Entergy

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

Stephen J. Bethay
Director, Nuclear Assessment

August 13, 2009

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

Stress Analysis Reports for Reactor Pressure Vessel (RPV) Jet Pump Instrumentation Nozzle Weld, RPV-N9A-1 Overlay Repair (Pilgrim Relief Request (PRR) -19) (TAC. NO. ME1151)

REFERENCES:

1. Entergy Letter No. 2.09.032, Pilgrim Relief Request (PRR)-19, Jet Pump Nozzle Weld, RPV-N9A-1 Repair Plan, dated May 1, 2009
2. Entergy Letter No. 2.09.037, Results of UT Examination of Jet Pump Instrumentation Nozzle RPV-N9A-1 Weld Overlay, dated May 15, 2009

LETTER NUMBER: 2.09.050

Dear Sir/Madam,

By this letter, Entergy submits to the NRC the attached Stress Analysis Summary reports demonstrating that the N9A nozzle to safe-end-weld dissimilar metal weld will perform its intended design function after weld overlay installation. This submittal and the submittal made by Reference 2 fulfill the commitments made in Reference 1.

The Stress Analysis Summary reports demonstrates that the proposed alternative presented in Pilgrim Relief Request (PRR)-19 (Reference 1) provides an acceptable level of quality and safety, within the scope of 10 CFR 50.55a(a)(3)(i).

There are no new commitments made in this submittal.

If you have any questions, please contact Pilgrim Licensing Manager, Mr. Joseph Lynch at 508 830-8403.

Sincerely,

Stephen J. Bethay
Director, Nuclear Safety Assurance

SJB/wgl

A047
NRR

ATTACHMENTS:

1. Structural Integrity Associates, Inc. Letter to Entergy (Mr. Ray Pace), "Stress Analysis Summary for Weld Overlay of Jet Pump Instrumentation Nozzle N9A" , dated August 10, 2009 (3 pages)

2. Structural Integrity Associates, Inc. File No. 0900530.306, "ASME Code, Section III Evaluation of N9A Jet Pump Instrument Nozzle with Weld Overlay Repair", dated August 10, 2009 (70 pages)

3. Structural Integrity Associates, Inc. File No. 0900530.307, "Residual Stress Analysis of Jet Pump Instrument Nozzle (N9A) with Weld Overlay Repair", dated August 10, 2009 (32 pages)

4. Structural Integrity Associates, Inc. File No. 0900530.308, "Crack Growth Analysis for Jet Pump Instrument Nozzle (N9A)", dated August 10, 2009 (55 pages)

cc:

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

Senior Resident Inspector
Pilgrim Nuclear Power Station

Mr. James S. Kim, Project Manager
Plant Licensing Branch I-1
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ATTACHMENT 1
To Entergy Letter No. 2.09.050

Structural Integrity Associates, Inc. Letter to Entergy (Mr. Ray Pace), "Stress Analysis Summary for Weld Overlay of Jet Pump Instrumentation Nozzle N9A", dated August 10, 2009

(3 pages)

Structural Integrity Associates, Inc.

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August 10, 2009
SI Report 0900530.401 Revision 0

Mr. Ray Pace
Entergy Nuclear Northeast
Pilgrim Nuclear Power Station
600 Rocky Hill Road
Plymouth, MA 02360

SUBJECT: Stress Analysis Summary for Weld Overlay of Jet Pump Instrumentation Nozzle N9A

References:

1. SI Calculation No. 0900530.306, Rev. 0, "ASME Code, Section III Evaluation of N9A Jet Pump Instrument Nozzle with Weld Overlay Repair."
2. Combustion Engineering, Inc., Report No. CENC-1139, "Analytical Report for Pilgrim Reactor Vessel", March 1971, SI File No. PNPS-10Q-211.
3. SI Calculation No. 0900530.308, Rev. 0, "Crack Growth Analysis for Jet Pump Instrumentation Nozzle (N9A)."
4. ASME Boiler & Pressure Vessel Code, Section XI, 1998 Edition, with Addenda through 2000.
5. SI Calculation No. 0900530.307, Rev. 0, "Residual Stress Analysis of Jet Pump Instrumentation Nozzle (N9A) with Weld Overlay Repair."

Dear Mr. Pace:

During the Spring 2009 outage, a full structural weld overlay repair was applied on the affected weld on the N9A Jet Pump Instrumentation Nozzle at Pilgrim Nuclear Power Station (PNPS). This repair was made over a previous 1984 weld overlay repair. The present repair meets all current design criteria, including requirements for inspection. The design basis of this repair was that the underlying flaw was assumed to be entirely through the original component wall, and extended entirely around the component circumference. Design was performed taking guidance from ASME Section XI Code Case N-504-3, which was conditionally approved in Regulatory Guide 1.147 Revision 15.

Code Case N-504-3 includes several requirements for evaluating and validating the weld overlay design. These include:

1. N-504-3 (f)(1): "The axial length and end slope of the reinforcement shall be sufficient to provide for load redistribution from the pipe into the deposited weld metal and back into the

pipe without violating applicable stress limits of Section III for primary local and bending stresses and secondary peak stresses."
2. N-504-3 (g)(2)): "For repaired welds the evaluation shall consider residual stresses produced by the weld overlay with other applied loads on the system...The evaluation shall demonstrate that the requirements of IWB-3640...are satisfied for the design life of the repair, considering potential flaw growth due to fatigue and the mechanism believed to have caused the flaw."
3. N-504-3 (g)(3): "The evaluation of other welds and components in the system shall consider potential increases in loading, including shrinkage effects, due to all overlays in the system, and shall identify and record the magnitude and location of the maximum shrinkage stress developed."

The purpose of this letter and the referenced calculations is to document the results of analyses that demonstrate meeting those requirements.

1. Code Reconciliation/Stress Analysis Summary

Structural Integrity Associates calculation 0900530.306 [1] was prepared to address requirement 1 above. This calculation reconciles the effects of the weld overlay repair of nozzle N9A at PNPS to the nozzle's original ASME Section III Stress Report [2].

The Reference [1] calculation evaluates the N9A Jet Pump Instrumentation Nozzle with the weld overlay repair under operating conditions using finite element analysis. It also addresses item (f)(1) of Code Case N-504-3, which requires that the overlay be sized so that it is able to provide for load redistribution from the pipe into the deposited weld metal and back into the pipe without exceeding applicable stress limits of ASME Section III for primary local and bending stresses and secondary peak stresses.

Multiple analyses consistent with the nozzle Stress Report [2] were performed with the applied weld overlay. The resulting stresses were compared to Section III Code allowable stresses to reconcile the repair with Reference [2] stress results and calculated fatigue usage.

The evaluation considered primary and secondary stress intensities, fatigue usage and applicable Code Case N-504-3 requirements. This evaluation concludes that the impact of the overlay is minor and generally produces a more favorable stress condition. The revised stresses are within Code allowable values, and fatigue usage is not significant. Therefore, the original Stress Report [2] which demonstrated Code compliance remains valid for the nozzle with the weld overlay repair.

2. Crack Growth Evaluation

Structural Integrity Associates calculation 0900530.308 [3] was prepared to address requirement 2 above. Linear elastic fracture mechanics (LEFM) analyses were performed to calculate crack growth in the nozzle-to-safe end dissimilar metal weld (DMW) for the reactor

pressure vessel (RPV) Jet Pump Instrumentation Nozzle N9A at PNPS. Loads considered were internal pressure and weld overlay (WOL) repair residual stresses, which were calculated in Structural Integrity Associates calculation 0900530.307 [5]. Both fatigue crack growth (FCG) and Intergranular Stress Corrosion Cracking (IGSCC) are considered.

This evaluation shows that a hypothetical flaw in the PNPS N9A nozzle-to-safe end weld performed during the Spring 2009 outage will not grow to a depth which reduces the weld overlay design basis, and therefore the overlay is predicted to remain acceptable and continue to meet the requirements of ASME Code, Section XI, Appendix C and Table IWB-3641-3 [4]. The WOL residual stresses provide a significant benefit to the mitigation of crack growth, especially for IGSCC growth. Taking credit for these residual stresses produces a negative stress intensity factor, resulting in no additional crack growth at this location.

3. Weld Overlay Shrinkage

Since the N9A nozzle is essentially a free end with no attached piping other than very flexible instrument lines, weld overlay shrinkage will produce no adverse affect on any other location at PNPS.

Conclusion

The above referenced calculations demonstrate that the post overlay evaluation requirements of Code Case N-504-3 have been met for the as-applied weld overlay repair to the N9A nozzle-to-safe end weld at Pilgrim Nuclear Power Station.

Very truly yours,

Hal L. Gustin
Associate

H L Gustin

Reviewed by:

Karen K Fujikawa

Karen Fujikawa
Senior Associate

cc: W. Lobo
G. Mileris
SI File No. 0900530.401

ATTACHMENT 2
To Entergy Letter No. 2.09.050

Structural Integrity Associates, Inc. File No. 0900530.306, "ASME Code, Section III Evaluation of N9A Jet Pump Instrument Nozzle with Weld Overlay Repair", dated August 10, 2009

(70 pages)