INDIANA
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July 2, 2009

AEP-NRC-2009-42
10 CFR 50.55a

Docket No.: 50-315

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

Subject: Donald C. Cook Nuclear Plant Unit 1
Response to Request for Additional Information Regarding Relief Request (ISIR-28) for Use of Weld Inlays as an Alternate Repair Technique for Alloy 82/182 Dissimilar Metal Welds in Reactor Vessel Safe End-to-Primary Nozzles (TAC NO. MD9997)

References:

1. Letter from Joseph N. Jensen, Indiana Michigan Power Company (I&M), to Nuclear Regulatory Commission (NRC) Document Control Desk, "Use of Weld Inlays as an Alternate Repair Technique for Reactor Vessel Safe End-to-Primary Nozzle Alloy 82/182 welds," AEP-NRC-2008-25, dated October 7, 2008 (ML083010238).
2. Letter from Terry A. Beltz, NRC, to Joseph N. Jensen, I&M, "Donald C. Cook Nuclear Plant, Unit 1 – Request for Additional Information Regarding Relief Request (ISIR-28) for Use of Weld Inlays as an Alternate Repair Technique for Alloy 82/182 Dissimilar Metal Welds in Reactor Vessel Safe End-to-Primary Nozzles (TAC NO. MD9997)," dated April 15, 2009 (ML090710602).

Dear Sir or Madam:

By Reference 1, Indiana Michigan Power Company (I&M), the licensee for Donald C. Cook Nuclear Plant Unit 1, submitted a relief request (ISIR-28) for use of weld inlays as an alternative repair technique for Reactor Vessel Safe End-to-Primary Nozzle Alloy 82/182 welds. Reference 2 transmitted the Nuclear Regulatory Commission's request for additional information (RAI) regarding the Request for Relief. This letter provides I&M's response to the RAI.

Enclosure 1 to this letter provides a revised relief request (ISIR-28) for use of weld inlays as an alternate repair technique for Reactor Vessel Safe End-to-Primary Nozzle Alloy 82/182 welds. The request has been revised in response to questions presented in the RAI. Differences between the revision and Reference 1 proposed alternate repair technique are indicated by margin marks in Enclosure 1 of this letter.

Enclosure 2 provides I&M's response to the RAI. Westinghouse Electric Company LLC (Westinghouse) and AREVA NP Inc. (AREVA) have designated certain information in Enclosure 2 as proprietary pursuant to 10 CFR 2.390. Therefore, it is requested that Enclosure 2 be withheld from public disclosure. Enclosure 3 contains a non-proprietary version of Enclosure 2. Enclosure 4 provides an affidavit from Westinghouse and an affidavit from AREVA setting forth the basis on

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which information contained in Enclosure 2 may be withheld from public disclosure. Enclosure 5 contains commitments made in response to the RAI.

Should you have any questions, please contact James M. Petro, Jr., Manager of Regulatory Affairs, at (269) 466-2489.

Sincerely,

R. A. Hruby, Jr.

Raymond A. Hruby, Jr.
Vice President - Site Support Services

RSP/rdw

Enclosures:

1. Revised Relief Request (ISIR-28) for Use of Weld Inlays as an Alternate Repair Technique for Alloy 82/182 Dissimilar Metal Welds in Reactor Vessel Safe End-to-Primary Nozzles (previously submitted as AEP-NRC-2008-25, Attachment: ISIR-28; Enclosure: Weld Inlay and Potential Repair Weld Inlays for Reactor Vessel Safe End-to-Primary Nozzle Alloy 82/182 Dissimilar Metal Welds Mitigative/Repair Inlay).

2. Response to Request for Additional Information Regarding Relief Request (ISIR-28) for Use of Weld Inlays as an Alternate Repair Technique for Alloy 82/182 Dissimilar Metal Welds in Reactor Vessel Safe End-to-Primary Nozzles (Proprietary).

3. Response to Request for Additional Information Regarding Relief Request (ISIR-28) for Use of Weld Inlays as an Alternate Repair Technique for Alloy 82/182 Dissimilar Metal Welds in Reactor Vessel Safe End-to-Primary Nozzles (Non-Proprietary).

4. Westinghouse Affidavit for Withholding Weld Information from Public Disclosure and AREVA Affidavit for Withholding Existing Configuration Drawings from Public Disclosure.

5. Regulatory Commitments.

c: T. A. Beltz – NRC Washington DC
K. D. Curry - AEP Ft. Wayne
J. T. King – MPSC
MDEQ – WHMD/RPS
NRC Resident Inspector
M. A. Satorius – NRC Region III

Enclosure 1 to AEP-NRC-2009-42

Revised Relief Request (ISIR-28) for Use of Weld Inlays as an Alternate Repair Technique for Alloy 82/182 Dissimilar Metal Welds in Reactor Vessel Safe End-to-Primary Nozzles (previously submitted as AEP-NRC-2008-25, Attachment: ISIR-28; Enclosure: Weld Inlay and Potential Repair Weld Inlays for Reactor Vessel Safe End-to-Primary Nozzle Alloy 82/182 Dissimilar Metal Welds Mitigative/Repair Inlay)

10 CFR 50.55a REQUEST
Proposed Alternative in Accordance with 10 CFR 50.55a(a)(3)(i)

ISIR-28
USE OF WELD INLAYS AS AN ALTERNATIVE REPAIR TECHNIQUE

1.0 ASME Code Components Affected

Code components associated with this request are Class 1 NiCrFe dissimilar metal welds (DMWs) with Alloy 82/182 weld metal in the reactor vessel (RV) safe end-to-primary nozzle butt welds, exposed to reactor coolant (RC) that are susceptible to Primary Water Stress Corrosion Cracking (PWSCC). There are a total of eight (8) DMWs, four (4) hot leg (HL) nozzles and four (4) cold leg (CL) nozzles, that are scheduled to have inlay welds applied to the inside surface of the DMWs. The weld inlays, using nickel alloy ERNiCrFe-7A (Alloy 52M) filler metal, will extend from the stainless steel safe end, across the DMW, to the stainless steel cladding on the inside surface of the HL and CL nozzles, protecting the DMWs from the RC. The safe end-to-nozzle welds are scheduled for mitigation/repair during refueling outage U1C23 that is currently scheduled to commence in October 2009.

1.1 Category and System Details

Code Class:	Class 1
Reference:	ASME Code, Section XI, 1989, no Addenda ASME Code Case N-416-1 ASME Section III, 1965 Edition, including Addenda through Winter 1966 (Original Construction Code) ASME Section III, 1989 Edition (Modification Design Code) ASME Code Case N-638-1 ASME Code Case N-695 (Preservice/Inservice Inspection Qualification Requirements) ASME Section III, 1998 Edition, including Addenda through 2000 (Construction Code Nondestructive Examination)

Examination Categories:	B-F
Item Number:	B5.10
System Welds:	Reactor Coolant System

1.2 Component Descriptions

The application of this alternative is to apply inlay welds on eight (8) safe end-to-primary nozzle DMWs. The inlays will extend outward from the stainless steel cladding on the ferritic low alloy steel RV nozzles, across the adjacent DMWs, to the stainless steel safe ends. The applicable weld identification numbers are listed in Table 1. The general configuration for the nozzle locations is shown in Figures 1 and 2.

TABLE 1
WELD NUMBERS BY ISI DESIGNATION

Item	Location	Weld Number by ISI Designation DMW ID
1	Nozzle-to-Safe End "Hot Leg"	1-RPV-1-01
2	Nozzle-to-Safe End "Cold Leg"	1-RPV-1-02
3	Nozzle-to-Safe End "Hot Leg"	1-RPV-2-01
4	Nozzle-to-Safe End "Cold Leg"	1-RPV-2-02
5	Nozzle-to-Safe End "Hot Leg"	1-RPV-3-01
6	Nozzle-to-Safe End "Cold Leg"	1-RPV-3-02
7	Nozzle-to-Safe End "Hot Leg"	1-RPV-4-01
8	Nozzle-to-Safe End "Cold Leg"	1-RPV-4-02

1.3 Component Materials

The applicable materials are depicted in Table 2.

TABLE 2

HOT LEG AND COLD LEG NOZZLE MATERIALS

Nozzle (P-No. 3, Gr 3)	Nozzle Cladding (A-No. 8)	Safe End-to-Nozzle DMW (F-No. 43)	Nozzle DMW Buttering (F-No. 43)	Safe End (P-No. 8, Gr. 1)	Safe End Cladding (A-No. 8 and F-No. 43)
SA-508, Cl 2	Type 308, 309, and 312	Alloy 82/182	Alloy 182	SA-182, Gr F316	Type 312L (OD & ID) Alloy 82 (OD & ID)

2.0 Applicable Code Edition and Addenda

Donald C. Cook Nuclear Plant (CNP) Unit 1 is currently in the Third Inservice Inspection (ISI) interval, scheduled to end on February 28, 2010. The American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code) of record for the current ISI interval is Section XI, 1989 Edition, no Addenda (Reference 8.2) for the Repair/Replacement Program.

3.0 Applicable Code Requirement

The applicable ASME Code requirements for which relief is requested are:

1. ASME Section XI Case N-638-1 (Reference 8.1) with condition as specified in Regulatory Guide 1.147 Revision 15 Code Case N-638-1 (Reference 8.1) provides requirements for ambient temperature machine gas tungsten-arc dissimilar metal welding using the temperbead technique that is applicable for welding on ferritic low alloy steel.

4.0 Reason for Request

Indiana Michigan Power Company (I&M), CNP Unit 1, is proposing to take a proactive approach and apply weld inlays (see Figure 1) and potential repair weld inlays (see Figure 2) on the RV safe end-to-primary nozzle DMWs to prevent the potential occurrence of PWSCC, or remove associated flaws and mitigate the potential for recurrence of PWSCC. During U1C23, eight (8) DMWs, four (4) on the HL and four (4) on the CL, located at the RV primary nozzles are scheduled for weld inlays.

The enclosure to this relief request provides a General Process Description that includes the Alternative Requirements for welding using the remote machine gas tungsten-arc welding (GTAW) process and using the ambient temperature temperbead method.

DMWs, primarily consisting of Alloy 82/182 weld metal, are frequently used in pressurized water reactor (PWR) construction to connect stainless steel safe ends-to-vessel nozzles that are typically constructed of low alloy ferritic steel. These welds have shown a tendency for PWSCC degradation due to exposure to the RC environment. [See Material Reliability Program: Primary System Piping Butt Weld Inspection and Evaluation Guideline (MRP-139), EPRI, Palo Alto, CA: 2005 (Reference 8.3), for DMW repair classification/examination category based on PWSCC susceptibility and mitigation actions.]

Based on application of weld inlays and potential repair weld inlays, I&M requests code relief from the following ASME Section XI Code Case N-638-1 items:

1. Code Case N-638-1, Paragraph 1.0(a); The maximum area of an individual weld based on the finished surface shall be 100 square inches (sq. in.), and the depth of the weld shall not be greater than one-half of the ferritic base metal thickness.

2. Code Case N-638-1, Paragraph 1.0(c); If a defect penetrates into the ferritic base material, repair of the base material, using a non-ferritic weld filler material, may be performed in accordance with the Code Case, provided the depth of repair in the base material does not exceed 3/8 inch (in.).

3. Code Case N-638-1, Paragraph 3.0(d) and 4.0(c); The maximum interpass temperature for field applications shall be 350 degrees Fahrenheit (°F) regardless of the interpass temperature during qualification, and areas from which weld-attached thermocouples have been removed shall be ground and examined using a surface examination method.

4. Code Case N-638-1, Paragraph 4.0(b); The final weld surface and the band around the area defined in paragraph 1.0(d) shall be examined using a surface and ultrasonic methods when the completed weld has been at ambient temperature for at least 48 hours. The ultrasonic examination shall be in accordance with Appendix 1.

5.0 Proposed Alternative and Basis for Relief

1. The maximum area of an individual weld based on the finished surface shall be 300 sq. in., and the depth of the weld shall not be greater than 2.0 in.

   ASME Section XI Code Case N-638-4 specifies a maximum finished surface area of 500 sq. in. The maximum depth of flaw removal is 2.0 in. This exceeds the one-half depth requirement by approximately 0.58 in. The weld residual stress analysis shows no adverse effects of this repair welding (Reference 8.4).

2. The depth into the base material is based on flaw removal up to 2 in.

   It was assumed that flaw removal up to 2-in depth, near the buttering-to-nozzle fusion zone, results in a maximum depth of nozzle low alloy ferritic steel material being replaced by the Alloy 82/52M weld as shown in Figure 2. Analysis shows that the nozzle low alloy ferritic steel that is replaced by the Alloy 82/52M weld material does not adversely affect the structural integrity of the DMW region (Reference 8.4). Alloy 82 weld metal will be used to fill deep repairs, and an inlay of Alloy 52M will be added over the Alloy 82 to provide corrosion resistance. Alloy 52M may be used to fill shallow repairs.

3. Use of heat flow analysis or measurement of the maximum interpass temperature on a test coupon that is equal to or less than the thickness of the item to be welded using the maximum permitted heat input specified on the applicable welding procedure specification.

   ASME Section XI Code Case N-638-4 specifies these alternatives in lieu of direct interpass temperature measurement, as a clarification, when thermocouples are not used.

4. Acceptance nondestructive examination (NDE) (ultrasonic testing and liquid pentrant testing and/or eddy current) will be performed 48 hours after the third temperbead layer is deposited over the ferritic steel nozzle. No NDE of the ferritic steel nozzle preheated band after welding.

   Acceptance NDE 48 hours after the third temperbead layer is deposited over the ferritic steel nozzle is sufficient to verify the integrity of the weld and adjacent heat-affected-zone (Reference 8.5).

The purpose of the weld inlay is to provide PWSCC and corrosion resistant weld material over the inner surface of the DMW so that the PWSCC susceptible Alloy 82/182 material is not exposed to the reactor coolant system water environment. The application of the proposed alternatives are equal to or surpass the requirements of ASME Section XI Code Case N-638-1 items for which relief is requested. Therefore, the use of the proposed alternative will continue to provide an acceptable level of quality and safety consistent with provisions of 10 CFR 50.55a(a)(3)(i).

6.0 Precedents

1) Weld inlay or corrosion resistant clad on Arkansas Nuclear One Unit 1 RV safe end-to-core flood nozzle DMWs (ML070040338).
2) For temperbead welding, 500 sq. in. of weld surface has been approved by the Nuclear Regulatory Commission in a letter to Arkansas Nuclear One, Unit 1 (ML0811301738).

7.0 Duration of Proposed Alternative

The duration of the proposed alternative is for the fourth interval for the installation and examination activities.

8.0 References

8.1 Code Case N-638-1, "Similar and Dissimilar Metal Welding Using Ambient Temperature Machine GTAW Temper Bead Technique," dated February 13, 2003.

8.2 ASME Boiler & Pressure Vessel Code, Section XI, 1989 Edition, No Addenda.

8.3 Materials Reliability Program: Primary System Piping Butt Weld Inspection and Evaluation Guidelines (MRP-139), EPRI, Palo Alto, CA: 2005.

8.4 Areva Engineering Information Record, Document Identifier 51-9082202-000, Weld Inlay Analytical Justification.

8.5 Temperbead Welding Applications: 48-Hour Hold Requirements for Ambient Temperature Temperbead Welding, EPRI, Palo Alto, CA: 2006.

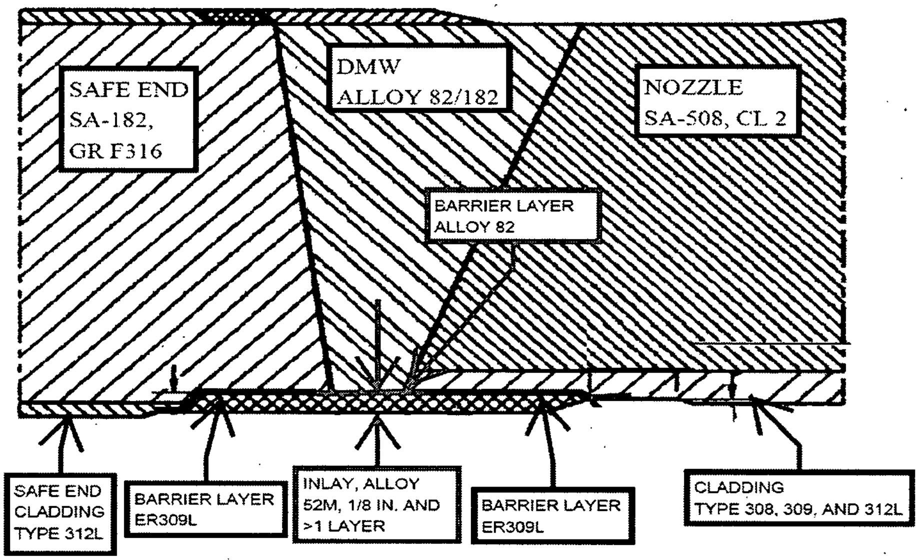


Figure 1 – Typical Weld Inlay Configuration

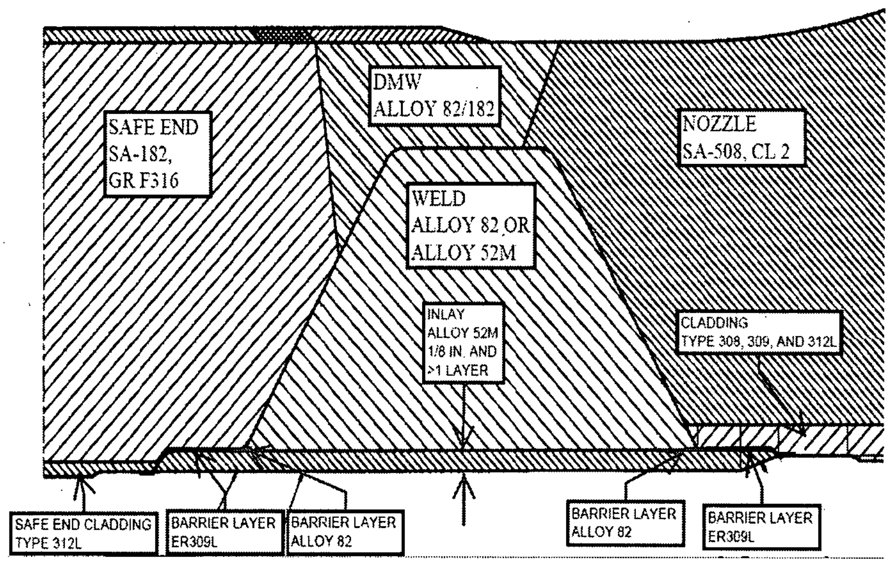


Figure 2 – Typical Weld Inlay Repair Configuration

(1/8 in. and more than one layer minimum thick Alloy 52M cover on inner surface over all Alloy 82)

Enclosure to ISIR-28
WELD INLAY AND POTENTIAL REPAIR WELD INLAYS FOR REACTOR VESSEL SAFE END-TO PRIMARY NOZZLE ALLOY 82/182 DISSIMILAR METAL WELDS MITIGATIVE/REPAIR INLAY

General Process Description

The following describes the overall process.

Ultrasonic Testing (UT) will be performed on the dissimilar metal welds (DMW) prior to commencing with modification activities. The UT is performed to satisfy the Section XI, IWB-2000 requirement for inservice examination and to provide information to determine the extent of additional machining required in the event that flaws are detected.

Based on the UT results, and after determination of the DMW boundaries exposed to the reactor coolant (RC), a cavity will be machined around the full inside circumference of the DMW and a liquid penetrant testing (PT) performed. The final cavity configuration will be dependent on the flaws detected in the DMW and the minimum cavity width will be sufficient to provide for the weld inlay to completely cover the exposed DMW inner surface with more than one layer and at least 1/8 inch (in.) final thickness using nickel alloy ERNiCrFe-7A (Alloy 52M).

Welding of the cavity will be performed with Alloy 52M. The final weld inlay inner surface contour will be essentially equivalent with the original DMW surface contour and blended with the adjacent surrounding surfaces (see Figure 1). For DMWs where flaws with significant through-wall depths are removed, ERNiCr-3 (Alloy 82) may be used to partially fill the cavity; however, Alloy 52M will be used on at least the inner 1/8 in. and more than one layer of the final inlay thickness (see Figure 2).

Acceptance PT will be performed on the weld inlay and acceptance UT and preservice UT on the final modified DMW, including the weld inlay, will be performed.

Design

The mitigative/repair weld inlay will satisfy the requirements specified in the Alternative Requirements (Appendix 1), using Primary Water Stress Corrosion Cracking (PWSCC) resistant Alloy 52M filler metal. The weld is deposited into a cavity that is machined across the entire inner surface of the DMW that is exposed to the RC (see Figure 1). For cases using repair weld inlays at depths greater than 1/8 in., Alloy 82 may be used to partially fill the cavity; however, Alloy 52M will be used on at least the inner 1/8 in. and more than one layer of the final inlay thickness (see Figure 2).

Stress Analyses

Primary and secondary stress and fatigue analyses for both the inlet and outlet nozzles are performed in accordance with NB-3200, Section III (Reference 1) for the modified DMW to show compliance therewith. The stress analyses consider the following final modified configurations:

1) 0.13 in. deep cavity requiring more than one layer and at least 1/8 in. thick weld inlay of Alloy 52M for the full inner circumference (see Figure 1).
2) 2 in. deep local repair weld inlay (see Figure 2) using Alloy 82 or Alloy 52M with at least 1/8 in. and more than one layer of the final inlay thickness of Alloy 52M weld inlay applied thereon.

Flaw Growth Analyses

Flaw growth analyses for postulated flaws are performed in accordance with IWB-3640. Minimal flaw growth occurs for the assumed design life of the modified DMWs and flaw growth in the weld inlay is significantly less than its 1/8 in. minimum thickness, such that the Alloy 82/182 material would not be exposed to the RC during its design life.

Residual stresses for the modified DMW are calculated based on the original DMW configuration. This analysis also assumes a full circumferential 50% through-wall weld repair from the inside surface of the DMW has previously occurred. Also, the residual stress analysis takes into account the effects of the safe end-to-pipe weld. For the mitigative inlay configuration, a 3/16 in. deep cavity is machined in the DMW and the surrounding material (see Figure 1). A single layer of Alloy 82 is deposited therein, then the cavity is filled with Alloy 52M material. For the 2 in. repair configuration, a 2 in. deep cavity (see Figure 2) is machined and filled back with Alloy 82 material with at least 1/8 in. thick and more than one layer Alloy 52M material at the inside surface.

Planar flaws are postulated to exist in the newly applied weld inlay and in the original DMW. Both circumferential and axial flaws are evaluated in conjunction with the maximum size flaw permitted by the inservice examination acceptance standards of Table IWB-3514-2:

For the 1/8 in. Weld Inlay Design Case:

Postulated flaws in weld inlay:

1) Circumferential surface flaw of 1/16 in. depth through the inlay weld thickness, inside diameter (ID) surface connected for the entire circumference of the inlay.
2) Axial surface flaw of 1/16 in. depth through the inlay weld thickness, ID surface connected for the entire width (axial length) of the inlay.

Postulated flaws in the original DMW:

1) Full circumferential subsurface flaw of 3/8 in. depth in the remaining DMW, originating at the weld inlay/DMW interface for the entire circumference of the inlay.
2) Axial subsurface flaw of 3/8 in. depth in the remaining DMW, originating at the weld inlay/DMW interface for the entire width (axial length) of the inlay.

For the Repair Weld Design Case:

Postulated flaws in weld inlay:
1) Circumferential surface flaw of 1/16 in. depth through the inlay weld thickness, ID surface connected for the entire circumference of the inlay.
2) Axial surface flaw of 1/16 in. depth through the inlay weld thickness, ID surface connected for the entire width (axial length) of the inlay.

Postulated flaws in the original DMW:
1) Full circumferential surface flaw postulated to exist from the outside surface of the DMW to the 2-in. boundary depth of the newly deposited weld material.
2) Axial surface flaw postulated to exist from the outside surface of the DMW to the 2-in. boundary depth of the newly deposited weld material for the entire width (axial length) of the inlay.

Leak-Before-Break (LBB) Evaluation

Since the original geometry and loads are not significantly modified by the weld inlay (see Figure 1), or repair weld inlay (see Figure 2), when applicable, and the replacement weld inlay material (Alloy 52M) has equal or superior fracture toughness than the existing materials, LBB remains applicable at these locations. Furthermore, gas tungsten-arc welding (GTAW) is used for the weld inlay and repair weld inlay. GTAW exhibits higher fracture toughness properties with either Alloy 82 or Alloy 52M than the shielded metal arc welding process which was the process used for the original DMWs at these locations.

Evaluation of Weld Shrinkage Effects

The axial weld shrinkage caused by the weld inlay (see Figure 1) and repair weld inlay (see Figure 2) has a negligible effect on the attached piping. The radial weld shrinkage has a negligible effect on the nozzle configuration.

Welding

The welding will be performed in accordance with the Alternative Requirements using the remote machine GTAW process and using the ambient temperature temperbead method (Appendix 1 and 2).

During recent DMW overlay activities, where Alloy 52M was used for the filler metal, there were some cases where flaws occurred in a portion of the first layer of the overlay deposited on the austenitic stainless steel items (safe ends, pipe, etc.). The flaw characteristics observed are indicative of hot cracking. This phenomenon has not been observed on the ferritic steel or ENiCrFe-3 (Alloy 182) DMWs when welding Alloy 52M thereon.

A barrier weld will be used on all the stainless steel items prior to welding being performed. The barrier layer will use ER309L on the stainless steel and ERNiCr-3 (Alloy 82) on the stainless steel near the DMW to stainless steel fusion zones and on the adjacent DMW surfaces.

The weld inlay filler metal covering the Alloy 82 barrier welds and the balance of the DMW surface, including deep weld repairs where Alloy 82 is used, will be Alloy 52M. The minimum as-deposited Cr content for at least the final 1/8 in. and more than one layer of the weld inlay thickness will be 24%.

The Alternative Requirements (Appendix 1) specifies the maximum finished surface area of the weld inlay over the low alloy ferritic steel base material to be 300 square inches (sq. in.), which exceeds the 100 sq. in. maximum surface area specified in Code Case N-638-1 (Reference 2), Paragraph 1.0(a). Section XI Code Case N-638-4 specifies a maximum finished surface area of 500 sq. in. over the ferritic material.

The Alternative Requirements (Appendix 1) specifies the maximum cavity depth for weld repair is 2 in. That exceeds the depth of low alloy ferritic steel of 1/2 the ferritic steel thickness at the nozzle interface permitted by Code Case N-638-1 (Reference 2), Paragraph 1.0(a), for temperbead welding. Analysis shows that the nozzle low alloy ferritic steel that is replaced by the Alloy 82/52M weld material does not adversely affect the structural integrity of the DMW region.

The Alternative Requirements (Appendix 1) does not specify the maximum permitted depth into the low alloy ferritic steel for weld repair using nonferritic weld material, whereas the maximum depth into the low alloy ferritic steel nozzle material is 3/8 in. permitted by Code Case N-638-1 (Reference 2), Paragraph 1.0(c), for temperbead welding. It was assumed that flaw removal up to a 2 in. depth, near the buttering-to-nozzle fusion zone, resulting in a maximum depth of nozzle low alloy ferritic steel material being replaced by the Alloy 82/52M weld. Analysis shows that the nozzle low alloy ferritic steel that is replaced by the Alloy 82/52M weld material does not adversely affect the structural integrity of the DMW region.

Code Case N-638-1 (Reference 2), Paragraph 3.0(d) specifies a maximum interpass temperature of 350 degrees Fahrenheit (°F) and implies temperature monitoring by thermocouples may be required by Paragraph 4.0(c). Since direct temperature measurement methods will be impractical to perform during welding operations from inside the nozzle, the Alternative Requirements (Appendix 1) specifies interpass temperature shall be determined by either:

a) performing heat flow calculations using the variables listed therein; or
b) measurement of the maximum interpass temperature on a test coupon that is equal to or less than the thickness of the item to be welded using the maximum permitted heat input specified on the applicable welding procedure specification.

Section XI Code Cases N-638-2 through -4 specify these alternatives in lieu of direct interpass temperature measurement.

Examination

Prior to machining, UT will be performed on the DMW in accordance with Section XI (Reference 3) and procedures, personnel, and equipment that have been qualified in accordance with Code Case N-695 (Reference 4). The results of this examination will determine if there are PWSCC related flaws or other adverse pre-existing conditions.

Following machining and prior to inlay welding (see Figure 1) and repair welding (see Figure 2), PT will be performed in accordance with NB-5000, Section III (Reference 1). IWB-3514-2, Section XI (Reference 3), acceptance criteria will be applicable.

Following welding, acceptance PT (see Figure 1) will be performed thereon in accordance with NB-5000(b), Section III (Reference 1) and IWA-2222, Section XI (Reference 3). Because ambient temperature temperbead welding is used, the examination will be conducted at least 48 hours after the completion of the third temperbead layer over the low alloy ferritic steel base material. The acceptance criteria of NB-5352, Section III (Reference 1) will apply with the additional requirement that rounded indications with major dimensions greater than 1/16 in. are unacceptable. For areas outside of the inlay, the inservice examination acceptance standards of Table IWB-3514-2 shall apply. Eddy current will be used as a baseline for future examinations.

Acceptance UT will be performed on the weld inlay (see Figure 1) in accordance with Section V (2004 Edition), Article 4, Cladding – Technique One, using calibration blocks in accordance with Figure T-434.4.2.2. Because ambient temperature temperbead welding is used, the examination will be conducted at least 48 hours after the completion of the third temperbead layer over the low alloy ferritic steel base material. The acceptance criteria will be in accordance with NB-5330, Section III (Reference 1). When deep repair welding is performed (see Figure 2), acceptance UT of the repair weld below the weld inlay will be performed in accordance with Section V (2004 Edition), Article 4, and the acceptance criteria will be in accordance with NB-5330, Section III (Reference 1).

The requirement for NDE of the 1-1/2T band in Code Case N-638-1 (Reference 2) is specified to assure all flaws in the area of the repair have been removed or addressed, since these flaws may be associated with the original flaw and may have been overlooked. In this case, the repair welding is being performed as a result of PWSCC concerns occurring in the DMW and not for defects in the nozzle ferritic steel.

Preservice UT of the modified DMW, including the weld inlay (see Figure 1) and repair weld/weld inlay (see Figure 2), when applicable, will be performed in accordance with Section XI (Reference 3) and procedures, personnel, and equipment that have been qualified in accordance with Code Case N-695 (Reference 5). The inservice acceptance standards of IWB-3514.4 (Reference 3) will be applicable. UT will be performed no sooner than 48 hours after completion of the third temperbead layer over the low alloy ferritic steel nozzle base material.

The 48-hour delay is intended to provide time for delayed hydrogen cracking occurrence. The Alternative Requirements (Appendix 1) specifies the machine GTAW process to be used for temperbead welding, thereby eliminating the use of welding processes requiring flux for arc shielding.

The machine GTAW temperbead process uses a welding process that is inherently free of hydrogen. The GTAW process relies on bare welding electrodes and bare wire filler metal with no flux to absorb moisture. An inert gas blanket provides shielding for the weld and surrounding metal, which protects the region during welding from the atmosphere and the moisture it may contain and typically produces porosity-free welds. In accordance with the weld procedure qualification, welding grade argon is used for the inert gas blanket. To further reduce the likelihood of hydrogen effects, specific controls will be used to ensure the welding electrodes, filler metal, and weld region are free of all sources of hydrogen.

In addition, the use of the machine GTAW temperbead process provides precise control of heat input, bead placement, bead size and contour. The precise control over these factors afforded by the machine GTAW process provides effective tempering of the nozzle low alloy ferritic steel heat-affected zone (HAZ) resulting in achievement of lower hardness and tempered martensite. This further reduces susceptibility to hydrogen-induced cracking.

Temperbead Welding Applications, 48-Hour Hold Requirements for Ambient Temperature Temperbead Welding, EPRI, Palo Alto, CA: 2006 (Reference 6) provides justification for reducing the 48-hour hold time on P-No. 3, Group No. 3 low alloy ferritic steel base material, starting after completion of the third temperbead layer, as specified in the Alternative Requirements (Appendix 1). This report addresses microstructural issues, hydrogen sources, tensile stress and temperature, and diffusivity and solubility of hydrogen in steels. Past industry experience with the use of the machine GTAW process has resulted in no detection of hydrogen induced cracking after the 48-hour hold nondestructive examination or subsequent inservice inspections.

Inservice examination volumetric and surface examinations will be performed on all modified DMWs as specified in the Alternative Requirements (Appendix 1).

References

1) ASME Boiler & Pressure Code, Section III, 1989 Edition, No Addenda.

2) Code Case N-638-1, "Similar and Dissimilar Metal Welding Using Ambient Temperature Machine GTAW Temper Bead Technique," dated February 13, 2003.

3) ASME Boiler & Pressure Vessel Code, Section XI, 1989 Edition, No Addenda.

4) Code Case N-695, "Qualification Requirements for Dissimilar Metal Piping Welds," dated May 21, 2003.

5) Code Case N-695, "Qualification Requirements for Dissimilar Metal Piping Welds," dated May 21, 2003.

6) Temperbead Welding Applications: 48-Hour Hold Requirements for Ambient Temperature Temperbead Welding, EPRI, Palo Alto, CA: 2006.

Enclosure to ISIR-28
Appendix 1

ALERNATIVE REQUIREMENTS FOR REACTOR REQUIREMENTS FOR REACTOR VESSEL SAFE END-TO-PRIMARY NOZZLE ALLOY 82/182 DISSIMILAR METAL WELD MODIFICATION USING WELD INLAY

1.0 GENERAL

a. The weld inlay shall be applied on the inside surface of the full penetration circumferential austenitic nickel alloy welds (DMWs) on the low alloy steel components, including nozzles (P-No. 3) to safe ends or piping components (P-No. 8 or 43), inclusive of the UNS N06082 or W86182 DMWs that join the two items.

b. Appendix 1 shall apply to DMWs and adjacent component nozzles, cladding, piping, and their austenitic stainless steel welds, if applicable, consisting of the following materials and combinations thereof:
   i. P-No. 8 and P-No. 43.
   ii. P-No. 8 or 43 and P-No. 3.

c. The location of the DMW fusion zones shall be determined.

d. All welding shall use Welding Procedure Specifications qualified in accordance with Appendix 2.

e. Ambient temperature temperbead welding shall be performed in accordance with Appendix 2.

f. The final 1/8 in. inlay thickness shall contain at least 24% Chromium (Cr) as deposited. The Cr content of the deposited weld metal shall be determined by chemical analysis of a coupon from a mockup representative of the materials on which the inlay will be deposited using the applicable production weld parameters and the same production weld metal classification. The weld filler metal used for the mockup shall have Cr content no greater than that to be used for the inlay. The results shall be documented.

g. Welding shall be performed using the machine GTAW process. ERNiCrFe-7A (Alloy 52M) filler metal shall be used for at least the final 1/8 in. thickness and more than one layer (inlay). ERNiCr-3 (Alloy 82) may be used for repair welding, when applicable, beyond at least 1/8 in. and more than one layer thickness from the inside final surface.

h. To reduce the potential of hot cracking when applying an austenitic nickel alloy over P-No. 8 base metal, austenitic stainless steel welds, or cladding, it shall be permissible to apply ER309L austenitic stainless steel filler material and Alloy 82 near the DMW fusion zones, over the austenitic stainless steel material. The Alloy 82 shall be subsequently covered with at least 1/8 in. thick and more than one layer of Alloy 52M complying with 1.0(f) and (g).

i. Unless otherwise specified, all Section III and Section XI references in this Appendix shall be as specified in Section 1.1 of relief request.

2.0 DESIGN, STRESS ANALYSES, AND FLAW GROWTH ANALYSES

a. Design

The thickness of the inlay over the exposed portion of the original DMW at the inner surface shall comply with the following.

i. The minimum final thickness of the inlay shall consist of at least 1/8 in. of Alloy 52M at the inner surface.

ii. The minimum thickness of the inlay using Alloy 52M in accordance with 2.0a.i. shall extend over and beyond the final inner surface DMW fusion zones by at least twice the demonstrated accuracy of the locating technique of 1.0c or 1/4 in., whichever is greater.

iii. The maximum thickness of the repair weld, if required, including the weld inlay shall be 2 in.

iv. The design life of the modified DMWs shall be 30 additional years and shall be verified by the stress analyses specified in 2.0b and the flaw growth analyses specified in 2.0c considering the postulated flaws.

b. Stress Analyses

i. Stress and fatigue analyses shall be performed in accordance with NB-3200. The stress analyses evaluate the following modified DMW configurations.

1. 0.13 in. deep cavity requiring a 0.13 in. thick weld inlay for the full inner circumference.
2. 2 in. thick, local cavity repair weld inlay with weld inlay thereon.

c. Flaw Growth Analyses

i. Flaw growth analyses for postulated flaws shall be performed in accordance with IWB-3640. The residual stress analyses shall assume a full circumferential 50% through-wall weld repair from the inside surface of the original DMW has previously occurred.

ii. Planar flaws shall be postulated to exist in the newly applied weld inlay and in the original DMW as follows.

1. Circumferential flaw of 1/16 in. depth through the inlay weld thickness, surface connected for the entire circumference of the inlay.
2. Axial flaw of 1/16 in. depth through the inlay weld thickness, surface connected for the entire width (axial length) of the inlay.
3. Circumferential flaw of depth equal to the maximum acceptable flaw depth per Table IWB-3514-2, in the remaining DMW, originating at the weld inlay/DMW interface for the entire circumference of the inlay.
4. Axial flaw of depth equal to the maximum acceptable flaw depth per Table IWB-3514-2, in the remaining DMW, originating at the weld inlay weld inlay/DMW interface for the entire width (axial length) of the inlay.

d. Any changes in applied loads, as a result of weld shrinkage from the inlay, or deep weld repair, when applicable, on the other items in the piping system (e.g., support loads and clearances and nozzle loads) shall be evaluated. Existing flaws previously accepted by analytical evaluation shall be evaluated in accordance with IWB-3640, as applicable.

3.0 EXAMINATION

a. General

i. The examination requirements of this Appendix shall be applicable in lieu of all other examination requirements.

ii. Nondestructive examination procedures shall be in accordance with NB-5000 for acceptance examinations and IWA-2200 for preservice and inservice examinations and as specified herein.
iii. Nondestructive examination personnel shall be qualified in accordance with IWA-2300, and as specified herein.
iv. The final surface of the inlay shall be suitable for surface and volumetric examination.
v. Examinations required after inlay welding shall be performed no sooner than 48 hours after completion of the third temperbead layer over the ferritic steel nozzle.
vi. All flaws detected that are not associated with the DMW modification activity shall meet the requirements of IWB-3000.
vii. All examinations will be performed from the ID.

b. Examination Prior to Application of the Inlay
i. Prior to machining and inlay welding, the applicable DMW volume shall be ultrasonically examined using procedures, personnel, and equipment that have been qualified in accordance with Code Case N-695. Ultrasonic examination acceptance criteria shall be in accordance with the inservice examination acceptance standards of IWB-3514.
ii. After machining and prior to welding, the area to be welded shall be examined using the liquid penetrant examination method. The acceptance criteria shall be in accordance with IWB-3514-2.

c. Acceptance Examination of the Inlay
i. The inlay surface, including at least 1/2 in. of adjacent material, shall be examined using the liquid penetrant examination method in accordance with NB-5000. Acceptance criteria for the weld inlay shall be in accordance with NB-5352 with the additional requirement that rounded indications with major dimension greater than 1/16 in. shall not be permitted. Criteria for the balance of the surface examination area shall be in accordance with the inservice examination acceptance standards of Table IWB-3514-2.
ii. The inlay volume, at least 1/8 in. thickness, including the fusion zones shall be ultrasonically examined in accordance with Section V, Article 4, using Cladding Technique One. Calibration standards shall be in accordance with Figure T-434.4.2.2 as shown in Article 4 of ASME Section V. The acceptance criteria of NB-5330 shall apply. The repair weld volume, when applicable, shall be ultrasonically examined in accordance with Section V, Article 4. The acceptance criteria of NB-5330 shall apply.

d. Preservice Examination
i. Surface examination is required of the inlay surface. Examination requirements and acceptance criteria shall be as specified in 3.0c.i.
ii. The modified DMW examination volume (see Figure E1) shall be ultrasonically examined using procedures, personnel, and equipment that have been qualified in accordance with Code Case N-695. Ultrasonic examination acceptance criteria shall be in accordance with the inservice examination acceptance standards of IWB-3514.

e. Inservice Examination

i. Volumetric and surface examination shall be performed on all the modified DMWs no sooner than the third refueling outage and no later than 10 years following inlay welding.

   1. Ultrasonic examination shall be performed using procedures, personnel, and equipment that have been qualified in accordance with Code Case N-695. The inservice examination acceptance standards of IWB-3514 shall be applicable.

ii. Examination volumes that show no indications of cracking shall be placed into a population to be examined on a sample basis. 25% of this population shall receive a volumetric examination performed from the outside diameter surface, or a volumetric examination and a surface examination performed from the weld ID surface. The 25% sample shall be added to the Inservice Inspection Program in accordance with IWB-2410 and shall be examined once each inspection interval.

iii. If inservice examinations reveal crack growth or new cracking meeting the acceptance standards of IWB-3132, the DMW examination volume shall be reexamined during the first refueling outage following discovery of the growth or new cracking. The weld examination volume shall be subsequently examined during each of the next two refueling outages.

Figure 3-1: Inside Surface Full (360°) Circumferential Flaw

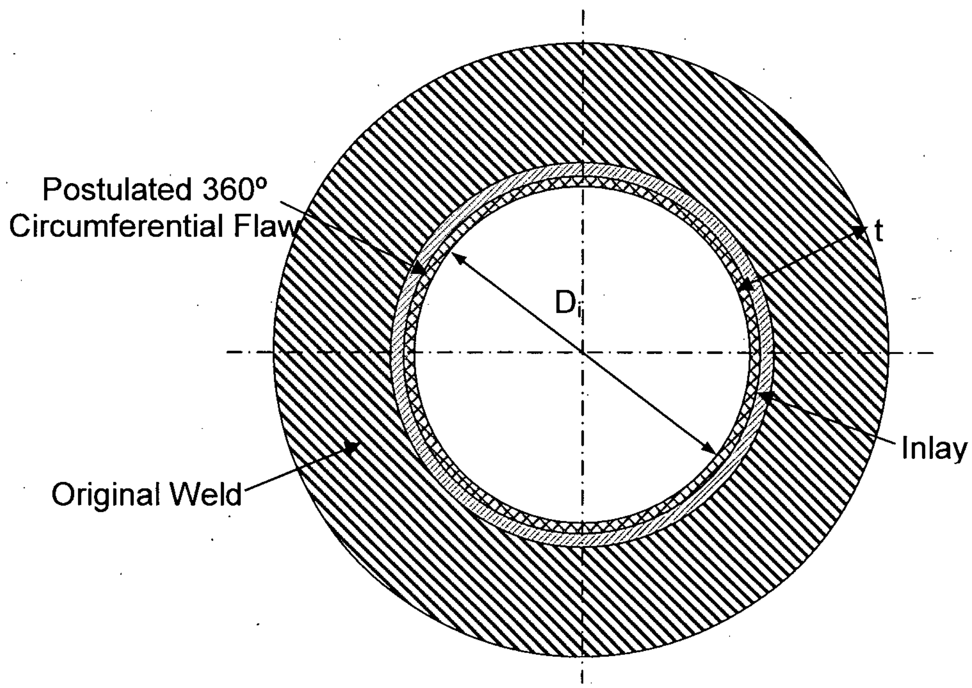
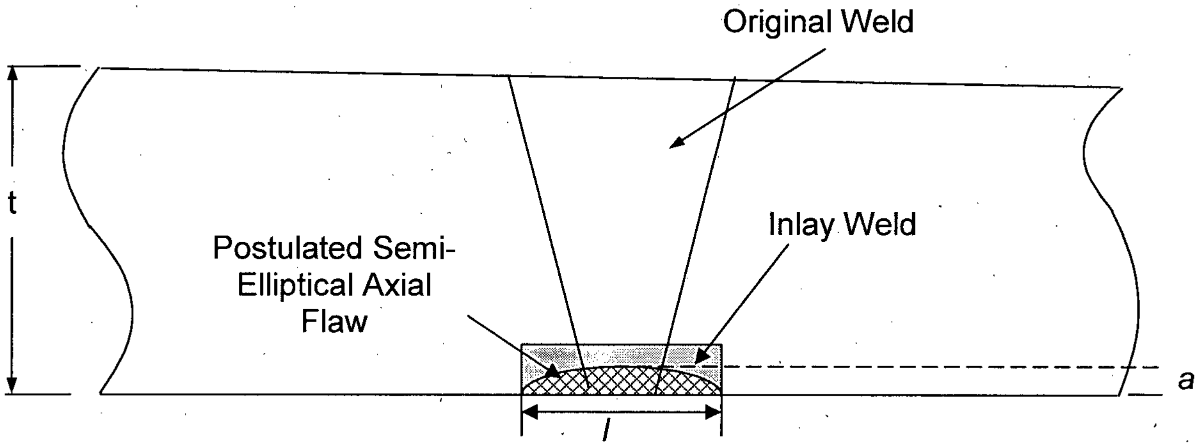


Figure 3-2: Inside Surface Semi-Elliptical Axial Flaw



NOTE: Figure 3-1 and Figure 3-2 identify the flaw locations for Postulated 360° Circumferential Flaw and Postulated Semi-Elliptical Axial Flaw. Section c.ii provides a detailed description of flaw growth.

iv. Any volumetric examinations that reveal crack growth or new cracking meeting the acceptance standards shall also be subject to a surface examination. The acceptance standards of 3.0c.i. shall be applicable. This surface examination shall also be required in any subsequent examinations required by 3.0e.iii.

1. If the examinations required by 3.0e.iii or 3.0e.iv. reveal that the flaw(s) remain essentially unchanged for three successive examinations, the weld examination schedule may revert to the sample and schedule of examinations. This DMW shall be included in the 25% sample population.

v. For volumetric examinations performed from the outside surface if new cracking or the growth of existing cracking is detected, additional surface examinations shall also be performed from the inside surface in the same outage and in subsequent outages as applicable for volumetric examinations.

f. The 25% sample shall consist of the same welds in the same sequence during successive intervals to the extent practical provided the 25% sample contains the welds that experience the highest operating temperature in the item. If hot leg and cold leg welds are included in the same item, the initial 25% sample does not need to include the cold leg welds. Those welds not included in the 25% sample shall be examined prior to the end of the evaluation period if the plant is to be operated beyond that time.

4.0 PRESSURE TESTING

A system leakage test shall not be required for a weld inlay thickness of 10% or less of the original DMW thickness. A system leakage test shall be performed in accordance with IWA-5000 for weld inlays greater than 10% of the original DMW thickness.

5.0 DOCUMENTATION

Use of Appendix 1 shall be documented on Form NIS-2.

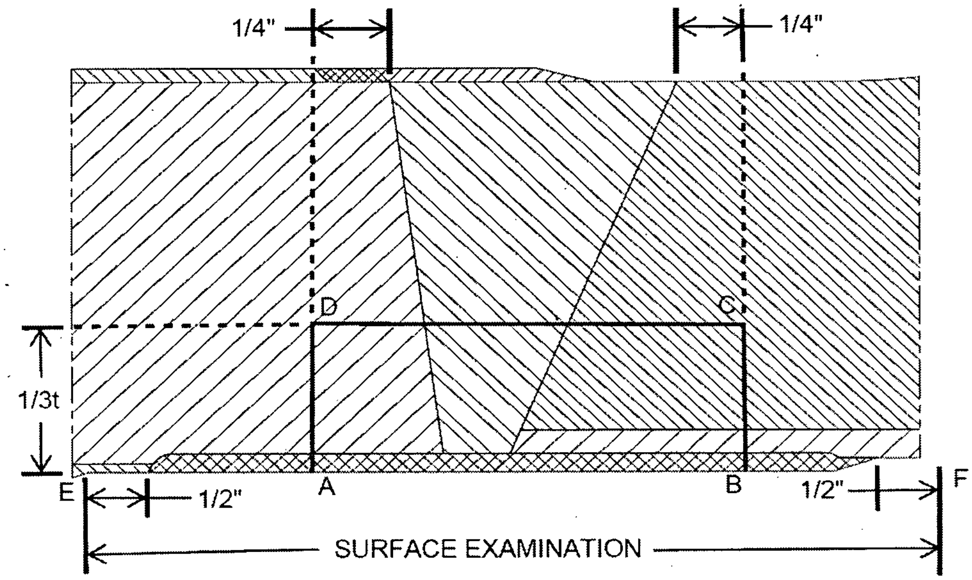


Figure E1a – Examination Volume Non-Repaired
Volumetric Examination A-B-C-D
Surface Examination E-F

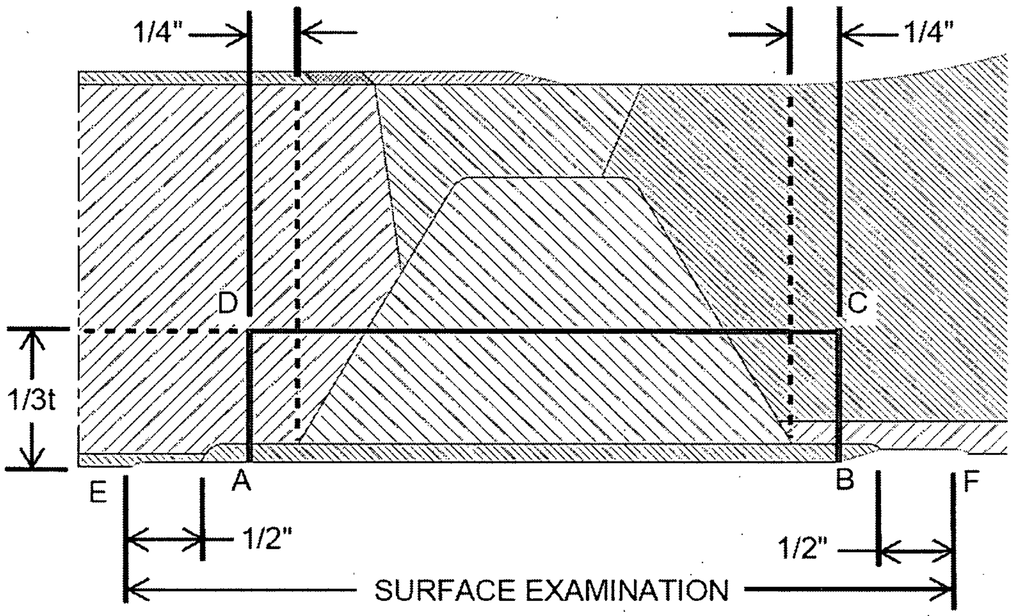


Figure E1b – Examination Volume Repaired
Volumetric Examination A-B-C-D
Surface Examination E-F

NOTE: 1/4" distance assures that the inlay material bounds the Alloy 82/182 material sufficiently.

1/2" distance defines the area to be examined outside the repair.

Enclosure to ISIR-28
Appendix 2

AMBIENT TEMPERATURE TEMPERBEAD WELDING

1.0 GENERAL REQUIREMENTS

1.1 The maximum area of an individual inlay weld based on the finished surface over the ferritic base material shall be 300 sq. in.

1.2 Repair/replacement activities on a DMW in accordance with this Appendix shall be limited to those along the fusion line of a nonferritic weld to ferritic base material on which 1/8 in. or less nonferritic weld deposit exists above the original fusion line.

1.3 Prior to welding, the area to be welded and a band around the area of at least 1-1/2 times the component thickness or 5 in., whichever is less, shall be at least 50°F.

2.0 WELDING QUALIFICATIONS

The welding procedures and the welding operators shall be qualified in accordance with Section IX and the requirements of 2.1 and 2.2.

2.1 Procedure Qualification

a) The base materials for the welding procedure qualification shall be of the same P-Number and Group Number as the materials to be welded. The materials shall be postweld heat treated to at least the time and temperature that was applied to the materials to be welded.

b) The root width included angle of the cavity in the test assembly shall be no greater than the minimum specified for the barrier weld.

c) The maximum interpass temperature for the first three layers of the test assembly shall be 150°F.

d) The test assembly cavity depth shall be at least 1 in. The test assembly thickness shall be at least twice the test assembly cavity depth. The test assembly shall be large enough to permit removal of the required test specimens. The test assembly dimensions surrounding the cavity shall be at least the test assembly thickness and at least 6 in. The qualification test plate shall be prepared in accordance with Figure 1-1.

e) Ferritic base material for the procedure qualification test shall meet the impact test requirements of the Construction Code and Owner's Requirements. If such requirements are not in the Construction Code and Owner's Requirements, the impact properties shall be determined by Charpy V-notch impact tests of the procedure qualification base material at or below the lowest service temperature of the item to be repaired. The location and orientation of the test specimens shall be similar to those required in (f), below, but shall be in the base metal.

f) Charpy V-notch tests of the ferritic HAZ shall be performed at the same temperature as the base metal test of (e), above. Number, location, and orientation of test specimens shall be as follows:

1) The specimens shall be removed from a location as near as practical to a depth of one half the thickness of the deposited weld metal. The coupons for HAZ impact specimens shall be taken transverse to the axis of the weld and etched to define the HAZ. The notch of the Charpy V-notch specimen shall be cut approximately normal to the material surface in such a manner as to include as much HAZ as possible in the resulting fracture. When the material thickness permits, the axis of a specimen shall be inclined to allow the root of the notch to be aligned parallel to the fusion line.
2) If the test material is in the form of a plate or a forging, the axis of the weld shall be oriented parallel to the principal direction of rolling or forging.
3) The Charpy V-notch test shall be performed in accordance with SA-370. Specimens shall be in accordance with SA-370, Figure 11, Type A. The test shall consist of a set of three full-size 10 mm X 10 mm specimens. The lateral expansion, percent shear, absorbed energy, test temperature, orientation and location of all test specimens shall be reported in the Procedure Qualification Record.

g) The average lateral expansion value of the three HAZ Charpy V-notch specimens shall be equal to or greater than the average lateral expansion value of the three unaffected base metal specimens. However, if the average lateral expansion value of the HAZ Charpy V-notch specimens is less than the average value for the unaffected base metal specimens and the procedure qualification meets all other requirements of this appendix, either of the following shall be performed:
1) The welding procedure shall be requalified.
2) An *Adjustment Temperature* for the procedure qualification shall be determined in accordance with the applicable provisions of NB-4335.2 of Section III, 2001 Edition with 2002 Addenda. The Reference Temperature for Nil Ductility Transition (RT_{NDT}) or lowest service temperature of the materials for which the welding procedure will be used shall be increased by a temperature equivalent to that of the Adjustment Temperature.

2.2 Performance Qualification

Welding operators shall be qualified in accordance with Section IX.

3.0 WELDING PROCEDURE REQUIREMENTS

The welding procedure shall include the following requirements.

3.1 The area to be welded shall be buttered with a deposit of at least three layers to achieve at least 1/8 in. (3mm) and more than one layer at the final inner surface of inlay weld thickness using Alloy 52M with the heat input for each layer controlled to within ±10% of that used in the procedure qualification test. The heat input of the first three layers shall not exceed 45,000 Joule/inch (1,800 Joule/millimeter) under any conditions. Particular care shall be taken in the placement of the weld layers of the austenitic inlay weld filler material at the toe of the inlay weld to ensure that the HAZ and ferritic base metal are tempered. Subsequent layers shall be deposited with a heat input not exceeding that used for layers beyond the third layer in the procedure qualification.

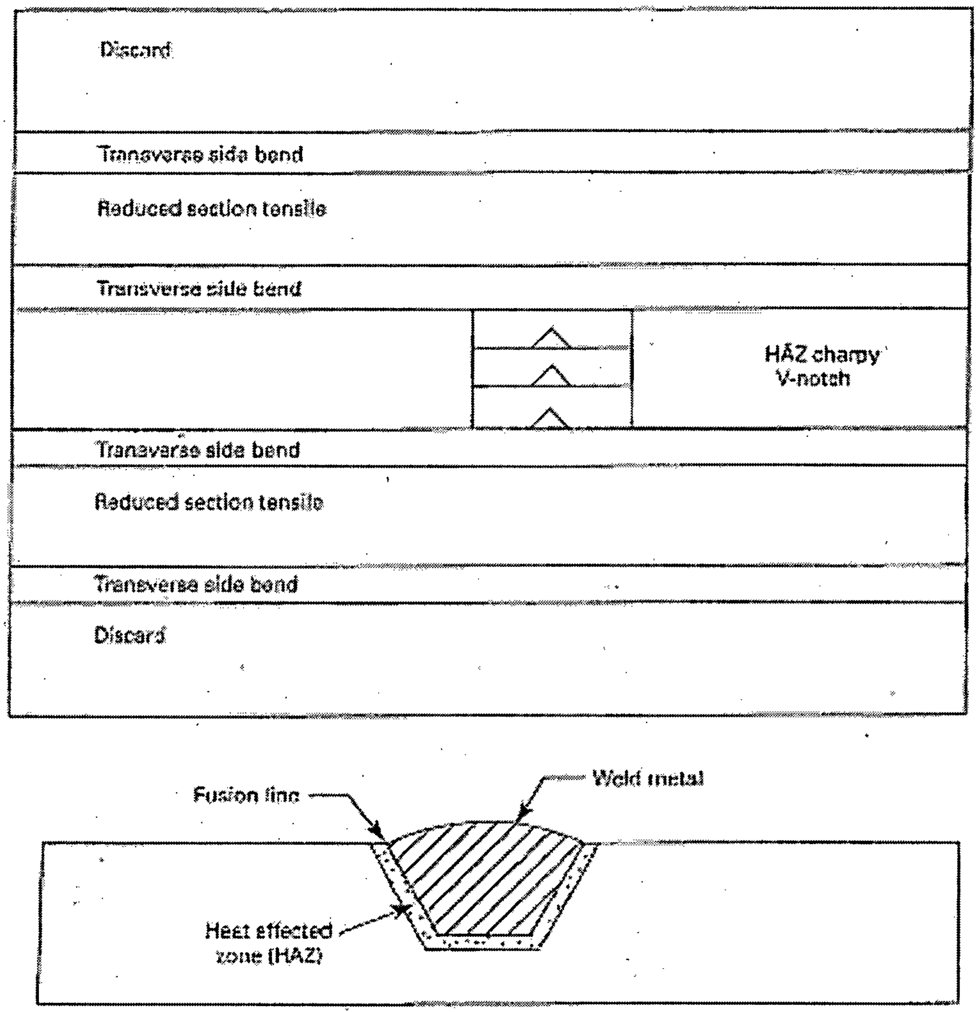
3.2 The maximum interpass temperature for field applications shall be 350°F for all weld layers regardless of the interpass temperature used during qualification. The interpass temperature limitation of QW-406.3 need not be applied.

3.3 The interpass temperature shall be determined by one of the following methods:

a) Heat flow calculations using the variables listed below as a minimum:
   1) welding heat input
   2) initial base material temperature
   3) configuration, thickness, and mass of the item being welded
   4) thermal conductivity and diffusivity of the materials being welded
   5) arc time per weld pass and delay time between each pass
   6) arc time to complete the weld

b) Measurement of the maximum interpass temperature on a test coupon that is equal to or less than the thickness of the item to be welded. The maximum heat input of the welding procedure shall be used in the welding of the test coupon.

3.4 Particular care shall be given to ensure that the weld region is free of all potential sources of hydrogen. The surfaces to be welded, filler metal, and shielding gas shall be suitably controlled.



GENERAL NOTE: Base metal Charpy impact specimens are not shown. This figure illustrates a similar-metal weld.

Fig. 1-1 QUALIFICATION TEST PLATE

Enclosure 3 to AEP-NRC-2009-42

Response to Request for Additional Information Regarding Relief Request (ISIR-28) for Use of Weld Inlays as an Alternate Repair Technique for Alloy 82/182 Dissimilar Metal Welds in Reactor Vessel Safe End-to-Primary Nozzles (Non-Proprietary)

Response to Request for Additional Information Regarding Relief Request (ISIR-28) for Use of Weld Inlays as an Alternate Repair Technique for Alloy 82/182 Dissimilar Metal Welds in Reactor Vessel Safe End-to-Primary Nozzles

In Reference 1, Indiana Michigan Power Company (I&M) submitted a relief request for use of weld inlays as an alternative repair technique for reactor vessel safe end-to-primary nozzle Alloy 82/182 welds. Reference 2 transmitted the Nuclear Regulatory Commission's (NRC) request for additional information (RAI) regarding the request for relief. The requested information is provided below.

1. ***Attachment: 10 CFR 50.55a Request: Proposed Alternative in Accordance with 10 CFR 50.55a(a)(3)(i)***

NRC RAI 1-1(a)

In Section 1.1:

Clarify why the ASME Code, Section III, 1989 edition is referenced as the modification design code whereas the ASME Code, Section III, 1998 edition including addenda through 2000 is referenced as the construction code nondestructive examination. The NRC staff's question is focused on the different sets of Section III editions that are referenced.

I&M Response to NRC RAI 1-1(a)

ASME Section III, 1989 Edition is the Code of record for the current inservice inspection (ISI) interval. The addition of ASME Section III, 1998 Edition including Addenda through 2000 is due to Regulatory Guide 1.147 and Code Case N-638-1. Regulatory Guide 1.147 conditionally approved code case N-638-1. The conditional approval requires the use of the ASME Section III, 1998 Edition through 2000 Addenda for Non-Destructive Evaluation (NDE).

NRC RAI 1-1(b)

Clarify whether or which of these codes will be used in the inlay installation.

I&M Response to NRC RAI 1-1(b)

Both ASME code editions are applicable to the inlay modification. ASME Section III, 1989 Edition, no Addenda is the Design code for the inlay modification. AMSE Section III, 1998 Edition through 2000 Addenda is the Construction Code for NDE of the inlay installation.

NRC RAI 1-1(c)

The reference of the 1998 edition of the ASME Code, Section III, is inconsistent with the applicable code of record for the third inservice inspection (ISI) interval which is the 1989 edition of the ASME Section XI. Please clarify the discrepancy.

I&M Response to NRC RAI 1-1(c)

The responses to NRC RAIs 1-1(a) and 1-1(b) provide an explanation of why two AMSE Code editions are referenced.

NRC RAI 1-2

In Section 1.2:

Provide a design drawing with dimensions of the pipe configuration being mitigated, including the reactor vessel nozzle, dissimilar metal welds (DMW), safe end, similar metal weld, and pipe segment. The design drawing should include the following information: the nominal diameter, thickness, and inside surface and outside surface length of each component noted in the preceding sentence; the distance between the center line of the DMW and safe end; and, actual thickness and length of the inlay.

I&M Response to NRC RAI 1-2

The requested design information is provided in the AREVA propriety documents 02-9069388C-000 (Donald C. Cook Nuclear Plant (CNP) Unit 1 Reactor Vessel Outlet Nozzle Existing Configuration) and 02-9069389C-000 (CNP Unit 1 Reactor Vessel Inlet Nozzle Existing Configuration) attached to this enclosure. The inlay will be at least 1/8 inch thick and extend over and beyond the DMW fusion zones by at least 1/4 inch as described in Paragraph 2.0(a)(i) and (ii) of Appendix 1 in the relief request.

NRC RAI 1-3

By letter dated June 1, 2007 (ADAMS Assession No. ML071550420), South Carolina Electric & Gas (SCE&G) submitted a relief request for V.C. Summer regarding full structural weld overlay. In the submittal SCE&G committed to submit (a) within 14 days of the weld overlay examination, the overlay examination results, and (b) prior to Mode 4, the summary of the stress analysis demonstrating that the weld overlay will provide the structural integrity of the original weld and flaw growth calculations. In Sections 2.0.b and 2.0.c of Appendix 1 to Relief Request ISIR-28, the licensee specified stress analyses and flaw growth calculations to be performed. However, the licensee has not committed to submit inlay examination and stress analysis.

Discuss whether the following documents will be submitted: (a) the inlay examination results within 14 days of completing the weld inlay examination, and (b) a summary of the stress analysis and flaw growth calculations of the DMW and inlay prior to Mode 4 and the final report within 60 days of plant restart.

I&M Response to NRC RAI 1-3

The examination results will be submitted as requested. A summary of the stress analysis and flaw growth calculations of the DMW and inlay will also be submitted. Refer to Enclosure 5, Regulatory Commitments.

NRC RAI 1-4

In Section 7.0 of the relief request, the licensee asked for the remaining service life of the DMWs as the duration of the request. The NRC staff notes that the ISI inspection requirements may change in the future. In addition, the NRC staff is working generically regarding the long-term weld inlay inspection requirements. The NRC staff is willing to consider approving the inspection portion of the request on an ISI interval basis.

Please revise the submittal accordingly.

I&M Response to NRC RAI 1-4

The interval request is for the fourth interval. The inlay is scheduled to be installed at the beginning of the fourth interval. Section 7.0 of the relief request was revised to reflect this change.

NRC RAI 1-5

Please discuss the inspection history of the subject DMWs, including the year of inspections, the inspection method, and results.

I&M Response to NRC RAI 1-5

There have been two ISI examinations using Ultrasonic Examination (UT). These examinations were performed in accordance with ASME Section XI. ISI examinations were performed in 1985 at the end of the first ISI interval and in 1995 at the end of the second ISI interval. No indications were observed in either case.

NRC RAI 1-6

Please discuss whether the inlay is considered as the primary system pressure boundary (i.e., does the inlay provide structural support for the primary system loadings?)

I&M Response to NRC RAI 1-6

The inlay is considered as part of the primary system pressure boundary. The revised stress analysis credits the portion of the inlay over the dissimilar metal weld. The portion over the cladding is not credited.

NRC RAI 1-7

Section 1.2, Table 2, states that the safe end cladding is made of Type 312L and Alloy 82 weld material. However, Figures 1 and 2 do not identify the Alloy 82 weld material at the safe end cladding.

Identify or describe the location of the Alloy 82 weld material at the safe end cladding in Figures 1 and 2.

I&M Response to NRC RAI 1-7

The requested information is provided on the Westinghouse proprietary drawing and table of as-found conditions provided below.

Figure 2 – (PROPRIETARY)

Table 1 - (PROPRIETARY)

(a-f)

2. ***Enclosure: Weld Inlay and Potential Repair Weld Inlays for Reactor Vessel Safe End-To-Primary Nozzle Alloy 82/812 Dissimilar Metal Welds Mitigative/Repair Inlay***

NRC RAI 2-1

Leak-Before-Break (LBB) Evaluation: The licensee stated that LBB remains applicable at the DMW locations.

Discuss why the "inlay" and the "repair inlay" will not affect the original LBB analysis assumptions and results.

I&M Response to NRC RAI 2-1

Since the original geometry and loads are not significantly modified by the weld inlay or repair weld inlay and the replacement weld inlay material (Alloy 52M and Alloy 82) has equal or superior fracture toughness than the existing materials, LBB remains applicable to inlay and repair inlay. Furthermore, the machine gas tungsten-arc welding process (GTAW) is used for the weld inlay and repair weld inlay. GTAW exhibits equivalent or better fracture toughness properties with either Alloy 82 or Alloy 52M than the shielded metal arc welding process using Alloy 182 which was the primary welding process used for the original DMWs at these locations. Furthermore, the UT and liquid penetrant (PT) acceptance examinations on the new welds must comply with the acceptance criteria specified in NB-5330 and NB-5350, respectively. In addition, NB-5350 is modified for the inlay surface examination to specify no rounded indications with major dimension greater than 1/16 inch major dimension shall be permitted.

The geometry, material, applied loading or operating conditions at the LBB identified joint location have to be changed sufficiently to warrant an LBB re-analysis. As a result of the weld inlay, the geometry, material and, therefore, the applied loadings remain the same as those provided in the original LBB submittal. The operating conditions also remain the same. The weld residual stresses, determined for the dissimilar metal weld, are not considered in an LBB analysis. Therefore, I&M has concluded that the LBB margins, i.e., a factor of ten for the leak detection capability and a factor of two for the leakage flaw size are retained per the NRC-approved safety evaluation report (SER) for LBB analysis for CNP Units 1 and 2. Per the SER, the minimum margin on flaw size at the reactor vessel nozzles occurs at the hot leg and is a factor of 5.0 which is significantly greater than the required margin of two.

The inlay provides a protective barrier to prevent Primary Water Stress Corrosion Cracking (PWSCC). In the original LBB analysis, no stress corrosion cracking mechanisms were identified. The inlay preserves this assumption. The repair inlay is a weld to repair an unacceptable indication. This weld will be made using Alloy 52M for shallow repairs and Alloy 82 for deeper repairs. The Alloy 82 is the same material reviewed as part of the original LBB evaluation. The 52M is relatively thin and has no appreciable structural contribution.

The inlay does not change the geometry or the potential leak path assumed in the existing LBB analysis. Further, the thickness of the inlay weld layer is within the definition of the nominal pipe diameter of the Reactor Coolant System piping as specified by the ASME Code, Section III, and the presence of the inlay does not change the geometrical basis of the original LBB analysis.

The inlay weld layer isolates the Alloy 82 weld from contact with the primary coolant. This isolation barrier will eliminate the potential susceptibility of the Alloy 82 material from PWSCC and preserves the assumptions of the LBB analysis in terms of stress corrosion cracking.

The existing configurations of the reactor vessel primary nozzles (both hot and cold legs) were compared with the final configurations after the planned weld inlay mitigation operations as well as potential repair inlay mitigation operations. The geometry and material content of the existing and resulting configurations were assessed. For a given primary nozzle, the geometry with the weld inlay is essentially similar to the existing configuration. The thin inner wall layer of Alloy 52M inlay material protects the PWSCC prone Alloy 82 weld of the DMW from contact with the primary water and thus avoid degradation due to PWSCC. The temper bead gas-tungsten arc welding and detailed steps used in the welding process ensure that the homogeneous inlay layer is well fused with the existing materials and is devoid of cracks or defects. Thus, the resultant weld will continue to satisfy the LBB analysis criteria at these locations.

NRC RAI 2-2

Evaluation of Weld Shrinkage Effects:

NRC RAI 2-2(a)

The licensee stated that weld shrinkage caused by the inlay has a negligible effect on the attached piping. Discuss the results of mockup testing and/or stress analysis that demonstrate(s) that inlay weld shrinkage has negligible effect on the attached piping.

I&M Response to NRC RAI 2-2(a)

Axial weld shrinkage was measured on two mockups. The average axial weld shrinkage of each mockup due to the weld inlay was 0.020 inch and 0.025 inch. The mockup testing results demonstrate that weld shrinkage resulting from the inlay will have a negligible effect on the attached piping. When applied to the actual pipe thickness, this shrinkage does not cause compressive forces sufficient to result in measurable shrinkage of the reactor coolant system piping.

NRC RAI 2-2(b)

Section 2.0.d of Appendix 1 states that any changes in applied loads as a result of weld shrinkage from the inlay shall be evaluated. Discuss how weld shrinkage in the inside surface of the pipe is evaluated and how weld shrinkage is considered in the stress analysis of the pipe.

I&M Response to NRC RAI 2-2(b)

The stress analysis assumed that the weld shrinkage effects were negligible. The assumption has been verified through mockup testing (see Answer to 2-2(a)).

NRC RAI 2-3

On page 4, fourth paragraph, the licensee stated that "...Analysis shows that the nozzle low alloy ferritic steel that is replaced by the Alloy 82/52M weld material does not adversely affect the structural integrity of the DMW region..."

NRC RAI 2-3(a)

Clarify the phrase, "...the nozzle ...is replaced by the Alloy 82/52M weld metal..."

I&M Response to NRC RAI 2-3(a)

The purpose of the fourth paragraph on Page 4 is to provide a description of the repair of a deep flaw. The contingency plan is to excavate the flaw and create geometry for a repair weld to be applied. The configuration of the existing weld resembles a "V". This configuration would require the nozzle portion of the adjoining material to be excavated to allow the repair weld placement. Alloy 82 will be used to fill a deep repair with Alloy 52M providing the inlay cover. Alloy 52M may be used to fill shallow repairs. Section 5 of the relief request was revised to clarify use of Alloy 82 and Alloy 52M.

NRC RAI 2-3(b)

Describe the subject analysis and provide the results of the analysis.

I&M Response to NRC RAI 2-3(b)

Detailed analyses of the hot and cold leg nozzles were performed and documented. These analyses provide complete ASME Section III qualifications. A summary document describing the analytical methodology and actual results will be submitted (refer to Enclosure 5, Regulatory Commitments).

NRC RAI 2-4

NRC RAI 2-4(a)

On page 5, second paragraph, the licensee specified that "...Following welding, acceptance/preservice PT and/or eddy current (ET) be performed thereon in accordance with NB-5000, Section III, and IWA-2222, Section XI..."

This statement needs to be clarified because it is not clear exactly which NDE will be performed using which technique per which ASME Code sections and subarticles.

I&M Response to NRC RAI 2-4(a)

Following welding, acceptance and/or preservice surface examination using the liquid penetrant (PT) method shall be performed on the inlay surface, including at least 1/2 inch (13 millimeters (mm)) of adjacent material. Acceptance criteria for the inlay shall be in accordance with

Section III, NB-5352 except rounded indications with major dimension greater than 1/16 inch (1.5 mm) shall not be permitted. The adjacent material shall satisfy the surface examination acceptance criteria for base material of the Construction Code or Section III, NB-2500. The surface examinations shall be conducted no sooner than 48 hours after the completion of the third temper bead layer over the ferritic steel base material. Page 11 of the revised relief, second paragraph has been revised to clarify use of PT and ET examinations.

NRC RAI 2-4(b)

In Sections 3.0.c and 3.0.d of Appendix 1 to Relief Request ISIR-28, it does not appear that eddy current testing will be used to perform acceptance or preservice examination.

Clarify the discrepancy between the above statement on page 5 and Appendix 1.

I&M Response to NRC RAI 2-4(b)

Acceptance of the inlay is established with PT and UT examinations. The use of ET is a baseline examination to facilitate future ISI examinations. If ET finds a flaw indication, it will be dispositioned in accordance with IWB-3000. Acceptance criteria for the inlay shall be in accordance with Section III, NB-5352 except rounded indications with major dimension greater than 1/16 inches (1.5 mm) shall not be permitted. The adjacent base material shall satisfy the surface examination acceptance criteria of IWB-3514.

NRC RAI 2-4(c)

Discuss whether PT and ET will be performed underwater. If the surface examination is performed underwater, discuss the qualification of PT and ET for underwater examinations.

I&M Response to NRC RAI 2-4(c)

The PT surface examination will be performed in a dry environment only. The PT examination is the acceptance examination for the installation of the inlay. The ET examination to locate the DMW fusion zones is performed under water. The nozzle and DMW region will be filled with water to perform UT and ET. Water is used for these examinations and acts as a coupling. This form of examination is regularly performed and follows normal qualification requirements.

NRC RAI 2-4(d)

If ET is used, discuss the acceptance criteria used to disposition the flaw.

I&M Response to NRC RAI 2-4(d)

ET will not be used for acceptance examinations. The ET is a baseline examination for future examinations. A flaw discovered in the ET examination will be evaluated in relation to the flaw characteristics including shape, size depth, etc. Based on the evaluation, corrective measures may be required.

NRC RAI 2-4(e)

Discuss the qualification of welding for inlay and DMW repair underwater.

I&M Response to NRC RAI 2-4(e)

No underwater welding will be performed.

3. ***Enclosure: Appendix 1: Alternative Requirements for Reactor Requirements [sic] for Reactor Vessel Safe End-to-Primary Nozzle Alloy 82/182 Dissimilar Metal Weld Modification***

NRC RAI 3-1

Section 1.0.c states that the location of the DMW fusion zones shall be determined.

Please discuss how the fusion zones are determined.

I&M Response to NRC RAI 3-1

ET will determine the fusion line. The DMW boundaries will be expanded by 0.25 inches or twice the accuracy of the ET technique which ever is greater to ensure the susceptible material is removed.

NRC RAI 3-2

Section 1.0.d states that all welding shall use Welding Procedure Specifications qualified in accordance with Appendix 2, Ambient Temperature Temperbead Welding, to the October 7, 2008, submittal. The staff notes that for the weld overlay design, temperbead welding is used only for the low alloy nozzle portion of the overlay installation and is not used for the welding on the piping, safe ends, or DMW.

NRC RAI 3-2(a)

Discuss whether the ambient temperature temper bead welding is the only welding process that will be used to install the inlay on the nozzle, safe end, pipe, and DMW. If welding procedures other than the temperbead welding will be used in the inlay application, Section 1.0.d needs to be revised to specify various welding procedures (qualified to which ASME requirements) for various components.

I&M Response to NRC RAI 3-2(a)

Even though not required when welding on non-ferritic materials, temper bead welding is the only welding process that will be used to install the inlay on the nozzle (ferritic), safe end (non-ferritic), pipe (non-ferritic), and DMW (non-ferritic).

NRC RAI 3-2(b)

Clarify whether the ambient temperature temperbead welding will be used to repair a degraded DMW prior to the inlay installation. If temperbead welding will not be used, provide requirements for the welding process and procedures that will be used to repair the degraded DMW in Section 1.0.

I&M Response to NRC RAI 3-2(b)

Temper bead welding will be used to repair a degraded DMW prior to the inlay installation.

NRC RAI 3-3

Section 1.0.g requires that Alloy 52M weld metal be used for at least the final 1/8 inch thickness and more than one layer. Section 1.0.g also states that "...Alloy 82 may be used for repair welding, when applicable, beyond at least 1/8 inch, and more than one layer thickness from the inside final surface..."

NRC RAI 3-3(a)

Clarify what is meant by "...beyond at least 1/8 inch, and more than one layer thickness from the inside final surface..."

I&M Response to NRC RAI 3-3(a)

Per Section 1.0(g), Alloy 52M is required to be deposited on the inside diameter (ID) "...for at least the final 1/8 inch thickness and more than one layer..." The remaining weld metal (beyond the ID and toward the outside diameter (OD) where the Alloy 52M is required to be used) may be Alloy 82. The area where it is acceptable to use Alloy 82 is described as "... beyond at least 1/8 inch and more than one layer thickness from the inside final surface."

NRC RAI 3-3(b)

Clarify the application of Alloy 82 and Alloy 52 with respect to their thickness and location in the inlay and DMW configuration. A sketch would help to clarify the question.

I&M Response to NRC RAI 3-3(b)

See revised Figures 1 and 2 in the relief request.

NRC RAI 3-4(a)

Section 1.0.h permits the application of a stainless steel buffer layer; however, the buffer layer is not shown in Figures 1 and 2 on page 6 of the relief request.

Reconcile Section 1.0.h and Figures 1 and 2. Also, specify the exact components that require a stainless steel buffer layer to be applied in Section 1.0.h.

I&M Response to NRC RAI 3-4(a)

The stainless steel buffer (Sulfur barrier) will be welded to the stainless steel safe end and cladding. See the sketches provided below. For substantial repairs, Alloy 82 will be used to fill the cavity. For shallow repairs, Alloy 52M will be used. When Alloy 52M is used, Alloy 82 and ER309L will be applied, where applicable, as barrier layers. Figures 1 and 2 were revised in the relief request to show the buffer layer.

NRC RAI 3-4(b)

Figures 1 and 2 show that stainless steel cladding is located on the inside surface of the low alloy ferritic nozzle. It appears from the figures that Alloy 52M will be welded directly to the stainless steel cladding.

Discuss whether a stainless steel buffer layer will be welded to the cladding prior to welding Alloy 52M. If that is the case, Figures 1 and 2 need to be revised.

I&M Response to NRC RAI 3-4(b)

A stainless steel barrier layer will be applied over high sulfur-phosphorous stainless steel safe end base material, nozzle cladding, and safe end cladding prior to welding Alloy 52M thereon. Refer to the figures above (3-4(a) response) for the location of ER309L and Alloy 82 barrier layers. Figures 1 and 2 were revised in the relief request to show the stainless steel buffer layer.

NRC RAI 3-4(c)
Discuss the welding procedures (under which ASME requirements) that will be used to install the stainless steel buffer layer if the ambient temperature temper bead welding is not used.

I&M Response to NRC RAI 3-4(c)

All welding (which includes ER309L/Alloy 82 barrier layer application, and Alloy 82/52M repair/inlay welding) will be performed using ambient temperature temper bead parameters.

NRC RAI 3-4(d)

Discuss whether the buffer layer will be considered as part of the total inlay thickness (considered to fulfill the minimum required thickness of the inlay).

I&M Response to NRC RAI 3-4(d)

The buffer layer will not be used to fulfill the minimum required thickness of the inlay. The buffer is 1/16 inch; the inlay is 1/8 inch. Where the barrier layer and the inlay replace pressure boundary materials, the replacement materials are considered pressure boundary materials (DMW and safe end). Where the barrier layer and inlay replace non-pressure boundary materials, the replacement materials are not considered to be pressure boundary materials (nozzle cladding).

NRC RAI 3-4(e)

Section 1.0.h states that "...it shall be permissible to apply ER309L austenitic stainless steel filler material and Alloy 82 near the DMW fusion zones, over the austenitic stainless steel material..."

Clarify this statement with a sketch and describe step by step how ER309L and Alloy 82 weld metals are deposited on the inside surface of the pipe, nozzle, safe end, and DMW.

I&M Response to NRC RAI 3-4(e)

Please refer to the responses for 3-4(a) and 3-4(b) for a description/sketch of where ER309L and Alloy 82 barrier layers are deposited. The ER309L barrier layer will be deposited first on the stainless steel safe end and cladding, stopping short of the DMW/stainless steel fusion line. Then the Alloy 82 barrier layer will be deposited on the DMW and extend beyond the DMW/stainless steel fusion lines until it ties in with the ER309L barrier layer.

NRC RAI 3-5

Section 2.0.a.i requires that the minimum final inlay thickness be at least 1/8 inches.

NRC RAI 3-5(a)

Discuss the thickness of each weld layer.

I&M Response to NRC RAI 3-5(a)

Each weld layer is approximately 1/16 inch thick.

NRC RAI 3-5(b)

Discuss the maximum allowed inlay thickness (excluding cavity repair) based on the stress analysis.

I&M Response to NRC RAI 3-5(b)

The ASME Section III, Structural Analysis for the Mitigative and Repair Inlay analyzed a 0.13 inch thick, 360 degrees (°) inlay deposition. A sensitivity study reconciled any deviation in inlay thickness up to 10 percent (%) of the nozzle wall thickness (0.256 inches – Outlet nozzles, 0.253 inches – Inlet nozzles) by showing that the inlay weld does not create a significant impact on stress intensity or cumulative fatigue usage factors.

NRC RAI 3-5(c)

Discuss the design thickness and number of the layers of the inlay (including the stainless steel buffer layer).

I&M Response to NRC RAI 3-5(c)

The design thickness of the inlay is 1/8 inch minimum consisting of more than one layer of Alloy 52M plus 1/16 inch for the stainless steel barrier layer.

NRC RAI 3-5(d)

Provide the thickness of the stainless steel buffer layer.

I&M Response to NRC RAI 3-5(d)

The stainless steel buffer layer consists of a single layer of ER309L, deposited using ambient temperature temper bead GTAW parameters, of approximately 1/16 inch thick.

NRC RAI 3-6

Section 2.0.a.iv states that the design life of the modified DMWs shall be 30 additional years. However, based on the scheduled inlay installation in October 2009, the end date of the third ISI interval of February 2010, and 20 years under the license renewal period, the inservice life of the modified DMW will exceed the design life of 30 years.

Discuss what actions will be taken if the operating life of the plant is projected to exceed the design life of the inlay.

I&M Response to NRC RAI 3-6

The design life is based on crack growth projections. Examinations described in the relief request will detect crack growth and establish new design life. The crack growth analysis is based on a 40-year design life.

NRC RAI 3-7(a)

Section 2.0.c.i states that the residual stress analysis shall assume a full circumferential 50% through wall weld repair from the inside surface of the DMW.

Discuss whether the analysis for the postulated 50% through wall flaw bounds the repair of the limiting 2-inch deep flaw as permitted by Section 2.0.b.i.2.

I&M Response to NRC RAI 3-7(a)

The analysis for the postulated 50% through-wall flaw does not bound the repair of the limiting 2-inch depth flaw. The limiting 2-inch deep flaw analysis was performed in addition to the postulated 50% through-wall analysis. Theses analyses are sequenced.

NRC RAI 3-7(b)

To repair a 2-inch deep flaw, discuss the maximum allowed dimension of the repair cavity in the axial and circumferential direction of the pipe without affecting residual stresses of the weld.

I&M Response to NRC RAI 3-7(b)

If there is no flaw detected by UT and PT inspections, there will be only mitigation layers. Two different configurations have been considered (with and without repair) independently. The residual stresses are simulated separately for both situations. The worst case 2-inch inlet cavity weld repair (see Figure 2 in the relief request) that envelopes the mitigation inlay and tapers to a width that approximates the width of the weld (at the 2 inch depth), and that is 360° around is evaluated for weld residual stresses.

NRC RAI 3-7(c)

If a flaw deeper than 2 inches in the DMW is identified, discuss the correction actions that will be taken.

I&M Response to NRC RAI 3-7(c)

If a flaw is deeper than 2 inches in the DMW, the 2 inch repair weld inlay will be performed from the ID. The size of the remaining flaw will have to be evaluated to IWB-3514-2 and, if necessary, IWB-3600, if it exceeds the acceptance standards of IWB-3500.

NRC RAI 3-7(d)

Are there any circumstances that the licensee is planning for in which any portion of a flaw may be left in service in the DMW? If yes, provide the technical basis.

I&M Response to NRC RAI 3-7(d)

It is possible that a portion of a flaw may remain in service. The remaining embedded portion of the flaw will be evaluated to IWB-3514-2 and, if necessary, may be evaluated using IWB-3600 rules. There are no plans to leave any portion of a flaw in service in the DMW that is above the acceptance criteria of IWB-3600.

NRC RAI 3-8

For flaw growth analyses, Sections 2.0.c.ii.1 and 2.0.c.ii.2 specify the postulated initial flaw size (circumferential and axial flaws) in the inlay to be 1/16 inch deep.

NRC RAI 3-8(a)

Discuss the percentage of pipe thickness of the 1/16 inch deep flaw because it is not clear whether the exact total thickness of the inlay is 1/8 inch.

I&M Response to NRC RAI 3-8(a)

The 1/16 inch deep flaw is about one weld layer thick and it is around 2.5% of the pipe thickness. It is assumed that any inside surface flaw bigger than 1/16 inch can be detected after welding and final machining operation.

NRC RAI 3-8(b)

Discuss the allowable (acceptable) flaw size and calculated final flaw size in the inlay in terms of percentage of the pipe thickness and actual depth.

I&M Response to NRC RAI 3-8(b)

The allowable final flaw size is approximately 5.0% of the pipe thickness, while the maximum final flaw size is approximately 2.9% of the pipe thickness. For the inlay, initial postulated flaw size is 50% of the mitigation thickness, the final flaw size is 55% of the mitigation thickness.

NRC RAI 3-8(c)

If the calculated final flaw size in the inlay exceeds the allowable flaw size, discuss the corrective actions.

I&M Response to NRC RAI 3-8(c)

The calculated final flaw size in the inlay does not exceed the allowable flaw size. Flaw growth summaries are discussed in response to RAI 1-3.

NRC RAI 3-9

For flaw growth analyses, Sections 2.0.c.ii.3 and 2.0.c.ii.4 also specify the postulated circumferential and axial flaws with maximum acceptable flaw depth per IWB-3514-2, originating at the weld inlay and DMW interface and growing in the DMW.

NRC RAI 3-9(a)

Discuss the allowable depth of the final flaw size.

I&M Response to NRC RAI 3-9(a)

The allowable final flaw sizes are calculated based on the Section XI Appendix C and the proximity rule in IWA-3320. The crack growth in the weld inlay shall not penetrate the inlay such that it may be considered as a surface connected flaw. This is satisfied by meeting the proximity rule. The final flaw size in the DMW is 0.378 inch.

NRC RAI 3-9(b)

Discuss the flaw growth rates and degradation mechanisms that will be used in the flaw growth analyses in Section 2.0.c.ii.

I&M Response to NRC RAI 3-9(b)

Crack growth rates are shown in Crack Growth Analysis summaries in response to RAI 1-3. The only degradation mechanism considered is fatigue with a penalty for PWR environment.

For the flaws postulated in Section 2.0.c.ii.3 and Section 2.0.c.ii.4, PWSCC mechanism is not activated because the crack tip material has no contact with the primary water.

NRC RAI 3-9(c)

If the final flaw size in the DMW exceeds the allowable, discuss what corrective action will be taken.

I&M Response to NRC RAI 3-9(c)

The final flaw size in the DMW does not exceed the allowable flaw size.

NRC RAI 3-9(d)

Discuss whether the postulated flaw in the inlay and the postulated flaw in the DMW are connected when performing the flaw growth analyses.

I&M Response to NRC RAI 3-9(d)

The flaw postulated in item 2.0.c.ii.1 and 2.0.c.ii.2 is a surface flaw, whereas the flaw postulated in item 2.0.c.ii.3 and 2.0.c.ii.4 is a subsurface flaw. Each of these flaw types are therefore considered separately. The subsurface (embedded) flaws are considered one single flaw that can grow in both DMW (at one crack tip) and the inlay (the other crack tip). The allowable flaw size calculations are also based on a given type of single flaw. However, as discussed in the response to NRC RAI 3-9(b), the two crack tips can have different growth rates depending on the material, environment and crack tip stress intensity factor.

NRC RAI 3-9(e)

Discuss whether the postulated flaws in the inlay and in the DMW are assumed to grow concurrently.

I&M Response to NRC RAI 3-9(e)

The postulated subsurface flaw grows concurrently at the two crack tips. For each transient cycle, the crack growth is calculated for both crack tips and added to the total crack depth.

NRC RAI 3-10

Two inlay applications were proposed: one application assumes that the DMW is not degraded and the other application assumes that the DMW is degraded. The postulated flaw size in the inlay for both applications is the same for the flaw growth analyses.

However, the postulated flaws in the DMW for the flaw growth calculations are not the same for both applications. For the non-degraded DMW, the postulated flaw is 3/8 inch deep initiated from the inside surface of the pipe (as stated on page 2 of Enclosure 1). For the degraded DMW, the postulated flaw is 2 inch deep initiated from the outside surface of the DMW (as stated on page 3 of Enclosure 1). However, this difference is not reflected in Sections 2.0.c.ii.3 and 2.0.c.ii.4.

These two sections should be revised to be consistent with the description in Enclosure 1 of the October 7, 2008, letter.

I&M Response to NRC RAI 3-10

The postulated flaw in the degraded DMW case is the "as found" flaw. The flaw up to 2 inches deep will be repaired. After the repairs, no flaws will be in contact with the inlay. The crack growth for the repair case is only for the postulated flaw in the inlay.

NRC RAI 3-11

Section 3.0.a.iv states that the final surface of the inlay shall be suitable for surface and volumetric examination. Many of the NRC-approved weld overlay relief requests require a surface finish of 250 micro-in (6.3 micrometers) root mean square or better and the flatness sufficient to allow for adequate examination.

Discuss why a quantitative specification for surface smoothness is not required in the inlay design.

I&M Response to NRC RAI 3-11

There are no exceptions needed to applicable ASME Code and Electric Power Research Institute (EPRI) requirements concerning surface conditions for qualification of the examinations performed for inlay installation. Therefore, specific inlay final surface requirements are not defined in this relief request, since these requirements are defined by applicable ASME Code and EPRI requirements. The machining, PT, and UT processes are all automated. The machining process will be used during qualification to produce the surface for the PT and UT examinations. The requirement is that the surface be suitable for PT and UT, which will be demonstrated during qualification.

NRC RAI 3-12

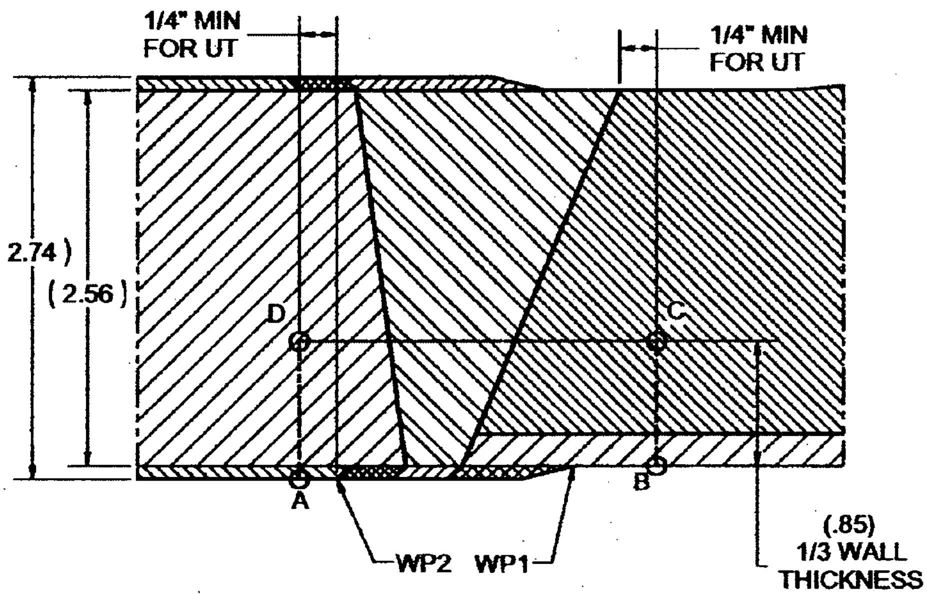
Sections 3.0.b.i and 3.0.b.ii provide requirements for pre-inlay examinations.

NRC RAI 3-12(a)

Discuss and provide a drawing of the required UT examination volume in term of specific axial length and volume of the DMWs, safe ends and nozzles.

I&M Response to NRC RAI 3-12(a)

The pre-inlay examination volume is consistent with the requirements of MRP-139, Materials Reliability Program: Primary System Piping Butt Weld Inspection and Evaluation Guidelines, as referenced in the relief request, and includes the inner 1/3t volume with an axial extent that is 1/4 inch beyond the weld or buttering (as applicable) fusion line measured at the widest point. See the figure below for pre-inlay examination volume (A-B-C-D).



PRE MACHINE EXAMINATION VOLUME

NRC RAI 3-12(b)

Discuss whether 100 percent coverage will be achieved on the required examination volume.

I&M Response to NRC RAI 3-12(b)

Based on available information regarding the weld configuration, 100% coverage is expected to be obtained. The actual coverage obtained will be assessed following the scanning of the weld during the outage.

NRC RAI 3-12(c)

Sections 3.0.b.i and 3.0.b.ii allow flaws detected in the DMW that are acceptable per IWB-3514-2 to remain in service. Provide technical basis for leaving flaws in DMWs in service because the staff has concern regarding this practice.

I&M Response to NRC RAI 3-12(c)

As indicated in 2.c.ii.3 and 2.c.ii.4, full circumferential and axial flaws (axial length of the inlay), respectively are postulated with depth equal to the maximum acceptable flaw depth per Table IWB-3514-2. The detailed flaw growth analyses for each of the above postulated flaws has demonstrated that the final flaw sizes, considering a 40-year design life, meet the ASME Section XI acceptance criteria.

NRC RAI 3-12(d)

Discuss whether the pre-inlay UT will be performed from the outside surface or inside surface of the pipe. If the UT will be performed from the inside surface of the pipe, the current UT technique cannot meet the 0.125 inch root-mean-square (RMS) error required by the ASME Code on flaw depth sizing.

Also, please clarify whether the RMS error limitation can be satisfied.

I&M Response to NRC RAI 3-12(d)

All UT examinations will be performed from the inside surface of the pipe. The Section XI, Appendix VIII qualified procedure used for depth sizing of service induced flaws does not meet the Code required 0.125 inch RMS error; refer to ISIR-27 (ML083540071).

ISIR-27 is NRC approval for I&M to use the demonstrated 0.224 inches instead of the 0.125 inches specified for depth sizing. In the event an indication is detected that requires depth sizing, the 0.099-inch difference between the required root mean square error (RMSE) and the demonstrated RMSE (0.224 inches – 0.125 inches = 0.099 inches) will be added to the measured through-wall extent for comparison with applicable acceptance criteria. If the examination vendor demonstrates an improved depth sizing RMSE prior to the examination, the excess of that improved RMSE over the 0.125-inch RMSE requirement, if any, will be added to the measured value for comparison with applicable acceptance criteria.

If a flaw is detected, the measured flaw depth will be adjusted (increased) as indicated above and that value used for comparison to the Section XI, IWB-3500 acceptance standard or used for IWB-3600 analysis, if applicable. If the flaw will be completely removed, the depth sizing accuracy would not be relevant. If a portion of the flaw will be left in service (embedded), the flaw can be sized using the techniques used for initial flaw sizing and will be applicable for monitoring the flaw size during subsequent examinations.

NRC RAI 3-12(e)

If an indication(s) is detected in the DMW by the pre-inlay UT, the licensee needs to commit to notify the NRC Project Manager as soon as possible (prior to inlay installation) by telephone or electronic mails.

I&M Response to NRC RAI 3-12(e)

I&M commits to notify the NRC Project Manager of rejectable indications (refer to Enclosure 5, Regulatory Commitments).

NRC RAI 3-13(a)

For the acceptance and preservice examinations, Sections 3.0.c.1 and 3.0.d.i permit small rounded indications with major dimension no greater than 1/16 inch to remain inservice per ASME Section III, NB-5352. The site of these indications has the potential to initiate planar flaws. The licensee stated that planar flaws are postulated to exist in the inlay and in the original DMW. The NRC staff is concerned that the inlay is made of only a few weld layers and a flaw with any depth may over time grow through the inlay and invalidate the basis of isolating the DMW from the primary coolant.

Provide the technical basis for the proposed acceptance criteria of the surface examination. For acceptance and preservice examinations, the NRC staff considers penetrant test (PT) white (i.e., no indications) to be acceptable.

I&M Response to NRC RAI 3-13(a)

The postulated flaw growth calculation for the inlay demonstrates that the acceptance criteria for small rounded indications with major dimension no greater than 1/16 inch is acceptable for the inlay. The analysis includes two different flaw scenarios, both involving a flaw 1/16 inch deep. One scenario is a 360° circumferential flaw and the second scenario is an axial flaw the entire length of the inlay. The analysis of both cases are conservative for the acceptance examination requirements and show that the flaws have negligible growth and do not break through the 1/8-inch inlay thickness for the life of the plant. In addition, future ISI examinations will include the inlay. I&M's response to NRC RAI 3-17(a) provides the technical basis for the inspection schedule.

Furthermore, there is no known evidence of crack initiation in Alloy 52 from any study to date. A summary of crack initiation studies to date is documented in MRP-237, Revision 1 (ML081370264). Alloy 690/52/152 crack initiation and crack growth research and development collaboration is ongoing. Until such time that evidence of crack initiation is identified, I&M considers that a "PT white criteria" is an undue hardship that would likely impact dose and productivity.

NRC RAI 3-13(b)

Section 3.0.c.i states that "...Criteria for the balance of the surface examination area shall be in accordance with the inservice examination acceptance standards of Table IWB-3514-2..."

Define "the balance of the surface examination area" in Section 3.0.c.i or in Figure E1.

I&M Response to NRC RAI 3-13(b)

The balance of the surface examination area is the portion of the 309L barrier layer which is not covered by 52M inlay weld material and at least 1/2 inch of adjacent material on each side of the inlay.

NRC RAI 3-13(c)

Discuss whether an intermediate PT will be performed after each layer is deposited during inlay installation. If no intermediate PT is required, discuss the reason.

I&M Response to NRC RAI 3-13(c)

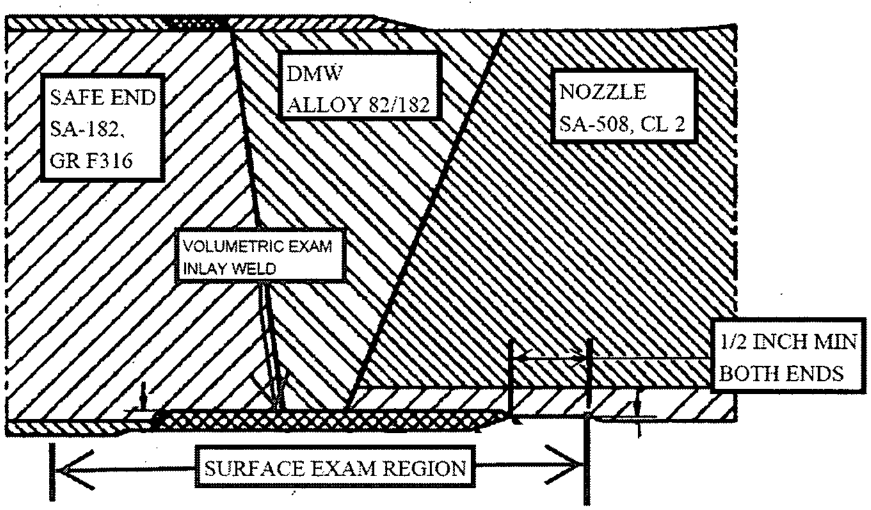
PT will not be performed after each layer is deposited during inlay installation. The welding process will be monitored remotely by installers utilizing a camera system as welding is performed. Any anomalies during the welding process will be corrected upon discovery, if required. The final acceptance and/or preservice UT of the inlay volume will provide adequate assurance of installation. No cracks, lack of fusion, or incomplete penetration are permitted.

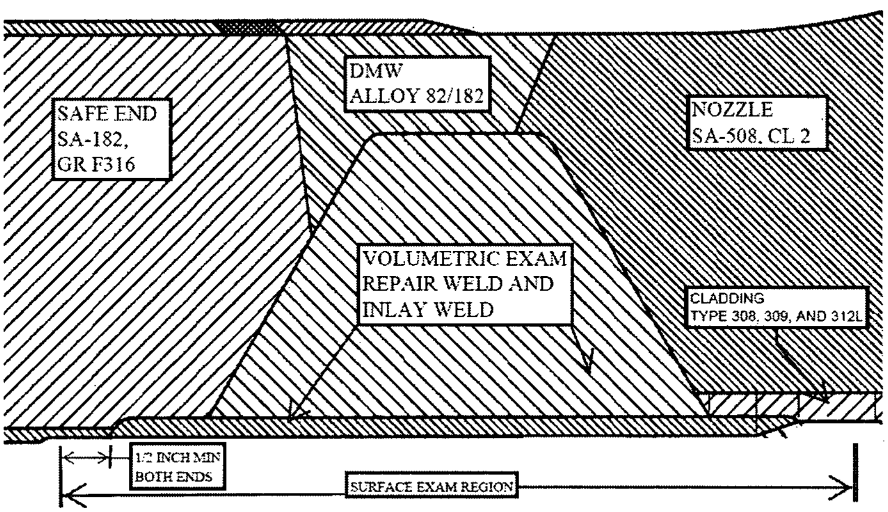
NRC RAI 3-13(d)

Specify or reference the required examination volume and area for the acceptance examination in Section 3.0.c (such as Figure E1).

I&M Response to NRC RAI 3-13(d)

The inlay surface, plus an additional 1/2 inch minimum of adjacent material, will be surface examined. The complete inlay volume, including the fusion zones, will be volumetrically examined. Please refer to the sketches below.





NRC RAI 3-14(a)

Please revise Section 3.0.c.ii to state that the acceptance examination UT will be performed from the inside surface of the pipe, if this is the case.

I&M Response to NRC RAI 3-14(a)

Section 3.0.a.vii of Appendix 1 to the relief request was revised to clarify that all examinations will be performed from the ID. Section 3.0.a.vii encompasses examination performed under Section 3.0.c.ii, thus acceptance examination UT will be performed from the inside surface of the pipe.

NRC RAI 3-14(b)

Section 3.0.c.ii states that "...Calibration standards shall be in accordance with Figure T-434.4.2.2..."

This statement should be revised to read: "...Calibration standards shall be in accordance with Figure T-434.4.2.2 as shown in Article 4 of ASME Section V..." This revision is to clarify where Figure T-434.4.2.2 is located.

I&M Response to NRC RAI 3-14(a)

Section 3.0.c.ii of Appendix 1 to the relief request was revised to clarify where Figure T-434.4.2.2 is located.

NRC RAI 3-15

For preservice examination, Section 3.0.d.ii specifies the required examination volume of the modified DMW as shown in Figure E1. The required examination includes the inner 1/3 region of the DMW. If the DMW is repaired prior to inlay installation and the repair is deeper than 1/3 thickness of the DMW, the required examination volume in Figure E1 would not cover the deep flaw repair (e.g., the repair of a 2-inch flaw) because a 2-inch flaw is more than 1/3 thickness of the hot leg or cold leg pipe thickness.

NRC RAI 3-15(a)

In this scenario, discuss how the repaired volume in the DMW that is outside of the required inspection volume per Figure E1 can be ensured of the structural integrity.

I&M Response to NRC RAI 3-15(a)

The full volume of any repair weld to the DMW will be examined to ASME Section III requirements using NB-5330 acceptance standards. The inner 1/3 thickness volume is only applicable to the pre-inlay and the preservice UT examinations of the modified DMW to ASME Section XI requirements.

NRC RAI 3-15(b)

Section 3.0.d.ii should be revised to indicate that the preservice UT is performed from the inside surface of the DMW. This is to differentiate the ISI requirement in Section 3.0.e.ii which allows UT from the outside surface of the DMW.

I&M Response to NRC RAI 3-15(b)

Section 3.0.a.vii of Appendix 1 to the relief request was revised to clarify that all examinations will be performed from the inner diameter (ID). Section 3.0.a.vii encompasses Section 3.0.d.ii, thus preservice UT is performed from the inside surface of the pipe.

NRC RAI 3-15(c)

Section 3.0.d.ii states that the preservice UT is performed in accordance with Code Case N-695. The NRC staff notes that Code Case N-695 is applicable to the inspection of DMWs using EPRI's Performance Demonstration Initiative to satisfy the ASME Code, Section XI, Appendix VIII, Supplement 10. Supplement 10 is related to the UT of DMW, not to the inlay design. Also, Code Case N-695 does not provide specifications for the inspection of inlays.

NRC RAI 3-15(c)(1)

Please provide the technical basis of how Code Case N-695 can be applied to the inspection of the inlay.

I&M Response to NRC RAI 3-15(c)(1)

Code Case N-695 is not applicable to the inspection of the inlay. There are three separate UT examinations performed; the pre-inlay, inlay acceptance, and preservice. Only the pre-inlay and the preservice are performed in accordance with Code Case N-695. The inlay acceptance UT examination is performed in accordance with ASME Section III requirements using a calibration standard in accordance with Figure T-434.4.2.2 as shown in Article 4 of ASME Section V (all Section V references are to the 2001 Edition with the 2002 Addenda) and Section III, NB-5330(b) acceptance standard.

NRC RAI 3-15(c)(2)

Explain whether Appendix VIII permits extension of Supplement 10 to the inlay configuration. Address whether extending Supplement 10 to the inlay configuration meets the requirements of 10 CFR 50.55a or does the request for alternative ISIR-28 need to address extension of the UT qualification.

I&M Response to NRC RAI 3-15(c)(2)

Appendix VIII, Supplement 10, states that it is not applicable to welds containing supplemental corrosion resistant cladding and does not address extension of the qualification to the inlay configuration. Section XI, Appendix I (1995 edition and later) states that if Appendix VIII is not applicable then the examination is to be performed using procedures in accordance with Section V, Article 4. However, the quality of the examination is greatly enhanced using Appendix VIII demonstrated procedures. Accordingly, I&M has elected to use the Supplement 10 demonstrated procedures as permitted by Section V, Article 4 and Article 1, T-150(a).

In order to assure that the Supplement 10 procedures are not adversely affected by the application of weld inlay, a separate demonstration was performed using a full scale DMW mockup containing an inlay. This demonstration was sponsored by the Pressurized Water Reactor Owner's Group (ML081910753). This activity concluded that inlaid components can be reliably examined using current Appendix VIII qualified procedures with no further demonstration required for procedures, personnel, or equipment.

NRC RAI 3-16

In Figure E1, there are no definitions and specifications for A and B points, and ¼-inch and ½-inch lines.

NRC RAI 3-16(a)

Clarify how points A and B are selected, and how the demarcation line for the ½ inch and ¼ inch distance is selected.

I&M Response to NRC RAI 3-16(a)

The examination axial boundaries established by points A and B (for volumetric) or E and F (for surface) are relative to the edges of the Alloy 52M material, sulfur mitigation layer (if applicable), or the DM weld toes and buttering (where applicable) whichever extends the greatest distance from the weld centerline.

The examination volume will be determined by the bounding structural weld toe, either on the OD and/or the ID. The examination volume will be as illustrated in the figures shown in the answer to NRC RAI 3-16(b), or a combination of the two figures depending on the size and location of the repair weld.

NRC RAI 3-16(b)

Provide the basis of the ¼ inch and ½ inch distances. Section 2.0.a.ii does specify ¼ inches from the DMW fusion zones; however, it is not clear how the ¼ inch distance discussed in Section 2.0.a.ii is applicable to Figure E1.

Also, please provide the definition and explanation in Figure E1 as footnotes.

I&M Response to NRC RAI 3-16(b)

The 1/4 inch and 1/2 inch examination distances are modified by the inlay design which may extend the examination boundaries further as described in 3-16(a) above. The 1/4 inch distance discussed in Section 2.0.a.ii assures that the inlay material bounds the Alloy 82/182 material sufficiently. The actual boundaries of the final as-welded deposits determine the examination boundaries. Figure E1 of the relief request was revised to clarify the 1/4 inch and 1/2 inch distances. Volumetric examination and surface examination are described in the revised figure for the non-repaired inlay and the repaired inlay.

NRC RAI 3-17

Section 3.0.e.i states that volumetric and surface examinations shall be performed on all the modified DMWs no sooner than the third refueling outage and no later than 10 years following inlay welding.

NRC RAI 3-17(a)

Discuss the technical basis for this inspection schedule.

I&M Response to NRC RAI 3-17(a)

The design life of the inlay is 40 years. Examinations are scheduled for volumetric and surface examination of Alloy 52/152 inlay material. Surface examination of all welds will be performed no sooner than the third refueling outage and no later than 10 years following inlay.

A surface examination (ET or PT) along with the UT of the nozzle weld within 10 years after mitigation provides sufficient inspection frequency to detect early inlay/cladding failures based on crack growth analysis. For cracking to initiate, the inlay or cladding would have to crack through its thickness and then PWSCC would have to initiate and grow to produce an unacceptable indication. The surface examination is required to assure that the inlay or clad does not allow a leak path to the susceptible material.

Examinations earlier than the first 10 years of service were originally proposed primarily because of concerns that the boundary of the susceptible material may not be clearly understood and coverage of the susceptible material may not be 100%. This concern is being addressed by a requirement that the pre-mitigation inspection confirm the extent of the susceptible material by a positive technique by ET.

Examination volumes that show no indications of cracking will be placed into a population to be examined on a sample basis. 25% of this population shall receive a volumetric examination and a surface examination performed from the weld ID surface. The 25% sample shall be added to the ISI Program for inspection every 10 years (refer to Enclosure 5, Regulatory Commitments).

NRC RAI 3-17(b)

Revise Section 3.0.e.i to clarify whether the UT and surface examination are performed from the inside surface of the DMW because Section 3.0.e.ii allows the UT to be performed from either inside surface or outside surface of the DMW.

I&M Response to NRC RAI 3-17(b)

Section 3.0.a.vii of Appendix 1 to the relief request has been added to clarify location and states that examinations are performed from the ID. Figure E1 of the relief request was revised to clarify volumetric and surface examination criteria.

NRC RAI 3-18

Section 3.0.e does not appear to provide reference or definition as to the required examination volume for inservice examinations. It appears that Section 3.0.e.i should be revised to require that the examination volume in Figure E1 be followed for the inservice examinations performed from both inside diameter and outside diameter of the pipe.

Please clarify.

I&M Response to NRC RAI 3-18

Section 3.0.a.vii of Appendix 1 to the relief request has been added to clarify location and states that examinations are performed from the ID. Figure E1 of the relief request was revised to clarify volumetric and surface examination criteria.

NRC RAI 3-19

Section 3.0.e.ii states that 25% of the population of DMWs with no indications shall receive a volumetric examination performed from the outside diameter (OD) surface, or a volumetric examination and a surface examination performed from the weld inside diameter (ID) surface.

NRC RAI 3-19(a)

If the preservice UT of an inlaid DMW is performed from the ID surface and the subsequent ISI UT is performed from the OD surface, the inspection results of the OD UT inspection will not be comparable to the results of the ID UT inspection.

Discuss how the UT inspection results from ID and OD surface can be compared.

I&M Response to NRC RAI 3-19(a)

The inservice examinations are planned from the ID.

NRC RAI 3-19(b)

Clarify which ASME Code, Section XI, Appendix VIII supplement will be used to qualify the ISI UT performed from the OD surface of the pipe.

I&M Response to NRC RAI 3-19(b)

All examinations are planned from the ID.

NRC RAI 3-19(c)

An inlay thickness of 0.125 inch on a reactor vessel nozzle would be on the order of 5% of the wall thickness or less. The probability of detection for a crack of this depth in the inlay from the OD surface would be expected to be low since 10% is often viewed as the threshold of UT detection. Also, once a potential crack reaches the Alloy 82/182 weld, the weld may not be inspected (under the proposed 25% sample) or the inspection interval is long (10 years) and the crack growth rate is high.

I&M Response to NRC RAI 3-19(c)

Crack growth increases exponentially with temperature. The hot legs operate at a higher temperature than the cold legs. If PWSCC were to occur, the growth in the hot leg would be greater. Based on this, the hot legs will serve as a leading indicator. These can be examined from the ID without removing the core barrel.

NRC RAI 3-19-(d)

Therefore, please discuss why a surface examination is not required for the UT performed from the weld outside surface whereas a surface examination is required for the UT performed from the weld inside surface.

I&M Response to NRC RAI 3-19(d)

Examinations are planned to be performed from the ID

NRC RAI 3-20

Section 3.0.e.iii states that if inservice examinations reveal crack growth or new cracking meeting the acceptance standards of IWB-3132.3, the DMW examination volume shall be reexamined during the first refueling outage following discovery of the growth or new cracking. IWB-3132.3 of the 1989 edition of the ASME Code, Section XI, which is the code of record, states that the component that contains a flaw shall be replaced.

Please provide the following:

NRC RAI 3-20(a)

Clarify if this is the intent of Section 3.0.e.iii;

I&M Response to NRC RAI 3-20(a)

Section 3.0.e.iii has been revised to refer to IWB-3132. The intent is to comply with the evaluation, acceptance, and repair actions as described in IWB-3000, Standards for Examination Evaluation, and IWB-4000, Repair/Replace Activity.

NRC RAI 3-20(b)

Revise Section 3.0.e.iii to clearly define the location (in the inlay and/or DMW) of the detected new flaw or crack growth;

I&M Response to NRC RAI 3-20(b)

Section 3.0.e.iii was revised to clearly define the location of the detected new flaw or crack growth. Figures 3-1 and 3-2 were added in Section 3.0.e.iii to clarify the location.

The basis document for Code Case flaw growth evaluations for the postulated flaws as described below is performed in accordance with IWB-3640 of Section XI of the ASME B&PV Code, whereby stress intensity factors associated with the transient and sustained normal operating loads, including welding residual stresses obtained above are calculated.

Planar flaws are postulated to exist in the newly applied weld inlay and in the original DMW. Both circumferential and axial flaws are evaluated in conjunction with the maximum size flaw permitted by the inservice examination acceptance standards of Table IWB-3514-2 of Section XI.

Four types (two surface-connected and two subsurface) of flaws are postulated to exist in the DMW at the time the weld inlay is applied. Postulated inside surface flaw configurations include an inside surface full (360°) circumferential flaw and semi-elliptical axial flaw as shown in Figure 3-1 and Figure 3-2, respectively. The initial flaw depths for the internal surface circumferential and axial flaws are taken to be 50% of the thickness of the weld inlay from the inside surface (1/16 inch flaw depth in 1/8 inch thick inlay). Postulated subsurface flaw configurations include full (360°) circumferential flaw and semi-elliptical axial flaw as shown in Figure 3-1 and Figure 3-2, respectively. The depth of the subsurface flaws is 3/8 inch located in the DMW just below the inlay. The length of an axial flaw (inside surface or subsurface) is the entire DMW width.

The four types of flaws are summarized as follows:

Postulated flaws in weld inlay:

1. Circumferential flaw of depth 50% through the weld inlay thickness, surface connected for the entire circumference of the inlay.
2. Axial flaw of depth 50% through the weld inlay thickness, surface connected for its entire width.

Postulated flaws in original DMW:

3. Circumferential flaw of depth equal to the maximum acceptable flaw depth per Table IWB-3514-2, below the interface of Weld Inlay and DMW for the entire circumference.

4. Axial flaw of depth equal to the maximum acceptable flaw depth per Table IWB-3514-2, below the interface of weld inlay and DMW for the entire width of the DMW.

NRC RAI 3-20(c)

If a new flaw is detected in the inlay, the staff's position is that that flaw should satisfy Table IWB-3410-1. A flaw that exceeds Table IWB-3410-1 should be removed.

I&M Response to NRC RAI 3-20(c)

The Table IWB-3410 is being used to set the reexamination frequency as cracked or uncracked. Flaws may be evaluated under IWB-3600, which requires submittal to the NRC.

NRC RAI 3-21

Sections 3.0.e.ii, 3.0.e.iv, and 3.0.f discussed a sample inspection of 25% of the DMW. However, the licensee has not provided requirements for inspection expansion if an indication or flaw growth is detected in any weld in the sample inspection.

Discuss the reason why inspection expansion is not considered in the relief request.

I&M Response to NRC RAI 3-21

The 25% sample size will be 2 hot leg nozzle welds. If sample examinations reveal flaws exceeding the acceptance requirements, the examination shall be further extended to include the remaining hot leg welds. Should more flaws be revealed not meeting the acceptance standards, a second examination expansion will include the cold leg welds to reach the required number of additional examinations.

NRC RAI 3-22

The NRC staff notes that ASME Code Case N-770 provides different examination frequencies for the inlay application of the non-degraded DMW and degraded DMW.

Section 3.0.e needs to state whether the ISI examination requirements for both inlay applications (i.e., the non-degraded DMW and the degraded DMW) are the same. If they are not the same, Section 3.0.e needs to be revised to specify the examination requirement for each of the applications.

I&M Response to NRC RAI 3-22

I&M considers that Section 3.0.e does not need to be changed. The existing welds do not have any identified flaws. Based on this, the welds would be classified as uncracked in Code Case N-770. The examination frequency then applies to the Alloy 52/152 inlay material for volumetric and surface examination. Surface examination of all welds no sooner than the third refueling outage and no later than 10 years following.

Examination volumes that show no indications of cracking shall be placed into a population to be examined on a sample basis. 25% of this population shall receive a volumetric examination and a surface examination performed from the weld ID surface. The two hot leg welds will represent a conservative sample because of the higher operating temperature. The 25% sample shall be added to the ISI Program and shall be examined once each inspection interval.

An embedded flaw greater than allowed by IWB-3400 would have a separate analysis under IWB-3600. The re-examination frequency would be in accordance with the results of the analysis.

NRC RAI 3-23(a)

Provide the technical basis for the sample inspection strategy in Section 3.0.f.

I&M Response to NRC RAI 3-23(a)

The basis for the sample strategy is the hot legs operate at a higher temperature than the cold legs. Crack growth studies show a temperature dependency (refer to Advanced FEA Evaluation of Growth of Postulated Circumferential PWSCC Flaws in Pressurizer Nozzle Dissimilar Metal Welds (MRP-216): Evaluations Specific to Nine Subject Plants, EPRI, Palo Alto, CA: 2007. 1015383) (ML072410240). This would allow for hot leg examinations which would act as a leading indicator of PWSCC. The hot legs are accessible without removing the lower internals (core barrel).

NRC RAI 3-23(b)

It was stated that those welds not included in the 25% sample shall be examined prior to the end of the evaluation period. Please define or clarify the "evaluation period".

I&M Response to NRC RAI 3-23(b)

The evaluation period is established based upon flaw growth analysis as required in IWB-3600. With the welds classified as uncracked the time between examinations becomes 10 years.

NRC RAI 3-24

Section 4.0 states that a system leakage test shall not be required for a weld inlay thickness of 10% or less of the original DMW thickness.

Provide the technical basis why a system leakage will not be perform if the inlay thickness is 10% or less of the original DMW thickness for the inlay configuration and for the inlay repair configuration.

I&M Response to NRC RAI 3-24

Section XI, IWA-4700(b)(4) exempts pressure vessel repairs from performing a system leakage test where the repaired cavity does not exceed 10% of the minimum design wall thickness. Therefore, the inlay would not require one, but repairs greater than 0.256 inches for the outlet nozzles and 0.253 inches for the inlet nozzles would. The welds are included in the Class 1 System Pressure Test performed at the end of each refueling outage.

NRC RAI 3-25

The inlay design allows repair to a degraded DMW prior to inlay installation. However, the licensee did not specify NDE requirements for the DMW repair in Section 3, Examination.

Provide requirements for the NDE examinations for the case where a DMW is being repaired prior to inlay installation.

I&M Response to NRC RAI 3-25

If weld repair is required, the weld repair volume shall be ultrasonically examined in accordance with Section V, Article 4 (All Section V references are to the 2001 Edition with the 2002 Addenda). The acceptance criteria of Section III, NB-5330 shall apply. The examination shall be conducted no sooner than 48 hours after the completion of the third temper bead layer over the ferritic steel base material.

4. Enclosure: Appendix 2—Ambient Temperature Temperbead Welding

NRC RAI 4-1

Section 1.1 states that the maximum finished surface area of the inlay over the low alloy ferritic base metal is 500 square inches. Code Case N-638-1 allows only 100 square inch area over the low alloy ferritic base metal. The NRC has approved the use of 500 square inch area over the ferritic base metal for the weld overlay installation based on the industry's finite element analysis. The staff notes that N-638-1 can be generically applied to the overlay and inlay design. However, it is not clear whether the industry's finite element model for the 500 square inch overlay area is applicable to the proposed 500 square inch weld inlay area.

Describe the stress analysis and its results that demonstrate the acceptability of the 500 square inch weld inlay area covering the inside surface of the ferritic nozzle base metal.

I&M Response to NRC RAI 4-1

The relief request was revised to reflect a maximum surface area of 300 square inches. The maximum surface area for a combined mitigation and repair weld inlay would be less than 300 square inches. The following discussion is based upon EPRI Technical Report 1003616, "Additional Evaluations to Expand Repair Limits for Pressure Vessels and Nozzles", March 2004 (See ML073250004). Under EPRI sponsorship, Structural Integrity Associates performed FEA and evaluated weld repair areas over 100 square inches. A 126 square inch temper bead weld overlay repair for a boiling water reactor feedwater nozzle was modeled. Two weld cavities on the inside surface of a ferritic steel reactor vessel were evaluated, a 100 square inch weld repair and a 500 square inch weld repair. The ID repair cavities are comparable to the Inlay mitigation / repair. Residual stresses were evaluated for the OD overlay and reactor vessel ID welds. The results from the finite element analyses showed that: 1) the larger weld repair area did not have any detrimental affects on the weld residual stress, 2) in some cases the residual stress distributions are improved, and 3) tempering of the HAZ was unaffected by the overlay.

NRC RAI 4-2

Section 3.3 specifies that the interpass temperature shall be determined by heat flow calculations or measurement of a test coupon.

Discuss whether the heat flow calculations and the test coupon approach have been qualified to determine accurately the interpass temperature at the inside surface of a pipe for the welding inlay underwater.

I&M Response to NRC RAI 4-2

The test coupon approach will be used to determine the interpass temperature at the inside surface of a pipe for the weld inlay. The weld inlay will not be applied underwater. Therefore, there is no difference between a test coupon measurement and application of the weld inlay. This process is currently being qualified. A summary is required to be submitted in the NIS-2 (owner's acceptance review) package.

AREVA 02-9069388C-000 - (PROPRIETARY)

AREVA 02-9069389C-000 - (PROPRIETARY)

Enclosure 4 to AEP-NRC-2009-42

Westinghouse Affidavit for Withholding Weld Information from Public Disclosure and AREVA Affidavit for Withholding Existing Configuration Drawings from Public Disclosure

Westinghouse

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Our ref: CAW-09-2544

April 6, 2009

APPLICATION FOR WITHHOLDING PROPRIETARY INFORMATION FROM PUBLIC DISCLOSURE

Subject: LTR-PCAM-07-74, Figure 2 and Table 1, "D. C. Cook Unit 1 RV Inlet Nozzle Weld Information" (Proprietary)

The proprietary information for which withholding is being requested in the above-referenced report is further identified in Affidavit CAW-09-2544 signed by the owner of the proprietary information, Westinghouse Electric Company LLC. The affidavit, which accompanies this letter, sets forth the basis on which the information may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in paragraph (b)(4) of 10 CFR Section 2.390 of the Commission's regulations.

Accordingly, this letter authorizes the utilization of the accompanying affidavit by American Electric Power.

Correspondence with respect to the proprietary aspects of the application for withholding or the Westinghouse affidavit should reference this letter, CAW-09-2544 and should be addressed to J. A. Gresham, Manager, Regulatory Compliance and Plant Licensing, Westinghouse Electric Company LLC, P.O. Box 355, Pittsburgh, Pennsylvania 15230-0355.

Very truly yours,

J A Gresham

J. A. Gresham, Manager
Regulatory Compliance and Plant Licensing

cc: G. Bacuta (NRC OWFN 12E-1)

Enclosures

AFFIDAVIT

COMMONWEALTH OF PENNSYLVANIA:

ss

COUNTY OF ALLEGHENY:

Before me, the undersigned authority, personally appeared J. A. Gresham, who, being by me duly sworn according to law, deposes and says that he is authorized to execute this Affidavit on behalf of Westinghouse Electric Company LLC (Westinghouse), and that the averments of fact set forth in this Affidavit are true and correct to the best of his knowledge, information, and belief:

J. A. Gresham, Manager
Regulatory Compliance and Plant Licensing

Sworn to and subscribed before me
this 6th day of April, 2009

Sharon L. Markle
Notary Public

COMMONWEALTH OF PENNSYLVANIA
Notarial Seal
Sharon L. Markle, Notary Public
Monroeville Boro, Allegheny County
My Commission Expires Jan. 29, 2011
Member, Pennsylvania Association of Notaries

(1) I am Manager, Regulatory Compliance and Plant Licensing, in Nuclear Services, Westinghouse Electric Company LLC (Westinghouse), and as such, I have been specifically delegated the function of reviewing the proprietary information sought to be withheld from public disclosure in connection with nuclear power plant licensing and rule making proceedings, and am authorized to apply for its withholding on behalf of Westinghouse.

(2) I am making this Affidavit in conformance with the provisions of 10 CFR Section 2.390 of the Commission's regulations and in conjunction with the Westinghouse "Application for Withholding" accompanying this Affidavit.

(3) I have personal knowledge of the criteria and procedures utilized by Westinghouse in designating information as a trade secret, privileged or as confidential commercial or financial information.

(4) Pursuant to the provisions of paragraph (b)(4) of Section 2.390 of the Commission's regulations, the following is furnished for consideration by the Commission in determining whether the information sought to be withheld from public disclosure should be withheld.

(i) The information sought to be withheld from public disclosure is owned and has been held in confidence by Westinghouse.

(ii) The information is of a type customarily held in confidence by Westinghouse and not customarily disclosed to the public. Westinghouse has a rational basis for determining the types of information customarily held in confidence by it and, in that connection, utilizes a system to determine when and whether to hold certain types of information in confidence. The application of that system and the substance of that system constitutes Westinghouse policy and provides the rational basis required.

Under that system, information is held in confidence if it falls in one or more of several types, the release of which might result in the loss of an existing or potential competitive advantage, as follows:

(a) The information reveals the distinguishing aspects of a process (or component, structure, tool, method, etc.) where prevention of its use by any of Westinghouse's competitors without license from Westinghouse constitutes a competitive economic advantage over other companies.

(b) It consists of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), the application of which data secures a competitive economic advantage, e.g., by optimization or improved marketability.

(c) Its use by a competitor would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing a similar product.

(d) It reveals cost or price information, production capacities, budget levels, or commercial strategies of Westinghouse, its customers or suppliers.

(e) It reveals aspects of past, present, or future Westinghouse or customer funded development plans and programs of potential commercial value to Westinghouse.

(f) It contains patentable ideas, for which patent protection may be desirable.

There are sound policy reasons behind the Westinghouse system which include the following:

(a) The use of such information by Westinghouse gives Westinghouse a competitive advantage over its competitors. It is, therefore, withheld from disclosure to protect the Westinghouse competitive position.

(b) It is information that is marketable in many ways. The extent to which such information is available to competitors diminishes the Westinghouse ability to sell products and services involving the use of the information.

(c) Use by our competitor would put Westinghouse at a competitive disadvantage by reducing his expenditure of resources at our expense.

(d) Each component of proprietary information pertinent to a particular competitive advantage is potentially as valuable as the total competitive advantage. If competitors acquire components of proprietary information, any one component may be the key to the entire puzzle, thereby depriving Westinghouse of a competitive advantage.

(e) Unrestricted disclosure would jeopardize the position of prominence of Westinghouse in the world market, and thereby give a market advantage to the competition of those countries.

(f) The Westinghouse capacity to invest corporate assets in research and development depends upon the success in obtaining and maintaining a competitive advantage.

(iii) The information is being transmitted to the Commission in confidence and, under the provisions of 10 CFR Section 2.390, it is to be received in confidence by the Commission.

(iv) The information sought to be protected is not available in public sources or available information has not been previously employed in the same original manner or method to the best of our knowledge and belief.

(v) The proprietary information sought to be withheld in this submittal is that which is appropriately marked in LTR-PCAM-07-74, Figure 2 and Table 1, "D. C. Cook Unit 1 RV Inlet Nozzle Weld Information," (Proprietary) dated September 17, 2007, for submittal to the Commission, being transmitted by American Electric Power letter and Application for Withholding Proprietary Information from Public Disclosure, to the Document Control Desk.

This information is part of that which will enable Westinghouse to:

(a) Provide American Electric Power with the information needed to respond to an RAI concerning reactor vessel nozzle weld inlay.

Further this information has substantial commercial value as follows:

(a) Westinghouse plans to sell the use of this information to its customers for purposes of providing fabrication details of the reactor vessel nozzle welds

(b) Westinghouse can sell support and defense of the use of the fabrication details of the reactor vessel nozzle welds

(c) The information requested to be withheld reveals the distinguishing aspects of a methodology which was developed by Westinghouse.

Public disclosure of this proprietary information is likely to cause substantial harm to the competitive position of Westinghouse because it would enhance the ability of competitors to provide similar calculations and licensing defense services for commercial power reactors without commensurate expenses. Also, public disclosure of the information would enable others to use the information to meet NRC requirements for licensing documentation without purchasing the right to use the information.

The development of the technology described in part by the information is the result of applying the results of many years of experience in an intensive Westinghouse effort and the expenditure of a considerable sum of money.

In order for competitors of Westinghouse to duplicate this information, similar technical programs would have to be performed and a significant manpower effort, having the requisite talent and experience, would have to be expended.

Further the deponent sayeth not.

Proprietary Information Notice

Transmitted herewith are proprietary and/or non-proprietary versions of documents furnished to the NRC in connection with requests for generic and/or plant-specific review and approval.

In order to conform to the requirements of 10 CFR 2.390 of the Commission's regulations concerning the protection of proprietary information so submitted to the NRC, the information which is proprietary in the proprietary versions is contained within brackets, and where the proprietary information has been deleted in the non-proprietary versions, only the brackets remain (the information that was contained within the brackets in the proprietary versions having been deleted). The justification for claiming the information so designated as proprietary is indicated in both versions by means of lower case letters (a) through (f) located as a superscript immediately following the brackets enclosing each item of information being identified as proprietary or in the margin opposite such information. These lower case letters refer to the types of information Westinghouse customarily holds in confidence identified in Sections (4)(ii)(a) through (4)(ii)(f) of the affidavit accompanying this transmittal pursuant to 10 CFR 2.390(b)(1).

Copyright Notice

AFFIDAVIT

COMMONWEALTH OF VIRGINIA)
) ss.
CITY OF LYNCHBURG)

1. My name is Gayle F. Elliott. I am Manager, Product Licensing, for AREVA NP Inc. and as such I am authorized to execute this Affidavit.

2. I am familiar with the criteria applied by AREVA NP to determine whether certain AREVA NP information is proprietary. I am familiar with the policies established by AREVA NP to ensure the proper application of these criteria.

3. I am familiar with the AREVA NP information contained in drawing 02-9069388C-000, "DC Cook Unit 1 Reactor Vessel Outlet Nozzle Existing Configuration," dated 4/22/2008, and drawing 02-9069389C-000, "DC Cook Unit 1 Reactor Vessel Inlet Nozzle Existing Configuration," dated 4/22/2008 and referred to herein as "Documents." Information contained in these Documents has been classified by AREVA NP as proprietary in accordance with the policies established by AREVA NP for the control and protection of proprietary and confidential information.

4. These Documents contain information of a proprietary and confidential nature and is of the type customarily held in confidence by AREVA NP and not made available to the public. Based on my experience, I am aware that other companies regard information of the kind contained in these Documents as proprietary and confidential.

5. These Documents have been made available to the U.S. Nuclear Regulatory Commission in confidence with the request that the information contained in these Documents be withheld from public disclosure. The request for withholding of proprietary information is

made in accordance with 10 CFR 2.390. The information for which withholding from disclosure is requested qualifies under 10 CFR 2.390(a)(4) "Trade secrets and commercial or financial information."

6. The following criteria are customarily applied by AREVA NP to determine whether information should be classified as proprietary:

(a) The information reveals details of AREVA NP's research and development plans and programs or their results.

(b) Use of the information by a competitor would permit the competitor to significantly reduce its expenditures, in time or resources, to design, produce, or market a similar product or service.

(c) The information includes test data or analytical techniques concerning a process, methodology, or component, the application of which results in a competitive advantage for AREVA NP.

(d) The information reveals certain distinguishing aspects of a process, methodology, or component, the exclusive use of which provides a competitive advantage for AREVA NP in product optimization or marketability.

(e) The information is vital to a competitive advantage held by AREVA NP, would be helpful to competitors to AREVA NP, and would likely cause substantial harm to the competitive position of AREVA NP.

The information in these Documents is considered proprietary for the reasons set forth in paragraphs 6(b) and 6(c) above.

7. In accordance with AREVA NP's policies governing the protection and control of information, proprietary information contained in these Documents have been made available, on a limited basis, to others outside AREVA NP only as required and under suitable agreement providing for nondisclosure and limited use of the information.

8. AREVA NP policy requires that proprietary information be kept in a secured file or area and distributed on a need-to-know basis.

9. The foregoing statements are true and correct to the best of my knowledge, information, and belief.

SUBSCRIBED before me this 18th

day of June 2009.

Lisa Y. Harris-Scruggs

Lisa Y. Harris-Scruggs
NOTARY PUBLIC, COMMONWEALTH OF VIRGINIA
MY COMMISSION EXPIRES: 9/30/09
Reg. # 254386

LISA Y. HARRIS-SCRUGGS
Notary Public
Commonwealth of Virginia
254386
My Commission Expires Sep 30, 2009

Regulatory Commitments

The following table identifies those actions committed to by Indiana Michigan Power Company (I&M) in this document. Any other actions discussed in this submittal represent intended or planned actions by I&M. They are described to the Nuclear Regulatory Commission (NRC) for the NRC's information and are not regulatory commitments.

Commitment	Date
I&M will provide the Preemptive Weld Inlay ultrasonic examination results to the NRC.	Within 14 days after the completion of the last ultrasonic examination of the weld inlays.
I&M will complete stress analysis summaries of the preemptive weld inlay to the NRC.	August 28, 2009
I&M will add the 25% inlay examination sample requirement to the Inservice Inspection Program.	March 1, 2010 (Part of fourth interval ISI inspection program)
I&M will notify the NRC Project Manager of any rejectable indication detected in the DMW by the pre-inlay UT.	Prior to inlay installation by telephone or electronic mail