April 21, 2008

Vice President, Operations
Entergy Operations, Inc.
Waterford Steam Electric Station, Unit 3
17265 River Road
Killona, LA 70057-3093

SUBJECT: WATERFORD STEAM ELECTRIC STATION, UNIT 3 - REQUEST FOR ALTERNATIVE W3-R&R-006 – PROPOSED ALTERNATIVE TO ASME CODE REQUIREMENTS FOR WELD OVERLAY (TAC NO. MD5388)

Dear Sir or Madam:

Pursuant to paragraph 50.55a(a)(3)(i) of Title 10 of the *Code of Federal Regulations* (10 CFR), Entergy Operations, Inc. (the licensee), submitted, by letter dated April 26, 2007, as revised by supplemental letter dated February 21, 2008, an alternative to the requirements of American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, IWA-4000 for mitigating primary water stress-corrosion cracking on nine specific dissimilar metal welds using preemptive full structural weld overlays at Waterford Steam Electric Station, Unit 3 (Waterford 3). The licensee proposed the alternative for the current second 10-year inservice inspection (ISI) interval which ends on May 30, 2008.

The U.S. Nuclear Regulatory Commission (NRC) staff has reviewed the licensee's submittal and determined that the proposed alternative provides an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the NRC staff authorizes the use of the proposed alternative for the second 10-year ISI interval at Waterford 3.

All other ASME Code, Section XI requirements for which relief was not specifically requested and approved in this relief request remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

The staff's safety evaluation is enclosed.

Sincerely,

/RA/

Thomas G. Hiltz, Chief
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-382

Enclosure: Safety Evaluation

cc w/encl: See next page

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Entergy Operations, Inc.
Waterford Steam Electric Station, Unit 3
17265 River Road
Killona, LA 70057-3093

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REQUEST FOR ALTERNATIVE W3-R&R-006

INSTALLATION OF WELD OVERLAYS ON DISSIMILAR METAL WELDS

ENTERGY OPERATIONS, INC.

WATERFORD STEAM ELECTRIC STATION, UNIT 3

DOCKET NO. 50-382

1.0 INTRODUCTION

By letter dated April 26, 2007 (Reference 1), as revised by supplemental letter dated February 21, 2008 (Reference 2), Entergy Operations, Inc. (the licensee), submitted for U.S. Nuclear Regulatory Commission (NRC) staff review and approval Request for Alternative W3-R&R-006 to the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, IWA-4330. Request for Alternative W3-R&R-006 is designed to mitigate primary water stress-corrosion cracking (PWSCC) on dissimilar metal welds (DMWs) of the Pressurizer Nozzle to Surge Line, Pressurizer Nozzle to Relief Valve (two locations), Pressurizer Spare Nozzle (capped), Pressurizer Nozzle to Spray Line, Hot Leg Loop 1 Nozzle to Surge Line, Hot Leg Loop 1 Nozzle to Drain Line, Hot Leg Loop 1 Nozzle to Shutdown Cooling (SDC) Line, and Hot Leg Loop 2 Nozzle to SDC Line using full structural weld overlays at Waterford Steam Electric Station, Unit 3 (Waterford 3). To facilitate inspection of the adjacent stainless steel welds after installation of the structural weld overlays, the weld overlays for six of nine DMWs will be extended across the stainless steel welds. The licensee proposed the alternative for the current second 10-year inservice inspection (ISI) interval which ends on May 30, 2008.

In Reference 2, the licensee responded to the NRC staff's request for additional information and revised Request for Alternative W3-R&R-006. The NRC staff evaluated the issues in the proposed alternative in References 1 and Reference 2; however, Reference 2 will be the version upon which this safety evaluation is based.

Request for Alternative W3-R&R-006 is similar to Request for Alternative ANO1-R&R-010 at Arkansas Nuclear One (ANO), Unit 1 and Relief Request ISI-GEN-ALT-06-03 at Joseph M. Farley Nuclear Plant (Farley) and Vogtle Electric Generating Plant (Vogtle). The ANO Request for Alternative ANO1-R&R-010 was approved by the NRC on April 6, 2007 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML070850915), and the Farley and Vogtle Relief Request ISI-GEN-ALT-06-03 was approved by the NRC on April 3, 2007 (ADAMS Accession No. ML070790240).

A DMW is a weld that joins two pieces of metal that are not of the same material. In the proposed alternative, the DMW joins the ferritic (i.e., carbon steel) nozzle to the austenitic

stainless steel safe end or piping. The DMW itself is made of nickel-based Alloy 82/182. The proposed preemptive weld overlay is a process by which weld filler metal that is resistant to stress-corrosion cracking is deposited on the outside surface of the degraded pipe including the original pipe weld.

2.0 REGULATORY REQUIREMENTS

Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), paragraph 50.55a(g)(4), ASME Code Class 1, 2, and 3 components (including supports) must meet the requirements, except the design and access provisions and the preservice examination requirements, set forth in the ASME Code, Section XI, "Rules for Inservice Inspection (ISI) of Nuclear Power Plant Components," to the extent practical within the limitations of design, geometry, and materials of construction of the components. The regulations require that inservice examination of components and system pressure tests conducted during the first 10-year interval and subsequent intervals comply with the requirements in the latest edition and addenda of Section XI of the ASME Code incorporated by reference in 10 CFR 50.55a(b), 12 months prior to the start of the 120-month interval, subject to the limitations and modifications listed therein.

Pursuant to 10 CFR 50.55a(a)(3), alternatives to requirements may be authorized by the NRC if the licensee demonstrates that: (i) the proposed alternatives provide an acceptable level of quality and safety, or (ii) compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

The applicable Code of record for the second 10-year ISI program interval at Waterford 3 is the 1992 Edition of the ASME Code, Section XI, without addenda. The ultrasonic examinations (UT) of the proposed preemptive full structural weld overlays will be performed in accordance with Appendix VIII, Supplement 11 of the 1995 Edition/1996 Addenda of ASME Section XI except as modified by Performance Demonstration Initiative (PDI) program.

3.0 LICENSEE'S PROPOSED ALTERNATIVE

3.1 ASME Code Components Affected

The licensee proposes to install a preemptive full structural weld overlay on the DMWs listed in Table 1. The weld overlay will also be installed on six similar metal welds, also identified in Table 1.

TABLE 1
DISSIMILAR METAL WELD DETAILS

Nozzle Type and Pipe Size	Material Identification				
	Nozzle carbon steel	ISI weld	Safe end (SE)	ISI Weld (SST)	Pipe/Fitting
Pressurizer to Surge Line 12 in. NPS	SA 508, Cl. 2 w/ SST Clad	DMW 82/182 ID 16-017	SA- 351, CF8M (Cast SST)	SST Weld ID 16-016(1)	SA-351, CF8M (Pipe)
Pressurizer to Relief Valve (RC-317A) 6" NPS	SA 508, Cl. 2 w/ SST Clad	DMW 82/182 ID 26-006	SA- 351, CF8M (Cast SST)	SST Weld ID 26-0076	SA-403, WP304 (Elbow)
Pressurizer to Relief Valve (RC-317B) 6" NPS	SA 508, Cl. 2 w/ SST Clad	DMW 82/182 ID 26-001	SA- 351, CF8M (Cast SST)	SST Weld ID 26-002	SA-403, WP304 (Elbow)
Pressurizer spare nozzle (Capped) 4" NPS	SA 508, Cl. 2 w/ SST Clad	DMW 82/182 ID 26-010	SA-351, CF8M (Cast SST)	SST Weld ID 26-011	SA-403, WP304/316 (End Cap)
Pressurizer to spray line 4" NPS	SA 508, Cl. 2 w/ SST Clad	DMW 82/182 ID 25-029	SA-182, Type 316	SST Weld ID 25-028(1)	SA-376, TP304 (Pipe)
Hot Leg 1 to SDC 14' NPS	SA 105, Cl. 2 w/ SST Clad	DMW 82/182 ID 15-006	SA- 351, CF8M (Cast SST)	SST Weld ID 21-001(1)	SA-358, Type 304 (Pipe)
Hot Leg 2 to SDC 14' NPS	SA 105, Cl. 2 w/ SST Clad	DMW 82/182 ID 06-006	SA- 351, CF8M (Cast SST)	SST Weld ID 22-001(1)	SA-358, Type 304 (Pipe)
Hot Leg 1 to Surge line 12' NPS	SA 105, Cl. 2 w/ SST Clad	DMW 82/182 ID 15-006	SA- 351, CF8M (Cast SST)	SST Weld ID 16-001(1)	SA-351, CF8M (Pipe)
Hot Leg to Drain 2" NPS	SA 105, Cl. 2 w/ SST Clad	DMW 82/182 ID 15-009	SA-182, Type 316	SST Weld ID 32-001(1)	SA-376, TP304 (Pipe)

NPS = nominal pipe size; SDC = shutdown cooling; SST = stainless steel, Code Class 1

(1) To facilitate preservice/ISI of these austenitic stainless steel welds, the preemptive structural weld overlay for each DMW will be extended across the stainless steel weld.

3.2 Code Requirements

Subarticle IWA-4170(b) of the ASME Code, Section XI, requires that repairs and the installation of replacement items be performed in accordance with the Owner's Design Specification and the original Construction Code of the component or system. Alternatively, Subarticle IWA-4170(b) of the ASME Code, Section XI, allows for use of later Editions and

Addenda of the Construction Code or ASME Code, Section III. Subarticles IWA-4300 and IWA-4500 of the ASME Code, Section XI, provide defect removal and alternative welding methods when the requirements of IWA-4170(b) cannot be met.

Subarticle IWA-4800 of the ASME Code, Section XI, requires the performance of preservice examinations based on IWB-2200 of the ASME Code, Section XI, for Class 1 components.

The ASME Code, Section XI, Table IWB-2500-1, Categories B-F and B-J, prescribes ISI requirements for Class 1 butt welds.

Appendix VIII, Supplement 11 of the ASME Code, Section XI, specifies performance demonstration requirements for UT of weld overlays.

3.3 Proposed Alternative

Pursuant to 10 CFR 50.55a(a)(3)(i), the licensee proposes the following as alternatives to the Code requirements specified above. The proposed alternatives are applicable to the nine DMWs and adjacent stainless steel welds identified in Section 3.1 above.

The licensee will install preemptive full structural weld overlays in accordance with the proposed alternatives specified in Attachments 2 and 3 to Enclosure 3 of Reference 2 (Attachment 2 and 3 of Reference 2). These alternatives are based on the methodology of ASME Code, Section XI, Code Case N-740, "Dissimilar Metal Weld Overlay for Repair of Class 1, 2, and 3 Items Section XI, Division 1." The alternative to design, fabrication, examination, pressure testing, and ISI of preemptive full structural weld overlays is described in Attachment 2 of Reference 2. The alternative applicable to ambient temperature temper bead welding is described in Attachment 3 of Reference 2. The ambient temperature temper bead welding will be applied to the welds as an alternative to the post-weld heat treatment requirements of the ASME Code, Section III.

The licensee will perform UT of the proposed preemptive full structural weld overlays in accordance with Appendix VIII, Supplement 11 of the 1995 Edition through 1996 Addenda of ASME Code, Section XI, except as modified by the Performance Demonstration Initiative (PDI) Program. The proposed PDI alternatives to Appendix VIII, Supplement 11 are specified in Attachment 6 of Reference 2.

3.4 Duration of the Alternative

In the February 21, 2008, supplement, the licensee stated that Request for Alternative W3-R&R-006 is applicable to the second 10-year ISI interval at Waterford 3 which concludes on May 30, 2008. The licensee intends to implement the request during the 15th refueling outage (RF-15) which is scheduled for spring 2008.

4.0 TECHNICAL EVALUATION

As stated above, Request for Alternative W3-R&R-006 is based on Code Case N-740. Code Case N-740 combines the requirements in Code Case N-504-2, "Alternative Rules for Repair of Class 1, 2, and 3 Austenitic Stainless Steel Piping Section XI, Division 1," and Code Case N-638-1, "Similar and Dissimilar Metal Welding Using Ambient Temperature Machine

GTAW [gas tungsten arc welding] Temper Bead Technique Section XI, Division 1." The NRC staff has endorsed Code Cases N-504-3, "Alternative Rules for Repair of Class 1, 2, and 3 Austenitic Stainless Steel Piping Section XI, Division 1," and N-638-1 in Regulatory Guide (RG) 1.147, Revision 15, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," and Code Case N-504-2 in RG 1.147, Revision 14, but not Code Case N-740. RG 1.147 requires that Appendix Q to the ASME Code, Section XI, be used when using Code Case N-504-3. The staff evaluated the acceptability of Request for Alternative W3-R&R-006 based on the requirements of Code Cases N-504-3 and N-638-1. The staff endorsed the use of Code Case N-504-3 in RG 1.147, Revision 15, during the same time period it was reviewing the Waterford 3 submittal. However, when the original submittal (Reference 1) was made by the licensee, Code Case N-504-3 had not been endorsed. Therefore, some of the issues that the staff raised during the review of the licensee's submittal were based on Code Case N-504-2 and the discussion below will contain references to Code Case N-504-2 as well. The staff notes that the licensee's submittal has considered the differences between Code Cases N-504-2 and N-504-3.

The licensee has addressed in W3-R&R-006 satisfactorily many technical issues related to the design, analysis, and examination of the weld overlay that the staff raised in its safety evaluation for the ANO Request for Alternative ANO1-R&R-010 and for the Farley and Vogtle Relief Request ISI-GEN-ALT-06-03. Therefore, the staff evaluated herein only the following technical issues that are plant-specific to Waterford 3.

4.1 General Requirements

Section 1.0, "General Requirements," of Attachment 2 of Reference 2, provides requirements for the specification of the base metal (carbon steel, stainless steel, and Alloy 82/182) and weld overlay filler metal (Alloy 52M), surface condition of the base metal, and chromium content of the weld overlay deposits. The proposed alternative is consistent with Code Case N-504-3; Code Case N-638-1; Appendix Q to the ASME Code, Section XI; the ANO Request for alternative ANO1-R&R-010, and the Farley and Vogtle Relief Request ISI-GEN-ALT-06-03 with the following exception.

In Reference 1, the licensee stated that it may apply a butter (transitional) layer of austenitic stainless steel filler metal across the austenitic stainless steel base metal. Paragraph (e) of Code Case N-504-3 requires specific delta ferrite content in the weld layer when austenitic stainless steel weld metal is used. The NRC staff asked the licensee to discuss whether paragraph (e) of Code Case N-504-3 is applicable to the butter layer if austenitic stainless steel filler metal is applied. In addition, the licensee was requested to identify the austenitic stainless steel weld filler metal and to provide the maximum and minimum delta ferrite content for the heat of austenitic stainless steel filler wire to be used, as stated on the Certified Material Test Report (CMTR).

In Enclosure 1 to Reference 2, the licensee responded that Code Case N-504-2 provides rules for installing austenitic stainless steel weld overlays onto austenitic stainless steel materials (i.e. welds and base materials) as a means of reducing a defect to a flaw of acceptable size. Code Case N-504-2 was originally developed as a repair method for austenitic stainless steel welds subject to intergranular stress corrosion cracking (IGSCC) in Boiling Water Reactor (BWR) systems. While BWR austenitic stainless steels are susceptible to IGSCC, Pressurized-Water Reactor (PWR) systems are not. IGSCC can occur when the

following three essential conditions exist simultaneously at a given location: (1) a susceptible microstructure (i.e. sensitized austenitic material), (2) tensile stress, and (3) a susceptible environment having a critical oxygen content. The essential conditions are interdependent such that critical levels for each essential condition will vary depending upon the strength of the other two. Should any of these conditions be removed, then IGSCC cannot occur.

Paragraph (e) of Code Case N-504-3 requires weld reinforcement layers to have a deposited delta ferrite content of at least 7.5 ferrite number (FN, also expressed in percentages). Alternatively, an as-deposited delta ferrite content of 5 FN may also be accepted provided this lower value is substantiated by evaluation. This delta ferrite requirement is applicable to stainless steel weld overlays that are subject to IGSCC. Weld metals containing even small additions of delta ferrite are less susceptible to sensitization, and thereby, more resistant to IGSCC. As noted in paragraph 2.1 of NUREG-0313, Revision 2, "…weld metal with low carbon and controlled ferrite (such as 308L with 7.5% minimum ferrite) is resistant to sensitization and IGSCC…" However, NUREG-0313 also considers austenitic stainless steels with 5 percent delta ferrite resistant to sensitization and IGSCC depending on carbon content and other possible factors. As an additional benefit, small additions of one to three percent delta ferrite in austenitic weld deposits reduce the tendency for hot cracking or fissuring especially when welds are highly restrained.

The licensee does not believe that the delta ferrite requirement of Code Case N-504-3, paragraph (e) is applicable to the austenitic stainless steel butter layer of Request for Alternative W3-R&R-006 for the following reasons:

a. IGSCC is a credible degradation mechanism for austenitic stainless steel in oxidizing BWRs environments. However, there is no industry experience to suggest that IGSCC is a concern for PWRs. In general, adverse environmental conditions in PWRs have been reduced and are not conducive to IGSCC. Therefore, IGSCC is not a credible degradation mechanism for the Waterford 3 hot-leg piping.

b. The austenitic stainless steel butter layer will not be included in the structural weld overlay thickness as defined in Attachment 2 to W3-R&R-006. The delta ferrite requirements of Code Case N-504-2, paragraph (e) only apply to the structural layers of a weld overlay. They do not apply to nonstructural weld layers. Conversely, paragraphs (c) and (d) of the code case do apply to nonstructural weld layers but clearly do not include any delta ferrite requirements. Therefore, if nonstructural layers for a weld overlay subject to IGSCC do not require delta ferrite testing, then a nonstructural stainless steel butter layer (for an Alloy 52M weld overlay) that is not subject to IGSCC certainly does not require delta ferrite testing.

For Waterford 3, the stainless steel butter layers will be deposited with ER308L filler metal which has a maximum of 0.03 percent carbon. The use of low-carbon filler metals greatly reduces the potential for sensitizing austenitic stainless steel weld deposits. The licensee stated that the ER308L filler metal it uses will have a delta ferrite content of between 5 percent and 15 percent FN as documented on the applicable CMTR. This delta ferrite content is consistent with Code Case N-504-2 and NUREG-0313, Revision 2. It is also consistent with ASME Code, Section III and RG 1.44, "Control of the Use of Sensitized

Stainless Steel." According to NB-2433.2 of ASME Code, Section III, all austenitic stainless steel filler metals must have a minimum delta ferrite of at least 5 FN as reported on the CMTR. RG 1.44, paragraphs C.4.b and C.5.a, provide exceptions to recommended controls for materials subject to sensitization based on a delta ferrite content of 5 FN. Regarding hot cracking, a minimum delta ferrite of 5 FN provides more than adequate resistance to fissuring as noted in RG 1.31, "Control of Ferrite in Stainless Steel Weld Metal."

The licensee stated further that the butter weld layer will be deposited with a welding procedure that has been qualified in accordance with the ASME Code, Section IX. Liquid penetrant (PT) examinations will be performed prior to and after deposition of the butter layer. The second PT examination is performed to ensure that the completed butter layer is free from cracks and other unacceptable indications prior to deposition of the Alloy 52M weld overlay.

The staff agrees with the licensee that the minimum delta ferrite requirement of Code Case N-504-3, paragraph (e), does not apply to the butter layer at Waterford 3. The staff finds that the licensee will deposit the butter layer on the pipe and perform examination in accordance with the requirements of the ASME Code and Code Case N-504-2. The staff finds that the licensee has responded to the staff concern satisfactorily.

4.2 Crack-Growth Considerations and Design

Section 2, "Crack Growth Considerations and Design," of Attachment 2 to Reference 2, provides the requirements for weld overlay design, design-basis flaw size, and the crack-growth calculation. The crack-growth calculation assures that the growth of the crack in the base metal will be mitigated or minimized by the installation of the weld overlay. The Section 2 requirements are consistent with Code Case N-504-3; the ANO Request for Alternative ANO1-R&R-010; the Farley and Vogtle Relief Request ISI-GEN-ALT-06-03; and Appendix Q to the ASME Code, Section XI. The significant issues are discussed below.

The licensee stated that the design basis for full structural weld overlays is to maintain the original design margins with no credit taken for the underlying primary water stress-corrosion cracking (PWSCC)-susceptible weldments. The assumed design-basis flaw for the purpose of sizing the weld overlays is 360 degrees and 100 percent through the original wall thickness of the DMWs. Regarding the crack-growth analysis for the preemptive full structural weld overlay, a flaw originating from the inside diameter with a depth of 75 percent and a circumference of 360 degrees will be assumed. A 75 percent through-wall flaw is the largest flaw that could remain undetected in the base metal. A preservice volumetric examination will be performed after application of the weld overlay using an ASME Code, Section XI, Appendix VIII (as implemented through PDI) examination procedure. This examination will verify that there is no cracking in the upper 25 percent of the base material. The preservice examination will also demonstrate that the assumption of a 75 percent through-wall crack is conservative. The PDI procedure is not qualified to examine the lower 75 percent of the pipe-wall thickness. Therefore, a conservative approach is that a 75 percent through-wall crack is assumed to exist in the lower 75 percent of the pipe-wall thickness.

The licensee stated that if no flaws were identified in the upper 25 percent of the original weld, the flaw depth for crack-growth calculation would be 75 percent through-wall in the original weld. If any crack-like flaws are found during the preservice examination in the upper

25 percent of the original weld or base metal, an analyzed flaw (the postulated 75 percent through-wall flaw plus the portion of the as-found flaw in the upper 25 percent) would be used for the crack-growth calculation. The staff finds that the proposed flaw size for the crack-growth calculation is conservative and, therefore, is acceptable.

As part of the weld overlay design, the licensee will perform the following analyses. The licensee will perform nozzle-specific stress analyses to establish a residual stress profile in each subject nozzle. Post-weld overlay residual stresses at normal operating conditions will be shown to result in beneficial compressive stresses on the inside surface of the components, assuring that further crack initiation due to PWSCC is highly unlikely.

The licensee will also perform fracture mechanics analyses to predict crack growth for postulated flaws. Crack growth due to PWSCC and fatigue will be analyzed for the original DMW. The analyses will demonstrate that the postulated cracks will not grow beyond the design basis for the weld overlays. The licensee will demonstrate that applying the weld overlay does not impact the conclusions of the existing stress reports. The stress and fatigue criteria of ASME Code, Section III, will be met for regions of the overlays remote from the assumed cracks.

The licensee will measure shrinkage during the overlay application. Shrinkage stresses at other locations in the piping systems arising from the weld overlays will be demonstrated not to have an adverse effect on the systems. Clearances of affected support and restraints will be checked after the overlay repair, and will be reset within the design ranges as required. The licensee will evaluate the total added weight on the piping systems due to the overlays for potential impact on piping system stresses and dynamic characteristics. The as-built dimensions of the weld overlays will be measured and evaluated to demonstrate that they meet or exceed the minimum design dimensions of the overlays.

The staff finds that the licensee proposed analyses and shrinkage measurements are consistent with paragraph (g) of Code Case N-504-3 and are, therefore, acceptable.

4.3 Examination and Inspection

Section 3, “Examination and Inspection,” of Attachment 2 to Reference 2 provides requirements for the acceptance examination, preservice examination, and inservice examination after the weld overlay is installed. The length, surface finish, and flatness requirements of the weld overlay are specified in the weld overlay design to provide the required examination volume of the weld overlay as shown in Figures 1 and 2 of Attachment 2, Reference 2.

4.3.1 Acceptance Examination

Section 3.0(a), “Acceptance Examination,” of Attachment 2 of Reference 2, requires a surface and UT examination of an installed weld overlay. The requirements of the acceptance examination are acceptable because they are consistent with Code Case N-504-3; Appendix Q to the ASME Code, Section XI; the ANO-1 Relief Request ANO1-R&R-010; and the Farley and Vogtle Relief Request ISI-GEN-ALT-06-03.

4.3.2 Preservice Examination

Section 3.0(b), "Preservice Inspection," of Attachment 2, Reference 2, requires an UT of the installed weld overlay and the upper (outer) 25 percent of the original pipe-wall thickness. The required examination volume is defined in Figure 2 of Attachment 2, Reference 2. The staff finds that the preservice examination requirements are acceptable because they are consistent with Code Case N-504-3; the ANO Request for Alternative ANO1-R&R-010; the Farley and Vogtle Relief Request ISI-GEN-ALT-06-03; and the ASME Code, Section XI, Appendix Q.

4.3.3 Inservice Examination

Section 3.0(c) of Attachment 2 of Reference 2 requires inservice examination be conducted ultrasonically with the examination volume defined in Figure 2 of Attachment 2 of Reference 2. The requirements in Section 3.0(c) of Attachment 2 are consistent with the ANO Request for Alternative ANO1-R&R-010; the Farley and Vogtle Relief Request ISI-GEN-ALT-06-03; and the ASME Code, Section XI, Appendix Q with the following exception.

In Section V.A.3.c, Reference 1, the licensee discussed the inspection issues regarding cast austenitic stainless steel (CASS) which was used to fabricate the safe end at the hot-leg "A" to surge line nozzle and hot-leg "B" to SDC nozzle. The licensee stated and the staff agrees that the UT has not been qualified in accordance with Appendix VIII, Supplement 11 of the ASME Code, Section XI, in the examination of CASS. The licensee stated further that a flaw with a depth of 75 percent of pipe thickness and circumference of 360 degrees will be assumed in the crack-growth calculation for the cast stainless steel safe ends. In light of the limited UT capability to examine CASS, the staff determined that the postulated 75 percent depth flaw in the crack-growth calculation was not sufficiently conservative to demonstrate the structural integrity of the CASS component.

The licensee stated that, to address this issue, it will perform UT examination during the first or second refueling outage following weld overlay application per Section 3.0(c)(1) in addition to performing UT examinations every 10 years, pending qualified PDI techniques for CASS.

The licensee further stated that until PDI procedures are qualified for CASS materials, it will perform "best effort" ISI of the CASS component per the ASME Code, Section XI, Appendix III. The use of Appendix III for examination of CASS is consistent with subarticle VIII-3110(c) of Appendix VIII to the ASME Code, Section XI. Once qualified, the licensee will implement these PDI procedures at the next scheduled ISI as required by Section 3.0(c) of Attachment 2, Reference 2.

The staff finds that the licensee's strategy for additional examination of the CASS component is acceptable.

4.4 Proposed Ambient Temperature Temper Bead Welding

The requirements for the proposed ambient temperature temper bead welding are discussed in Attachment 3 to Reference 2, and are based on Code Case N-638-1. The requirements in Attachment 3 to W3-R&R-006 are consistent with Code Case N-638-1; the ANO Request for

Alternative ANO1-R&R-010; and the Farley and Vogtle Relief Request ISI-GEN-ALT-06-03, with one exception, as discussed below.

Paragraph 1.0(a) of Code Case N-638-1 limits the maximum area of an individual weld to 100 square inches on the ferritic-base material using temper bead welding. However, the proposed alternative allows the weld surface area up to 500 square inches on the ferritic-base material. The licensee stated that technical justification for allowing weld overlays on ferritic materials with surface areas up to 500 square inches is provided in the white paper supporting the changes in ASME Code Case N-638-3 and Electric Power Research Institute Report (EPRI) Report 1011898, "Justification for the Removal of the 100 Square Inch Temper Bead Weld Repair Limitation." The ASME white paper notes that the original limit of 100 square inches in Code Case N-638-1 was arbitrary. The white paper cites evaluations of a 12-inch diameter nozzle weld overlay to demonstrate adequate tempering of the weld heat-affected zone, residual stress evaluations demonstrating acceptable residual stresses in weld overlays ranging from 100 to 500 square inches, and service history in which weld repairs exceeding 100 square inches were NRC approved and applied to DMW nozzles in several BWR and PWR applications. Some of the cited repairs are greater than 15 years old, and have been inspected several times with no evidence of any continued degradation.

The above theoretical arguments and empirical data have been verified in practice by extensive field experience with temperbead weld overlays, with ferritic material coverage ranging from less than 10 square inches up to and including 325 square inches. It can be seen from the information above that the original DMW weld overlay was applied over 20 years ago, and weld overlays with low-alloy steel coverage in the 100-square inch range have been in service for 5 to 15 years. Several overlays have been applied with low alloy steel coverage significantly greater than the 100 square inches. These overlays have been examined with PDI qualified techniques, in some cases multiple times, and none have shown any signs of new cracking or growth of existing cracks.

The staff notes that the proposed 500-square-inch weld area has also been addressed in EPRI Report 1014351, "Repair and Replacement Applications Center: Topical Report Supporting Expedited NRC Review of Code Cases for Dissimilar Metal Weld Overlay Repairs, December 2006." The technical basis for the 500-square-inch weld area was also presented in slides entitled, "Bases for 500 square Inch Weld Overlay Over Ferritic Material," in an NRC-ASME public meeting held on January 10, 2007 (ADAMS Accession No. ML070470565). Based on EPRI 1014351, the staff finds that the proposed 500-square-inch weld area on the ferritic material is acceptable because the stress analysis presented in EPRI Report 1014351 shows that the structural integrity of ferritic material is not adversely affected by a 500-square-inch weld overlay area.

4.5 Performance Demonstration Initiative Program

Appendix VIII, Supplement 11 of the 1995 Edition through 1996 Addenda of ASME Code, Section XI, specifies requirements for performance demonstration of UT procedures, equipment, and personnel used to detect and size flaws in full structural overlays of wrought austenitic piping welds. The current UT technology cannot meet the requirements of Appendix VIII, Supplement 11. Therefore, the industry initiated the PDI Program as an alternative to satisfy the requirements of ASME Code, Section XI, Appendix VIII. To this end, EPRI has developed a program for qualifying equipment, procedures, and personnel in

accordance with the UT criteria of Appendix VIII, Supplement 11. Prior to the Supplement 11 program, EPRI was maintaining a performance demonstration program (the precursor to the PDI program) for weld overlay qualification under the Tri-party Agreement with the NRC, BWR Owner's Group, and EPRI, as discussed in the NRC letter dated July 3, 1984. Later, the NRC staff recognized the EPRI PDI program for weld overlay qualifications as an acceptable alternative to the Tri-party Agreement in its letter dated January 15, 2002, to the PDI Chairman (ADAMS Accession No. ML020160532).

The PDI program is routinely assessed by the staff for consistency with the current ASME Code and proposed changes. The PDI program does not fully comport with the existing requirements of Supplement 11. The PDI representatives presented the differences between Supplement 11 and the PDI program at public meetings in which the NRC participated (Memorandum from Donald G. Naujock to Terence Chan, "Summary of Public Meeting Held January 31 - February 2, 2002, with PDI Representatives," March 22, 2002 (ADAMS Accession No. ML010940402), and Memorandum from Donald G. Naujock to Terence Chan, "Summary of Public Meeting Held June 12 through June 14, 2001, with PDI Representatives," November 29, 2001 (ADAMS Accession No. ML013330156)). Based on the discussions at these public meetings, the staff determined that the industry's PDI program provides an acceptable level of quality and safety.

The licensee proposed to use the PDI program as indicated in Attachment 6 to Enclosure 3 of Reference 2, to satisfy the Appendix VIII, Supplement 11, qualification requirements. The PDI initiatives will be used for qualification of UT to detect and size flaws in the preemptive full structural weld overlays of this request. The NRC staff evaluated the differences between the PDI program and Supplement 11 as shown in Attachment 6 to W3-R&R-006. The NRC staff concludes that the justifications for the differences are acceptable and the PDI program provides an acceptable level of quality and safety. Therefore, the proposed Waterford 3 PDI program is acceptable for use in lieu of Supplement 11 of Appendix VIII to the ASME Code, Section XI.

4.6 Commitments

As part of Request for Alternative W3-R&R-006, the licensee made the following commitments as shown in Enclosure 4 of Reference 2:

(1) The licensee will submit the following information to the NRC within 14 days from completing the final UTs of the completed weld overlays:

- Weld overlay examination results including a listing of indications detected,
- Disposition of all indications using the standards of ASME Code, Section XI, IWB-3514-2 and/or IWB-3514-3 criteria and, if possible, the type and nature of the indications, and

- A discussion of any repairs to the weld overlay material and/or base metal and the reason for the repairs.

(2) Prior to entry into Mode 4 start-up from RF15, the licensee will submit to the NRC a stress analysis summary demonstrating that the hot-leg piping nozzles

will perform their intended design functions after the weld overlay installation. The stress analysis report will include results showing that the requirements of NB-3200 and 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 Code, Section XI, are satisfied. The results will show that the postulated crack including its growth in the nozzles will not adversely affect the integrity of the overlaid welds.

(3) Unless PDI procedures are qualified in time to support the preservice examinations required by Attachment 2, the licensee will perform a "best effort" preservice examination of the cast stainless steel region, following installation of the weld overlays during refueling outage RF15.

(4) Until PDI procedures are qualified to examine the upper 25 percent of the cast stainless steel, Entergy will perform "best effort" ISI of the region shown in Figure 2 of Attachment 2. Once qualified, the licensee will implement these PDI procedures at the next scheduled ISI as required by paragraph 3.0(c) of Attachment 2. Note: ISI of weld overlays for stainless steel welds is performed at the frequencies required by the Waterford 3 ISI Program as stipulated in Section V.A.3.

(5) ISI of the DMW weld overlays with cast stainless steel safe ends will be performed at a higher frequency than those without cast stainless steel safe ends. First, the initial UT inspection of the DMW weld overlays will be performed during the first or second refueling outage after installation. Then, instead of being inspected on a 25 percent sample basis, these weld overlays will be UT examined once every 10 years from the date of installation until such time when a technique is qualified to examine cast stainless steel in accordance with the PDI Program. Once the subject DMW overlays are UT examined by a qualified PDI technique (for cast stainless steel) and no planar flaws are detected, then the DMW overlays will be placed into a population in which 25 percent of that population is examined once every 10 years. Until such time, the UT inspections of the subject DMW overlays (with cast stainless steel safe ends) will not be credited to satisfy the 25 percent sample inspection requirement. Note: ISI of weld overlays for stainless steel welds is performed at the frequencies required by the Waterford 3 ISI Program as stipulated in Section V.A.3.j.

The NRC staff finds that the above commitments are acceptable because the weld overlay examination results and stress analysis will provide verification of the condition of the weld overlays after installation.

5.0 CONCLUSION

The NRC staff has reviewed the licensee's submittal and determined that Request for Alternative W3-R&R-006 (Reference 2), will provide an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the staff authorizes the use of Request for Alternative W3-R&R-006 for the installation of full structural weld overlays on the dissimilar metal welds of the Pressurizer Nozzle to Surge Line, Pressurizer Nozzle to Relief Valve (two

locations), Pressurizer Spare Nozzle (capped), Pressurizer Nozzle to Spray Line, Hot Leg Loop 1 Nozzle to Surge Line, Hot Leg Loop 1 Nozzle to Drain Line, Hot Leg Loop 1 Nozzle to SDC Line, and Hot Leg Loop 2 Nozzle to SDC Line at Waterford 3 for the second ISI interval which ends on May 30, 2008.

All other ASME Code, Section XI requirements for which relief was not specifically requested and approved in this relief request remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

6.0 REFERENCES

1. Letter dated April 26, 2007, from Entergy Operations, Inc. (John F. McCann), to NRC (Document Control Desk), "Request for Alternative W3-R&R-006 Proposed Alternative to ASME Code Requirements for Weld Overlay Repairs" (ADAMS Accession No. ML071230223).

2. Letter dated February 21, 2008, from Entergy Operations, Inc. (Robert J. Murillo), to NRC (Document Control Desk), "Revised Request for Alternative W3-R&R-006 – Proposed Alternative to ASME Code Requirements for Weld Overlay Repairs" (ADAMS Accession No. ML080560268).

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