valve body will be visually inspected to ensure that no physical damage due to mechanical agitation has occurred.

Based on its review of the EWR, the NRC staff provided the following audit questions to TVA during the audit videoconference on August 11, 2022:

1. The TVA technical evaluation (Engineering Work Request (ERW)) states that mechanical agitation shall not include bolting and flanges. Clarify the TVA plan to use mechanical agitation of the piping.
2. The ERW contact force calculation does not include the continuous force or load exerted on the valve body due to hydraulic pressure of the fluid in the system. Please clarify.
3. ERW Page 5 of 6 under "After" states, in part, that "Ensure satisfactory completion of surveillance test." Clarify if the TVA plan is to perform the ASME OM Code, Subsection ISTC, required test at this time.
4. On ERW page 4 of 6, the formula considers "a" as total length of the valve: (1) Clarify not using piping system with valve (with weight) and supported at both ends instead of using valve length and its weight; (2) explain neglecting pipe and valve vibration associated with mechanical agitation.
5. The ERW attached drawing shows 8" and 10" swing check valves (page 3 of Attachment 1) for the Salem plant. Clarify that this drawing is also applicable for TVA 8" and 10" valves.
6. Explain if any additional steps are being planned by the TVA evaluation based on lessons learned from similar issues at Salem, and Turkey point.
7. The ERW does not specify the check valve leakage (measurement) when TVA will use a mechanical agitator. Clarify if there is any range of leakage at which mechanical agitators plan to be used.
8. The ERW states that attached is the Engineering Evaluation from Salem that includes a table of valve types/sizes and methods/limitation for mechanical agitation used in Salem procedures. It also states that attached is the NRC inspection report where NRC witnesses these methodologies and reviewed procedures. Are these provided?
9. The ERW is not clear regarding the mallets (rubber, dead blow, or metal) used in the calculations for weight and applied forces, and used in the mechanical agitation process list of before, during, and after requirements.
10. In the ERW, the "before" list of mechanical agitation process requirements states that to prevent preconditioning, the as-found test results are obtained "or" the valve is declared inoperable. The purpose of the "or" in this sentence is not clear.
11. The ERW does not discuss the feedback process following disassembly and inspection to ensure that the continued use of the mechanical agitation process is acceptable.

During the audit videoconferences on August 11 and 15, 2022, the NRC audit team discussed with TVA personnel the specific provisions of Alternative Request RV-02, as supplemented. The NRC audit team also discussed with TVA personnel the approach assumed in the EWR for calculating the stress in the valve body and load on the body during the mechanical agitation as

described in the request, as supplemented. The NRC audit team independently evaluated the provisions of the request, as supplemented, and the stress calculations in the EWR technical evaluation.

During the audit videoconferences, TVA personnel clarified the following provisions of the mechanical agitation process for the NRC staff to better understand Alternative Request RV-02 as supplemented:

1. Mechanical agitation of the valves within the scope of Alternative Request RV-02 will be applied to the valve body and will not be applied directly to the piping.
2. The EWR excluded the continuous force or load exerted on the valve body from hydraulic pressure of the fluid in the system as a conservatism.
3. The EWR applied the mechanical agitation to the valve length rather than the entire unsupported pipe length. The evaluation applied a factor of 4 to accommodate vibration and other uncertainties as a conservatism.
4. In accordance with the EWR, the TVA procedures will specify the type and size of the mallet (rubber, dead blow, or metal) to be applied for each size of check valve to be mechanically agitated. For 2-inch check valves, the TVA procedures will specify that the mallet will be swung approximately 30 degrees about the elbow. For 6-, 8-, and 10-inch check valves, the TVA procedures will specify that the mallet will be swung approximately 120 degrees about the elbow. The TVA procedures will specify that excessive force shall not be used to accelerate the mallet head (such as using the individual's body to accelerate the mallet head).
5. The TVA procedures to be prepared to implement Alternative Request RV-02 will require that information from the disassembly and inspection of a check valve that underwent mechanical agitation will be evaluated as part of the Corrective Action Program to provide assurance of the continued adequacy of the mechanical agitation process.

TVA indicated that the mechanical agitation requirements listed in the TVA technical evaluation will be incorporated into plant procedures.

## 5.0 AUDIT CONCLUSION

Based on the audit review described above, including the clarifications provided by TVA, the NRC staff concludes that TVA does not need to further supplement Alternative Request RV-02.

Attachment:  
List of Participants



## List of Participants

### **U.S. Nuclear Regulatory Commission (NRC) Audit Team**

<u>Name</u>	<u>Title, Branch</u>
Buckberg, Perry	Senior Project Manager, NRR/DORL/LPL2-2
Bedi, Gurjendra	Mechanical Engineer, NRR/DEX/EMIB
Scarborough, Thomas	Senior Mechanical Engineer, NRR/DEX/EMIB
Tseng, Ian	Mechanical Engineer, NRR/DEX/EMIB
Bailey, Stewart	Branch Chief, NRR/DEX/EMIB
Smith, Stephen	Senior Safety and Plant Systems Engineer, NRR/DSS/STSB

### **Tennessee Valley Authority Team**

Wells, Russell  
Taylor, Andrew  
Ridgell, Earl  
Williams, Gordon  
Gowin, Mark  
Dang, Duke  
Skiba, Timothy  
Moon, Jason  
Haraway, Tyler  
Smith, Tyler  
Greene, Luke  
Hughes, Shawna  
Todd, James  
McNeil, Andrew

### **Acronyms:**

NRR – Office of Nuclear Reactor Regulation  
DORL – Division of Operating Reactor Licensing  
LPL2-2 – Plant Licensing Branch 2-2  
DEX – Division of Engineering and External Hazards  
EMIB – Mechanical Engineering and Inservice Testing Branch  
DSS – Division of Safety Systems  
STSB – Technical Specifications Branch

SUBJECT: SEQUOYAH NUCLEAR PLANT, UNITS 1 AND 2 – SUMMARY OF REGULATORY AUDIT FOR ALTERNATIVE REQUEST RV-02 (EPID L 2021 LLR 0034) DATED SEPTEMBER 28, 2022

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OFFICE	NRR/DORL/LPLII-2/PM	NRR/DORL/LPLII-2/LA	NRR/DEX/EMIB/BC	NRR/DORL/LPLII-2/BC
NAME	PBuckberg	RButler	SBailey (KHsu for)	DWrona
DATE	09/19/2022	09/23/2022	09/16/2022	09/27/2022
OFFICE	NRR/DORL/LPLII-2/PM			
NAME	PBuckberg (KGreen for)			
DATE	09/28/2022			

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