TENNESSEE VALLEY AUTHORITY

1101 Market Street, Chattanooga, Tennessee 37402

CNL-22-062

June 28, 2022

10 CFR 50.55a

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Sequoyah Nuclear Plant, Units 1 and 2
Renewed Facility Operating License Nos. DPR-77 and DPR-79
NRC Docket Nos. 50-327 and 50-328

Subject: **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)**

References:
1. TVA letter to NRC, CNL-22-024, "Sequoyah Nuclear Plant, Units 1 and 2, American Society of Mechanical Engineers Operation and Maintenance Code, Request for Alternative RV-02," dated March 15, 2022 (ML22074A315)

2. NRC electronic mail to TVA, "Revised Request for Additional Information re Sequoyah Nuclear Plant Alternative Request RV-02 (EPID L-2022-LLR-0034)," dated May 27, 2022 (ML22151A010)

In Reference 1, Tennessee Valley Authority (TVA) requested Nuclear Regulatory Commission (NRC) approval of an inservice testing (IST) alternative request RV-02, for the Sequoyah Nuclear Plant (SQN), Units 1 and 2. The alternative request applies to the SQN Units 1 and 2 pressure isolation valves (PIV) listed in the enclosure to Reference 1 and would allow operation for one cycle if certain pressure isolation valves undergo mechanical agitation as a means to achieve acceptable valve seat leakage.

In Reference 2, the NRC issued a revised request for additional information (RAI) and requested TVA respond by June 30, 2022. The enclosure to this submittal provides the TVA response to the RAI.

There are no new regulatory commitments associated with this submittal. Please address any questions regarding this request to slrymer@tva.gov.

Respectfully,

Digitally signed by Rymer, Stuart Loveridge
Date: 2022.06.28 15:08:02 -04'00'

Stuart L. Rymer
Director (Acting), Nuclear Regulatory Affairs

Enclosure:

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

cc (Enclosure):

NRC Regional Administrator – Region II
NRC Senior Resident Inspector – Sequoyah Nuclear Plant
NRC Project Manager – Sequoyah Nuclear Plant

Enclosure

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

Tennessee Valley Authority Introduction

In Reference 1, Tennessee Valley Authority (TVA) requested Nuclear Regulatory Commission (NRC) approval of an inservice testing (IST) alternative request RV-02, for the Sequoyah Nuclear Plant (SQN), Units 1 and 2.

The alternative request applies to the SQN Units 1 and 2 pressure isolation check valves (PIV) listed in the enclosure to Reference 1 and would allow operation for one cycle if certain pressure isolation valves undergo mechanical agitation as a means to achieve acceptable valve seat leakage.

Since the submittal of Reference 1, TVA has developed a technical evaluation to formally document the guidance for performing mechanical agitation of the PIVs described in Reference 1. In developing this evaluation, TVA has researched industry precedence and obtained copies of other nuclear power plants' procedures/engineering evaluations related to similar safety related check valves. For example, in Reference 2, NRC stated, "The inspectors determined that the Salem Nuclear Generating Station, Units 1 and 2 technical evaluations associated with the Emergency Core Cooling System (ECCS) check valve leakage and mechanical agitation were sufficiently thorough and based on the best available information, troubleshooting, sound engineering judgment, and relevant operating history." As noted in Reference 2, "Based on interviews and a maintenance history review, the inspectors noted that mechanical agitation did not adversely impact ECCS check valve operation or result in any internal check valve damage." Also in Reference 3, NRC reviewed the Surry Power Station Unit 1 procedure 1-OPT-SI-014, "Cold Shutdown Test of SI Check Valves to RCS Cold Legs," Revision 22, following mechanical agitation of safety injection (SI) to reactor coolant system (RCS) cold leg check valve 1-SI-79 and associated document ETE-SU-2016-0052, "Engineering Evaluation for Mechanical Agitation of 1-SI-79, Revision 0," and had no findings or observations.

Similarly, the technical evaluation that TVA has developed for performing mechanical agitation on the PIV check valves, which are 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 American Society of Mechanical Engineers (ASME) Operation and Maintenance (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.

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 Reference 1.

As noted in Reference 1, TVA recognizes 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 Section V of 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.

The following provides TVA's response to each of the NRC Requests for Additional Information (RAI).

References

1. TVA letter to NRC, CNL-22-024, "Sequoyah Nuclear Plant, Units 1 and 2, American Society of Mechanical Engineers Operation and Maintenance Code, Request for Alternative RV-02," dated March 15, 2022 (ML22074A315)
2. NRC letter to PSEG Nuclear LLC – N09, "Salem Nuclear Generating Station, Unit Nos. 1 and 2 – NRC Integrated Inspection Report 05000272/2012005 and 05000311/2012005," dated February 7, 2013 (ML13038A672)
3. NRC letter to Dominion Energy, "Surry Power Station – NRC Integrated Inspection Report 05000280/2016004 and 05000281/2016004," dated February 1, 2017 (ML17032A308)

NRC Introduction

References

1. *Letter from Tennessee Valley Authority [TVA] to U.S. Nuclear Regulatory Commission (NRC), Sequoyah Nuclear Plant (SQN), Units 1 and 2, American Society of Mechanical Engineers Operation and Maintenance Code, Request for Alternative RV-02, dated March 15, 2022 (ADAMS Accession No. ML22074A315).*
2. *Summary of February 16, 2022, public pre-application meeting with Tennessee Valley Authority regarding a future submittal of a request for an alternative to requirements for addressing Pressure Isolation Valve Leakage (ADAMS Accession No. ML22048B785).*

Regulatory Basis

The SQN Units 1 and 2 Inservice Testing Program implements the American Society of Mechanical Engineers (ASME) Operation and Maintenance Code as required by SQN Units 1 and 2 Technical Specification 5.5.6, "Inservice Testing Program," and Title 10 of the Code of Federal Regulations (10 CFR) 50.55a(f). Subsection ISTC-3630 of the SQN Units 1 and 2 Operation and Maintenance Code of record requires PIV 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." In accordance with 10 CFR 50.55a(z)(2), the NRC staff may authorize an alternative to an ASME Code requirement if the licensee demonstrates that the specified requirements of this section would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Requests for Additional Information

EMIB-RAI-1

Alternative Request RV-02, Section V, in the subsection "Summary," first paragraph, states:

> *The proposed alternative would permit continued startup if the PIV [pressure isolation valve] could be demonstrated to have acceptable seat leakage following mechanical agitation. The valve would only be acceptable for normal operation for one cycle and only if the final PIV seat leakage met the TS [Technical Specification] leakage criteria. 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 disc 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 licensee is requested to provide the following information:

(a) Clarify how the mechanical agitation activity described in Alternative Request RV-02 relates to preconditioning.

(b) Specify the general design, including manufacturer/vendor, for the current check valves within the scope of the request, and describe how mechanical agitation will provide sealing for the various check valve designs.

TVA Response

(a) As noted in Section IV to Reference 1, "TVA recognizes that mechanical agitation is a troubleshooting tool rather than a repair method." Where possible, prior to using mechanical agitation, other measures such as testing at a higher pressure or venting the test header to create a larger 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 the valve has been declared inoperable. Therefore, there is no relation between the mechanical agitation activity described in the proposed alternative request and preconditioning as described in NUREG-1482, Revision 3, "Guidelines for Inservice Testing at Nuclear Power Plants: Inservice Testing of Pumps and Valves and Inservice Examination and Testing of Dynamic Restraints (Snubbers) at Nuclear Power Plants."

(b) The two-inch PIV check valves listed in Section I of the alternative request are stainless steel Y-pattern piston check valves manufactured by Rockwell, Anchor Darling, Flowserve or Crane. The six-inch PIV check valves listed in Section I of the alternative request are stainless steel swing check valves manufactured by the Velan Engineering Company. The eight-inch and ten-inch PIV check valves listed in Section I of the alternative request are stainless steel swing check valves manufactured by the Darling Valve and Manufacturing Company. TVA notes that the response to this RAI does not restrict TVA from using other valve vendors, as necessary, in the event that the PIVs within the scope of this alternative request need to be replaced or repaired.

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 seat leakage.

EMIB-RAI-2

Alternative Request RV-02, Section VI, "Basis for Proposed Alternative," Item 2, "Description of the mechanical agitation to be used, if needed," states:

> *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 1/2" 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 disc 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.*

The licensee is requested to provide the following information:

(a) Describe any experience with mechanical agitators at Sequoyah or other plants if known.

(b) Specify the size of the actual mechanical agitators used on the 2-inch through 10-inch valves at Sequoyah if applied in the past.

(c) Specify and describe the procedures that have been established to control the mechanical agitation activity such that the hand-operated and power-operated tools will not damage the valve seat, valve stem or pressure boundary function, etc.

(d) Describe the weak link analysis that has been performed to verify that the mechanical agitation activity will not damage the check valves

(e) Specify any available standard, or industry or vendor guidelines, that will be used in applying the mechanical agitators.

TVA Response

(a) Experience with mechanical agitators at SQN for the PIVs within the scope of the alternative request is provided below. Only those PIVs with documented mechanical agitation experience are described below. Experience with mechanical agitators at other plants is described in the TVA Introduction Section to this RAI response.

1-VLV-63-562

In November 2010 (U1R17), 1-VLV-63-562 experienced excessive leakage during leak rate testing and the valve was mechanically agitated. Following mechanical agitation, the valve successfully passed its leak rate test. The valve was leak tested during the following outage in March 2012 (U1R18) and passed its leak rate test. In October 2013 (U1R19), the valve was disassembled and inspected, and it was determined the valve disc needed to be lapped. The subsequent leak test was performed successfully.

1-VLV-63-632 and 1-VLV-63-634

In March 2011, SQN Unit 1 received an unexpected residual heat removal (RHR) discharge pressure high alarm while online. Troubleshooting determined valves 1-VLV-63-632 and 1-VLV-63-634 were leaking by causing RHR discharge pressure to increase. Subsequently, these valves were agitated with no success. During the subsequent refueling outage in March 2012 (U1R18), the valves were disassembled and inspected and determined the seat and disc needed to be lapped. The subsequent leak test measured zero leakage.

1-VLV-63-560

In May 2015 (U1R20), leak testing of 1-VLV-63-560 was suspended due to excessive leakage. The valve was mechanically agitated and successfully passed its leak rate test. No further maintenance has been performed on the valve, and test data shows it has met the leakage acceptance criteria with no further mechanical agitation.

1-VLV-63-558

In November 2019 (U1R23), 1-VLV-63-558 experienced excessive leakage during testing. The valve was mechanically agitated twice. After the second agitation the valve seated, and zero leakage was measured. The valve was successfully tested during U1R24 with zero leakage.

2-VLV-63-559

In December 2012 (U2R18), excessive leakage was observed during testing of 2-VLV-63-559. Following multiple agitations while venting the test header, the valve successfully seated, and zero leakage was measured. In May 2014 (U2R19), the valve was disassembled and inspected and the seating surfaces to the disc and seat were found damaged. A new valve was installed and successfully leak tested.

2-VLV-63-644

In December 2015 (U2R20), 2-VLV-63-644 was agitated as troubleshooting due to possible leak-by. The valve subsequently passed its leak test. The valve has had no subsequent maintenance and the leakage test data has been acceptable.

2-VLV-63-634

In May 2017 (U2R21), 2-VLV-63-634 was found leaking excessively. The valve was agitated and retested with zero leakage measured. In December 2018 (U2R22), the valve was again found leaking excessively. After agitation, the valve was retested with zero leakage measured. During testing of this valve in U2R24, the valve was suspected of being stuck open due to leakage observed during testing. However, after venting the test header and increasing RCS pressure, the valve reseated with no agitation. TVA plans to repair the valve in U2R25 (spring 2023).

(b) 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. As noted in the TVA introduction section to this RAI response, 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) As noted in the TVA Introduction Section to this RAI response, 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. The TVA Introduction section includes the information requested by the NRC in this RAI.

(d) As noted in the TVA Introduction section to this RAI response, the technical evaluation that TVA has 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.

This 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 is not aware of any available standard, or industry or vendor guidelines regarding mechanical agitation. However, as noted in the TVA Introduction section to this RAI response, TVA has obtained some industry precedence 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.

EMIB-RAI-3

Alternative Request RV-02, Section VI, Item 1, "Review of Maintenance History of the PIVs," states, in part:

> *6" inclined seat swing check valves*
>
> *PIV leak test history has been generally satisfactorily (leakage present on 27.8% of tests on SQN Unit 1 and 30.3% on SQN Unit 2 – no as-left failures).*
>
> *10" vertical seat swing check valves*
>
> *PIV leak test history has improved in the last few outages and acceptable leak rates have been obtained in all cases (leakage present on 52.8% of tests on SQN Unit 1 and 75% on SQN Unit 2 – no as-left failures).*

The licensee is requested to provide the following information:

(a) Provide the evaluation of the cause of this high occurrence of leakage for the 6-inch and 10-inch check valves.

(b) Provide the leakage rate history for 8-inch PIVs and describe the evaluation of the leakage rates.

TVA Response

(a) The PIV leak test history provided in the Alternative Request RV-02, Section VI, Item 1, refers to the "frequency" of test performances where leakage is detected and is not indicative of the "quantity" of leakage. The most probable cause for the high occurrence of leakage is attributed to testing these valves at low system pressure. Reactor coolant system pressure is used to backseat the primary (inboard) check valves, while cold leg accumulator pressure is used to backseat the secondary (outboard) valves. In the cases with the six-inch and ten-inch valves, more pressure is needed to adequately backseat these valves. The tests are normally performed during startup from a refueling outage starting in Mode 5 where typical RCS pressure is approximately 350 pounds per

square inch (psig), up to Mode 3 when RCS pressure is near normal operating pressure. Performance of these tests at low RCS pressure minimizes personnel hazard and provides a conservative leak rate, which provides early indication of potential problems.

(b) The eight-inch PIVs are 1-VLV-63-640, 1-VLV-63-643, 2-VLV-63-640, and 2-VLV-63-643. They are vertical seat swing check valves with a leakage acceptance criterion of four gallons per minute (gpm). As shown in Tables 1 and 2, these valves have been good performers with no failures to date.

Table 1		
Unit 1 Outage	**1-VLV-63-640 leakage (gpm)**	**1-VLV-63-643 leakage (gpm)**
U1R24 2021	0	0
U1R23 2019	0	0
U1R22 2018	0	0
U1R21 2016	0	0
U1R20 2015	0	0
U1R19 2013	0.14	0.10
U1R18 2012	0.636	0.14
U1R17 2010	0	0
U1R16 2009	0	0.015
U1R15 2007	0	0
U1R14 2006	0	0
U1R13 2004	0.17	0
U1R12 2003	0	0
U1R11 2001	0	0
U1R10 2000	0	0

Table 2		
Unit 2 Outage	**2-VLV-63-640 leakage (gpm)**	**2-VLV-63-643 leakage (gpm)**
U2R24 2021	0	0
U2R23 2020	0	0
U2R22 2018	0.337	0
U2R21 2017	0	0
U2R20 2015	0	0
U2R19 2014	0	0
U2R18 2012	0	0
U2R17 2011	0	0
U2R16 2009	0	0
U2R15 2008	0.489	0.548
U2R14 2006	0	0
U2R13 2005	0	0
U2R12 2003	0	0
U2R11 2002	0	0
U2R10 2000	0	0

EMIB-RAI-4

Alternative Request RV-02, Section VI, Item 3, "Design of the PIV check valves," discusses the failures of PIVs at Sequoyah.

The licensee is requested to provide the following information:

(a) Discuss if any PIVs experienced any subsequent physical damage or degradation after a mechanical agitator was applied.

(b) Describe the evaluation of the design of each check valve to demonstrate that if a valve initially fails its leak rate test and the alternative is applied, there is no reasonable potential for disk separation or failure that might impede flow if the valve must open to perform its safety function.

TVA Response

(a) The TVA response to EMIB-RAI-2(a) describes the operating experience with mechanical agitation of the PIVs that are within the scope of the alternative request. This operating experience shows that once mechanical agitation was successful in getting the valves to seat, the as-left leakage met acceptance criteria, and the valve remained in the closed position for the duration of the cycle with no further issues. Review of subsequent maintenance for valves that were mechanically agitated revealed no physical damage to internal parts as a result of the mechanical agitation. Any observed indications were associated with the seating surfaces of the disc and valve seat. This damage is most likely due to steam cuts from leak-by discovered during testing rather than due to mechanical agitation. There were also instances where no subsequent maintenance was performed for valves that were mechanically agitated and the valves met leakage acceptance criteria without further agitation.

(b) See the TVA responses to EMIB-RAI 2(b) and 2(c) regarding the evaluation that TVA has performed of the design of each PIV check valve, within the scope of this alternative request, to demonstrate that, if a PIV initially fails its leak rate test and the alternative is applied, the induced stresses in the valves due to mechanical agitation will not cause structural failure. Furthermore, TVA has performed benchmarking for the mechanical agitation process at other plants in the industry, as well as internal operating experience, to show that similar valves, which have had mechanical agitation applied, continue to perform their safety function as required. Based on the above information, if a valve initially fails its leak rate test and the alternative is applied, there is no reasonable potential for disc separation or failure that might impede flow if the valve must open to perform its safety function. Additionally, TVA has not experienced any failure of the PIVs, within the scope of the alternative request, to pass their required flow rate during open exercise testing required by ASME OM Code subsections ISTC-3522 and ISTC-5222. The open exercise testing is described in more detail in the response to EMIB-RAI 8.

EMIB-RAI-5

Alternative Request RV-02, Section IV, "Reason for Request," states, in part:

> *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.*

The licensee is requested to provide the following information:

> *Describe how the method to be used when implementing Alternative Request RV-02 will continue to meet ASME OM Code, paragraph ISTC-3630, "Leakage Rate for Other Than Containment Isolation Valves," subparagraph ISTC-3630(b), "Differential Test Pressure," and subparagraph ISTC-3630(e), "Analysis of Leakage Rates," while performing PIV leakage testing at a lower pressure.*

TVA Response

The test methodology for leak testing the PIVs will not change when implementing alternative request RV-02. The PIVs that are tested at less than full RCS operating pressure of 2235 psig have the results extrapolated to full RCS operating pressure. Equations are provided in the test surveillances to extrapolate the leakage to full RCS pressure. This meets the requirements of ASME OM code subparagraphs ISTC-3630(b) and ISTC-3630(e). The extrapolated leakage is verified to be less than the limit specified in SQN TS Surveillance Requirement (SR) 3.4.14.1. The leakage limit specified in SR 3.4.14.1 is 0.5 gpm per nominal inch of valve size for water, which is the same limit specified in ASME OM code subparagraph ISTC-3630(e)(1). The alternative request will allow the use of mechanical agitation to aid in seating the valve. Once a valve is mechanically agitated, the valve will be retested using its normal surveillance to ensure it meets acceptance criteria before the valve is declared operable.

EMIB-RAI-6

Alternative Request RV-02, Section V, "Proposed Alternative," in the subsection "Description of the Proposed Alternative," states, in part, that PIVs that have been mechanically agitated and subsequently passed seat leakage testing, will be repaired, or replaced during the next refueling outage.

In order to support to the long-term effectiveness of Alternative Request RV-02, please discuss any plans to leak test these PIVs before they are disassembled and inspected at the next refueling outage prior to commencing with their repair or replacement to determine if agitation caused any adverse effects on valve performance.

TVA Response

As noted in the TVA Introduction section to this RAI response, TVA plans to disassemble and inspect the PIV internals, prior to any repair or replacement maintenance, to determine if mechanical agitation had any adverse effects on the valve. However, for the PIVs within the scope of this alternative request which are mechanically agitated, TVA does not plan to leak test the valves at the next refueling outage prior to commencing with the repair or replacement for the following reasons.

- Although testing during shutdown is possible, PIV leak tests are typically performed during startup at low RCS pressure to minimize personnel hazard. Leak testing of the PIVs are performed inside containment utilizing steel braided hoses, a graduated cylinder, and stopwatch to collect and measure leakage from a drain or vent valve. Various manual valves are also operated to depressurize the test header and to align the check valves for testing. In order to maximize differential pressure across the check valve, personnel would have to enter inside containment soon after shutdown when

ambient temperature is high, which has the potential to unnecessarily jeopardize personnel safety and increase the risk of a human performance issue.

- The PIVs in the RHR cold leg injection lines (i.e., 1/2-VLV-63-560, -561, -562, -563, -632, -633, -634, and -635) cannot be leak tested upon Mode 4 entry because these valves are opened due to RHR being inservice for shutdown cooling. Shutdown cooling is not terminated until after core offload, and at that point there is no RCS pressure to backseat the check valves.
- Any additional information gained from an in-service test is not anticipated to offset the risk of the possible personnel safety or potential human performance issue as there is expected to be little gained through an as-found test versus an internal inspection that could be done immediately upon disassembly to identify any internal degradation.

EMIB-RAI-7

Alternative Request RV-02, Section VI, "Basis for Proposed Alternative," Item 4, "Description of Preventive Maintenance of the PIVs," first paragraph, states, "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."

Please explain this statement in light of the requirement under Alternative Request RV-02 that all PIVs that have been mechanically agitated must undergo repair or replacement, and retesting, at the next refueling outage.

TVA Response

The above quote from the proposed alternative request refers to the current preventative maintenance (PM) process at SQN to evaluate and identify PIVs recommended for internal inspection for an upcoming outage. This PM is performed prior to outage scope freeze, and it identifies which PIVs to recommend for internal inspection based on the following considerations; length of time from the previous inspection, leak rate trends, system pressurization occurrences, gas accumulation in the system, cold leg accumulator leak rate trends, and consequences of leakage on the plant and outage schedule. This PM is a separate program.

As noted in the RAI, TVA plans to repair or replace any PIV within the scope of this alternative request that has been mechanically agitated, at the next refueling outage in addition to the previously mentioned PM.

EMIB-RAI-8

Alternative Request RV-02, Section VI, Item 5, "Description of PIV Open Exercise Testing," states in part:

> *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.*

The licensee is requested to describe the ASME OM Code Appendix II check valve condition monitoring plan referenced in this item.

TVA Response

The check valves are in the check valve condition monitoring program with the leak test credited as the closed exercise test. For the open exercise test, flow is put through the check valves during comprehensive pump testing of the SI and RHR pumps (performed during an outage). Although total design pump flow is measured during pump testing (immediately downstream of the pump), not every injection line is instrumented and measured during each pump test. Therefore, to verify each check valve is exercised open and can pass a required flow rate, at least one check valve per outage, on an alternating basis, is instrumented to measure flow through the valve. The flow through each of the injection legs is balanced using orifices and needle valves which are locked to ensure they maintain the flow balance.

EMIB-RAI-9

During the pre-submittal meeting on February 16, 2022, the licensee indicated that recent operating experience has heightened TVA's awareness that mechanical agitation can lead to adequate valve sealing in addition to recent similar experience during the last Sequoyah Unit 2 outage. Please describe this experience during the last Sequoyah Unit 2 outage referenced in this meeting, and its impact on the provisions in Alternative Request RV-02.

TVA Response

In fall 2021, coincident with the SQN Unit 2 outage (U2R24), TVA became aware of industry peer questions about PIV leakage testing, which initiated an industry survey through the Inservice Testing Owners Group (ISTOG) list serve email service regarding PIV leakage testing. The SQN Unit 2 PIV leakage testing activities started soon after the industry questions and survey. Specifically, valve 2-VLV-63-634 exhibited excess leakage and failed to meet the leakage rate acceptance criteria during the initial leakage test at low pressure. This initial leak rate failure initiated site discussions regarding the possibility of using mechanical agitation on this valve in lieu of corrective maintenance. However, a subsequent PIV leakage test on 2-VLV-63-634 at a higher test pressure (more favorable test conditions) resulted in an acceptable leakage rate.

TVA's review of the ASME OM Code and industry operating experience search that revealed a 2019 Green Non-Cited Violation at Turkey Point (ML19105B281) regarding the unacceptable use mechanical agitation for preconditioning, 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 alternative to the requirements of ASME OM Code subsection ISTC-3630.