Entergy

Entergy Nuclear Operations, Inc.
Pilgrim Station
600 Rocky Hill Road
Plymouth, MA 02360

Stephen J. Bethay
Director, Nuclear Assessment

October 12, 2004

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D.C. 20555-0001

SUBJECT: Entergy Nuclear Operations, Inc.
Pilgrim Nuclear Power Station
Docket No. 50-293
License No. DPR-35

Response to NRC Request for Additional Information and Revised Pilgrim Relief Request, PRR-39, Rev.1 (TAC NO. MC2496)

REFERENCE:

1. Entergy Letter No. 2.04.015, 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, dated, March 15, 2004.

2. NRC Request for Additional Information, dated June 28, 2004.

LETTER NUMBER: 2.04.091

Dear Sir or Madam:

Attachment 1 to this letter provides Pilgrim response to the NRC Request for Additional Information in support of PRR-39 (Reference 1). Attachment 2 provides revised PRR-39, Rev. 1, which incorporates changes in the weld overlay examination requirements and an additional relief from the maximum finished surface area as specified in Code Case N-638.

There are no commitments contained in this letter.

If you have any questions or require additional information, please contact Mr. Bryan Ford, Licensing Manager, at (508) 830-8403.

Sincerely,

Stephan J. Bethay

Attachment 1: Pilgrim Response to NRC Request for Additional Information (10 pages)
Attachment 2: Pilgrim Relief Request, (PRR)-39, Revision 1 (7 pages)

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CC: Mr. Lee Licata, Project Manager
Office of Nuclear Reactor Regulation
Mail Stop: 0-8B-1
U.S. Nuclear Regulatory Commission
1 White Flint North
11555 Rockville Pike
Rockville, MD 20852

U.S. Nuclear Regulatory Commission
Region 1
475 Allendale Road
King of Prussia, PA 19406

Senior Resident Inspector
Pilgrim Nuclear Power Station

ATTACHMENT 1

Pilgrim Response to NRC Request for Additional Information

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

NRC QUESTION NO. 1

Discuss whether hydrogen water chemistry as discussed in BWRVIP-75 has been implemented in the primary water system to mitigate the potential of stress corrosion cracking in the recirculation and core spray piping. Discuss whether there have been any chemical excursions occurred in the primary water system that would affect the welds in the proposed relief request. Discuss whether corrective actions have been implemented to minimize the chemical excursions.

PILGRIM RESPONSE

PNPS has maintained an average hydrogen water chemistry (HWC) availability of 90.7 % for the past five operating cycles since June 1993, as shown in Table 1 below. The HWC availability for the current operating cycle (15) is 93.0%. HWC availability should be 80% or greater for the weld inspection interval for a moderate HWC plant in accordance with the SER for BWRVIP-75.

Only one chemical intrusion from a condensate polisher in December 2000 has occurred while above 200° F. This has been accounted for in the availability calculation. The intrusion was due to a failed condensate polisher lateral and underdrain. This problem was subsequently corrected for all the condensate polishers by a redesign of the laterals and underdrains.

A review of the welds in Pilgrim Relief Request-39 showed that 6 safe end to nozzle welds receive protection from Hydrogen Water Chemistry (HWC). The 6 Core Spray (CS) welds are not protected by HWC. This is summarized in Table 2.

TABLE 1:PILGRIM OPERATING CYCLE HWC AVAILABILITY

Operating Cycle	Dates	% HWC Availability
10	6/93 – 3/95	89.3
11	6/95 – 2/97	86.7
12	4/97 – 5/99	94.0
13	7/99 – 4/01	91.4
14	5/01 – 4/03	92.3
Average for 10 to 14	6/93 to 4/03	90.7 Average
15	5/03 - 9/04 (to date)	93.0

TABLE 2: INSPECTION HISTORY OF PILGRIM IGSCC CATEGORY "D" INCONEL 182 WELDS

PIPE / NOZZLE WELD ID	HWC PROTECTED	LAST INSPECTION	INSPECTION METHOD	INSPECTION FREQUENCY
14-A-1	NO	1999	AUTO	100% every 6 years
14-B-1	NO	1999	AUTO	100% every 6 years
2R-N1B -1	YES	1995	AUTO	100% every 10 years
2R-N2D -1	YES	1995	AUTO	100% every 10 years
2R-N2E -1	YES	1995	AUTO	100% every 10 years
2R-N2F -1	YES	1995	AUTO	100% every 10 years
2R-N2G -1	YES	1997	AUTO	100% every 10 years
2R-N2J -1	YES	1995	AUTO	100% every 10 years
14-A-3	NO	1999	AUTO	100% every 6 years
14-B-3	NO	1999	AUTO	100% every 6 years
14-A-10A	NO	1999	MANUAL	100% every 6 years
14-B-10A	NO	1999	MANUAL	100% every 6 years

Note: 2R-N1A-1 is a Category A weld

NRC QUESTION NO. 2

Request the following:

a. Identify the materials for the welds, nozzles, safe ends, pipe, reducers, and valves of the core spray and recirculation systems that are listed in the relief request, Section A, Component Identification.

b. Identify the corresponding P-Number and Group number of the base metal per Code Case N-638, subsection 2.1(a).

c. Provide the wall thickness and diameter of the pipes covered in the relief request.

d. Provide the thickness of nozzles, safe ends, reducers, and valves where the weld overlay will be made.

PILGRIM RESPONSE:

Table 3 below provides the above requested information.

TABLE 3: RPV NOZZLE SAFE END AND DISSIMILAR METAL PIPE WELDS MATERIAL DATA

NOZZLE/ WELD ID	WELD DESCRIPTION	SYSTEM	MATERIALS	WALL THICKNESS (In.)	DIAMETER (In.)	BASE METAL P-Number	BASE METAL GROUP Number	INSPECTION METHOD	BWRVIP-75 INSPECTION SCHEDULE REFERENCE	WATER CHEMISTRY	BWRVIP-75 INSPECTION FREQUENCY
N1B	NOZZLE TO SAFE END	RECIRC	A-508 CL.2 NOZZLE FORGING, INCONEL 182 BUTTER, SA 182 F316 (Nuclear Grade C .020%max) SAFE END FORGING	2.15	29.31	3 8	3 1	Auto UT per PDI/App. VIII Suppl. 10	PAGES 3-6,3-7 & 3-12, CATEGORY D, SECTION 3.4	HWC	ONCE EVERY 10 YEARS
N2D	SAFE END TO NOZZLE	RECIRC	A-508 CL.2 NOZZLE FORGING, INCONEL 182 BUTTER, SA 182 F316 (Nuclear Grade C .020%max) SAFE END FORGING	1.31	13.38	3 8	3 1	Auto UT per PDI/App. VIII Suppl. 10	BWRVIP-75 PAGES 3-6,3-7 & 3-12, CATEGORY D, SECTION 3.4	HWC	ONCE EVERY 10 YEARS
N2E	SAFE END TO NOZZLE	RECIRC	A-508 CL.2 NOZZLE FORGING, INCONEL 182 BUTTER, SA 182 F316 (Nuclear Grade C .020%max) SAFE END FORGING	1.31	13.38	3 8	3 1	Auto UT per PDI/App. VIII Suppl. 10	BWRVIP-75 PAGES 3-6,3-7 & 3-12, CATEGORY D, SECTION 3.4	HWC	ONCE EVERY 10 YEARS
N2F	SAFE END TO NOZZLE	RECIRC	A-508 CL.2 NOZZLE FORGING, INCONEL 182 BUTTER, SA 182 F316 (Nuclear Grade C .020%max) SAFE END FORGING	1.31	13.38	3 8	3 1	Auto UT per PDI/App. VIII Suppl. 10	BWRVIP-75 PAGES 3-6,3-7 & 3-12, CATEGORY D, SECTION 3.4	HWC	ONCE EVERY 10 YEARS
N2J	SAFE END TO NOZZLE	RECIRC	A-508 CL.2 NOZZLE FORGING, INCONEL 182 BUTTER, SA 182 F316 (Nuclear Grade C .020%max) SAFE END FORGING	1.315	13.38	3 8	3 1	Auto UT per PDI/App. VIII Suppl. 10	BWRVIP-75 PAGES 3-6,3-7 & 3-12, CATEGORY D, SECTION 3.4	HWC	ONCE EVERY 10 YEARS

NOZZLE/ WELD ID	WELD DESCRIPTION	SYSTEM	MATERIALS	WALL THICK NESS (in.)	DIAMETE R (in.)	BASE METAL P-Number	BASE METAL GROUP Number	INSPECTION METHOD	BWRVIP-75 INSPECTION SCHEDULE REFERENCE	WATER CHEMISTRY	BWRVIP-75 INSPECTION FREQUENCY
N2G	SAFE END TO NOZZLE	RECIRC	A-508 CL.2 NOZZLE FORGING, INCONEL 182 BUTTER, SA 182 F316 (Nuclear Grade C .020%max) SAFE END FORGING	1.31	13.38	3 8	3 1	Auto UT per PDI/App. VIII Suppl. 10	BWRVIP-75 PAGES 3-6,3-7 & 3-12, CATEGORY D, SECTION 3.4	HWC	ONCE EVERY 10 YEARS
N6A	SAFE END TO NOZZLE	CORE SPRAY	A-508 CL.2 NOZZLE FORGING, INCONEL 182 BUTTER, SA 182 Gr. F316 (C<.025%) SAFE END FORGING	1.13	12.88	3 8	3 1	Auto UT per PDI/App. VIII Suppl. 10	BWRVIP-75 PAGES 3-6,3-7 & 3-12, CATEGORY D, SECTION 3.4	NWC	ONCE EVERY 6 YEARS
N6B	SAFE END TO NOZZLE	CORE SPRAY	A-508 CL.2 NOZZLE FORGING, INCONEL 182 BUTTER, SA 182 Gr. F316 (C<.025%) SAFE END FORGING	1.13	12.88	3 8	3 1	Auto UT per PDI/App. VIII Suppl. 10	BWRVIP-75 PAGES 3-6,3-7 & 3-12, CATEGORY D, SECTION 3.4	NWC	ONCE EVERY 6 YEARS
14-A-3	PIPE TO REDUCER	CORE SPRAY	SA 333 Gr. 6 CS seamless PIPE*, Inconel 182 butter, SA 182 Gr. F316 S.S. REDUCER	0.55	10.78	1 8	1 1	Auto UT per PDI/App. VIII Suppl. 10	BWRVIP-75 PAGES 3-6,3-7 & 3-12, CATEGORY D, SECTION 3.4	NWC	ONCE EVERY 6 YEARS
14-B-3	PIPE TO REDUCER	CORE SPRAY	SA 333 Gr. 6 CS seamless PIPE*, Inconel 182 butter, SA 182 Gr. F316 S.S. REDUCER	0.55	10.78	1 8	1 1	Auto UT per PDI/App. VIII Suppl. 10	BWRVIP-75 PAGES 3-6,3-7 & 3-12, CATEGORY D, SECTION 3.4	NWC	ONCE EVERY 6 YEARS
14-A-10A	VALVE TO PIPE (1400-6A)	CORE SPRAY	CAST S.S. ASTM A351 GR CF8M VALVE BODY, INCONEL 182 BUTTER, SA 333 Gr. 6 CS seamless PIPE*	0.59 (valve ends taper to ~1.2" away from weld)	10.78	8 1	1 1	Manual UT per PDI/App. VIII Suppl. 10	BWRVIP-75 PAGES 3-6,3-7 & 3-12, CATEGORY D, SECTION 3.4	NWC	ONCE EVERY 6 YEARS

NOZZLE/ WELD ID	WELD DESCRIPTION	SYSTEM	MATERIALS	WALL THICKNESS (In.)	DIAMETER (In.)	BASE METAL P-Number	BASE METAL GROUP Number	INSPECTION METHOD	BWRVIP-75 INSPECTION SCHEDULE REFERENCE	WATER CHEMISTRY	BWRVIP-75 INSPECTION FREQUENCY
14-B-10A	VALVE TO PIPE (1400-6B)	CORE SPRAY	CAST S.S. ASTM A351 GR CF8M VALVE BODY, INCONEL 182 BUTTER, SA 333 Gr. 6 CS seamless PIPE*	0.59 (valve ends taper to ~1.2" away from weld)	10.78	8 1	1 1	Manual UT per PDI/App. VIII Suppl. 10	BWRVIP-75 PAGES 3-6,3-7 & 3-12, CATEGORY D, SECTION 3.4	NWC	ONCE EVERY 6 YEARS
			* with requirements of SA652 paragraphs RL, RM, RW, RX and RZ.								

NRC QUESTION NO. 3

The licensee specified in the table in Section B, Examination and Repair Requirements, Subsection labeled Examination Requirements that either ultrasonic testing or mechanical height measurement will be used to measure the thickness of the weld overlay.

a. Discuss the subsection in Code Case N-504-2 that specifies these requirements.

b. Discuss which method most likely be used and the reasons for preferring one method over the other method in terms of reliability, sensitivity, and accuracy.

PILGRIM RESPONSE

Code Case N-504-2, paragraphs (c) and (g) provide examination requirements to verify the integrity of the overlay. A PT surface examination will be performed on the area to be welded in accordance with ASME Code Section III, NB, 1992. If localized seal welding is required, this examination will be performed after the localized seal welding is completed. A final PT examination in accordance with ASME Code Section III, NB, 1992 and ASME Code Section XI, 1989 will be performed after completing all weld overlays.

Code Case N-504-2 does not specify the method for measuring overlay thickness. A UT thickness examination will be performed to demonstrate that the weld overlay meets the thickness requirements of the repair plan. UT is the preferred method for determining the thickness of the weld overlay. The Table in PRR-39 includes mechanical measurements as an alternative to UT where suitable reference surfaces are available. If for any reason the UT method is not used to provide thickness data, mechanical measurements will be used where a suitable reference surface is available. Both methods provide reliable and accurate thickness measurement results, but UT method is more sensitive to the surface roughness and requires a smooth surface for the UT probe. The final examination, in addition to a VT-2, will be a PDI/UT volumetric examination using procedure PDI-UT-8 in accordance with PRR-38.

A UT of the weld overlay volume will be performed to demonstrate that the repair volume is unflawed and meets thickness requirements of the design following application of the repair. Since the weld repair material is highly resistant to on going crack propagation and provides compressive residual stress, this examination assures continued integrity and adequacy of the weld overlay.

NRC QUESTION NO. 4

In Sections C and D, the licensee stated that the system leak test is adequate to ensure the pressure boundary integrity; however, supporting basis was not provided. Code Case N-504-2, paragraph (h) specifies, in part, that if a flaw penetrates the original pressure boundary prior to or during the welding operation, a system hydrostatic test shall be performed. If the system pressure boundary has not been penetrated, a system leakage, in-service, or functional test shall be performed. Code Case N-416-2 allows a system leakage test in lieu of a hydrostatic pressure test in weld repairs if a nondestructive examination is performed in accordance with the 1992 Edition of ASME Section III, which specifies that radiographic examination be performed. The staff has the following questions:

a. Clarify whether a radiographic examination will be performed on the weld repair per the 1992 Edition of ASME Section III, if a flaw penetrates the pressure boundary prior to or during the welding process. If a radiographic examination will not be performed, discuss the basis and justify the performance of a ultrasonic examination in lieu of a radiographic examination of the weld overlay repair.

b. Discuss technical basis why the system leak test is adequate as compared to a hydrostatic test in demonstrating the structural and leakage integrity of the weld overlay repair.

c. In Section C, fifth paragraph, last sentence, the licensee stated that a system leak test of completed repairs may be used in lieu of hydrostatic test. Discuss whether a system leak test will be performed after each completed repair.

PILGRIM RESPONSE

Response to item a:

The overlay welding would be examined to Supplement 11 as modified by Relief Request PRR-38 for specific Performance Demonstration Initiative (PDI) procedural details. The qualified procedures are in accordance with the ultrasonic acceptance standards included in Section III NB-5330. The ultrasonic procedures and personnel used for this examination, result in a weld material assessment for an overlay that cannot be achieved by radiography. This is based on the special nature of the weld overlay, which is similar to that recognized in ASME Code Section III NB-5270 "Special Welds" and the allowance as described in NB-5279 that there are special exceptions requiring ultrasonic rather than radiographic examinations. Pressure vessel and safe-end welded piping are filled with reactor water, which precludes use of radiography for weld material assessment. Removal of fuel and draining the vessel to accommodate radiography presents additional nuclear safety and personal hazards. Radiography is not qualified under PDI for weld overlay inspections. Thus UT PDI examination is the preferred method for weld method assessment. The qualification process for the Supplement 11 ultrasonic examination, the ability to size flaws for length and depth, and the fact that the qualification includes flaws that may be created during fabrication, meets the ultrasonic procedural requirements of the cited ASME III paragraphs.

The final weld examination would be a complete ultrasonic volumetric examination (UT) using EPRI Performance Demonstration Initiative (PDI) procedure PDI-UT-8 in accordance with Relief Request PRR-38. The weld overlay would meet the requirements of the ASME Code Section XI repair plan and PDI-UT-8. There would be no deviations from ASME Code Section III 1992 methods as discussed above and acceptance criteria or PDI/UT procedures.

ASME Section XI allows a repair to be performed by either removing a flaw or reducing it to an acceptable size, as documented for instance in Code Case N-504-2. The weld overlay approach does the latter. The allowable flaw size is defined in Table IWB-3641-1 (since Normal/Upset loads govern). The initial flaw is conservatively assumed to be entirely through wall and to extend entirely around the circumference of the repair location (through wall x 360 degrees around). The weld overlay approach applies additional thickness to the flawed location, such that the resulting as-repaired component meets the requirements of IWB-3640. This approach has been extensively used since the mid-1980's in repair of BWR piping. The weld overlay also imparts a compressive residual stress, which has been shown to reduce crack growth.

The weld overlay repairs will be completed as an ASME Code Section XI repair using Code Case N-504-2 as the construction code for the repair design, fabrication, and examination methods applicable to a structural overlay type of repair. This type of repair is not included in ASME Code Section III.

The nondestructive examination (NDE) of weld overlays is not addressed in ASME Code Section III since it is a construction code used for the initial installation of welded joints. Welding performed under an ASME Code Section XI repair plan is typically examined in accordance with the code of construction, when applicable, and any Section XI baseline (preservice) inservice inspection (ISI) examinations.

For weld overlay repairs, the construction code is Code Case N-504-2 and the required examinations are by the liquid penetrant and ultrasonic methods. This Code Case is prescriptive about all aspects of the weld overlay repair including the overlay design, its fabrication, and the examinations performed before, during, and after the welding.

The type of weld examinations to be performed on the structural overlay weld would be based on ASME Code Case N-504-2 as the construction code for the overlay weld repair, rather than ASME

Code Section III butt weld joint fabrication, such that the required volumetric examination of weld overlay would be by the ultrasonic rather than radiographic method. An initial liquid penetrant (PT) surface examination would be performed on the area to be welded in accordance with N-504-2. This examination will be performed if required after the localized seal welding is completed. A final PT examination in accordance with N-504-2 and ASME Code Section III 1992 would be performed after completing all weld overlay layers. An ultrasonic thickness examination will also be performed to demonstrate that the weld overlay met the thickness requirements of the repair plan.

In conclusion, the applicable weld fabrication and examination requirements of Code Cases N-504-2 and N-416-2, ASME Code Section III, and ASME Code Section XI (with PRR-38) will be met.

Response to Items b and c:

The Code Case N-504-2 includes the following pressure test requirements:

> "The completed repair shall be pressure tested in accordance with IWA-5000. If the flaw penetrated the original pressure boundary prior to welding, or if any evidence of the flaw penetrating the pressure boundary is observed during the welding operation, a system hydrostatic test shall be performed in accordance with IWA-5000. If the system pressure boundary has not been penetrated, a system leakage, inservice, or functional test shall be performed in accordance with IWA-5000."

The above pressure testing requirements are consistent with ASME Code Section XI Subarticle IWA-4700 "Pressure Test" rules that are applicable to all pressure boundary weld repairs performed under Section XI as follows:

> "After repairs by welding on the pressure retaining boundary, a system hydrostatic test shall be performed in accordance with IWA-5000."

Code Case N-416-2 is routinely used to allow a system leakage test to be performed in lieu of a system hydrostatic pressure test in most all cases of weld repairs to existing piping, pump, and valve components at PNPS and other plants, including repairs that entirely replace components or penetrate the pressure boundary. Code Case N-416-2 is approved in Table 2 of Regulatory Guide 1.147, Rev. 13, which requires that:

> "(a) NDE shall be performed on welded repairs and fabrication and installation joints in accordance with the methods and acceptance criteria of the applicable Subsection of the 1992 Edition of Section III."

Section III applies to the original welds and is not applicable to weld overlays as discussed earlier. Accordingly, PNPS continued to apply paragraph (b) of Code Case N-416-2, which directs system leakage test using the 1992 Edition of Section XI in accordance with IWA-5000 at nominal operating pressure and temperature, in lieu of hydrostatic testing requirement.

With respect to hydrostatic pressure testing, an additional consideration is that ASME Code Case N-498-4 (approved in Table 2, RG 1.147, Rev. 13) is used at PNPS and other plants to allow a system leakage test to be performed in lieu of a system hydrostatic pressure test performed at the 10-year interval as required by ASME Code Section XI. Furthermore, the difference in the required test pressure between the system leakage test and a system hydrostatic pressure test in accordance with Section XI Article IWB-5000 is no greater than 10%. Therefore, there is essentially little difference in the actual test conditions that are experienced between the system leakage test and a system hydrostatic pressure test per Section XI, which is part of the basis for the exemption allowed by the Code Cases.

A system leak test will not be performed after each completed repair. After all repairs are completed, the system leakage test performed in accordance with the NRC approved Code Cases N-416-2 and N-498-4, surface examinations per ASME III and ASME XI, and UT examination performed using PDI process in accordance with ASME Code Section XI, Appendix

VIII, Supplement 11 and PRR-38, provide assurance that the weld overlay design, fabrication, and examinations met Code Cases N-504-2 and N-416-2, ASME Code Section III, and ASME Code Section XI.

NRC QUESTION NO. 5

The licensee stated that re-inspection of the welds will be conducted in accordance with the guidance in the industry topical report, BWRVIP-75.

a. Discuss the exact inspection schedule for the welds in the proposed relief request. Identify the page, category, and section in BWRVIP-75 that discusses the inspection schedule that the licensee will follow.

b. Discuss the inspection method that will be used in the re-inspection of the welds.

PILGRIM RESPONSE

Pilgrim intends to inspect any overlaid DM welds in accordance with the requirements for Category E overlaid welds as described in BWRVIP-75 Table 3-1 and section 3.5.1.1, which states in part "For weld overlays applied in the future, a preservice examination followed by an inservice examination within three outages is required".

After this initial inservice examination within 3 outages of the repair, the inspection schedule would then revert to the sample frequency shown in Table 3-1, i.e. either 25% or 10% every 10 years depending on water chemistry classification.

The re-inspection of the welds will be conducted using VT-2 and PDI/UT methods in the re-inspection of the welds.

NRC QUESTION NO. 6

In Section F, the licensee stated, "The proposed alternative applies to the repairs of RPV nozzle safe-end and piping welds for the scheduled outage and for the remaining service life of this weld." The staff has reservation about approving a relief request on a long-term basis. In general, the staff approves relief requests for one inspection interval with certain fixed starting and end calendar dates. In Section D, fourth paragraph, the licensee alludes to the third interval in-service inspection program; however, the staff is not clear to which inspection interval the proposed relief request will be applied. The licensee is requested to:

a. Identify to which inspection interval(s) this relief request will be applicable.

b. Identify the current inspection interval.

c. Provide the end date of the operating license of the plant and the starting and the starting and end dates of the relevant inspection intervals (i.e., 3rd and the 4th intervals).

PILGRIM RESPONSE:

Pilgrim is in the 3rd in-service inspection interval, which began on July 1, 1995, and will end on June 30, 2005.

The 4th in-service inspection interval would begin on July 1, 2005 and would end on June 30, 2015.

Pilgrim Operating License expires on June 8, 2012.

PRR-39 is applicable to the 3rd in-service inspection interval and Entergy intends to apply it to the remaining service life of this weld, i.e., 4th interval as discussed below.

The upcoming RFO-15 is the last remaining refueling outage in this 3rd interval. The 4th interval is short by 3 years since the license expires on June 8, 2012. The service life available for these welds is 8 years, less than the normal ISI interval duration of 10 years. Thus, it is the intent of Entergy to apply the relief request for the remaining duration of 3rd and 4th intervals until the expiration of Operating License on June 8, 2012. Upon approval of PRR-39, Entergy intends to incorporate it into the 4th ISI interval program to conserve Pilgrim and NRC staff resources.

ATTACHMENT 2

PILGRIM RELIEF REQUEST (PRR) NO. – 39, Rev. 1

Alternative Repair Plan for

Reactor Pressure Vessel Nozzle Safe-End and Dissimilar Metal (DM) Piping Welds

A. COMPONENT IDENTIFICATION

A full structural weld overlay repair is proposed for the weldment associated with the following austenitic reactor pressure vessel nozzle safe-end and dissimilar metal (DM) piping welds. This is a contingency repair plan to be used if needed during the upcoming refueling outage-15.

WELD ID	DESCRIPTION	SYSTEM	DRAWING
14-A-1	SAFE END TO NOZZLE	CS	ISI-I-14-1
14-B-1	SAFE END TO NOZZLE	CS	ISI-I-14-1
2R-N1B-1	SAFE END TO NOZZLE	RECIRC	ISI-I-2R-A
2R-N2D-1	SAFE END TO NOZZLE	RECIRC	ISI-I-2R-A
2R-N2E-1	SAFE END TO NOZZLE	RECIRC	ISI-I-2R-A
2R-N2F-1	SAFE END TO NOZZLE	RECIRC	ISI-I-2R-B
2R-N2G-1	SAFE END TO NOZZLE	RECIRC	ISI-I-2R-B
2R-N2J-1	SAFE END TO NOZZLE	RECIRC	ISI-I-2R-B
14-A-3	PIPE TO REDUCER	CS	ISI-I-14-1
14-B-3	PIPE TO REDUCER	CS	ISI-I-14-1
14-A-10A	VALVE TO PIPE	CS	ISI-I-14-1
14-B-10A	VALVE TO PIPE	CS	ISI-I-14-1

These welds fall within the scope of GL 88-01 and BWRVIP-75.

The weld overlay material for the proposed repair is as follows:

- For machine gas tungsten arc welding (GTAW), the weld material is ASME Section II, Part C, SFA 5-14 Filler Wire ER NiCrFe-7 UNS NO6052 F-No. 43 known commercially as Alloy 52.
- For manual shielded metal arc weld (SMAW) welding, the weld material is ASME Section II, Part C, SFA 5-11 Weld Electrode E NiCrFe-7 UNS W86152 known commercially as Alloy 152.

B. EXAMINATION AND REPAIR REQUIREMENTS

Weld overlay will be designed consistent with the requirements of NUREG-0313, (which was implemented by Generic Letter 88-01), ASME Code Cases N-504-2, N-638, and ASME, Section XI, Paragraph IWB-3640.

Welder Qualification and Welding Procedures

All welders and welding procedures will be qualified in accordance with ASME Section XI and any special requirements from Section XI or applicable code cases.

If necessary, a manual SMAW procedure will be qualified to facilitate localized repairs and to provide a seal weld, prior to the overlay. This procedure uses UNS W86152 SMAW electrodes consistent with ASME Section XI requirements. Personnel qualified in accordance with the Welding Procedure Specification for welding Alloy 52/152 will perform the repair activities.

Welding Wire Material

A consumable welding wire highly resistant to intergranular stress corrosion cracking (IGSCC) will be used for the overlay material. This material, designated UNS N06052, is a nickel-based weld filler material (commonly referred to as Alloy 52), and will be applied using the GTAW process. Alloy 52 is identified as F-No. 43 Grouping for Ni-Cr-Fe, classification UNS N06052 Filler Metal. Alloy 52 contains about 30% chromium, which imparts excellent corrosion resistance to this material. Alloy 152 welding wire will be used for manual (SMAW) seal welding activities.

Weld Overlay Design

The weld overlay will extend around the full circumference of the weldment location in accordance with NUREG-0313, Code Case N-504-2, Generic Letter 88-01, and BWRVIP-75. The overlay will be performed using a standard overlay design as described in NUREG-0313, Section 4.4.1. This design assumes a crack completely through the wall for 360°. The calculation methods for design of the overlay will be in accordance with NUREG-0313, Section 4.1.

The specific thickness and length will be computed using the guidance provided in ASME Section XI, Code Case N-504-2, and ASME Section XI, Paragraph IWB-3640, 1989 Edition. The overlay will completely cover any flaw location and the existing Inconel 182 weld deposit butter with the highly corrosion resistant Alloy 52 material. In order to accomplish this objective, it is necessary to weld on the low alloy steel (LAS) material. A temper bead welding approach will be used for this purpose according to the provisions of ASME Code Case N-638. This code case provides for machine GTAW temper bead weld repairs to P No. 3 nozzle materials (SA 508 Cl. 2) at ambient temperature. The temper bead approach was selected because temper bead welding supplants the requirement for post weld heat treatment (PWHT) of heat-affected zones in welded LAS material.

The Code case N-638, General Requirements, 1(a) limits the maximum finished surface area of the weld overlay repair to 100 sq. in. The overlay repair (design and fabrication) on large diameter (13 and 29-inch OD) recirculation nozzle safe-end welds would exceed the 100 sq in. limit. EPRI Technical Report 1003616, "Additional Evaluations to Extend Repair Limits for Pressure Vessels and Nozzles", dated March 2004, justifies extending the size of the temper bead repairs up to 500 sq. in finished area. Susquehanna Station has used the EPRI Report as justification for recent nozzle weld overlay repairs.

Examination Requirements

The repair, pre-service inspection (PSI), and in-service inspection (ISI) examinations of the weld overlay repair will be performed in accordance with the ISI Program and Plan along with NUREG-0313, Generic Letter 88-01, and approved plant procedures as specified by the ISI Repair/Replacement Program.

The weld overlay will be examined using the industry developed PDI procedure, as approved in PRR-38 (Relief from ASME Code Section XI, Appendix VIII, Supplement 11, Qualification Requirements for Full Structural Overlaid Wrought Austenitic Piping Welds, TAC No. MC0961, dated February 26, 2004).

System leakage testing will be performed as allowed by Code Case N-416-2 with the additional condition that hold times specified in IWA-5213 (d) be observed, in lieu of the system hydrostatic test required by Code Case N-504-2. This complies with Regulatory Guide 1.147, Revision 13, relative to the NRC's conditional acceptance of Code Case N-416-2. The VT-2 inspections will be performed with the insulation removed from the locations where the proposed weld overlays are performed. This will allow a 10 minute hold before the VT-2 is performed.

The examinations and acceptance criteria, as identified below, will be in accordance with ASME Code, Section III, 1992 Edition, Subsection NB for Class 1 Components, ASME Code Section XI, 1989 Edition, and Code Cases N-504-2 and N-638.

A description of the required examinations for the weld overlay is provided in the following table.

Examination Description	Method	Technique	Reference
Weld Overlay Surface Area Preparation Exam	PT	Visible Dye	N-504-2
First Two Weld Overlay Layers Surface Exam	PT	Visible Dye	N-504-2
First Two Weld Overlay Layers Thickness Measurements	UT or Mechanical	0° Long. UT or Mechanical Height Measurement	N-504-2
Completed Overlay Thickness Measurements	UT or Mechanical	0° Long. UT or Mechanical Height Measurement	N-504-2
Surface Exam of Final Overlay Surface and Adjacent Band within 1.5t (7/8" Band) of Weld Overlay. This also serves as Preservice Surface Examination of completed overlay.	PT	Visible Dye	NB-5350 IWB-3514 N-638 N-504-2
Volumetric Exam of Final Overlay and Adjacent Band within 1.5t (7/8" Band) of Weld Overlay. This also serves as Preservice Volumetric Examination of completed overlay.	UT	PDI procedure	ASME 1995, Section XI Appendix VIII; ASME 1989 Section XI
Preservice Baseline Exam of Final Overlay Outer 25% of the Underlying Pipe Wall to Identify the Original Flaws.	UT	PDI Procedure	N-504-2

The acceptance criteria for the volumetric examinations shall be ASME Code Section XI, Paragraph IWB-3514, "Standards for Examination Category B-F, Pressure Retaining Dissimilar Metal Welds, and Examination Category B-J, Pressure Retaining Welds in Piping".

It is noted that the curvatures of reactor nozzles require an exception to the ultrasonic inspection requirement for a 1.5t adjacent band volumetric examination at the end of the overlay on the nozzle end. The PT examination of this surface will constitute the acceptance testing for the overlay deposit.

Thickness will be characterized at four (4) azimuths representing each of the four (4) pipe quadrants. Thickness measurements will be determined using UT techniques or by mechanical measurement. Liquid penetrant examinations will be performed at the same stages of the overlay application as the thickness measurements identified above.

The alternative, as described below, provides an acceptable level of quality and safety while neither draining the reactor vessel nor applying preheat and post weld heat treatments.

C. ALTERNATIVE TO REPAIR REQUIREMENTS

The repair will utilize ASME Code Case N-504-2, "Alternative Rules for Repair of Class 1, 2, and 3 Austenitic Stainless Steel Piping," and Code Case N-638, "Similar and Dissimilar Metal Welding Using Ambient Temperature Machine GTAW Temper Bead Technique," with the following exceptions and clarifications.

Clarification of Code Case N-504-2 for Applicability to Nickel-Based Austenitic Alloy

Code Case N-504-2 was prepared specifically for austenitic stainless steel material. An alternate application to use nickel-based austenitic materials (i.e., Alloy 52) is requested due to the specific configuration of the nickel-based austenitic weldment.

Exception from Code Case N-504-2 Paragraph (b)

Code Case N-504-2 paragraph (b) requires that the reinforcement weld metal shall be low carbon (0.035 % maximum) austenitic stainless steel. In this application, a nickel-based filler is required and Alloy 52 has been selected in place of low carbon austenitic stainless steel.

Exception from Code Case N-504-2 Paragraph (e)

Code Case N-504-2 paragraph (e) requires as-deposited delta ferrite measurements of at least 7.5% for the weld reinforcement. These measurements have no meaning for nickel-based materials and will not be performed for this overlay.

Exception from Code Case N-504-2 Paragraph (h)

Code Case N-504-2 paragraph (h) requires a system hydrostatic test of completed repairs if the repaired flaw penetrated the original pressure boundary or if there is any observed indication of the flaw penetrating the pressure boundary during repairs. A system leak test of completed repairs will be used in lieu of a hydrostatic test.

Use of Code Case N-638 Applicability

Code Case N-638 shall be applied to the nozzle material.

Exception from Code Case N-638 Paragraph 1 (a)

The Code case N-638, General Requirements, 1(a) limits the maximum finished surface area of the weld overlay repair to 100 sq. in. Relief is requested to extend the size of the repairs up to 500 sq. in finished area to accommodate overlay repair on large diameter (13 and 29 -inch OD) recirculation nozzle safe-end welds.

D. BASIS FOR THE ALTERNATIVE

Clarification of Code Case N-504-2 for Applicability to Nickel-Based Austenitic Steel

The weldment being addressed is austenitic material having a mechanical behavior similar to austenitic stainless steel. The weldment is designed to be highly resistant to IGSCC and is compatible with the existing weldment and base metal materials. Accordingly, this alternative provides an acceptable level of quality and safety. Therefore, Code Case N-504-2 should be interpreted to apply equally to both materials.

Exception from Code Case N-504-2 Paragraph (b)

A consumable welding wire highly resistant to IGSCC was selected for the overlay material. This material, designated UNS N06052, is a nickel-based alloy weld filler material, commonly referred to as Alloy 52, and will be applied using the GTAW process. Alloy 52 contains about 30% chromium, which imparts excellent stress corrosion cracking resistance to this material. By comparison, Alloy 82 is identified as an IGSCC resistant material in NUREG 0313 and contains about 18 to 22% chromium while Alloy 182 has a nominal chromium composition of 13 to 17%. Alloy 52 with its high chromium content provides a high level of resistance to IGSCC consistent with the requirements of the code case. Therefore, this alternative provides an acceptable level of quality and safety.

Exception from Code Case N-504-2 Paragraph (e)

The composition of nickel-based Alloy 52 is such that delta ferrite is not formed during welding. Ferrite measurement requirements were developed for welding of 300 series stainless steels that required delta ferrite to develop corrosion resistance. Weld using Alloy 52 is 100% austenitic and contains no delta ferrite due to the high nickel composition (approximately 60% Ni and low iron content). Alloy 52 with its high chromium content provides a high level of resistance to hot cracking and IGSCC consistent with the purpose for the delta ferrite requirements for stainless steels of the code case. Therefore, this alternative provides an acceptable level of quality and safety.

Exception from Code Case N-504-2 Paragraph (h)

In lieu of the hydrostatic pressure test requirements defined in Code Case N-504-2, the required pressure test shall be performed in accordance with the Third Interval ISI

Program and Plan and Code Case N-416-2 with the exception that the volumetric examination performed shall be an ultrasonic examination of the weld overlay. These alternative requirements are sufficient to demonstrate that the overlay is of adequate quality to ensure the pressure boundary integrity. Accordingly, this alternative provides an acceptable level of quality and safety.

Use of Code Case N-638 Applicability

Code Case N-638 was developed for temper bead applications for similar and dissimilar metals. It permits the use of machine GTAW process at ambient temperature without the use of preheat or PWHT on Class 1, 2, and 3 components.

Temper bead welding methodology is not new. Numerous applications over the past decade have demonstrated the acceptability of temper bead technology in nuclear environments. Temper bead welding achieves heat affected zone (HAZ) tempering and grain refinement without subsequent PWHT. Excellent HAZ toughness and ductility are produced. Use of Code Case N-638 has been accepted in Regulatory Guide 1.147 Revision 13 as providing an acceptable level of quality and safety.

The overlay repair on large diameter (13 and 29-inch OD) recirculation nozzle safe-end welds would exceed the 100 sq. in. limit specified in Code Case N-638, paragraph 1(a). EPRI Technical Report 1003616, "Additional Evaluations to Extend Repair Limits for Pressure Vessels and Nozzles", dated March 2004, justifies extending the size of the temper bead repairs up to 500 sq. in. finished area. The ASME Code Committees have recognized that the 100 sq. in. restriction on the overlay surface area is excessive and a draft code case, RRM-04, is currently being progressed within ASME Section XI to increase the area limit to 500 sq. in. Furthermore, Three Mile Island and V. C. Summer have completed weld overlay repairs involving approximately 200 and 300 sq. inches respectively. Susquehanna Station in its Relief Request No. 31 has used the EPRI Report, ASME proposed draft code case, V. C. Summer and Three Mile Island expanded repairs as justifications for recent expanded nozzle weld overlay repairs. As discussed in the EPRI Report, increasing the allowed areas for ambient temper bead repairs did not detrimentally change the residual stresses, thereby providing an acceptable level of quality and safety.

E. CONCLUSION

Weld overlays involve the application of weld metal circumferentially over and in the vicinity of the flawed weld to restore ASME Section XI margins as required by ASME Code Case N-504-2. Weld overlays have been used in the nuclear industry as an acceptable method to repair flawed weld. The use of overlay filler material that provides excellent resistance to IGSCC provides an effective barrier to crack extension.

The design of the overlay uses methods that are standard in the industry for size determination of pipe-to-pipe overlays. There are no new or different approaches used in these overlay designs that would be considered first of a kind or inconsistent with previous approaches. The overlay is designed as a full structural overlay in accordance with the recommendation of NUREG-0313, which was forwarded by Generic Letter 88-01, and Code Case N-504-2 and ASME Section XI Paragraph IWB-3640.

Temper bead techniques, as defined by Code Case N-638, will produce a tough corrosion resistant overlay deposit that meets or exceeds all code requirements for the weld overlay.

Pilgrim concludes that the contingency repair plan presents an acceptable level of quality and safety to satisfy the requirements of 10CFR50.55a(a)(3)(i). Similar proposed alternatives to the requirements of 10CFR50.55a(c)(3) have been previously approved by the NRC for James A Fitzpatrick (TAC No. MB0252, dated October 26, 2000), Duane Arnold Energy Center (NRC Staff's letter dated November 19, 1999), Nine Mile Point Unit 2 plant (NRC Staff's letter dated March 30, 2000) and for Pilgrim to repair the RPV N10 nozzle to safe-end weld (PRR-36 and 38).

F. DURATION OF THE PROPOSED ALTERNATIVE

The proposed alternative applies to the repairs of RPV nozzle safe-end and piping welds for the scheduled outage and for the remaining service life of this weld. Re-inspection will be per BWRVIP-75 Guidelines.