Tennessee Valley Authority, 1101 Market Street, Chattanooga, Tennessee 37402

CNL-15-186

November 18, 2015

10 CFR 50.4
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 - American Society of Mechanical Engineers Operation and Maintenance Code Relief Requests for Fourth Ten-Year Inservice Test Interval**

References:

1. TVA letter to NRC, "Sequoyah Nuclear Plant, Units 1 and 2, – Inservice Test (IST) Program Update and Associated Relief Requests for Third Ten-Year Interval," dated January 10, 2006 (ML060130281)
2. NRC letter to TVA, "Sequoyah Nuclear Plant, Units 1 and 2 – Request for Relief from Requirements of the ASME Code (TAC NOS. MC9537, MC9538, MC9539, MC9540, MC9541, MC9542, MC9543, MC9544, MC9545, MC9546, MC9547, MC9548, MC9549, MC9550, MC9551, MC9552, MC9553, and MC9554)," dated July 27, 2006 (ML061790733)
3. TVA letter to NRC, "American Society of Mechanical Engineers Request for Relief RP-01," dated April 1, 2011 (ML110950682)
4. NRC letter to TVA, "Safety Evaluation of Relief Request No. RP-01, Revision 1 for the Third 10-Year Inservice Testing Program Interval (TAC NOS. MES982 and MES983)," dated March 13, 2012 (ML12025A159)
5. TVA letter to NRC, CNL-14-229, "American Society of Mechanical Engineers Request for Relief RP-07," dated December 31, 2014 (ML14365A207)
6. TVA letter to NRC, CNL-15-136, "Response to NRC Request for Additional Information Regarding American Society of Mechanical Engineers Request for Relief RP-07 (TAC Nos. MF5585 AND MF5586)," dated July 22, 2015

Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a, the purpose of this letter is to request the Nuclear Regulatory Commission's (NRC) approval of the following requests for relief from the American Society of Mechanical Engineers (ASME) Operation and Maintenance (OM) Code for the Sequoyah Nuclear Plant (SQN), Units 1 and 2 fourth ten-year inservice testing (IST) program interval that begins June 1, 2016.

Relief Request Number	Subject	Basis for Relief
Pump Relief Request - RP-01	Essential Raw Cooling Water (ERCW) Screen Wash Pump Flow Measurement	Compliance with the specified code requirements results in hardship or unusual difficulty without a compensating increase in the level of quality and safety and the proposed alternative provides an acceptable level of quality and safety in accordance with 10 CFR 50.55a(z).
Pump Relief Request - RP-02	Residual Heat Removal (RHR) Pump Flow Measurement	Compliance with the Code requirements is considered impractical pursuant to 10 CFR 50.55a(f)(6)(i) and the proposed alternative provides an acceptable level of quality and safety in accordance with 10 CFR 50.55a(z)(1).
Pump Relief Request - RP-04	Pump Vibration Reference Values and Acceptance Criteria	The alternatives proposed in the relief request provide an acceptable level of quality and safety pursuant to 10 CFR 50.55a(z)(1).
Pump Relief Request - RP-06	RHR Pump Vibration Measurements	Compliance with the specified code requirements results in hardship or unusual difficulty without a compensating increase in the level of quality and safety and the proposed alternative provides an acceptable level of quality and safety in accordance with 10 CFR 50.55a(z).
Pump Relief Request - RP-08	IST Class 2 and 3 Pump Testing Requirements Using OMN-18	The alternatives proposed in the relief request provide an acceptable level of quality and safety pursuant to 10 CFR 50.55a(z)(1).
Valve Relief Request - RV-01	Reactor Head Vent Valve Stroke Timing	Compliance with the Code requirements is considered impractical pursuant to 10 CFR 50.55a(f)(6)(i) and the proposed alternative provides an acceptable level of quality and safety in accordance with 10 CFR 50.55a(z)(1).

Additional details regarding these relief requests are provided in Enclosures 1 and 2.

By letter dated January 10, 2006 (Reference 1), Tennessee Valley Authority (TVA) submitted the SQN IST program update and the associated requests for relief for SQN's third ten-year interval that began June 1, 2006. By letter dated July 27, 2006 (Reference 2), the NRC authorized the use of those relief requests for SQN's third IST interval that will end May 31, 2016. By letter dated April 1, 2011 (Reference 3), TVA requested a revised relief request for RP-01 for the third ten-year interval which was approved by NRC in Reference 4. With the exception of relief request RP-08, the above relief requests were previously approved by the NRC for SQN's third ten-year IST interval. An additional relief request (RP-07) that also applies to the fourth ten-year interval was submitted by TVA to NRC in References 5 and 6 and is currently being reviewed by the NRC. The enclosures list relief requests that were approved by NRC for the SQN IST third ten-year interval, but are no longer needed for the IST fourth ten-year interval.

The previous ten-year IST relief request for SQN (Reference 1) was submitted to the NRC with the revised overall IST program plan for the associated ten-year interval. However, in order to ensure timely submission of these relief requests for the upcoming fourth ten-year IST interval, TVA is submitting the associated relief requests separately and in advance of the revised overall IST program plan. The Sequoyah Nuclear Plant IST program is being revised to comply with the 2004 Edition through 2006 Addenda of the ASME OM code as currently endorsed by NRC in 10 CFR 50.55a. The revised IST program plan for the fourth ten-year interval will be submitted by separate correspondence following NRC approval of the enclosed relief requests.

As aforementioned, SQN's fourth ten-year IST interval begins June 1, 2016. TVA requests NRC review and approval of the enclosed relief requests to support the June 1, 2016, start date.

There are no regulatory commitments contained in this letter. Should you have any questions, please contact Russ Wells at (423) 751-8130.

Respectfully,

J. W. Shea

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Enclosures

1. Pump Inservice Test Program Relief
2. Valve Inservice Test Program Relief Requests

cc (Enclosures):
NRC Regional Administrator – Region II
NRC Senior Resident Inspector – Sequoyah Nuclear Plant
NRR Project Manager - Sequoyah Nuclear Plant

Enclosure 1
Pump Inservice Test Program Relief Requests
Pump Relief Request - RP-01
ERCW Screen Wash Pump Flow Measurement

ASME Operations and Maintenance (OM) Code Components Affected

Pump ID	Pump Description	Pump Type	Code Class	OM Group
0-PMP-67-470	ERCW Screen Wash Pump A-A	Vertical Line Shaft	3	A
0-PMP-67-477	ERCW Screen Wash Pump B-B			
0-PMP-67-482	ERCW Screen Wash Pump C-B			
0-PMP-67-487	ERCW Screen Wash Pump D-A			

ASME Code Edition and Addenda

ASME OM Code 2004 Edition through 2006 Addenda

Applicable Code Requirement

ISTB-5210 Preservice Testing
(a) In systems where resistance can be varied, flow rate and differential pressure shall be measured at a minimum of five points. If practicable, these points shall be from pump minimum flow to at least pump design flow. A pump curve shall be established based on the measured points. At least one point shall be designated as the reference point(s). Data taken at the reference point will be used to compare the results of inservice tests. A pump curve need not be established for pumps in systems where resistance cannot be varied.

ISTB-5221 Group A Test Procedure
(b) The resistance of the system shall be varied until the flow rate equals the reference point. The differential pressure shall then be determined and compared to its reference value. Alternatively, the flow rate shall be varied until the differential pressure equals the reference point and the flow rate determined and compared to the reference flow rate value.

ISTB-5223 Comprehensive Test Procedure
(b) The resistance of the system shall be varied until the flow rate equals the reference point. The differential pressure shall then be determined and compared to its reference value. Alternatively, the flow rate shall be varied until the differential pressure equals the reference point and the flow rate determined and compared to the reference flow rate value.

Reason for Request

The configuration of the Essential Raw Cooling Water (ERCW) Screen Wash Pump discharge piping system does not provide straight lengths of piping that will support the installation of a permanent flow measuring device or the utilization of a portable flow measuring device capable of providing accurate flow rate measurements. The lack of permanent or temporary flow instrumentation makes it impractical to adjust pump flow to specific value(s) and measure the associated differential pressure as required for performance of Preservice, Group A, and comprehensive pump tests.

Enclosure 1
Pump Inservice Test Program Relief Requests
Pump Relief Request - RP-01
Essential Raw Cooling Water (ERCW) Screen Wash Pump Flow Measurement

Burden Caused by Compliance

Significant system modifications, such as piping rerouting and support redesign, would be required to obtain a configuration that would provide reliable flow readings. Refer to the Proposed Alternative and Basis of Use section for further details.

Proposed Alternative and Basis for Use

Proposed Alternative
Testing will be performed by setting the system resistance to the same point for each test with the throttle valves full open. Flow will not be measured. The remaining variable that could affect system resistance is the condition of the spray nozzles. The condition of the spray nozzles will be inspected during each test performance with corrective action initiated as necessary, thus providing assurance that the condition of the spray nozzle will not affect flow rate. With system resistance maintained constant for each test, pump degradation would be identified through changes in differential pressure. Differential pressure is calculated using inlet (based on lake level or suction pressure) and discharge pressure. The pump will be trended for degradation based on differential pressure at this point. Vibration readings will also be taken at this reference point. The pump will be tested in this manner for the Preservice Test, the quarterly Group A, and biennial comprehensive inservice tests.

Instrument accuracy and acceptance criteria for pump differential pressure and vibration will meet the requirements of Table ISTB-3510-1 and Table ISTB-5221-1, respectively. Preservice test data for differential pressure and vibration data will be evaluated to verify it represents acceptable pump operation and will be used as reference values for subsequent quarterly Group A and comprehensive inservice tests.

Basis for Use
The piping design does not provide permanent in-line instrumentation to measure flow. The pump design (vertical line shaft) and discharge piping do not allow the use of portable flow measuring equipment such as ultrasonic flow meters. These pumps take suction from the pump pit directly below the pump deck and are positioned on the deck adjacent to the traveling screens. The discharge piping for each pump is short and open ended, containing several elbows, reducers, and valves prior to entering the traveling screen enclosure. The configuration of this piping system does not provide straight lengths of piping that will support the installation of a permanent flow measuring device or the utilization of a portable flow measuring device capable of providing accurate flow rate measurements. Significant system modifications, such as piping rerouting and support redesign, would be required to obtain a configuration that would provide reliable flow readings.

Flow is not the critical parameter for these pumps. The nature of their operation is to ensure that sufficient pressure is maintained at the spray nozzles during flushing operations of the traveling water screens to ensure that sufficient force is exerted on the debris accumulated on the screen to remove it. This can be verified by visual observation verifying the effectiveness of the flushing operation.

A review of maintenance history determined that the spray nozzles are not susceptible to plugging. The spray nozzles are inspected by personnel during spray operation with corrective maintenance initiated as required.

Isometric drawings and photographs of the screen wash pump system were provided to show piping configuration in Enclosure 3 of the TVA letter to NRC, "Sequoyah Nuclear Plant (SQN), Response to Request for Additional Information (RAI) Associated With Inservice Test (IST) Program and Associated Relief Requests for Third 10-Year Interval," dated April 17, 2006 (ML061100186). A significant plant modification would be required to install flow instrumentation for this system. A plant modification would include rerouting 3-inch diameter piping and the associated piping supports and rerouting heat trace equipment for four pumps. The feasibility of installing temporary flow instrumentation was considered for utilizing portable ultrasonic flow instrumentation during testing. Accurate and repeatable flow measurement requires the ultrasonic flow sensor to be positioned on straight runs of piping (preferably horizontal). The current system piping configuration has no straight runs of piping that meets the requirements for adequate installation of the ultrasonic flow sensor. Based on the information provided above, compliance with the ASME OM Code requirements is impractical and the proposed alternative provides reasonable assurance of the operational readiness of the ERCW Screen Wash Pumps.

Duration of the Proposed Alternative

This request is for the duration of the fourth IST ten-year Interval (begins June 1, 2016, and ends May 31, 2026).

Precedents

This relief request was previously approved for SQN's third ten-year interval by References 2 and 4 of the cover letter. A similar relief request (PV-02) was approved by the NRC for the Watts Bar Nuclear Plant Unit 1 second ten-year interval on March 9, 2007 (ML070090504).

Enclosure 1
Pump Inservice Test Program Relief Requests
Pump Relief Request - RP-02
RHR Pump Flow Measurement

ASME OM Code Affected Components

Pump ID	Pump Description	Pump Type	Code Class	OM Group
1-PMP-74-10	RHR Pump 1A-A	Cent.	2	A
1-PMP-74-20	RHR Pump 1B-B			
2-PMP-74-10	RHR Pump 2A-A			
2-PMP-74-20	RHR Pump 2B-B			

ASME Code Edition and Addenda

ASME OM Code 2004 Edition through 2006 Addenda

Applicable Code Requirement

Table ISTB-3000-1 Inservice Test Parameters
This table specifies the pump parameters to be measured during preservice, Group A, Group B, and comprehensive tests.

ISTB-5121 Group A Test Procedure
Group A tests shall be conducted with the pump operating at a specified reference point. The test parameters shown in Table ISTB-3000-1 shall be determined and recorded as required by this paragraph. The test shall be conducted as follows:
(b) The resistance of the system shall be varied until the flow rate equals the reference point. The differential pressure shall then be determined and compared to its reference value. Alternatively, the flow rate shall be varied until the differential pressure equals the reference point and the flow rate determined and compared to the reference flow rate value.
(e) All deviations from the reference values shall be compared with the ranges of Table ISTB-5121-1 and corrective action taken as specified in ISTB-6200.

Reason for Request

Residual Heat Pump (RHR) pumps are tested using the minimum flow recirculation line provided for pump protection. No other flow path is available to meet the Group A quarterly testing of ISTB. The miniflow path is of fixed resistance, instrumented, and limits flow to the minimum required flow for pump protection. The nominal miniflow rate is 500 gpm for pump protection.

Proposed Alternative and Basis for Use

Proposed Alternative
The RHR Pumps will be Group A tested quarterly using the minimum flow recirculation line where differential pressure and vibration will be measured and trended. The RHR Pumps will be subjected to a Comprehensive Pump test in accordance with ISTB requirements each refueling outage.

Enclosure 1
Pump Inservice Test Program Relief Requests
Pump Relief Request - RP-02
RHR Pump Flow Measurement

Basis for Use

Test results during previous ten-year inspection intervals have shown variations of recorded flow readings which exceed ISTB allowable range requirements. The RHR pump miniflow rate is measured using an installed flow measuring device in the 14-inch pump discharge header while flowing through the 3-inch miniflow line which includes a 2-inch miniflow return valve. The flow measuring device meets ISTB range and accuracy requirements, however, small changes in the differential pressure across the flow element equate to relatively large changes in the flow. A differential pressure change of two inches of water at the flow element would equal a 44 gpm change in flow.

While operating through the miniflow recirculation line, the pump is operating in the flat portion of the pump curve near shutoff head conditions. In this region of the pump's hydraulic curve, very small changes in the developed head correspond to large changes in produced flow. For example, a change in developed head of 0.15 psig would result in a change of approximately 52 gpm. A change in flow in excess of 3000 gpm would be required for the differential pressure to exceed the ISTB acceptable range of 0.9 times the reference value.

With the configuration of the installed flow instrumentation and the resulting negligible effect that changes in the flow have on differential pressure while operating on minimum flow path, maintaining compliance to ISTB specified flow ranges is not practical. Additionally, TVA considered performing testing during cold shutdowns and determined it is not practical to perform testing during cold shutdown as the RHR system is typically inservice and relied upon for heat removal and safe operation of the plant. Flow adjustments for testing purposes could affect safe plant operation in maintaining the plant while in the cold shutdown state.

This relief request meets the intent of Position 9 in Attachment 1 to Generic Letter 89-04. The RHR system is typically in service during cold shutdown conditions. Safe operation of the plant is affected by changes to system configurations and flow adjustments required for testing (see page 21 of Enclosure 2 of the TVA response to NRC RAIs regarding the SQN third ten-year interval (ML061100186)).

No other flow measurement means are available that will provide the repeatability necessary to meet ISTB ranges.

Duration of the Proposed Alternative

This request is for the duration of the fourth IST ten-year Interval (begins June 1, 2016, and ends May 31, 2026).

Precedents

This relief request was previously approved for SQN's third ten-year interval by Reference 2 of the cover letter.

Enclosure 1
Pump Inservice Test Program Relief Requests
Pump Relief Request - RP-03
Boric Acid Transfer Pumps

Relief request RP-03 was approved for the third IST 120-month interval, but is no longer needed for the fourth IST 120-month interval.

Enclosure 1
Pump Inservice Test Program Relief Requests
Pump Relief Request - RP-04
Pump Vibration Reference Values and Acceptance Criteria

ASME OM Code Affected Components

Pump ID	Pump Description	Pump Type	Code Class	OM Group
0-PMP-67-432	Essential Raw Cooling Water Pumps	Vertical Line Shaft	3	A
0-PMP-67-436				
0-PMP-67-440				
0-PMP-67-444				
0-PMP-67-452				
0-PMP-67-456				
0-PMP-67-460				
0-PMP-67-464				
0-PMP-70-51	Component Cooling Water Pumps	Centrifugal	3	A
1-PMP-70-38				
1-PMP-70-46				
2-PMP-70-33				
2-PMP-70-59				
0-PMP-313-303	Shutdown Board Room Chilled Water Pumps	Centrifugal	3	A
0-PMP-313-338				
1-PMP-62-230	Boric Acid Transfer Pumps	Centrifugal	3	A
1-PMP-62-232				
2-PMP-62-230				
2-PMP-62-232				
1-PMP-63-10	Safety Injection Pumps	Centrifugal	2	B
1-PMP-63-15				
2-PMP-63-10				
2-PMP-63-15				
1-PMP-72-10	Containment Spray Pumps	Centrifugal	2	B
1-PMP-72-27				
2-PMP-72-10				
2-PMP-72-27				
1-PMP-3-118	Auxiliary Feedwater (Motor) Pumps	Centrifugal	3	A
1-PMP-3-128				
2-PMP-3-118				
2-PMP-3-128				
0-PMP-67-470	ERCW Screen Wash Pumps	Vertical Line Shaft	3	A
0-PMP-67-477				
0-PMP-67-482				
0-PMP-67-487				
1-PMP-3-142	Auxiliary Feedwater (Steam) Pumps	Centrifugal	3	B
2-PMP-3-142				

Enclosure 1
Pump Inservice Test Program Relief Requests
Pump Relief Request - RP-04
Pump Vibration Reference Values and Acceptance Criteria

Pump ID	Pump Description	Pump Type	Code Class	OM Group
1-PMP-62-104	Centrifugal Charging Pumps	Centrifugal	2	A
1-PMP-62-108				
2-PMP-62-104				
2-PMP-62-108				
1-PMP-74-10	RHR Pumps	Centrifugal	2	A
1-PMP-74-20				
2-PMP-74-10				
2-PMP-74-20				

ASME Code Edition and Addenda

ASME OM Code 2004 Edition through 2006 Addenda

Applicable Code Requirement

ISTB-3300 Reference Values
(a) Initial reference values shall be determined from the results of testing meeting the requirements of ISTB-3100, Preservice Testing, or from the results of the first inservice test.

Tables ISTB 5121-1 and ISTB-5221-1
The tables establish the ranges of acceptability of reference values. Specifically, the tables require the use of 2.5 and 6 times the reference values in determining acceptable ranges of vibration unless those calculated values exceed the absolute limits specified in the Tables.

ISTB-5121(e), ISTB-5123(e), ISTB-5221(e), and ISTB-5223(e)
All deviations from the reference values shall be compared with the ranges of Table ISTB-5121-1 (and Table ISTB-5221-1) and corrective action taken as specified in ISTB-6200. The vibration measurements shall be compared to both the relative and absolute criteria shown in the alert and required action ranges of Table ISTB-5121-1 (and Table ISTB-5221-1). For example, if vibration exceeds either $6V_r$ or 0.7 in./sec (1.7 cm/sec), the pump is in the required action range.

ISTB-5122(d) and ISTB-5222(d)
All deviations from the reference values shall be compared with the ranges of Table ISTB-5121-1 (and Table ISTB-5221-1) and corrective action taken as specified in ISTB-6200.

Enclosure 1
Pump Inservice Test Program Relief Requests
Pump Relief Request - RP-04
Pump Vibration Reference Values and Acceptance Criteria

Reason for Request

Relief is being requested for establishing a vibration reference value (V_r) because the data collected during preservice or inservice testing for those vibration points that have unusually low levels of vibration (smooth running pumps). This request applies only to values for V_r associated with vibration testing. Small values for V_r result in small acceptable ranges for pump operation. The acceptable range defined in Table ISTB-5121-1 and Table ISTB-5221-1 is less than or equal to $2.5V_r$. Based on a small acceptable range, a smooth running pump could be subject to unnecessary corrective action caused by numerically small changes in vibration levels.

The list of affected components for his relief request, as approved by the NRC for the third ten-year interval, was expanded to include all pumps in the IST program. This will allow for application of this relief to those pumps with measured V_r less than or equal to 0.05 inches per second (ips).

Proposed Alternative and Basis for Use

Proposed Alternative
Pumps with a measured V_r less than or equal to 0.05 ips for a particular vibration measurement location will have subsequent test results for that location compared to an acceptable range based on 0.05 ips. In addition to the applicable ASME OM Code requirements, all pumps in the IST program will be included in and will remain in the Predictive Maintenance Program regardless of their smooth running status.

When new reference values are established, the measured parameters will be evaluated for each location to determine if the provisions of this relief request still apply. If the measured V_r is greater than 0.05 ips, the requirement of ISTB-3300 will be applied. Conversely, if the measured V_r is less than or equal to 0.05 ips, a minimum value of 0.05 ips will be used in determining the acceptable, alert, and required action ranges of the OM code.

Basis for Use
For very small reference values, hydraulic noise and instrument error can be a significant portion of the vibration reading and affect the repeatability of subsequent measurements. Also, experience gathered from the Predictive Maintenance Program has shown that changes in vibration levels in the range of 0.05 ips do not normally indicate significant degradation in pump performance.

To avoid unnecessary corrective action, a minimum V_r of 0.05 ips is being established for velocity measurements. This minimum value will be applied to individual vibration locations for the pumps listed in the above table where the measured reference value is less than 0.05 ips. The Predictive Maintenance Program currently employs the following predictive monitoring techniques on an as applicable and as needed basis:

A. Vibration monitoring and analysis beyond that required by ISTB,
B. Oil sampling and analysis, and
C. Thermographic Analysis.

Bearing temperature trending is available for a number of the components through the plant process computer system. If the measured parameters are discovered to be outside the normal operating range or to be trending toward an unacceptable degraded state, appropriate actions are taken that may include.

A. Increased monitoring to establish rate of change,
B. Review of component specific information to identify cause, and
C. Removal of the pump from service to perform maintenance.

Periodic reports are generated from test data, both IST and Predictive Maintenance collected.

This alternative to the requirements of ISTB-3300 provides an acceptable level of quality and safety.

Duration of the Proposed Alternative

This request is for the duration of the fourth IST ten-year Interval (begins June 1, 2016, and ends May 31, 2026).

Precedents

This relief request was previously approved for SQN's third ten-year interval by Reference 2 of the cover letter. A similar relief request (PV-01) was approved by the NRC for the Watts Bar Nuclear Plant Unit 1 second ten-year interval on March 9, 2007 (ML070090504). Additional regulatory precedents are listed below:

- A similar relief request (PRR8) was approved by the NRC for the Beaver Valley Power Station Unit 2 on February 14, 2008 (ML080140299).

- A similar relief request (PRR-04) was approved by the NRC for the James A. FitzPatrick Nuclear Power Plant on November 27, 2007 (ML072910422).

- A similar relief request (P-1) was approved by the NRC for the North Anna Power Station Units 1 and 2 on January 28, 2002 (ML020280439).

Enclosure 1
Pump Inservice Test Program Relief Requests
Pump Relief Request - RP-05
Calibration Range of Digital Instrument

Relief request RP-05 was approved for the third IST 120-month interval, but is no longer needed for the fourth IST 120-month interval.

Enclosure 1
Pump Inservice Test Program Relief Requests
Pump Relief Request - RP-06
RHR Pump Vibration Measurements

ASME OM Code Affected Components

Pump ID	Pump Description	Pump Type	Code Class	OM Group
1-PMP-74-10	RHR Pump 1A-A	Cent.	2	A
1-PMP-74-20	RHR Pump 1B-B			
2-PMP-74-10	RHR Pump 2A-A			
2-PMP-74-20	RHR Pump 2B-B			

ASME Code Edition and Addenda

ASME OM Code 2004 Edition through 2006 Addenda

Applicable Code Requirement

ISTB-3510, General
(e) *Frequency Response Range:* The frequency response range of the vibration-measuring transducers and their readout system shall be from one-third minimum pump shaft rotational speed to at least 1000 Hz.

ISTB-5121, Group A Test Procedure
(d) Vibration (displacement or velocity) shall be determined and compared with the reference value. Vibration measurements shall be broad band (unfiltered). If velocity measurements are used, they shall be peak. If displacement amplitudes are used, they shall be peak-to-peak.

Reason for Request

TVA proposes to exclude from the ISTB Group A pump test the vibration measurement in the range from one-third up to one-half pump shaft rotational speed. The exclusion of vibration measurements from one-third to one-half minimum pump shaft rotational speed will exclude the readings associated with the natural frequencies as described below. It has been shown that these frequencies do not affect pump performance. Excluding this range of vibration for test measurements would prevent placing the pumps in an “Increased Frequency” test status. Placing SQN’s RHR pumps on an increased frequency test status provides no added value for monitoring pump performance. The dominant peak at one-third running speed masks data trending at the frequencies that represent actual pump/motor health.

Burden Caused by Compliance

This results in an unnecessary burden because increasing the test frequency of the pumps would result in additional wear on the equipment and potential challenges to the plant. Pump degradation, due to real physical problems, will be evident with the pump test monitoring the representative pump/motor condition frequencies and without masking the unrelated structural resonant peak. This will ensure appropriate corrective actions are taken to address those levels of vibration that could result in pump degradation.

Enclosure 1
Pump Inservice Test Program Relief Requests
Pump Relief Request - RP-06
RHR Pump Vibration Measurements

Proposed Alternative and Basis for Use

Proposed Alternative
Vibration measurements of the upper motor bearing of the RHR pumps will be taken during the ISTB Group A pump tests in a range from one-half minimum pump shaft rotational speed to at least 1000 Hz.

Basis for Use
Historical Data: Historical documents for pump performance indicate that a high vibration condition has existed on SQN's RHR pumps since original installation of these pumps. This condition also existed prior to the ASME conversion to the ISTB pump criteria that incorporated an expanded frequency range for measurement of pump vibration (one-third to one-half rotational speed). TVA has monitored this condition for SQN's RHR pumps and concludes there is no degradation of the pump/motor/foundation assembly from the inherent high vibration in this range.

Manufacturer Data: Westinghouse Electric Company (Westinghouse), provider of SQN's RHR pumps, issued Technical Bulletin NSID-TB-86-02 Revision 1, "Vibration Motor Resonant Vibration - Residual Heat Removal Pumps," dated September 23, 1986, that advised utilities of the potential for a high vibration condition in vertical pump/motor/foundation support assemblies. The bulletin references the condition that SQN is experiencing. Consultation with Westinghouse and the results of TVA's evaluation of this issue are provided below.

Attempts to Correct Vibration Issue: In accordance with the vendor recommendations from NSID-TB-86-02, TVA inspected SQN's RHR pumps and pump supports to verify there were no loose supporting connections contributing to the vibration condition. Plant modifications to lower vibration by installing additional supports was not a preferred option based on a concern for relocation of the vibration to other points in the pump/motor/foundation. Attempts to relocate the vibration were found to have limited success at other utilities and in some instances vibration levels were increased.

Spectral Analysis: Analysis of the condition indicates that the vibration occurs in a low frequency range less than one-half rotational speed. Analysis indicates there are no problems with the bearings or rotating elements (i.e., imbalance or misalignment). TVA's request is restricted to those frequencies that exhibit the natural resonance vibration levels. The results and evaluation of TVA's spectral analysis were provided in the original relief request during the second ten year interval.

Enclosure 1
Pump Inservice Test Program Relief Requests
Pump Relief Request - RP-06
RHR Pump Vibration Measurements

Pump/System Design: The RHR system pumps for SQN are the typical design for more recent Westinghouse four loop plants, which are centrifugal pumps with the motor in the vertical position. There is no typical bearing housing(s) associated with these pumps as there are with centrifugal pumps where the pump and the driver are in the horizontal position. The pump and motor utilize one continuous shaft. There is no coupling located along the shaft and all of the bearings for the pump/motor assembly are located in the motor. Although mounted vertically, these pumps are not vertical line shaft pumps. Two motor designs exists for this application with different bearing arrangements. In one design the bearing located in the upper motor housing acts as a thrust and upper radial bearing while the lower bearing is a radial bearing. In the other pump/motor design, the lower motor housing bearing acts as the thrust and lower radial bearing while the upper bearing is a radial bearing.

The pump support is designed to support the pump and the motor which rests on top of the pump. The motor is unrestrained and is in effect a large moment arm. The bearings for this pump are within the motor.

Compliance with ASME ISTB: The natural system frequency of 10 to 11 Hz exhibits sufficient force such that when measurements are taken during quarterly pump testing at the upper motor bearing, the vibration readings are outside of the OM Code acceptable range limits. When applying the OM Code criteria, the vibration limits will place the pump consistently in the “Alert Range” or the “Required Action Range.”

TVA originally took a literal reading of OM Part 6 wording to determine if vibration testing is required for the RHR pumps. Because the bearings are part of the motor (i.e., pump driver), these vibration points were not included in SQN’s IST program. TVA evaluates these measurements in accordance with ISTB acceptance criteria for pump vibration.

Plant Operation and Pump Vibration History: Prior to initial operation of either unit, a nonconformance report was written which identified a natural frequency of the RHR pumps of 10 to 11 Hz . At the time, the seismic qualification of the pump had been performed based upon no natural frequencies below 33 Hz . The safety implication was that the RHR pumps did not meet their design basis for seismic qualification. TVA performed design changes and reanalysis of the pump support structure and piping system to qualify the 10 to 11 Hz natural frequency condition. Westinghouse approved the changes.

Both units were shut down for approximately three years beginning in 1985. Both units remained on RHR at shut down cooling flow conditions (greater than 2,000 gallons per minute [gpm]) in order to maintain the RCS in accordance with the Technical Specifications. During this time, there were no problems with the RHR pumps. The pumps operated continuously with no adverse conditions identified.

Both units at SQN were again shut down in 1993 for approximately one year. During this time, both units remained on RHR with the pumps operating at full flow conditions. The pumps operated continuously with no adverse conditions identified.

Enclosure 1
Pump Inservice Test Program Relief Requests
Pump Relief Request - RP-06
RHR Pump Vibration Measurements

Advanced Vibration Diagnostics: TVA has performed advanced vibration diagnostics to assess the condition on all four RHR pumps. The same 10 to 11 Hz natural frequency identified in the late 1970's was identified again.

Impact testing was performed on all four RHR pump/motor assemblies. The testing revealed the following data:

Pump ID	Natural Frequency of Motor Alone	Natural Frequency of Motor and Frame[1]
1A-A	14 to 16 Hz	120 to 350 Hz
1B-B	11 Hz	175 to 331 Hz
2A-A	10 Hz	287 to 356 Hz
2B-B	11 to 13 Hz	100 to 350 Hz
[1]Based on location on the frame.		

The testing performed on the 1A RHR pump motor revealed a 14 to 16 Hz response frequency range on the motor. The motor/support frame frequency response is between 120 and 350 Hz . The overall vibration levels on the 1A RHR pump are stable and below the alert range. However, the vibration occurring at the 14 Hz frequency is contributing to the overall levels.

For the 1B and 2A RHR pump motors, this data confirms the previous evaluation that a resonant condition exists at 11 and 10 Hz, respectively. The testing revealed that the motor upper bearing exhibited natural frequencies at approximately 10 and 11 Hz, respectively, which is coincident with the maximum amplitude vibration measurement for the same point found during OM Code quarterly pump testing.

The testing performed on the 2B RHR pump motor revealed a 11 to 13 Hz response frequency range on the motor. The motor support/frame frequency response is between 100 and 350 Hz . The overall vibration levels on 2B RHR pump are stable and below alert range. However, the vibration occurring at the 11 Hz frequency is contributing to the overall levels.

ISTB Group A pump testing is performed with the pump operating on miniflow (the nominal miniflow rate is 500 gpm for pump protection). The pump operation flow characteristics create low frequency flow pulsations which tend to excite the structural resonant frequencies of the machine assembly. Spectra analysis of vibration data collected during pump testing activities indicates a dominant peak between 10 to 14 Hz for all RHR pump motors. To improve the vibration would require separating the low natural frequencies away from the operating frequency of 29.8 Hz. Physical modifications to drive the natural frequency up beyond 30 Hz (greater than 15 percent of operating frequency as a rule of thumb) can be unpredictable and difficult even when performed with detailed analysis. Efforts at other plants have been unsuccessful due to shifting the vibration to adjacent components, such as the pump or piping.

Full Flow Testing: Near full flow vibration data obtained during refueling outages shows that the vibration is greatly reduced at near full flow conditions. This indicates that the higher test measurements occur only during the quarterly tests, which are conducted with the RHR pumps on miniflow. The pumps are designed to run at full-flow conditions for normal plant operations and for accident conditions. Thus, the minimum flow test configuration causes the motor structure to be excited and a higher vibration to be present during the quarterly pump tests.

This testing supports the expected results identified by Westinghouse in Technical Bulletin NSID-TB-86-02.

Civil/Structural Evaluations: TVA originally modeled the pump and its support as a rigid anchor. During the reanalysis discussed above, the pump and its support were modeled as a flexible member. The results of this analysis confirmed that the measured natural frequency of approximately 10 to 11 Hz was a system frequency (i.e., pump, pump support, and piping). The reanalysis changed the nozzle loads on the pump and on local pipe supports to meet the new support loads. The pump support was also stiffened, incidental to the vibration issue described above.

An engineering review has been performed on the results of the advanced vibration diagnostics with respect to the vibration issue. The review determined that the new measurements reflect the vibration issue identified during initial system operation and is not a new vibration issue. Based upon this analysis, the pump and its structure continue to meet the design requirements for acceptable operation.

ISI Examinations of the Piping and Supports: A review of ISI examinations of pipe welds and pipe supports in the area surrounding the pumps was performed. All of the examinations in this area, which did not meet the acceptance criteria, were minor indications and are characterized as typical indications found during inservice examinations following the completion of construction activities. No failures were associated with any of these indications. None of the indications could be characterized as defects due to pump vibration.

No further indications have been identified. The issues found by in-service examination are indicative that the vibration issue is a natural frequency of the system and not a destructive vibration force.

Duration of the Proposed Alternative

This request is for the duration of the fourth IST ten-year Interval (begins June 1, 2016, and ends May 31, 2026).

Precedents

This relief request was previously approved for SQN's third ten-year interval by Reference 2 of the cover letter.

Enclosure 1
Pump Inservice Test Program Relief Requests
Pump Relief Request - RP-08
IST Class 2 and 3 Pump Testing Requirements Using OMN-18

ASME OM Code Affected Components

Pump ID	Pump Description	Pump Type	Code Class	OM Group
0-PMP-67-432	Essential Raw Cooling Water Pumps	Vertical Line Shaft	3	A
0-PMP-67-436				
0-PMP-67-440				
0-PMP-67-444				
0-PMP-67-452				
0-PMP-67-456				
0-PMP-67-460				
0-PMP-67-464				
0-PMP-70-51	Component Cooling Water Pumps	Centrifugal	3	A
1-PMP-70-38				
1-PMP-70-46				
2-PMP-70-33				
2-PMP-70-59				
0-PMP-313-303	Shutdown Board Room Chilled Water Pumps	Centrifugal	3	A
0-PMP-313-338				
1-PMP-62-230	Boric Acid Transfer Pumps	Centrifugal	3	A
1-PMP-62-232				
2-PMP-62-230				
2-PMP-62-232				
1-PMP-72-10	Containment Spray Pumps	Centrifugal	2	B
1-PMP-72-27				
2-PMP-72-10				
2-PMP-72-27				
0-PMP-67-470	ERCW Screen Wash Pumps	Vertical Line Shaft	3	A
0-PMP-67-477				
0-PMP-67-482				
0-PMP-67-487				

ASME Code Edition and Addenda

ASME OM Code 2004 Edition through 2006 Addenda

Applicable Code Requirement

ISTB-3300 Reference Values
(e)(1) Reference values shall be established within ±20% of pump design flow rate for the comprehensive test.

(e)(2) Reference values shall be established within ±20% of pump design flow for the Group A and Group B tests, if practicable. If not practicable, the reference point flow rate shall be established at the highest practical flow rate.

Enclosure 1
Pump Inservice Test Program Relief Requests
Pump Relief Request - RP-08
IST Class 2 and 3 Pump Testing Requirements Using OMN-18

ISTB-3400 Frequency of Inservice Tests
An inservice test shall be run on each pump as specified in Table ISTB-3400-1.

Table ISTB-3400-1 Inservice Test Frequency
This table requires Group A and Group B tests to be performed quarterly and Comprehensive test be performed biennially.

Table ISTB-3510-1 Required Instrument Accuracy
This table specifies instrument accuracies for Group A, Group B, Comprehensive and Preservice tests.

Table ISTB-5121-1 Centrifugal Pump Test Acceptance Criteria
This table specifies the required acceptance criteria for Group A, Group B, and Comprehensive Tests for centrifugal pumps.

Table ISTB-5221-1 Vertical Line Shaft and Centrifugal Pumps Test Acceptable Criteria
This table specifies the required acceptance criteria for Group A, Group B, and Comprehensive Tests for vertical line shaft centrifugal pumps.

Reason for Request

The ASME OM Code committee approved Code Case OMN-18, Alternate Testing Requirements for Pumps Tested Quarterly within ±20 percent of Design Flow, which was incorporated into the 2009 edition of the ASME OM Code. This Code Case has not yet been endorsed by the NRC in Regulatory Guide 1.192, Rev 1, Operation and Maintenance Code Case Acceptability, ASME OM Code, August 2014. However, NRC has approved similar relief requests for this Code Case as noted in the Precedents section.

This Code Case allows the elimination of the requirement for the Comprehensive Pump Test (CPT) with its associated acceptance criteria, if the quarterly test is performed at ±20 percent of design flow and the instrumentation meets the accuracy requirements of Table ISTB-3510-1 for the comprehensive and preservice tests. The basis for the testing strategy in this Code Case is that a quarterly Group A pump test, performed at the CPT flow rate with more accurate instrumentation, is more effective in assessing a pump's operational readiness than a standard Group A test in conjunction with a biennial CPT.

ISTB allows the categorization of pumps in the IST program. As such, a pump that otherwise meets the requirements of Group B, could be categorized as a Group A (or AB) pump, and test according to the provisions of Code Case OMN-18. In doing this, additional data (vibration and flow or differential pressure) would be obtained quarterly, rather than once every two years.

As a result of the increased requirements on the parameters imposed by the proposed alternative during applicable quarterly tests, there is no added value in performing the biennial comprehensive test on the affected pumps.

Enclosure 1
Pump Inservice Test Program Relief Requests
Pump Relief Request - RP-08
IST Class 2 and 3 Pump Testing Requirements Using OMN-18

Proposed Alternative and Basis for Use

Proposed Alternative
TVA is proposing to utilize the provisions of Code Case OMN-18 and perform a modified Group A test in lieu of performing the code required comprehensive pump test. The modified Group A test will be performed at ±20 percent of design flow. The instrumentation used will meet the accuracy requirements of Table ISTB-3510-1 for the comprehensive and preservice tests. Vibration tests will be performed with the same vibration acceptance criteria as the standard Group A pump test. Additionally, TVA will utilize an acceptable range high limit of 106 percent or lower for quarterly testing, which is also consistent with the planned code applicable to CPT.

Basis for Use
The use of more accurate pressure gauges and a more limiting acceptable range during every modified quarterly Group A test compensates for the elimination of the CPT. The CPT has a more limiting acceptable range upper bound for differential pressure of 103 percent. Regular testing with more accurate instrumentation and tighter acceptance criteria will provide for better trending of pump performance. Instead of performing seven tests with pressure instruments with ±2 percent accuracy and then performing the eighth test with pressure instruments with a minimum of ±0.5 percent accuracy, all eight tests will be performed with the same ±0.5 percent accurate instruments or better. Due to the improved accuracy, consistent testing methodology, and the addition of quarterly vibration monitoring on Group AB pumps, deviations in actual pump performance indicative of impending degradation are more easily recognized during quarterly performance trending activities.

The provision of this request as an alternative to the requirements of ISTB-3400 and Tables ISTB-3400-1, ISTB-5121-1, and ISTB5221-1 provides a reasonable alternative to the code requirements based on the determination that the proposed alternative will provide adequate indication of pump performance, permit detection of component degradation, and continue to provide an acceptable level of quality and safety.

Duration of the Proposed Alternative

This request is for the duration of the fourth IST ten-year Interval (begins June 1, 2016, and ends May 31, 2026).

Precedents

- A similar relief request (PR-01) was approved by the NRC for the Oyster Creek Nuclear Generating Station on June 21, 2012 (ML120050329).

- A similar relief request (PR-9) was approved by the NRC for the St. Lucie, Units 1 and 2 on July 1, 2011 (ML11143A077).

- A similar relief request (PR-3) was approved by the NRC for the Perry Nuclear Power Plant, Unit 1, on October 8, 2009 (ML092640690).

Enclosure 2
Valve Inservice Test Program Relief Requests
Valve Relief Request - RV-01
Reactor Head Vent Valve Stroke Timing

ASME OM Code Affected Components

Valve ID	Description	Class	Cat.	Size	Type	Act.
1-FSV-68-396	Reactor Vessel Head Vent	2	B-Act	1	GB	SO
1-FSV-68-397	Reactor Vessel Head Vent	2	B-Act	1	GB	SO
2-FSV-68-396	Reactor Vessel Head Vent	2	B-Act	1	GB	SO
2-FSV-68-397	Reactor Vessel Head Vent	2	B-Act	1	GB	SO

ASME Code Edition and Addenda

ASME OM Code 2004 Edition through 2006 Addenda

Applicable Code Requirement

ISTC-3300 Reference Values
Reference values shall be determined from the results of preservice testing or from the results of inservice testing. These tests shall be performed under conditions as near as practicable to those expected subsequent inservice testing…

ISTC-3310 Effects of Valve Repair, Replacement, or Maintenance on Reference Values
When a valve or its control system has been replaced, repaired, or has undergone maintenance[1] that could affect the valve's performance, a new reference value shall be determined or the previous value reconfirmed by an inservice test run before the time it is returned to service or immediately if not removed from service…

ISTC-3510 Exercising Test Frequency
Active Category A, Category B, and Category C check valves shall be exercised nominally every three months, except as provided by ISTC-3520, ISTC-3540, ISTC-3550, ISTC-3570, ISTC-5221, and ISTC-5222…

ISTC-5151 Valve Stroke Testing
(a) Active valves shall have their stroke times measured when exercised in accordance with ISTC-3500.
(b) The limiting value(s) of full-stroke time of each valve shall be specified by the Owner.
(c) Stroke time shall be measured to at least the nearest second.
(d) Any abnormality or erratic action shall be recorded (see ISTC-9120), and an evaluation shall be made regarding need for corrective action.

ISTC-5152 Stroke Time Acceptance Criteria
Test results shall be compared to reference values established in accordance with ISTC-3300, ISTC-3310, or ISTC-3320.

[1] Adjustment of stem packing, limit switches, or control system valves, and removal of the bonnet, stem assembly, actuator, obturator, or control system components are examples of maintenance that could affect valve performance parameters.

(a) Valves with reference stroke times of greater than 10 sec shall exhibit no more than ±25% change in stroke time when compared to the reference value.
(b) Valves with reference stroke times of less than or equal to 10 sec shall exhibit no more than ±50% change in stroke time when compared to the reference value.
(c) Valves that stroke in less than 2 sec may be exempted from ISTC-5152(b). In such cases the maximum limiting stroke time shall be 2 sec.

ISTC-5153 Stroke Test Corrective Action
(a) If a valve fails to exhibit the required change of obturator position or exceeds the limiting values of full-stroke time [see ISTC-5151(b)], the valve shall be immediately declared inoperable.
(b) Valves with measured stroke times that do not meet the acceptance criteria of ISTC-5152 shall be immediately retested or declared inoperable. If the valve is retested and the second set of data also does not meet the acceptance criteria, the data shall be analyzed within 96 hr to verify that the new stroke time represents acceptable valve operation, or the valve shall be declared inoperable. If the second set of data meets the acceptance criteria, the cause of the initial deviation shall be analyzed and the results documented in the record of tests (see ISTC-9120).

Reason for Request

Relief is being requested from measuring stroke times, establishing reference values, comparing stroke times to acceptance criteria/limiting values, and taking corrective action related to stroke time acceptance criteria/limiting values for the reactor vessel head vent throttles valves.

These solenoid valves have no position indication and are totally enclosed which prevents visual confirmation of the valve position and therefore the inability to measure the time that it takes the valve to stroke. These valves are throttle valves with an operator which positions the valve at 0%, 25%, 50%, and 100%, which is set through the use of a thumbwheel. However, these valves are fast acting valves with a stroke time of less than two seconds and a stroke of approximately 1/4 inch.

Burden Caused by Compliance

Significant system modifications, such as alteration of the valve's control circuit to provide a separate handswitch to permit instantaneous valve operation, would be required to allow for the performance of valve stroke time testing.

Proposed Alternative and Basis for Use

Proposed Alternative
Verify the valve operates properly through the use of acoustic instrumentation every refueling outage.

Enclosure 2
Valve Inservice Test Program Relief Requests
Valve Relief Request - RV-01
Reactor Head Vent Valve Stroke Timing

Basis for Use
The acoustic instrumentation takes a signal of the system noise prior to opening the valve. The valve is opened by operating the thumbwheel and another acoustic signal is obtained at the full open position. The valve is then closed and another acoustic signal is obtained at full closed. The initial acoustic signal at full closed is compared to the second acoustic signal taken at the full closed position. Comparative values provides assurance that the valve is moving to the correct positions and that the valve is operating acceptably. However, the signals do not provide the means to measure the amount of time it takes to go from one position to the other. These valves are one-inch diameter Target Rock valves with a seal welded bonnet. They are the second of two one-inch diameter valves in parallel to each other and are normally closed.

An enhanced maintenance program of disassembly and inspection was considered. This method was not considered appropriate for the following reasons.

- This process can lead to assembly and operational problems due to distortion of the valve parts caused by the repetitive welding process to reinstall the seal weld every refueling outage. This is not considered acceptable for the purposes of testing and could lead to premature replacement of the valves.

- The repetitive removal of the seal weld between the body and the bonnet can cause another problem. When the seal weld is removed, a small amount of the base metal also has to be removed in order to find a separation point past the heat affected zone where the weld metal has not penetrated into the base metal so that the bonnet can be removed from the body. Every time this operation is performed, more of the base metal is removed until the required thickness no longer exists which makes the valve non-functional.

- Once the valve is opened and the internals of valve are examined, the condition of the internal parts do not typically give one any more indication of acceptable valve operation than the acoustic monitoring.

Considering that there is no known feasible method for measuring the stroke time and an enhanced maintenance program does not provide additional assurance of acceptable valve operation and can possibly be detrimental to acceptable valve operation, the method described above using acoustical instrumentation provides the only known method from which acceptable valve operation can be determined. A refueling outage is the only time the valves can be monitored and the only time maintenance can be performed because the valves are located inside containment.

Duration of the Proposed Alternative

This request is for the duration of the fourth IST ten-year Interval (begins June 1, 2016, and ends May 31, 2026).

Enclosure 2
Valve Inservice Test Program Relief Requests
Valve Relief Request - RV-01
Reactor Head Vent Valve Stroke Timing

Precedents

This relief request was previously approved for SQN's third ten-year interval by Reference 2 of the cover letter.

Enclosure 2
Valve Inservice Test Program Relief Requests
Valve Relief Request - RV-02
Alternative to Auxiliary Air Compressor ERCW Valve Stroke

Relief request RV-02 was approved for the third IST 120-month interval, but is no longer needed for the fourth IST 120-month interval.

Enclosure 2
Valve Inservice Test Program Relief Requests
Valve Relief Request - RV-03
RHR Valve Exercising During Cold Shutdown

Relief request RV-03 was approved for the third IST 120-month interval, but is no longer needed for the fourth IST 120-month interval.