Tennessee Valley Authority

ASME/NRC OM Code Symposium (NRC2025)

Sequoyah Nuclear Plant (SQN) Inservice Testing (IST) Program Alternative Request Approval for Mechanical Agitation of Pressure Isolation Valve Testing

July 2025

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Introduction

- On September 29, 2022, TVA received Nuclear Regulatory Commission (NRC) approval, in accordance with 10 CFR 50.55a(z)(2), to allow the use of mechanical agitation for troubleshooting certain pressure isolation valves (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.
- This was an industry first of a kind alternative request.
- PIV testing at SQN is performed during startup from a refueling outage. If one of these PIVs fails and cannot pass at a higher pressure, without this alternative request, there is no remedy other than to repair or replace the valve as required in ISTC-3630(f). There is no other corrective action allowed by the ASME OM code.
- Without this alternative, SQN would be required to descend to a lower mode, possibly remove fuel from the reactor vessel, and drain the reactor coolant system (RCS) to a level which would allow the valve to be reworked.
- The approved alternative is applicable for the duration of the SQN Units 1 and 2 fourth IST ten-year interval.

Background

- In fall 2021, TVA became aware of industry peer questions about PIV leakage testing, which initiated an industry survey through the 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.
- 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.

Timeline

- 2/16/2022 – TVA conducts a presubmittal meeting with NRC (ML22046A295)
- 3/15/2022 – TVA submits alternative request RV-02 to NRC (ML22074A315)
- 5/27/2022 – NRC issues a request for additional information (RAI) (ML22151A010)
- 6/28/2022 – TVA responds to the RAI (ML22179A357)
- 8/10/22 to 8/15/2022 - NRC conducts a regulatory audit to review the TVA technical evaluation document for performing mechanical agitation of the PIVs (ML22220A107). NRC audit determines no further information is required to support the alternative request (ML22263A008)
- 9/29/2022 – NRC approves the alternative request (ML22263A375)

Applicable Code Requirements

- The code of record for SQN is the ASME OM Code 2004 Edition through 2006 Addenda.
- 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 section ISTC-3630(f), “Corrective Action,” states, “Valves or valve combinations with leakage rates exceeding the valves specified by the Owner per ISTC-3630(e) shall be declared inoperable and either repaired or replaced. A retest demonstrating acceptable operation shall be performed following any required corrective action before the valve is returned to service.”
- ASME OM Code, Subsection ISTC-5221(a)(1), “Valve Obturator Movement,” states “Check valves having 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 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	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-63-632/633/634/635	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
SQN Unit 1 and 2	1/2-VLV-63-560/561/562/563	RHR 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

Reason for Request

- PIV testing is performed in accordance with ISTC-3630 and is normally performed during startup from a refueling outage (Modes 5 through 3).
- These valves are difficult to test because there are no block valves to allow individual tests using a temporary pressure source as is done for local leak rate tests (LLRTs). The test is conducted using RCS or CLA pressure and requires system manipulations with multiple entries into Limiting Conditions for Operations (LCOs), often on or close to the outage critical path.
- In some cases, mechanical agitation has been necessary to get the valve to seat well enough to achieve an acceptable leakage rate. Mechanical agitation is a troubleshooting tool rather than a repair method.
- Without this alternative request, if one of the affected PIVs fails and cannot pass at a higher pressure, there is no remedy other than to repair or replace the valve as required in ISTC-3630(f). There is no other corrective action allowed by the ASME OM code.
- Failure of a PIV, places the unit into a 72 hours Technical Specification (TS) Required Action, and if not met, requires the unit be in Mode 3 in six hours and Mode 5 in 36 hours.

Basis for Hardship

- The TS leakage criteria is the same as the ASME OM Code general criteria for PIVs, and the ASME OM Code does not allow use of analysis to declare a valve acceptable (non-conforming but operable).
- If the PIV fails the SR 3.4.14.1 and OM Code leakage acceptance criteria, then SQN TS 3.14.14, Required Action A.1 requires isolation of the high-pressure portion of the affected system from the low-pressure portion by use of one closed manual, deactivated automatic, or check valve within four hours and Required Action A.2 requires restoration of the RCS PIV to within limits within 72 hours.
- In order to repair or replace a failed PIV, the plant would have to reverse startup activities by lowering pressure, possibly remove fuel from the reactor vessel, and RCS water level as required 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.

Approved Alternative

- If PIV leakage rate testing is not acceptable at the highest possible test pressure (using only RCS or CLA pressure), 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.
- PIVs declared inoperable due to unacceptable seat leakage may be mechanically agitated to help the valve disc seat.
- 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.

Mechanical Agitation Process

TVA developed a technical evaluation to formally document the guidance for performing mechanical agitation of the PIVs based on industry precedence. Key elements of this technical evaluation are provided below:

- 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 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.

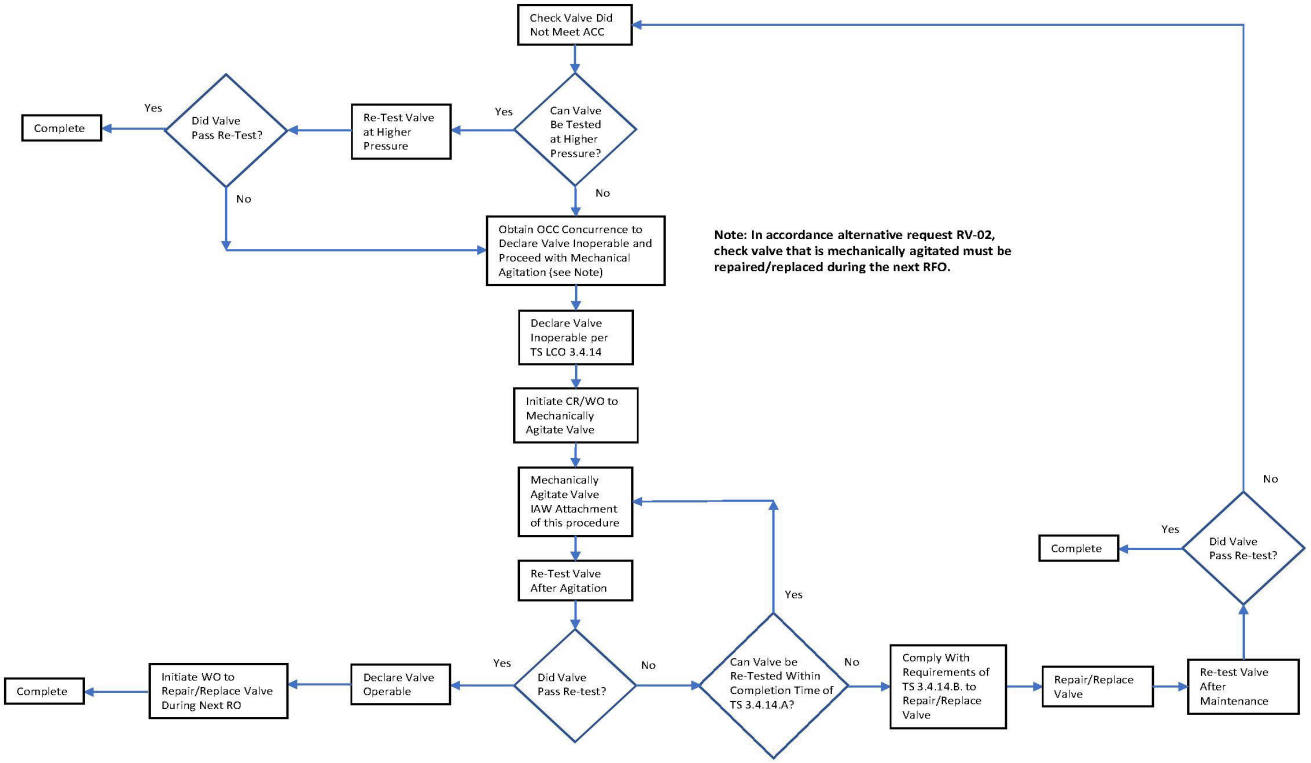
Mechanical Agitation Process (cont'd)

- 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.
  - 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.

Mechanical Agitation Process (cont'd)

- 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.
- Site procedures have been revised to include the mechanical agitation process and the approved alternative request.

Mechanical Agitation Flow Chart



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Other Similar NRC-approved Alternative Requests

- Following NRC approval of the TVA alternative request related to mechanical agitation, NRC approved the following similar alternative requests:
- On December 8, 2022, Dominion submitted a similar alternative request for the Surry Power Station Unit 1 to allow use of the mechanical agitation process for pressure isolation valve 1-51-241 seat leakage testing (Accession Number ML22342B248) for the remainder of their current operating cycle. NRC granted verbal approval on December 9, 2022 (ML23058A144) and the formal NRC Safety Evaluation was issued on April 25, 2023 (ML23102A283).
- Subsequently, on October 12, 2023, Dominion submitted a similar alternative request for the Surry Power Station Units 1 and 2 to allow use of the mechanical agitation process for their Category A pressure isolation valves for their sixth 10-year IST interval (ML23285A092). NRC approval was granted on August 12, 2024 (ML24164A001).

Revision to the Alternative Request

- On March 26, 2025, TVA submitted a revision to the SQN Alternative Request TV-02 for mechanical agitation of PIVS to:
  - To reflect a change in the SQN Units 1 and 2 Technical Specification (TS) Surveillance Requirement (SR) 3.4.14.1, “Reactor Coolant System (RCS) Pressure Isolation Valve (PIV) Leakage” to only reference the Inservice Testing Program (IST) Program for the Frequency and
  - Indicate that For PIVs that have been mechanically agitated and subsequently 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. If needed, the mechanical agitation can be re-performed.
- The revised alternative request is currently pending NRC review and approval.

Lessons Learned

- Early and frequent discussions with the NRC were a key element in getting approval of the alternative request.
- Mechanical agitation is a troubleshooting tool rather than a repair method.
- Have a well documented history of the maintenance history of the subject valves and previous instances of using mechanical agitation.
- Have a thorough and well detailed technical evaluation to support the use of mechanical agitation.
- Engage affected stakeholders (e.g., Operations, Work Management, Engineering)


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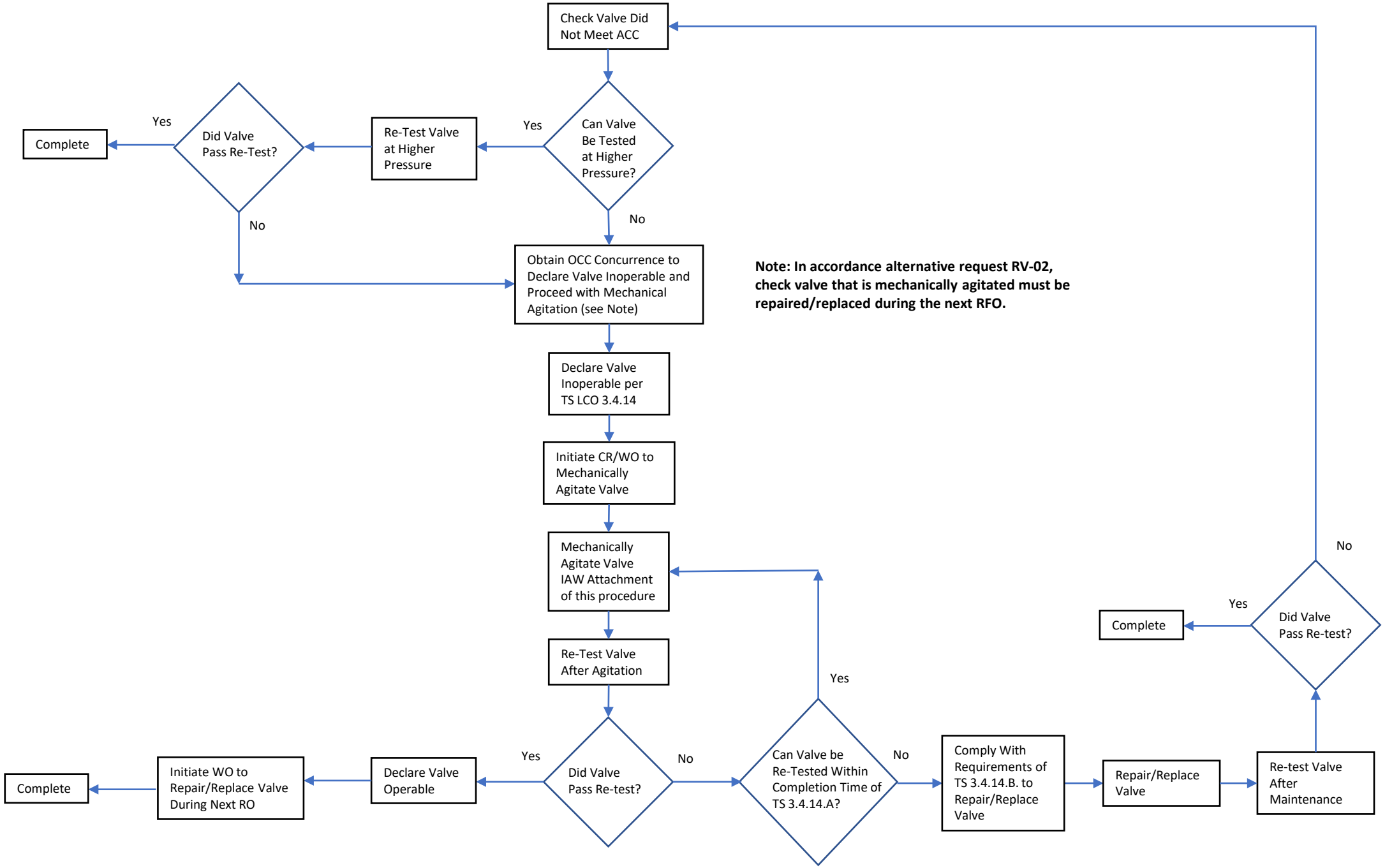
Check Valve Did Not Meet ACC
Can Valve Be Tested at Higher Pressure?
Yes
Re-Test Valve at Higher Pressure
Did Valve Pass Re-Test?
Yes
Complete
No
No
Obtain OCC Concurrence to Declare Valve Inoperable and Proceed with Mechanical Agitation (see Note)
Note: In accordance alternative request RV-02, check valve that is mechanically agitated must be repaired/replaced during the next RFO.
Declare Valve Inoperable per TS LCO 3.4.14
Initiate CR/WO to Mechanically Agitate Valve
Mechanically Agitate Valve IAW Attachment of this procedure
Re-Test Valve After Agitation
Did Valve Pass Re-test?
Yes
Declare Valve Operable
Initiate WO to Repair/Replace Valve During Next RO
Complete
No
Can Valve be Re-Tested Within Completion Time of TS 3.4.14.A?
Yes
No
Comply With Requirements of TS 3.4.14.B. to Repair/Replace Valve
Repair/Replace Valve
Re-test Valve After Maintenance
Did Valve Pass Re-test?
Yes
Complete
No