



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

October 18, 2016

Mr. Joseph W. Shea  
Vice President, Nuclear Licensing  
Tennessee Valley Authority  
1101 Market Street, LP 3R-C  
Chattanooga, TN 37402-2801

SUBJECT: WATTS BAR NUCLEAR PLANT, UNIT 1 – RELIEF FROM THE  
REQUIREMENTS OF THE ASME CODE FOR REACTOR PRESSURE  
VESSEL FLANGE SEAL LEAK-OFF PIPING (CAC NO. MF7606)

Dear Mr. Shea:

By letter dated April 15, 2016 (Agencywide Documents Access and Management System Accession No. ML16109A055), Tennessee Valley Authority (TVA) submitted a request to the Nuclear Regulatory Commission (NRC) for the use of an alternative to certain American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (B&PV Code), Section XI requirements at the Watts Bar Nuclear Plant (WBN), Unit 1. TVA requested an alternative test plan in lieu of certain inservice inspection (ISI) requirements of the 2007 Edition through 2008 Addenda of the ASME B&PV Code, Section XI, for the ISI program at WBN, Unit 1, during the third 10-year ISI program interval, which is currently scheduled to begin in 2016.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(z)(2), TVA requested to use an alternative system leakage test (ISPT-02) of the reactor pressure vessel (RPV) head flange seal leak-off piping on the basis that complying with the specified requirement would result in hardship or unusual difficulty.

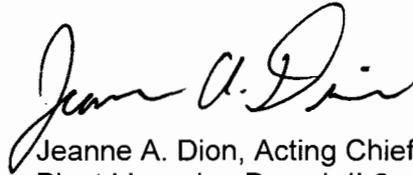
The NRC staff finds that the proposed alternative described in alternative request ISPT-02 provides reasonable assurance of structural integrity and leak tightness of the RPV head flange seal leak-off piping. The NRC staff finds that complying with the specified ASME B&PV Code requirement would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. The NRC staff has reviewed the subject request and concludes, as set forth in the enclosed safety evaluation, that TVA has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(z)(2) and is in compliance with the requirements of the ASME Code, Section XI. Therefore, the NRC staff authorizes the proposed alternative in request ISPT-02 for the third ISI interval at WBN, Unit 1.

J. Shea

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If you have any questions, please contact the project manager, Robert Schaaf, at 301-415-6020 or [Robert.Schaaf@nrc.gov](mailto:Robert.Schaaf@nrc.gov).

Sincerely,

A handwritten signature in black ink, appearing to read "Jeanne A. Dion". The signature is fluid and cursive, with the first name being the most prominent.

Jeanne A. Dion, Acting Chief  
Plant Licensing Branch II-2  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

Docket No. 50-390

Enclosure:  
Safety Evaluation

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION  
ALTERNATIVE REQUEST ISPT-02 REGARDING REACTOR PRESSURE VESSEL FLANGE  
RELATED TO THE INSERVICE TESTING PROGRAM THIRD 10-YEAR INTERVAL  
WATTS BAR NUCLEAR PLANT, UNIT 1  
TENNESSEE VALLEY AUTHORITY  
DOCKET NO. 50-390

1.0 INTRODUCTION

By letter dated April 15, 2016 (Agencywide Documents Access and Management System Accession No. ML16109A055), Tennessee Valley Authority (TVA, the licensee), submitted alternative request ISPT-02 to the U.S. Nuclear Regulatory Commission (NRC). The licensee requested to use an alternative test plan in lieu of certain inservice inspection (ISI) requirements of the 2007 Edition through 2008 Addenda of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (B&PV) Code, Section XI for the ISI program at Watts Bar Nuclear Plant (WBN), Unit 1 during the third 10-year ISI program interval, which is currently scheduled to begin in 2016.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, Section 50.55a(z)(2), the licensee proposed an alternative system leakage test of the reactor pressure vessel (RPV) flange seal leak-off piping on the basis that complying with the specified requirement would result in a hardship or unusual difficulty without a compensating increase in the level of quality and safety.

2.0 REGULATORY EVALUATION

It states in 10 CFR 50.55a(g)(4), that ASME Code Class 1, 2, and 3 components (including supports) must meet the requirements, except design and access provisions and preservice examination requirements, set forth in ASME Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," to the extent practical within the limitations of design, geometry, and materials of construction of the components. The inservice examination of components and system pressure tests conducted during the first 10-year interval and subsequent intervals must comply with the requirements in the latest edition and addenda of Section XI of the ASME Code, incorporated by reference in 10 CFR 50.55a(b), 12 months prior to the start of the 120-month interval, subject to the conditions listed therein. Exceptions are allowed where alternatives have been authorized by the NRC pursuant to paragraphs 10 CFR 50.55a(z)(1) or 10 CFR 50.55a(z)(2).

Enclosure

In proposing alternatives, the licensee must demonstrate that (1) the proposed alternatives provide an acceptable level of quality and safety (10 CFR 50.55a(z)(1)); or (2) compliance would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety (10 CFR 50.55a(z)(2)).

Based on the above, and subject to the following technical evaluation, the NRC staff finds that regulatory authority exists for the licensee to request and the Commission to authorize the alternative requested by the licensee.

### 3.0 TECHNICAL EVALUATION

#### 3.1 The Licensee's Alternative Request ISPT-02

ASME Code Section XI Requirements:

IWC-5221 "System Leakage Test Pressure," states that "The system leakage test shall be conducted at the system pressure obtained while the system, or portion of the system, is in service performing its normal operating function or at the system pressure developed during a test conducted to verify system operability (e.g., to demonstrate system safety function or satisfy technical specification surveillance requirements)."

The system/component affected at WBN, Unit 1, is the RPV Head Flange Seal Leak-Off Detection Piping. This includes piping from the two RPV taps and terminating at the inline isolation valve 1-FCV-68-22 of the common header to the Reactor Coolant Drain Tank.

The licensee states in part:

#### Basis for Relief

The RPV head flange seal leak detection line is separated from the reactor pressure boundary by one (inner) O-ring located on the vessel flange. A second (outer) O-ring is located on the opposite side of the inner tap in the vessel flange. This line is required during plant operation and will indicate failure of the inner flange seal O-ring. To test this line would require the installation of plugs on the leak detection line at the vessel flange. Installing such plugs would allow the line to be leak tested, but would prevent an inservice leak test. Installing and removing the plugs or pressure connections would require installation personnel to spend time in the estimated 20-40 mRem/minute field which creates an As Low As Reasonably Achievable (ALARA) concern.

With no plugs installed, when the vessel head is installed, an adequate pressure test cannot be performed due to the fact that the inner O-ring is designed to withstand pressure in one direction only. Pressurization in the opposite direction would likely damage the O-ring. Pressure testing of this line during the ASME Code, Class 1 System Leakage Test is precluded because the line will only be pressurized in the event of a failure of the inner O-ring. Purposely failing the inner O-ring to perform the ASME Code required test would require purchasing a new set of O-rings, additional time and radiation exposure to detension the reactor vessel head, install the new O-rings, and reset and re-tension the reactor vessel head. TVA estimates the dose to perform these tasks (detension the reactor vessel head, install new O-rings, and reset and re-tension the

reactor vessel head) at approximately 5 Rem. The highest dose rates for this evolution are 1 - 1.5 Rem/hour at the reactor vessel flange. Therefore, this is considered to be a hardship and burden on WBN, Unit 1.

#### Alternative Examinations

- 1) A VT-2 visual examination of the accessible portions (from the biological shield wall to 1-FCV-68-22) in lower containment of the ASME Code Class 2 piping of the RPV flange leak detection line will be performed during every other refueling outage, to satisfy the once per Inservice Period frequency, at ambient conditions when the RPV head is off and the reactor cavity is flooded and has been flooded above the vessel flange for a minimum of 4 hours. The static head of 25.5 feet or 11 pounds per square inch gauge (psig) provided by the filled reactor cavity on the leak detection line will allow for the detection of any gross indications in the line. This examination will be performed every other refueling outage (once per period) as per the frequency specified by ASME B&PV Code, Section XI, Table IWC-2500-1.
- 2) A VT-2 visual examination of the accessible portions (RPV flange to the point the leak-off lines enter the biological shield wall) in upper containment (reactor vessel cavity) of the ASME Code Class 2 piping of the RPV flange leak detection line will be performed during every other refueling outage, to satisfy the once per Inservice Period frequency, at ambient conditions when the RPV head is off and the reactor cavity is drained to look for indications of leakage from the flange seal leak detection lines. This examination will be performed once per period (typically every other refueling outage) as per the frequency specified by ASME B&PV Code, Section XI, Table IWC-2500-1.
- 3) The RPV flange leak detection line is ASME Section III Code Class 2 piping, and consists of approximately 21 feet of 3/4- and 3/8-inch piping and less than 12-inches of 1-inch piping. The piping design conditions are 2485 psig and 650 °F. A VT-2 visual examination of the inaccessible portions (through the biological shield wall) will be performed each refueling outage from under the vessel as part of the reactor coolant system Class 1 system leakage test.
- 4) Leakage past the RPV Flange Seal O-rings is monitored by plant instrumentation (temperatures in excess of 140 °F). In the event leakage is detected, plant procedures direct the header isolation valve 1-FCV-68-22 to be closed.

#### 3.2 NRC Staff Evaluation

The NRC staff has evaluated the proposed alternative ISPT-02 pursuant to 10 CFR 50.55a(z)(2). In its review, the NRC staff focused on whether compliance with the specified requirements of 10 CFR 50.55a(g), or portions thereof, would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Due to the existing design and configuration of the RPV head flange seal leak-off detection piping, system leakage testing at a pressure corresponding to Code requirement IWC-5221 would be unusually difficult. To test the leak-off line, the licensee would have to install and remove temporary test connections at the vessel flange. This temporary mod is completed in

an estimated radiation field of 20-40 mrem/minute, which represents an ALARA concern. With no temporary connections installed and the vessel head in place, an adequate pressure test cannot be completed due to the fact that the inner O-ring that seals the RPV flange during normal operation is designed to withstand pressure in one direction only. Pressure testing the flange to meet Code requirements would challenge and likely damage the RPV flange O-ring set, which then would require replacement. The licensee estimates that replacement activities of the O-ring set would yield personnel radiation exposure of approximately 5 Rem.

Based on the evaluation above, the NRC staff concludes that complying with the ASME Code, Section XI, IWC-5221 requirement for leak testing the RPV head flange seal leak-off detection piping at a pressure corresponding to pressures developed under normal operation would result in a hardship and unusual difficulty.

The licensee proposes to perform VT-2 visual examination of the accessible portions of the RPV flange and leak-off line piping when the RPV head is off and the reactor cavity is flooded above the vessel flange for a minimum of 4 hours. This configuration subjects the RPV flange and leak-off piping to a static pressure of 11 psig developed by the flooded cavity, which has a normal water level during refueling operations of about 25.5 feet above the RPV flange. The licensee also proposes to perform VT-2 visual examination of the accessible portions of the RPV flange and leak-off line piping when the RPV head is off and the reactor cavity is drained. These examination activities shall be performed every other refueling outage, which meets the requirements of the ASME Code.

Based on materials of construction, service conditions, and evaluation of industry operating experience, including WBN, Unit 1, the NRC staff did not identify any documented known degradation mechanism such as stress corrosion cracking and fatigue in the RPV flange leak-off piping and its welded connections. The NRC staff further concludes that if any significant leakage were to occur in the leak-off line during the time of pressurization during each refueling outage, boric acid accumulation would be discernable during a visual examination. The NRC staff, therefore, finds that the proposed low test pressure will provide reasonable assurance of the leak tightness of the subject leak-off lines and demonstrate that the leak-off lines can perform their intended function. The NRC staff also finds that compliance with the system leakage test pressure requirements would result in a hardship without a compensating increase in the level of quality and safety.

#### 4.0 CONCLUSION

As set forth above, the NRC staff finds that the proposed alternative described in alternative request ISPT-02 provides reasonable assurance of structural integrity and leak tightness of the RPV head flange seal leak-off piping. The NRC staff finds that complying with the specified ASME Code requirement would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(z)(2) and is in compliance with the requirements of the ASME Code, Section XI. Therefore, the NRC staff authorizes the proposed alternative in request ISPT-02 for the third ISI interval at WBN, Unit 1 currently scheduled to begin May 27, 2016.

All other ASME Code, Section XI, requirements for which relief has not been specifically requested and approved in this relief request remain applicable, including third party review by the Authorized Nuclear Inservice Inspector.

Principal Contributor: Michael Farnan

Date: October 18, 2016

J. Shea

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If you have any questions, please contact the project manager, Robert Schaaf, at 301-415-6020 or [Robert.Schaaf@nrc.gov](mailto:Robert.Schaaf@nrc.gov).

Sincerely,

*/RA/*

Jeanne A. Dion, Acting Chief  
Plant Licensing Branch II-2  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

Docket No. 50-390

Enclosure:  
Safety Evaluation

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