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U.S. Nuclear Regulatory Commission
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Washington, D. C. 20555

Subject: Proposed Alternative to ASME Code Requirements for Weld Overlay Repair, RR-21 at James A. FitzPatrick Nuclear Power Plant

James A. FitzPatrick Nuclear Power Plant
Docket No. 50-333
License No. DPR-59

Dear Sir or Madam:

Pursuant to 10 CFR 50.55a(z)(1), James A. FitzPatrick Nuclear Power Plant (JAF) proposes Relief Request RR-21, "Weld Overlay of "A" Residual Heat Removal Low Pressure Coolant Injection Loop Dissimilar Metal Weld."

During Refueling Outage R22, a flaw was found by ultrasonic testing (UT) examination on the "A" Residual Heat Removal Low Pressure Coolant Injection Loop weld number 24-10-130. The weld is a Class 1 dissimilar metal weld located between a carbon steel valve and an austenitic stainless steel fitting (tee). In order to restore the pressure boundary and structural integrity of the weld, JAF proposes to perform a full structural weld overlay based on ASME Code Cases N-504-4 and N-638-4 with certain exceptions. Both ASME code cases have been conditionally approved by the NRC in Regulatory Guide 1.147. As a condition to using Code Case N-504-4 in Regulatory Guide 1.147, the provisions of Appendix Q of ASME Section XI must also be met.

The proposed alternative as described in Attachment 1 complies with 10 CFR 50.55a(z)(1) and provides an acceptable level of quality and safety. Approval of RR-21 is requested by February 2, 2017, in support of the current Refueling Outage.

Attachment 2 summarizes new regulatory commitments made by this submittal. Should you have any questions, please contact the Regulatory Assurance Manager, Mr. William C. Drews, at (315) 349-6562.

Very truly yours,
Mark Flaherty / M. Hawes

For/by Telecon
Brian R. Sullivan
Site Vice President

BRS:WCD:mh

Attachment 1: Relief Request RR-21: Weld Overlay of "A" Residual Heat Removal Low Pressure Coolant Injection Loop Dissimilar Metal Weld
Attachment 2: List of Regulatory Commitments

cc: USNRC, Region I Administrator
USNRC, Project Manager
USNRC, Resident Inspector
NYSERDA
NYPSC

JAFP-17-0010

Attachment 1

Relief Request RR-21:
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(24 pages)

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Weld Overlay of "A" Residual Heat Removal Low Pressure Coolant Injection Loop Dissimilar Metal Weld

I. ASME CODE COMPONENTS AFFECTED

Component: ISI Weld 24-10-130 "A" Residual Heat Removal (RHR) Low Pressure Coolant Injection (LPCI) Dissimilar Metal Weld (DMW) – Tee to Gate Valve

Code Class: 1

ASME Category: R-A, Item R1.16

References:

1. ASME Section XI, 2001 Edition/2003 Addenda except as listed in References 2 and 3
2. ASME Section XI, 2001 Edition/No Addenda to be used for Appendix VIII, "Performance Demonstration for Ultrasonic Examination Systems"
3. Appendix Q of ASME Section XI, 2004 Edition/2005 Addenda as required by Regulatory Guide 1.147
4. USAS B31.1.0, Power Piping, 1967 Edition/1969 Addenda
5. ASME B31.1, Power Piping, 2007 Edition/No Addenda
6. ASME Section III, Subsection NB, 1992 Edition/No Addenda
7. ASME Code Case N-578-1, Risk Informed Requirements for Class 1, 2 or 3 Piping, Method B
8. ASME Code Case N-504-4, Alternative Rules for Repair of Classes 1, 2 and 3 Austenitic Stainless Steel Piping
9. ASME Code Case N-638-4, Similar and Dissimilar Metal Welding using Ambient Temperature Machine GTAW Temper Bead Technique
10. EPRI Report BWRVIP-75-A, Technical Basis for Revisions to Generic Letter 88-01 Inspection Schedules (1012621), dated October 11, 2005
11. SEP-ISI-007, ASME Section XI Fourth Ten-Year Inspection Interval Inservice Inspection Program Plan
12. Relief Request RR-5, Relief from ASME Section XI Appendix VIII, Supplement 11 Requirements for Structural Weld Overlays (PDI)
13. EPRI Report GC-111050, Ambient Temperature Preheat for Machine GTAW Temperbead Applications
14. Structural Integrity Report No. 1501389.402.R1, RHR Flaw Growth Evaluation

Unit / Inspection Interval: James A. FitzPatrick Nuclear Power Plant (JAF) / Fourth (4th) 10-Year Interval

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II. APPLICABLE CODE REQUIREMENT

American Society of Mechanical Engineers (ASME) Section XI, Subsections IWA-4411 and IWA-4520(a) require that repair/replacement activities be performed and examined in accordance with the Owner's Requirements and the original Construction Code of the component or system. Alternatively, Subsections IWA-4411(a) and (b) allow use of later Editions/Addenda of the Construction Code or a later different Construction Code such as ASME Section III – either in its entirety or portions thereof, Code Cases, and revised Owner's Requirements. IWA-4420 specifies requirements for performing defect removal and the associated nondestructive examinations for repairs performed with and without welding. IWA-4600(b) provides temper bead welding requirements as an alternative to the welding and postweld heat treatment requirements of the Construction Code. Preservice/inservice examination requirements for ISI weld 24-10-130 are as specified in Table 1, Examination Category R-A, Item R1.16 of Code Case N-578-1.

As an alternative to the above, ASME Section XI Code Cases N-504-4 and N-638-4 specify requirements for performing the following:

- Code Case N-504-4 provides alternative requirements to reduce a defect to a flaw of acceptable size in austenitic stainless steel materials by deposition of a structural weld overlay (WOL) on the outside surface of the pipe or component. The NRC has conditionally approved this Code Case in Regulatory Guide 1.147 with the following conditions:

  "The provisions of Section XI, Nonmandatory Appendix Q, "*Weld Overlay Repair of Class 1, 2, and 3 Austenitic Stainless Steel Piping Weldments*," must also be met. In addition, the following conditions shall be met: (a) the sum of laminar flaw length in any direction shall not exceed 10% of the overlay with a total reduction in area equal to or less than Table IWB-3514-3; (b) the finished overlay surface shall be 250 micro-in (6.3 micrometers) root mean square or smoother; (c) the surface flatness shall be adequate for ultrasonic examination; and (d) radiography shall not be used to detect planar flaws under or masked by laminar flaws."

- Code Case N-638-4 establishes requirements for performing ambient temperature temper bead welding as an alternative to the preheat and post-weld heat treat (PWHT) requirements of the Construction Code. The NRC has conditionally approved this Code Case in Regulatory Guide 1.147 with the following conditions:

  "(1) Demonstration for ultrasonic examination of the repaired volume is required using representative samples which contain construction type flaws."

  "(2) The provisions of 3(e)(2) or 3(e)(3) may only be used when it is impractical to use the interpass temperature measurement methods described in 3(e)(1), such as in situations where the weldment area is inaccessible (e.g., internal bore welding) or when there are extenuating radiological conditions."

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III. REASON FOR PROPOSED ALTERNATIVE

Intergranular stress corrosion cracking (IGSCC) in boiling water reactor (BWR) piping was identified as a problem in the United States in the early 1970s. Initially, cracking was only observed in small-bore piping. However, in 1982 cracking caused by IGSCC was also identified in large-bore piping. James A FitzPatrick (JAF) manages this condition by performing routine inservice inspections in accordance with ASME Section XI and the inspection requirements of BWRVIP-75-A.

- Refueling Outage R22 Inspections

  JAF is presently in Refueling Outage R22. During this outage, ISI welds 24-10-130, 24-10-131, 24-10-132, 24-10-142, 24-10-143, and 24-10-144 were ultrasonically (UT) examined to comply with the inspection requirements of BWRVIP-75-A for Category "D" welds. As defined in BWRVIP-75-A, paragraph 3.4, Category "D" welds are "those made of susceptible material that have not been treated with an IGSCC remedy and in which cracks have not been reported". UT examination of these welds was performed in accordance with Appendix VIII, Supplement 10 as implemented by the EPRI Performance Demonstration Initiative (PDI). In performing these UT examinations, an indication indicative of intergranular stress corrosion cracking (IGSCC) was detected in ISI weld 24-10-130, "A" RHR LPCI DMW – Tee to Gate Valve. The indication is axially oriented and located within the weld and butter. The estimated length of the indication is 0.95". The depth of the indication is 0.81" with a remaining ligament from the outside weld surface of 0.34". The indication is located 62.25" clockwise from top dead center (TDC) (looking at tee in the direction of flow) or 13" counter-clockwise from TDC. See Figure 1 for additional details.

  Regarding scope expansion, six (6) additional Category "D" welds will be UT examined during the Refueling Outage R22 to comply with the scope expansion criteria of BWRVIP-75-A, paragraph 3.4.1. Welds to be examined are as follows: N2B-SE, N2D-SE, N2E-SE, N2F-SE, N2G-SE, N2J-SE.

- Weld Overlay Repair Plans

  ISI weld 24-10-130 is an Alloy 82/182 dissimilar metal weld that joins an austenitic stainless steel (A-403, WP304) reducing tee to a cast carbon steel (A-216, WCB) valve. The austenitic stainless steel tee material was solution annealed, water quenched (per the specification), and, as such, is resistant to IGSCC. However, the heat of welding creates a heat affected zone (HAZ) in this material that becomes sensitized due to carbide precipitation in the grain boundaries rendering the HAZ potentially susceptible to IGSCC in a BWR environment.

  An ASME Section XI, IWA-4000 repair to ISI weld 24-10-130 is not feasible. The RHR LPCI piping is 24" nominal pipe size (NPS) while the Reactor Recirculation piping is 28" NPS. The Reactor Recirculation piping is open to the reactor vessel. To drain the piping, Jet Pump nozzle plugs would have to be installed from the Reactor Pressure Vessel inside diameter. The plugs are currently not available.

  As an alternative to an IWA-4000 repair, Entergy intends to install a structural weld overlay (WOL) to repair the subject weld. Structural WOLs have been used for years on piping in both BWRs and pressurized water reactors (PWRs) to arrest the growth of flaws while establishing a new structural pressure boundary. However, the 2001 Edition/2003 Addenda of ASME Section XI, which is the JAF code of record for performing repair/replacement

activities, does not include requirements for installing structural WOLs on DMWs and non-austenitic stainless steels. Moreover, requirements for installing full structural WOLs on DMWs and non-austenitic stainless steels are not presently included in any Edition/Addenda of ASME Section XI or Code Cases currently approved by the NRC.

WOLs on DMWs and non-austenitic stainless steels in BWRs have generally been applied in accordance with various revisions of ASME Code Cases N-504 and N-638. At present, Code Case revisions N-504-4 and N-638-4 are "conditionally accepted" by the NRC in Regulatory Guide 1.147. Application of these code cases to DMWs and non-austenitic stainless steels requires a relief request since Code Case N-504-4 was written specifically for austenitic stainless steel weldments and Code Case N-638-4 contains some restrictions and requirements that do not apply to the proposed JAF WOL.

Entergy intends to use Code Cases N-504-4 and N-638-4 to install a structural WOL on ISI weld 24-10-130. To do this, Entergy has initiated this relief request to propose alternatives to certain requirements in these code cases. The full structural WOL will be applied by deposition of ERNiCrFe-7A (Alloy 52M) filler metal on the outside surface of the DMW and adjacent base materials. See Table 2 for additional details.

ISI weld 24-10-130 is currently a Category "D" weld as defined BWRVIP-75-A and described above. However, once the WOL is installed, this weld will be reclassified as Category "E" weld. As defined in BWRVIP-75-A, paragraph 3.5, Category "E" welds "are defined by GL 88-01 as cracked weldments that have been mitigated by either a weld overlay repair or a stress improvement process." Regarding future inservice inspections, this WOL will be inspected in accordance with BWRVIP-75-A, paragraph 3.5.1.1. In addition, ASME Section XI inservice inspections will be performed in accordance with Appendix Q, Section Q-4300.

IV. PROPOSED ALTERNATIVE

Pursuant to 10 CFR 50.55a(z)(1), Entergy proposes an alternative to specific ASME Section XI Code requirements in Code Cases N-504-4 and N-638-4, as conditionally approved by the NRC in Regulatory Guide 1.147. The proposed alternatives for each ASME Section XI code case are specified below:

A. Code Case N-504-4 (as conditionally approved in Regulatory Guide 1.147)

1. Code Case N-504-4 and Appendix Q strictly apply to austenitic stainless steel piping and weldments. As an alternative, Entergy proposes to use Code Cases N-504-4 and Appendix Q to install a WOL on A-216, WCB carbon steel (gate valve), Alloy 82/182 welds, and A-403, WP304 austenitic stainless steel (tee) using Alloy 52M (ERNiCrFe-7A) filler metal.

2. Code Case N-504-4, paragraph (b) and Appendix Q, paragraph Q-2000(a) require that weld metal used to fabricate WOLs be low carbon [0.035% (max.)] austenitic stainless steel. As an alternative, Entergy proposes to perform WOL welding using Alloy 52M (ERNiCrFe-7A). However, WOL buffer layers, as shown in Figure 2 and 3 and discussed in Section V.B(4) will be deposited with ER308L filler metal (austenitic stainless steel) and comply with this requirement.

3. Code Case N-504-4, paragraph (e) and Appendix Q, paragraph Q-2000(d) require that the WOL consist of at least two austenitic stainless steel weld layers, each layer having an as-deposited delta ferrite content of at least 7.5 FN or 5 FN under certain conditions.

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As an alternative, Entergy proposes to install the WOL welding using ERNiCrFe-7A (Alloy 52M) which is purely austenitic. Therefore, this delta ferrite requirement does not apply to ERNiCrFe-7A filler metal. However, as shown in the Figure 2 and 3 and discussed in Section V.B(4), WOL buffer layers will be deposited with ER308L filler metal (austenitic stainless steel) and comply with this delta ferrite requirement.

4. Code Case N-504-4, paragraph (f)(1) and Appendix Q, paragraph Q-3000(b)(2) require that the end transition slope of the WOL not exceed 45°. However, it is not possible to meet this requirement at some azimuthal locations (e.g., 0° and 180°) due to the configuration or geometry of the weldment as shown in Figure 2 and 3. As an alternative, Entergy proposes to blend the WOL into the associated components and demonstrate the acceptability of the end transition slope by analysis.

5. Code Case N-504-4, paragraph (h) requires that a system hydrostatic test be performed in accordance with IWA-5000 if a flaw penetrates the pressure boundary during welding. As an alternative, Entergy proposes to perform a system leakage test in accordance with IWA-5000 should this condition occur.

6. Code Case N-504-4, paragraph (j) and Appendix Q, section Q-4100 specify requirements for acceptance examination of WOLs. Figure Q-4100-1 of Appendix Q defines the UT examination volume. However, the configuration of the weldment and geometric limitations imposed by the adjoining tee may restrict Entergy's ability to examine 100% of this WOL examination volume. As an alternative, Entergy proposes the following: (a) Perform a manual phased array UT examination by conducting scans from the WOL surface and both base materials surfaces, as necessary, to obtain the maximum coverage possible. The proposed overlay design allows for greater than 90% interrogation of the examination volume, as defined in Figure Q-4100-1.

7. Code Case N-504-4, paragraph (i) and Appendix Q, section Q-4200 specify preservice inspection requirements for WOLs while section Q-4300 of Appendix Q specifies inservice inspection requirements. Figure Q-4300-1 of Appendix Q defines the UT examination volume for both preservice and inservice inspections. However, the configuration of the weldment and geometric limitations imposed by the adjoining tee may restrict Entergy's ability to examine 100% of this examination volume. As an alternative, Entergy proposes to perform a manual phased array UT examination by conducting scans from the WOL surface and both base materials surfaces, as necessary, to obtain the maximum coverage possible. The proposed overlay design allows for greater than 90% interrogation of the examination volume, as defined in Figure Q-4300-1.

8. Appendix Q, paragraph Q-4000 specifies that procedures and personnel for examining weld overlays be qualified in accordance with Appendix VIII, Supplement 11 of ASME Section XI. As an alternative, Entergy proposes to UT examine the WOL in accordance with Appendix VIII, Supplement 11 except as modified by the EPRI PDI Program. Additionally, a non-destructive examination (NDE) mock-up of the proposed WOL configuration has been fabricated. The mock-up contains manufactured flaws and will be used for training, prior to performing the actual WOL examination to ensure that the qualified examiners are familiarized with aspects of the JAF WOL examination.

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B. Code Case N-638-4 (as conditionally approved in Regulatory Guide 1.147)

1. Code Case N-638-4, paragraph 3 specifies several methods for measuring or monitoring weld interpass temperatures (e.g., pyrometers, temperature indicating crayons, thermocouples). However, as a condition to Code Case N-638-4, Regulatory Guide 1.147 restricts use of the interpass temperature monitoring methods of paragraphs 3(e)(2) and 3(e)(3) to cases where it is impractical to use the methods of paragraph 3(e)(1) due to inaccessibility or radiological conditions. In monitoring preheat and interpass temperatures during WOL welding, Entergy proposes the following alternative:

   "Preheat and interpass temperatures will be measured using a contact pyrometer. In the first three layers, the interpass temperature will be measured every three to five passes. After the first three layers, interpass temperature measurements will be taken every six to ten passes for the subsequent layers. Contact pyrometers will be calibrated in accordance with approved calibration and control program documents."

2. Code Case N-638-4, paragraphs 4(a)(1) and 4(b) state that a VT-1 visual examination may alternatively be performed on the area to be welded (prior to repair welding) if it is impractical to perform a surface examination. Entergy will not use the alternative VT-1 visual examination method. Rather, prior to WOL welding, Entergy will perform a surface examination of the area to be welded as required by Code Case N-504-4, paragraphs (c) and (d), and Appendix Q, paragraphs Q-2000(b) and Q-2000(c).

3. Code Case N-638-4, paragraphs 4(a), 4(a)(2), and 4(a)(4) state that all welds (including repair welds) shall be volumetrically examined in accordance with the requirements and acceptance criteria of the Construction Code or ASME Section III. As a condition to Code Case N-638-4, Regulatory Guide 1.147 all states:

   "Demonstration for ultrasonic examination of the repaired volume is required using representative sample which contain construction type flaws."

   As an alternative, Entergy proposes to volumetrically examine the WOL using the UT method in accordance with the requirements and acceptance criteria of paragraph Q-4100 of ASME Section XI, Appendix Q. Entergy will also comply with the performance demonstration requirements of ASME Section XI, Appendix VIII, Supplement 11 as modified by the EPRI PDI program.

V. Basis for Proposed Alternative

Entergy intends to install a WOL on ISI weld 24-10-130 in accordance with ASME Section XI Code Case N-504-4 as supplemented by Nonmandatory Appendix Q and Code Case N-638-4 using the proposed alternatives specified in Section IV of this Request. These code cases have been conditionally approved by the NRC in Regulatory Guide 1.147.

This proposed alternative provides an acceptable methodology for preventing potential failures due to IGSCC based on the use of filler metals that are resistant to IGSCC (e.g., Alloy 52M), enhancing the residual stress profile along the inside diameter of the original weld, and imposing post-overlay preservice and inservice inspection requirements that ensure structural integrity for the life of the plant.

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A. WOL Design and Verification

The fundamental design basis for full structural WOLs is to maintain the original design margins with no credit taken for the underlying IGSCC-susceptible weldments. The assumed design basis flaw for the purpose of structural sizing of the WOL is a flaw completely around the circumference (360°) and 100% through the original wall thickness of the dissimilar metal weld. Regarding the crack growth analysis, the detected axial flaw described in Section III, above, will be analyzed. The specific analyses and verifications to be performed are summarized as follows:

- A stress analysis will be performed to establish a residual stress profile in the WOL and the underlying weld and base materials. The analysis will then simulate application of the WOL to determine the final residual stress profile. Post-WOL residual stresses at normal operating conditions are expected to result in an improved stress condition on the inside surface of the underlying weld and base materials, reducing or eliminating further crack initiation in susceptible materials due to IGSCC.
- Fracture mechanics analyses will also be performed to predict crack growth of the detected flaw. Crack growth due to IGSCC and fatigue will be analyzed. The crack growth analyses will consider all design loads and transients, plus the post-WOL and through-wall residual stress distributions.
- The analyses will demonstrate that applying the WOL does not impact the conclusions of the existing stress reports. The ASME Code, Section III primary stress criteria will continue to be met.
- Shrinkage will be measured during the WOL application. Shrinkage stresses at other locations in the piping systems arising from the WOL will be demonstrated not to have an adverse effect on the systems. Clearances of affected supports and restraints will be checked after the overlay repair and will be reset within the design ranges if required.
- The added weight on the piping systems due to the WOL will be evaluated for potential impact on piping system stresses and dynamic characteristics.
- The as-built dimensions of the WOL will be measured and evaluated to demonstrate that they meet or exceed the minimum design dimensions of the WOL.

B. Suitability of Proposed Alternatives to ASME Code Case N-504-4 and Appendix Q

WOLs have been used for repair and mitigation of cracking in BWRs since the early 1980s. In Generic Letter (GL) 88-01, NRC Position on Intergranular Stress Corrosion Cracking (IGSCC) in BWR Austenitic Stainless Steel Piping, the NRC approved the use of ASME Section XI acceptance standards for determining the acceptability of installed WOLs. In addition, BWRVIP-75-A, which has been approved by the NRC, also allows for the use of ASME Section XI acceptance standards for determining the acceptability of installed WOLs. Accordingly, a WOL will be installed on ISI weld 24-10-130 in accordance with ASME Section XI Code Case N-504-4 and Appendix Q. Compliance with Appendix Q is required by Regulatory Guide 1.147. However, as described in Section IV of this Request, Entergy has proposed several alternatives to Code Case N-504-4 and Appendix Q that are necessary to support the installation of the new WOL. The suitability of the proposed alternatives is provided below.

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1) Code Case N-504-4 and Appendix Q apply strictly to austenitic stainless steel piping and weldments. As an alternative, Entergy has proposed to use Code Cases N-504-4 and Appendix Q to install a WOL on A-216, WCB carbon steel valve body, Alloy 182/82 weld, and an A-403, WP304 stainless steel tee using ERNiCrFe-7A (Alloy 52M) filler metal. This proposed alternative is acceptable because the WOL design, fabrication, examination, and preservice/inservice inspection requirements of Code Case N-504-4 and Appendix Q may also be applied to nickel alloy WOLs of non-austenitic stainless steels. While some material requirements in Code Case N-504-4 and Appendix Q may only apply to austenitic stainless steels, Entergy has identified these requirements and proposed alternatives to appropriately address them.

2) Code Case N-504-4, paragraph (b) and Appendix Q, paragraph Q-2000(a) require that weld metal used to fabricate WOLs be low carbon steel (0.035%) austenitic stainless steel. This requirement was included in Code Case N-504-4 and Appendix Q to reduce the sensitization potential of the austenitic stainless steel WOL, thereby reducing its susceptibility to IGSCC. As an alternative, Entergy has proposed to perform WOL welding using ERNiCrFe-7A (Alloy 52M) weld metal. While carbon content is not a critical factor in assessing resistance of nickel alloys to IGSCC, the chromium content is. As documented in Section 3.1 of the ASME white paper (RRM-02-05/BC04-1003) which supported Code Case N-740, a minimum chromium content of 20% is necessary to ensure resistance to IGSCC. Because ERNiCrFe-7A (Alloy 52M) weld metal has a high chromium content (28 – 31.5%), it has excellent resistance to IGSCC.

3) Code Case N-504-4, paragraph (e) and Appendix Q, paragraph Q-2000(d) require that the WOL consist of at least two austenitic stainless steel weld layers, each layer having an as-deposited delta ferrite content of at least 7.5 FN or 5 FN under certain conditions. This requirement was included in Code Case N-504-4 and Appendix Q to reduce the sensitization potential of the austenitic stainless steel WOL, thereby reducing its susceptibility to IGSCC. As an alternative, Entergy has proposed to perform WOL welding using ERNiCrFe-7A (Alloy 52M) weld metal which has a purely austenitic microstructure. Therefore, the requirement to measure delta ferrite does not apply to this material. The susceptibility of nickel alloys to IGSCC is dependent on its chromium content as explained above. Furthermore, the chromium content of the first layer of Alloy 52M weld metal could be reduced due to dilution with the underlying base and weld materials. Because this is the case, Entergy has imposed the following restriction on the first layer of the WOL which is consistent with ASME Section XI Code Case N-740-2:

> "The first layer of Alloy 52M weld metal deposited may not be credited toward the required thickness. Alternatively, a diluted layer may be credited toward the required thickness, provided the portion of the layer over the austenitic base material, austenitic weld, and the associated dilution zone from an adjacent ferritic base material contains at least 20% chromium. The chromium content of the deposited weld metal may be determined by chemical analysis of the production weld or from a representative coupon taken from a mockup prepared in accordance with the WPS (or a representative WPS) for the production weld."

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4) As noted above, WOLs will be installed using Alloy 52M (ERNiCrFe-7A) filler metal. However, Alloy 52M weld metal has a demonstrated sensitivity to certain impurities, such as sulfur, when deposited onto austenitic stainless steel base materials. To mitigate this condition, Entergy intends to deposit buffer layers of ER308L austenitic stainless steel filler metal across the A-403, WP403 austenitic stainless steel tee prior to installation of the WOL. While the balance of these initial layers will be deposited with Alloy 52M weld metal, an Alloy 82 bridge bead (or transitional bead) will also be deposited over the fusion line between the existing Alloy 82/182 weld and the stainless steel tee. The Alloy 82 bridge bead will be deposited with ERNiCr-3 filler metal. The ER308L filler metal will have a maximum carbon content of 0.03% and a delta ferrite content of 5 - 15 FN as reported on the CMTR. Buffer layers will be deposited with a welding procedure and welders that have been qualified in accordance with ASME Section IX. Liquid penetrant (PT) examinations will be performed prior to and after deposition of the buffer layer. The second PT examination is performed to ensure that the completed buffer layer is free from cracks and other unacceptable indications prior to deposition of the Alloy 52M weld overlay. Finally, the thickness of the buffer layers will not be structurally credited towards the minimum design thickness of the WOL. See Table 2 for additional detail.

5) Code Case N-504-4, paragraph (f)(1) and Appendix Q, paragraph Q-3000(b)(2) require that the end transition slope of the WOL not exceed 45°. However, it is not possible to comply with this requirement at some azimuthal locations (e.g., 0° and 180°) due to the configuration (geometry) of the adjoining RHR valve and tee as shown in Figure 2 and 3. It is Entergy's intent to comply with this requirement where possible. However, the configuration of the adjacent RHR valve and tee limits Entergy's ability to comply with this requirement at some locations. To address this issue, Entergy will analyze the as-built configuration of the WOL using finite element analysis (FEA) to demonstrate compliance with the applicable stress limits of the Construction Code. According to Appendix Q, paragraph Q-3000(b)(2), the performance of analysis is an acceptable method for demonstrating the suitability of this type of end transition slope.

6) Code Case N-504-4, paragraph (h) requires that a system hydrostatic test be performed in accordance with IWA-5000 when a flaw penetrates the pressure boundary. If the pressure boundary has not been penetrated, Code Case N-504-4 allows performance of a system leakage test. Pressure testing is not addressed by Appendix Q. As an alternative, Entergy proposes to perform a system leakage test in accordance with IWA-5000. This proposal is consistent with the pressure testing requirements of IWA-4540, except that, the NDE requirements of IWA-4540 would not apply to a WOL. However, the WOL acceptance examinations will include both liquid penetrant (PT) and UT examinations. PT examinations will be performed in accordance with the Construction Code or ASME Section III while the UT examination will be performed in accordance with Appendix VIII, Supplement 11 of ASME Section XI as implemented by the EPRI PDI Program. The UT acceptance standards are specified in Appendix Q, paragraph Q-4100(c) which defaults to Tables IWB-3514-2 and 3.

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7) Code Case N-504-4, paragraph (j) and Appendix Q, section Q-4100 specify requirements for acceptance examination of WOLs. Figure Q-4100-1 of Appendix Q defines the UT examination volume. However, the configuration of the weldment and geometric limitations imposed by the adjoining tee may restrict Entergy's ability to examine 100% of this WOL examination volume. As an alternative, Entergy has proposed to perform a UT examination to the maximum possible extent, which is expected to include greater than 90% of the examination volume as defined in Figure Q-4100-1. Therefore, these examinations would obtain "essentially 100%" coverage (i.e., greater than 90%) as defined in NRC Information Notice 98-42 and ASME Code Case N-460 which has been unconditionally approved by the NRC in regulatory Guide 1.147.

8) Code Case N-504-4, paragraph (i) and Appendix Q, section Q-4200 specify preservice inspection requirements for WOLs while section Q-4300 of Appendix Q specifies inservice inspection requirements. Figure Q-4300-1 of Appendix Q defines the UT examination volume for both preservice and inservice inspections. However, the configuration of the weldment and geometric limitations imposed by the adjoining tee may restrict Entergy's ability to examine 100% of this WOL volume. As an alternative, Entergy proposes to perform UT examination to the maximum extent possible. Entergy believes that by scanning from all available WOL and base material surfaces, the proposed examination will include greater than 90% of the preservice/inservice examination volume of Figure Q-4300-1. Finally, these preservice/inservice examinations would constitute "essentially 100%" coverage (i.e., greater than 90%) based on guidance provided by the NRC in Information Notice 98-42 and the ASME alternative provided in Code Case N-460 which has been unconditionally approved in Regulatory Guide 1.147.

9) Appendix Q, paragraph Q-4000 specifies that procedures and personnel for examining weld overlays be qualified in accordance with Appendix VIII, Supplement 11 of ASME Section XI. As an alternative, Entergy proposed to UT examine the WOL in accordance with Appendix VIII, Supplement 11 except as modified by the EPRI PDI Program. This alternative is necessary because the industry cannot meet the requirements of Appendix VIII, Supplement 11. Therefore, the PDI Program modifications to Appendix VIII, Supplement 11 as described in Table 3 will be utilized. Additionally, a non-destructive examination (NDE) mock-up of the proposed WOL configuration has been fabricated. The mock-up contains manufactured flaws and will be used for training, prior to performing the actual WOL examination to ensure that the qualified examiners are familiarized with aspects of the JAF WOL examination.

C. Suitability of Proposed Alternatives to Code Case N-638-4

An ambient temperature temperbead welding technique will be used when welding on the ferritic base material of the carbon steel valve (for ISI weld 24-10-130) in lieu of the preheat and PWHT requirements of Construction Code. Research by the Electric Power Research Institute (EPRI) and other organizations on the use of an ambient temperature temperbead process using the machine gas tungsten arc welding (GTAW) process is documented in EPRI Report GC-111050. According to the EPRI report, repair welds performed with an ambient temperature temperbead procedure utilizing the machine GTAW process exhibit mechanical properties equivalent to or better than those of the surrounding base material.

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Laboratory testing, analysis, successful procedure qualifications, and successful repairs have all demonstrated the effectiveness of this process.

The ambient temperature temperbead technique of Code Case N-638-4 will be used. Code Case N-638-4 was conditionally approved by the NRC in Regulatory Guide 1.147. The suitability of the proposed alternatives is provided below.

1) Code Case N-638-4, paragraph 3(e)(1) states that the interpass temperature during welding shall be determined by temperature measurement (e.g., pyrometers, temperature indicating crayons, thermocouples). In monitoring preheat and interpass temperatures during WOL welding, Entergy has proposed the following:

   > "Preheat and interpass temperatures will be measured using a contact pyrometer. In the first three layers, the interpass temperature will be measured every three to five passes. After the first three layers, interpass temperature measurements will be taken every six to ten passes for the subsequent layers. Contact pyrometers will be calibrated in accordance with approved calibration and control program documents."

   The proposed preheat and interpass temperature controls are based on field experience with depositing WOLs and have been successfully used throughout the industry. Interpass temperatures beyond the third layer have no impact on the metallurgical properties of the ferritic steel heat affected zone.

2) Code Case N-638-4, paragraphs 4(a)(1) and 4(b) state that a VT-1 visual examination may alternatively be performed on the area to be welded (prior to repair welding) if it is impractical to perform a surface examination. As a clarification, Entergy will not use the alternative VT-1 visual examination method. Rather, prior to WOL welding, Entergy will perform a surface examination of the area to be welded as required by Code Case N-504-4, paragraphs (c) and (d), and Appendix Q, paragraphs Q-2000(b) and Q-2000(c).

3) Code Case N-638-4, paragraphs 4(a) and 4(a)(4) state that all welds (including repair welds) shall be volumetrically examined in accordance with the requirements and acceptance criteria of the Construction Code or ASME Section III. As an alternative, Entergy proposes to volumetrically examine the WOL using the UT method in accordance with the requirements and acceptance criteria of Appendix Q, Section Q-4100 of ASME Section XI. The UT examination requirements and acceptance standards in Appendix Q, paragraph Q-4100 were developed specifically for WOLs unlike those in Code Case N-638-4. According to Article Q-4000, UT examination procedures and personnel shall be qualified in accordance with Appendix VIII of ASME Section XI. Supplement 11 of Appendix VIII specially addresses qualification requirements for WOLs. When UT examinations are performed in accordance with Appendix VIII, Supplement 11 (as implemented through EPRI PDI Program), the examinations are considered more sensitive for detecting fabrication and service-induced flaws than traditional radiographic and ultrasonic examination methods. Furthermore, construction-type flaws have been included in the PDI qualification sample sets for evaluating procedures and personnel. Appendix Q, Article Q-4100 also establishes UT acceptance standards for WOL examinations. Similar to NB-5330, the UT examination must assure adequate fusion with the base material and detect welding flaws such as interbead lack of fusion, inclusions, and cracks. Detected planar

and laminar flaws are required to meet the acceptance standards of Tables IWB-3514-2 and 3, respectively. Paragraph Q-4100(c) also limits the reduction in coverage due to a laminar flaw to less than 10% while uninspectable volumes are assumed to contain the largest radial planar flaw that could exist within the volume. The conditions in Regulatory Guide 1.147 applicable to Appendix Q will also be met.

D. Additional NDE Information

The length, surface finish, and flatness of the WOL will comply with Q-4100(a) to facilitate examination in accordance with ASME Section XI, Appendix Q. Figure Q-4100-1 describes the examination volume for acceptance examinations while Figure Q-4300-1 does the same for preservice and inservice examinations. Preservice and inservice examination requirements are specified in Q-4200 and Q-4300 of Appendix Q. The examinations required by Code Case N-504-4/Appendix Q and Code Case N-638-4 as amended by the proposed alternatives of this Relief Request provide adequate assurance that the integrity of the proposed WOL is consistent with the structural integrity assumptions of the design.

E. NRC Submittals

As listed in Attachment 2, Entergy will submit the following information to the NRC within fourteen (14) days from completion of JAF's Refueling Outage, R22:

- WOL examination results including a listing of indications detected[1], if any.
- Disposition of indications using the standards of ASME Section XI, IWB-3514-2 and/or IWB-3514-3 criteria and, if possible, the type and nature of the indications[2]
- A discussion of any repairs to the WOL material and/or base metal and the reason for the repairs.
- A description of the examination coverage achieved during the examination of the Weld Overlay DM welds

Entergy will also submit to the NRC a stress analysis summary demonstrating that the WOL on ISI weld 24-10-130 will perform its intended design function after WOL installation. The stress analysis report will include results showing that the requirements of NB-3200 and/or NB-3600 of the ASME Code, Section III are satisfied. The stress analysis will also include results showing that the requirements of IWB-3000 of the ASME Section XI Code are satisfied. The results will show that the detected IGSCC crack including its growth in the nozzle will not adversely affect the integrity of the overlay repair. This information will be submitted to the NRC within 90 days of completing JAF's Refueling Outage, R22.

[1] The recording criteria of the ultrasonic examination procedure to be used for the WOL examination requires that all indications, regardless of amplitude, be investigated to the extent necessary to provide accurate characterization, identity, and location. Additionally, the procedure requires that all indications, regardless of amplitude, that cannot be clearly attributed to the geometry of the overlay configuration be considered flaw indications.

[2] The ultrasonic examination procedure requires that all suspected flaw indications are to be plotted on a cross-sectional drawing of the weld and that the plots should accurately identify the specific origin of the reflector.

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VI. DURATION OF PROPOSED ALTERNATIVE

The proposed alternative is applicable to the fourth (4^{th}) 10-Year ISI interval for JAF and the period of extended operation which expires October 17, 2034. The inservice inspection requirements of this proposed alternative are applicable for the life of the WOL associated with ISI weld 24-10-130.

VII. PRECEDENTS

This request is similar in nature to the following alternative(s) for installation of WOLs.

- NRC letter, Grand Gulf Nuclear Station, Unit 1 – Relief Request ISI-17 Re: Use of ASME Code Cases N-638-4 and N-504-4 for the Third 10-Year Inservice Inspection Interval (TAC No. ME8525), dated August 17, 2012 (ML12214A318)
- NRC letter, Pilgrim Nuclear Power Station·- Relief Request No. PRR-15, Rev. 01, Approval to Include Remaining Reactor Pressure Vessel (RPV) Safe-End Welds in Contingency Repair Plan for Full Structural Weld Overlays (TAC No. MD2663), dated April 2, 2007 (ML070590479)
- NRC letter, Pilgrim Nuclear Power Station·- Pilgrim Relief Request PRR-39, Alternative Contingency Repair Plan for Reactor Pressure Vessel Nozzle Safe-End and Dissimilar Metal Piping Welds Using ASME Code Cases N-638 and N-504-2, With Exceptions (TAC No. MC2496), dated April 12, 2005 (ML050880137)
- NRC letter, Arkansas Nuclear One, Unit No.1 - Approval of Relief Request ANO1-R&R-011 to Use a Proposed Alternative to the American Society of Mechanical Engineers Boiler and Pressure Vessel Code Requirements for Weld Overlay Repairs (TAC No. MD6958), dated June 18, 2008 (ML081130173)
- NRC letter, James A. FitzPatrick Nuclear Power Plant - Request for Alternative JAF RR-7, Rev. 1 to Install a Weld Overlay on N2C Nozzle to Recirculation Inlet Piping Safe-End Dissimilar Metal Weld (TAC No. MD9780), dated April 1, 2009 (ML090710008)
- NRC letter, Relief Request (PRR)-19, to Install a Weld Overlay on Jet Pump Instrumentation Nozzle Weld RPV-N9A-1 – Pilgrim Nuclear Power Station (TAC No. ME1151), Dated September 11, 2009 (ML092370549)

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TABLE 1: ISI WELD 24-10-130 DMW DETAILS

Nominal Pipe Size	Material Identification		
	Gate Valve	Weld	Recirculating Tee
24" NPS	A-216, WCB[1]	Alloy 82 /182[2]	A-403, WP-304[3]

Notes:

1. ASTM A-216, Grade WCB is P-Number 1, Group 2 carbon steel.
2. Dissimilar metal weld includes butter on carbon steel valve. ENiCrFe-3 (Alloy 182) and ERNiCr-3 (Alloy 82) are F-Number 43 nickel alloys.
3. ASTM A-403, Grade WP304 is a P-Number 8 austenitic stainless steel.

FIGURE 1: ISI WELD 24-10-130 DMW FLAW DETAILS

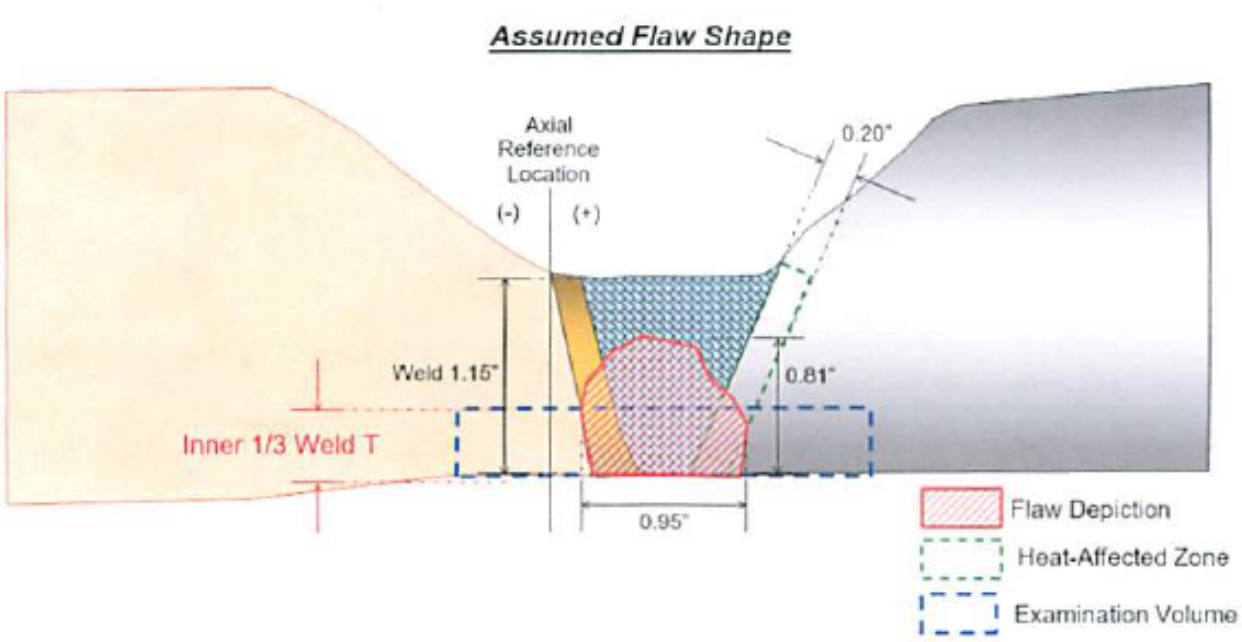

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TABLE 2: WELD OVERLAY OF ISI WELD 24-10-130 [6]

Material Identification						
Tee (Item 1)	Gate Valve (Item 2)	DM Weld (Item 3)	DM Butter (Item 4)	WOL (Item 5)	Bridge Beads (Item 6)	Buffer Layers (Item 7)
A-403, WP-304[1]	A-216, WCB[2]	Alloy 82/182[3]	Alloy 182[3]	Alloy 52M[4]	Alloy 82[3]	ER308L[5]

Notes:

1. ASTM A-403, Grade WP304 is a P-Number 8 austenitic stainless steel.
2. ASTM A-216, Grade WCB is P-Number 1, Group 2 carbon steel.
3. Dissimilar metal weld includes butter on carbon steel valve. ENiCrFe-3 (Alloy 182) and ERNiCr-3 (Alloy 82) are F-Number 43 nickel alloys.
4. ERNiCrFe-7A (Alloy 52M) is an F-Number 43 nickel alloy.
5. ER308L is an A-No. 8 austenitic stainless steel.
6. See Figure 2 for WOL configuration at 0° and 180° and Figure 3 for WOL configuration at 90° and 270°. Figure item numbers are referenced in table (above).

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FIGURE 2: WELD OVERLAY OF ISI WELD 24-10-130 (0° AND 180°)

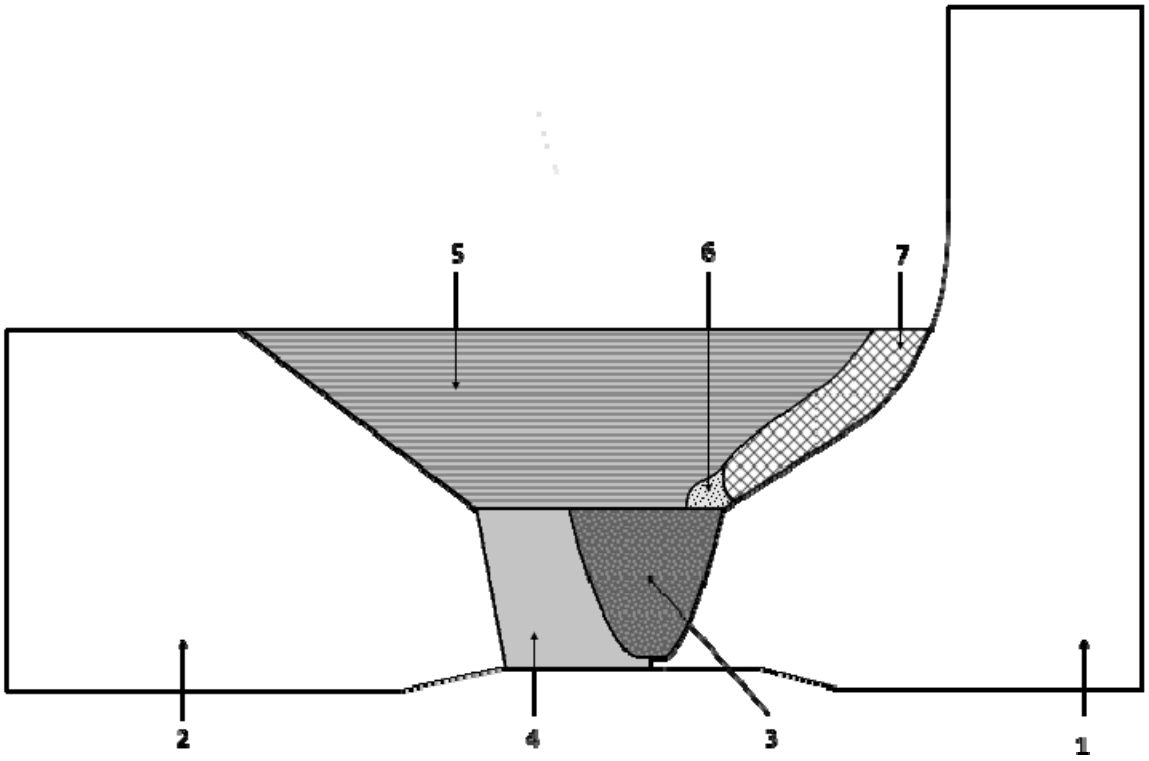

FIGURE 3: WELD OVERLAY OF ISI WELD 24-10-130 (90° AND 270°)

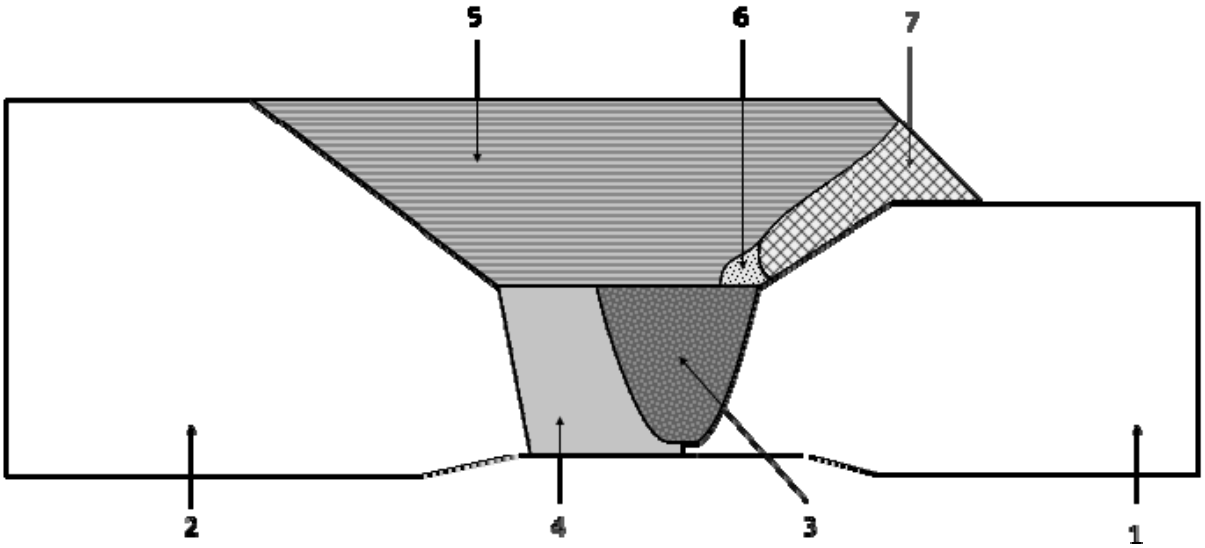

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TABLE 3: COMPARISON OF ASME SECTION XI APPENDIX VIII, SUPPLEMENT 11 TO PERFORMANCE DEMONSTRATION INITIATIVE	
Appendix VIII Supplement 11: Qualification Requirements for Full Structural Overlaid Wrought Austenitic Piping Welds	**PDI Program: The Proposed Alternative to Supplement 11 Requirements**
1.0 SPECIMEN REQUIREMENTS	
1.1 General. The specimen set shall conform to the following requirements.	*No Change*
(b) The specimen set shall consist of at least three specimens having different nominal pipe diameters and overlay thicknesses. They shall include the minimum and maximum nominal pipe diameters for which the examination procedure is applicable. Pipe diameters within a range of 0.9 to 1.5 times a nominal diameter shall be considered equivalent. If the procedure is applicable to pipe diameters of 24 in. or larger, the specimen set must include at least one specimen 24 in. or larger but need not include the maximum diameter. The specimen set must include at least one specimen with overlay thickness within -0.1 in. to +0.25 in. of the maximum nominal overlay thickness for which the procedure is applicable.	*(b)* The specimen set shall consist of at least three specimens having different nominal pipe diameters and overlay thicknesses. They shall include the minimum and maximum nominal pipe diameters for which the examination procedure is applicable. Pipe diameters within a range of 0.9 to 1.5 times a nominal diameter shall be considered equivalent. If the procedure is applicable to pipe diameters of 24 in. or larger, the specimen set must include at least one specimen 24 in. or larger but need not include the maximum diameter. The specimen set shall include specimens with overlays not thicker than 0.1 in. more than the minimum thickness, nor thinner than 0.25 in. of the maximum nominal overlay thickness for which the examination procedure is applicable. **Basis**: To avoid confusion, the overlay thickness tolerance contained in the last sentence was reworded.
(*d*) *Flaw Conditions*	
(1) *Base metal flaws*. All flaws must be cracks in or near the butt weld heat-affected zone, open to the inside surface, and extending at least 75% through the base metal wall. Flaws may extend 100% through the base metal and into the overlay material; in this case, intentional overlay fabrication flaws shall not interfere with ultrasonic detection or characterization of the cracking. Specimens containing IGSCC shall be used when available.	(1) *Base metal flaws*. All flaws must be in or near the butt weld heat-affected zone, open to the inside surface, and extending at least 75% through the base metal wall. Intentional overlay fabrication flaws shall not interfere with ultrasonic detection or characterization of the base metal flaws. Specimens containing IGSCC shall be used when available. At least 70 percent of the flaws in the detection and sizing tests shall be cracks and the remainder shall be alternative flaws. Alternative flaw mechanisms, if used, shall provide crack-like reflective characteristics and shall be limited by the following:

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TABLE 3: COMPARISON OF ASME SECTION XI APPENDIX VIII, SUPPLEMENT 11 TO PERFORMANCE DEMONSTRATION INITIATIVE

Appendix VIII Supplement 11: Qualification Requirements for Full Structural Overlaid Wrought Austenitic Piping Welds	PDI Program: The Proposed Alternative to Supplement 11 Requirements
	(a) The use of Alternative flaws shall be limited to when the implantation of cracks produces spurious reflectors that are uncharacteristic of actual flaws. (b) Flaws shall be semi-elliptical with a tip width of less than or equal to 0.002 inches. **Basis**: Paragraph 1.1(d)(1) requires that all base metal flaws be cracks. Implanting a crack requires excavation of the base material on at least one side of the flaw. While this may be satisfactory for ferritic materials, it does not produce a useable axial flaw in austenitic materials because the sound beam, which normally passes only through base material, must now travel through weld material on at least one side, producing an unrealistic flaw response. To resolve this issue, the PDI program revised this paragraph to allow use of alternative flaw mechanisms under controlled conditions. For example, alternative flaws shall be limited to when implantation of cracks precludes obtaining an effective ultrasonic response, flaws shall be semi-elliptical with a tip width of less than or equal to 0.002 inches, and at least 70% of the flaws in the detection and sizing test shall be cracks and the remainder shall be alternative flaws. The statement "intentional overlay fabrication flaws shall not interfere with ultrasonic detection or characterization of the base metal flaws" was included into paragraph 1.1(d)(1). Additionally, to avoid confusion, the phrase "and the remainder shall be alternate flaws" was added to the second to last sentence of this paragraph.

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TABLE 3: COMPARISON OF ASME SECTION XI APPENDIX VIII, SUPPLEMENT 11 TO PERFORMANCE DEMONSTRATION INITIATIVE	
Appendix VIII Supplement 11: Qualification Requirements for Full Structural Overlaid Wrought Austenitic Piping Welds	**PDI Program: The Proposed Alternative to Supplement 11 Requirements**
(e) Detection Specimens	
(1) At least 20% but less than 40% of the flaws shall be oriented within ± 20 deg. of the pipe axial direction. The remainder shall be oriented circumferentially. Flaws shall not be open to any surface to which the candidate has physical or visual access. The rules of IWA-3300 shall be used to determine whether closely spaced flaws should be treated as single or multiple flaws.	(1) At least 20% but less than 40% of the base metal flaws shall be oriented within ± 20 deg. of the pipe axial direction. The remainder shall be oriented circumferentially. Flaws shall not be open to any surface to which the candidate has physical or visual access. **Basis**: The requirement for axially oriented overlay fabrication flaws in paragraph 1.1(e)(1) was excluded from the PDI Program as an improbable scenario. Weld overlays are typically applied using automated Gas Tungsten Arc Welding techniques with the filler metal being applied in a circumferential direction. Because resultant fabrication induced discontinuities would also be expected to have major dimensions oriented in the circumferential direction axial overlay fabrication flaws are unrealistic. The requirement for using IWA-3300 for proximity flaw evaluation in paragraph 1.1(e)(1) was excluded, instead, indications will be sized based on their individual merits.
(2) Specimens shall be divided into base and overlay grading units. Each specimen shall contain one or both types of grading units.	(2) Specimens shall be divided into base metal and overlay fabrication grading units. Each specimen shall contain one or both types of grading units. Flaws shall not interfere with ultrasonic detection or characterization of other flaws.
(a)(1) A base grading unit shall include at least 3 in. of the length of the overlaid weld. The base grading unit includes the outer 25% of the overlaid weld and base metal on both sides. The base grading unit shall not include the inner 75% of the overlaid weld and base metal overlay material, or base metal-to-overlay interface.	*(a)(1)* A base metal grading unit includes the overlay material and the outer 25% of the original overlaid weld. The base metal grading unit shall extend circumferentially for at least 1 inch and shall start at the weld centerline and be wide enough in the axial direction to encompass one half of the original weld crown and a minimum of 0.50" of the adjacent base material. **Basis**: The phrase "and base metal on both sides", was inadvertently included in the description of a base metal grading unit. The PDI program intentionally excludes this requirement because some of the qualification samples include flaws on both sides of the weld. This paragraph was also

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TABLE 3: COMPARISON OF ASME SECTION XI APPENDIX VIII, SUPPLEMENT 11 TO PERFORMANCE DEMONSTRATION INITIATIVE

Appendix VIII Supplement 11: Qualification Requirements for Full Structural Overlaid Wrought Austenitic Piping Welds	PDI Program: The Proposed Alternative to Supplement 11 Requirements
	modified to require that a base metal grading unit include at least 1 inch of the length of the overlaid weld, rather than 3 inches.
(a)(2) When base metal cracking penetrates into the overlay material, the base grading unit shall include the overlay metal within 1 in. of the crack location. This portion of the overlay material shall not be used as part of any overlay grading unit.	*(a)(2)* When base metal flaws penetrate into the overlay material, the base metal grading unit shall not be used as part of any overlay fabrication grading unit.
(a)(3) When a base grading unit is designed to be unflawed, at least 1 in. of unflawed overlaid weld and base metal shall exist on either side of the base grading unit. The segment of weld length used in one base grading unit shall not be used in another base grading unit. Base grading units need not be uniformly spaced around the specimen.	*(a)(3)* Sufficient unflawed overlaid weld and base metal shall exist on all sides of the grading unit to preclude interfering reflections from adjacent flaws. **Basis**: This paragraph was modified to require sufficient unflawed overlaid weld and base metal to exist on all sides of the grading unit to preclude interfering reflections from adjacent flaws, rather than the 1 inch requirement.
(b)(1) An overlay grading unit shall include the overlay material and the base metal-to-overlay interface of at least 6 square inch. The overlay grading unit shall be rectangular, with minimum dimensions of 2 inches.	*(b)(1)* An overlay fabrication grading unit shall include the overlay material and the base metal-to-overlay interface for a length of at least 1 inch. **Basis**: This paragraph was modified to define an overlay fabrication grading unit as including the overlay material and the base metal-to-overlay interface for a length of at least 1 inch, rather than the 6 square inch requirement.
(b)(2) An overlay grading unit designed to be unflawed shall be surrounded by unflawed overlay material and unflawed base metal-to-overlay interface for at least 1 in. around its entire perimeter. The specific area used in one overlay grading unit shall not be used in another overlay grading unit. Overlay grading units need not be spaced uniformly about the specimen.	*(b)(2)* Overlay fabrication grading units designed to be unflawed shall be separated by unflawed overlay material and unflawed base metal-to-overlay interface for at least 1 inch at both ends. Sufficient unflawed overlaid weld and base metal shall exist on both sides of the overlay fabrication grading unit to preclude interfering reflections from adjacent flaws. The specific area used in one overlay fabrication grading unit shall not be used in another overlay fabrication grading unit. Overlay fabrication grading units need not be spaced uniformly about the specimen.

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TABLE 3: COMPARISON OF ASME SECTION XI APPENDIX VIII, SUPPLEMENT 11 TO PERFORMANCE DEMONSTRATION INITIATIVE	
Appendix VIII Supplement 11: Qualification Requirements for Full Structural Overlaid Wrought Austenitic Piping Welds	**PDI Program: The Proposed Alternative to Supplement 11 Requirements**
	Basis: This paragraph states that overlay fabrication grading units designed to be unflawed shall be separated by unflawed overlay material and unflawed base metal-to-overlay interface for at least 1 inch at both ends, rather than around its entire perimeter.
(b)(3) Detection sets shall be selected from Table VIII-S2-1. The minimum detection sample set is five flawed base grading units, ten unflawed base grading units, five flawed overlay grading units, and ten unflawed overlay grading units. For each type of grading unit, the set shall contain at least twice as many unflawed as flawed grading units.	*(b)(3)* Detection sets shall be selected from Table VIII-S2-1. The minimum detection sample set is five flawed base metal grading units, ten unflawed base metal grading units, five flawed overlay fabrication grading units, and ten unflawed overlay fabrication grading units. For each type of grading unit, the set shall contain at least twice as many unflawed as flawed grading units. For initial procedure qualification, detection sets shall include the equivalent of three personnel qualification sets. To qualify new values of essential variables, at least one personnel qualification set is required. **Basis**: This paragraph states that overlay fabrication grading units designed to be unflawed shall be separated by unflawed overlay material and unflawed base metal-to-overlay interface for at least 1 inch at both ends, rather than around its entire perimeter.
(f) Sizing Specimen	
(*1*) The minimum number of flaws shall be ten. At least 30% of the flaws shall be overlay fabrication flaws. At least 40% of the flaws shall be cracks open to the inside surface.	*(1)* The minimum number of flaws shall be ten. At least 30% of the flaws shall be overlay fabrication flaws. At least 40% of the flaws shall be open to the inside surface. Sizing sets shall contain a distribution of flaw dimensions to assess sizing capabilities. For initial procedure qualification, sizing sets shall include the equivalent of three personnel qualification sets. To qualify new values of essential variables, at least one personnel qualification set is required.
(*3*) Base metal cracking used for length sizing demonstrations shall be oriented circumferentially.	*(3)* Base metal flaws used for length sizing demonstrations shall be oriented circumferentially.

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TABLE 3: COMPARISON OF ASME SECTION XI APPENDIX VIII, SUPPLEMENT 11 TO PERFORMANCE DEMONSTRATION INITIATIVE	
Appendix VIII Supplement 11: Qualification Requirements for Full Structural Overlaid Wrought Austenitic Piping Welds	**PDI Program: The Proposed Alternative to Supplement 11 Requirements**
(*4*) Depth sizing specimen sets shall include at least two distinct locations where cracking in the base metal extends into the overlay material by at least 0.1 in. in the through-wall direction.	*(4)* Depth sizing specimen sets shall include at least two distinct locations where a base metal flaw extends into the overlay material by at least 0.1 inch in the through-wall direction.
2.0 CONDUCT OF PERFORMANCE DEMONSTRATION	
The specimen inside surface and identification shall be concealed from the candidate. All examinations shall be completed prior to grading the results and presenting the results to the candidate. Divulgence of particular specimen results or candidate viewing of unmasked specimens after the performance demonstration is prohibited.	The specimen inside surface and identification shall be concealed from the candidate. All examinations shall be completed prior to grading the results and presenting the results to the candidate. Divulgence of particular specimen results or candidate viewing of unmasked specimens after the performance demonstration is prohibited. The overlay fabrication flaw test and the base metal flaw test may be performed separately. **Basis**: The PDI Program revised paragraph 2.0 allowing the overlay fabrication and base metal flaw tests to be performed separately.
2.1 Detection Test.	
Flawed and unflawed grading units shall be randomly mixed. Although the boundaries of specific grading units shall not be revealed to the candidate, the candidate shall be made aware of the type or types of grading units (base or overlay) that are present for each specimen.	Flawed and unflawed grading units shall be randomly mixed. Although the boundaries of specific grading units shall not be revealed to the candidate, the candidate shall be made aware of the type or types of grading units (base metal or overlay fabrication) that are present for each specimen.
2.2 Length Sizing Test	
(d) For flaws in base grading units, the candidate shall estimate the length of that part of the flaw that is in the outer 25% of the base wall thickness.	*(d)* For flaws in base metal grading units, the candidate shall estimate the length of that part of the flaw that is in the outer 25% of the base metal wall thickness.

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TABLE 3: COMPARISON OF ASME SECTION XI APPENDIX VIII, SUPPLEMENT 11 TO PERFORMANCE DEMONSTRATION INITIATIVE	
Appendix VIII Supplement 11: Qualification Requirements for Full Structural Overlaid Wrought Austenitic Piping Welds	**PDI Program: The Proposed Alternative to Supplement 11 Requirements**
2.3 Depth Sizing Test.	
For the depth sizing test, 80% of the flaws shall be sized at a specific location on the surface of the specimen identified to the candidate. For the remaining flaws, the regions of each specimen containing a flaw to be sized shall be identified to the candidate. The candidate shall determine the maximum depth of the flaw in each region.	*(a)* The depth sizing test may be conducted separately or in conjunction with the detection test. *(b)* When the depth sizing test is conducted in conjunction with the detection test and the detected flaws do not satisfy the requirements of 1.1(f), additional specimens shall be provided to the candidate. The regions containing a flaw to be sized shall be identified to the candidate. The candidate shall determine the maximum depth of the flaw in each region. *(c)* For a separate depth sizing test, the regions of each specimen containing a flaw to be sized shall be identified to the candidate. The candidate shall determine the maximum depth of the flaw in each region.
3.0 ACCEPTANCE CRITERIA	
3.1 Detection Acceptance Criteria.	
Examination procedures, equipment, and personnel are qualified for detection when the results of the performance demonstration satisfy the acceptance criteria of Table VIII-S2-1 for both detection and false calls. The criteria shall be satisfied separately by the demonstration results for base grading units and for overlay grading units.	*(a)* Examination procedures are qualified for detection when; *(1)* All flaws within the scope of the procedure are detected and the results of the performance demonstration satisfy the acceptance criteria of Table VIII-S2-1 for false calls. *(2)* At least one successful personnel demonstration has been performed meeting the acceptance criteria defined in (3b). *(3)* Examination equipment and personnel are qualified for detection when the results of the performance demonstration satisfy the acceptance criteria of Table VIII-S2-1 for both detection and false calls. *(4)* The criteria in (2), (3) shall be satisfied separately by the demonstration results for base metal grading units and for overlay

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TABLE 3: COMPARISON OF ASME SECTION XI APPENDIX VIII, SUPPLEMENT 11 TO PERFORMANCE DEMONSTRATION INITIATIVE	
Appendix VIII Supplement 11: Qualification Requirements for Full Structural Overlaid Wrought Austenitic Piping Welds	**PDI Program: The Proposed Alternative to Supplement 11 Requirements**
	fabrication grading units. **Basis**: The PDI Program allows procedure qualification to be performed separately from personnel and equipment qualification. Historical data indicate that, if ultrasonic detection or sizing procedures are thoroughly tested, personnel and equipment using those procedures have a higher probability of successfully passing a qualification test. In an effort to increase the passing rate, PDI has elected to perform procedure qualifications separately in order to assess and modify essential variables that may affect overall system capabilities. For a procedure to be qualified, the PDI program requires three times as many flaws to be detected (or sized) as shown in Supplement 11 for the entire ultrasonic system. The personnel and equipment are still required to meet Supplement 11.
3.2 Sizing Acceptance Criteria.	
(a) The RMS error of the flaw length measurements, as compared to the true flaw lengths, is less than or equal to 0.75 inch. The length of base metal cracking is measured at the 75% through-base-metal position.	*(a)* The RMS error of the flaw length measurements, as compared to the true flaw lengths, is less than or equal to 0.75 inch. The length of base metal flaws is measured at the 75% through-base-metal position.
(b) All extensions of base metal cracking into the overlay material by at least 0.1 inch. are reported as being intrusions into the overlay material.	**This requirement is omitted.** **Basis**: The requirement for reporting all extensions of cracking into the overlay is omitted from the PDI Program because it is redundant to the RMS calculations performed in paragraph 3.2(c), and its presence adds confusion and ambiguity to depth sizing as required by paragraph 3.2(c). This also makes the weld overlay program consistent with the Supplement 2 depth sizing criteria.
(c) The RMS error of the flaw depth measurements, as compared to the true flaw depths, is less than or equal to 0.125 inch.	*(b)* The RMS error of the flaw depth measurements, as compared to the true flaw depths, is less than or equal to 0.125 inch.

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Attachment 2

List of Regulatory Commitments

List of Regulatory Commitments

This table identifies actions discussed in this letter for which Entergy commits to perform. Any other actions discussed in this submittal are described for the NRC's information and are **not** commitments.

COMMITMENT	TYPE (Check one)		SCHEDULED COMPLETION DATE (If Required)
	ONE-TIME ACTION	CONTINUING COMPLIANCE	
Submit to the NRC: • Weld overlay examination results including a listing of indications detected, if any; • disposition of indications using the standards of ASME Section XI, Subsection IWB-3514-2 and/or IWB-3514-3 criteria and, if possible, the type and nature of the indications; • discussion of any repairs to the weld overlay material and/or base metal and the reason for the repairs; and • description of the examination coverage achieved during the examination of the Weld Overlay dissimilar metals welds.	**X**		14 days after completing JAF's Refueling Outage R22
Submit to the NRC a stress analysis summary demonstrating that the repaired dissimilar metal weld (DMW) will perform its intended design function after weld overlay installation.	**X**		Within 90 days of completing JAF's Refueling Outage R22