June 17, 2002

John R. Hamilton
Manager, Engineering Programs
Entergy Operations, Inc.
PO Box 31995
Jackson, MS 39286-1995

SUBJECT: ARKANSAS NUCLEAR ONE, UNITS 1 AND 2, AND WATERFORD STEAM ELECTRIC STATION, UNIT 3 - RE: REQUEST FOR RELIEF FROM THE REQUIREMENTS OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME) BOILER AND PRESSURE VESSEL CODE (CODE) - USE OF ALTERNATIVE THERMAL REMOVAL TECHNIQUES FOR REACTOR VESSEL HEAD PENETRATION REPAIRS (TAC NOS. MB4485, MB4486, AND MB4490)

Dear Mr. Hamilton:

By letter dated March 14, 2002, Entergy Operations, Inc. (Entergy, the licensee) requested relief (Request Number PWR-R&R-002, Revision 0) from ASME Code requirements for the thermal removal process. Entergy submitted the request to use an Electrical Discharge Machining (EDM) process should repairs of reactor pressure vessel head penetration nozzles or J-welds become necessary at Arkansas Nuclear One, Units 1 and 2 (ANO-1 and ANO-2), and Waterford Steam Electric Station, Unit 3 (Waterford 3). Entergy plans to utilize the EDM process to excavate Primary Water Stress Corrosion Cracking cracks or other defects and remove weld crown surfaces of repair welds to facilitate performance of final Non-Destructive Examination.

Pursuant to 10 CFR 50.55a(a)(3)(i), Entergy proposes an alternative to the thermal removal requirements of paragraph IWA-4322 of the 1992 Edition of ASME Code Section XI applicable to P-Number 43 (Inconel) materials. Instead of mechanically removing 1/16" of material from all thermally processed areas as required by IWA-4322, Entergy proposes to qualify the EDM process in accordance with IWA-4461.4 of the 1995 Edition, 1997 Addenda of ASME Code Section XI. IWA-4461.4 allows the use of thermal methods for metal removal without further mechanical processing if the thermal removal method is qualified in accordance with this paragraph. In addition to the requirements of IWA-4461.4, Entergy will also perform additional qualification testing and metal removal as determined by that qualification testing.

The U. S. Nuclear Regulatory Commission (NRC) staff concludes that the use of the EDM process as an alternative to the thermal removal process provides an acceptable level of quality and safety. Therefore, the licensee's proposed relief is authorized pursuant to Section 50.55a(a)(3)(i) of Title 10 of the *Code of Federal Regulations*, for the third ten-year inservice inspection intervals at ANO-1, and ANO-2, and the second ten-year interval at Waterford 3.

June 17, 2002

In view of the immediate and possible need during the past refueling outage (RFO 15), the staff provided, on April 18, 2002, a verbal authorization for the use of the EDM process as an alternative to the thermal removal process at ANO-2. However, subsequent inspections resulted in not requiring the use of the EDM process at ANO-2.

This relief is valid for the current inspection interval for the three plants as follows: ANO-1, which ends on May 31, 2007; ANO-2, which ends on March 25, 2010; and Waterford 3, which ends on June 30, 2007.

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 Nos.: 50-313, 50-368, and 50-382

Enclosure: Safety Evaluation

cc w/encl: See next page

In view of the immediate and possible need during the past refueling outage (RFO 15), the staff provided, on April 18, 2002, a verbal authorization for the use of the EDM process as an alternative to the thermal removal process at ANO-2. However, subsequent inspections resulted in not requiring the use of the EDM process at ANO-2.

This relief is valid for the current inspection interval for the three plants as follows: ANO-1, which ends on May 31, 2007; ANO-2, which ends on March 25, 2010; and Waterford 3, which ends on June 30, 2007.

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Robert A. Gramm, Chief, Section 1
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

USE OF ELECTRICAL DISCHARGE MACHINING

REQUEST FOR RELIEF

ENTERGY OPERATIONS, INC.

ARKANSAS NUCLEAR ONE, UNITS 1 AND 2

WATERFORD STEAM ELECTRIC STATION, UNIT 3

DOCKET NOS. 50-313, 50-368, AND 50-382

1.0 INTRODUCTION

By letter dated March 14, 2002, Entergy Operations, Inc. (Entergy, the licensee), submitted Relief Request Number PWR-R&R-002, Revision 0, requesting relief from the requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (the Code) for an alternative to the thermal removal requirements of paragraph IWA-4322 of the 1992 Edition of ASME Code Section XI applicable to P-Number 43 (Inconel) materials.

This relief requests the use of an Electrical Discharge Machining (EDM) process should repairs of reactor pressure vessel (RPV) head penetration nozzles or J-welds become necessary at Arkansas Nuclear One, Units 1 and 2 (ANO-1 and ANO-2), and Waterford Steam Electric Station, Unit 3 (Waterford 3). Entergy plans to utilize the EDM process to excavate Primary Water Stress Corrosion Cracking (PWSCC) cracks or defects and remove weld crown surfaces of repair welds to facilitate performance of final Non-Destructive Examination (NDE).

Pursuant to 10 CFR 50.55a(a)(3)(i), Entergy proposes an alternative to the thermal removal requirements of paragraph IWA-4322 of the 1992 Edition of ASME Code Section XI applicable to P-Number 43 (Inconel) materials. Instead of mechanically removing 1/16" of material from all thermally processed areas as required by IWA-4322, Entergy proposes to qualify the EDM process in accordance with IWA-4461.4 of the 1995 Edition, 1997 Addenda of ASME Code Section XI. IWA-4461.4 allows the use of thermal methods for metal removal without further mechanical processing if the thermal removal method is qualified in accordance with this paragraph. In addition to the requirements of IWA-4461.4, Entergy will also perform additional qualification testing and metal removal as determined by that qualification testing.

The staff has reviewed and evaluated the licensee's request and supporting information on the proposed alternative weld repair criteria to the Code requirements for ANO-1, ANO-2, and Waterford 3, pursuant to the provisions of 10 CFR 50.55a(a)(3)(i).

2.0 BACKGROUND

RPV head penetration nozzles at ANO-2 and Waterford 3 are considered to have a moderate susceptibility to PWSCC. ANO-1 has already experienced cracking in some RPV head penetration nozzles. Susceptibility rankings for ANO-1, ANO-2, and Waterford 3 have been reported to the U.S. Nuclear Regulatory Commission (NRC) in response to NRC Bulletin 2001-01. RPV head penetration nozzles at ANO-1, ANO-2, and Waterford 3 are manufactured from SB-166 or SB-167 Alloy 600 materials which are P-Number 43 Inconel alloys.

Should repairs of RPV head penetration nozzles or J-welds become necessary at ANO-1, ANO-2, or Waterford 3, Entergy plans to utilize the EDM process to excavate PWSCC cracks or defects and remove weld crown surfaces of repair welds to facilitate performance of final NDE. EDM is considered a thermal removal process by the ASME Code. As such, a minimum of 1/16" of material must be mechanically removed from all EDM processed areas to comply with IWA-4322. However, use of mechanical removal processes could have deleterious affects on the Alloy 600 RPV head penetration nozzles and welds. Specifically, the use of mechanical removal processes such as grinding or machining could result in an increased susceptibility of Alloy 600 materials and their associated welds to PWSCC.

3.0 EVALUATION OF THE RELIEF REQUEST

Use of Electrical Discharge Machining

The items for which relief is requested:

1R-1, 2R-1, and RC MRCT0001
RPV head Penetration Nozzles

Code Requirement:

IWA-4322 of ASME Code Section XI

Licensee's Proposed Alternative:

Pursuant to 10 CFR 50.55a(a)(3)(i), Entergy proposes an alternative to the thermal removal requirements of IWA-4322 applicable to P-Number 43 materials. Instead of mechanically removing 1/16" of material from all thermally processed areas as required by IWA-4322, Entergy proposes to qualify the EDM process in accordance with IWA-4461.4 of the 1995 Edition, 1997 Addenda of ASME Code Section XI. After discussions with the NRC, Entergy will also perform the following, in addition to the requirements of IWA-4461.4:

1. Determine the thickness of the resultant oxide layer on the cut surface by metallographic examination during the EDM process qualification.

2. Based upon the oxide thickness measurements obtained during the EDM qualification process, remove the oxide layer from cut or excavated surfaces when performing repair activities on RPV head penetration nozzles or J-welds.

Licensee's Basis for Relief (as stated):

"IWA-4322 of the 1992 Edition of ASME Section XI requires the removal of a minimum of 1/16" of material from all thermally processed areas of P-Number 43 materials. Entergy believes that the basis of this requirement is to ensure that thermally cut or excavated surfaces are free of unacceptable surface irregularities, oxides, and fissures that were created by the thermal removal process.

Suitability of IWA-4461.4 of ASME Section XI, 1995 Edition, 1997 Addenda

The qualification requirements of IWA-4461.4 ensure that the proposed thermal process is capable of producing a surface finish that is free of cracks or fissures and meets the required surface roughness criteria of the owner. Where the cut surface is exposed to a corrosive medium, then corrosion testing or evaluations must also be performed. The qualification requirements of IWA-4461.4 are summarized below.

(a) The qualification test shall consist of two coupons of the same P-Number material to be cut in production.

(b) The qualification coupons shall be cut using the maximum heat input to be used in production.

(c) The thermally cut surface of each coupon shall be visually examined at 10X and shall be free of cracks. The Owner shall specify surface roughness acceptable for the application and shall verify that the qualification coupon meets the criterion.

(d) Each qualification test coupon shall be cross-sectioned, and the exposed surfaces shall be polished, etched with a suitable etchant, and visually examined at 10X. All sectioned surfaces shall be free of cracks.

(e) Corrosion testing of the thermally cut surface and heat affected zone shall be performed if the cut surface is to be exposed to a corrosive media. Alternatively, corrosion resistance of the thermally cut surface may be evaluated. The Owner shall specify the acceptance criteria.

In addition to the qualification testing requirements of IWA-4461.4 of ASME Section XI, 1995 Edition, 1997 Addenda, Entergy will determine the thickness of the resultant oxide layer on the cut surfaces as part of the EDM qualification. The thickness of the resultant oxide layer will be determined by metallographic examination. Based on the oxide thickness measurements obtained during the EDM process qualification, post-EDM polishing operations will be performed to ensure that the oxide surface layer is removed."

Evaluation:

The staff has evaluated the licensee's request and supporting information on its request to use Relief Request Number PWR-R&R-002, for the EDM process for metal removal should repairs of RPV head penetration nozzles or J-welds become necessary at ANO-1, ANO-2, and Waterford 3, and concluded that it provides an acceptable alternative method of weld removal.

This is based on the fact that 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. The licensee has committed to removing that oxide layer by mechanical means after metal removal by the EDM process. The amount of metal removed will be determined by the qualification requirements of IWA-4461.4, ASME Code Section XI, 1995 Edition, 1997 Addenda, with the additional requirements that Entergy will determine the thickness of the resultant oxide layer on the cut surfaces as part of the EDM qualification. The thickness of the resultant oxide layer will be determined by metallographic examination. Based on the oxide thickness measurements obtained during the EDM process qualification, post-EDM polishing operations will be performed to ensure that the oxide surface layer is removed.

Further, Entergy believes that compliance with the repair rules as stated in IWA-4322 of the 1992 Edition of ASME Code Section XI would result in an increased susceptibility of RPV head penetration nozzles to PWSCC and the proposed alternative would provide an acceptable level of quality and safety.

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

4.0 CONCLUSION

The NRC staff concludes that the licensee's request and supporting information for use of the EDM process for metal removal should repairs of the RPV head penetration nozzles or J-welds at ANO-1, ANO-2, and Waterford 3 be necessary provides an acceptable alternative method of metal removal for weld repair or removal of weld crown surfaces of repair welds to facilitate performance of final NDE. Therefore, the proposed relief is authorized pursuant to 10 CFR 50.55a(a)(3)(i) at ANO-1, ANO-2, and Waterford 3, since the applicant has demonstrated that the proposed alternative would provide an acceptable level of quality and safety. This relief is valid for the current inspection interval for the three plants as follows: ANO-1, which ends on May 31, 2007; ANO-2, which ends on March 25, 2010; and Waterford 3, which ends on June 30, 2007.

Principal Contributor: EAndruszkiewicz

Date: June 17, 2002

Arkansas Nuclear One
Waterford Generating Station 3

cc:

Executive Vice President
& Chief Operating Officer
Entergy Operations, Inc.
P. O. Box 31995
Jackson, MS 39286-1995

Director, Division of Radiation
Control and Emergency Management
Arkansas Department of Health
4815 West Markham Street, Slot 30
Little Rock, AR 72205-3867

Winston & Strawn
1400 L Street, N.W.
Washington, DC 20005-3502

Mike Schoppman
Framatome ANP, Richland, Inc.
Suite 705
1911 North Fort Myer Drive
Rosslyn, VA 22209

Senior Resident Inspector
U.S. Nuclear Regulatory Commission
P. O. Box 310
London, AR 72847

Regional Administrator, Region IV
U.S. Nuclear Regulatory Commission
611 Ryan Plaza Drive, Suite 400
Arlington, TX 76011-8064

County Judge of Pope County
Pope County Courthouse
Russellville, AR 72801

Vice President, Operations Support
Entergy Operations, Inc.
P. O. Box 31995
Jackson, MS 39286-1995

Wise, Carter, Child & Caraway
P. O. Box 651
Jackson, MS 39205

Chairman
Louisiana Public Services Commission
P.O. Box 91154
Baton Rouge, LA 70825-1697

Mr. Michael E. Henry, Administrator
and State Liaison Officer
Department of Environmental Quality
P. O. Box 82135
Baton Rouge, LA 70884-2135

Director
Nuclear Safety Assurance
Entergy Operations, Inc.
17265 River RoadKillona, LA 70066-0751

General Manager Plant Operations
Waterford 3 SES
Entergy Operations, Inc.
17265 River Road
Killona, LA 70066-0751

Licensing Manager
Entergy Operations, Inc.
17265 River Road
Killona, LA 70066-0751

Resident Inspector/Waterford NPS
P. O. Box 822
Killona, LA 70066-0751

Parish President Council
St. Charles Parish
P. O. Box 302
Hahnville, LA 70057

Mr. Craig G. Anderson
Vice President Operations, ANO
Entergy Operations, Inc.
1448 S. R. 333
Russellville, AR 72801

Mr. Joseph E. Venable
Vice President Operations
Entergy Operations, Inc.
17265 River Road
Killona, LA 70066-0751