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August 21, 2002
IPN-02-068
NL-02-114

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
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Washington, DC 20555-0001

SUBJECT: Indian Point 2 Nuclear Power Plant
Docket No. 50-247
Indian Point 3 Nuclear Power Plant
Docket No. 50-286
ASME Code Relief Requests to Use Alternative Repair Methods and NDE Techniques for Reactor Vessel Head Penetration Nozzles

References: See below

Dear Sir:

This letter transmits two identical requests for relief from ASME Section XI Code requirements RR-62 (Attachment 1) is for Indian Point Nuclear Generating Unit No. 2 (IP2) and RR 3-32 (Attachment 2) is for Indian Point Nuclear Generating Unit No. 3 (IP3). Entergy Nuclear Operations, Inc. (ENO) proposes to use the alternative repair and the non-destructive examination requirements of later editions of the applicable code. These requests are contingent on the need for repairs.

A similar request for relief has been submitted for Entergy's ANO Unit 1 plant (Reference 1).

These requests for relief are submitted pursuant to 10CFR50.55a(a)(3)(i), (g)(5)(iii), and (g)(6)(i). The proposed alternatives provide an acceptable level of quality and safety. Approval for RR-62 for IP2 is needed by October 1, 2002 to support the Fall 2002 refueling outage. Although RR 3-32 for IP3 is needed to support IP3's Spring 2003 refueling outage, (which is currently scheduled for late March - early April 2003) we request that you review both requests concurrently, since both relief requests are essentially identical.

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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

References:

1. Entergy Operations, Inc. letter, M. A. Krupa to USNRC dated July 8, 2002 (CNRO-2002-00040), regarding ANO Unit 1, "Proposed Alternative to ASME Examination Requirements for Repairs Performed on Reactor Vessel Head Penetrations."

cc:

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Attachments:

I. Indian Point Nuclear Generating Unit No. 2 Third Ten-Year Inservice Inspection Interval Program Plan, Relief RR-62, Revision 0 (IP2)

II. Indian Point Nuclear Generating Unit No. 3, Third Ten-Year Inservice Inspection Interval Program Plan, Relief RR 3-32, Revision 0 (IP3)

ATTACHMENT I TO NL-02-114/IPN-02-068

INDIAN POINT NUCLEAR GENERATING UNIT NO. 2

THIRD TEN-YEAR INSERVICE INSPECTION INTERVAL PROGRAM PLAN

Relief RR-62, Revision 0 (IP2)

ENTERGY NUCLEAR OPERATIONS, INC.

INDIAN POINT NUCLEAR GENERATING UNIT NO. 2
DOCKET NO. 50-247
DPR-26

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Inservice Inspection Plan - 3rd interval

A. ASME CODE COMPONENT(S) AFFECTED

Code Class	:	1
References	:	Table IWB-2500-1, Category B-E
Examination Category:	:	B-E
Item Numbers:	:	B4.12, B4.13
Description	:	Reactor Pressure Vessel (RPV) Head Penetration Nozzles

B. APPLICABLE CODE EDITION AND ADDENDA

B.a ASME Section XI, 1989 Edition

IWA-4120 (a) of ASME Section XI, 1989 Edition states

> *"Repairs shall be performed in accordance with the Owner's Design Specification and the original Construction Code of the component or system. Later editions and Addenda of the Construction Code or of Section III, either in their entirety or portions thereof, and Code Cases may be used."*

The original construction code for the IP2 and IP3 RPV is ASME Section III, 1965 Edition, Summer 1966 Addenda (Reference 3). As allowed by ASME Section XI, localized weld repairs of the RPV head penetration nozzle base materials will be performed in accordance with the 1989 Edition of ASME Section III (Reference 4). The applicable ASME Section III, 1989 Edition requirements, corresponding to ASME Section III, 1965 Edition, Summer 1966 Addenda, are discussed below.

B.b NB-4000

NB-4000 establishes fabrication, installation, and repair requirements for ASME Class 1 components. According to NB-4131, when defects are identified in materials that exceed the limits of NB-2500, the condition is corrected in accordance with the requirements of NB-2500 for the applicable product form, with the exception that the limitation on depth of weld repair does not apply. The IP2 and IP3 RPV head penetration nozzles are manufactured from SB-167 pipe/tube. NB-2550 establishes examination and repair requirements that are applicable to ASME Class 1 tubular products such as RPV head penetration nozzles.

B.c NB-2559

NB-2559 states,

> *"Repair of defects shall be in accordance with NB-2539, except repair by welding is not permitted on copper-nickel alloy and nickel alloy materials."*

The restriction in NB-2559 that prohibits repair welding on copper-nickel alloy or nickel alloy materials, although not specifically stated, was only intended to apply to heat exchanger tubing; it was not intended to restrict welding repairs of other copper-nickel or nickel alloy materials such as nozzles. The ASME Code corrected this requirement in the 1993 Addenda of the 1992 Edition as follows: *"Repair of defects shall be in accordance with NB-2539, except repair by welding is not permitted on copper-nickel alloy or nickel alloy heat exchanger tubes."* Therefore, repair welding of RPV head penetration nozzles base material can be performed in accordance with NB-2539 as clarified by the 1993 Addenda of ASME Section III

B.d NB-2539

NB-2539 establishes requirements for performing base material repairs by welding. These requirements address defect removal, qualification of welding procedures and welders, blending of repaired areas, and examination of repair welds.

Defect removal requirements for base materials are specified in NB-2539.1 as follows:

> *"The defect shall be removed or reduced to an imperfection of acceptable size by suitable mechanical or thermal cutting or gouging methods and the cavity prepared for repair (NB-4211.1)."*

Examination requirements for completed repair welds are specified in NB-2539.4 as follows:

> *"Each repair weld shall be examined by the magnetic particle method or by liquid penetrant method. In addition, when the depth of the repair cavity exceeds the lesser of 3/8-inch or 10% of the section thickness, the repair weld shall be radiographed after repair in accordance with NB-5110 and to the acceptance standards of NB-5320."*

B.e IWA-4310 (ASME Section XI, 1989 Edition)

ASME Section XI also imposes repair requirements that supplement or amend the repair rules of the construction code. Where applicable, compliance with these additional requirements is mandatory. With respect to localized repair welding of RPV head penetration nozzle base materials, the following supplemental requirements apply:

IWA-4310 establishes requirements for performing defect removal. Just like NB-2539.1, these requirements also permit the acceptance of un-removed portions of flaws based upon the flaw evaluation rules of ASME Section XI. Supplementing the defect removal requirements in ASME Section III, IWA-4310 applies to the performance of localized weld repairs of RPV head penetration nozzle base materials.

IWA-4310 states

> *"Defects shall be removed or reduced in size in accordance with this Article. The component shall be acceptable for continued service if the resultant section thickness created by the cavity is equal to or greater than the minimum design thickness. If the resulting section thickness is reduced below the minimum design thickness, the component shall be repaired in accordance with this Article. Alternatively, the component may be evaluated and accepted in accordance with the design rules of either the Construction Code, or Section III, when the Construction Code was not*

Section III."

This requirement is further clarified in IWA-4310 (ASME Section XI, 1992 Edition), which states

> *"Defects shall be removed or reduced in size in accordance with this Paragraph. The component shall be acceptable for continued service if the resultant section thickness created by the cavity is equal to or greater than the minimum design thickness. If the resulting section thickness is reduced below the minimum design thickness, the component shall be repaired or replaced in accordance with this Article. Alternatively, the defect removal area and any remaining portion of the flaw may be evaluated and the component accepted in accordance with the appropriate flaw evaluation rules of Section XI or the design rules of either the Construction Code, or Section III, when the Construction Code was not Section III."*

B.f IWA-4331 (a) (ASME Section XI, 1992 Edition)

IWA-4331 (a) establishes nondestructive examination requirements that are applicable to defect removal surfaces including surfaces of repair cavities prepared for welding. Supplementing the examination requirements in ASME Section III, IWA-4331 (a) applies to localized weld repairs in RPV head penetration nozzle base materials.

IWA-4331 (a) states

> *"After final grinding, the affected surfaces, including surfaces of cavities prepared for welding, shall be examined by the magnetic particle or liquid penetrant method to ensure that the indication has been reduced to an acceptable limit in accordance with IWA-3000. This examination is not required when defect elimination removes the full thickness of the weld and the back side of the weld joint is not accessible for removal of examination materials."*

C. RELIEF REQUESTED

ENO proposes alternatives to defect removal and nondestructive examination (NDE) requirements associated with localized contingency weld repairs of RPV nozzle base materials, at the following locations:

- Along the inside diameter of the nozzle, above the J-weld. (See Figures 1 and 2.)
- Along the inside diameter of the nozzle, adjacent to the J-weld. (See Figures 1 and 3.)
- Along the inside diameter of the nozzle, below the J-weld. (See Figures 1 and 4.)
- Along the outside diameter of the nozzle below the J-weld. (See Figures 1 and 5.)

This request addresses defect removal and nondestructive examination (NDE) associated with the above contingency repairs. However, it does not apply when a temper bead welding process is utilized to perform weld repairs of RPV head penetration nozzle base materials. Additionally, this relief request does not apply to weld repairs of RPV head penetration nozzle

J-welds

An overview of ASME Code requirements applicable to the above base material repair scenarios is provided below. This overview identifies the various examination sequences required by the Construction Code and ASME Section XI.

C.a Localized Weld Repair of Head Penetration Nozzle Base Materials

C.a.i Defect Removal

Defects are either removed or reduced in size in accordance with IWA-4310. The IWA-4310 defect removal requirements are consistent with NB-2539.1 in that both of these paragraphs require that the defect be removed or reduced to an imperfection of acceptable size However, IWA-4310 also includes a provision that allows acceptance of a defect removal area and an un-removed portion of a flaw based on an evaluation performed *"in accordance with the appropriate flaw evaluation rules of ASME Section XI."* The applicable paragraphs of ASME Sections III and XI are provided below.

ASME Section III, NB-2539.1 states, in part, *"The defect shall be removed or reduced to an imperfection of acceptable size..."*

ASME Section XI, IWA-4310 (ASME Section XI, 1992 Edition) states

> *"Defects shall be removed or reduced in size in accordance with this Paragraph. The component shall be acceptable for continued service if the resultant section thickness created by the cavity is equal to or greater than the minimum design thickness. If the resulting section thickness is reduced below the minimum design thickness, the component shall be repaired or replaced in accordance with this Article. Alternatively, the defect removal area and any remaining portion of the flaw may be evaluated and the component accepted in accordance with appropriate flaw evaluation rules of Section XI or the design rules of either the Construction Code, or Section III, when the Construction Code was not Section III."*

ENO proposes, as an alternative to NB-2539.1 and IWA-4310 (ASME Section XI, 1989 Edition), to use the embedded flaw technique. This technique, which reduces the flaw to a Code acceptable size and overlays the flaw with weld material, would be used as an alternative. The embedded flaw will be isolated from the reactor coolant to preclude further propagation from primary water stress corrosion cracking (PWSCC.) The unflawed portion of the base metal and repair weld of the area maintain the structural integrity of the embedded flaw repair areas.

C.a.ii Defect Removal Methods

When defects are removed using a thermal removal process, a minimum of 1/16-inch of material must be mechanically removed from the thermally processed areas in accordance with IWA-4322. The ASME Section XI requirement pertaining to defect removal supplements the defect removal requirements of ASME Section III. While both ASME Sections III and XI allow use of thermal and mechanical removal processes, only ASME Section XI requires the mechanical removal of 1/16-inch (minimum) of material from all thermally processed areas. The applicable paragraphs of ASME Sections III and XI are provided below.

ASME Section III, NB-2539.1 states, in part, *"The defect shall be removed or reduced to an imperfection of acceptable size by suitable mechanical or thermal cutting or gouging methods..."*

ASME Section XI, IWA-4322 states *"If thermal removal processes are used on P-No. 8 and P-No. 43 materials, a minimum of 1/16-inch material shall be mechanically removed from the thermally processed areas."*

ASME Section XI, IWA-4330 allows the use of mechanical removal processes on defect removal areas in repair weld cavities.

As an alternative to IWA-4322 (separate from this relief request, and subject to NRC approval), when defects will be removed, ENO plans to use the electrical discharge machining (EDM) process to perform defect removal (Reference 8). The EDM process results in thin depth of the heat-affected zone. ENO will remove the heat-affected zone material by mechanical means.

In addition, when defects are not removed but are reduced to an acceptable size, ENO proposes, as an alternative to NB-2539.1 and IWA-4310 (ASME Section XI, 1989 Edition), to use the embedded flaw technique. In the proposed repairs, the defects will be embedded by the embedded flaw technique, to isolate them from the reactor coolant and preclude further propagation from primary water stress corrosion cracking (PWSCC.) The unflawed portion of the base metal and repair weld of the area maintain the structural integrity of the embedded flaw repair areas. The repaired area will be considered to be a permanent repair that will provide an acceptable level of quality and safety.

C.a.iii Preparation of Repair Cavity

Repair cavities for localized weld repairs of RPV head penetration nozzle base materials are prepared in accordance with IWA-4330. The ASME Section XI requirements in IWA-4330 supplement the repair cavity preparation requirements of ASME Section III. Although NB-2539.1 of ASME Section III states that the repair cavity is to be prepared for welding, it does not establish requirements to accomplish this. IWA-4330 (b) does. According to IWA-4330 (b), the repair cavity must be ground smooth and clean with beveled sides and edges rounded to provide suitable accessibility for welding. The applicable paragraphs of ASME Sections III and XI are provided below.

ASME Section III, NB-2539.1 states in part *"The defect shall be removed or reduced to an imperfection of acceptable size ... and the cavity prepared for welding."*

ASME Section XI, IWA-4330 (b) states *"Where repair welding is required, the cavity shall be ground smooth and clean with beveled sides and edges rounded to provide suitable accessibility for welding."*

ENO will machine the cavity using the EDM process. This process results in a smooth cavity with beveled sides to provide suitable accessibility for welding. The heat-affected zone will be removed by mechanical means.

C.a.iv Repair Cavity Examination

Prior to welding, the repair cavity is examined by the liquid penetrant method in accordance with IWA-4331 (a). [Although IWA-4331 (a) allows either a liquid penetration examination or a magnetic particle examination, a magnetic particle examination cannot be performed since the nozzle material to be examined is non-magnetic] Although NB-2558 (b) of ASME Section III specifies that the repair cavity is to be examined by the examination method that originally disclosed the defect, IWA-4331 (a) of ASME Section XI amends this requirement by requiring a liquid penetrant examination regardless of product form. [Note that NB-2539, as invoked by NB-2559, does not address examination of the repair cavity. Repair cavity examinations are performed in accordance with NB-2558 (b)] The applicable paragraphs of ASME Sections III and XI are provided below.

ASME Section III, NB-2558 (b) states *"After defect elimination, the area is examined by the method which originally disclosed the defect to assure that the defect has been removed or reduced to an imperfection of acceptable size."*

ASME Section XI, IWA-4331 (a) states

> *"After final grinding, the affected surfaces, including surfaces of cavities prepared for welding, shall be examined by the magnetic particle or liquid penetrant method to ensure that the indication is reduced to an acceptable limit in accordance with IWA-3000. This examination is not required when defect elimination removes the full thickness of the weld and the back side of the weld joint is not accessible for removal of examination materials."*

Entergy proposes, as an alternative to the repair cavity examination requirements of IWA-4331(a) in "Proposed Alternatives," Section C.b.i, below.

C.a.v Qualification of Welding Procedures and Welders

Welding procedures and welders or welding operators are qualified in accordance with NB-4000 of ASME Section III and ASME Section IX as required by NB-2539.2. ASME Section XI invokes the qualification requirements of ASME Section III without specifying any supplements or amendments. The applicable paragraphs of ASME Sections III and XI are provided below.

ASME Section III, NB-2539.2 states *"The welding procedures and welders or welding operators shall be qualified in accordance with NB-4000 and Section IX."*

ASME Section XI, IWA-4170(b) states

> *"Repairs and installation of replacement items shall be performed in accordance with the Owner's Design Specification and the original Construction Code of the component or system. Later editions and Addenda of the Construction Code or of Section III, either in their entirety or portions thereof, and Code Cases may be used."*

Entergy proposes that these requirements will be met in the proposed repair program.

C.a.vi Blending of Repaired Areas

The weld surface is blended uniformly into the surrounding surface after completing the repair as required by NB-2539.3. ASME Section XI invokes the repair requirements of ASME Section III without specifying any supplements or amendments. The applicable paragraphs of ASME Sections III and XI are provided below.

ASME Section III, NB-2539.3 states *"After repair, the surface shall be blended uniformly into the surrounding surface."*

ASME Section XI, IWA-4170(b) states

> *"Repairs and installation of replacement items shall be performed in accordance with the Owner's Design Specification and the original Construction Code of the component or system. Later editions and Addenda of the Construction Code or of Section III, either in their entirety or portions thereof, and Code Cases may be used."*

Entergy proposes that these requirements will be met in the proposed repair program.

C.a.vii Examination of Repair Welds

Repair welds in RPV head penetration nozzles are examined by the liquid penetrant method in accordance with NB-2539.4. When the repair cavity depth exceeds the lesser of 3/8-inch or 10% of the section thickness, a radiographic examination of the repair weld is also required by NB-2539.4. ASME Section XI invokes the ASME Section III examination requirements without specifying any supplements or amendments. The applicable paragraphs of ASME Sections III and XI are provided below.

ASME Section III, NB-2539.4 states

> *"Each repair weld shall be examined by the magnetic particle or liquid penetrant method. In addition, when the depth of the repair cavity exceeds the lesser of 3/8-inch or 10% of the section thickness, the repair weld shall be radiographed after repair in accordance with NB-5110 and to the acceptance standards of NB-5320."*

ASME Section XI, IWA-4170 (b) states

> *"Repairs and installation of replacement items shall be performed in accordance with the Owner's Design Specification and the original Construction Code of the component or system. Later editions and Addenda of the Construction Code or of Section III, either in their entirety or portions thereof, and Code Cases may be used."*

Entergy proposes alternatives to the examination requirements of NB-2539.4, in "Proposed Alternatives" Sections C.b.i and C.b.ii, below.

C.b Proposed Alternatives

C.b.i 10CFR50.55a(a)(3)(i) Alternatives

Pursuant to the provisions of 10CFR50.55a(a)(3)(i), ENO proposes alternatives to defect removal and examination requirements applicable to localized repair welds in RPV head penetration nozzle base materials specified in ASME Section XI IWA-4331 (a) and ASME Section III NB-2539.4. Specifically, ENO proposes the following alternatives:

As an alternative to defect removal in accordance with ASME Section III, 1989 Edition, NB-2539.1 and ASME Section XI, 1989 Edition, IWA-4310, ENO proposes to use the embedded flaw technique. In the proposed repairs, defects will not be completely removed. Instead, the defects will be repaired by the embedded flaw technique. This technique is a permanent repair not requiring follow-up inspections, and that will provide an acceptable level of quality and safety.

As an alternative to a magnetic particle or liquid penetrant examination of the repair cavity in accordance with IWA-4331 (a) of ASME Section XI, ENO proposes to perform the following:

Flaw Characterization

Prior to defect removal, RPV head penetration nozzles will be examined by the ultrasonic and eddy current examination methods to characterize all flaws.

Flaw Evaluation

All flaws in RPV head penetration nozzles will be evaluated for acceptance. Flaws that exceed the acceptance limits of the flaw evaluation will be reduced to an acceptable size prior to welding.

Examination of Repair Weld

Upon completion of welding, the repair weld will be examined by the ultrasonic and eddy current methods to verify that the as left dimensions of the flaw comply with the acceptance limits of the component. When the eddy current examination cannot be performed due to the surface profile of the repair weld or other prohibitive conditions, then a liquid penetrant examination will be performed as an alternative.

Ultrasonic examinations will be performed as described in Section D.a.i. Acceptance criteria shall be in accordance with NB-5330.

Eddy current examinations will be performed as described in Section D.a.i.

The liquid penetrant examination and acceptance criteria will be in accordance with NB-2546 of ASME Section III.

As an alternative to a magnetic particle or liquid penetrant examination of the completed repair weld in accordance with NB-2539.4 of ASME Section III, Entergy proposes to perform an eddy current examination. When an eddy current examination cannot be performed due to the surface profile of the repair weld or other

prohibitive conditions, then a liquid penetrant examination will be performed.

Eddy current examinations will be performed as described in Section D.b.

The liquid penetrant examination and acceptance criteria will be in accordance with NB-2546 of ASME Section III.

C.b.ii 10CFR50.55a(g)(5)(iii) Alternative

Pursuant to the provisions of 10CFR50.55a(g)(5)(iii), Entergy requests relief from ASME Section III NB-2539.4, which requires a radiographic examination of completed repair welds when the depth of the repair cavity exceeds the lesser of 3/8-inch or 10% of the section thickness. As an alternative to this examination, Entergy proposes to perform ultrasonic and eddy current examinations, as follows:

Ultrasonic examinations will be performed as described in Section D.c. Acceptance criteria shall be in accordance with NB-5330.

Eddy current examinations will be performed as described in Section D.c.
The alternatives proposed above, are specific to the localized weld repairs of RPV head penetration nozzle base materials at locations described below.

- Along the inside diameter of the nozzle, above the J-weld. See Figures 1 and 2.
- Along the inside diameter of the nozzle, adjacent to the J-weld. See Figures 1 and 3.
- Along the inside diameter of the nozzle, below the J-weld. See Figures 1 and 4.
- Along the outside diameter of the nozzle below the J-weld. See Figures 1 and 5.

D. BASIS FOR RELIEF

D.a IWA-4331 (a) – Surface Examination of Repair Cavity

IWA-4331 (a) of ASME Section XI requires a magnetic particle or liquid penetrant examination of all repair cavities prior to repair welding. Magnetic particle testing is a nondestructive examination method used to detect surface and near-surface discontinuities in magnetic materials. However, the IP2 and IP3 RPV head penetration nozzles are manufactured from SB-167 nickel alloy, which is not magnetic. Therefore, examination of repair weld cavities in RPV head penetration nozzles by the magnetic particle method is not possible.

Liquid penetrant testing is a nondestructive method that reveals open-surface discontinuities by bleed-out of a liquid penetrant medium against a contrasting background developer. When a surface examination of an RPV head penetration nozzle is required, liquid penetrant would be the appropriate examination method.

D.a.i Suitability of Proposed Alternative

RPV head penetration nozzles will be examined by the ultrasonic and eddy current examination methods as described below to characterize all flaws prior to defect excavation. Identified flaws will be evaluated for acceptance in accordance with IWB-3600. Flaws that exceed the acceptance limits of the IWB-3600 flaw evaluation will be removed or reduced to an acceptable size prior to welding. Upon completion of repair welding, the repair weld region will be re-examined using the ultrasonic and eddy current examination methods to verify that the as-left flaw dimensions are still within the acceptance limits of the IWB-3600 flaw evaluation. In the unlikely event that an eddy current examination cannot be performed due to the surface profile of a repair weld or some other prohibitive condition, then a liquid penetrant examination will be performed as an alternative. In conclusion, a surface examination is performed on a repair cavity to ensure that cracks and other unacceptable defects have been removed prior to welding. However, when a flaw is left in the component by design in accordance with IWA-4310, then a surface examination of the repair cavity is no longer beneficial. Conversely, the proposed alternative ensures that the structural integrity of the RPV head penetration nozzle is maintained.

The ultrasonic examination will be performed using a combination of Time of Flight Diffraction (TOFD) and standard 0° pulse-echo techniques. The TOFD approach utilizes two pairs of transducers pointed at each other. One of the transducers sends sound into the inspection volume, and the other transducer receives the reflected and diffracted signals, as they interact with the material. There will be one TOFD pair looking in the axial direction of the penetration tube, and one TOFD pair will be looking in the circumferential direction of the penetration tube. The TOFD technique is primarily responsible for detecting and characterizing planar-type defects within the full volume of the penetration tube. This TOFD ultrasonic technique will be used for pre-inspection flaw characterization and post-repair inspection.

The standard 0° pulse-echo ultrasonic approach utilizes a straight beam transducer. The 0° technique is primarily responsible for plotting the penetration tube outside diameter location and the J-grove attachment weld location, which will aid in defect orientation and sizing information. Additionally, the 0° technique will be capable of locating and sizing any laminar-type defects that may be encountered such as lack of fusion. This ultrasonic technique will be used for pre-inspection flaw characterization and post-repair inspection.

The eddy current examination complements the ultrasonic examination by providing sensitivity to surface and subsurface flaws along the inspection surface. The eddy current approach utilizes a 5-mm diameter, "cross wound" probe design, which is capable of operating frequencies between 75 and 500 kHz. This technique is primarily responsible for detection and length sizing of defects, that are open to the inside diameter surface of the penetration tube. Since this particular probe design produces eddy currents that penetrate approximately 0.030-inch into the inside diameter surface, it will also aid in the evaluation of very shallow surface defects. For post-repair inspection purposes, this eddy current examination technique will provide the necessary surface examination of the weld repair area. This eddy current technique will be used in the flaw characterization and post-repair inspections.

The above ultrasonic and eddy current examination techniques have been demonstrated capable of detecting axial and circumferential PWSCC indications in the nozzle material,

utilizing cracked nozzle samples. Entergy submitted a detailed summary of these demonstrations to the NRC staff in Reference 14.

D.b NB-2539.4 – Surface Examination of Repair Welds

NB-2539.4 of ASME Section III requires a magnetic particle or liquid penetrant examination of all repair welds. However, the IP2 and IP3 RPV head penetration nozzles are manufactured from SB-167 nickel alloy, which is not magnetic. Repair welds will be performed using Inconel filler metals that are also non-magnetic. Therefore, as discussed previously under "Surface Examination of Repair cavity," examination of repair welds in RPV head penetration nozzles by the magnetic particle method is not possible.

D.b.i Suitability of Proposed Alternative

Eddy current examinations have been proposed as an alternative to magnetic particle testing. The eddy current examination provides sensitivity to surface and subsurface flaws along the inspection surface. More details on the eddy current examination method are provided in Section D.a, above.

A liquid penetrant examination of repair welds in RPV head penetration nozzle base materials is an acceptable examination according to NB-2539.4. As discussed previously under "Surface Examination of Repair Cavity," liquid penetrant examination will only be performed when the eddy current examination cannot be performed due to the surface profile of a repair weld or some other prohibitive condition.

D.c NB-2539.4 – Radiographic Examination of Repair Welds

NB-2539.4 requires a radiographic examination of base material repair welds when the depth of the repair cavity exceeds the lesser of 3/8-inch or 10% of the section thickness. However, a radiographic examination of the repair weld is not appropriate.

D.c.i Impracticality of Radiographic 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 unsharpness 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 impossible. Multiple exposures, complex geometry and thickness, and the adverse radiological environment make radiographic examination of RPV head penetration nozzle repair welds impractical.

D.c.ii Suitability of Proposed Alternative

Meaningful radiographic examination of repair welds in RPV head penetration nozzle base materials cannot be performed. As an alternative, ENO proposes to utilize the ultrasonic and eddy current examination methods.

E. CONCLUSION

E.a 10CFR50.55a(a)(3)

10CFR50.55a(a)(3) states

> *"Proposed alternatives to the requirements of (c), (d), (e), (f), (g), and (h) of this section or portions thereof may be used when authorized by the Director of the Office of Nuclear Reactor Regulation. The applicant shall demonstrate that:*
>
> *The proposed alternatives would provide an acceptable level of quality and safety, or compliance with the specified requirements of this section would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety."*

Entergy believes that the proposed alternatives identified Sections C.b.i and C.b.ii, and discussed in Sections D.a and D.b, above, provide an acceptable level of quality and safety to the repair rules as stated in Reference 1 and as described in Section B of this request. Therefore, we request that the proposed alternative be authorized pursuant to 10CFR50.55a(a)(3)(i).

E.b 10CFR50.55a(g)(5)(iii)

10CFR50.55a(g)(5)(iii) states

> *"If the licensee has determined that conformance with certain code requirements is impractical for its facility, the licensee shall notify the Commission and submit, as specified in 50.4, information to support the determinations."*

10CFR50.55a(g)(6)(i) states

> *"The Commission will evaluate determinations under paragraph (g)(5) of this section that code requirements are impractical. The Commission may grant such relief and may impose such alternative requirements as it determines 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."*

Entergy believes the radiographic examination required by ASME Section III NB-2539.4 for base material weld repairs is impractical since it cannot be performed. Entergy has proposed an alternative examination (identified in Section C.b.ii and discussed in Section D.c) that provides an acceptable level of quality and safety. Therefore, Entergy requests relief from performing a radiographic examination and authorization to perform the proposed alternative examination pursuant to 10CFR50.55a(g)(6)(i).

F. PERIOD FOR WHICH RELIEF IS REQUESTED

Relief is requested for the remainder of the third inspection interval, through April 3, 2006.

G. ATTACHMENTS TO RELIEF

G.a List of Figures

Figure 1 –Typical RPV Head Penetration Nozzle

Figure 2 – RPV Nozzle Repair Weld: Inside Diameter and Above J-Weld

Figure 3 – RPV Nozzle Repair Weld: Inside Diameter and Adjacent to J-Weld

Figure 4 – RPV Nozzle Repair Weld: Inside Diameter and Below J-Weld

Figure 5 – RPV Nozzle Repair Weld; Outside Diameter and Below J-Weld

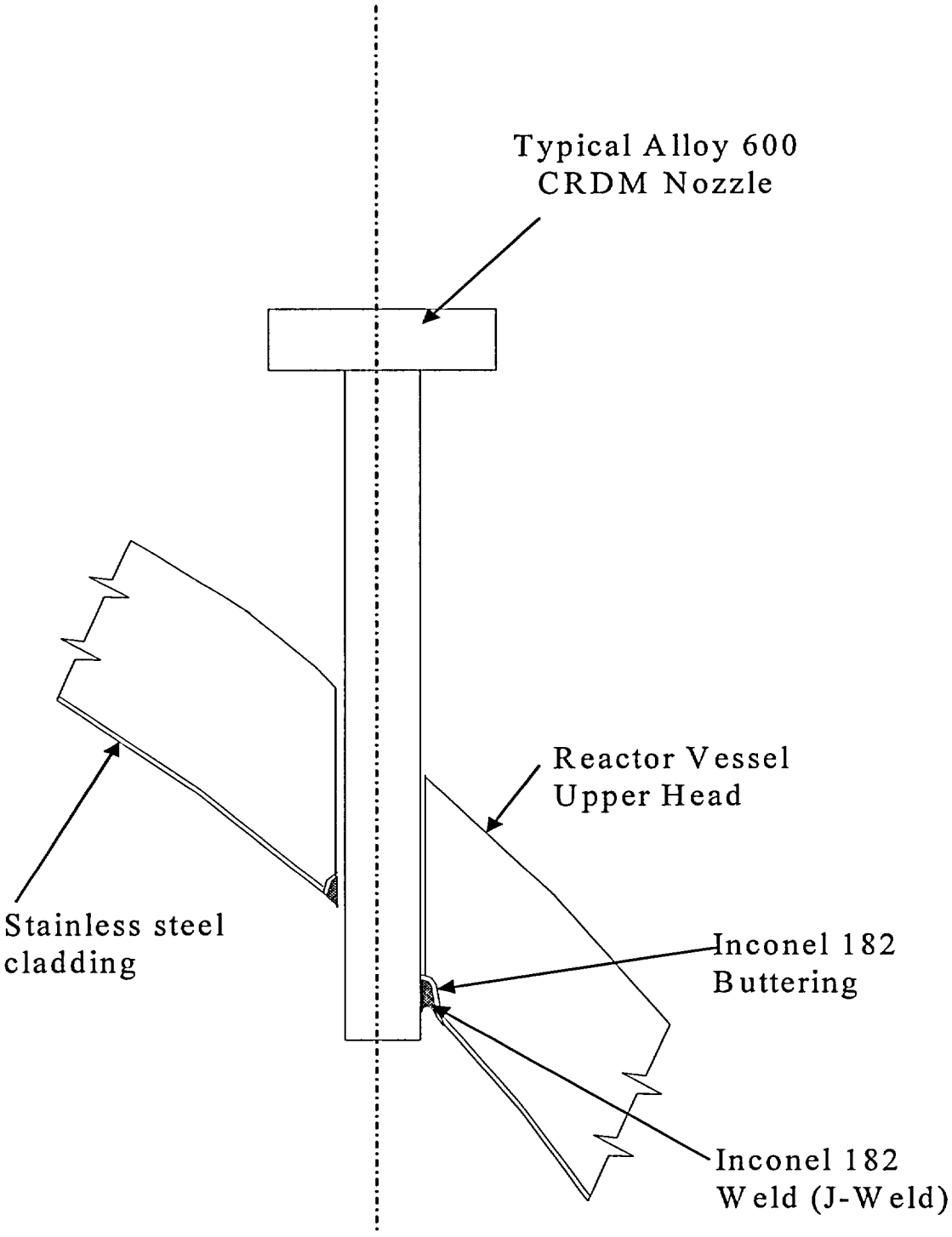
H. REFERENCES

1. ASME Section XI, 1989 Edition.
2. ASME Section XI, 1992 Edition.
3. ASME Section III, 1965 Edition, Summer 1966 Addenda.
4. ASME Section III, Subsection NB, 1989 Edition.
5. ASME Section III, Subsection NB, 1992 Edition.
6. Consolidated Edison Letter, dated September 4, 2001 (NL-01-106) regarding thirty-day response to NRC Bulletin 2001-01.
7. ENO Letter, M. Kansler to USNRC, dated September 24, 2001 (NL-01-113) regarding supplemental thirty-day response to NRC Bulletin 2001-01.
8. ENO Letter, M. Kansler to USNRC dated July 1, 2002 (NL-02-094/IPN-02-053), ASME Code Relief Requests to Use EDM for Contingency Repairs on RPV Head Penetration Nozzles.
9. ENO Letter, M. Kansler to USNRC (IPN-01-079/NL-01-133), dated November 13, 2001, Revised Vessel Head Penetration Inspection Plans, NRC Bulletin 2001-01, "Circumferential Cracking of reactor Pressure Vessel Head Penetration Nozzles."
10. USNRC Letter, P.D. Milano to M. Kansler, Bulletin 2001-01, dated April 8, 2002, "Circumferential Cracking of reactor Pressure Vessel Head Penetration Nozzles," Responses for Indian Point Units 2 and 3.
11. ENO Letter, J. Herron to USNRC (NL-02-050/IPN-02-023), dated April 2, 2002, "Submittal of 15 Day Response to NRC Bulletin 2002-01," for Indian Point Units 2 and 3.

12. ENO Letter, F. Dacimo to USNRC, dated July 23, 2002 (NL-02-101), "NRC Bulletin 2001-01-Reactor Pressure Vessel Head penetration Nozzle Inspection Plan for 2002 Refueling Outage (2R15)," for Indian Point Unit 2.

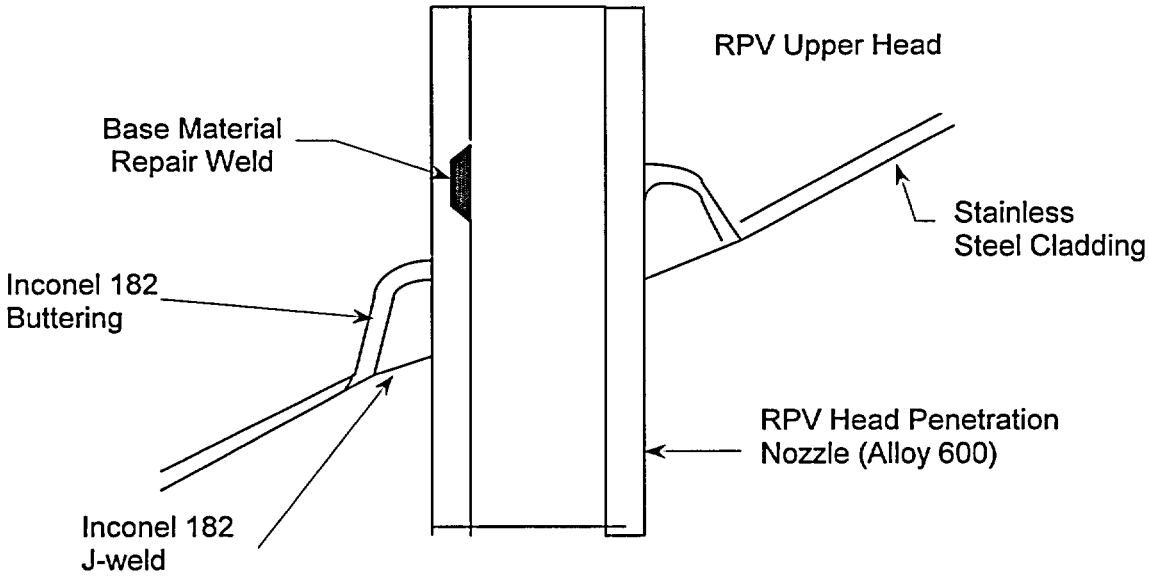
13. ENO Letter, M. R. Kansler to USNRC, dated July 29, 2002 (NL-02-104/IPN-02-061), "ASME Code relief Requests to Use an Alternative to Temper Bead Welding Requirements for Contingency Repairs on Reactor Vessel Head Penetration Nozzles," for Indian Point Units 2 and 3.

14. Letter 0CAN060202 from Entergy Operations, Inc. to the NRC, "Submittal of Demonstration Report for Volumetric Examination of Vessel Head Penetration Nozzles," dated June 17, 2002.



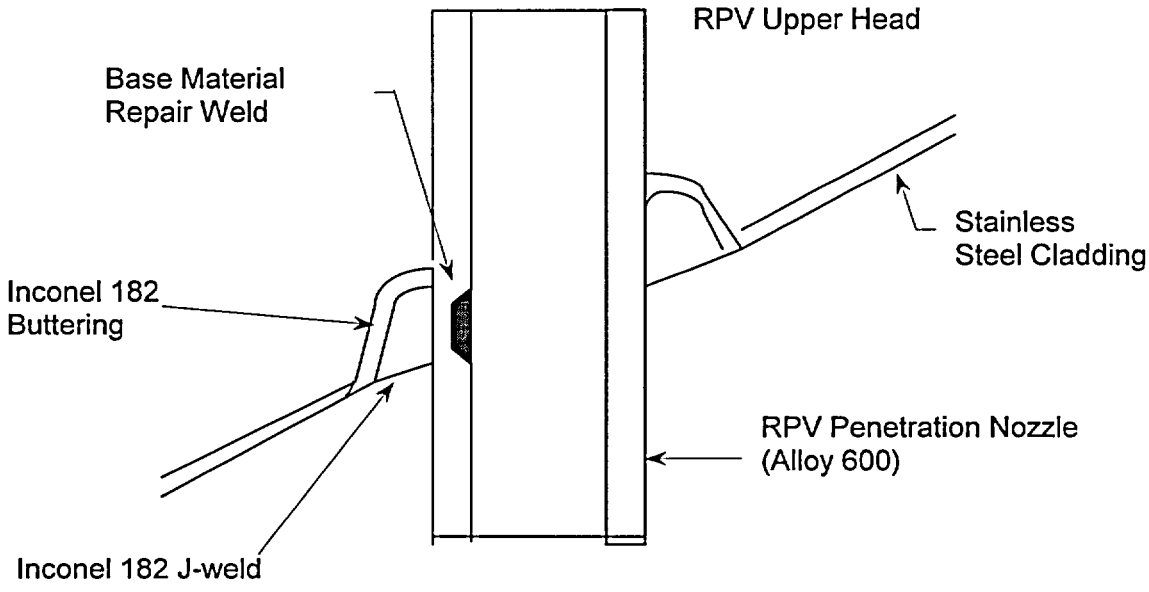
TYPICAL RPV HEAD PENETRATION NOZZLE

FIGURE 1



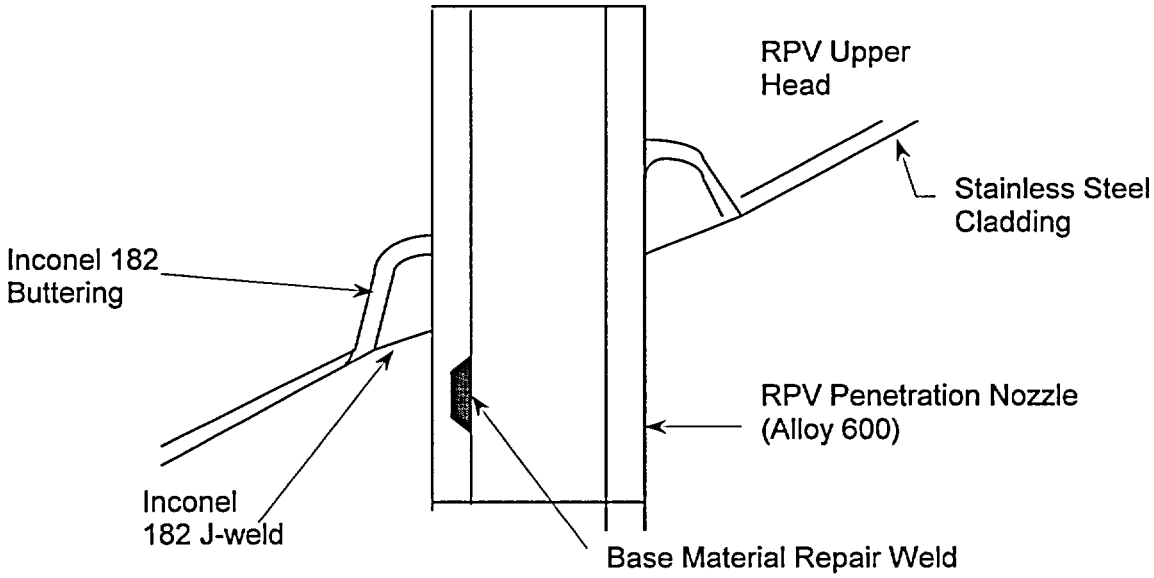
RPV Nozzle Repair Weld: Inside Diameter and Above J-Weld

FIGURE 2



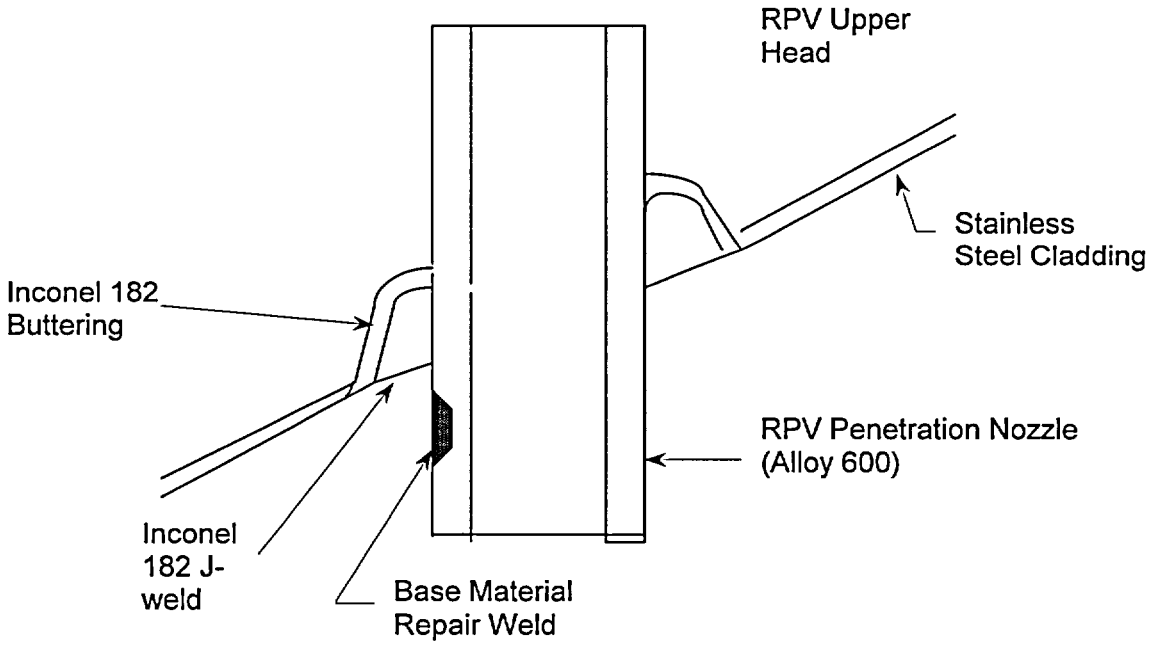
RPV Nozzle Repair Weld: Inside Diameter and Adjacent to J-Weld

FIGURE 3



RPV Nozzle Repair Weld: Inside Diameter and Below J-Weld

FIGURE 4



RPV Nozzle Repair Weld: Outside Diameter and Below J-Weld
FIGURE 5

ATTACHMENT II TO NL-02-114/IPN-02-068

INDIAN POINT NUCLEAR GENERATING UNIT NO. 3

THIRD TEN-YEAR INSERVICE INSPECTION INTERVAL PROGRAM PLAN

Relief RR 3-32, Revision 0 (IP3)

ENTERGY NUCLEAR OPERATIONS, INC.

INDIAN POINT NUCLEAR GENERATING UNIT NO. 3
DOCKET NO. 50-286
DPR-64

TABLE OF CONTENTS

B. ASME CODE COMPONENT(S) AFFECTED

Code Class	:	1
References:	:	Table IWB-2500-1, Category B-E
Examination Category:	:	B-E
Item Numbers:	:	B4.12, B4.13
Description	:	Reactor Pressure Vessel (RPV) Head Penetration Nozzles

C. APPLICABLE CODE EDITION AND ADDENDA

B.a ASME Section XI, 1989 Edition

IWA-4120 (a) of ASME Section XI, 1989 Edition states

> *"Repairs shall be performed in accordance with the Owner's Design Specification and the original Construction Code of the component or system. Later editions and Addenda of the Construction Code or of Section III, either in their entirety or portions thereof, and Code Cases may be used."*

The original construction code for the IP2 and IP3 RPV is ASME Section III, 1965 Edition, Summer 1966 Addenda (Reference 3). As allowed by ASME Section XI, localized weld repairs of the RPV head penetration nozzle base materials will be performed in accordance with the 1989 Edition of ASME Section III (Reference 4). The applicable ASME Section III, 1989 Edition requirements, corresponding to ASME Section III, 1965 Edition, Summer 1966 Addenda, are discussed below.

B.b NB-4000

NB-4000 establishes fabrication, installation, and repair requirements for ASME Class 1 components. According to NB-4131, when defects are identified in materials that exceed the limits of NB-2500, the condition is corrected in accordance with the requirements of NB-2500 for the applicable product form, with the exception that the limitation on depth of weld repair does not apply. The IP2 and IP3 RPV head penetration nozzles are manufactured from SB-167 pipe/tube. NB-2550 establishes examination and repair requirements that are applicable to ASME Class 1 tubular products such as RPV head penetration nozzles.

B.c NB-2559

NB-2559 states,

> *"Repair of defects shall be in accordance with NB-2539, except repair by welding is not permitted on copper-nickel alloy and nickel alloy materials."*

The restriction in NB-2559 that prohibits repair welding on copper-nickel alloy or nickel alloy materials, although not specifically stated, was only intended to apply to heat exchanger tubing; it was not intended to restrict welding repairs of other copper-nickel or nickel alloy materials such as nozzles. The ASME Code corrected this requirement in the 1993 Addenda of the 1992 Edition as follows: *"Repair of defects shall be in accordance with NB-2539, except repair by welding is not permitted on copper-nickel alloy or nickel alloy heat exchanger tubes."* Therefore, repair welding of RPV head penetration nozzles base material can be performed in accordance with NB-2539 as clarified by the 1993 Addenda of ASME Section III.

B.d NB-2539

NB-2539 establishes requirements for performing base material repairs by welding. These requirements address defect removal, qualification of welding procedures and welders, blending of repaired areas, and examination of repair welds.

Defect removal requirements for base materials are specified in NB-2539.1 as follows:

> *"The defect shall be removed or reduced to an imperfection of acceptable size by suitable mechanical or thermal cutting or gouging methods and the cavity prepared for repair (NB-4211.1)."*

Examination requirements for completed repair welds are specified in NB-2539.4 as follows:

> *"Each repair weld shall be examined by the magnetic particle method or by liquid penetrant method. In addition, when the depth of the repair cavity exceeds the lesser of 3/8-inch or 10% of the section thickness, the repair weld shall be radiographed after repair in accordance with NB-5110 and to the acceptance standards of NB-5320."*

B.e IWA-4310 (ASME Section XI, 1989 Edition)

ASME Section XI also imposes repair requirements that supplement or amend the repair rules of the construction code. Where applicable, compliance with these additional requirements is mandatory. With respect to localized repair welding of RPV head penetration nozzle base materials, the following supplemental requirements apply:

IWA-4310 establishes requirements for performing defect removal. Just like NB-2539.1, these requirements also permit the acceptance of un-removed portions of flaws based upon the flaw evaluation rules of ASME Section XI. Supplementing the defect removal requirements in ASME Section III, IWA-4310 applies to the performance of localized weld repairs of RPV head penetration nozzle base materials.

IWA-4310 states

> *"Defects shall be removed or reduced in size in accordance with this Article. The component shall be acceptable for continued service if the resultant section thickness created by the cavity is equal to or greater than the minimum design thickness. If the resulting section thickness is reduced below the minimum design thickness, the component shall be repaired in accordance with this Article. Alternatively, the component may be evaluated and accepted in accordance with the design rules of either the Construction Code, or Section III, when the Construction Code was not*

Section III."

This requirement is further clarified in IWA-4310 (ASME Section XI, 1992 Edition), which states

> *"Defects shall be removed or reduced in size in accordance with this Paragraph. The component shall be acceptable for continued service if the resultant section thickness created by the cavity is equal to or greater than the minimum design thickness. If the resulting section thickness is reduced below the minimum design thickness, the component shall be repaired or replaced in accordance with this Article. Alternatively, the defect removal area and any remaining portion of the flaw may be evaluated and the component accepted in accordance with the appropriate flaw evaluation rules of Section XI or the design rules of either the Construction Code, or Section III, when the Construction Code was not Section III."*

B.f IWA-4331 (a) (ASME Section XI, 1992 Edition)

IWA-4331 (a) establishes nondestructive examination requirements that are applicable to defect removal surfaces including surfaces of repair cavities prepared for welding. Supplementing the examination requirements in ASME Section III, IWA-4331 (a) applies to localized weld repairs in RPV head penetration nozzle base materials.

IWA-4331 (a) states

> *"After final grinding, the affected surfaces, including surfaces of cavities prepared for welding, shall be examined by the magnetic particle or liquid penetrant method to ensure that the indication has been reduced to an acceptable limit in accordance with IWA-3000. This examination is not required when defect elimination removes the full thickness of the weld and the back side of the weld joint is not accessible for removal of examination materials."*

C. RELIEF REQUESTED

ENO proposes alternatives to defect removal and nondestructive examination (NDE) requirements associated with localized contingency weld repairs of RPV nozzle base materials, at the following locations:

- Along the inside diameter of the nozzle, above the J-weld. (See Figures 1 and 2.)
- Along the inside diameter of the nozzle, adjacent to the J-weld. (See Figures 1 and 3.)
- Along the inside diameter of the nozzle, below the J-weld. (See Figures 1 and 4.)
- Along the outside diameter of the nozzle below the J-weld. (See Figures 1 and 5.)

This request addresses defect removal and nondestructive examination (NDE) associated with the above contingency repairs. However, it does not apply when a temper bead welding process is utilized to perform weld repairs of RPV head penetration nozzle base materials. Additionally, this relief request does not apply to weld repairs of RPV head penetration nozzle

J-welds.

An overview of ASME Code requirements applicable to the above base material repair scenarios is provided below. This overview identifies the various examination sequences required by the Construction Code and ASME Section XI.

C.a Localized Weld Repair of Head Penetration Nozzle Base Materials

C.a.i Defect Removal

Defects are either removed or reduced in size in accordance with IWA-4310. The IWA-4310 defect removal requirements are consistent with NB-2539.1 in that both of these paragraphs require that the defect be removed or reduced to an imperfection of acceptable size. However, IWA-4310 also includes a provision that allows acceptance of a defect removal area and an un-removed portion of a flaw based on an evaluation performed *"in accordance with the appropriate flaw evaluation rules of ASME Section XI."* The applicable paragraphs of ASME Sections III and XI are provided below.

ASME Section III, NB-2539.1 states, in part, *"The defect shall be removed or reduced to an imperfection of acceptable size..."*

ASME Section XI, IWA-4310 (ASME Section XI, 1992 Edition) states

> *"Defects shall be removed or reduced in size in accordance with this Paragraph. The component shall be acceptable for continued service if the resultant section thickness created by the cavity is equal to or greater than the minimum design thickness. If the resulting section thickness is reduced below the minimum design thickness, the component shall be repaired or replaced in accordance with this Article. Alternatively, the defect removal area and any remaining portion of the flaw may be evaluated and the component accepted in accordance with appropriate flaw evaluation rules of Section XI or the design rules of either the Construction Code, or Section III, when the Construction Code was not Section III."*

ENO proposes, as an alternative to NB-2539.1 and IWA-4310 (ASME Section XI, 1989 Edition), to use the embedded flaw technique. This technique, which reduces the flaw to a Code acceptable size and overlays the flaw with weld material, would be used as an alternative. The embedded flaw will be isolated from the reactor coolant to preclude further propagation from primary water stress corrosion cracking (PWSCC.) The unflawed portion of the base metal and repair weld of the area maintain the structural integrity of the embedded flaw repair areas.

C.a.ii Defect Removal Methods

When defects are removed using a thermal removal process, a minimum of 1/16-inch of material must be mechanically removed from the thermally processed areas in accordance with IWA-4322. The ASME Section XI requirement pertaining to defect removal supplements the defect removal requirements of ASME Section III. While both ASME Sections III and XI allow use of thermal and mechanical removal processes, only ASME Section XI requires the mechanical removal of 1/16-inch (minimum) of material from all thermally processed areas. The applicable paragraphs of ASME Sections III and XI are provided below.

ASME Section III, NB-2539.1 states, in part, *"The defect shall be removed or reduced to an imperfection of acceptable size by suitable mechanical or thermal cutting or gouging methods..."*

ASME Section XI, IWA-4322 states *"If thermal removal processes are used on P-No. 8 and P-No. 43 materials, a minimum of 1/16-inch material shall be mechanically removed from the thermally processed areas."*

ASME Section XI, IWA-4330 allows the use of mechanical removal processes on defect removal areas in repair weld cavities.

As an alternative to IWA-4322 (separate from this relief request, and subject to NRC approval), when defects will be removed, ENO plans to use the electrical discharge machining (EDM) process to perform defect removal (Reference 8). The EDM process results in thin depth of the heat-affected zone. ENO will remove the heat-affected zone material by mechanical means.

In addition, when defects are not removed but are reduced to an acceptable size, ENO proposes, as an alternative to NB-2539.1 and IWA-4310 (ASME Section XI, 1989 Edition), to use the embedded flaw technique. In the proposed repairs, the defects will be embedded by the embedded flaw technique, to isolate them from the reactor coolant and preclude further propagation from primary water stress corrosion cracking (PWSCC.) The unflawed portion of the base metal and repair weld of the area maintain the structural integrity of the embedded flaw repair areas. The repaired area will be considered to be a permanent repair that will provide an acceptable level of quality and safety.

C.a.iii Preparation of Repair Cavity

Repair cavities for localized weld repairs of RPV head penetration nozzle base materials are prepared in accordance with IWA-4330. The ASME Section XI requirements in IWA-4330 supplement the repair cavity preparation requirements of ASME Section III. Although NB-2539.1 of ASME Section III states that the repair cavity is to be prepared for welding, it does not establish requirements to accomplish this. IWA-4330 (b) does. According to IWA-4330 (b), the repair cavity must be ground smooth and clean with beveled sides and edges rounded to provide suitable accessibility for welding. The applicable paragraphs of ASME Sections III and XI are provided below.

ASME Section III, NB-2539.1 states in part *"The defect shall be removed or reduced to an imperfection of acceptable size ... and the cavity prepared for welding."*

ASME Section XI, IWA-4330 (b) states *"Where repair welding is required, the cavity shall be ground smooth and clean with beveled sides and edges rounded to provide suitable accessibility for welding."*

ENO will machine the cavity using the EDM process. This process results in a smooth cavity with beveled sides to provide suitable accessibility for welding. The heat-affected zone will be removed by mechanical means.

C.a.iv Repair Cavity Examination

Prior to welding, the repair cavity is examined by the liquid penetrant method in accordance with IWA-4331 (a). [Although IWA-4331 (a) allows either a liquid penetration examination or a magnetic particle examination, a magnetic particle examination cannot be performed since the nozzle material to be examined is non-magnetic.] Although NB-2558 (b) of ASME Section III specifies that the repair cavity is to be examined by the examination method that originally disclosed the defect, IWA-4331 (a) of ASME Section XI amends this requirement by requiring a liquid penetrant examination regardless of product form. [Note that NB-2539, as invoked by NB-2559, does not address examination of the repair cavity. Repair cavity examinations are performed in accordance with NB-2558 (b)]. The applicable paragraphs of ASME Sections III and XI are provided below.

ASME Section III, NB-2558 (b) states *"After defect elimination, the area is examined by the method which originally disclosed the defect to assure that the defect has been removed or reduced to an imperfection of acceptable size."*

ASME Section XI, IWA-4331 (a) states

> *"After final grinding, the affected surfaces, including surfaces of cavities prepared for welding, shall be examined by the magnetic particle or liquid penetrant method to ensure that the indication is reduced to an acceptable limit in accordance with IWA-3000. This examination is not required when defect elimination removes the full thickness of the weld and the back side of the weld joint is not accessible for removal of examination materials."*

Entergy proposes, as an alternative to the repair cavity examination requirements of IWA-4331(a) in "Proposed Alternatives," Section C.b.i, below.

C.a.v Qualification of Welding Procedures and Welders

Welding procedures and welders or welding operators are qualified in accordance with NB-4000 of ASME Section III and ASME Section IX as required by NB-2539.2. ASME Section XI invokes the qualification requirements of ASME Section III without specifying any supplements or amendments. The applicable paragraphs of ASME Sections III and XI are provided below.

ASME Section III, NB-2539.2 states *"The welding procedures and welders or welding operators shall be qualified in accordance with NB-4000 and Section IX."*

ASME Section XI, IWA-4170(b) states

> *"Repairs and installation of replacement items shall be performed in accordance with the Owner's Design Specification and the original Construction Code of the component or system. Later editions and Addenda of the Construction Code or of Section III, either in their entirety or portions thereof, and Code Cases may be used."*

Entergy proposes that these requirements will be met in the proposed repair program.

C.a.vi Blending of Repaired Areas

The weld surface is blended uniformly into the surrounding surface after completing the repair as required by NB-2539.3. ASME Section XI invokes the repair requirements of ASME Section III without specifying any supplements or amendments. The applicable paragraphs of ASME Sections III and XI are provided below.

ASME Section III, NB-2539.3 states *"After repair, the surface shall be blended uniformly into the surrounding surface."*

ASME Section XI, IWA-4170(b) states

> *"Repairs and installation of replacement items shall be performed in accordance with the Owner's Design Specification and the original Construction Code of the component or system. Later editions and Addenda of the Construction Code or of Section III, either in their entirety or portions thereof, and Code Cases may be used."*

Entergy proposes that these requirements will be met in the proposed repair program.

C.a.vii Examination of Repair Welds

Repair welds in RPV head penetration nozzles are examined by the liquid penetrant method in accordance with NB-2539.4. When the repair cavity depth exceeds the lesser of 3/8-inch or 10% of the section thickness, a radiographic examination of the repair weld is also required by NB-2539.4. ASME Section XI invokes the ASME Section III examination requirements without specifying any supplements or amendments. The applicable paragraphs of ASME Sections III and XI are provided below.

ASME Section III, NB-2539.4 states

> *"Each repair weld shall be examined by the magnetic particle or liquid penetrant method. In addition, when the depth of the repair cavity exceeds the lesser of 3/8-inch or 10% of the section thickness, the repair weld shall be radiographed after repair in accordance with NB-5110 and to the acceptance standards of NB-5320."*

ASME Section XI, IWA-4170 (b) states

> *"Repairs and installation of replacement items shall be performed in accordance with the Owner's Design Specification and the original Construction Code of the component or system. Later editions and Addenda of the Construction Code or of Section III, either in their entirety or portions thereof, and Code Cases may be used."*

Entergy proposes alternatives to the examination requirements of NB-2539.4, in "Proposed Alternatives" Sections C.b.i and C.b.ii, below.

C.b Proposed Alternatives

C.b.i 10CFR50.55a(a)(3)(i) Alternatives

Pursuant to the provisions of 10CFR50.55a(a)(3)(i), ENO proposes alternatives to defect removal and examination requirements applicable to localized repair welds in RPV head penetration nozzle base materials specified in ASME Section XI IWA-4331 (a) and ASME Section III NB-2539.4. Specifically, ENO proposes the following alternatives:

As an alternative to defect removal in accordance with ASME Section III, 1989 Edition, NB-2539.1 and ASME Section XI, 1989 Edition, IWA-4310, ENO proposes to use the embedded flaw technique. In the proposed repairs, defects will not be completely removed. Instead, the defects will be repaired by the embedded flaw technique. This technique is a permanent repair not requiring follow-up inspections, and that will provide an acceptable level of quality and safety.

As an alternative to a magnetic particle or liquid penetrant examination of the repair cavity in accordance with IWA-4331 (a) of ASME Section XI, ENO proposes to perform the following:

Flaw Characterization

Prior to defect removal, RPV head penetration nozzles will be examined by the ultrasonic and eddy current examination methods to characterize all flaws.

Flaw Evaluation

All flaws in RPV head penetration nozzles will be evaluated for acceptance. Flaws that exceed the acceptance limits of the flaw evaluation will be reduced to an acceptable size prior to welding.

Examination of Repair Weld

Upon completion of welding, the repair weld will be examined by the ultrasonic and eddy current methods to verify that the as left dimensions of the flaw comply with the acceptance limits of the component. When the eddy current examination cannot be performed due to the surface profile of the repair weld or other prohibitive conditions, then a liquid penetrant examination will be performed as an alternative.

Ultrasonic examinations will be performed as described in Section D.a.i. Acceptance criteria shall be in accordance with NB-5330.

Eddy current examinations will be performed as described in Section D.a.i.

The liquid penetrant examination and acceptance criteria will be in accordance with NB-2546 of ASME Section III.

As an alternative to a magnetic particle or liquid penetrant examination of the completed repair weld in accordance with NB-2539.4 of ASME Section III, Entergy proposes to perform an eddy current examination. When an eddy current examination cannot be performed due to the surface profile of the repair weld or other

prohibitive conditions, then a liquid penetrant examination will be performed.

Eddy current examinations will be performed as described in Section D.b.

The liquid penetrant examination and acceptance criteria will be in accordance with NB-2546 of ASME Section III.

C.b.ii 10CFR50.55a(g)(5)(iii) Alternative

Pursuant to the provisions of 10CFR50.55a(g)(5)(iii), Entergy requests relief from ASME Section III NB-2539.4, which requires a radiographic examination of completed repair welds when the depth of the repair cavity exceeds the lesser of 3/8-inch or 10% of the section thickness. As an alternative to this examination, Entergy proposes to perform ultrasonic and eddy current examinations, as follows:

Ultrasonic examinations will be performed as described in Section D.c. Acceptance criteria shall be in accordance with NB-5330.

Eddy current examinations will be performed as described in Section D.c.
The alternatives proposed above, are specific to the localized weld repairs of RPV head penetration nozzle base materials at locations described below:

- Along the inside diameter of the nozzle, above the J-weld. See Figures 1 and 2.
- Along the inside diameter of the nozzle, adjacent to the J-weld. See Figures 1 and 3.
- Along the inside diameter of the nozzle, below the J-weld. See Figures 1 and 4.
- Along the outside diameter of the nozzle below the J-weld. See Figures 1 and 5.

D. BASIS FOR RELIEF

D.a IWA-4331 (a) – Surface Examination of Repair Cavity

IWA-4331 (a) of ASME Section XI requires a magnetic particle or liquid penetrant examination of all repair cavities prior to repair welding. Magnetic particle testing is a nondestructive examination method used to detect surface and near-surface discontinuities in magnetic materials. However, the IP2 and IP3 RPV head penetration nozzles are manufactured from SB-167 nickel alloy, which is not magnetic. Therefore, examination of repair weld cavities in RPV head penetration nozzles by the magnetic particle method is not possible.

Liquid penetrant testing is a nondestructive method that reveals open-surface discontinuities by bleed-out of a liquid penetrant medium against a contrasting background developer. When a surface examination of an RPV head penetration nozzle is required, liquid penetrant would be the appropriate examination method.

D.a.i Suitability of Proposed Alternative

RPV head penetration nozzles will be examined by the ultrasonic and eddy current examination methods as described below to characterize all flaws prior to defect excavation. Identified flaws will be evaluated for acceptance in accordance with IWB-3600. Flaws that exceed the acceptance limits of the IWB-3600 flaw evaluation will be removed or reduced to an acceptable size prior to welding. Upon completion of repair welding, the repair weld region will be re-examined using the ultrasonic and eddy current examination methods to verify that the as-left flaw dimensions are still within the acceptance limits of the IWB-3600 flaw evaluation. In the unlikely event that an eddy current examination cannot be performed due to the surface profile of a repair weld or some other prohibitive condition, then a liquid penetrant examination will be performed as an alternative. In conclusion, a surface examination is performed on a repair cavity to ensure that cracks and other unacceptable defects have been removed prior to welding. However, when a flaw is left in the component by design in accordance with IWA-4310, then a surface examination of the repair cavity is no longer beneficial. Conversely, the proposed alternative ensures that the structural integrity of the RPV head penetration nozzle is maintained.

The ultrasonic examination will be performed using a combination of Time of Flight Diffraction (TOFD) and standard 0° pulse-echo techniques. The TOFD approach utilizes two pairs of transducers pointed at each other. One of the transducers sends sound into the inspection volume, and the other transducer receives the reflected and diffracted signals, as they interact with the material. There will be one TOFD pair looking in the axial direction of the penetration tube, and one TOFD pair will be looking in the circumferential direction of the penetration tube. The TOFD technique is primarily responsible for detecting and characterizing planar-type defects within the full volume of the penetration tube. This TOFD ultrasonic technique will be used for pre-inspection flaw characterization and post-repair inspection.

The standard 0° pulse-echo ultrasonic approach utilizes a straight beam transducer. The 0° technique is primarily responsible for plotting the penetration tube outside diameter location and the J-grove attachment weld location, which will aid in defect orientation and sizing information. Additionally, the 0° technique will be capable of locating and sizing any laminar-type defects that may be encountered such as lack of fusion. This ultrasonic technique will be used for pre-inspection flaw characterization and post-repair inspection.

The eddy current examination complements the ultrasonic examination by providing sensitivity to surface and subsurface flaws along the inspection surface. The eddy current approach utilizes a 5-mm diameter, "cross wound" probe design, which is capable of operating frequencies between 75 and 500 kHz. This technique is primarily responsible for detection and length sizing of defects, that are open to the inside diameter surface of the penetration tube. Since this particular probe design produces eddy currents that penetrate approximately 0.030-inch into the inside diameter surface, it will also aid in the evaluation of very shallow surface defects. For post-repair inspection purposes, this eddy current examination technique will provide the necessary surface examination of the weld repair area. This eddy current technique will be used in the flaw characterization and post-repair inspections.

The above ultrasonic and eddy current examination techniques have been demonstrated capable of detecting axial and circumferential PWSCC indications in the nozzle material,

utilizing cracked nozzle samples. Entergy submitted a detailed summary of these demonstrations to the NRC staff in Reference 14.

D.b NB-2539.4 – Surface Examination of Repair Welds

NB-2539.4 of ASME Section III requires a magnetic particle or liquid penetrant examination of all repair welds. However, the IP2 and IP3 RPV head penetration nozzles are manufactured from SB-167 nickel alloy, which is not magnetic. Repair welds will be performed using Inconel filler metals that are also non-magnetic. Therefore, as discussed previously under "Surface Examination of Repair cavity," examination of repair welds in RPV head penetration nozzles by the magnetic particle method is not possible.

D.b.i Suitability of Proposed Alternative

Eddy current examinations have been proposed as an alternative to magnetic particle testing. The eddy current examination provides sensitivity to surface and subsurface flaws along the inspection surface. More details on the eddy current examination method are provided in Section D.a, above.

A liquid penetrant examination of repair welds in RPV head penetration nozzle base materials is an acceptable examination according to NB-2539.4. As discussed previously under "Surface Examination of Repair Cavity," liquid penetrant examination will only be performed when the eddy current examination cannot be performed due to the surface profile of a repair weld or some other prohibitive condition.

D.c NB-2539.4 – Radiographic Examination of Repair Welds

NB-2539.4 requires a radiographic examination of base material repair welds when the depth of the repair cavity exceeds the lesser of 3/8-inch or 10% of the section thickness. However, a radiographic examination of the repair weld is not appropriate.

D.c.i Impracticality of Radiographic 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 unsharpness 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 impossible. Multiple exposures, complex geometry and thickness, and the adverse radiological environment make radiographic examination of RPV head penetration nozzle repair welds impractical.

D.c.ii Suitability of Proposed Alternative

Meaningful radiographic examination of repair welds in RPV head penetration nozzle base materials cannot be performed. As an alternative, ENO proposes to utilize the ultrasonic and eddy current examination methods.

E. CONCLUSION

E.a 10CFR50.55a(a)(3)

10CFR50.55a(a)(3) states

> *"Proposed alternatives to the requirements of (c), (d), (e), (f), (g), and (h) of this section or portions thereof may be used when authorized by the Director of the Office of Nuclear Reactor Regulation. The applicant shall demonstrate that:*
>
> *The proposed alternatives would provide an acceptable level of quality and safety, or compliance with the specified requirements of this section would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety."*

Entergy believes that the proposed alternatives identified Sections C.b.i and C.b.ii, and discussed in Sections D.a and D.b, above, provide an acceptable level of quality and safety to the repair rules as stated in Reference 1 and as described in Section B of this request. Therefore, we request that the proposed alternative be authorized pursuant to 10CFR50.55a(a)(3)(i).

E.b 10CFR50.55a(g)(5)(iii)

10CFR50.55a(g)(5)(iii) states

> *"If the licensee has determined that conformance with certain code requirements is impractical for its facility, the licensee shall notify the Commission and submit, as specified in 50.4, information to support the determinations."*

10CFR50.55a(g)(6)(i) states

> *"The Commission will evaluate determinations under paragraph (g)(5) of this section that code requirements are impractical. The Commission may grant such relief and may impose such alternative requirements as it determines 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."*

Entergy believes the radiographic examination required by ASME Section III NB-2539.4 for base material weld repairs is impractical since it cannot be performed. Entergy has proposed an alternative examination (identified in Section C.b.ii and discussed in Section D.c) that provides an acceptable level of quality and safety. Therefore, Entergy requests relief from performing a radiographic examination and authorization to perform the proposed alternative examination pursuant to 10CFR50.55a(g)(6)(i).

F. PERIOD FOR WHICH RELIEF IS REQUESTED

Relief is requested for the remainder of the third inspection interval, through July 20, 2009.

G. ATTACHMENTS TO RELIEF

G.a List of Figures

Figure 1 –Typical RPV Head Penetration Nozzle

Figure 2 – RPV Nozzle Repair Weld: Inside Diameter and Above J-Weld

Figure 3 – RPV Nozzle Repair Weld: Inside Diameter and Adjacent to J-Weld

Figure 4 – RPV Nozzle Repair Weld: Inside Diameter and Below J-Weld

Figure 5 – RPV Nozzle Repair Weld; Outside Diameter and Below J-Weld

H. REFERENCES

1. ASME Section XI, 1989 Edition.

2. ASME Section XI, 1992 Edition.

3. ASME Section III, 1965 Edition, Summer 1966 Addenda.

4. ASME Section III, Subsection NB, 1989 Edition.

5. ASME Section III, Subsection NB, 1992 Edition.

6. Consolidated Edison Letter, dated September 4, 2001 (NL-01-106) regarding thirty-day response to NRC Bulletin 2001-01.

7. ENO Letter, M. Kansler to USNRC, dated September 24, 2001 (NL-01-113) regarding supplemental thirty-day response to NRC Bulletin 2001-01.

8. ENO Letter, M. Kansler to USNRC dated July 1, 2002 (NL-02-094/IPN-02-053), ASME Code Relief Requests to Use EDM for Contingency Repairs on RPV Head Penetration Nozzles.

9. ENO Letter, M. Kansler to USNRC (IPN-01-079/NL-01-133), dated November 13, 2001, Revised Vessel Head Penetration Inspection Plans, NRC Bulletin 2001-01, "Circumferential Cracking of reactor Pressure Vessel Head Penetration Nozzles."

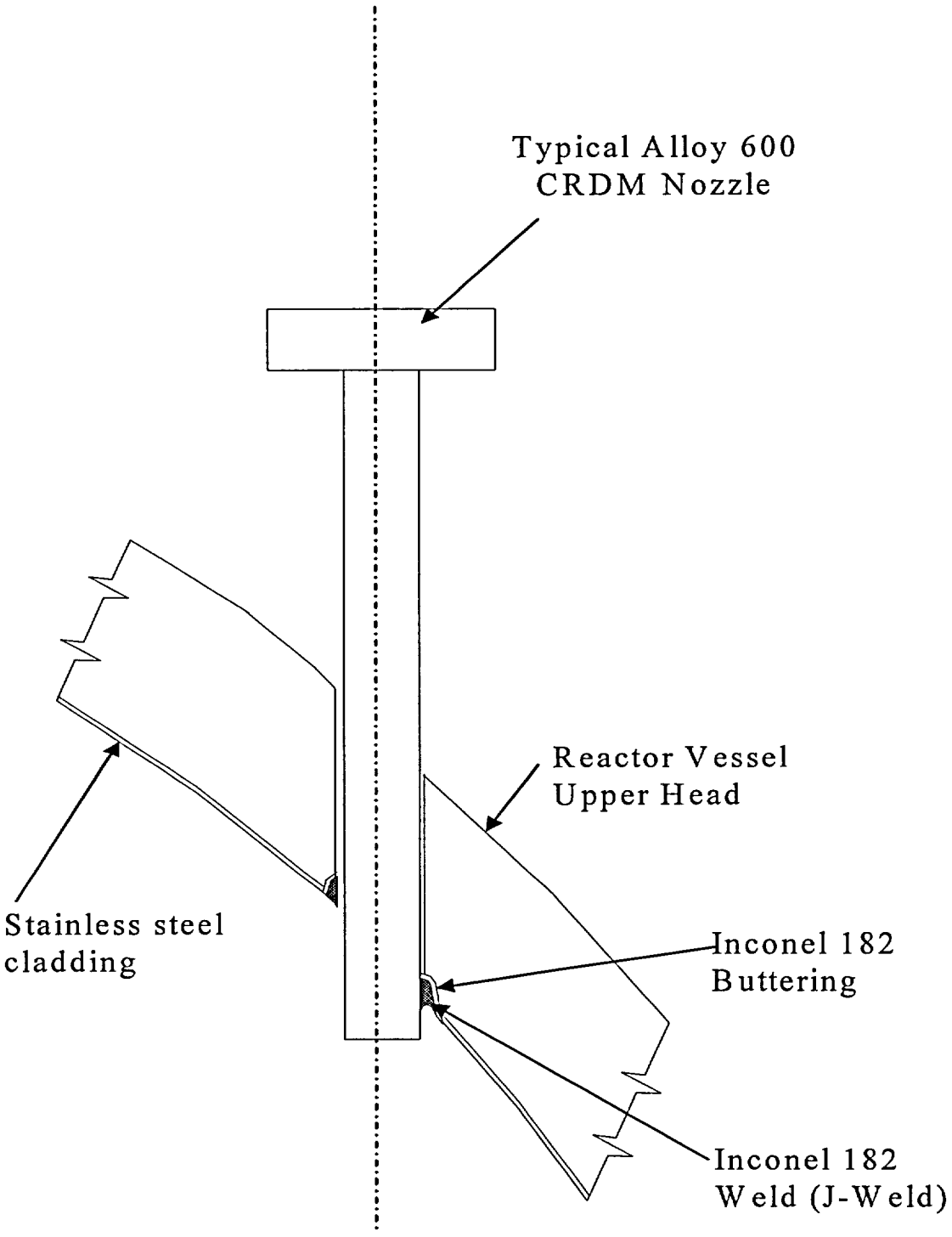
10. USNRC Letter, P.D. Milano to M. Kansler, Bulletin 2001-01, dated April 8, 2002, "Circumferential Cracking of reactor Pressure Vessel Head Penetration Nozzles," Responses for Indian Point Units 2 and 3.

11. ENO Letter, J. Herron to USNRC (NL-02-050/IPN-02-023), dated April 2, 2002, "Submittal of 15 Day Response to NRC Bulletin 2002-01," for Indian Point Units 2 and 3.

12. ENO Letter, F. Dacimo to USNRC, dated July 23, 2002 (NL-02-101), "NRC Bulletin 2001-01-Reactor Pressure Vessel Head penetration Nozzle Inspection Plan for 2002 Refueling Outage (2R15)," for Indian Point Unit 2.

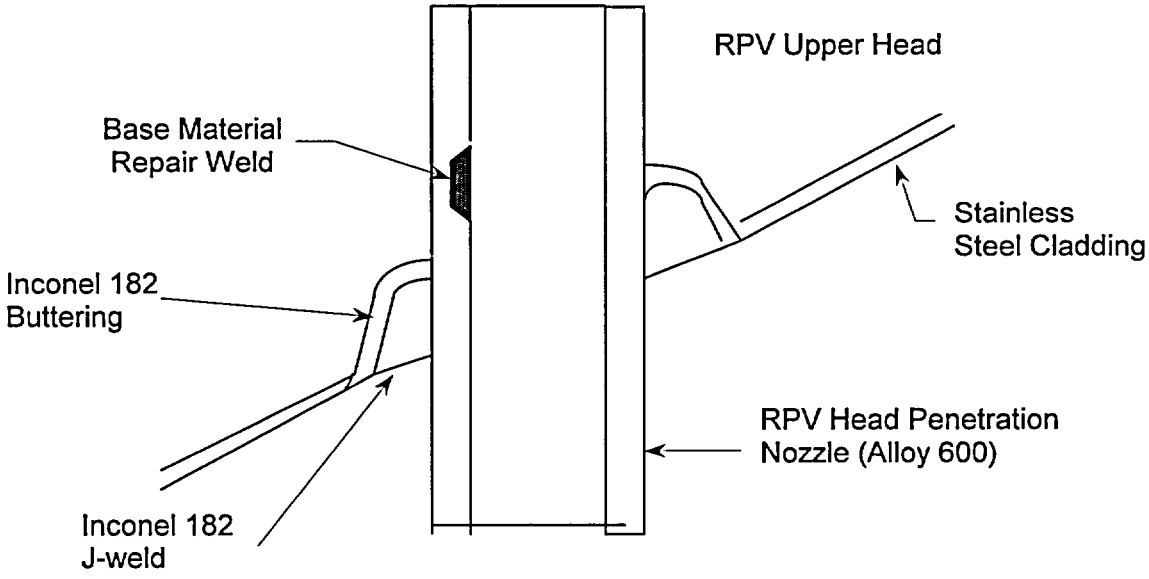
13. ENO Letter, M. R. Kansler to USNRC, dated July 29, 2002 (NL-02-104/IPN-02-061), "ASME Code relief Requests to Use an Alternative to Temper Bead Welding Requirements for Contingency Repairs on Reactor Vessel Head Penetration Nozzles," for Indian Point Units 2 and 3.

14. Letter 0CAN060202 from Entergy Operations, Inc. to the NRC, "Submittal of Demonstration Report for Volumetric Examination of Vessel Head Penetration Nozzles," dated June 17, 2002.



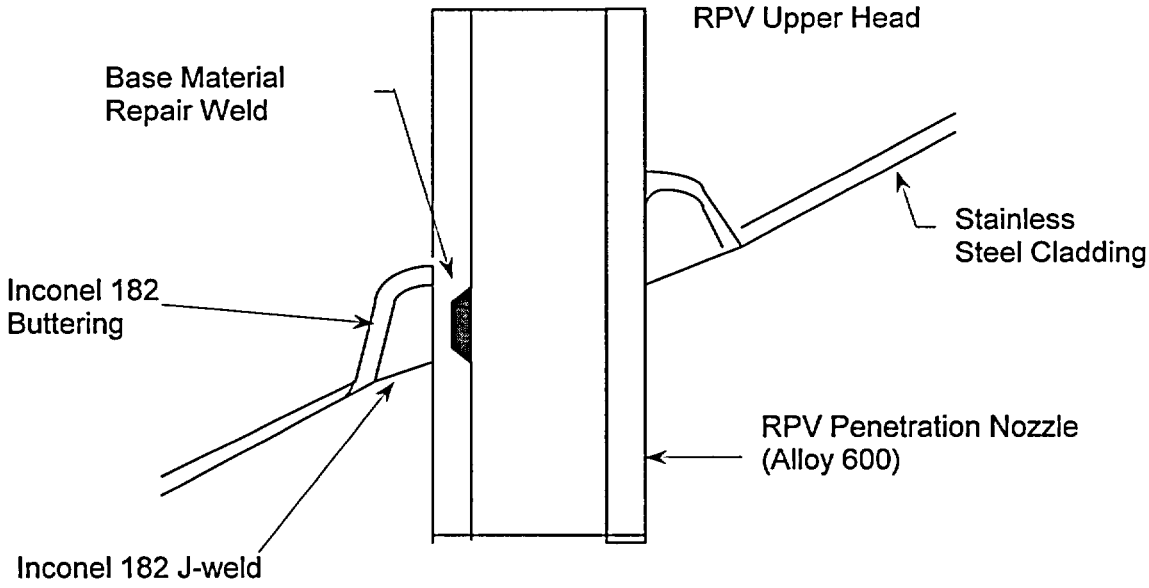
TYPICAL RPV HEAD PENETRATION NOZZLE

FIGURE 1



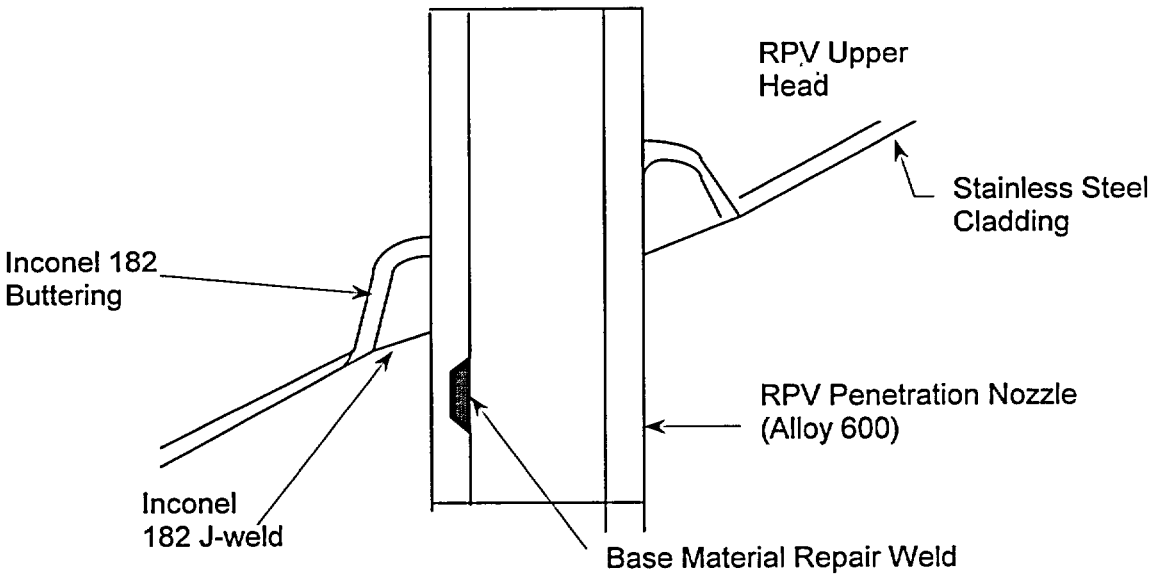
RPV Nozzle Repair Weld: Inside Diameter and Above J-Weld

FIGURE 2



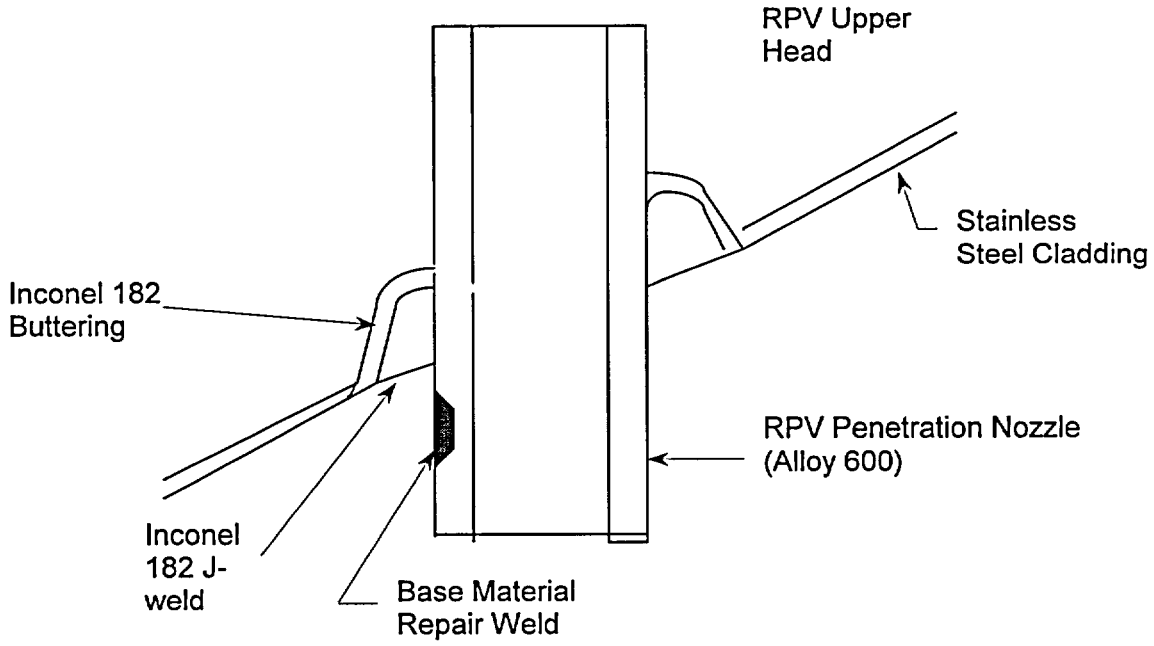
RPV Nozzle Repair Weld: Inside Diameter and Adjacent to J-Weld

FIGURE 3



RPV Nozzle Repair Weld: Inside Diameter and Below J-Weld

FIGURE 4



RPV Nozzle Repair Weld: Outside Diameter and Below J-Weld

FIGURE 5