TENNESSEE VALLEY AUTHORITY

1101 Market Street, Chattanooga, Tennessee 37402

CNL-22-024

March 15, 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: Sequoyah Nuclear Plant, Units 1 and 2, American Society of Mechanical Engineers Operation and Maintenance Code, Request for Alternative RV-02

In accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a, "Codes and Standards," paragraph (z)(2), Tennessee Valley Authority (TVA) requests Nuclear Regulatory Commission (NRC) approval of the enclosed inservice testing (IST) alternative request, for the Sequoyah Nuclear Plant (SQN), Units 1 and 2. The American Society of Mechanical Engineers (ASME) Operation and Maintenance (OM) Code of Record for SQN Units 1 and 2 is the ASME OM Code 2004 Edition through 2006 Addenda. The duration of the proposed alternative request is through the remainder of the fourth ten-year IST interval, which is scheduled to end on June 30, 2026.

The alternative request applies to the SQN Units 1 and 2 pressure isolation valves (PIV) listed in the enclosure to this submittal. The applicable ASME OM Code requirements are listed below.

- Subsection ISTC-3630, “Leakage Rate for Other Than Containment Isolation Valves,” requires testing of PIVs to verify their seat leakages within acceptable limits and also states “Valve closure before seat leakage testing shall be by using the valve operator with no additional closing force applied.”
- Subsection ISTC-3630(a) requires PIV leakage rate testing to be conducted at least once every two years.
- Subsection ISTC-3630(f), “Corrective Action,” states “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.”
- Subsection ISTC-5221(a)(1), “Valve Obturator Movement,” states “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 function(s) (see ISTA-1100), and verify on cessation or reversal of flow, the obturator has traveled to the seat.”

- Subsection ISTC-5224, "Corrective Action," 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."

As discussed in the enclosure to this letter, compliance with Subsections ISTC-3630, ISTC-3630(f), ISTC-5221(a)(1), and ISTC-5224 for the PIVs listed in the enclosure to this submittal would cause a hardship or unusual difficulty without a compensating increase in the level of quality or safety in order to perform the repair or replacement activity required by ISTC-3630(f). Therefore, TVA is submitting this alternative request in accordance with 10 CFR 50.55a(z)(2). The enclosure to this letter describes the proposed alternative and the basis for use.

TVA requests approval of this alternative request by October 15, 2022, to support the upcoming SQN Unit 1 Cycle 25 refueling outage (U1R25) scheduled for October 22, 2022.

There are no new regulatory commitments associated with this submittal. Please address any questions regarding this request to Stuart L. Rymer, Senior Manager, Fleet Licensing, at slrymer@tva.gov.

Respectfully,

Digitally signed by Carla Edmondson
Date: 2022.03.15 19:23:11 -04'00'

James T. Polickoski
Director, Nuclear Regulatory Affairs

Enclosure:

Sequoyah Nuclear Plant (SQN) Unit 1 and 2 American Society of Mechanical Engineers (ASME) Operation and Maintenance (OM) 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

Sequoyah Nuclear Plant (SQN) Unit 1 and 2
American Society of Mechanical Engineers (ASME) Operation and Maintenance (OM) Code Request for Alternative RV-02

I. ASME OM Code Components Affected

Site/Unit	Component ID	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

II. ASME Code Edition and Addenda

ASME OM Code 2004 Edition through 2006 Addenda

III. Applicable Code Requirements

ASME OM Code, Subsection ISTC-3630, “Leakage Rate for Other Than Containment Isolation Valves,” states “Valve closure before seat leakage testing shall be by using the valve operator with no additional closing force applied.”

ASME OM Code, Subsection ISTC-3630(a) requires pressure isolation valve (PIV) leakage rate testing to be conducted at least once every two years.

ASME OM Code, Subsection ISTC-3630(f), “Corrective Action,” states “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.”

ASME OM Code, Subsection ISTC-5221(a)(1), "Valve Obturator Movement" states, "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 function(s) (see ISTA-1100), and verify on cessation or reversal of flow, the obturator has traveled to the seat."

ASME OM Code, Subsection ISTC-5224, "Corrective Action," 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."

IV. Reason for 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 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 gpm per nominal inch of valve size up to a maximum of 5 gpm at an RCS pressure ≥ 2215 psig 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 Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(f). As previously noted, the Code of Record for SQN Units 1 and 2 is the ASME OM Code 2004 Edition through 2006 Addenda, which 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 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, would cause a hardship or unusual difficulty without a compensating increase in the level of quality or safety in order to perform the repair or replacement activity required by ISTC-3630(f).

V. Proposed Alternative

Summary

The proposed alternative would permit continued startup if the PIV 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 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.

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 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 provisions 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.

VI. Basis for Proposed 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.
- 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.

Further justification for the proposed alternative is provided below.

1. Review of Maintenance History of the PIVs

   Condition Reports and WOs 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 that timeframe, the following intrusive maintenance activities were performed.

   <u>2" Y-pattern spring-loaded piston check valves</u>

   PIV leak test history has been generally satisfactorily (leakage present on 14% of tests on SQN Unit 1 and 5.9% on SQN Unit 2 - no as-left failures).

   - SQN Unit 1 - one rework in 2019 followed by one replacement of the same valve in 2021.
   - SQN Unit 2 - two reworks with spring and disc replacements (one in 2020 and one in 2021).

   <u>6" inclined seat swing check valves</u>

   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).

   - SQN Unit 1 - seven valve reworks (four in 2012, one in 2019, and two in 2021) with replacement of one of the valves in 2021. Inspections found seat damage in 2012 and 2019, and disc degradation or buildup in all cases.
   - SQN Unit 2 - two valve reworks (one in 2014 and one in 2015), and one replacement in 2014 (replaced the reworked valve in the same outage). Seat and disc damage found in 2014 and disc buildup found in 2015.

   <u>10" vertical seat swing check valves</u>

   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).

   - SQN Unit 1 - one valve rework in 2013 and the disc was replaced.
   - SQN Unit 2 - two valve reworks (one in 2015 and one in 2020). The disc was replaced in 2015; there were no replacements in 2020.

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

   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.

3. Design of the PIV check valves

Failure of a check valve disc to open (stuck closed), or detachment of the disc 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 disc is closed for long periods of time, allowing corrosion to bond the disc to other parts of the valve internals. Another failure mechanism is when the disc 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 disc 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 disc will fail to open, or become detached when flow is required. During the 17 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 disc 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

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 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

   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.

VII. Duration of Proposed Alternative

The duration of the proposed alternative request will be through the remainder of the fourth ten-year IST interval, which is scheduled to end on June 30, 2026.

VIII. Precedents

None