August 1, 2003

Mr. James J. Sheppard
President and Chief Executive Officer
STP Nuclear Operating Company
South Texas Project Electric
Generating Station
P. O. Box 289
Wadsworth, TX 77483

SUBJECT: SOUTH TEXAS PROJECT, UNIT 1 - REQUEST FOR RELIEF, RR-ENG-2-35, FROM THE REQUIREMENTS OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME) BOILER AND PRESSURE VESSEL CODE (CODE) CONCERNING USE OF AN ELECTRO-DISCHARGE MACHINING (EDM) PROCESS (TAC NO. MB9655)

Dear Mr. Sheppard:

By letter dated June 13, 2003, as supplemented by letters dated June 26, 2003, and July 1, 2003, STP Nuclear Operating Company, the licensee, submitted a request to use an EDM process without subsequent mechanical processing of the cut surfaces as part of the repair/replacement program for the reactor vessel bottom-mounted instrument (BMI) penetrations in Unit 1. South Texas Project (STP), Unit 1, proposes to remove boat samples from two BMI nozzle penetrations (#1 and #46) inside the bottom of the flooded reactor vessel in Unit 1 using the EDM process.

The U. S. Nuclear Regulatory Commission (NRC) staff concludes that the use of the EDM process without subsequent mechanical processing of the cut surfaces as part of the repair/replacement program for the reactor vessel BMI penetrations in Unit 1 provides an acceptable level of quality and safety. Therefore, the proposed relief is authorized pursuant to 10 CFR 50.55a(3)(i) of Title 10 of the *Code of Federal Regulations*, for relief request RR-ENG-2-35 at STP, Unit 1. The use of this Code Case is authorized for use only for repair of the BMI penetrations (#1 and #46) in the Unit 1 reactor vessel during the current unit's forced outage.

In view of the immediate need during the current forced outage, the NRC staff provided on July 9, 2003, a verbal authorization granting the relief.

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

The NRC staff's safety evaluation is enclosed.

Sincerely,

/RA/

Robert A. Gramm, Chief, Section 1
Project Directorate IV
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-498

Enclosure: Safety Evaluation

cc w/encl: See next page

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

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*Staff provided SE with minor editorial changes used.
** See prior concurrence NRR-028

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

USE ALTERNATIVE THERMAL REMOVAL TECHNIQUES FOR

REACTOR VESSEL BOTTOM-MOUNTED INSTRUMENT PENETRATIONS

REQUEST FOR RELIEF RR-ENG-2-35

SOUTH TEXAS PROJECT NUCLEAR OPERATING COMPANY

SOUTH TEXAS PROJECT, UNIT 1

DOCKET NO. 50-498

1.0 INTRODUCTION

By letter dated June 13, 2003, as supplemented by letters dated June 26, 2003, and July 1, 2003, STP Nuclear Operating Company (STPNOC), the licensee, submitted a request to use an Electro-Discharge Machining (EDM) process without subsequent mechanical processing of the cut surfaces as part of the repair/replacement program for the reactor vessel bottom-mounted instrument (BMI) penetrations in Unit 1.

South Texas Project (STP), Unit 1, proposes to remove boat samples from two BMI nozzle penetrations (#1 and #46) inside the bottom of the flooded reactor vessel in Unit 1 using the EDM process. However, IWA-4322 of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code), Section XI, 1989 Edition, no Addenda specifies: "If thermal removal processes are used on P-No. 8 and P-No.43 materials, a minimum of 1/16 in. material shall be removed from the thermally processed area."

Pursuant to Section 10 CFR 50.55a(a)(3)(i) of Title 10 of the *Code of Federal Regulations*, STP, Unit 1, proposes to remove the boat samples using an EDM process qualified in accordance with IWA-4461.4 of ASME Section XI, 1998 Edition through 2000 Addenda which will demonstrate that the removal of material as specified in IWA-4322 of ASME Code Section XI, 1989 Edition, no Addenda is not necessary on the basis that it provides an acceptable level of quality and safety.

2.0 BACKGROUND

The Inservice Inspection (ISI) of the ASME Code Class 1, 2, and 3 components is to be performed in accordance with Section XI of the ASME Code and applicable edition and addenda as required by 10 CFR 50.55a(g), except where specific relief has been granted by the Commission pursuant to 10 CFR 50.55a(g)(6)(i). Section 10 CFR 50.55a(a)(3) states in part 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) will 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. The ISI code of record for STP, Unit 1, second 10-year ISI interval is the 1989 Edition of the ASME Code.

3.0 EVALUATION OF RELIEF REQUEST

3.1 Subject of Relief Request:

Pursuant to 10 CFR 50.55a(a)(3)(i), the licensee requests NRC approval of a request for alternative to mechanical processing of thermally cut surfaces as part of the repair/replacement program for the reactor vessel BMI penetrations in Unit 1.

3.2 The Items for which Relief is Requested:

Reactor vessel BMI nozzle penetrations. There are 58 BMI nozzles welded to the bottom head of the reactor vessel. The ASME Code Class is Class 1. The EDM cut will include a small piece of the nozzle (penetration tube) and the J-groove weld deposit only. The nozzle material is ASME SB-166 UNS N06600, which is a P-No. 43 material. The weld deposit is ASME SFA 5.11 filler metal classification ENiCrFe-3 and ASME SFA 5.14 filler metal classification ERNiCr-3, which are F-No. 43 filler materials. These filler metals are the filler metal equivalent of a P-No. 43 base material.

3.3 Code Requirement:

ASME Code, Section XI, 1989 Edition with no Addenda, Article IWA-4300 provides requirements related to defect removal. IWA-4322 specifies: "If thermal removal processes are used on P-No. 8 and P-No. 43 materials, a minimum of 1/16 in. material shall be removed from the thermally processed area."

3.4 Licensee's Proposed Alternative (as stated):

> STPNOC proposes to use ASME Section XI Code, 1998 Edition, Division 1 with addenda through 2000 Addenda (1998 A2000), Paragraph IWA-4461.4, "Alternative to Mechanical Processing", which states that mechanical processing of thermally cut surfaces for P-No. 8 and P-No. 43 materials is not required when using a thermal metal removal process that meets the qualification requirements contained in this paragraph.

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

> ASME Code Section XI, 1989 Edition, no Addenda, Paragraph IWA-4120(c) states:
>
> Later Editions and Addenda of Section XI, either in their entirety or portions thereof, may be used for the repair program, provided these Editions and Addenda of Section XI at the time of the planned repair have been incorporated by reference in amended regulations of the regulatory authority having jurisdiction at the plant site."
>
> The January 1, 2003 version of 10 CFR 50.55a(b)(2) states:
>
> As used in this section, references to Section XI of the ASME Boiler and Pressure Vessel Code refer to Section XI, and include the 1970 Edition through the 1976 Winter Addenda, and the 1977 Edition (Division 1) through the 2000 Addenda (Division 1), subject to the following limitations and modifications..." There are no limitations or qualifications cited for Paragraph IWA-4461.4. Therefore, the 1998 Edition with addenda through the 2000 Addenda of ASME Code Section XI has been incorporated by reference by the regulatory authority having jurisdiction at the South Texas Project.
>
> STP proposes to remove boat samples from two BMI nozzle penetrations (#1 and #46) inside the bottom of the flooded reactor vessel in Unit 1 using an electrodischarge machining (EDM) process. Mechanical removal of 1/16-inch of material in the thermally processed area as required by IWA-4322 of ASME Section XI 1989 Edition is extremely difficult at this location. Furthermore, removal of 1/16 inch of material in the thermally processed area is generally recognized to be unnecessary since only a very shallow heat affected zone on the order of 2 mils results from the EDM process. This EDM application will be performed under water which will further minimize the heating effects. STP proposes to remove the boat samples using an EDM process qualified in accordance with IWA-4461.4 of ASME Section XI 1998 Edition through 2000 Addenda which will demonstrate that the removal of material as specified in IWA-4461.3 is not necessary.

In its letter dated June 26, 2003, STPNOC indicated that:

> STPNOC will implement the boat sample removal of flaw segments from Unit 1 BMI J-groove welds and nozzle base material only if the EDM thermal cutting process is successfully qualified in accordance with IWA-4461.4, including having met the criteria that no cracking will be detected by the Code-prescribed visual examination in any qualification coupons. An oxide layer on the EDM-cut surfaces is not a mechanical discontinuity and should not be considered a stress riser or crack initiation site. STPNOC has evaluated the original J-groove weld, buttering, and adjacent base material of the vessel bottom head with

full-depth, postulated flaws and determined them to be acceptable. Additionally, in the event that a flaw (e.g., fatigue cracking or stress corrosion cracking) should subsequently originate at the EDM-cut surface for any reason, STPNOC is performing another Code evaluation, which conservatively postulates the existence of such flaws in conjunction with a boat sample excavation. The preliminary results of the analysis indicate that such flaws are likewise acceptable.

This will provide an acceptable level of quality and safety.

3.6 Staff Evaluation:

ASME Section XI has recognized that underwater welding is a specialized process that requires specialized testing and essential variables. EDM is a thermal metal removal process that leaves a heat affected zone similar to a weld heat affected zone. Since the EDM that is proposed by this relief request is being performed underwater, the licensee's contractor will perform the test coupon cutting underwater to simulate the production conditions on the test specimens. The production water depth of approximately 60 feet, will not be simulated due to limitations of the mock-up facility. Based on the contractor's experience using the EDM process on submerged reactor components and internals at various depths, water depth (hydrostatic pressure) has been shown to be a non-critical parameter. During the EDM process, deionized water is injected into the cut region to flush away the cut debris and to maintain a dielectric region between the electrode and the workpiece. This water is typically injected at 30-50 psig. At deeper water depths, this injection pressure is increased to compensate for the static head. All other cutting parameters are kept the same regardless of water depth.

EDM, although considered a thermal process for removing metal since it uses an electrical arc, leaves an extremely small oxide layer on the cut surface of the metal remaining after the removal process. STPNOC will only implement the boat sample removal of flaw segments from STP, Unit 1, BMI J-groove welds and nozzle base material if the EDM thermal cutting process is successfully qualified in accordance with IWA-4461.4, including having met the criteria that no cracking will be detected by the Code-prescribed visual examination in any qualification coupons. The licensee states that an oxide layer on the EDM-cut surfaces is not a mechanical discontinuity and should not be considered a stress riser or crack initiation site. They have evaluated the original J-groove weld, buttering, and adjacent base material of the vessel bottom head with full-depth, postulated flaws and determined them to be acceptable. Additionally, in the event that a flaw (e.g., fatigue cracking or stress corrosion cracking) should subsequently originate at the EDM-cut surface for any reason, STPNOC is performing another Code evaluation, which conservatively postulates the existence of such flaws in conjunction with a boat sample excavation. The preliminary results of the analysis indicate that such flaws are likewise acceptable.

The original J-groove weld of the two repaired BMI penetrations has been re-classified under ASME Section XI Code ISI requirements as a Class 1, Table IWB-2500-1, Examination Category B-N-2, Item B13.60 weld. This weld is an interior attachment to the reactor vessel beyond the core belt region. Accessible interior attachment welds are subject to a VT-3 visual examination of the exposed weld surface under the STPNOC ISI program for the second interval. The VT-3 visual examination of this weld is intended to detect the presence of cracking, corrosion, erosion, or other structural degradation. ISI examinations of reactor vessel

interior attachment welds below the core belt region will be performed in conjunction with the examinations of the vessel shell and bottom head welds when the internals and core barrel are removed. At the next inspection of the reactor vessel attachment welds, the licensee will perform an enhanced VT-1 examination (defined as the ability to discern a 0.5 mil wire against a neutral gray background) of the EDM surfaces to inspect for potential cracking related to the EDM process.

The NRC staff has evaluated the licensee's Relief Request RR-ENG-2-35, and supporting information for removal of boat samples from two BMI nozzle penetrations (#1 and #46) inside the bottom of the flooded reactor vessel in Unit 1 using an EDM process and has concluded that it provides an acceptable alterative method of metal removal. This is based on the fact that STPNOC will perform the qualification testing required by IWA-4461.4 in ASME Section XI; that they will perform the test coupon cutting underwater; that the next ISI VT-3 visual examination of the repaired BMI J-groove welds will be augmented with an enhanced visual examination of the cut surfaces; and that they have evaluated the original J-groove weld, buttering, and adjacent base material of the vessel bottom head with full-depth, postulated flaws and determined them to be acceptable. Also, should a flaw subsequently originate at the EDM-cut surface for any reason, STPNOC is performing another Code evaluation, which conservatively postulates the existence of such flaws in conjunction with a boat sample excavation. The preliminary results of the analysis indicate that such flaws are likewise acceptable.

Therefore pursuant to 10 CFR 50.55a(a)(3)(i), the proposed alternative would provide an acceptable level of quality and safety.

4.0 CONCLUSION

The NRC staff concludes that the use of the EDM process without subsequent mechanical processing of the cut surfaces as part of the repair/replacement program for the reactor vessel BMI penetrations in Unit 1 provides an acceptable level of quality and safety. Therefore, the proposed relief is authorized pursuant to 10 CFR 50.55a(3)(i) for relief request RR-ENG-2-35 at STP, Unit 1. The use of this Code Case is authorized for use only for repair of the BMI penetrations (#1 and #46) in the Unit 1 reactor vessel during the current unit's forced outage.

Principal Contributor: E. Andruszkiewicz

Date: August 1, 2003

South Texas, Unit 1

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