February 26, 2004

Mr. Michael Kansler
President
Entergy Nuclear Operations, Inc.
440 Hamilton Avenue
White Plains, NY 10601

SUBJECT: PILGRIM NUCLEAR POWER STATION - PILGRIM RELIEF REQUEST NO. 38, RELIEF FROM ASME CODE, SECTION XI, APPENDIX VIII, SUPPLEMENT 11, "QUALIFICATION REQUIREMENTS FOR FULL STRUCTURAL OVERLAID WROUGHT AUSTENITIC PIPING WELDS" (TAC NO. MC0961)

Dear Mr. Kansler:

By letter dated October 7, 2003, Entergy Nuclear Operations, Inc. (ENO), submitted Pilgrim Relief Request (PRR)-38, requesting relief from selected American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI requirements related to the qualification for examination of pressure retaining welds in piping at the Pilgrim Nuclear Power Station. ENO submitted the request pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.55a(a)(3)(i) as a proposed alternative to the requirements of ASME Code, Section XI, Appendix VIII, Supplement 11.

The staff has reviewed the request against the requirements of 10 CFR 50.55a(g)(6)(ii)(C) as related to the implementation of ASME Code, Section XI, Appendix VIII, Supplement 11. On October 9, 2003, the staff granted verbal authorization to use the proposed alternative. The results of this review are documented in the enclosed Safety Evaluation.

Based on the information provided, the staff concludes that the proposed alternative provides an acceptable level of quality and safety. Therefore, the alternative is authorized pursuant to 10 CFR 50.55a(a)(3)(i) for the remaining portion of the third in-service inspection interval.

If you have any questions, please contact Travis Tate at (301) 415-8474.

Sincerely,

/RA/

Darrell Roberts, Acting Chief, Section 2
Project Directorate I
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-293

Enclosure: As stated

cc w/encl: See next page

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Docket No. 50-293
Enclosure: As stated
cc w/encl: See next page
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

QUALIFICATION REQUIREMENTS FOR FULL STRUCTURAL OVERLAID

WROUGHT AUSTENITIC PIPING WELDS

ENTERGY NUCLEAR GENERATION COMPANY

ENTERGY NUCLEAR OPERATIONS, INC.

PILGRIM NUCLEAR POWER STATION

DOCKET NO. 50-293

1.0 INTRODUCTION

By letter dated October 7, 2003, Entergy Nuclear Operations, Inc. (ENO or the licensee), submitted Pilgrim Relief Request (PRR)-38, requesting relief from selected American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI requirements related to the qualification for examination of pressure retaining welds in piping at the Pilgrim Nuclear Power Station (Pilgrim).

The relief request would authorize the use of a proposed alternative program to the Class 1, pressure retaining welds in piping examination requirements of ASME Code, Section XI, Appendix VIII, Supplement 11, "Qualification Requirements for Full Structural Overlaid Wrought Austenitic Piping Welds," for the remaining portion of the third in-service inspection (ISI) interval.

2.0 REGULATORY EVALUATION

In a final rulemaking on September 22, 1999 (64 FR 51370), the U.S. Nuclear Regulatory Commission (NRC or the Commission) imposed a requirement for expedited implementation of Appendix VIII to Section XI of the ASME Code. That appendix contains several supplements, which licensees were to implement on a phased basis over a three-year period, with Supplement 11 scheduled to be implemented by November 22, 2001. The NRC concluded that the expedited implementation of Appendix VIII was "... necessary to bring the facilities described into compliance with General Design Criterion 14, Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, Appendix A, or similar provisions in the licensing basis for these facilities, and Criterion II, 'Quality Assurance Program,' and Criterion XVI, 'Corrective Actions,' of Appendix B to 10 CFR Part 50" (64 FR 51394).

Prior to November 22, 2001, the requirements for conducting full structural overlaid wrought austenitic piping weld qualifications and examinations using ultrasonic techniques were

stipulated in Appendix III to Section XI of the ASME Code. Since that date, however, these requirements are stipulated in Appendix VIII to Section XI of the ASME Code. A significant difference between these appendices is that Appendix III consists of prescriptive-based criteria, while Appendix VIII consists of performance-based criteria. This is important because the performance-based criteria substantially improve the ability of an examiner to detect and characterize flaws during ultrasonic examination of components and, thereby, provide for more reliable examination results.

In accordance with 10 CFR 50.55a(g)(4), ASME Code Class 1, 2, and 3 components must meet the requirements set forth in ASME Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plants Components" to the extent practical within the limitations of design, geometry, and materials of construction of the components. The regulations require that all inservice examinations 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 ASME Code, Section XI, incorporated by reference in 10 CFR 50.55a(b) on the date 12 months prior to the start of the 10-year interval. For Pilgrim, the 1989 Edition to ASME Code, Section XI, is the applicable edition for the current 10-year ISI interval.

In accordance with 10 CFR 50.55a(g)(6)(ii)(C), the implementation of Supplements 1 through 8, and 10 through 13 of Appendix VIII to Section XI, 1995 Edition with the 1996 Addenda of the ASME Code is required on a phased schedule ending on November 22, 2002. Supplement 11 was required to be implemented by November 22, 2001. Additionally, 10 CFR 50.55a(g)(6)(ii)(C)(2) requires licensees implementing the 1989 Edition and earlier editions of Section XI of the ASME Code to implement the 1995 Edition with the 1996 Addenda of Appendix VIII and supplements to Appendix VIII of Section XI of the ASME Code.

Alternatives to requirements may be authorized or relief granted by the NRC pursuant to 10 CFR 50.55a(a)(3)(i), 10 CFR 50.55a(a)(3)(ii), or 10 CFR 50.55a(g)(6)(i). In proposing alternatives or requesting relief, the licensee must demonstrate that: (1) the proposed alternatives provide an acceptable level of safety; (2) compliance would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety; or (3) conformance is impractical for the facility. Pursuant to 10 CFR 50.55a(g)(4)(iv), ISI items may meet the requirements set forth in subsequent editions and addenda of the ASME Code that are incorporated by reference in 10 CFR 50.55a(b), subject to the limitations and modifications listed therein, and subject to Commission approval. Portions of editions and addenda may be used provided that related requirements of the respective editions and addenda are met.

The licensee submitted the request, pursuant to 10 CFR 50.55a(a)(3)(i), as a proposed alternative to the implementation of ASME Code Section XI, Appendix VIII, Supplement 11 for the remaining portion of the third ISI interval.

3.0 TECHNICAL EVALUATION

3.1 Code Requirements for which Relief is Requested

The licensee requested relief from the requirements of ASME Code, Section XI, Appendix VIII, Supplement 11 (1995 Edition with 1996 Addenda), the implementation of which is required in accordance with 10 CFR 50.55a(g)(6)(ii)(C).

The licensee proposed to use the Electric Power Research Institute (EPRI) - Performance Demonstration Initiative (PDI) program as an alternative to the following Supplement 11 requirements:

- Paragraph 1.1(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.

- Paragraph 1.1(d)(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 the ultrasonic detection or characterization of the cracking. Specimens containing [intergranular stress-corrosion cracking] IGSCC shall be used when available.

- Paragraph 1.1(e)(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.

- Paragraph 1.1(e)(2) Specimens shall be divided into base and overlay grading units. Each specimen shall contain one or both types of grading units.

- Paragraph 1.1(e)(2)(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 interference.

- Paragraph 1.1(e)(2)(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.

- Paragraph 1.1(e)(2)(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.

- Paragraph 1.1(e)(2)(b)(1) An overlay grading unit shall include the overlay material and the base metal-to-overlay interference of at least 6 sq. in. The overlay grading unit shall be rectangular, with minimum dimensions of 2 in.

- Paragraph 1.1(e)(2)(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.

- Paragraph 1.1(e)(2)(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.

- Paragraph 1.1(f)(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.

- Paragraph 1.1(f)(3) Base metal cracking used for length sizing demonstrations shall be oriented circumferentially.

- Paragraph 1.1(f)(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.

- Paragraph 2.0 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.

- Paragraph 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.

- Paragraph 2.2(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.

- Paragraph 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.

- Paragraph 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.

- Paragraph 3.2(a) Sizing Acceptance Criteria. The [root mean square] 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 75% through-base-metal position.

- Paragraph 3.2(b) All extensions of base metal cracking into the overlay material by at least 0.1 in. are reported as being intrusions into the overlay material.

- Paragraph 3.2(c) The RMS error of the flaw depth measurements, as compared to the true flaw depths, is less than or equal to 0.125 in.

3.1.1 System/Component(s) for which Relief is Requested

The requested relief from the Supplement 11 requirements applies to Class 1, pressure retaining welds in piping subject to examination using procedures, personnel, and equipment qualified to ASME Code, Section XI, Appendix VIII, Supplement 11 criteria.

3.2 Licensee's Proposed Alternative and Bases

Pursuant to the alternative provisions in 10 CFR 50.55a(a)(3)(i), the licensee proposed the following for the remaining portion of the third ISI interval. The proposed alternative will be implemented through the EPRI - PDI.

> Paragraph 1.1(d)(1) requires that all base metal flaws be cracks. As illustrated below [see figure in the submittal], 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 in., and at

least 70 percent of the flaws in the detection and sizing test shall be cracks and the remainder shall be alternative flaws.

Relief is requested to allow closer spacing of flaws provided they did not interfere with detection or discrimination. The existing specimens used to-date for qualification to the Tri-party (NRC/BWROG [Boiling Water Reactor Owners Group]/EPRI) agreement have a flaw population density greater than allowed by the current [ASME] Code requirements. These samples have been used successfully for all previous qualifications under the Tri-party agreement program. To facilitate their use and provide continuity from the Tri-party agreement program to Supplement 11, the PDI Program has merged the Tri-party test specimens into their weld overlay program. For example: 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; paragraph 1.1(d)(1) includes the statement that intentional overlay fabrication flaws shall not interfere with ultrasonic detection or characterization of the base metal flaws; paragraph 1.1(e)(2)(a)(1) was modified to require that a base metal grading unit include at least 1 (one) in. of the length of the overlaid weld, rather than 3 (three) in.; paragraph 1.1(e)(2)(a)(3) 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 (one) in. requirement of Supplement 11; paragraph 1.1(e)(2)(b)(1) 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 (one) in., rather than the 6 sq. in. requirement of Supplement 11; and, paragraph 1.1(e)(2)(b)(2) 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 (one) in. at both ends, rather than around its entire perimeter.

Additionally, 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 in paragraph 3.2(b) 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 it's 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.

These changes are contained in [ASME] Code Case N-653. A comparison between the 1995 Edition and 1996 Addenda of Supplement 11, [ASME] Code Case N-653, and the PDI Program is enclosed [in the submittal] as supporting documentation. The first (left) column identifies the [ASME] Code requirements, while the second (middle) column identifies the changes made by the [ASME] Code Case.

There are, however, some additional changes that were inadvertently omitted from the [ASME] Code Case. The most important change is paragraph 1.1(a)(1) where 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. To avoid confusion, several instances of the term “cracks” or “cracking” were changed to the term “flaws” because of the use of alternative flaw mechanisms. Additionally, to avoid confusion, the overlay thickness tolerance contained in paragraph 1.1(b) last sentence, was reworded and the phrase “and the remainder shall be alternative flaws” was added to the next to last sentence in paragraph 1.1(d)(1). Additional editorial changes were made to the PDI program to address an earlier request for additional information. The above changes are identified by bold print in the third (right) column of the attachment [in the submittal].

3.3 Evaluation

The U.S. nuclear utilities created the PDI to implement performance demonstration requirements contained in Appendix VIII of Section XI of the ASME Code. To this end, PDI has developed a program for qualifying equipment, procedures, and personnel for examinations of weld overlays in accordance with the ultrasonic testing (UT) criteria of Appendix VIII, Supplement 11. Prior to the Supplement 11 program, EPRI maintained a performance demonstration program for weld overlay qualification under the Tri-party Agreement[1]. Instead of having two programs with similar objectives, the NRC staff recognized the PDI program for weld overlay qualifications as an acceptable alternative to the Tri-party Agreement[2].

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. PDI presented the differences at public meetings in which the NRC participated[3, 4]. The differences are in flaw location within test specimens and fabricated flaw tolerances. The changes in flaw location permitted using test specimens from the Tri-party Agreement, and the changes in fabricated flaw tolerances provide UT acoustic responses similar to the responses associated with intergranular stress corrosion cracking. Based on the discussions at these public meetings and the review presented in a Pacific Northwest National Laboratory technical letter report (TLR) submitted in support of NRC staff’s analysis of Carolina Power and Light Company’s request for relief (RR-31), the staff determined that the PDI program provides an acceptable level of quality and safety.

Evaluations of the differences identified in the PDI program with Supplement 11, Paragraphs 1.1(b), 1.1(d)(1), 1.1(e)(1), 1.1(e)(2), 1.1(e)(2)(a)(1), 1.1(e)(2)(a)(2), 1.1(e)(2)(a)(3),

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1 The Tri-party Agreement is between NRC, EPRI, and the Boiling Water Reactor Owners Group (BWROG), “Coordination Plan for NRC/EPRI/BWROG Training and Qualification Activities of NDE (Nondestructive Examination) Personnel,” July 3, 1984.

2 Letter from William H. Bateman to Michael Bratton, “Weld Overlay Performance Demonstration Administered by PDI as an Alternative for Generic Letter 88-01 Recommendations,” January 15, 2002. ML020160532

3 Memorandum from Donald G. Naujock to Terence Chan, “Summary of Public Meeting Held January 31 - February 2, 2002, with PDI Representatives,” March 22, 2002. ML010940402

4 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. ML013330156

1.1(e)(2)(b)(1), 1.1(e)(2)(b)(2), 1.1(e)(2)(b)(3), 1.1(f)(1), 1.1(f)(3), 1.1(f)(4), 2.0, 2.1, 2.2(d), 2.3, 3.1, 3.2(a), 3.2(b) and 3.2(c) are as follows:

Paragraph 1.1(b) of Supplement 11 states limitations to the maximum thickness for which a procedure may be qualified. The ASME Code states that "The specimen set must include at least one specimen with overlay thickness within minus 0.10-inch to plus 0.25-inch of the maximum nominal overlay thickness for which the procedure is applicable." The ASME Code requirement addresses the specimen thickness tolerance for a single specimen set, but is confusing when multiple specimen sets are used. The PDI proposed alternative states that "the specimen set shall include specimens with overlay not thicker than 0.10-inch more than the minimum thickness, nor thinner than 0.25-inch of the maximum nominal overlay thickness for which the examination procedure is applicable." The proposed alternative provides clarification on the application of the tolerance. The tolerance is unchanged for a single specimen set; however, the proposed alternative clarifies the tolerance for multiple specimen sets by providing tolerances for both the minimum and maximum thicknesses. The proposed wording eliminates confusion while maintaining the intent of the overlay thickness tolerance. Therefore, the staff finds this PDI Program alternative maintains the intent of the Supplement 11 requirements and is acceptable.

Paragraph 1.1(d)(1) requires that all base metal flaws be cracks. PDI determined that certain Supplement 11 requirements pertaining to location and size of cracks would be extremely difficult to achieve. For example, flaw implantation requires excavating a volume of base material to allow a pre-cracked coupon to be welded into this area. This process would add weld material to an area of the specimens that typically consists of only base material, and could potentially make ultrasonic examination more difficult and not representative of actual field conditions. In an effort to satisfy the requirements, PDI developed a process for fabricating flaws that exhibit crack-like reflective characteristics. Instead of all flaws being cracks, as required by Paragraph 1.1(d)(1), the PDI weld overlay performance demonstrations contain at least 70% cracks with the remainder being fabricated flaws exhibiting crack-like reflective characteristics. The fabricated flaws are semi-elliptical with tip widths of less than 0.002-inches. The licensee provided further information describing a revision to the PDI Program alternative to clarify when real cracks, as opposed to fabricated flaws, will be used; "Flaws shall be limited to the cases where implantation of cracks produces spurious reflectors that are uncharacteristic of actual flaws." The NRC has reviewed the flaw fabrication process, compared the reflective characteristics between actual cracks and PDI-fabricated flaws, and found the fabricated flaws for this application provide assurance that the PDI program meets the intent of the Supplement 11 requirements. Therefore, the staff finds the proposed alternative to the Supplement 11 requirements are acceptable.

Paragraph 1.1(e)(1) requires that at least 20% but not less than 40% of the flaws shall be oriented within ±20 degrees of the axial direction (of the piping test specimen). Flaws contained in the original base metal heat-affected zone satisfy this requirement; however, PDI excludes axial fabrication flaws in the weld overlay material. PDI has concluded that axial flaws in the overlay material are improbable because the overlay filler material is applied in the circumferential direction (parallel to the girth weld); therefore, fabrication anomalies would also be expected to have major dimensions in the circumferential direction. The NRC finds, based upon engineering judgement, that this approach to implantation of fabrication flaws is reasonable for meeting the intent of the Supplement 11 requirements. Therefore, the staff concludes that the PDI's application of flaws oriented in the axial direction is acceptable.

Paragraph 1.1(e)(1) also requires that the rules of IWA-3300 shall be used to determine whether closely spaced flaws should be treated as single or multiple flaws. PDI treats each flaw as an individual flaw and not as part of a system of closely spaced flaws. PDI controls the flaws going into a test specimen set such that the flaws are free of interfering reflections from adjacent flaws. In some cases this permits flaws to be spaced closer than what is allowed for classification as a multiple set of flaws by IWA-3300, thus potentially making the performance demonstration more challenging than the existing requirements. Hence, the staff concludes that PDI's application for closely spaced flaws is acceptable.

Paragraph 1.1(e)(2) requires that specimens be divided into base metal and overlay grading units. The PDI program adds clarification with the addition of the word "fabrication" and ensures flaw identification by ensuring all flaws will not be masked by other flaws with the addition of "Flaws shall not interfere with ultrasonic detection or characterization of other flaws." PDI's alternative provides clarification and assurance that the flaws are identified. Therefore, the staff finds the PDI alternative to the Supplement 11 requirements is acceptable.

Paragraph 1.1(e)(2)(a)(1) requires that a base grading unit shall include at least three inches of the length of the overlaid weld, and the base grading unit includes the outer 25% of the overlaid weld and base metal on both sides. The PDI program reduced the criteria to one inch of the length of the overlaid weld and eliminated from the grading unit the need to include both sides of the weld. The proposed change permits the PDI program to continue using test specimens from the existing weld overlay program which have flaws on both sides of the welds. These test specimens have been used successfully for testing the proficiency of personnel for over 16 years. The weld overlay qualification is designed to be a near-side (relative to the weld) examination, and it is improbable that a candidate would detect a flaw on the opposite side of the weld due to the sound attenuation and re-direction caused by the weld microstructure. However, the presence of flaws on both sides of the original weld (outside the PDI grading unit) may actually provide a more challenging examination, as candidates must determine the relevancy of these flaws, if detected. The staff determined, based on engineering judgement, that PDI's use of the one inch length of the overlaid weld base grading unit and elimination from the grading unit the need to include both sides of the weld, as described in the PDI Program alternative, is an acceptable alternative to the Supplement 11 requirements. Therefore, the staff finds the proposed alternative acceptable.

Paragraph 1.1(e)(2)(a)(2) requires, when base metal cracking penetrates into the overlay material, that a portion of the base grading unit shall not be used as part of the overlay grading unit. The staff finds that the PDI program adjusts for the changes in Paragraph 1.1(e)(2)(a)(2) and conservatively states that when base metal flaws penetrate into the overlay material, no portion of it shall be used as part of the overlay fabrication grading unit. The staff finds that the PDI program also provided clarification by the addition of the term "flaws" for "cracks" and the addition of "fabrication" to "overlay grading unit." The staff concludes that the PDI Program alternative provides clarification and conservatism and, therefore, is acceptable.

Paragraph 1.1(e)(2)(a)(3) requires that for unflawed base grading units, at least one inch of unflawed overlaid weld and base metal shall exist on either side of the base grading unit. This is to minimize the number of false identifications of extraneous reflectors. The PDI program stipulates that unflawed overlaid weld and base metal exists on all sides of the grading unit and flawed grading units must be free of interfering reflections from adjacent flaws which addresses the same concerns as the ASME Code. Hence, the staff concludes that the PDI's application of

the variable flaw-free area adjacent to the grading unit meets the intent of the Supplement 11 requirements and is, therefore, acceptable.

Paragraph 1.1(e)(2)(b)(1) requires that an overlay grading unit shall include the overlay material and the base metal-to-overlay interface of at least six square inches. The overlay grading unit shall be rectangular, with minimum dimensions of two inches. The PDI program reduces the base metal-to-overlay interface to at least one inch (in lieu of a minimum of two inches) and eliminates the minimum rectangular dimension. This criterion is necessary to allow use of existing examination specimens that were fabricated in order to meet NRC Generic Letter 88-01 (Tri-party Agreement, July 1984). This criterion may be more challenging to meet than that of the ASME Code because of the variability associated with the shape of the grading unit. Based on engineering judgement, the staff concludes that PDI's application of the grading unit is an acceptable alternative to the Supplement 11 requirements and is acceptable.

Paragraph 1.1(e)(2)(b)(2) requires that unflawed overlay grading units shall be surrounded by unflawed overlay material and unflawed base metal-to-overlay interface for at least one inch around it's entire perimeter. The PDI program redefines the area by noting unflawed overlay fabrication grading units shall be separated by at least one inch of unflawed material at both ends and sufficient area on both sides to preclude interfering reflections from adjacent flaws. The staff determined that the relaxation in the required area on the sides of the specimens, while still ensuring no interfering reflections, may provide a more challenging demonstration than required by ASME Code because of the possibility for having a parallel flaw on the opposite side of the weld. Therefore, based on engineering judgement, the staff concludes that the PDI's application is an acceptable alternative to the Supplement 11 requirements.

Paragraph 1.1(e)(2)(b)(3) requirements are retained in the PDI program. In addition, the PDI program requires that initial procedure qualification contain three times the number of flaws required for a personal qualification. To qualify new values of essential variables, the equivalent of at least one personal qualification set is required. The staff concludes that PDI's additions enhance the ASME Code requirements and are, therefore, acceptable because it provides for a more stringent qualification criteria.

Paragraph 1.1(f)(1) requirements are retained in the PDI program, with the clarification change of the term "flaws" for "cracks." In addition, the PDI program includes the requirements that sizing sets shall contain a distribution of flaw dimensions to verify sizing capabilities. The PDI program also requires that initial procedure qualification contain three times the number of flaws required for a personal qualification. To qualify new values of essential variables, the equivalent of at least one personal qualification set is required. The staff concludes that PDI's additions enhance the ASME Code requirements and are, therefore, acceptable because it provides a more stringent qualification criteria.

Paragraphs 1.1(f)(3) and 1.1(f)(4) requirements are clarified by the PDI program by replacing the term "cracking" with "flaws" because of the use of alternative flaw mechanisms. The staff concludes that this clarification in the PDI program meets the intent of the ASME Code requirements and is acceptable.

Paragraph 2.0 requirements are retained in the PDI program alternative. In addition, the PDI program provides clarification that the overlay fabrication flaw test and the base metal flaw test

may be performed separately. The staff concludes that this clarification in the PDI program meets the intent of the ASME Code requirements and is acceptable.

Paragraphs 2.1 and 2.2(d) requirements are clarified by the PDI program by the addition of the terms “metal” and “fabrication”. The staff determined that the clarifications provide acceptable classification of the terms they are enhancing. Therefore, the staff concludes that the PDI program meets the intent of the ASME Code requirements and is acceptable.

Paragraph 2.3 requires that, for depth sizing tests, 80% of the flaws shall be sized at a specific location on the surface of the specimen identified to the candidate. This requires detection and sizing tests to be performed separately. The PDI revised the weld overlay program to allow sizing to be conducted either in conjunction with, or separately from, the flaw detection test. If performed in conjunction with detection and the detected flaws do not meet the Supplement 11 range criteria, additional specimens will be presented to the candidate with the regions containing flaws identified. Each candidate will be required to determine the maximum depth of flaw in each region. For separate sizing tests, the regions of interest will also be identified and the maximum depth and length of each flaw in the region will similarly be determined. In addition, PDI stated that grading units are not applicable to sizing tests, and that each sizing region will be large enough to contain the target flaw, but small enough such that candidates will not attempt to size a different flaw. The staff determined that the above clarification provides a basis for implementing sizing tests in a systematic, consistent manner that meets the intent of Supplement 11. Based on engineering judgement, the staff concludes that the PDI’s method is acceptable.

Paragraph 3.1 requires that examination procedures, equipment and personnel (as a complete ultrasonic system) are qualified for detection or sizing of flaws, as applicable, when certain criteria are met. 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 this 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 the Supplement 11 requirement; therefore, the PDI program criteria exceeds the ASME Code requirements for personnel, procedures, and equipment qualification. Therefore, the staff concludes that the PDI program criteria is acceptable.

Paragraph 3.2(a) requirements are clarified by the PDI program by replacing the term “cracking” with “flaws” because of the use of alternative flaw mechanisms. The staff concludes that this clarification in the PDI program maintains the intent of the ASME Code requirement and is acceptable.

Paragraph 3.2(b) requires that all extensions of base metal cracking into the overlay material by at least 0.10-inch are reported as being intrusions into the overlay material. The PDI program omits this criterion because of the difficulty in actually fabricating a flaw with a 0.10-inch minimum extension into the overlay, while still knowing the true state of the flaw dimensions. However, the PDI program requires that cracks be depth-sized to the tolerance specified in the ASME Code which is 0.125-inches. Since the ASME Code tolerance is close to the 0.10-inch

value of Paragraph 3.2(b), any crack extending beyond 0.10-inch into the overlay material would be identified as such from the characterized dimensions. The staff determined that reporting of an extension in the overlay material is redundant for performance demonstration testing because of the flaw sizing tolerance. Therefore, the staff concludes that PDI's omission of highlighting a crack extending beyond 0.10-inch into the overlay material is acceptable.

Paragraph 3.2(c) is renumbered to Paragraph 3.2(b) in the PDI program. The staff concludes that this PDI program change is administrative in nature and is, therefore, acceptable.

4.0 CONCLUSION

The staff has reviewed the licensee's submittal and determined that, in accordance with 10 CFR 50.55a(a)(3)(i), the proposed alternative program will provide an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the staff authorizes the proposed alternative for the remainder of the third ISI interval.

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.

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