



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

August 2, 2010

Vice President, Operations
Entergy Operations, Inc.
River Bend Station
5485 US Highway 61N
St. Francisville, LA 70775

SUBJECT: RIVER BEND STATION, UNIT 1 - RBS-ISI-015 PROPOSED ALTERNATIVE TO
10 CFR 50.55A EXAMINATION REQUIREMENTS FOR REACTOR PRESSURE
VESSEL WELD INSPECTIONS (TAC NO. ME2817)

Dear Sir or Madam:

By letter dated November 30, 2009, Entergy Operations, Inc. (Entergy, the licensee), submitted relief request (RR) RBS-ISI-015 for the third 10-year inservice inspection (ISI) interval program at the River Bend Station (RBS). The licensee requested an alternative in accordance with the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code) Case N-702, "Alternative Requirements for Boiling Water Reactor (BWR) Nozzle Inner Radius and Nozzle-to-Shell Welds," to the requirements of the ASME Code, Section XI, Table IWB-2500-1, Examination Category B-D, Full Penetration Welded Nozzles in Vessels – Inspection Program B B3.90 Nozzle-to-Vessel Welds and B3.100 Nozzle Inside Radius Sections.

The U.S. Nuclear Regulatory Commission (NRC) staff has reviewed the subject request and concludes, as set forth in the enclosed safety evaluation (SE), that the proposed alternative provides an acceptable level of quality and safety. In addition, the staff concludes that the RBS reactor pressure vessel (RPV) meets all five plant-specific criteria specified in the December 19, 2007, SE on the BWRVIP-108 report, which provides the technical basis for use of ASME Code Case N-702. The use of ASME Code Case N-702 is authorized until such time as the ASME Code-Case N-702 is published in a future version of Regulatory Guide (RG) 1.147 and incorporated by reference in Title 10 of the *Code Federal Regulations* (10 CFR), Section 50.55. At that time, if the licensee intends to continue implementing this ASME Code Case N-702, it must follow all provisions of ASME Code Case N-702 with conditions as specified in RG 1.147 and limitations as specified in paragraphs 50.55a(b)(4), (b)(5), and (b)(6) of 10 CFR, if any.

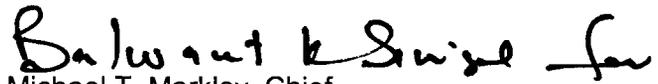
Accordingly, pursuant to 10 CFR 50.55(a)(3)(i), RR RBS-ISI-015 is authorized through the end of the third 10-year ISI interval from the requirements of Table IWB-2500-1 (Inspection Program B) of ASME Code, Section XI, pertaining to inspection of reactor pressure vessel nozzle-to-vessel shell welds and inner radii for nozzles specified in the Enclosure 1 of the submittal for RBS.

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

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If you have any questions, please contact me at 301-415-1445 or via e-mail at alan.wang@nrc.gov.

Sincerely,

A handwritten signature in black ink, appearing to read "Michael T. Markley". The signature is written in a cursive style with a long horizontal flourish at the end.

Michael T. Markley, Chief
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-458

Enclosure:
Safety Evaluation

cc w/encl: Distribution via Listserv



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REQUEST FOR ALTERNATIVE RBS-ISI-015

ALTERNATIVE EXAMINATION REQUIREMENTS

ENTERGY OPERATIONS, INC.

RIVER BEND STATION, UNIT 1

DOCKET NO. 50-458

1.0 INTRODUCTION

By letter dated November 30, 2009 (Agencywide Documents Access and Management System, (ADAMS) Accession No. ML093380288), Entergy Operations, Inc. (Entergy, the licensee), requested U.S. Nuclear Regulatory Commission (NRC) approval of an alternative, RBS-ISI-015, to the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, Table IWB-2500-1, Examination Category B-D, Full Penetration Welded Nozzles in Vessels – Inspection Program B B3.90 Nozzle-to-Vessel Welds and B3.100 Nozzle Inside Radius Sections at the River Bend Station, Unit 1 (RBS). Entergy has proposed an alternative in accordance with ASME Code Case N-702, "Alternative Requirements for Boiling Water Reactor (BWR) Nozzle Inner Radius and Nozzle-to-Shell Welds," for the third 10-year inservice inspection (ISI) interval program at RBS.

2.0 REGULATORY REQUIREMENTS

Inservice inspection (ISI) of the ASME Code Class 1, 2, and 3 components is performed in accordance with Section XI of the ASME Code and applicable addenda as required by Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.55a(g), except where specific relief has been granted by the Commission pursuant to 10 CFR 50.55a(g)(6)(i).

The regulations in 10 CFR 50.55a(a)(3) state that alternatives to the requirements of paragraph (g) may be used, when authorized by the NRC, if: (i) the proposed alternatives would provide an acceptable level of quality and safety, or (ii) compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. The regulations in 10 CFR 50.55a(g)(4) further state that ASME Code Class 1, 2, and 3 components (including supports) must meet the requirements, except design and access provisions and preservice examination requirements, set forth in the ASME Code, Section XI, to the extent practical within the limitations of design, geometry, and materials of construction of the components. The regulations require that inservice examination of components and system pressure tests conducted during the first 10-year interval and subsequent intervals comply with the requirements in the latest edition and addenda of

Enclosure

Section XI of the ASME Code incorporated by reference in 10 CFR 50.55a(b) 12 months prior to the start of the 120-month interval, subject to the limitations and modifications listed therein. The applicable ISI Code of record for the third 10-year ISI interval for RBS is the 2001 Edition with 2003 Addenda of Section XI of the ASME Code.

For all reactor pressure vessel (RPV) nozzle-to-vessel shell welds and nozzle inner radii, ASME Code, Section XI, requires 100 percent inspection during each 10-year ISI interval. However, ASME Code Case N-702 proposed an alternative which reduces the inspection of RPV nozzle-to-vessel shell welds and nozzle inner radius areas from 100 percent to 25 percent of the nozzles for each nozzle type during each 10-year interval. By letter dated December 19, 2007 (ADAMS Accession No. ML073600374), the NRC approved the Electric Power Research Institute (EPRI) Technical Report 1003557, "BWRVIP-108: BWR Vessel and Internals Project (BWRVIP), Technical Basis for the Reduction of Inspection Requirements for the Boiling Water Reactor Nozzle-to-Vessel Shell Welds and Nozzle Blend Radii," which is the underlying technical basis document for ASME Code Case N-702. The safety evaluation (SE) regarding the BWRVIP-108 report specified the plant-specific requirements that need to be satisfied by applicants using ASME Code Case N-702.

However, each licensee should demonstrate the plant-specific applicability of the BWRVIP-108 report to their units in the relief request by showing that all the following factors are less than 1.15:

- (1) the temperature factor defined as (RPV heat up and cooldown rate) / (100 °F/hour),

For the recirculation inlet nozzle,

- (2) the RPV pressure stress factor defined as $[(RPV \text{ pressure}) \times (RPV \text{ inner radius}) / (RPV \text{ thickness})] / 19332$,
- (3) the nozzle pressure stress factor defined as $(\text{pressure}/1000 \text{ psi}) \times \{[(\text{nozzle outer radius})^2 + (\text{nozzle inner radius})^2] / [(\text{nozzle outer radius})^2 - (\text{nozzle inner radius})^2]\} / 1637$,

For the recirculation outlet nozzle,

- (4) the RPV pressure stress factor defined as $[(RPV \text{ pressure}) \times (RPV \text{ inner radius}) / (RPV \text{ thickness})] / 16171$, and
- (5) the nozzle pressure stress factor defined as $(\text{pressure}/1000 \text{ psi}) \times \{[(\text{nozzle outer radius})^2 + (\text{nozzle inner radius})^2] / [(\text{nozzle outer radius})^2 - (\text{nozzle inner radius})^2]\} / 1977$.

This plant-specific information was required by the NRC staff to ensure that the probabilistic fracture mechanics (PFM) analysis documented in the BWRVIP-108 report applies to the RPV of the applicant's plant.

3.0 TECHNICAL EVALUATION

3.1 Request for Alternative RBS-ISI-015

ASME Code Requirements for which Relief is Requested

The licensee requested relief from the following requirements of the ASME Code, Section XI, 2001 Edition with 2003 Addenda, Table IWB-2500-1, Examination Category B-D, Full Penetration Welded Nozzles in Vessels – Inspection Program B. Item B3.90 requires volumetric examination of all Nozzle-to-Vessel welds. Item B3.100 requires volumetric examinations of all Nozzle Inside Radius Sections.

Components for which Relief is Requested

Code Class: 1

Component Numbers: N01, N02, N03, N05, N06, and N09

Examination Category: B3.90 and B3.100

Proposed Alternative and Basis for Use (as stated by licensee)

Pursuant to 10 CFR 50.55a(a)(3)(i), Entergy requests an alternative from performing the ASME Code required examinations of 100% of the vessel nozzle assemblies identified in Attachment 2¹. As an alternative, Entergy proposes the use of [ASME] Code Case N-702 ..., which would require examination of a minimum of 25% of the nozzle-to-vessel welds and inner radius sections, including at least one nozzle from each system and nominal pipe size... Both the inner radius and the nozzle-to-shell weld would be examined for each of the identified nozzle assemblies.

Electric Power Research Institute (EPRI) Technical Report 1003557, "BWRVIP-108: BWR Vessel and Internals Project (BWRVIP), Technical Basis for the Reduction of Inspection Requirements for the Boiling Water Reactor Nozzle-to-Vessel Shell Welds and Nozzle Blend Radii," ... provides the basis for ASME Code Case N-702. The evaluation found that failure probability due to a Low Temperature Overpressure event at the nozzle blend radius region and nozzle-to-vessel shell weld is very low (i.e. $< 1 \times 10^{-6}$ for 40 years) with or without inservice inspection. The report concludes that inspection of 25% of each nozzle type is technically justified.

[...]

On December 19, 2007, the NRC issued a Safety Evaluation (SE) ... approving the use of BWRVIP-108. Within Section 5 of the SE, it states that each licensee should demonstrate the plant-specific applicability of the BWRVIP-108 report to

¹ "Attachment 2" refers to an attachment to the licensee's submittal dated November 30, 2009.

their units in the request for alternative by meeting the criteria discussed in Section 5 of the SE. The RBS specific applicability is demonstrated in Attachment 3².

The RBS-specific applicability to each general and nozzle-specific criteria are as follows:

Criterion 1: the maximum RPV heatup/cool-down rate is less than 115 °F/hour

The maximum [RPV] Heatup/Cool-down rate is limited to less than 115 °F/hour

Criterion 2: for recirculation inlet nozzles, $(pr/t)/C_{RPV} < 1.15$

$$(pr/t)/C_{RPV} = 0.959 < 1.15$$

Criterion 3: for recirculation inlet nozzles, $[p(r_o^2+r_i^2)/(r_o^2-r_i^2)]/C_{NOZZLE} < 1.15$

$$[p(r_o^2+r_i^2)/(r_o^2-r_i^2)]/C_{NOZZLE} = 1.068 < 1.15$$

Criterion 4: for recirculation outlet nozzles, $(pr/t)/C_{RPV} < 1.15$

$$(pr/t)/C_{RPV} = 1.143 < 1.15$$

Criterion 5: for recirculation inlet nozzles, $[p(r_o^2+r_i^2)/(r_o^2-r_i^2)]/C_{NOZZLE} < 1.15$

$$[p(r_o^2+r_i^2)/(r_o^2-r_i^2)]/C_{NOZZLE} = 1.003 < 1.15$$

3.2 NRC Staff Evaluation

Criteria for Applying the BWRVIP-108 Report

The December 19, 2007, SE on the BWRVIP-108 Report specified five plant-specific criteria that licensees must meet in order to demonstrate that the BWRVIP-108 report results apply to their plants. The five criteria are related to the driving force of the PFM analysis for the recirculation inlet and outlet nozzles. It was stated in the December 19, 2007, SE that the nozzle material fracture toughness-related (RT_{NDT}) values used in the PFM analyses were based on data from the entire fleet of BWR RPVs. Therefore, the BWRVIP-108 report PFM analyses are bounding with respect to fracture resistance, and only the driving force of the underlying PFM analyses needs to be evaluated. It was also stated in the December 19, 2007, SE that except for the RPV heatup/cool-down rate, the plant-specific criteria are for the recirculation inlet and outlet nozzles only because the probabilities of failure, P(FIE)s, for other nozzles are an order of magnitude lower.

The licensee stated that Criterion 1 is satisfied because RBS maintains a maximum heatup/cool-down rate of 100 °F/hour, well below the 115 °F/hour criterion limit. For the remaining four criteria the licensee provided, in Attachment 3 of its submittal, RBS's plant-

² "Attachment 3" refers to an attachment to the licensee's submittal dated November 30, 2009.

specific data its evaluation of the driving force factors, or ratios, against the criteria established in the December 19, 2007, SE. The licensee's calculated results showed that the remaining four criteria are satisfied, and the NRC staff confirmed the accuracy of the calculations by performing the calculations independently.

The licensee did not address whether there have been any events during which the heatup/cool-down rate was in excess of 115 °F/hour, however this is not a concern as Criterion 1 refers only to normal operations, not typical transients.

The licensee notes that ASME Code Case N-720 stipulates that the VT-1 examination method may be used in lieu of the volumetric examination method for the inner radius sections. Entergy has adopted ASME Code Case N-648-1, "Alternative Requirements for Inner Radius Examinations of Class 1 Reactor Vessel Nozzles," with the provisions stipulated in Regulatory Guide (RG) 1.147, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," in the RBS Third Interval ISI Program Plan. The licensee, therefore, claims the right to perform examinations on inner radius sections with either the VT-1 or the volumetric method. The condition placed on the use of this Code Case is that "in place of UT examination, licensees may perform a visual examination with enhanced magnification that has a resolution sensitivity to detect a 1-mil width wire or crack..." As long as the VT-1 complies with the above-stated condition, the NRC staff concludes that the licensee's proposed alternative examination is acceptable as it provides reasonable assurance of verifying structural integrity of the nozzle's inner radii.

Finally, the NRC staff discussed previous indications found on the components for which alternative is requested with the licensee on February 3, 2010 (ADAMS Accession No. ML100350192). The licensee indicated that four indications had been detected, three on B13-D001-N05B-1 and one on B13-D001-N06C-1. In all cases, the indications were found to be acceptable per ASME Code, Section XI, IWB-3000, no through-wall defects were detected, and no changes were noted between the first and second inspections. This information does not cause a concern with respect to the use of the alternative as only a small number of acceptable indications have been found in the past two inspections and no pattern of degradation or indication growth has been detected.

3.0 CONCLUSION

The NRC staff has reviewed the submittal and concludes that the RBS RPV meets all five plant-specific criteria specified in the December 19, 2007, SE on the BWRVIP-108 report, which provides the technical basis for use of ASME Code Case N-702. The use of ASME Code Case N-702 is authorized until such time as the ASME Code-Case N-702 is published in a future version of RG 1.147 and incorporated by reference in 10 CFR 50.55a. At that time, if the licensee intends to continue implementing this ASME Code Case N-702, it must follow all provisions of ASME Code Case N-702 with conditions as specified in RG 1.147 and limitations as specified in paragraphs 10 CFR 50.55a(b)(4), (b)(5), and (b)(6), if any.

Accordingly, pursuant to 10 CFR 50.55a(a)(3)(i), this alternative is authorized through the end of the third 10-year ISI interval from the requirements of Table IWB-2500-1 (Inspection Program B) of ASME Code, Section XI, pertaining to inspection of RPV nozzle-to-vessel shell welds and

inner radii for nozzles specified in the Enclosure 1 of the submittal because an acceptable level of quality and safety can be maintained.

All other requirements of the ASME Code, Sections III and XI, for which relief has not been specifically requested and approved remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

Principal Contributor: D. Widrevitz

Date: August 2, 2010

If you have any questions, please contact me at 301-415-1445 or via e-mail at alan.wang@nrc.gov.

Sincerely,

/RA by Balwant k. Singal for/

Michael T. Markley, Chief
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-458

Enclosure:
Safety Evaluation

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