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September 26, 2002
NL-02-125
IPN-02-077

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Mail Stop O-P1-17
Washington, DC 20555-0001

SUBJECT: Indian Point Nuclear Generating Units No. 2 and No. 3
Docket Nos. 50-247 and 50-286
Response to Questions Regarding Relief Requests to Use an Alternative to Temper Bead Welding Requirements for Contingency Repairs on Reactor Vessel Head Penetration Nozzles

Reference: 1. Entergy letter to USNRC, NL-02-104 / IPN-02-061, "ASME Code Relief Requests to use an Alternative to Temper Bead Welding Requirements for Contingency Repairs on Reactor Vessel Head Penetration Nozzles" dated July 29, 2002

Dear Sir:

Entergy Nuclear Operations, Inc. (ENO) submitted a relief request (Reference 1) as a contingency in the event that the need for repairs is identified during the reactor vessel head inspections that will be conducted during the next refueling outages for Indian Point 2 (IP2) and Indian Point 3 (IP3). During a conference call with the NRC staff on September 3, 2002, ENO agreed to provide additional information regarding this request. The requested information, provided in Attachment I, supports NRC's review.

Also, after submitting Reference 1, ENO determined that a paragraph was inadvertently omitted from Section D.3 of both relief requests (RR 61 for IP2 and RR 3-31 for IP3). The missing information was discussed with the NRC staff on August 8, 2002. The corrected pages (pages 8 and 8a) for the relief requests are provided in Attachment II.

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There are no new commitments made in this letter. If you have any questions, please contact Ms. Charlene Faison at 914-272-3378.

Very truly yours,

Michael R. Kansler
Senior Vice President and
Chief Operating Officer

Attachments: As stated

cc:

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ATTACHMENT I TO NL-02-125 / IPN-02-077

INDIAN POINT NUCLEAR GENERATING UNITS NO. 2 and 3

Response to Questions Regarding Relief Requests

RR 61 (IP2) and RR 3-31 (IP3)

ENTERGY NUCLEAR OPERATIONS, INC.
INDIAN POINT NUCLEAR GENERATING UNITS NO. 2 and 3
DOCKET NOs. 50-247 and 50-286

RESPONSE TO QUESTIONS REGARDING RELIEF REQUESTS RR 61, Rev. 0 (IP2) AND RR 3-31, Rev. 0 (IP3) TO USE AN ALTERNATIVE TO TEMPER BEAD WELDING REQUIREMENTS FOR CONTINGENCY REPAIRS ON REACTOR VESSEL HEAD PENETRATION NOZZLES

The following are the Staff's questions on the subject Relief Requests as discussed at the September 3, 2002 telephone conference, and the Entergy responses:

Question #1. **The licensee proposes to use an infrared thermometer to monitor preheat and interpass temperatures in lieu of thermocouples and a recorder as required by IWA-4533(b). Provide additional information, including data or calculation, which justifies how the infrared thermometer method will ensure that the maximum interpass temperature of 350°F is not exceeded. Also, explain how the temperature data will be recorded / documented.**

Entergy Response:

IWA-4533(b) specifies that thermocouples and recording instruments shall be used to monitor process temperatures. As an alternative to IWA-4533(b), Entergy proposes to monitor preheat and interpass temperatures using an infrared thermometer as described under Item C.4 on page 3 of 25 of the subject relief requests. The basis for the proposed alternative is provided under item D.II.4 on page 9 of 25 of the relief requests. Entergy believes that monitoring of preheat and interpass temperatures with an infrared thermometer is an acceptable alternative when performing ambient temperature temper bead welding for the following reasons:

1. As shown below, the use of thermocouples and recording instruments is only required by ASME Sections III and XI when performing either (1) postweld heat treatment (PWHT) operations or (2) traditional temper bead welding operations with elevated preheat and postweld soak temperatures.

   - NB-4622.2 and 4622.3 of ASME Section III require use of thermocouples and recording instruments for monitoring and documenting process temperatures for PWHT operations.

   - NB-4622.9(c)(4), NB-4622.10(b)(5), and NB-4622.11(c)(5) of ASME Section III require use of thermocouples and recording instruments for monitoring the elevated preheat (350°F min.) and interpass (450°F max) temperatures.

   - IWA-4533(b) of ASME Section XI requires use of thermocouples and recording instruments for monitoring preheat and interpass temperatures, and the 450° to 550°F heat treatment.

   - Paragraph 3.0(b) of ASME Section XI Code Case N-432-1 requires the use of thermocouples and recording instruments for monitoring the elevated preheat (300°F min.), interpass (450°F max.), and postweld soak (450° - 550°F) temperatures of the traditional temper bead welding operation.

2. Except for traditional temper bead welding operations that are addressed in item 1 above, the use of thermocouples and recording instruments is allowed but never required by ASME Sections III and XI for monitoring welding process temperatures as shown below.

   - NB-4611 of ASME Section III addresses the need for preheat. According to NB-4611, "some practices for preheating are given in Appendix D as a general guide." Paragraph D-1120(b) of Appendix D states: "The preheat temperature may be checked by suitable methods such as temperature indicating crayons or thermocouple pyrometers to ensure that the required preheat is maintained during the welding operation." Although NB-4611 provides guidance on using preheat, it does not specify any particular method for monitoring preheat and allows the use of "any suitable method".

   - NB-4622.7 of ASME Section III establishes exemptions to PWHT based upon the application of elevated preheat temperatures. Although the use of preheat is critical in this application, NB-4622.7 does not specify any particular method for monitoring preheat.

   - NB-4613 of ASME Section III addresses interpass temperature considerations. According to NB-4613, "Consideration should be given to the limitation of interpass temperature for quenched and tempered materials to avoid detrimental affects on the mechanical properties". However, while NB-4613 addresses interpass temperature considerations, it does not specify any particular method for monitoring interpass temperature.

   - ASME Section XI Code Case N-606-1 establishes requirements for performing ambient temperature temper bead welding for BWR CRD housing/stub tube repairs. However, Code Case N-606-1 does not require the use of thermocouples or recording instruments for monitoring welding process temperatures.

   - ASME Section XI Code Case N-638 establishes requirements for performing ambient temperature temper bead welding. However, Code Case N-638 does not necessarily require the use of thermocouples or recording instruments for monitoring welding process temperatures. Code Case N-638 is the basis for the proposed alternative of this relief request.

3. Per Paragraph 1.0(d) of Enclosure 1 of the Relief Requests, the minimum preheat temperature shall not be less than 50° F. According to the Welding Procedure Specification (WPS), the minimum preheat temperature shall not be less than 55° F. During repair welding operations, the containment building temperatures at Indian Point Generating Units No. 2 and No. 3 (IP2 / IP3) should never be less than 55° F. However, to ensure compliance with the minimum preheat requirement of the WPS, the preheat temperature will be verified prior to welding as described in item 6 below. Therefore, the RPV head temperature will never violate the minimum preheat temperature requirement of the WPS or Enclosure 1 of the Relief Requests.

4. ASME Section IX defines interpass temperature as follows: "the highest temperature in the weld joint preparation immediately prior to welding; or in the case of multiple pass welds, the highest temperature in the section of the previously deposited weld metal immediately prior to welding." Because interpass temperature is the temperature in the weld joint immediately prior to welding, it is monitored on an intermittent basis – not continuously. Accordingly, interpass temperatures will be monitored throughout the welding process as described in item 6 below.

5. Interpass temperatures obtained during the welding procedure qualification of WPS 3-43/52-TB MC-GTAW-N638 and an actual weld repair of an RPV head penetration nozzle J-weld demonstrate that the interpass temperatures of WPS 3-43/52-TB MC-GTAW-N638 will not be exceeded during J-weld repairs at IP2 and IP3.

    - According to Procedure Qualification Record (PQR) 707 for WPS 3-43/52-TB MC-GTAW-N638, the minimum preheat temperature during the procedure qualification was 55° F. The maximum interpass temperatures obtained during the procedure qualification was 141° F for the first three layers and 169° F for the balance of welding. These values are well within the WPS interpass temperature limitations of 150° F and 350° F respectively. Therefore, since the heat sink of the procedure qualification test coupon is smaller than that of an RPV head and the heat input used in the procedure qualification is representative of that used in actual repair applications, the interpass temperatures expected during repair welding of RPV head penetration nozzle J-welds should be lower than that obtained during the procedure qualification. Note: Interpass temperatures obtained during the WPS qualification were the result of continuous welding (i.e. welding was not slowed or halted to keep interpass temperatures below the specified temperatures).

    - A ¾" deep x 4" long x 1" wide excavation in an RPV head penetration nozzle J-weld at another plant was repair welded using WPS 3-43/52-TB MC-GTAW-N638. During the repair, the maximum interpass temperatures never exceeded 115° F. Since WPS 3-43/52-TB MC-GTAW-N638 will also be used at IP2 and IP3, the 115° F interpass temperature should be representative of interpass temperatures at IP2 and IP3 during temper bead repair welding of RPV head penetration nozzle J-welds.

6. Preheat and interpass temperatures will be continuously monitored using an infrared thermometer as described on Page 9 of 25 of the Relief Request. The preheat temperature will be verified to be 55° F (minimum) prior to depositing the first weld layer. Prior to depositing the second and third weld layers, the interpass temperatures will be verified to be at least 55° F but less than 150° F. The interpass temperature of each remaining layer will be verified to be at least 55° F but less than 350° F prior to depositing the subsequent weld layers. The initial preheat temperature and the interpass temperatures for each weld layer will be recorded in the weld documentation of the repair traveler for each repair weld. The weld documentation of the repair traveler will be maintained as a permanent plant record.

Question #2: **The licensee proposes to use liquid penetration examination of the weld repaired region. IWA-4534(b) requires that nondestructive examination shall include radiography, if practical, ultrasonic examination and liquid penetrant examination. Provide additional information regarding the impracticality of radiography and ultrasonic examination. Also, provide additional discussion of how the proposed alternative provides an acceptable level of quality and safety.**

Entergy Response:

Impracticality of Volumetric Examinations

Radiography is not appropriate for base material weld repairs of RPV head penetration nozzles. Radiographic techniques require that the source of radiation be placed as near normal to the item being examined as possible, with the film in intimate contact with the item on the opposite surface. An attempt to radiograph repair welds in the RPV head penetration nozzles would have the radiation source being placed at various angles other than normal, penetrating from fractions of an inch of material thickness up to multiple inches of material thickness. Image quality indicators (penetrameters) would have to be placed on the inside bores of the RPV head penetration nozzles. Multiple exposures would be required, and the image distortion would increase as the repair weld moved up the nozzle bore. The required radiographic sensitivity and geometric sharpness would also not be obtainable with generally used radiographic techniques. Depending on the location of the repair weld, access to both surfaces of the RPV nozzle may not be available to allow radiographic examinations. In other cases, clearances between the RPV nozzles and the RPV head would make radiography of a repair weld impractical. Multiple exposures, complex geometry and thickness, and the adverse radiological environment make radiographic examination of RPV head penetration nozzle repair welds impractical.

Ultrasonic examination is not appropriate for base material weld repairs of RPV head penetration nozzles. The J-weld configuration and geometry of the penetration in the head limits access making it impractical to perform ultrasonic examination. Ultrasonic examination techniques require that the transducer be placed in intimate contact with the surface being examined. An attempt to ultrasonically examine repair welds in the RPV head penetration nozzles would have the transducer being placed at various locations with thicknesses varying from fractions of an inch of material thickness up to multiple inches of material thickness. Multiple readings utilizing various angle beams would be required to get meaningful data on the soundness of the repairs due to the rapidly changing thickness and geometry that would be increasing as the repair weld moved up the nozzle bore. The required sensitivity background reflection would also not be obtainable with generally used ultrasonic examination techniques. Depending on the location of the repair weld, access to both surfaces of the RPV nozzle may not be available to allow ultrasonic examination from either side to obtain confirmation of the readings.

Suitability of Proposed Alternative

The partial penetration J-welds of the RPV penetration nozzles were designed and fabricated in accordance with ASME Section III 1965 Edition, 1966 Addenda, Section N-457(c) and Figure N-462.4(d). According to N-457(c), the Code required examination for these partial penetration J-welds was a progressive liquid penetrant examination performed in accordance with N-462.4(d)(1). It should be noted that later editions of ASME Section III do not require volumetric examination of the J-welds either. According to N-462.4(d)(1) (equivalent to ASME Section III, 1989 Edition, NB-5245), partial penetration welds shall be examined progressively using either the magnetic particle or liquid penetrant method.

As an alternative to radiographic and ultrasonic examinations, ENO proposes to perform a progressive liquid penetrant of the J-weld repair weld in accordance with ASME Section III, 1989 Edition, NB-5245. The progressive liquid penetrant examinations will ensure that each weld pass meets the code acceptance criteria, thus ensuring the integrity of the whole weld as completed. Original fabrication records indicate that the J-welds, considered partial penetration welds, were only examined by the liquid penetrant method. Therefore, ENO believes the proposed alternative provides an acceptable level of quality and safety.

ATTACHMENT II TO NL-02-125 / IPN-02-077

INDIAN POINT NUCLEAR GENERATING UNITS NO. 2 and 3

Correction pages to Relief Requests

RR 61 (IP2), Rev. 0, pages 8 and 8a

RR 3-31 (IP3), Rev. 0, pages 8 and 8a

ENTERGY NUCLEAR OPERATIONS, INC.
INDIAN POINT NUCLEAR GENERATING UNITS NO. 2 and 3
DOCKET NOs. 50-247 and 50-286

performed after the completed repair weld has been at ambient temperature for at least 48 hours as required in Section 4.0 of Enclosure 1.

In conclusion, no elevated preheat or post weld bake above ambient temperature is required to achieve sound and tough repair welds when performing ambient temperature temper bead welding technique using the Machine GTAW welding process. This conclusion is based upon strong evidence that hydrogen cracking will not occur with the GTAW welding process. In addition, automatic or machine temper bead welding procedures without preheat will produce satisfactory toughness and ductility properties both in the weld and weld heat affected zones. The results of previous industry qualifications and repairs further support this conclusion. The use of an ambient temperature temper bead welding procedure will improve the feasibility of performing localized weld repairs with a significant reduction in radiological exposure. EPRI Report GC-111050, Section 6.0 concluded the following:

"Repair of RPV components utilizing machine GTAW temper bead welding at ambient temperature produces mechanical properties that are commonly superior to those of the service-exposed substrate. The risk of hydrogen delayed cracking is minimal using the GTAW process. Cold stress cracking is resisted by the excellent toughness and ductility developed in the weld HAZ (heat affected zone). Process design and geometry largely control restraint considerations, and these factors are demonstrated during weld procedure qualification."

II. Evaluation of Proposed Alternatives to ASME Section XI, IWA-4500 and IWA-4530

1. According to **IWA-4530**, repairs may be performed to dissimilar base materials and welds without the specified post weld heat treatment of ASME Section III provided the requirements of IWA-4531 through IWA-4534 are met. The temper bead welding rules of IWA-4531 through IWA-4534 apply to dissimilar materials such as P-No. 43 to P-No. 3 base materials welded with F-No. 43 filler metals. When using the GTAW-Machine welding process, the IWA-4500 and IWA-4530 temper bead welding technique is based fundamentally on an elevated preheat temperature of 300°F, a maximum interpass temperature of 400°F, and a post weld bake of 450°F - 550°F. The proposed alternative of Attachment 3 also establishes requirements to perform temper bead welding on dissimilar material welds that join P-No. 43 to P-No. 3 base materials using F-No. 43 filler metals. However, the temper bead welding technique of Enclosure 1 is an ambient temperature technique, which only utilizes the GTAW-Machine or GTAW-Automatic process. The suitability of the proposed ambient temperature temper bead welding technique is evaluated in this section. The results of this evaluation demonstrate that the proposed ambient temperature temper bead welding technique provides an acceptable level of quality and safety.

RELIEF REQUEST RR 61, Rev. 0 (corrected)

2. According to **IWA-4531(a) and (b)** the weld metal shall be deposited by the SMAW using F-No. 43 weld metal for P-No. 3 to P-No. 43 weld joints. The maximum bead width shall be three times the electrode core diameter. Also, the precautions of IWA-4521(b) shall be met. Only the Machine or Automatic GTAW welding process with F-No. 43 weld metal can be used when performing ambient temperature temper bead welding in accordance with Enclosure 1. This is suitable because, the heat penetration of subsequent weld layers is carefully applied to produce overlapping thermal profiles that develop an acceptable degree of tempering in the underlying heat affected zone.

RELIEF REQUEST RR 3-31, Rev. 0 (corrected)

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