June 6, 2001

Mr. J. W. Moyer, Vice President
Carolina Power & Light Company
H. B. Robinson Steam Electric Plant,
Unit No. 2
3581 West Entrance Road
Hartsville, South Carolina 29550

SUBJECT: H. B. ROBINSON ELECTRIC PLANT, UNIT NO. 2, REQUEST FOR RELIEF (RELIEF REQUEST NO. 32) REGARDING SURFACE EXAMINATION OF REACTOR PRESSURE VESSEL NOZZLE-TO-SAFE-END WELDS (TAC NO. MB1541)

Dear Mr. Moyer:

By letter dated March 21, 2001, and supplemented by letters dated March 30, April 5, and April 23, 2001, Carolina Power & Light Company, the licensee for H. B. Robinson Steam Electric Plant, Unit 2 (HBRSEP2), submitted a relief from certain American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code-required inspection criteria. Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(g)(6)(i), the licensee requested relief from the surface examination requirements of the ASME Code, Section XI, Table IWB-2500-1, Examination Category B-F, "Pressure Retaining Dissimilar Metal Welds," Item B5.10, "NPS 4 or Larger Nozzle-to-Safe-End Butt Welds."

During an April 5, 2001, telephone call, the licensee requested verbal approval of the subject relief request. The licensee explained that unanticipated circumstances associated with the pending refuelling outage impacted their ability to submit the request in a timely manner. The subject relief was verbally granted by the staff during the April 5, 2001, telephone call.

The Nuclear Regulatory Commission has reviewed and evaluated the subsequent information provided by the licensee. Based on this information, and pursuant to 10 CFR 50.55a(g)(6)(i), the staff has determined that the relief requested by the licensee was acceptable and concluded that surface examinations beyond those that are achievable for the subject welds are impractical and that the extended ultrasonic testing examination of the inner 40 percent through-wall in conjunction with a VT-2 (for insulated piping) examination would provide the same assurance of structural integrity of the subject welds as the obtainable 19 percent surface examination.

This relief is authorized for the third 10-year inservice inspection interval for HBRSEP2, which began on February 19, 1992. The enclosed Safety Evaluation documents our review.

If you have any questions, please contact R. Subbaratnam at 301-415-1478.

Sincerely,

***/RA by K.Jabbour Acting for/***

Patrick M. Madden, Acting Chief, Section 2
Project Directorate II
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-261

Enclosure: Safety Evaluation

cc w/encl: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

THIRD 10-YEAR INTERVAL INSERVICE INSPECTION PROGRAM

RELIEF REQUEST NO. 32 FROM THE ASME CODE, SECTION XI REQUIREMENTS

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2

DOCKET NUMBER 50-261

## 1.0 INTRODUCTION

The inservice inspection (ISI) of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (B&PV) Code (Code) Class 1, Class 2, and Class 3 components is to be performed in accordance with Section XI of the ASME Code and applicable edition and addenda as required by Title 10 of the *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 NRC, if the licensee demonstrates that: (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 (ISI) 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 third 10-year ISI interval at H. B. Robinson Steam Electric Plant (HBRSEP), Unit 2 is the 1986 Edition of Section XI of the ASME B&PV Code.

The staff has reviewed the information submitted by Carolina Power & Light Company, the licensee, in a letter dated March 21, 2001, and supplemented by letters dated March 30, April 5, and April 23, 2001, requesting relief from certain Code-required inspection criteria. Specifically, the licensee is requesting relief from surface examination requirements for reactor pressure vessel (RPV) nozzle-to-safe-end dissimilar metal welds. The licensee determined that surface examinations of the subject welds were impractical. The licensee proposed to perform a visual examination on the portion of the insulated pipe containing the welds.

## 2.0 WELD SURFACE EXAMINATION

The components affected by this request are the carbon steel nozzles welded to stainless steel safe-ends with Inconel weld material. These welds are identified below.

| Weld Identification Number | Location |
|---|---|
| CPL-107/1DM | "A" Hot Leg |
| CPL-107/14DM | "A" Cold Leg |
| CPL-107A/1DM | "B" Hot Leg |
| CPL-107A/14DM | "B" Cold Leg |
| CPL-107B/1DM | "C" Hot Leg |
| CPL-107B/14DM | "C" Cold Leg |

### 2.1 Requirements for which Relief is Requested

Pursuant to 10 CFR 50.55a(g)(6)(i), the licensee is requesting relief from the surface examination requirements of the ASME Code, Section XI, Table IWB-2500-1, Examination Category B-F, "Pressure Retaining Dissimilar Metal Welds," Item B5.10, "NPS 4 or Larger Nozzle-to-Safe-End Butt Welds." The relief is for the third 10-year ISI interval, which began February 19, 1992.

### 2.2 Licensee's Basis for Relief

Public Health and Safety

The primary initiator for cracking of RPV nozzle-to-safe end welds is the synergistic effect of primary water chemistry and residual stresses. Since this combination is confined to the inner weld diameter, ultrasonic examination of the inner diameter lower 1/3 weld volume is capable of detecting inner diameter defects in both the axial and circumferential directions. This results in a high degree of confidence in the ability to detect primary water stress corrosion cracking (PWSCC) utilizing inner diameter ultrasonic techniques.

Additionally, curves have been developed for an ASME B&PV Code, Section XI, Paragraph IWB-3600, "Analytical Evaluation of Flaws," evaluation of alloy 82/182, which is the weld material for the nozzle-to-safe-end welds. These curves indicate that for both longitudinal and circumferential flaws, the allowable flaw size is approximately 75% through-wall. For an extremely long flaw, the allowable flaw depth is shallower, but because a flaw on the outer diameter (OD) does not experience PWSCC, such flaws are not predicted to propagate. The curves for both the inlet and outlet nozzle-to-safe-end locations, both longitudinally and circumferentially orientated, show that the 10-, 20-, and 30-year curves are coincident, which confirms that a hypothetical indication on the OD is not predicted to propagate.

Performance of the Code-required surface examination is intended to indicate the presence of surface discontinuities and may be conducted by either a magnetic particle or liquid penetrant method. Linear indications that exceed the allowable linear surface flaw standards are required to be recorded. The proposed alternative examinations are the performance of VT-2 visual examinations during Modes 5 or 6 to inspect in accordance with IWA-5242, "Insulated Components," for evidence of leakage, including emphasis on areas of discoloration or residue

on surfaces examined. These alternative examinations, combined with the examination history provided above and the volumetric examinations performed from the inner weld diameter, provide adequate assurance regarding the condition and integrity of RPV nozzle-to-safe-end welds.

Personnel Hazards

Significant personnel hazards are associated with surface examination of the RPV nozzle-to-safe-end welds that are not commensurate with the benefits gained from performing such examinations. As indicated by the diagrams provided with the licensee submittal dated March 30, 2001, personnel preparing for and performing these surface examinations are required to wear personnel protective equipment, which includes anti-contamination clothing and respiratory protection. Elevated ambient temperatures in the area of these surface examinations, combined with the required use of personnel protective equipment in this physically confined area, create the potential for heat stress and exhaustion. These aspects of limited accessibility, personnel protective equipment, and elevated ambient temperatures result in a work environment where high radiation doses may be expected and an increased potential for personnel injury exists. Retrieval of an injured or impaired individual from the address area would be complex and physically difficult, and would involve additional risk and radiation exposure by rescue personnel.

Availability of Alternative Examination Techniques

Relief Request No. 18 authorized use of ultrasonic techniques to detect OD surface-connected flaws from the inner diameter of the reactor coolant system loop piping. This relief was approved pending a successful performance demonstration of an ultrasonic technique capable of detecting OD surface-connected flaws from the inside diameter, and on the basis that this technique be demonstrated using a calibration standard without machined notches or defects.

During February 2001, HBRSEP, Unit 2, in conjunction with a vendor and the Electric Power Research Institute (EPRI), conducted a performance evaluation of this ultrasonic technique on the full weld volume and the heat-affected zones using a mock-up typical of the HBRSEP, Unit 2, cold leg safe-end-to-elbow configuration. This attempt was not successful in detecting actual cracks due to attenuation in the cast material. Additional attempts to detect OD surface-connected flaws using such a mock-up were only partially successful in detecting the flaws selected for this performance demonstration, and also recorded overcalls in “clean” areas of the weld. Efforts to size some of the detected flaws utilizing this ultrasonic technique produced significant inaccuracies. This is significant recognizing that the mock-up had optimum conditions for ultrasonic examination.

## 3.0 EVALUATION

HBRSEP started commercial operation in 1971. Since then, only the accessible portion of the subject welds have been surfaced examined. For the 34.2-inch-diameter hot leg piping, the surface examined per weld is approximately 20 inches out of 107 inches or 19% coverage. For the 32.7-inch diameter cold leg piping, the surface examined is about the same coverage as the hot leg piping.

The difficulty in performing the examinations is caused by the cramped working conditions and physical obstructions. The welds are located under 2 inches of insulation at the base of concrete manholes measuring 3 feet 6 inches long by 1 foot 9 inches wide by approximately 7 feet 6 inches deep. The entries into the manholes are through 18-inch diameter openings. The narrow entry and limited working areas inside the manholes hinder movement while exposing the examiner to high radiation doses. In order for the examiner to perform a complete surface examination of the weld and to reduce dosage, the licensee would have to enlarge the concrete manholes. The licensee determined that reconstruction of the manholes was impractical.

The licensee determined that the dosage could be reduced by approximately 40% by replacing the limited surface examination with a limited visual testing (VT-2) examination of the same surface area. The examinations would be performed at the least optimal location--the top of the pipe. In the event of a through-wall crack, the borated water would go to the bottom of the insulation and drain out at the openings of the insulation joints. According to IWA-5242, a VT-2 examination of the horizontal insulated surface must be conducted at each insulation joint. Boron build-up and/or surface discoloration at the accessible insulation joints would indicate leakage.

However, the staff also believes that removing the insulation to perform the visual examination at the top of the pipe would provide little, if any, additional information on the weld integrity beyond a limited Code-required VT-2 examination. The staff brought up the limited value of a VT-2 uninsulated pipe examination during a teleconference on April 5, 2001. By performing a Code VT-2 examination on the insulated piping and not removing the insulation, the licensee would lower the examiners' exposure further. The licensee agreed with the staff and so stated in a supplement dated April 5, 2001.

For leakage to occur, there would have to be a through-wall crack. Such a crack would be detected during the Code-required, ultrasonic testing (UT) examination of the inner 1/3 through-wall weld volume. The licensee proposed to extend the UT examination beyond the inner 1/3 through-wall to the inner 40% through-wall weld volume for the subject examinations. The examinations will be performed using the prescriptive requirements of the Code during Refueling Outage 20.

The licensee also performed an evaluation of a postulated flaw from the OD and determined that the allowable flaw size in the weld material is 75% through-wall. Since the licensee will perform the examination from the inner pipe surface to a depth of 40% through-wall, any flaw of the allowable size from the OD would be detected. Therefore, a flaw would be detected before it extended through-wall.

Because the information acquired from a surface examination is based on only 19% of the required surface, the staff considers its contribution to weld integrity to be small. In the absence of greater surface coverage from penetrant testing, VT, or through-wall UT examinations or other nondestructive examination methods, the integrity of the subject welds is weighted toward the Code-required, inner 1/3 through-wall examinations. In lieu of the surface examination, the licensee agreed to extend the UT examination to the inner 40% through-wall in conjunction with a VT-2 insulated pipe examination. Based on the above, the staff determined that the UT examinations of the inner 40% through-wall depth, in conjunction with VT-2 insulated piping examinations, are as acceptable as the limited achievable surface

examinations that were previously performed. Based on the above finding and pursuant to 50.55a(g)(5)(iii), since the achievable surface examination coverage is less than the Code-required coverage and the proposed examination would only replace the limited achievable surface examination, the staff concludes that surface examinations beyond those which are achievable for the subject welds are impractical.

## 4.0 CONCLUSION

Based on the discussion above, the staff concludes that the Code-required surface examinations beyond the achievable surface examination area for the subject welds are impractical and that the extended UT examination of the inner 40% through-wall in conjunction with a VT-2 (for insulated piping) examination would provide the same assurance of structural integrity of the subject welds as the obtainable 19% surface examination. Therefore, pursuant to 10 CFR 50.55a(g)(6)(i), the staff grants relief for the subject welds during the third 10-year ISI interval. The granting of relief is authorized by law and will not endanger life or property or the common defense and security and is otherwise in the public interest giving due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility.

Principal Contributor: Donald G. Naujock, NRR

Date: June 6, 2001

cc:

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