March 24, 2000

Mr. J. A Scalice
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and Executive Vice President
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SUBJECT: WATTS BAR NUCLEAR PLANT - FIRST 10-YEAR INTERVAL INSERVICE INSPECTION PROGRAM PLAN REQUESTS FOR RELIEF NOS. 1-ISI-5 AND 1-ISI-6 (TAC NO. MA6446)

Dear Mr. Scalice:

By letter dated August 31, 1999, the Tennessee Valley Authority (TVA) submitted its First 10-Year Interval Inservice Inspection (ISI) Program Plan Requests for Relief Nos. 1-ISI-5 and 1-ISI-6 from the requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section XI, for the Watts Bar Nuclear Plant, Unit 1. The requests were for relief from the Code required volumetric examination on the steam generator nozzle-to-safe end welds and for the reactor vessel head-to-flange weld.

The Nuclear Regulatory Commission (NRC) staff, with technical assistance from its contractor, the Idaho National Engineering and Environmental Laboratory (INEEL), has reviewed the information provided in TVA's August 31, 1999, letter. The NRC staff's evaluation and conclusions are contained in the Enclosure, which includes the INEEL Technical Evaluation Report. The examinations performed by the licensee provide reasonable assurance of the structural integrity of the welds. Based on the impracticality of complying with the Code and the burden on the licensee if those requirements were imposed, relief is granted pursuant to 10 CFR 50.55a(g)(6)(i).

Sincerely,

/RA/

Richard P. Correia, Chief, Section 2
Project Directorate II
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-390

Enclosure: Safety Evaluation

cc w/enclosure: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REQUESTS FOR RELIEF NOS. 1-ISI-5 AND 1-ISI-6

FOR

TENNESSEE VALLEY AUTHORITY

WATTS BAR NUCLEAR PLANT

DOCKET NUMBER 50-390

1.0 INTRODUCTION

Inservice inspection (ISI) of the American Society of Mechanical Engineers (ASME) Code Class 1, 2, and 3 components is performed in accordance with Section XI of the ASME Boiler and Pressure Vessel (B&PV) Code and applicable addenda as required by Title 10, *Code of Federal Regulations* (10 CFR) Section 50.55a(g), except where specific written relief has been granted by the Commission pursuant to 10 CFR 50.55a(g)(6)(i). It is stated in 10 CFR 50.55a(a)(3) that alternatives to the requirements of paragraph (g) may be used, when authorized by the U.S. Nuclear Regulatory Commission (NRC), if (i) the proposed alternatives would provide an acceptable level of quality and safety or (ii) compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Pursuant to 10 CFR 50.55a(g)(4), ASME Code Class 1, 2, and 3 components (including supports) shall meet the requirements, except the design and access provisions and the pre-service 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. The regulations require that inservice examination of components and system pressure tests conducted during the first 10-year interval and subsequent intervals 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 limitations and modifications listed therein. The Code of record for the Watts Bar Nuclear Plant, Unit 1, first 10-year ISI interval is the 1989 Edition of the ASME B&PV Code.

2.0 EVALUATION

By letter dated August 31, 1999, Tennessee Valley Authority (licensee) submitted its First 10-Year Interval Inservice Inspection Program Plan Requests for Relief Nos. 1-ISI-5 and 1-ISI-6 for Watts Bar Nuclear Plant, Unit 1. It is noted that the dating of the licensee's letter may be subject to interpretation, but that it has been confirmed to be August 31, 1999.

The Idaho National Engineering and Environmental Laboratory (INEEL), has evaluated the information provided by the licensee in support of its First 10-Year Interval Inservice Inspection Program Plan Requests for Relief Nos. 1-ISI-5 and 1-ISI-6 for Watts Bar Nuclear Plant, Unit 1.

Based on the results of the review, the staff adopts the contractor's conclusions and recommendations presented in the Technical Letter Report (TLR) attached.

The information provided by the licensee in support of its alternative to the Code requirements has been evaluated and the basis for disposition is documented below.

Request for Relief 1-ISI-5: STEAM GENERATOR NOZZLE TO SAFE END WELDS

ASME Code, Section XI, Examination Category B-F, Item B5.70, requires 100% volumetric and surface examination, as defined by Figure IWB-2500-1, for pressure retaining dissimilar metal welds.

Pursuant to 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from the Code required volumetric examination on the steam generator nozzle-to-safe end welds.

The geometric configuration of the weld joint prevents ultrasonic examination from the nozzle side and the austenitic piping material prevents two-directional coverage from the pipe side, thus precluding full volumetric examination coverage. The steam generator nozzle design, therefore, makes the Code-required examination impractical. To examine the welds in accordance with the requirements of the Code, the steam generator nozzles would require design modification. Imposition of the Code requirements would result in a significant burden on the licensee.

The licensee obtained a significant portion (65% - 75%) of the required volumetric examination coverage. In addition, the licensee performed 100% of the required surface examinations on the subject welds. The partial volumetric examinations, combined with the Code-required surface examination provides reasonable assurance of the structural integrity of the steam generator nozzle-to-safe end welds. Relief is granted pursuant to 10CFR50.55a(g)(6)(i).

Request for Relief 1-ISI-6, REACTOR VESSEL HEAD-TO-FLANGE WELD

ASME Code, Section XI, Examination Category B-A, Item B1.40, requires 100% surface and volumetric examination, as defined by Figure IWB-2500-5, for reactor vessel head-to-flange welds.

Pursuant to 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from the Code-required volumetric examination for reactor vessel head-to-flange Weld No. W08-09-A. The complete circumferential reactor vessel head-to-flange weld is identified by two weld identifier numbers, W08-09-A and W08-09-B. Weld W08-09-A covers one-half of the total weld circumference, as shown on page E2A1-1 of the licensee's submittal, and is scheduled for inspection during the first ISI inspection interval. Thus, this relief is applicable only to weld W08-09-A. Weld W08-09-B is scheduled for inspection during the second ISI inspection interval.

The geometric curvature of the flange, in combination with restrictions caused by o-ring grooves, locations for o-ring clips, and access limitations caused by the lifting lugs preclude complete ultrasonic scans of the full volume of this weld. Therefore, the Code-required 100% volumetric examination is impractical. To gain access for 100% coverage, the component would have to be redesigned and modified. Imposition of the Code requirements would be a significant burden on the licensee.

The licensee is able to obtain a significant portion (75%) of the required volumetric examination coverage. In addition, the licensee will complete the Code-required 100% surface examination. These examinations provide reasonable assurance of the structural integrity of the subject weld. Relief is granted pursuant to 10 CFR 50.55a(g)(6)(i).

3. CONCLUSION

The staff concludes that certain inservice examinations are impractical and cannot be performed to the extent required by the Code at the Watts Bar Nuclear Plant, Unit No. 1. The examinations performed by the licensee provide reasonable assurance of the structural integrity of the subject welds. For Requests for Relief 1-ISI-5 and 1-ISI-6 relief is granted pursuant to 10 CFR 50.55a(g)(6)(i).

Attachment: INEEL Technical Letter Report

Principal Contributor: Thomas K. McLellan, NRR

Date: March 24, 2000

TECHNICAL LETTER REPORT
ON THE FIRST 10-YEAR INTERVAL INSERVICE INSPECTION
REQUESTS FOR RELIEF 1-ISI-5 AND 1-ISI-6
FOR
TENNESSEE VALLEY AUTHORITY
WATTS BAR NUCLEAR PLANT, UNIT NO. 1
DOCKET NUMBER: 50-390

1. INTRODUCTION

By letter dated August 3, 1999, the licensee, Tennessee Valley Authority, submitted Requests for Relief 1-ISI-5 and 1-ISI-6, seeking relief from the requirements of the ASME Code, Section XI, for the Watts Bar Nuclear Plant, Unit No. 1 first 10-year inservice inspection (ISI) interval. The Idaho National Engineering and Environmental Laboratory (INEEL) staff's evaluation of the subject requests for relief is in the following section.

2.0 EVALUATION

The information provided by Tennessee Valley Authority in support of the requests for relief from Code requirements has been evaluated and the bases for disposition are documented below. The Code of record for the Watts Bar Nuclear Plant, Unit No. 1, first 10-year ISI interval, which began May 27, 1996, is the 1989 Edition of Section XI of the ASME Boiler and Pressure Vessel Code.

2.1 Request for Relief 1-ISI-5, Examination Category B-F, Item B5.70, Pressure Retaining Dissimilar Metal Welds In Vessel Nozzles

Code Requirement: Examination Category B-F, Item B5.70, requires 100% volumetric and surface examination, as defined by Figure IWB-2500-1, for pressure retaining dissimilar metal welds.

Licensee's Code Relief Request: In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from the Code required volumetric examination on the steam generator nozzle-to-safe end welds.

Licensee's Basis for Relief Request (as stated):

> "The design configuration on the steam generator nozzle and the CF-8A piping material precludes an ultrasonic examination of the required volume for the nozzle-to-safe end butt welds. The design configuration and piping material limits ultrasonic examination of the Code required examination volume to approximately 65% on the steam generator 2 hot leg nozzle and approximately 75% on the steam generator 2 cold leg nozzle and steam generator 3 hot and cold leg nozzles.
>
> "The geometric configuration of the steam generator hemispherical chamber and nozzle and piping material precludes ultrasonic examination of essentially 100% of the required examination volume. The nozzles are integrally cast with the hemispherical chamber as shown on vendor drawing EDSK-341101B (Attachment

2)[1]. The hemispherical chamber is an SA-216 Gr. WCC casting, clad with austenitic stainless steel. The nozzles have buttered 308L safe ends. The main loop reactor coolant piping connections to the nozzle safe end are static cast SA-351, CF-8A elbows. The geometric configuration of the steam generator side of the weld joint prevents an ultrasonic scan from the nozzle side and the piping materials prevents two-directional coverage from the pipe side, thus precluding full volume examination. A representation of the achievable examination volume for the nozzle-to-safe end weld is depicted on each of the ultrasonic examination reports (Attachment 4). (Attachment 5 provides TVA's procedure for calculating ASME Code Coverage for NDE examinations).

"ASME Section XI requires that the examination volume C-D-E-F as depicted on Figure IWB-2500-8(c) be examined by four scan directions, two normal to the weld and two parallel to the weld. Due to the anisotropic course grain structure of cast stainless CF-8A materials, the examination was limited to the ½ vee technique using refracted longitudinal wave search units with a beam angle of 45 degrees. The welds received 100% one direction coverage from the elbow side with the sound beam directed toward the steam generator. No scans were performed from the steam generator side due to the nozzle taper interference, therefore, 0% coverage was obtained from this direction. Scans parallel to the weld were performed to the extent that loss of search unit contact occurred on the steam generator side of the weld. These welds were previously conditioned during pre-service inspection to maximize search unit coupling and provide access to the maximum extent precluding the nozzle configuration. Based on the extent of coverage obtained, it is reasonable to assure that flaws originating from the inner diameter would be detected to the degree comparable with industry standards.

"During the preservice inspection, examination volume for these four welds was also reported to be limited. The welds were included in Preserviece Inspection Program Request for Relief ISI-4. NRC approval was documented in the WBN Safety Evaluation Report, (NUREG-0847) Supplement 10, Appendix Z, Section 3.4. There are four additional nozzle-to-safe end welds required to be examined prior to the end of the first ten year interval. It is anticipated that based on the results of these examinations and the preservice examinations, code required examination coverage will not be obtained for the remaining nozzle-to-safe end welds. It is expected that request(s) for relief for the four remaining welds will be necessary in the future based upon actual coverage obtained following the examination.

"Conformance with the referenced Code requirement is impractical, therefore, this request for relief is submitted pursuant to 10 CFR 50.55a(g)(5)(iii). Due to the combined effect of the high percentage of ultrasonic examination coverage (65% - 75%), and 100% surface examination coverage, it is requested that relief be approved in accordance with 10 CFR 50.55a(g)(6)(i) for the first inspection interval."

1

Licensee's Proposed Alternative Examination (as stated):

"The Code required 100% volumetric examination of the lower one-third volume of the steam generator nozzle-to-safe end welds was performed on accessible areas

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Attachments provided in the licensee's submittal are not included in this report.

to the extent practical given the geometric configuration and piping materials of the nozzle-to-safe end butt weld. The Code required surface examinations were acceptable on 100% of the weld length for these welds during the Unit 1 Cycle 2 refueling outage."

Evaluation: The Code requires 100% surface and volumetric examination for dissimilar metal safe end welds. However, complete examination of the subject welds is limited by component geometry (one-sided access) and material properties (attenuative grain structure). The licensee included a sketch in the request for relief showing the nozzle geometry and the limitations of the examination volume. The geometric configuration of the weld joint prevents ultrasonic examination from the nozzle side and the austenitic piping material prevents two-directional coverage from the pipe side, thus precluding full volumetric examination coverage. The steam generator nozzle design, therefore, makes the Code-required examination impractical. To examine the welds in accordance with the requirements of the Code, the steam generator nozzles would require design modification. Imposition of the Code requirements would result in a significant burden on the licensee.

The licensee obtained a significant portion (65% - 75%) of the required volumetric examination coverage. In addition, the licensee performed 100% of the required surface examinations on the subject welds. The partial volumetric examinations, combined with the Code-required surface examination, will provide reasonable assurance of the continued structural integrity of the steam generator nozzle-to-safe end welds. Therefore, it is recommended that relief be granted pursuant to 10CFR50.55a(g)(6)(i).

2.2 Request for Relief 1-ISI-6, Examination Category B-A, Item B1.40, Reactor Vessel Head-To-Flange Weld

Code Requirement: Examination Category B-A, Item B1.40, requires 100% surface and volumetric examination, as defined by Figure IWB-2500-5, for reactor vessel head-to-flange welds.

Licensee's Code Relief Request: In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from the Code required volumetric examination for reactor vessel head-to-flange Weld No. W08-09-A.

Licensee's Basis for Relief Request (as stated):

"The design configuration of the reactor vessel head-to-flange weld precludes an ultrasonic examination of the required volume for the head-to-flange weld. The design configuration limits ultrasonic examination of the Code required examination volume to approximately 75%.

"The ASME Section XI Code requirements for reflectors oriented parallel to the weld stipulate that the angle beam search units shall be aimed at right angles to the weld axis, with the search units manipulated so that the ultrasonic beams pass throughout the entire volume of weld metal. The required examination volume A-B-C-D is depicted on ASME Section XI Figure IWB-2500-5. The head-to-flange weld configuration limits bi-directional coverage from the flange side due to the adjacent flange junction. This junction restricts the search unit scan surface. A representation of the achievable examination volume for the head-to-flange weld is

depicted with the coverage report provided by Southwest Research Institute (Attachments 4 and 5).

"The weld received 100% one direction coverage from the head side with the sound beam directed toward the flange. No scans were performed from the flange side due to the taper interference, therefore, 0% coverage was obtained from this direction. Scans parallel to the weld were performed to the extent that loss of search unit contact occurred on the flange side of the weld. Based on the extent of coverage obtained, it is reasonable to assure that flaws originating from the inner diameter would be detected.

"Ultrasonic examination from the flange face would not provide meaningful results based on the following:

The geometric configuration of the head-to-flange weld is not amenable for ultrasonic examination from the flange face. This is due to the geometric curvature of the head and the extensive metal path distance required to interrogate the required weld volume. Section A-A of Westinghouse drawing 30738-1535 provides general details of the reactor vessel head (Attachment 2).

The flange face contains two o-ring grooves (0.6 inch in width) around the circumference and contains 32 recessed locations for o-ring clips, which limit complete scan coverage from the flange face. Detail I of Westinghouse drawing 30738-1535 provides details of the o-ring grooves and clip locations on the flange face.

Previous examination results from pre-service examination did not reveal any flaws.

No industry events have identified flaw initiation in rector vessel head-to-flange welds.

"Conformance with the referenced Code requirement is impractical, therefore, this request for relief is submitted pursuant to 10 CFR 50.55a(g)(5)(iii). Due to the combined effect of the high percentage of ultrasonic examination coverage (75%), and 100% surface examination coverage, it is requested that relief be approved in accordance with 10 CFR 50.55a(g)(6)(i) for the first inspection interval.

Licensee's Proposed Alternative Examination (as stated):

"The Code required 100% volumetric examination of the full volume of the reactor vessel head-to-flange weld to be performed on accessible areas to the extent practical given the design configuration of the head-to-flange weld. The Code required surface examination to be performed on 100% of the weld length for this weld.

"To meet the Inspection Program B minimum/maximum examination requirements for Examination Category B-A as defined in ASME Section Xi, IWB-2412, the head-to-flange weld is divided into two sections. One section, W08-09-A, was scheduled for examination during the first period and was examined during the Cycle 2

refueling outage. The other section, W08-09-B, is scheduled for examination during the second period.

Evaluation: The Code requires 100% volumetric and surface examination of the RPV closure head-to-flange weld each inspection interval. Figures and attachments supplied by the licensee show that the geometric curvature of the flange, in combination with restrictions caused by o-ring grooves, locations for o-ring clips, and access limitations caused by the lifting lugs preclude complete ultrasonic scans of the full volume of this weld. Therefore, the Code-required 100% volumetric examination is impractical to achieve. To gain access for 100% coverage, the component would have to be redesigned and modified. Imposition of the Code requirements would result in a significant burden on the licensee.

The licensee is able to obtain a significant portion (75%) of the required volumetric examination coverage. In addition, the licensee will complete the Code-required 100% surface examination. These examinations should detect any existing patterns of degradation, and provide reasonable assurance of the continued structural integrity of the weld. Therefore, based on the impracticality of the Code volumetric coverage requirements, and the extent of examinations that will performed, it is recommended that relief be granted pursuant to 10 CFR 50.55a(g)(6)(i).

3. CONCLUSION

The INEEL staff evaluated the licensee's submittal and concluded that certain inservice examinations cannot be performed to the extent required by the Code at the 1 att1 1 1 a1 1 1 c1 ea1 1 1 1 ant1 1 1 n1 For Requests for Relief 1-ISI-5 and 1-ISI-6 it is concluded that the Code requirements are impractical for the subject welds. Therefore, it is recommended that relief be granted pursuant to 10 CFR 50.55a(g)(6)(i).

Mr. J. A. Scalice

Tennessee Valley Authority

WATTS BAR NUCLEAR PLANT

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