Entergy

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

Stephen J. Bethay
Director, Nuclear Assessment

July 12, 2004

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
1 White Flint North
11555 Rockville Pike
Rockville, MD 20852

SUBJECT: Entergy Nuclear Operations, Inc.
Pilgrim Nuclear Power Station
Docket No: 50-283
License No: DPR-35

Response to NRC Request for Additional Information on Pilgrim Relief Request No. 36 (TAC No. MC0921)

LETTER NUMBER: 2.04.059

REFERENCE:

1. Entergy Letter No. 2.03.114, Pilgrim Relief Request No. 36, Alternative Contingency Repair Plan for Generic Letter 88-01, Reactor Pressure Vessel Nozzle-to-End Cap Weld, Using ASME Code Cases N-638 and N-504-2 with Exceptions, dated, October 1, 2003.

2. Entergy Letter No. 2.03.116, Response to NRC Request for Additional Information for Pilgrim Relief Request No. 36, dated October 3, 2003.

Dear Sir or Madam:

The attachment to this letter provides Pilgrim's response to NRC Request for Additional Information related to Pilgrim's request under the referenced letters.

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,

Stephen J. Bethay

Stephen J. Bethay

WGL/dm

Attachment: Pilgrim Response to NRC Request for Additional Information on Pilgrim Relief Request No. 36 (4 Pages)

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

U.S. Nuclear Regulatory Commission, Region 1
475 Allendale Road
King of Prussia, PA 19408

Senior Resident Inspector
Pilgrim Nuclear Power Station

Pilgrim Response to NRC Request for Additional Information

Pilgrim Relief Request (PRR) - 36

Alternative Contingency Repair Plan for Generic Letter 88-01, Reactor Pressure Vessel Nozzle-to-End Cap Weld, Using ASME Code Cases N-638 and N-504-2 with Exceptions

NRC Question No. 1

Since American Society of Mechanical Engineers (ASME) Code Case N-504-2 was developed for a stainless steel weld overlay repair, please explain how the differing strengths, thermal expansion, and other material properties were taken into account for the use of Alloy 52/152 for the weld overlay repair.

Pilgrim Response

The weld overlay repair design for the Pilgrim RPV N10 CRD cap weld incorporated the Appendix C of ASME Section XI methodology. Alloys 52/152 are also austenitic materials that exhibit very high toughness, similar to that of austenitic stainless steels. As a result, the use of net section collapse methodology as detailed in Appendix C of ASME Section XI is appropriate for the evaluation of allowable flaw size and repair design.

The particular material property significant to this analysis is the allowable stress intensity Sm of the repair material. This property is significantly higher for the nickel-based alloys used in the repair, compared to the property value for austenitic stainless steels such as Type 304. The Sm value enters into the determination of the applied primary stress ratio (applied stresses divided by the allowable stress intensity), which is used to enter the Tables contained in IWB-3640 to determine allowable flaw size and thus required repair thickness. It is the Sm of the repair material that determines repair thickness, and not the Sm of the underlying base material, since the design basis of the repair is that the underlying flaw extends entirely through the original component thickness and entirely around the circumference of the component, such that no strength credit is taken for any remaining base material. This design assumption corresponds to the "Standard Weld Overlay" design as defined in NUREG-0313 Revision 2, Section 4.0. This approach has been used for repair of more than 1000 IGSCC flaws in BWR piping.

For conservatism in the Pilgrim design, the Sm value of 23.3 ksi was used (corresponding to Alloy 600 values) rather than the higher Sm of about 30 ksi applicable to the Alloy 690 class materials such as Alloy 52/152.

NRC Question No. 2

Please explain the analysis performed to support a conclusion that it is acceptable to leave the flaw in place.

Pilgrim Response

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 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.

NRC Question No. 3

In lieu of a hydrostatic pressure test, you requested an exception to ASME Code Case N-504-2 Paragraph (h) to perform the required pressure test in accordance with the Third Interval Inservice Inspection Program and Plan and ASME Code Case N-416-2, with the exception that an ultrasonic examination will be performed on the weld overlay. Please explain the surface examination performed on the weld overlay, including a justification for any deviation from ASME Code, Section III requirements.

Pilgrim Response

The original Reactor Vessel N-10 nozzle cap connection was a butt weld joint from the nozzle to a pipe cap. The butt weld joint was designed and examined in accordance with ASME Code Section III as the construction code. As such, the butt weld was a "Category B" joint and was examined in accordance with NB-5220, which requires radiographic and either liquid penetrant or magnetic particle methods for the volumetric and surface examinations.

The weld overlay repair completed most recently was performed as an ASME Code Section XI repair using Code Case N-504-2 as the construction code for the repair design and examination methods applicable to a structural overlay type of repair. Since this type of repair is not included in ASME Code Section III, no deviations from Section III are identified.

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 performed on the structural overlay weld were 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 was by the ultrasonic rather than radiographic method. An initial liquid penetrant (PT) surface examination was performed on the area to be welded in accordance with N-504-2.

This examination was performed after the localized seal welding to stop leakage was completed. A final PT examination in accordance with N-504-2 and ASME Code Section III 1992 was performed after all weld overlay was completed. An ultrasonic thickness examination was also performed to demonstrate that the weld overlay met the thickness requirements of the repair plan.

The final weld examination was 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 met the requirements of the ASME Code Section XI repair plan and PDI-UT-8. There were no deviations from ASME Code Section III 1992 methods and acceptance criteria or PDI/UT procedures.

ASME Code Section XI, Appendix VIII, Supplement 11 contains the specific requirements for examination of weld overlays. Examination procedures and personnel qualified to this supplement need to perform a blind test on samples which contain actual flaws. These samples not only contain base metal cracks but also flaws that may be created during the fabrication process such as lack of fusion. In addition to detection of flaws, the procedures and personnel must be qualified to size the flaws for both length and depth.

The N-10 nozzle overlay welding was 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 that there are special exceptions requiring ultrasonic examinations rather than radiographic as described in NB-5279. 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.

It is therefore concluded that 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) have been met.

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. 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.

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 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. 4

ASME Code Case N-416-2 requires that non-destructive examination be performed in accordance with the 1992 Edition of the ASME Code, Section III, when performing a system leakage test in lieu of a hydrostatic pressure test. Section III of the ASME Code requires that a radiographic test (RT) be performed. Please discuss the examination performed to meet the requirements of Section III of the ASME Code. Include a justification for any deviation from the ASME Code, Section III required RT.

Pilgrim Response

As presented in the response to question 3, there were no deviations from the weld examination requirements as referenced by ASME Code Case N-416-2. The type of weld examinations performed were based on ASME Code Case N-504-2 as the fabrication code for the overlay weld repair, rather than Section III fabrication such that the required volumetric examination was by the ultrasonic rather than radiographic method.