September 7, 2000

Mr. J. A Scalice
Chief Nuclear Officer
and Executive Vice President
Tennessee Valley Authority
6A Lookout Place
1101 Market Street
Chattanooga, Tennessee 37402-2801

SUBJECT: RELIEF FROM ASME CODE REQUIREMENTS FOR INSULATION REMOVAL FOR BOLTED CONNECTIONS FOR VT-2 EXAMINATION AT WATTS BAR NUCLEAR PLANT, ISPT-08 (TAC NO. MA8568)

Dear Mr. Scalice:

By letters dated March 23, July 21 and August 2, 2000, the Tennessee Valley Authority (TVA) submitted a request for relief from the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section XI, 1989 Edition, Paragraph IWA-5242(a) under Title 10, *Code of Federal Regulations* (10 CFR), Section 50.55a(a)(3)(ii), for the Watts Bar Nuclear Plant, Unit 1. The request was for approval of an alternative from the requirement to remove insulation for visual VT-2 examination of bolted connections during a system pressure test on systems borated for the purpose of controlling reactivity.

The staff has reviewed the information provided in TVA's March 23, July 21 and August 2, 2000, letters. The staff's evaluation and conclusions are contained in Enclosure 1. Based on the information provided in the relief request (Relief Request ISPT - 08), the staff concludes that compliance with the code requirements would result in a hardship without a compensating increase in the level of safety and quality, and that the licensee's proposed alternative will provide reasonable assurance of bolting integrity. Accordingly, the staff authorizes the use of such alternatives pursuant to 10 CFR 50.55a(a)(3)(ii).

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

Enclosures: Safety Evaluation

cc w/enclosures: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

OF RELIEF REQUESTS FROM ASME SECTION XI REQUIREMENTS

FOR RELIEF REQUEST ISPT-08

FOR

TENNESSEE VALLEY AUTHORITY

WATTS BAR NUCLEAR PLANT

DOCKET NUMBER 50-390

1.0 INTRODUCTION

Title 10, *Code of Federal Regulations* (10 CFR), Section 50.55a, requires that inservice inspection (ISI) of certain American Society of Mechanical Engineers (ASME) Code Class 1, 2, and 3 components be performed in accordance with Section XI of the ASME Boiler and Pressure Vessel (B&PV) Code (ASME Code) applicable Edition and Addenda, except where specific written relief has been granted by the U. S. Nuclear Regulatory Commission (NRC) pursuant to 10 CFR 50.55a(g)(6)(i). In 10 CFR 50.55a(a)(3), it states that alternatives to the requirements of paragraph (g) may be used, when authorized by the 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 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. 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. For Watts Bar Unit 1 (WBN), the applicable edition of Section XI of the ASME Code for the first ten-year ISI interval is the 1989 Edition.

The NRC staff's findings with respect to Tennessee Valley Authority's (TVA's or licensee's) proposed alternatives submitted on March 23, July 21 and August 2, 2000, are contained in this safety evaluation.

2.0 EVALUATION

2.1 LICENSEE'S EVALUATION

The Components for Which Relief is Requested:

Class 1, certain pressure retaining bolted connections in systems borated for the purpose of controlling reactivity, to include the 26 valves and associated components as listed in TVA submittal dated August 2, 2000, Enclosure 1, Attachment 1.

Requirement From Which Relief is Requested:

Subparagraph IWA-5242(a): "For systems borated for the purpose of controlling reactivity, insulation shall be removed from pressure retaining bolted connections for visual examination VT-2."

Licensee's Basis for Requesting Relief and Justification for Granting Relief:

The licensee contends that complying with IWA-5242(a) will result in a hardship or unusual difficulty without a compensating increase in the level of quality and safety. Relief from IWA-5242(a) is requested pursuant to 10 CFR 50.55a(a)(3)(ii).

The licensee acknowledges that all systems containing borated water could be susceptible to boric acid corrosion. There are areas in the plant that are difficult to inspect and scaffolding or ladder installation is required. This could result in significant personnel radiation exposure during insulation removal. Also, removal and reinstallation of insulation during pressure-testing at system pressure and temperature increases the risk of personal injury. The licensee has been granted relief from the requirements of IWA-5242(a) for the use of Code Case N-533, "Alternative Requirements for VT-2 Visual Examination of Class 1 Insulated Pressure-Retaining Bolted Connections." Code Case N-533 permits removal of the insulation during cold shutdown conditions.

The licensee considers the removal of insulation to inspect for corrosion on corrosion resistant bolting material unnecessary. The licensee also stated that the requirement to remove insulation places an undue burden on WBN, and does not enhance the safety or quality of the plant.

Alternative Examination:

The licensee proposed, as an alternative to IWA-5242(a), to conduct VT-2 visual inspections of bolted connections inside of the polar crane wall with the insulation in place, as follows:

> The proposed alternative examination is requested for use at WBN. This Alternative is not a request for use of Code Case N-533 as NRC has already approved its use for WBN as Relief Request ISPT-06 in a letter dated September 23, 1997.
>
> Bolted connections inside the polar crane wall and fabricated of materials resistant to boric acid corrosion in systems borated for the purpose of controlling reactivity shall

receive a visual VT-2 examination during the system pressure tests of IWB-5000 and IWC-5000 with the insulation installed. If evidence of leakage is detected, either by discovery of active leakage or evidence of boric acid crystals, the insulation shall be removed and the bolted connection shall be re-examined and the source of the leakage identified. If necessary, the mechanical connections shall be evaluated in accordance with the corrective measures of Subarticle IWA-5250, as modified by Relief Request ISPT-03 previously approved by NRC in a letter dated September 23, 1997.

Carbon steel bolted connections within the System Pressure Test boundaries will continue to receive an inspection for boric acid residue with the insulation removed in accordance with ASME Code Case N-533, as approved by the NRC for use at WBN in relief request ISPT-06.

If insulation is removed for planned maintenance, repair, or other inspection at a bolted connection in a system borated for the purpose of controlling reactivity, a visual examination shall be performed on the bolted connection prior to disassembly and, if evidence of leakage is discovered, evaluated in accordance with the corrective measures of Subarticle IWA-5250, as modified by previously approved relief request ISPT-03.

2.2 STAFF EVALUATION

The Code requires the removal of all insulation from pressure-retaining bolted connections in systems borated for the purpose of controlling reactivity when performing VT-2 visual examinations during system pressure tests. The Code requires this examination to be performed each refueling outage for Class 1 systems, and each inspection period for Class 2 and 3 systems.

The staff has developed a position over the years on the use of AISI Type 17-4 PH stainless steel (SA-564 Grade 630), AISI Type 410 stainless steel (SA-193 Grade 6), and A-286 stainless steel (SA-453 Grade 660) fasteners. Although, of the above, only the A-286 material is included in the WBN relief request, all three materials are discussed here to provide a complete discussion of fastener materials. The 17-4 PH stainless steel and the 410 stainless steel are suitable for use in contact with primary water if they are aged at a temperature of 1100°F or higher. If they are aged at a lower temperature, they become susceptible to primary water stress corrosion cracking. The hardness of these alloys should be below R_c 30 if they are properly heat treated. A-286 stainless steel is susceptible to stress corrosion cracking in primary water, particularly if preloaded above 100 thousand pounds per square inch (ksi). Bengtsson and Korhonen of ASEA-ATOM, Vasteras, Sweden, examined the behavior of A-286 in a boiling water reactor (BWR) environment, as reported in the Proceedings of the International Symposium on Environmental Degradation of Materials in Nuclear Power Systems-Water Reactors, August 22-25, 1983, Myrtle Beach, South Carolina, sponsored by National Association of Corrosion Engineers, the Metallurgical Society of AIME, and the American Nuclear Society. They found that A-286, in comparison to other tested materials, was the most susceptible material they tested to intergranular stress corrosion cracking in BWR water. They also found that A-286 is less likely to crack as the applied stress is reduced. Piascik and Moore from Babcock & Wilcox reported a number of vessel internals bolt failures of A-286 bolts in Nuclear Technology, Vol. 75, December 1986 in pressurized-water reactor water.

They correlated the failures with bolt fillet peak stress and found that bolts preloaded below 100 ksi showed no failures.

The NRC staff position is that any 17-4 PH stainless steel or 410 stainless steel stud or bolt aged at a temperature below 1100°F or with hardness above R_c 30 must have the thermal insulation removed for VT-2 examination during the system pressure test. For A-286 stainless steel studs or bolts, the preload must be verified to be below 100 ksi or the thermal insulation must be removed and the joint visually inspected. For nuts conforming to SA-194, experience indicates it would not be necessary to remove the thermal insulation for visual inspection.

The licensee's relief request does not address the possibility that A-286 fasteners could fail in service under insulation and the failure could go unnoticed. Also, the staff's position is that all valve bodies, pump casings, and piping must contain at least 10 percent chromium and be in the proper heat treatment condition because the insulation could create an autoclave and materials with less than 10 percent chromium could experience high corrosion rates. This corrosion could go unnoticed. The staff's position is that a licensee should also conduct a 4 hour hold time at operating temperature and pressure prior to conducting the VT-2 examination.

The NRC staff requested additional information (RAI) from the licensee in a letter dated May 19, 2000. The additional information requested was:

(a) heat treatment of any SA-194 Grade B6 (410 stainless steel) bolting;
(b) preload on SA-453 Grade 660 (A-286) bolted connections;
(c) chromium content of the piping, pump casings, and valve bodies that are under the insulation
(d) the hold time that will be imposed at operating pressure prior to conducting the VT-2 examination.

The licensee responded to the RAI in a letter dated July 21, 2000, from Ralph H. Shell to the NRC Document Control Desk. Since Unit 1 is operating, the licensee inspected bolting in Unit 2. The same vendor provided the analogous valves for both units. Five of the 26 valves inside of the polar crane wall did not have Certified Material Test Reports for the SA-194 nuts and the licensee removed those valves from the relief request. Seven valves had SA-194 nuts with hardnesses higher than R_C 30 and these valves were removed from the relief request. On June 1, 2000, the ASME Section XI Working Group on Pressure Testing sent Committee Correspondence to Andrea D. Lee of the NRC staff. This correspondence stated, "*SA-194 Grade 6 is a nut material and therefore should not be a concern for SCC [stress corrosion cracking] (being typically under compression).*" On July 27, 2000, the staff contacted the licensee, and informed the licensee that SA-194 nuts were not a concern and any actions taken with regard to SA-194 nuts were not necessary. On August 2, 2000, the licensee submitted a revised response to the RAI. All 26 of the valves inside the polar crane wall are included in the request for relief. The staff finds that the inclusion of all of the valves inside of the polar crane wall is appropriate.

The licensee reviewed the preloads for SA-453, Grade 660 (A-286) bolted connections and provided sufficient data to demonstrate that none of this bolting is preloaded above 100 ksi. The maximum WBN Unit 1 specified preload is 45 ksi. Some of the vendors permitted higher

preloads with the maximum being 65 ksi. The staff finds that the preloads for SA-453, Grade 660 are sufficiently low that there is a low probability for stress corrosion cracking to occur. The licensee provided data that indicates the insulated piping, pump casings, and valve bodies have chromium contents that exceed 16% in all cases. The staff finds that this chromium content is satisfactory. The licensee also stated that the 4-hour hold time is observed after reaching the operating pressure and temperature, and before performing the VT-2 examination.

These TVA responses resolve the four concerns addressed above and, accordingly, the staff finds this relief request acceptable.

2.3 STAFF SUMMARY

The staff concludes that the requested relief for bolted connections inside of the polar crane wall at WBN Unit 1 is acceptable because adherence to IWA-5242(a) does result in a hardship or unusual difficulty on insulated joints containing corrosion resistant bolting without a compensating increase in the level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(ii) relief is granted for the first inservice inspection interval at Watts Bar Unit 1.

3.0 CONCLUSION:

Based on the NRC staff's review of the information provided in the request for relief (Relief Request ISPT-08), the staff concludes that compliance with the code requirements would result in a burden without a compensating increase in the level of quality and safety, and that licensee's proposed alternatives will provide reasonable assurance of bolting integrity. Therefore, these proposed alternatives are authorized pursuant to 10 CFR 50.55a(a)(3)(ii).

Principal Contributor: J. Davis, NRR
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Date: September 7, 2000

Mr. J. A. Scalice
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WATTS BAR NUCLEAR PLANT

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