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

April 21, 2015

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

SUBJECT: WATTS BAR NUCLEAR PLANT, UNIT 1 – RELIEF REQUEST ISPT-03 REGARDING SYSTEM LEAKAGE TEST OF CLASS 1 PIPING ISOLATED BETWEEN NORMALLY CLOSED VALVES (TAC NO. MF4970)

Dear Mr. Shea:

By letter dated September 12, 2014 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML14267A368), as supplemented by letter dated February 13, 2015 (ADAMS Accession No. ML15048A203), Tennessee Valley Authority (the licensee) requested relief from the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code). The relief request ISPT-03 pertains to the system leakage test of Class 1 piping conducted at or near the end of each inspection interval at the Watts Bar Nuclear Plant (Watts Bar), Unit 1.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(a)(3)(ii) (retitled paragraph 50.55a(z)(2) as noticed in the *Federal Register* (79 FR 65776), dated November 5, 2014), the licensee proposed an alternative pressure boundary for the ASME Code system leakage test 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 and safety.

The U.S. Nuclear Regulatory Commission (NRC) staff reviewed the subject request and concludes, as set forth in the enclosed safety evaluation that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR paragraph 50.55a(a)(3)(ii). Alternatives to the requirements of paragraph (g) to 10 CFR 50.55a may be used when authorized by the NRC if the licensee demonstrates that the proposed alternatives will provide an acceptable level of quality and safety. The NRC staff determined that the proposed alternative provides reasonable assurance of structural integrity and leak tightness of the subject piping segments, and complying with the specified 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). Therefore, the NRC staff authorizes the use of the licensee's proposed alternative at Watts Bar, Unit 1, for the second 10-year inservice inspection interval which will end on May 26, 2016.

All other ASME Code, Section XI requirements for which relief was not specifically requested and authorized herein by the NRC staff remain applicable, including the third party review by the Authorized Nuclear Inservice Inspector.

If you have any questions, please contact the Project Manager, Jeanne Dion, at 301-415-1349 or Jeanne.Dion@nrc.gov.

Sincerely,

Jessie F. Quichocho, Chief
Watts Bar Special Projects Branch
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-390

Enclosure:
Safety Evaluation

cc w/enclosure: Distribution via ListServ

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELIEF REQUEST ISPT-03 REGARDING SYSTEM LEAKAGE TEST OF CLASS 1 PIPING ISOLATED BETWEEN NORMALLY CLOSED VALVES

TENNESSEE VALLEY AUTHORITY

WATTS BAR NUCLEAR PLANT, UNIT 1

DOCKET NUMBER 50-390

1.0 INTRODUCTION

By letter dated September 12, 2014 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML14267A368), as supplemented by letter dated February 13, 2015 (ADAMS Accession No. ML15048A203), Tennessee Valley Authority (the licensee) requested relief from the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code). The Relief Request ISPT-03 pertains to the system leakage test of Class 1 piping conducted at or near the end of each inspection interval at the Watts Bar Nuclear Plant (Watts Bar), Unit 1.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(a)(3)(ii) (retitled paragraph 50.55a(z)(2) as noticed in the *Federal Register* (79 FR 65776), dated November 5, 2014), the licensee proposed an alternative pressure boundary for the ASME Code system leakage test 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 and safety.

2.0 REGULATORY EVALUATION

Pursuant to 10 CFR 50.55a(g)(4), the ASME Code Class 1, 2, and 3 components (including supports) must meet the requirements, except the design and access provisions and the preservice examination requirements, set forth in the 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.

Pursuant to 10 CFR 50.55a(z), alternatives to the requirements of paragraph (g) of 10 CFR 50.55a may be used when authorized by the Director, Office of Nuclear Reactor Regulation. A proposed alternative must be submitted and authorized prior to implementation. The licensee must demonstrate (1) the proposed alternative would provide an acceptable level of quality and safety; or (2) compliance with the specified requirements of this section would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

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

3.0 TECHNICAL EVALUATION

3.1 Component Affected

The components affected are ASME Code Class 1 piping. In accordance with IWB-2500 (Table IWB-2500-1), they are classified as Examination Category B-P, Item Number B15.10.

The licensee identified these piping segments as part of the reactor coolant system (RCS) between and outboard of redundant check valves. They include the safety injection system cold leg accumulator piping, high pressure (charging system) and intermediate pressure (safety injection system) portions of emergency core cooling system and residual heat removal system piping, auxiliary spray system piping, and chemical volume and control system (CVCS) piping. The licensee provided descriptions of these piping segments in Table 1 – "Piping Segment Descriptions" of the Enclosure to the licensee's submitted relief request (hereafter, Table 1). The materials of construction of the piping segments under consideration are stainless steel (SA-376 Type 316 or Type 304).

3.2 Applicable Code Edition and Addenda

The code of record for the second 10-year inservice inspection (ISI) interval is the 2001 Edition through 2003 Addenda of the ASME Code.

3.3 Duration of Relief Request

The licensee submitted this relief request for the second 10-year ISI interval which began on May 27, 2007, and will end on May 26, 2016.

3.4 ASME Code Requirement

The ASME Code, Section XI, IWB-2500, Table IWB-2500-1, Examination Category B-P, requires the system leakage test be conducted according to IWB-5220, and the associated VT-2 visual examinations according to IWA-5240, prior to plant startup following each refueling outage. In accordance with IWB-5221(a), the system leakage test shall be conducted at a pressure not less than the pressure corresponding to 100 percent rated reactor power. In accordance with IWB-5222(a), the pressure retaining boundary during the system leakage test shall correspond to the reactor coolant boundary, with all valves in the position required for normal reactor operation startup. The required VT-2 visual examination shall, however, extend to, and include, the second closed valve at the boundary extremity. In accordance with IWB-5222(b), the pressure retaining boundary during the system leakage test conducted at or near the end of each inspection interval shall extend to all Class 1 pressure retaining components within the system pressure boundary.

3.5 Proposed Alternative, Basis for Use, and Reason for Relief

The licensee proposed an alternative to IWB-5222(b). For all piping segments (listed in Table 1 of the Enclosure to ISPT-03), the proposed alternative is to use a reduced test pressure for the leakage test. Table 1 provides the proposed test pressure for each segment.

The licensee proposed to test the piping segments from cold leg accumulator outlet isolation valve to outlet check valve at a pressure between 610 pounds per square inch gauge (psig) and 660 psig, using accumulators as required by technical specifications (TSs).

The licensee proposed to test the piping segments of high pressure (charging system) and intermediate pressure (safety injection system) portions of the emergency core cooling system and residual heat removal system at a pressure of at least 1500 psig using the safety injection pumps. The licensee stated that this is the pressure when the safety injection pump is running at its minimum recirculation flow mode.

The licensee proposed to test the piping segments of auxiliary spray line between isolation valve (1-FCV-62-84) and check valve (1-CKV-62-661) at a pressure of at least 325 psig, which is the existing trapped pressure in that segment when the auxiliary spray was last used. The licensee stated that the auxiliary spray is normally used during routine plant startup to provide pressurizer pressure control prior to starting the reactor coolant pump (RCP). Once the RCP is started, the pressurizer spray is available from its normal source, and the auxiliary spray is closed. The minimum pressure at which the RCP may be started is 325 psig. The exact pressure in this line cannot be predicted or measured without initiating the auxiliary spray. There are no test connections within this piping volume that will permit measurement of the exact pressure trapped between these two valves.

In a February 13, 2015, letter, the licensee stated that the three CVCS piping segments are the (1) charging flow path to RCS cold leg loop 1, (2) charging flow path to RCS cold leg loop 4, and (3) auxiliary spray line to the pressurizer. Under normal operating procedures, only one of the above charging flow paths is in service; the pressurizer auxiliary spray line is not normally used for this purpose. For this reason, it cannot be assured that check valve bounded segments will necessarily be at full operating pressure during the leakage test. With a charging pump in service, and by alternating the flow path, loop 4 charging flow path, and auxiliary spray flow path, it is expected that the section of piping between the associated check valves for these paths would be at or near normal RCS pressure (2235 psig) during the proposed leakage test.

The licensee stated that applicable requirements in IWA-5213 for test condition holding time and IWB-5240 for minimum test temperature will be met.

The licensee stated that the piping segments in Table 1 contain butt welds. The licensee has volumetrically examined a portion of the RCS piping butt welds during every 10-year ISI interval as required by the Watts Bar risk informed ISI program. The same welds inspected during the first 10-year ISI interval were also inspected during the second 10-year ISI interval to allow for trending. The licensee did not find any indications of excessive or abnormal wear during examinations performed in the first and second 10-year ISI intervals.

The licensee stated that it has not identified any indications of stress corrosion cracking (SCC) and thermal fatigue in any reactor coolant pressure boundary (RCPB) welds of the piping

segments under consideration. The licensee has not detected any leakage in the piping segments under consideration.

Additionally, the licensee stated that it has performed containment walkdowns according to the plant procedures prior to each refueling outage upon entry into Mode 3 that look for any RCS leaks. The licensee has also conducted walkdowns to the extent practical during any plant forced shutdowns/forced outages.

3.6 Basis for Hardship

The licensee stated that for performance of the ASME Code required system leakage test, the RCS would have to be brought to normal operating pressure of approximately 2235 psig, at which time the piping segments under consideration are isolated from the RCS by their respective isolation valves. The licensee also stated that there exists no method that is in compliance with the plant design and TSs and which does not require redesign of the RCS system piping to accommodate pressurization of the piping segments under consideration to full operating pressure to conduct the ASME Code leakage test.

The licensee stated several options that could be used to test the piping segments under consideration at full RCS pressure are (1) use of temporary high pressure hoses connected to the RCS test connections, or use of "jumper" around the isolation valves where such connections exist, (2) use of pumps connected to each piping segment where connections exist, and (3) opening valve 1-FCV-62-84 and initiating auxiliary spray for the auxiliary spray line. Bypassing isolation valves and the use of temporary hoses and external pumps conflict with plant design requirements. Bypassing isolation valves also defeats the 10 CFR 50.55a(c)(2)(ii) double isolation boundary required for the RCPB when the reactor vessel contains nuclear fuel. The option of opening valve 1-FCV-62-84 and initiating auxiliary spray has significant issues, including expenditure of one of ten allowed thermal stress cycles for the nozzle associated with this line. Initiating auxiliary spray will adversely impact the pressurizer pressure control and will cause a reduction in the pressurizer pressure. If the valve fails to reclose immediately, there is a significant probability that the action will result in a safety injection actuation based on low pressurizer pressure. The use of any of the above options would require a redesign of the RCS and an installation of new piping in accordance with the plant's construction code. Therefore, the above activities impose a burden that would result in a hardship or unusual difficulty for the licensee.

The licensee stated that its alternate leakage testing will achieve the greatest test pressure possible in each piping segment listed in Table 1 without any plant modifications and will remain in compliance with the plant TSs and design requirements when nuclear fuel is contained in the reactor.

3.7 NRC Staff Evaluation

The NRC staff has evaluated ISPT-03 pursuant to 10 CFR 50.55a(z)(2). 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.

Hardship

The NRC staff found that requiring the licensee to comply with IWB-5222(b) and extend the pressure boundary to all Class 1 components within the system boundary when conducting the system leakage test at or near the end of an ISI interval would result in hardship. The basis for the hardship is as follows. During normal operation, the piping segments in Table 1 are isolated from the reactor coolant by two valves. These valves were designed to serve as the double isolation barrier to the RCPB. The licensee could bypass the isolation valve by use of "jumper" around the valve or use high pressure connections and external pump to pressurize these piping segments to the RCS operating pressure to perform the required system leakage test. However, these actions defeat the double isolation criteria described in 10 CFR paragraph 50.55a(c)(2)(ii), conflict with the plant design requirements, and reduce safety of the plant operation. They would also pose unnecessary safety hazards to personnel operating equipment and performing the test in case of a break in any temporary connections. Furthermore, the licensee would have to redesign the RCS system piping, because compliant methods with the plant design and TSs do not exist to accommodate performance of the ASME Code leakage test of the piping segments under consideration.

The NRC staff noted that for the auxiliary spray line, the licensee could initiate auxiliary spray to facilitate the ASME Code required system leakage testing. However, this action would cause thermal stress cycles on the nozzle associated with this line. This transient is limited to a total of ten for the life of the plant. It would also adversely impact the pressurizer pressure control, causing reduction in the pressurizer pressure, and would possibly result in a safety injection actuation based on low pressurizer pressure if the valve failed to reclose immediately.

Therefore, the NRC staff determined that concerns from defeating the double isolation requirements in 10 CFR 50.55a(c)(2)(ii); modifying the existing configuration of components, which would create conditions that would conflict with the plant design requirements and TSs; creating unnecessary thermal transient for the associated nozzle in that line; and subjecting personnel to unnecessary safety hazards, constitute a hardship.

Test Pressure

In evaluating the licensee's proposed alternative, the NRC staff assessed whether it appeared that the licensee used the highest achievable test pressure to conduct system leakage testing and the manner in which the licensee adequately preformed the testing and the associated VT-2 visual examinations of the piping for leakage. The NRC staff found that the licensee will use the highest possible pressure that is obtainable to test the piping segments in Table 1 for leakage. The licensee will accomplish this testing without any modifications to existing configuration of the pipes and associated isolation valves without causing thermal design transients affecting the nozzle associated with the line, without creating conflict with the TSs and plant design requirements, and without creating unnecessary safety hazards to personnel. Specifically, the licensee will conduct the leakage tests as follows:

a. Piping segments from cold leg accumulator outlet isolation valve to outlet check valve using accumulator pressure (610 psig to 660 psig);

b. Piping segments from high pressure (charging system) and intermediate pressure (safety injection system) using the safety injection pumps running at pressure of at least 1500 psig;

c. Piping segments from auxiliary spray line between isolation valve and check valve using the existing trapped pressure of at least 325 psig in the pipes when the auxiliary spray was last used to test the pipes for leakage; and

d. Piping segments of CVCS (i.e., charging flow path to RCS cold leg loop 1 and charging flow path to RCS cold leg loop 4) and auxiliary spray line to pressurizer using the charging pump to test these segments of piping at or near normal RCS pressure.

As part of this system leakage testing, the licensee will perform the associated VT-2 visual examination of the piping under consideration in accordance with the IWA-5240 requirements to identify any leak or boron residue. Therefore, the NRC staff determined that the licensee's proposed system leakage test using the proposed test pressure accompanied with the IWA-5240 required VT-2 visual examination is adequate because the licensee will perform the test with use of the highest obtainable pressure specific to each section of piping based on its system alignment, as described in Table 1.

Safety Significance of Alternative Test Pressure

In addition to the analysis described above, the NRC staff evaluated the safety significance of performance of the system leakage test at an alternative reduced pressure. The NRC staff notes that the piping segments in Table 1 are made of stainless steel. Potential degradation mechanism of these pipes can include fatigue and SCC. However, fatigue cracks are known to have relatively slow growth, and field experience has shown that SCC under the conditions associated with the piping under consideration is not expected. It is expected that any significant degradation of the piping under consideration would be detected by the system leakage test performed under proposed maximum possible test pressure.

The NRC staff noted the piping under consideration contains butt welds. The volumetric examinations performed in accordance with the requirements of risk-informed ISI program during the first and second 10-year ISI interval revealed neither indications nor Class 1 pressure boundary leakage in these pipes.

The NRC staff noted that in the unlikely event that the piping segments in Table 1 developed a through wall flaw and a leak, the Watts Bar, Unit 1, existing reactor coolant leakage detection systems will be able to identify the leakage during normal operation, and the licensee will take appropriate corrective actions in accordance with the plant technical specifications. Therefore, the NRC staff determined that based on the alternative system leakage testing that subject this piping to the maximum possible pressure and the performance of the ASME Code required VT-2 visual examinations, it is reasonable to conclude that if significant service induced degradation occurs, evidence of that degradation will be detected either by the proposed examinations or the RCS leakage detection systems.

Therefore, the NRC staff finds that the proposed system leakage testing using the proposed test pressure is adequate to provide a reasonable assurance of structural integrity and leak tightness of the piping segments under consideration. Complying with the requirement specified

in IWB-5222(b) would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

4.0 CONCLUSION

As set forth above, the NRC staff determined that the proposed alternative provides reasonable assurance of structural integrity and leak tightness of the subject piping segments, and complying with the specified 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). Therefore, the NRC staff authorizes the use of the licensee's proposed alternative at Watts Bar, Unit 1, for the second 10-year ISI interval, which will end on May 26, 2016.

All other ASME Code, Section XI requirements for which relief was not specifically requested and authorized herein by the NRC staff remain applicable, including the third party review by the Authorized Nuclear Inservice Inspector.

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If you have any questions, please contact the Project Manager, Jeanne Dion, at 301-415-1349 or Jeanne.Dion@nrc.gov.

Sincerely,

/RA/

Jessie F. Quichocho, Chief
Watts Bar Special Projects Branch
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-390

Enclosure:
Safety Evaluation

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