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

September 29, 2022

Mr. James Barstow
Vice President, Nuclear Regulatory Affairs
and Support Services
Tennessee Valley Authority
1101 Market Street, LP 4A-C
Chattanooga, TN 37402-2801

SUBJECT: SEQUOYAH NUCLEAR PLANT, UNITS 1 AND 2 – AUTHORIZATION OF ALTERNATIVE REQUEST RV-02 FOR PRESSURE ISOLATION VALVE SEAT LEAKAGE (EPID L-2022-LLR-0034)

Dear Mr. Barstow:

By letter dated March 15, 2022 (Agencywide Documents and Access Management System (ADAMS) Accession No. ML22074A315), as supplemented by a letter dated June 28, 2022 (ML22179A357), Tennessee Valley Authority (TVA, the licensee) submitted Alternative Request RV-02 to the U.S. Nuclear Regulatory Commission (NRC) related to certain Inservice Testing (IST) requirements in the American Society of Mechanical Engineers (ASME) *Code for Operation and Maintenance of Nuclear Power Plants* (OM Code), Section IST, "Rules for Inservice Testing of Light-Water Reactor Power Plants," for certain pressure isolation valves (PIVs) at Sequoyah Nuclear Plant (SQN), Units 1 and 2.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(z)(2)), TVA requested that the NRC authorize Alternative Request RV-02 for certain PIVs at SQN Units 1 and 2 on the basis that compliance with the ASME OM Code requirements would result in hardship or unusual difficulty without compensating increase in level of quality or safety.

The staff finds that the proposed alternative as specified in Sequoyah Alternative Request RV-02 will provide reasonable assurance of the operational readiness of the applicable PIVs until the next refueling outage when repair and replacement activities will be conducted, in light of the hardship caused by implementation of the applicable ASME OM Code requirements without a compensating increase in the level of quality and safety. The NRC staff has determined, as set forth in the enclosed safety evaluation, that TVA has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(z)(2) for Alternative Request RV-02. Therefore, the NRC staff authorizes the use of Alternative Request RV-02, as supplemented, at SQN Units 1 and 2 for the remainder of the Fourth 10-year IST Program interval, which is scheduled to end on June 30, 2026.

All other ASME OM Code requirements for which relief or an alternative was not specifically requested and approved as part of this request remain applicable.

Please direct any inquiries to Mr. Perry Buckberg at 301-415-1383 or Perry.Buckberg@nrc.gov.

Sincerely,

David J. Wrona

Digitally signed by David J. Wrona
Date: 2022.09.29 09:43:54 -04'00'

David J. Wrona, Chief
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-327 and 50-328

Enclosure:
Safety Evaluation

cc: Listserv

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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

FOR ALTERNATIVE REQUEST RV-02

RELATED TO FOURTH 10-YEAR INSERVICE TESTING PROGRAM INTERVAL

TENNESSEE VALLEY AUTHORITY

SEQUOYAH NUCLEAR PLANT, UNITS 1 AND 2

DOCKET NUMBERS 50-327 AND 50-328

EPID NO. L-2022-LLR-0034

1.0 INTRODUCTION

By letter dated March 15, 2022 (Agencywide Documents and Access Management System (ADAMS) Accession No. ML22074A315), as supplemented by letter dated June 28, 2022 (ML22179A357), Tennessee Valley Authority (TVA) submitted Alternative Request RV-02 to the U.S. Nuclear Regulatory Commission (NRC) related to certain Inservice Testing (IST) requirements in the American Society of Mechanical Engineers (ASME) *Code for Operation and Maintenance of Nuclear Power Plants* (OM Code), Section IST, "Rules for Inservice Testing of Light-Water Reactor Power Plants," for certain pressure isolation valves (PIVs) at Sequoyah Nuclear Plant (SQN), Units 1 and 2.

Pursuant to subparagraph (2) in paragraph (z) in Part 50 to Title 10 of the *Code of Federal Regulations* (10 CFR 50.55a(z)(2)), TVA requested that the NRC authorize Alternative Request RV-02 for certain PIVs at SQN Units 1 and 2 on the basis that compliance with the ASME OM Code requirements would result in hardship or unusual difficulty without compensating increase in level of quality or safety.

In its letter dated June 28, 2022, TVA stated that it had developed a technical evaluation to formally document the guidance for performing mechanical agitation of the PIVs in accordance with Alternative Request RV-02. In developing this evaluation, TVA stated that it had researched industry precedents and obtained copies of other nuclear power plant procedures and engineering evaluations related to similar PIVs.

2.0 REGULATORY EVALUATION

The NRC regulations in 10 CFR 50.55a(f)(4), "Inservice testing standards requirement for operating plants," state, in part, that throughout the service life of a boiling or pressurized water-cooled nuclear power facility, pumps and valves that are within the scope of the ASME OM Code must meet the inservice test requirements (except design and access provisions) set forth in the ASME OM Code and addenda that become effective subsequent to editions and addenda specified in 10 CFR 50.55a(f)(2) and (3) and that are incorporated by reference in 10 CFR 50.55a(a)(1)(iv), to the extent practical within the limitations of design, geometry, and materials of construction of the components.

The NRC regulations in 10 CFR 50.55a(z) state, in part, that alternatives to the requirements of 10 CFR 50.55a(f) may be used, when authorized by the NRC, if TVA demonstrates (1) the proposed alternatives would provide an acceptable level of quality and safety, or (2) compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

The SQN Units 1 and 2 Fourth 10-Year IST Program interval began on September 1, 2016, and is scheduled to end on June 30, 2026.

3.0 TECHNICAL EVALUATION

3.1 Licensee’s Alternative Request RV-02

3.1.1 Applicable Code Edition and Addenda

The applicable ASME OM Code of Record for the SQN Units 1 and 2 Fourth 10-Year IST Program interval is the 2004 Edition through 2006 Addenda of ASME OM Code, which are incorporated by reference in 10 CFR 50.55a.

3.1.2 ASME Code Components Affected

In its submittal, TVA proposed alternative testing for the following PIVs in Table 1:

Table 1

Site/Unit	Component ID (Valve)	Component Description	Valve Type	OM Code Class	OM Category
SQN Unit 1 and 2	1/2-VLV-63-543/545/547/549	Safety Injection System (SIS) Hot Leg Secondary Check Valves	2" Y-Pattern Piston Check	1	A/C
SQN Unit 1 and 2	1/2-VLV-63-551/553/555/557	SIS Cold Leg Secondary Check Valves	2" Y-Pattern Piston Check	1	A/C
SQN Unit 1 and 2	1/2-VLV-63-558/559/641/644	SI/Residual Heat Removal (RHR) Hot Leg Primary Check Valves	6" Inclined Vertical Seat Swing Check	1	A/C
SQN Unit 1 and 2	1/2-VLV-63-560/561/562/563	SI Cold Leg Primary Check Valves	10" Vertical Seat Swing Check	1	A/C
SQN Unit 1 and 2	1/2-VLV-63-622/623/624/625	SIS Cold Leg Accumulator (CLA) Secondary Check Valves	10" Vertical Seat Swing Check	1	A/C

SQN Unit 1 and 2	1/2-VLV-63-632/633/634/635	RHR Cold Leg Secondary Check Valves	6" Inclined Vertical Seat Swing Check	1	A/C
SQN Unit 1 and 2	1/2-VLV-63-640/643	RHR Hot Leg Secondary Check Valves	8" Vertical Seat Swing Check	1	A/C

3.1.3 Applicable Code Requirement

The IST requirements in the 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, related to this alternative request are as follows:

Paragraph ISTC-3630, "Leakage Rate for Other Than Containment Isolation Valves," in part states, "Valve closure before seat leakage testing shall be by using the valve operator with no additional closing force applied."

Paragraph ISTC-3630(a) requires PIV leakage rate testing to be conducted at least once every two years.

Paragraph ISTC-3630(e), "Analysis of Leakage Rates," states:

Leakage rate measurements shall be compared with the permissible leakage rates specified by the plant Owner for a specific valve or valve combination. If the leakage rates are not specified by the Owner, the following rates shall be permissible:

(1) for water, 0.5D gal/min (12.4d ml/sec) or 5 gal/min (315 ml/sec), whichever is less, at function pressure differential
(2) for air, at function pressure differential, 7.5D standard ft^3/day (58d std. cc/min)

where

D = nominal valve size, in.
d = nominal valve size, cm

Paragraph ISTC-3630(f), "Corrective Action," in part states, "Valves or valve combinations with leakage rates exceeding the values specified by the Owner per ISTC-3630(e) shall be declared inoperable and either repaired or replaced."

Paragraph ISTC-5221, "Valve Obturator Movement," in subparagraph (a)(1) states, "Check valves that have a safety function in both the open and close directions shall be exercised by initiating flow and observing that the obturator has traveled to either the full open position or to the position required to perform its intended function(s) (see ISTA-1100), and verify that on cessation or reversal of flow, the obturator has traveled to the seat."

Paragraph ISTC-5224, "Corrective Action," in part states, "If a check valve fails to exhibit the required change of obturator position, it shall be declared inoperable. A retest showing acceptable performance shall be run following any required corrective action before the valve is returned to service."

3.1.4 Reason for Request

In its March 15, 2022, submittal, TVA provided the following reason for its request:

> SQN Units 1 and 2 have two separate, but related requirements, for leakage rate testing of PIVs (i.e., Technical Specifications (TS) and Inservice Testing (IST) Program.)
>
> SQN Units 1 and 2 TS 3.4.14, "RCS [Reactor Coolant System] Pressure Isolation Valve (PIV) Leakage," has the following requirements.
>
> - TS Limiting Condition for Operation (LCO) 3.4.14 is applicable in "Modes 1, 2, 3, and Mode 4, except valves in the residual heat removal (RHR) flow path when in, or during the transition to or from, the RHR mode of operation."
> - Surveillance Requirement (SR) 3.4.14.1 states, "Verify leakage from each RCS PIV is equivalent to ≤ 0.5 gallon per minute (gpm) per nominal inch of valve size up to a maximum of 5 gpm at an RCS pressure ≥ 2215 psig [pounds per square inch gage] and ≤ 2255 psig."
> - The frequency of SR 3.4.14.1 is: "In accordance with the Inservice Testing Program, and in accordance with the Surveillance Frequency Control Program AND Prior to entering MODE 2 whenever the unit has been in MODE 5 for 7 days or more if leakage testing has not been performed in the previous 9 months AND Within 24 hours following valve actuation due to automatic or manual action or flow through the valve."
> - If SR 3.4.14.1 is not satisfied, then TS 3.4.14 Required Action A.2 requires the reactor coolant system (RCS) PIV to be restored within limits within 72 hours, otherwise SQN Units 1 and 2 TS 3.4.14 Required Actions B.1 and B.2 require the unit to be in Mode 3 in six hours and Mode 5 in 36 hours, respectively.
>
> The proposed alternative request does not affect the above TS and SR.
>
> The SQN Units 1 and 2 IST Program implements the ASME OM Code as required by SQN Units 1 and 2 TS 5.5.6, "Inservice Testing Program" and 10 CFR 50.50a(f). The ASME OM Code requires the following.
>
> - OM Code, Subsection ISTC-3630 requires PIVs testing to verify their seat leakages within acceptable limits and states, "Valve closure before seat leakage testing shall be by using the valve operator with no additional closing force applied."
> - OM Code, Subsection ISTC-3630(a) requires PIV leakage rate testing to be conducted at least once every two years.
> - OM Code, Subsection ISTC-3630(b)(4) allows testing to be performed at reduced differential test pressure if the leakage result is correlated to leakage at an RCS pressure. SQN Units 1 and 2 SR 3.4.14.1 requires a test pressure between 2215 pounds per square inch gauge (psig) and 2255 psig. Nominal

RCS operating pressure of 2235 psig, as defined in SQN Units 1 and 2 TS Table 3.3.1-1 and SQN Updated Final Safety Analysis Report (UFSAR) Table 5.1-1, is used as the correlation pressure at SQN.

- The leakage testing requirement of ISTC-3630 is utilized to satisfy the requirements of subparagraphs ISTC-5221(a)(1) and ISTC-5224.

For each SQN unit there are 26 PIV check valves. Eight PIVs are two-inch diameter Y-pattern spring loaded piston check valves, eight PIVs are six-inch diameter inclined vertical seat swing check valves, and ten PIVs are two eight-inch and eight ten-inch diameter vertical seat swing check valves.

Historically, PIVs have been leak tested during startup from refueling outages (and certain other non-refueling outages) at lower differential test pressures (starting around 350 psi) in order to complete the required testing as soon as possible thereby eliminating/reducing impact on startup critical path. Leak testing is accomplished by using either RHR pressure, RCS pressure, or CLA pressure to backseat the check valves, and leakage is collected and measured over time at an upstream low pressure drain valve.

Most PIVs tested at the lower pressures met the leakage rate acceptance criteria when correlated to RCS pressure. However, some PIVs have required a higher test pressure (up to nominal RCS pressure) in order to achieve acceptable leakage results. Test procedures are written to allow testing at low or higher pressures.

In a few cases, mechanical agitation has been necessary to get the valve to seat well enough to achieve an acceptable leakage rate. TVA recognizes that mechanical agitation is a troubleshooting tool rather than a repair method. TVA also recognizes that OM Code, ISTC-3630(f) requires valves with leakage rates that exceed acceptance criteria to be declared inoperable and then, repaired or replaced followed with a re-test showing acceptable operation before return to service.

To repair or replace a failed PIV, the plant would have to reverse startup activities and cooldown, depressurize, reduce RCS water level, and remove fuel, as required, from the reactor vessel to perform repair or replacement of the failed PIV. This would have a significant impact on startup and outage duration and require emergent plant maneuvering to achieve the required configuration necessary for repair or replacement along with an increased shutdown safety risk. This evolution would also subject plant personnel to increased dose rates in a heat stress environment for an extended period of time to perform the actual repair or replacement. Work for one of these PIVs would require emergent support activities [e.g., work order (WO) planning and issue, scaffolds, insulation removal, radiological control (RADCON) surveys and coverage, operations tag outs and system alignments, engineering (various) inspections and support, quality control and inservice inspection support.]

Therefore, compliance with Subsections ISTC-3630, ISTC-3630(f), ISTC-5221(a)(1), and ISTC-5224, for the PIVs listed in the Section I of this enclosure [of the March 15, 2022, submittal], would cause a hardship or unusual difficulty without a compensating increase in the level of quality or safety inorder to perform the repair or replacement activity required by ISTC-3630(f).

3.1.5 Licensee's Proposed Alternative

TVA provided the following description of its proposed alternative:

Description of the Proposed Alternative

PIV seat leakage testing may begin at low pressures to expedite startup activities.

If PIV seat leakage does not meet the acceptance criteria at low pressures, then the affected system may be allowed to increase in pressure and temperature within TS limits and another seat leakage test performed. This process may be repeated until either the leakage acceptance criteria is met, or the maximum possible test pressure and temperature is reached.

If PIV seat leakage does not meet the acceptance criteria at the maximum possible test pressure and temperature, TVA will take the following actions.

- The PIV will be declared inoperable in accordance with the affected TS and the failed PIV will be entered into the TVA corrective action program, which will allow the provisions of this alternative to be invoked.

- In lieu of doing an ASME Code repair or replacement, the PIV may be mechanically agitated in accordance with the guidance provided in Section VI.2 of this alternative.

- After the PIV is mechanically agitated, it will be seat leakage tested using the normal test procedures. The incremental mechanical agitation and testing process may be repeated until seat leakage rate acceptance criteria is met or it is determined that corrective maintenance is required.

  - If the seat leakage test meets the acceptance criteria, then the PIV will be declared operable.

  - If the seat leakage test does not meet the acceptance criteria, then the PIV will be repaired or replaced during the outage of discovery.

- PIVs that have been mechanically agitated and subsequently passed seat leakage testing, will be repaired, or replaced during the next refueling outage.

- PIVs that are repaired or replaced must pass post-maintenance tests (including seat leakage tests) before being declared operable.

This alternative can be used for multiple PIVs in series or in parallel. Using the provision of this alternative request as an alternative to the specific requirements of ISTC-3630, ISTC-3630(f), ISTC-5221(a)(1) and ISTC-5224, which have been identified to be a hardship without a compensating increase in quality and safety pursuant to 10 CFR 50.55a(z)(2), will provide adequate indication of PIV function and operability.

3.1.6 Licensee's Basis for Proposed Alternative

TVA provided the following basis for its alternative:

The proposed alternative provides an acceptable level of quality and safety based on the following factors.

- The PIVs are very common check valve models and designs that are used in the industry and typically perform well until operation results in degradation of the seating surfaces.

- To backseat the piston checks, either the RHR or CLA must be in service and the test header upstream of the PIVs must be depressurized. Additional problems have been encountered with achieving enough of a pressure differential across the valve seats to force them closed. Because the seating pressure is from the RHR pumps and relatively low, high pressures in the upstream piping due to leaking boundary valves can prevent sufficient seating force required to achieve good test results. Also, PIVs 1/2-VLV-63-553 are mounted in the vertical direction with flow down so that gravity cannot help close those valve discs.

- To backseat the inclined vertical seat checks requires RCS pressure or CLA pressure. Unless there is a significant pressure differential across the seat, the disc may not be pushed into the seat with enough force to achieve full contact. The disc is slightly inclined so gravity does not help keep the disc closed as much as it would for a vertically mounted check valve.

- To backseat the vertical seat checks requires either RCS, RHR or CLA pressure. Unless there is a significant pressure differential across the seat, the disc may not be pushed into the seat with enough force to achieve full contact. The disc is completely vertical on its seat, so gravity has minimal impact on keeping the disc closed.

- SQN has experienced problems with achieving a consistent pressure differential across the PIV seats due to the numerous connections and branches involved in the PIV configuration. TVA has been able to achieve the required pressure differential through increased downstream (seating) pressure, valve realignment, venting, cycling of valves, but only after extensive troubleshooting and procedure changes. Leakage past these PIVs will show up as increased pressure in the SIS test header or the SI or RHR pump header piping, and usually before any seat leakage tests have problems. However, a failed test for these PIVs would require the emergent activities discussed previously to effect repair or replacement.

- Once PIVs are closed with acceptable seat leakage rate, the PIVs would not be required to open unless a loss of coolant accident (LOCA) occurred (or normal shutdown cooling flow for the RHR PIVs) and would not be required to

> perform the PIV function again following a LOCA. Should a LOCA occur, the plant would be shutdown for an extended period of time, which would allow the maintenance planned for the next refueling outage to be performed prior to startup following the LOCA. For PIVs opened by flow during shutdowns, the required seat leakage tests will be performed, and acceptable results obtained prior to entering Mode 2 or the plant cannot start up. There has not been any instance at SQN where a PIV failed to open when required.

In addition, TVA provided additional justification for its proposed alternative that the NRC staff summarizes below:

1. Review of Maintenance History of the PIVs.

   TVA provided a detailed description of its review of the maintenance history of the PIVs within the scope of its alternative request. TVA stated that Condition Reports and Work Orders for each PIV were reviewed going back to the Cycle 17 Refueling Outage (R17) for both units (spring 2010 for SQN Unit 1 and spring 2011 for SQN Unit 2). In its March 15, 2022, and June 28, 2022, submittals, TVA identified intrusive maintenance activities that were performed for specific check valve sizes and types.

2. Description of the mechanical agitation to be used, if needed.

   TVA described the mechanical agitation to be used on the PIVs. For example, mechanical agitation is performed using a tool appropriately sized for the valve in question and for the location of the valve. The primary consideration is that the tool should not deform the valve body. The impact surface of the tool should be relatively large (greater than ½" diameter is preferred), and approximately flat or slightly rounded. The tool will contact the valve body surface so that it does not impact the body with an edge or sharp point. If available, a rubber coated tool may be used. In cases where there is limited access, a power-operated tool may be used provided the same precautions discussed above can be used. Agitation should be applied incrementally, starting with minimal force, and may be applied to different locations on the body, until either the disk is freed, or the plant determines agitation will not be successful. Because this activity does not lend itself to quantifiable parameters, the task is performed using the skill of the craft within the limitations discussed above. Because mechanical agitation is not a repair or replacement activity, this alternative is needed to avoid potential unnecessary emergent demands on plant equipment, resources, and personnel.

3. Design of the PIV check valves.

   TVA described the design of the PIV check valves. For example, failure of a check valve disk to open (stuck closed), or detachment of the disk from valve internals, is normally due to service conditions and/or process fluid. Most failures are associated with carbon steel valves in raw water systems where the disk is closed for long periods of time, allowing corrosion to bond the disk to other parts of the valve internals. Another failure mechanism is when the disk operates long-term in a less than full open position, allowing hinge pin wear in a raw water environment. The process fluid for the PIVs at SQN is RCS water, which is maintained within strict chemistry and cleanliness standards. The valves are designed for service in a boric acid solution and are comprised of stainless steel materials. The individual branches of hot leg and cold leg injection are flow balanced to within ten gallons per minute (gpm) of each other, alleviating potential low flow conditions. These valves only see flow during shutdown cooling operation, periodic (once per refuel outage) IST Program tests, or during a LOCA. Although the valve disk may not be physically full open during some of the time it is in service, this occurs during a very small portion of the lifetime of the valve. Because the conditions for corrosion are not present by design, and open position occurs a small percentage of the time, it is not likely that any disk will fail to open, or become detached when flow is required. During the R17 rework or replacement activities discussed above, which included a visual inspection of the valve internals, there were no issues related to freedom of motion of the valve internals. During some rework activities, the disk spring, hanger, and hanger hardware have been replaced, not due to damage or wear, but as a normal good practice while the valve is disassembled. Also, during each refueling outage, these valves have design flow rates passed through them as part of the IST Program or TS related testing. There have been no instances of check valve failure to open for these tests, which proves their ability to open on demand in a LOCA.

4. Description of Preventive Maintenance of the PIVs.

   TVA described the preventive maintenance performed on the PIVs. For example, each unit has a scoping preventive maintenance (PM) to evaluate and identify PIVs to recommend for inspection and repair (or replace) for an upcoming refueling outage. The PM is performed by System Engineering and is generated prior to the outage scope freeze to allow for timely identification and scoping into the refueling outage. The PM considers length of time from previous inspection, leak rate test results, system pressurization, gas accumulation in the system, CLA leak rate trends, and consequences of leakage on the plant and outage schedule when determining which valve(s) to recommend for inspection and/or repair. As an example, the SQN Unit 2 PM recommended check valves 2-VLV-63-557 and 2-VLV-63-563 for inspection and repair for the SQN U2R23 refueling outage (spring 2020) based on troubleshooting efforts performed during the cycle that suspected these two valves were leaking by and contributing to the pressurization of the SQN Unit 2 SI discharge headers. The valves were scoped into the outage and subsequently inspected and/or repaired during SQN U2R23 (2-VLV-63-557 had its spring and disc replaced, whereas 2-VLV-63-563 was inspected, with no disc and seat interface issues, and found to be acceptable).

   In addition, valves 1-VLV-63-558, 1-VLV-63-559, 2-VLV-63-558, and 2-VLV-63-559 have active PMs for disassembly and inspection on a 6RO [refueling outage] frequency. The PMs were established as a result of the degradation found during the inspection of 2-VLV-63-559 during the U2R19 refueling outage in spring 2014. Since the initiation of the PMs, 1-VLV-63-559 was inspected during U1R21, and 2-VLV-63-558 and 2-VLV-63-559 are currently scheduled for inspection during the U2R25 in spring 2023. PMs for the remaining valves will be generated in the future on an as-needed basis.

5. Description of PIV Open Exercise Testing.

   TVA described the open exercise testing of the PIVs. For example, the PIVs are tested in the open direction during comprehensive pump testing of the RHR pumps and SI pumps with design flow rates. Flow through the hot and cold leg injection lines are balanced using orifices and locked throttled valves thereby ensuring equivalent flow through each valve. While total pump design flow is instrumented and measured during every comprehensive pump test, flow through each individual injection line is instrumented and measured on an alternating basis in accordance with the check valve condition monitoring plan.

3.1.7 Sequoyah Alternative Request RV-02 June 28, 2022, Supplement

In its supplement dated June 28, 2022, to Alternative Request RV-02, TVA responded to several requests for additional information (RAIs) provided by the NRC staff. In this section, the NRC staff summarizes the TVA responses as follows:

TVA Technical Evaluation

TVA developed a technical evaluation to formally document the guidance for performing mechanical agitation of the PIVs. In developing this evaluation, TVA researched industry precedents and obtained copies of other nuclear power plant procedures and engineering evaluations related to similar valves. Regarding NRC inspector evaluation of mechanical agitation of valves at other nuclear power plants, TVA referenced Salem Nuclear Generating Station, Unit Nos 1 and 2 – NRC Integrated Inspection Report 05000272/2012005 and 0500031/2012005, dated February 7, 2013 (ML13038A672), and Surry Power Station – NRC Integrated Inspection Report 05000280/2016004 and 05000281/2016004," dated February 1, 2017 (ML17032A308).

TVA indicated that its technical evaluation for performing mechanical agitation on the PIVs within the scope of the alternative request, includes, but is not limited to, the following information:

- Following the failure of a PIV to meet the SQN 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 2-inch check valves may be performed by tapping the valve body using a 5-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 and 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 6-inch, 8-inch, and 10-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.

TVA stated that the applicable TVA procedures will be revised to incorporate the technical evaluation prior to performing any mechanical agitation of the SQN PIVs within the scope of the Alternative Request RV-02.

TVA stated that mechanical agitation is a troubleshooting tool rather than a repair method. Specifically, if a PIV within the scope of this proposed alternative request does not meet the ASME OM Code and TS required seat leakage, the PIV will be declared inoperable. In lieu of doing an ASME Code repair or replacement, the PIV may be mechanically agitated in accordance with the above proceduralized guidance to assist in determining the cause of the valve failure and will be subsequently leak tested in accordance with the normal test procedures. As noted in the proposed alternative request, PIVs that have been mechanically agitated and subsequently passed seat leakage testing will be repaired or replaced during the next refueling outage.

Preconditioning of PIVs

TVA stated that mechanical agitation is a troubleshooting tool rather than a repair method. Further, TVA stated that where possible, prior to using mechanical agitation, other measures such as testing at higher pressure or venting the test header to create a lager differential pressure across the check valve will be used to seat the check valve, as allowed by the test procedures. Mechanical agitation will only be deployed after the as-found results have been obtained and/or valve has been declared inoperable. Hence, there is no relation between the use of the mechanical agitation activity as described in the proposed alternative request and preconditioning.

Mechanical Agitation for Reducing Check Valve Seat leakage

TVA stated that mechanical agitation can create relative motion between valve internals and the in-body seating surfaces for both Y-piston check valves and swing check valves. This relative motion can aid in valve seating when full differential pressures cannot be achieved by overcoming static forces that may be preventing an ideal seating position. Relative motion can also free any particulate that may be preventing adequate seating. Past experience with mechanical agitation has been successful at reducing check valve leakage.

TVA Past Experience with Mechanical Agitators at SQN for PIVs

a. TVA provided a detailed list of its experience with mechanical agitation at SQN for PIVs within the scope of the alternative request.

b. TVA stated that past experiences of mechanical agitation at SQN have not been defined and controlled. Mechanical agitation has been left up to the “skill of the craft” to implement. TVA has recently developed a technical evaluation to control mechanical agitation and limit the size of the agitator for the various size PIVs listed in the proposed alternative request.

c. TVA is developing proceduralized guidance on the use of mechanical agitation, based on a TVA engineering evaluation and industry precedence, which will ensure that the tools used to perform the mechanical agitation will not damage the valve seat, valve stem, or pressure boundary function.

d. The TVA technical evaluation developed for performing mechanical agitation on the PIV check valves, which are within the scope of the alternative request, includes an analysis that provides a reasonable determination that the above mechanical agitation process will not create damage to the PIV. This analysis ensures that the induced stresses in the PIVs, due to mechanical agitation, will not exceed any previously evaluated seismic stresses and that any localized stresses are minimal and negligible.

   TVA stated that this technical evaluation includes an estimation of the applied force using the equations of a pendulum and a conservative impact factor of two and compares that force to the design basis seismic loads on the valve. In addition, a conservative estimation of the localized stresses on the valve body are determined by considering the impact force to be applied to a flat plate with a thickness equal to the valve minimum wall thickness and comparing computed stress in the plate to allowable stress for the valve material.

e. TVA stated that it is not aware of any available standard, or industry or vendor guidelines regarding mechanical agitation. However, as noted in the TVA Introduction section to an RAI response, TVA has obtained some industry precedents for proceduralized guidance on performing mechanical agitation for check valves, that the NRC has reviewed. TVA has developed a technical evaluation for mechanical agitation and the applicable TVA procedures will be revised to incorporate this technical evaluation prior to performing any mechanical agitation of the SQN PIVs within the scope of the alternative request. This action is tracked by the TVA Corrective Action Program.

Leak Test History of PIVs

TVA provided additional discussion of the leak test history of the PIVs within the scope of Alternative Request RV-02 provided in its March 15, 2022, submittal.

Design of PIV Check Valves

TVA provided additional discussion of the design of the PIV check valves within the scope of Alternative Request RV-02 provided in its March 15, 2022, submittal.

Meeting ASME OM Code, ISTC-3630

TVA provided clarification of its method to continue to meet the requirements of ASME OM Code, Subsection ISTC, paragraph ISTC-3630, when implementing Alternative Request RV-02. Further, TVA stated that the test methodology for leak testing the PIVs will not change when implementing Alternative Request RV-02.

Testing Prior to Disassembly and Inspection at the Next Refueling Outage

TVA discussed its basis for not conducting leak testing of the valves undergoing mechanical agitation at the next RFO prior to commencing repair or replacement activities. For example, this testing is typically conducted during the startup process. In addition, some PIVs are in service during the shutdown mode. Information from such testing is not anticipated to provide significant information beyond that obtained from disassembly and inspection from a personnel safety and human performance perspective.

Other Clarifications

TVA clarified other aspects of the information in its March 15, 2022, submittal. For example, TVA clarified the plans for repair or replacement of any PIV within the scope of the request that is mechanically agitated during the next RFO. TVA described its condition monitoring plan activities for check valves within the scope of the alternative request. TVA discussed how it became aware of industry questions regarding PIV leakage testing. TVA noted that it had reviewed a violation identified by the NRC inspectors at the Turkey Point nuclear power plant (ML19105B281) in 2019 regarding unacceptable use of mechanical agitation, which resulted in TVA's determination that the use of mechanical agitation, in lieu of corrective maintenance and valve closure with no additional closing force applied, would require a request for an alternative to the requirements of ASME OM Code, Subsection ISTC, paragraph ISTC-3630, in accordance with 10 CFR 50.55a(z).

3.2 NRC Staff Evaluation

At nuclear power plants, PIVs are defined as two valves in series within the reactor coolant pressure boundary that separate the high-pressure RCS from a lower pressure system. For SQN Units 1 and 2, these PIVs must be leak tested in accordance with the requirements in the applicable paragraphs of ASME OM Code (2004 Edition through the 2006 Addenda), Subsection ISTC, as incorporated by reference in 10 CFR 50.55a, such as ISTC-3630 requiring that valve closure before seat leakage testing shall be by using the valve operator with no additional closing force applied; ISTC-3630(a) requiring PIV leakage rate testing to be conducted at least once every 2 years; ISTC-3630(f) requiring that valves or valve combinations with leakage rates exceeding values specified by the Owner per ISTC-3630(e) shall be declared inoperable and either repaired or replaced; ISTC-5221(a)(1) requiring that check valves that have a safety function in both the open and closed directions shall be exercised by initiating flow and observing that the obturator has traveled to either the full open position or to the position to perform its intended functions, and verify on cessation or reversal of flow, the obturator has traveled to the seat; and ISTC-5224 requiring that if a check valve fails to exhibit the required change of obturator position, it shall be declared inoperable, and a retest showing acceptable performance shall be run following any required corrective action before the valve is returned to service.

Under 10 CFR 50.55a(z)(2), TVA submitted the proposed PIV leakage testing approach in Sequoyah Alternative Request RV-02, as supplemented (herein after referred to as Alternative Request RV-02), based on its assertion that compliance with the specified requirements in the applicable paragraphs in the ASME OM Code as incorporated by reference in 10 CFR 50.55a would result in a hardship without a compensating increase in the level of quality and safety. In particular, TVA states that the approach described in Alternative Request RV-02, would permit continued startup if a PIV within the scope of the request could be demonstrated to have acceptable seat leakage following mechanical agitation. TVA states that the valve would only be acceptable for normal operation for one operating cycle and only if the final PIV seat leakage met the TS leakage criteria. TVA indicates that this alternative will apply to ISTC-3630 requirements as they relate to use of additional closing force to achieve PIV closure before seat leakage testing, ISTC-3630(f) requirements as they relate to corrective action following a failed seat leakage test, ISTC-5221(a)(1) requirements as they relate to demonstrating that a PIV check valve disk travel to its seat following cessation of flow, and ISTC-5224 requirements as they relate to retesting following any required corrective action before the valve is returned to service.

The NRC staff reviewed the alternative to the applicable PIV leakage testing requirements of the ASME OM Code as incorporated by reference in 10 CFR 50.55a proposed by TVA in Sequoyah Alternative Request RV-02.

In Sequoyah Alternative Request RV-02, TVA stated that historically PIVs have been leak tested during startup from refueling outages (and certain other non-refueling outages) at low differential pressures to complete the required testing as soon as possible to reduce the impact on startup schedule. TVA indicated that most of the PIVs tested at the low differential pressures meet the leak rate acceptance criteria, while some PIVs require a higher test pressure in order to achieve acceptable leak rate results. However, other PIVs do not always meet the leakage rate acceptance criteria even at the higher test pressures. Repair or replacement of a PIV that failed its leak test requires TVA to reverse the plant's startup activities and cool down, depressurize, reduce RCS water level, and remove fuel, as required, from the reactor vessel. This can have a significant impact on startup and outage duration, and require emergent plant maneuvering to achieve the required configuration necessary for repair or replacement along with an increased shutdown safety risk. This evolution can also subject plant personnel to increased radiation exposure in a heat stress environment for an extended period of time to perform the actual repair or replacement. This work requires a wide range of emergent support activities at the plant site.

In Sequoyah Alternative Request RV-02, TVA proposed that for a PIV within the scope of the request that does not meet the seat leakage acceptance criteria at the maximum possible test pressure, the following approach will be implemented:

- The PIV will be declared inoperable in accordance with the affected TS, and the failed PIV will be entered into the TVA corrective action program, which will allow the provisions of this alternative to be invoked.

- Following the failure of a PIV to meet the TS and ASME OM Code leakage testing requirements, mechanical agitation will be used to assist in troubleshooting the PIV failure.

- In lieu of performing an ASME Code repair or replacement, the PIV may be mechanically agitated in accordance with the following:

    - ➢ 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 2-inch check valves may be performed by tapping the valve body using a 5-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 and 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 6-inch, 8-inch, and 10-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 TVA technical evaluation includes an analysis that provides a reasonable determination that the above mechanical agitation process will not create damage to the PIV.

- After the PIV is mechanically agitated, it will be seat leakage tested using the normal test procedures. The incremental mechanical agitation and testing process may be repeated until seat leakage rate acceptance criteria is met or it is determined that corrective maintenance is required.

  - ➢ If the seat leakage test meets the acceptance criteria, then the PIV will be declared operable.

  - ➢ If the seat leakage test does not meet the acceptance criteria, then the PIV will be repaired or replaced during the outage of discovery.

- PIVs that have been mechanically agitated and subsequently passed seat leakage testing, will be repaired, or replaced during the next refueling outage.

- 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.

- PIVs that are repaired or replaced must pass post-maintenance tests (including seat leakage tests) before being declared operable.

In its letter dated June 28, 2022, TVA emphasized that mechanical agitation of a PIV is a troubleshooting tool rather than a repair method. Further, TVA states that where possible, prior to using mechanical agitation, other measures such as testing at higher pressure or venting the test header to create a lager differential pressure across the check valve will be used to seat the check valve, as allowed by the test procedures. TVA states that mechanical agitation will only be deployed after the as-found results have been obtained and/or valve has been declared inoperable. Hence, TVA asserts, and the NRC staff agrees, that there is no relation between the use of the mechanical agitation activity as described in the proposed alternative request and unacceptable preconditioning of the applicable PIVs.

In its letter dated June 28, 2022, TVA described experience with mechanical agitation at SQN for PIVs within the scope of the alternative request. This TVA experience shows that all PIVs passed the leakage test with mechanical agitation, except valves 1-VLV-63-632 and 1-VLV-63-634. TVA notes that experience with mechanical agitation at SQN has not always been controlled, and use of mechanical agitation has been left to the “skill of the craft” to implement. An evaluation of these other instances of mechanical agitation of valves is outside the scope of this review of Sequoyah Alternative Request RV-02.

In its June 28, 2022, letter TVA also 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 request. Based on the TVA description of its mechanical agitation process in

Alternative Request RV-02, the NRC staff determined that a regulatory audit 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. The NRC staff conducted a regulatory audit (ML22220A107) from August 10, 2022, to August 15, 2022, to review the TVA technical evaluation document.

As a result of the regulatory audit, the NRC staff considered whether TVA has adequately specified the provisions of the mechanical agitation process requested to be authorized for the PIVs within the scope of Alternative Request RV-02 for SQN Units 1 and 2. The NRC staff also considered whether that TVA has demonstrated by its technical evaluation that the stress induced in the applicable PIVs during the mechanical agitation process to be implemented under Alternative Request RV-02 will not damage the valve body or cause localized deformation, nor endanger plant personnel performing the mechanical agitation of the applicable PIVs. As indicated by TVA, all steps taken to apply mechanical agitation as described in Alternative Request RV-02 on which the TVA technical evaluation is based are to be included in the TVA procedures. The NRC staff issued its summary of the regulatory audit for Sequoyah Alternative Request RV-02 on September 28, 2022 (ML22263A008).

4.0 CONCLUSION

As described above, the NRC staff finds that TVA has justified its proposed mechanical agitation process described in Sequoyah Alternative Request RV-02 to be applied if a PIV within the scope of the request fails its OM Code-required leakage test as an alternative to the applicable requirements in the ASME OM Code (2004 Edition through 2006 Addenda) as incorporated by reference in 10 CFR 50.55a. The staff finds that the proposed alternative as specified in Sequoyah Alternative Request RV-02 will provide reasonable assurance of the operational readiness of the applicable PIVs until the next refueling outage when repair and replacement activities will be conducted, in light of the hardship caused by implementation of the applicable ASME OM Code requirements without a compensating increase in the level of quality and safety. Accordingly, the NRC staff concludes that TVA has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(z)(2) for Alternative Request RV-02. Therefore, the NRC staff authorizes the use of Alternative Request RV-02 at SQN Units 1 and 2 for the remainder of the Fourth 10-year IST Program interval, which is scheduled to end on June 30, 2026.

All other ASME OM Code requirements as incorporated by reference in 10 CFR 50.55a for which relief or an alternative was not specifically requested, and granted or authorized (as appropriate), in the subject request remain applicable.

Principal Contributor: G. Bedi, NRR
T. Scarbrough, NRR

Dated: September 29, 2022

SUBJECT: SEQUOYAH NUCLEAR PLANT, UNIT NOS. 1 AND 2 - AUTHORIZATION OF ALTERNATIVE REQUEST RV-02 FOR PRESSURE ISOLATION VALVE SEAT LEAKAGE (EPID L-2022-LLR-0034) DATED SEPTEMBER 29, 2022

DISTRIBUTION:
PUBLIC
PM File Copy
RidsACRS_MailCTR Resource
RidsNrrDorlLpl1 Resource
RidsNrrDexEmib Resource
RidsNrrLARButler Resource
RidsNrrPMSequoyah Resource
RidsRgn2MailCenter Resource
TScarbrough, NRR
GBedi, NRR

ADAMS Accession No.: ML22263A375

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	9/27/2022	9/16/2022	9/29/2022

OFFICIAL RECORD COPY