



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

April 29, 2021

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

SUBJECT: WATTS BAR NUCLEAR PLANT, UNIT 1 – PROPOSED ALTERNATIVE
IST-RR-8 TO THE REQUIREMENTS OF THE ASME OM CODE FOR THE
RESIDUAL HEAT REMOVAL PUMP 1B-B (EPID L-2020-LLR-0116)

Dear Mr. Barstow:

By letter dated September 1, 2020 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML20245E518), the Tennessee Valley Authority (TVA, the licensee) submitted a request (IST-RR-8) to the U.S. Nuclear Regulatory Commission (NRC) for the use of an alternative to certain American Society of Mechanical Engineers (ASME) Code for Operation and Maintenance of Nuclear Power Plants (OM Code) requirements at Watts Bar Nuclear Plant (Watts Bar), Unit 1.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(z)(2), the licensee requested to use an alternative on the basis that complying with the specified requirement would result in hardship or unusual difficulty without a compensating increase in the level of quality or safety due to the need to perform a mid-cycle shutdown in order to perform the increased testing frequency.

The NRC staff has reviewed the subject request and concludes, as set forth in the enclosed safety evaluation, that TVA has adequately addressed all regulatory requirements set forth in 10 CFR 50.55a(z)(2) for Alternative Request IST-RR-8. The NRC staff has determined that IST-RR-8 provides reasonable assurance that residual heat removal (RHR) pump 1B-B is operationally ready. Therefore, the NRC staff authorizes Alternative Request IST-RR-8 until the end of the U1R17 refueling outage, which is scheduled to be completed by November 27, 2021.

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

If you have any questions, please contact the Project Manager, Kim Green.

Sincerely,

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

Docket No. 50-390

Enclosure:
Safety Evaluation

cc: Listserv



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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

PROPOSED ALTERNATIVE IST-RR-8 TO THE REQUIREMENTS OF THE

ASME OM CODE FOR THE RESIDUAL HEAT REMOVAL PUMP 1B-B

TENNESSEE VALLEY AUTHORITY

WATTS BAR NUCLEAR PLANT, UNIT 1

DOCKET NO. 50-390

1.0 INTRODUCTION

By letter dated September 1, 2020 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML20245E518), the Tennessee Valley Authority (TVA, the licensee) submitted a request (IST-RR-8) to the U.S. Nuclear Regulatory Commission (NRC) for the use of an alternative to certain American Society of Mechanical Engineers (ASME) Code for Operation and Maintenance of Nuclear Power Plants (OM Code) requirements at Watts Bar Nuclear Plant (Watts Bar), Unit 1. During refueling outage comprehensive pump test (CPT) of the residual heat removal (RHR) pump 1B-B on May 21, 2020, two vibration measurements were identified in the alert range. As required by ASME OM Code, pump vibration(s) identified during inservice testing (IST) in the alert range require test frequency doubling; resulting in a CPT to be performed prior to the next scheduled refueling outage in the fall of 2021. The licensee proposed an alternative that would permit continued performance monitoring of the 1B-B RHR pump by performing quarterly Group A tests in lieu of performing the CPT at the increased test frequency.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(z)(2), the licensee requested to use an alternative on the basis that complying with the specified requirement would result in hardship or unusual difficulty without a compensating increase in the level of quality or safety due to the need to perform a mid-cycle shutdown in order to perform the increased testing frequency.

2.0 REGULATORY EVALUATION

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

10 CFR 50.55a(a)(1)(iv), to the extent practical within the limitations of design, geometry, and materials of construction of the components.

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

3.0 TECHNICAL EVALUATION

3.1 Licensee's Alternative Request IST-RR-8

The licensee requested an alternative to the requirements of the ASME OM Code for IST frequency for a pump in the alert range.

ISTB-6200(a), "Alert Range," states that if the measured test parameter values fall within the alert range of Table ISTB-5121-1, Table ISTB-5221-1, Table 5321-1, or Table ISTB-5321-2, as applicable, the frequency of testing specified in ISTB-3400 shall be doubled until the cause of the deviation is determined and the condition is corrected.

The licensee has requested to use the proposed alternative described below for RHR pump 1B-B. The pump is ASME *Boiler and Pressure Vessel Code* (BPV Code), Section III, Class 2, and is classified as a Group A pump.

The licensee requested that the proposed alternative request be authorized through the completion of the U1R17 refueling outage, which is currently scheduled to be completed by November 27, 2021.

The ASME OM Code of record for Watts Bar, Unit 1, is the 2004 Edition through 2006 Addenda. The third 10-year interval for the Watts Bar, Unit 1, IST Program started on October 22, 2015 and is scheduled to end on October 21, 2025.

Reason for Request

The licensee states that the RHR pump 1B-B is a safety-related, vertical, single stage centrifugal motor-driven pump, with the motor installed on a supporting head, which is supported by the stuffing box extension/casing. The pump impeller is mounted to the motor shaft and the RHR pump flow is limited to 3000 gallons per minute (gpm) per pump during two pump operation (normal cooldown mode).

The RHR system is designed to perform post-accident safety-related functions, normal safety-related functions, and normal non-safety-related functions. The post-accident safety functions of the RHR system are to (1) operate as an emergency core cooling system (ECCS) subsystem, (2) operate as a subsystem of the containment spray system (CSS), and (3) provide a flow path to the reactor coolant system (RCS) from the spent fuel pool cooling and cleaning system (SFPCS) during flood mode when the reactor vessel head is removed.

The RHR pump 1B-B CPT is performed during refueling outages (18-month cycle) with the reactor head removed from the reactor vessel, allowing flow to be directed into the reactor cavity in order to achieve the required CPT flow rate. On May 21, 2020, during the Watts Bar,

Unit 1, Cycle 16 refueling outage (U1R16) performance of the CPT, vibration measurements for the RHR pump 1B-B motor outboard horizontal and vertical locations entered the alert range of Table ISTB-5121-1. The corrective actions of ISTB-6200(a) require the test frequency to be doubled. Therefore, another performance of the CPT is required in 12 months (one half of the two-year CPT frequency stated in ISTB-3400), which would require Unit 1 to be shut down and the reactor head removed.

The proposed alternative would permit continued performance monitoring of the RHR pump 1B-B by performing quarterly Group A tests in lieu of performing the CPT at the increased test frequency. The licensee stated that the Group A test can be performed safely while the unit is operational.

If approved, this would eliminate the need to shut down the plant in order to perform the CPT. The licensee considers shutting down the plant to perform the CPT an undue hardship due to the risks associated with plant transients. This alternative request will only apply to ISTB-6200 requirements as they relate to doubling of the CPT test frequency. With subsequent Group A testing, if any measured IST parameter exceeds the alert criteria, the requirements of ISTB-6200(a) will be followed (i.e., the Group A test would be performed at the prescribed increased frequency).

Proposed Alternative

The licensee proposed supplementing the regularly scheduled quarterly RHR pump 1B-B Group A pump test with spectral analysis of the resulting vibration data in lieu of performing the increased frequency (12 months) CPT.

3.2 NRC Staff Evaluation]

Paragraph (a) in ISTB-6200 of the ASME OM Code states that the testing frequency specified in ISTB-3400 is to be doubled for pumps with measured test parameter values that fall within the alert range of the applicable table (Table ISTB-5121-1, in this case).

This IST requirement, together with the other IST requirements in the ASME OM Code as incorporated by reference in 10 CFR 50.55a, provides reasonable assurance of the operational readiness of the safety-related pumps at Watts Bar, Unit 1. The purpose of this increased CPT testing frequency for pumps in the alert range is to monitor for additional performance degradation until the cause of the deviation is determined, and the condition is corrected. The staff notes that the performance of RHR pump 1B-B can be tracked and trended from testing performed at flow rates other than those specified for the CPT. The reference point flow rate values for the CPT are established in accordance with ISTB-3300 within ± 20 percent of pump design flow, or at the highest practicable flow rate for the Group A test if the CPT flow rate cannot be achieved. The NRC staff reviewed information provided by the licensee that indicates that the Group A test reference flow rate is 700 gpm and the CPT reference flow rate is 4262 gpm, which exceeds the design basis accident analysis flow of 4018 gpm. The licensee states that in order to achieve the CPT reference flow rate, Unit 1 must be shut down and reactor head removed to allow flow through the reactor vessel into the refueling cavity.

The NRC staff reviewed a comparison of RHR pump 1B-B vibration data taken at the Group A flow rate and CPT flow rate that showed increasing trends at both flow rates. While the vibration level at the Group A flow rate cannot be directly correlated to the vibration level at the CPT flow rate, the NRC staff confirmed the licensee's assertion that the general trends are in

agreement - demonstrating that the Group A test is an adequate means of monitoring of pump performance degradation.

Table 1 provides the licensee's comparison of the baseline vibration reference values for the quarterly Group A and the 2-year CPT, as provided by the licensee. The baseline reference values for the CPT are considered to be smooth-running utilizing a baseline of 0.050 inches per second (ips) as a default value per Alternative Request IST-RR-01 (ADAMS Accession No. ML14289A222), with the exception of bearing location A in the vertical direction. None of the bearing location/directions are considered to be smooth-running for the Group A test.

Bearing Location	Measurement Direction	Quarterly Group A Test (700 gpm)	Comprehensive Test (4262 gpm)
A	Horizontal	0.160 ips	0.03394 ips
A	Vertical	0.186 ips	0.06652 ips
A	Axial	0.114 ips	0.02837 ips
B	Horizontal	0.074 ips	0.02591 ips
B	Vertical	0.145 ips	0.02685 ips

Within its submittal, the licensee outlined the maintenance and diagnostic history of RHR pump 1B-B dating back to preoperational testing in 1994. The licensee first noted slightly elevated vibration levels in May 2018 during a quarterly Group A test, as shown in Figure 3 of its submittal. The Group A test in November 2018 indicated slightly elevated vibration levels in five locations, which plateaued in later tests, as shown in Figure 6 of the licensee's submittal.

During the CPT performed in May 2020, measured vibrations at bearing locations A-H and A-V entered the alert range. The next Group A test, performed June 8, 2020, confirmed that bearing location A-V continued an upward trend, with a vibration level of 0.297 ips. Bearing location A-H showed a downward step change, but the other bearing location measurements showed a slight upward trend as well. The NRC staff verified these trends in the data provided by the licensee.

The licensee identified cracked and missing paint around mechanical fasteners on the support structure for RHR pump 1B-B and determined the structure may have loosened due to the pump/motor assembly not being doweled in place with the mounting holes being slotted to allow for some installation assistance. The licensee performed a conditional (non-routine) quarterly Group A test on June 24, 2020, while tightening the pump support structure and monitoring vibration levels. The tightening did not appreciably change the vibration levels, although the test results gathered prior to the support tightening did increase from the June 8, 2020, results.

The licensee stated in its initial submittal that a spectral analysis of the vibration data does not identify any spectral trend that points to a degrading mechanical/electrical condition, despite an overall amplitude trend in the increasing direction. An oil analysis was performed with viscosity, wear metals, and chemistry values within normal operating ranges.

As a result of discussion between the NRC staff and the licensee during a Category 1 public teleconference held on July 28, 2020, (ADAMS Accession No. ML20213C711) and commitments made in its initial submittal, the licensee provided the following additional information in a supplement dated October 20, 2020 (ADAMS Accession No. ML20294A422)

regarding performance of a follow-up oil analysis and results of the next quarterly Group A test for RHR pump 1B-B:

- Oil analysis determined that viscosity, wear particles, and chemistry values were within normal operating ranges and no moisture was noted in the system.
- Overall peak vibration values resulting from the Group A test remained below the Alert limits, with two values increasing, two values decreasing, and one remaining approximately the same.

Although the pump vibrations are elevated, the NRC staff has determined that RHR pump 1B-B will continue to meet its prescribed safety function and flow requirements with the vibration measurements in the alert range, based on the absence of degrading pump performance, as discussed above.

The licensee's request to perform quarterly Group A tests of RHR pump 1B-B in lieu of the CPT with Unit 1 operational is reasonable because (1) the vibration data exhibits similar trends between the CPT and Group A Test, (2) the licensee will perform spectral analysis of pump vibration data along with performance of the Group A test, (3) the pump bearing oil sample analyses were within normal operating ranges, and (4) the hydraulic parameters have not indicated any significant degradation in the hydraulic performance of the pump. The NRC staff concludes that shutting down the plant to comply with the IST requirements, in this case, would result in an undue hardship due to the risks associated with plant transients. Finally, the NRC staff finds the licensee's proposed alternative provides reasonable assurance of the operational readiness of RHR pump 1B-B until the end of the U1R17 refueling outage (scheduled to be completed by November 27, 2021).

4.0 CONCLUSION

As set forth above, the NRC staff has determined that Alternative Request IST-RR-8 provides reasonable assurance that RHR pump 1B-B is operationally ready. Accordingly, the NRC staff concludes that the licensee has adequately addressed all regulatory requirements set forth in 10 CFR 50.55a(z)(2) for Alternative Request IST-RR-8. Therefore, the NRC staff authorizes Alternative Request IST-RR-8 until the end of the U1R17 refueling outage, which is scheduled to be completed by November 27, 2021.

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

Principal Contributor: N. Hansing, NRR

Date: April 29, 2021

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