



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

June 6, 2016

Mr. John McCann
Vice President, Regulatory Assurance
Entergy Services, Inc.
1340 Echelon Parkway
Jackson, MS 39213

SUBJECT: ARKANSAS NUCLEAR ONE, UNITS 1 AND 2; GRAND GULF NUCLEAR STATION, UNIT 1; JAMES A. FITZPATRICK NUCLEAR POWER PLANT; INDIAN POINT ENERGY CENTER, UNITS 2 AND 3; PALISADES NUCLEAR PLANT; PILGRIM NUCLEAR POWER STATION; RIVER BEND STATION, UNIT 1; AND WATERFORD STEAM ELECTRIC STATION, UNIT 3 - RELIEF REQUEST RR-EN-15-2, PROPOSED ALTERNATIVE TO USE AMERICAN SOCIETY OF MECHANICAL ENGINEERS BOILER AND PRESSURE VESSEL CODE CASE N-786-1, "ALTERNATIVE REQUIREMENTS FOR SLEEVE REINFORCEMENT OF CLASS 2 AND 3 MODERATE-ENERGY CARBON STEEL PIPING, SECTION XI, DIVISION 1" (CAC NOS. MF6654, MF6655, MF6656, MF6657, MF6658, MF6659, MF6660, MF6661, MF6662, AND MF6663)

Dear Mr. McCann:

By letter dated August 20, 2015, as supplemented by letter dated December 4, 2015, Entergy Operations Inc. and Entergy Nuclear Operations, Inc. (Entergy) submitted a request to the Nuclear Regulatory Commission (NRC) for the use of alternatives to the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, Article IWA-4000, for the specific repair/replacement activity identified in relief request RR EN-15-2 at Arkansas Nuclear One, Units 1 and 2; Grand Gulf Nuclear Station, Unit 1; James A. Fitzpatrick Nuclear Power Plant; Indian Point Energy Center, Units 2 and 3; Palisades Nuclear Plant; Pilgrim Nuclear Power Station; River Bend Station, Unit 1; and Waterford 3 Steam Electric Station.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(z)(2), Entergy proposed an alternative to use ASME Code Case N-786-1, "*Alternative Requirements for Sleeve Reinforcement of Class 2 and 3 Moderate Energy Carbon Steel Piping Section XI, Division 1,*" in relief request RR EN-15-2 to repair defects in ASME Code Class 2 and 3 moderate energy piping without removing the existing defect by installing sleeves around the piping, thereby, restoring structural integrity and/or leak tightness to the degraded pipe on the basis that compliance with the specified ASME Code repair would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

The Nuclear Regulatory Commission (NRC) staff has reviewed the subject request and finds that the proposed alternative provides reasonable assurance of structural integrity and leak tightness of the subject piping and that complying with the specified ASME Code requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. Accordingly, the NRC staff concludes that Entergy has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(z)(2). Therefore,

the NRC staff authorizes the use of relief request RR EN-15-2 for the repair of ASME Code Class 2 and 3 moderate energy carbon steel piping at Arkansas Nuclear One, Unit 1, for the fourth and fifth 10-year inspection intervals; Arkansas Nuclear One, Unit 2, for the fourth 10-year inspection interval; Grand Gulf Nuclear Station, for the third and fourth 10-year inspection intervals; Indian Point Energy Center, Unit 2, for the fourth and fifth 10-year inspection intervals; Indian Point Energy Center, Unit 3, for the fourth 10-year inspection interval, James A. Fitzpatrick Nuclear Power Plant, for the fourth and fifth 10-year inspection intervals; Palisades Nuclear Plant, for the fourth and fifth 10-year inspection intervals; Pilgrim Nuclear Power Station, for the fifth 10-year inspection interval; River Bend Station, Unit 1, for the third and fourth 10-year inspection intervals; and Waterford Steam Electric Station, Unit 3, for the third and fourth 10-year inspection intervals.

The authorization of relief request RR EN-15-2 does not imply or infer NRC approval of ASME Code Case N-786-1. All other ASME Code, Section XI, requirements for which relief was not specifically requested and authorized by the NRC staff will remain applicable including third-party review by the Authorized Nuclear Inservice Inspector.

If you have any questions, please contact Richard V. Guzman, Senior Project Manager, at (301) 415-1030 or Richard.Guzman@nrc.gov.

Sincerely,



Travis L. Tate, Chief
Plant Licensing Branch I-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-313, 50-368, 50-255,
50-416, 50-293, 50-333, 50-458,
50-247, 50-286, 50-382

Enclosure:
Safety Evaluation

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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

PROPOSED ALTERNATIVE TO UTILIZE ASME CODE CASE N-786-1

RELIEF REQUEST RR EN-15-2

ENTERGY OPERATIONS INC.

ENTERGY NUCLEAR OPERATIONS, INC.

ARKANSAS NUCLEAR ONE, UNITS 1 AND 2; GRAND GULF NUCLEAR STATION, UNIT 1;

JAMES A. FITZPATRICK NUCLEAR POWER PLANT; INDIAN POINT ENERGY CENTER,

UNITS 2 AND 3; PALISADES NUCLEAR PLANT; PILGRIM NUCLEAR POWER STATION;

RIVER BEND STATION, UNIT 1; AND WATERFORD STEAM ELECTRIC STATION, UNIT 3

DOCKET NOS. 50-313, 50-368, 50-416, 50-333, 50-247, 50-286,

50-255, 50-293, 50-458, AND 50-382

1.0 INTRODUCTION

By letter dated August 20, 2015 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML15232A711), as supplemented by letter dated December 4, 2015, (ADAMS Accession No. ML16005A172), Entergy Operations Inc. and Entergy Nuclear Operations, Inc. (Entergy/the licensee) submitted a request to the Nuclear Regulatory Commission (NRC) for the use of alternatives to the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, Article IWA-4000, for the specific repair/replacement activity identified in relief request RR EN-15-2 at Arkansas Nuclear One, Units 1 and 2; Grand Gulf Nuclear Station, Unit 1; James A. Fitzpatrick Nuclear Power Plant; Indian Point Energy Center Units 2 and 3; Palisades Nuclear Plant; Pilgrim Nuclear Power Station; River Bend Station, Unit 1; and Waterford 3 Steam Electric Station.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(z)(2), Entergy proposed an alternative to use ASME Code Case N-786-1, "Alternative Requirements for Sleeve Reinforcement of Class 2 and 3 Moderate Energy Carbon Steel Piping Section XI, Division 1," in relief request RR EN-15-2 to repair defects in ASME Code Class 2 and 3 moderate energy piping without removing the existing defect by installing sleeves around the piping, thereby, restoring structural integrity and/or leak tightness to the degraded pipe on the basis that compliance with the specified ASME Code repair would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Enclosure

2.0 REGULATORY EVALUATION

Entergy requested authorization of an alternative to the requirements of ASME Code, Section XI, Article IWA-4000, pursuant to 10 CFR 50.55a(z)(2).

Section 50.55a(g)(4) of 10 CFR states, in part, that ASME Code Class 1, 2, and 3, components (including supports) shall meet the requirements, except the design and access provisions and the preservice examination requirements, set forth in the ASME Code, Section XI, “Rules for Inservice Inspection (ISI) of Nuclear Power Plant Components.”

Section 50.55a(z) of 10 CFR states, in part, that alternatives to the requirements of 10 CFR 50.55a(g) may be used, when authorized by the NRC, if Entergy demonstrates: (1) the proposed alternatives would provide an acceptable level of quality and safety; or (2) compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Based on the above evaluation, and subject to the following technical evaluation, the NRC staff finds that it has the regulatory authority to authorize the alternative proposed by Entergy.

3.0 TECHNICAL EVALUATION

The affected components are ASME Code Class 2 and 3 moderate energy carbon steel piping systems that carry fluid at a maximum operating temperature and pressure of less than or equal to 200 degrees Fahrenheit (°F) and 275 psig, respectively.

3.1 Applicable Code Edition and Addenda

Table 1- Applicable Plants with Associated 10-Year Intervals and ASME Code Editions

Plant	ISI Interval	ASME Section XI Edition/Addenda	Interval Start	Interval End
Arkansas Nuclear One Unit 1(ANO-1) (Note 1)	4	2001 Edition/ 2003 Addenda	5/31/2008	5/30/2017
	5	2007 Edition/ 2008 Addenda (Note 3)	5/31/2017	5/30/2027
Arkansas Nuclear One Unit 2 (ANO-2)	4	2001 Edition/ 2003 Addenda	3/26/2010	3/25/2020
Grand Gulf Nuclear Station (GGNS) (Note 1)	3	2001 Edition/ 2003 Addenda	5/31/2008	6/1/2017
	4	2007 Edition/ 2008 Addenda (Note 3)	6/2/2017	6/1/2027
Indian Point Energy Center Unit 2 (IPEC-2) (Note 2)	5	2007 Edition/ 2008 Addenda	6/1/2016	5/31/2026
Indian Point Energy Center Unit 3 (IPEC-3)	4	2001 Edition/ 2003 Addenda	7/21/2009	7/20/2019
James A Fitzpatrick Nuclear Power Plant (JAF) (Note 1)	4	2001 Edition/ 2003 Addenda	3/1/2007	12/31/2016
Palisades Nuclear Plant (PLP) (Note 2)	5	2007 Edition/ 2008 Addenda	12/13/2015	12/12/2025
Pilgrim Nuclear Power Station (PNPS) (Note 2)	5	2007 Edition/ 2008 Addenda	7/1/2015	6/30/2025
River Bend Station, Unit 1 (RBS) (Note 1)	3	2001 Edition/ 2003 Addenda	5/31/2008	11/30/2017
	4	2007 Edition/ 2008 Addenda (Note 3)	12/1/2017	11/30/2027

Plant	ISI Interval	ASME Section XI Edition/Addenda	Interval Start	Interval End
Waterford Steam Electric Station, Unit 3 (WF3) ^(Note 1)	3	2001 Edition/ 2003 Addenda	5/31/2008	6/30/2017
	4	2007 Edition/ 2008 Addenda ^(Note 3)	7/1/2017	6/30/2027

Notes:

- 1) The 3rd ISI [Inservice Inspection] intervals for GGNS, RBS, and WF3 and the 4th ISI interval for ANO-1 end within 1-1/2 years of the requested relief request approval date. The licensee requested the approval this alternative for the 3rd and 4th GGNS, RBS, and WF3 intervals and the 4th and 5th ANO-1 intervals.
- 2) The 4th ISI intervals for IPEC-2, PLP, and PNPS end prior to the requested relief request approval date. The licensee requested the approval of this alternative for the 5th IPEC-2, PLP, and PNPS ISI intervals.
- 3) The licensee stated that ANO-1 GGNS, RBS, and WF3 will update to the 2007 Edition/2008 Addenda except as otherwise required by the NRC in 10 CFR 50.55a(g)(4)(ii).

3.2 Proposed Alternative

In lieu of the requirements of ASME Code, Section XI, IWA-4000, Entergy proposed to use ASME Code Case N-786-1, “*Alternative Requirements for Sleeve Reinforcement of Class 2 and 3 Moderate Energy Carbon Steel Piping Section XI, Division 1,*” and additional conditions specified in the relief request to repair degradation in ASME Code Class 2 and 3 moderate energy carbon steel piping.

Code Case N-786-1 (the code case) provides the design of a Type A sleeve, partial-structural Type B sleeve, and full-structural Type B sleeve to repair the subject pipe. The general design and construction of these repair methods are summarized as follows:

Type A Sleeve

The Type A sleeve consists of two semi-cylindrical sections of a rolled plate which are placed over the defect area and longitudinally welded to form a sleeve over the degraded pipe. The ends of the sleeve are not welded to the pipe, but under certain circumstances may be sealed. Hardenable filler material may be used to fill gaps between the sleeve and the pipe. The Type A sleeve is intended to be used when reinforcement of thinned areas in the pipe is required. The Type A sleeve may only be used when the pipe is capable of meeting longitudinal strength requirements and when the existing degradation and the predicted degradation after the repair are not expected to result in leakage. The relief request limits the maximum service life of a Type A sleeve repair from the time of installation to the next refueling outage.

Partial-Structural Type B Sleeve

The partial-structural Type B sleeve consists of two semi-cylindrical sections of a rolled plate which are placed over the defect area and longitudinally welded to form a sleeve over the degraded pipe. The ends of a partial-structural Type B sleeve are fillet-welded to the pipe. Filler and gasket material may be used between the pipe and the sleeve as

needed. The partial-structural Type B sleeve is intended for use for pressure plus partial-structural reinforcement of thinned areas that penetrate, or are expected to penetrate, the wall of the existing pipe and cause leakage. The partial-structural Type B sleeve is designed to accommodate design loadings at the pipe segment being reinforced, taking partial credit for the degraded pipe segment after factoring in predicted degradation over the life of the repair. Partial credit is considered taken if the design relies on any portion of the pipe segment beneath the sleeve, other than the base metal beneath the attachment welds, to provide structural or pressure integrity. The relief request limits the maximum service life of a partial-structural Type B sleeve repair from the time of installation to the next refueling outage.

Full-Structural Type B Sleeve

The full-structural Type B sleeve consists of two semi-cylindrical sections of a rolled plate which are placed over the defect area and longitudinally welded to form a sleeve over the degraded pipe. The ends of a full-structural Type B sleeve are welded to the pipe as a partial penetration attachment weld. Filler and gasket material may be used between the pipe and the sleeve as needed. The full-structural Type B sleeve is used to support pressure plus full-structural reinforcement of thinned areas that penetrate, or are expected to penetrate the pipe wall and cause leakage. The full-structural Type B sleeve is designed to accommodate pressure, axial and circumferential design loadings at the degraded location for the design life of the repair without taking credit for any portion of the degraded pipe segment. The relief request permits the full-structural Type B sleeve repair to remain in service as long as the repair remains serviceable.

The proposed alternative will follow Section 1 of the code case. The NRC staff determined the significant requirements of Entergy's proposed alternative in combination with Section 1 of the code case are summarized below.

3.2.1 General Requirements

Paragraph 1(a) of the code case requires that installation of the sleeve follow a repair/replacement plan satisfying the ASME Code, Section XI, IWA-4150.

Paragraph 1(b) of the code case specifies that design, material and installation of the repair shall follow the ASME Code, Section XI, IWA-4000, except as stated in the code case.

Paragraph 1(e) of the code case states that the code case may be applied only to piping not required to be ultrasonically examined for inservice inspection.

Paragraph 1(f) of the code case prohibits the application of reinforcing sleeves to pumps, valves, expansion joints, vessels, heat exchangers, tubing, flanges, flanged joints, socket welded or threaded joints, or branch connection welds.

3.2.2 Initial Evaluation

The proposed alternative will follow Section 2 of the code case with the following additional clarification and modifications.

Section 2(a) of the code case requires the inspection of the degraded area of the pipe prior to sleeve installation. Before repairing the pipe, Entergy stated that it will ultrasonically measure the material beneath the pipe surface to which the reinforcing sleeve is to be applied to establish the existing wall thickness and the extent and configuration of the degraded area to be reinforced. Entergy further stated that it will also examine the adjacent area to verify that the repair will encompass the entire unacceptable area, and that the adjacent base material is of sufficient thickness to accommodate the attachment welds at the edges of the sleeve. The area of evaluation will be dependent on the degradation mechanism present, but shall extend at least a distance of $0.75\sqrt{RT_{nom}}$ (R and T are the radius and nominal thickness of the pipe, respectively) beyond the edge of any sleeve attachment weld.

Section 2(b) of the code case states that the cause, the extent, and the rate of degradation in the piping shall be determined and evaluated to ensure that there will be no other unacceptable locations within the surrounding area that could affect the integrity of the reinforced areas for the life of the repair. Entergy stated that it will identify surrounding areas that are showing signs of degradation and included in its plan for thickness monitoring inspections of full structural Type B sleeve. Entergy will determine the dimension of the surrounding areas for evaluation based on the type and rate of degradation present.

In the December 4, 2015, submittal, Entergy clarified that the extent of condition is addressed in accordance with the Owners' operability procedures and corrective action program. Entergy further stated that when leakage or a degraded condition is identified in a Class 2 or 3 component at an Entergy nuclear plant, an operability evaluation is required. Entergy explained that as part of the immediate operability determination, an extent of condition assessment will be performed to comply with Entergy's operability procedure. Entergy's corrective action program also requires the extent of condition assessments of degraded conditions. Entergy noted that its Owner operability procedures and processes are based on NRC Inspection Manual 0326, Operability Determinations & Functionality Assessment for Conditions Adverse to Quality or Safety.

Paragraph 2(c) requires that the effects of the sleeve and attachment welds on the piping and any remaining degradation be evaluated in accordance with the ASME Code, Section XI, IWA-4311.

The proposed alternative in Section 5 of the relief request requires that if the cause of the degradation is not determined, the maximum permitted service life of any reinforcing sleeve shall be the time until the next refueling outage.

3.2.3 Design

The proposed alternative will follow Section 3 of the code case with additional clarification and modifications. Sections 3.1(a) and 3.1(b)(2) of the code case require that the maximum service

life of Type A and partial-structural Type B sleeves is until the next refueling outage. The proposed alternative includes the following two clarifications for the sleeve service life:

- a. Reinforcing sleeves installed before the end of the 10-year ISI interval will be removed during the next refueling outage after installation, even if that refueling outage occurs after the end of the 10-year ISI interval. In this case, absent detrimental defects or degradation, duration of the proposed alternative would be until the first refueling outage after the end date of the ISI Interval for the applicable Entergy plant.
- b. Some piping systems are required to be functional and cannot be repaired during refueling outages. The repair of these piping can only be performed when the plant is operating during the fuel cycle. For this unique case, Type A and partial-structural Type B reinforcing sleeves will be removed prior to, but no later than, the refueling outage unless specific regulatory relief is obtained.

Paragraph 3.2(a) of the code case requires that the sleeves will be designed in accordance with the ASME Code, Section III, NC-3100 and NC-3600 or ND-3100 and ND-3600, and Section III, Appendices, Mandatory Appendix II.

Paragraph 3.2(k) of the code case states that the thickness of each sleeve is sufficient to support the required design loads plus a corrosion allowance equal to, or greater than, two times the maximum rate observed at the location of the repair for the duration of the repair or between inspections. If the degradation rate at the repaired location is unknown, Entergy will apply four times the maximum degradation rate observed for that pipe system or a similar pipe system at the same plant site for the same degradation mechanism. If both the degradation rate at the repaired location and the cause of the degradation are not conclusively determined, Entergy will apply four times the maximum degradation rate observed for all degradation mechanisms observed for that pipe system or a similar pipe system at the same plant site.

Paragraph 3.2(o) of the code case permits branch connections to be installed on sleeve only for the filling or venting purposes during installation or leakage testing of the sleeve. The branch pipe can only be in Nominal Pipe Size (NPS) 1-inch or smaller in size.

The NRC staff determined the remaining paragraphs of Section 3.2 provide typical requirements on the design and installation of the sleeve and, therefore, are not discussed further in this SE.

3.2.4 Water Backed Applications

The proposed alternative will follow Section 4 of the code case in the water backed applications.

Paragraph 4(a) of the code case requires manual welding of the sleeve on water backed piping using the shield metal arc welding process and low hydrogen electrodes.

Paragraph 4(b) of the code case requires installation of a gasket or sealant beneath the sleeve when welding a sleeve to a leaking area. Section 5 of the relief request specifies that when gasket material is used in accordance with paragraph 4(b) of the code case in water-backed applications, any residual moisture will be removed by heating prior to welding.

Paragraph 4(c) of the code case requires that for piping materials other than P-No. 1 Group 1, the surface examination of welds will be performed no sooner than 48 hours after completion of welding.

3.2.5 Installation

The proposed alternative will follow the installation requirements in Section 5 of the code case.

Paragraph 5(e) of the code case requires that weld metal be deposited using a groove-welding procedure qualified in accordance with the ASME Code, Section IX and the Construction Code.

Paragraph 5(d) of the code case requires that if welding is performed on a wet surface, the maximum permitted life of the sleeve will be the time until the next refueling outage.

Paragraph 5(g) of the code case requires that provision for venting during the final closure weld or pressure testing shall be made if necessary. The proposed alternative clarified that for the Type B sleeve, small branch connections may be needed for venting, injecting hardenable filler, or system leakage test connections.

The NRC staff determined the remaining paragraphs of Section 5 provide generally accepted practices of piping repair and are not discussed further in this SE.

3.2.6 Examination

The proposed alternative will follow Section 6, Examination, of the code case which provides requirements for the acceptance examination of installed sleeves.

Paragraph 6(a) of the code case requires that all welds be examined using the liquid penetrant or magnetic particle method and shall satisfy the surface examination acceptance criteria for welds of the Construction Code or the ASME Code, Section III (NC-5300 or ND-5300).

The NRC staff determined the remaining paragraphs of Section 6 provide generally accepted industry inspection procedures and are not discussed further in this SE.

3.2.7 Pressure Testing

The proposed alternative will follow Section 7, Pressure Testing, of the code case which requires that a system leakage test be conducted after the repair in accordance with the ASME Code, Section XI IWA-5000 prior to, or as part of, returning to service. For the Type B sleeve, pressure taps shall be installed for pressure testing.

3.2.8 Inservice Examination

The proposed alternative will follow Section 8, Inservice Examination, of the code case. In addition, the proposed alternative provided the following additional requirements and clarifications.

Paragraph 8(a) requires preservice and inservice examination be performed on full-structural Type B sleeves in accordance with the ASME Code, Section XI, IWC-2000 or IWD-2000.

Paragraph 8(c) of the code case states that the owner shall prepare a plan to repeat the thickness monitoring inspections at least every refueling outage, to verify that minimum design thicknesses required by the Construction Code or ASME Code, Section III, are not violated in the sleeve or at the attachment welds, including the underlying base metal.

Paragraph 8(c)(1) of the code case requires more frequent inspections of the thickness when warranted by the degradation rate. Paragraph 8(c)(2) requires physical access to inspect full-structural Type B sleeves.

In addition, Entergy stated that: (1) it will perform a baseline thickness examination for completed full-structural Type B reinforcing sleeves, attachment welds, and surrounding areas; (2) it will implement the thickness monitoring inspections of full-structural Type B sleeves at every refueling outage; (3) it will schedule more frequent thickness monitoring, when appropriate, based on degradation rates that are calculated using the reductions in thicknesses observed between scheduled thickness monitoring inspections; (4) it will continue to monitor and evaluate wall thickness of any full-structural Type B sleeve inservice after the end of the ISI intervals; and (5) it will remove any degraded full-structural Type B sleeve prior to infringing upon design minimum wall thickness.

Section 5 of the relief request states that when used on buried piping, the area of full-structural Type B reinforcing sleeves must be physically accessible for the required examinations which could necessitate installation of removable barriers at the repair location in lieu of backfilling the pipe at that location. If a buried piping system carrying radioactive fluid was repaired by the proposed alternative, Entergy stated that it will monitor and detect radioactive fluid leakage in accordance with the standard plant monitoring practices for all buried piping containing radioactive fluids. Entergy stated that it will follow Nuclear Energy Institute (NEI) 07-07, "Industry Ground Water Protection Initiative-Final Guidance Document," dated August 2007, in addition to monitoring the buried pipe in accordance with the code case.

Paragraph 8(d) of the code case requires visual monitoring on a monthly basis for evidence of leakage in Type A sleeve and partial-structural Type B sleeve repairs. If the areas containing these sleeves are not accessible for direct observation, monitoring will be accomplished by visual assessment of surrounding areas or ground surface areas above the sleeves on buried piping, or monitoring of leakage collection systems, if available.

In the December 4, 2015, submittal, Entergy responded to the NRC staff's question on the adequacy of the inspections to detect potential cavitation in a repaired pipe. Entergy stated that the inservice inspection monitoring requirements in Section 8 of the code case apply to all degraded conditions including cavitation. For Type A and partial-structural Type B sleeves, the proposed alternative requires visual monitoring at least monthly and the maximum service life of these reinforcement sleeves is the time to the end of the next refueling outage. For Type B full-structural sleeves, the proposed alternative requires that thickness monitoring be performed at least every refueling outage. More frequent thickness monitoring will be performed when warranted by the observed degradation rates. In all cases, the design thickness is required to be maintained at least until the performance of the next scheduled thickness inspection.

Entergy stated that the maximum service life of these reinforcement sleeves is determined by the design. Entergy concludes that the inspection requirements in Section 8 of Code Case N-786-1 provide high assurance that piping repaired due to cavitation will not fail or degrade below minimum design thickness requirements. In performing thickness monitoring, Entergy intends to use ultrasonic thickness measuring techniques unless direct measurement is feasible and more accurate.

The NRC staff determined the remaining paragraphs of Section 8 provide generally accepted requirements and are not discussed further in this SE.

3.2.9 Hardship Justification

Entergy stated that the proposed alternative provides technically sound temporary repairs in the form of reinforcing sleeves where there is inadequate time for evaluation, design, material procurement, planning and scheduling of an appropriate permanent repair or replacement, due to the impact on system availability, maintenance rule applicability, or availability of replacement materials. Additionally, the proposed alternative provides technically sound long-term repairs configured to permit on-going degradation monitoring, equal to or exceeding the level of quality and safety associated with permanent ASME Code repairs or replacements. The alternative in some cases could necessitate extending technical specification actions to install a permanent repair/replacement, putting the plant at higher safety risks than warranted compared with the short time necessary to install a technically sound sleeve repair. Entergy further stated that without the use of this code case in some situations, it may be necessary to shut the plant down in order to perform an ASME code repair/replacement activity; however, this results in an unnecessary plant transient and the loss of safety system availability as compared to maintaining the plant online.

3.3 Duration of Proposed Alternative

Entergy stated that the proposed alternative is for the remainder of each plant's 10-year inspection interval as specified in Table 1 above. Installation of reinforcing sleeves in accordance with this relief request cannot take place after the end of the 10-year ISI interval for the unit. Any Type A and partial-structural Type B reinforcing sleeves installed before the end of the 10-year ISI interval will be removed during the next refueling outage, even if that refueling outage occurs after the end of the 10-year ISI interval.

3.4 NRC Staff's Evaluation

The NRC staff considered Entergy's proposed alternative to consist precisely of the code case, which has not been approved for use by the NRC, and the modifications as discussed above. For clarity, the NRC staff's review of the proposed alternative will follow the organizational structure of the code case. The NRC staff's review of this relief request is limited to the context of the Entergy fleet as shown in Table 1 above and does not constitute a generic review of the code case.

3.4.1 General Requirements

Entergy proposed no modifications to Section 1, *General Requirements*, of the code case.

The NRC staff finds acceptable that the design, material, and installation of the sleeve will follow the ASME Code, Section XI, IWA-4000 and IWA-4150.

The NRC staff notes that paragraph 1(e) of the code case limits the repair to piping that is not required to be examined by ultrasonic examination to be of significance as ultrasonic examinations may not provide reliable results when performed through sleeves once they are installed on a pipe. Therefore, the NRC staff finds the limitation imposed by paragraph 1(e) acceptable.

Paragraph 1(f) of the code case prohibits the application of reinforcing sleeves to pumps, valves, expansion joints, vessels, heat exchangers, tubing, flanges, flanged joints, socket welded or threaded joints, or branch connection welds. The NRC staff finds these limitations acceptable because the sleeve design, by its nature, is not suitable to be used in the aforementioned configurations such as pumps, valves and flanges.

The NRC staff finds that the contents of Section 1 of the code case provide reasonable assurance for the structural integrity of the pipes using the sleeve repair method.

3.4.2 Initial Evaluation

Entergy proposed no modifications to Section 2, *Initial Evaluation*, of the code case.

The NRC staff finds that paragraph 2(a) of the code case requires the extent of the initial inspection be based on the corrosion mechanism involved but will extend at least a distance of $0.75\sqrt{RT_{nom}}$ (R is the radius of the pipe and T_{nom} is the thickness) beyond the edge of any sleeve attachment weld to be a reasonable inspection distance to assure that the sleeve repair will be welded to a section of pipe with sufficient strength to support the repair.

The extent of condition assessment as required by paragraph 2(b) of the code case and further clarification by Entergy in its December 4, 2015, submittal is acceptable to the NRC staff because it provides reasonable assurance that additional degradation of similar piping will be detected.

The NRC staff finds that paragraph 2(c) of the code case provides specific guidance (i.e., the ASME Code, Section XI, IWA-4311) to evaluate the impact of the sleeve and attachment weld on the pipe. This guidance will provide evaluation consistency among nuclear plants in the sleeve repair and, therefore, is acceptable.

As the relief request stated, if the cause of the degradation is not determined, the maximum permitted service life of any reinforcing sleeve shall be the time until the next refueling outage. The NRC staff finds this limitation acceptable because it is a defense-in-depth measure to prohibit the long term use of the sleeve if the pipe degradation is unknown.

The NRC staff finds the initial evaluation requirements in Section 2 of the code case as proposed by Entergy to be acceptable.

3.4.3 Design

Entergy proposed no modifications to Section 3, *Design*, of the code case, except the additional clarification, as discussed below:

The NRC staff finds that the design as required in paragraphs 3.1(a) and 3.1(b) and additional clarification on the sleeve service life acceptable because the allowable duration for use of each type of sleeve to be consistent with the intended function described as well as initial and subsequent inspection requirements.

The NRC staff finds paragraph 3.2(a) acceptable because the sleeve design will follow the ASME Code, Section III, NC/ND-3100 and NC/ND-3600, and Section III Appendices, such as Mandatory Appendix II, in addition to the Entergy imposed limitations as discussed above.

The NRC staff finds the required corrosion rate calculation in paragraph 3.2(k) of the code case to be of critical importance to the acceptability of the proposed alternative. The NRC staff finds that: (a) the use of plant-specific, measured corrosion rates; (b) the requirement that the corrosion mechanism be determined or the repair removed at the next refueling outage; and (c) the use of a safety factor of either 2 or 4 as required in paragraph 3.2(k) of the code case will provide an adequate corrosion rate to ensure that the sleeves will perform their intended functions for either the life of the repair (Type A and partial-structural Type B) or until the next scheduled inspection (full structural Type B). The NRC staff further finds acceptable that the relief request has specified acceptance criteria to remove a degraded full structural Type B sleeve prior to either the sleeve, attachment welds, or the pipe wall beneath the attachment welds reaching the minimum design thickness as required by the Construction Code or the ASME Code, Section III.

The NRC staff finds Paragraph 3.2(o) of the code case acceptable because it permits branch connections less than 1-inch or smaller in size to be installed on sleeve only for the filling or venting purposes during installation or leakage testing of the sleeve. The NRC staff finds that the small branch connection will not affect the structural integrity of the sleeve significantly.

3.4.4 Water Backed Applications

Entergy proposed no modifications to Section 4, *Water Backed Applications*, of the code case, except the additional limitation discussed below:

Paragraph 4(a) of the code case requires that the shielded metal arc welding and low-hydrogen electrodes be used to weld the sleeves on water backed piping. The low hydrogen electrode will minimize the introduction of hydrogen in the finished weld, thereby, minimize the potential for weld cracking. Therefore, the NRC staff finds paragraph 4(a) of the code case acceptable.

For piping materials other than P-No. 1 Group 1, Entergy will perform a surface examination of welds no sooner than 48 hours after completion of welding as required in paragraph 4(c). The

NRC staff finds this requirement acceptable because 48 hours is a typical hold time for the surface examination of a completed weld.

As for paragraph 4(b) of the code case, the relief request states that Type B reinforcing sleeves may be applied to leaking systems by installing a gasket or sealant between the sleeve and the pipe, and then clamping the reinforcing sleeve halves to the piping prior to welding. If welding of any type of sleeve occurs on a wet surface, the maximum permitted life of the sleeve will be the time until the next refueling outage. The NRC staff finds that the limitation for a sleeve that is welded on a wet surface is acceptable because this limitation ensures that the sleeve repair will not cause potential degradation beyond the next refueling outage.

In addition, Entergy stated that when gasket material is used in accordance with paragraph 4(b) of the Code Case in water-backed applications, it will require removal of any residual moisture by heating prior to welding. The NRC staff finds this requirement acceptable because residual moisture, which is detrimental to welding, will be removed prior to welding.

3.4.5 Installation

Entergy proposed no modifications to Section 5, *Installation*, of the code case, except the additional conditions, as discussed below:

The NRC staff finds acceptable that if welding of any type of sleeve occurs on a wet surface, the maximum permitted life of the sleeve will be the time until the next refueling outage as stated in Paragraph 5(d) of the code case. This limitation is consistent with Section 5 of the relief request addressing welding on a wet surface as specified in paragraph 4(b) and as discussed above.

The NRC staff finds acceptable that welding of the sleeve will follow the ASME Code, Section IX and Construction Code as specified in paragraph 5(e) of the code case because Section IX provides generally accepted welding practice.

Paragraph 5(g) of the code case specifies the need for venting during the final closure weld or pressure testing. The NRC staff determines that the limitation on the use of branch connections for the above stated purposes to 1-inch normal pipe size or smaller as specified in paragraph 3.2(o) of the code case to be reasonable because the limitation on branch connection size is needed to minimize any adverse loadings from the branch connection to affect the structural integrity of the installed sleeve.

3.4.6 Examination

Entergy proposed no modifications to Section 6, *Examination*, of the code case, which provides requirements for the acceptance examination of the repaired pipe immediately after the sleeve installation.

The proposed alternative will follow the requirements of the Construction Code or ASME Code, Section III, in the acceptance examination of the installed sleeve and will disposition any examination results accordingly as stated in paragraph 6(a) of the code case. Therefore, the NRC staff finds the acceptance examination is adequate to provide reasonable assurance of the structural integrity of the repaired pipe and, therefore, is acceptable.

3.4.7 Pressure Testing

Entergy proposed no modifications to Section 7, *Pressure Testing*, of the code case. The NRC staff finds that the proposed pressure testing is acceptable because it is consistent with IWA-5000 of the ASME Code, Section XI.

3.4.8 Inservice Examination

Entergy proposed no modifications to Section 8, *Inservice Examination*, of the code case.

The NRC staff finds that Entergy will: (1) examine the full-structural Type B sleeve, attachment weld and underling base metal every refueling outage to ensure that minimum required thickness per the Construction Code or the ASME Code, Section III, is not violated; (2) perform more frequent inspections of the thickness when warranted by the degradation rate; (3) make physically accessible for the inspection of the buried pipe after repaired by a full-structural Type B sleeve; (4) continue to monitor and evaluate wall thickness of any full-structural Type B sleeve inservice after the end of the ISI intervals; and (5) remove the full-structural Type B sleeve prior to infringing upon design minimum wall thickness.

The NRC staff determined that the proposed ISI for the full-structural Type B sleeve is acceptable because the inspection frequency, inspection accessibility and acceptance criteria are adequate to monitor the condition of the full-structural Type B sleeve repair.

The NRC staff finds that Entergy will conduct monthly monitoring of the Type A sleeve and partial structural Type B sleeve. If these sleeve repairs are inaccessible for direct observation, Entergy may visually evaluate the surrounding area of the repaired pipe location or leakage collection system if available. The NRC staff finds that a monthly visual examination is sufficient to monitor the structural integrity and leak tightness of the Type A sleeve and partial structural Type B sleeve because these two sleeve repairs have a limited design life to the next refueling outage.

The NRC staff noted that the degradation rate caused by cavitation can be unpredictable and requires rigorous inspection. In a response dated December 4, 2015, to the NRC's request for additional information, Entergy stated that the proposed inspection regiment as discussed above is able to detect cavitation. The NRC staff finds that wall thickness measurement every refueling outage of the full-structural Type B sleeve repair and the monthly visual examination of the Type A or partial-structural Type B sleeve repair are sufficient to detect leakage from the potential cavitation.

3.4.9 Hardship Justification

The NRC staff evaluated the technical aspects of this request against the criteria contained in 10 CFR 50.55a(z)(2), i.e., the existence of a hardship or unusual difficulty without a compensating increase in quality or safety. The NRC staff finds that performing the specified ASME Code compliant repairs will result in the need for a plant shutdown or delay in startup, which may cause unnecessary plant transients and are undesirable in terms of plant safety because they increase loads on the systems and components. The NRC staff, therefore, finds

that requiring an ASME Code compliant repair is a hardship without a compensating increase in plant quality or safety.

3.4.10 Summary

The NRC staff finds that the proposed alternative will provide reasonable assurance of the structural integrity and leak tightness of the repaired pipe because: (1) The scope of sleeve application is clearly defined; (2) Entergy will design and install the sleeve in accordance with the Construction Code, and ASME Code, Sections III, IX, and XI; (3) The proposed evaluation of the degraded pipe prior to sleeve installation is adequate; (4) Welding associated with the sleeve repair will be performed in accordance with the ASME Code, Section IX and Construction Code; (5) the proposed acceptance examinations, preservice and inservice examinations are adequate to verify the pipe wall thickness and the condition of the repair; and (6) Entergy will perform pressure testing in accordance with the ASME Code, Section XI, IWA-5000.

4.0 CONCLUSION

As set forth above, the NRC staff determined that the proposed alternative provides reasonable assurance of structural integrity and leak tightness of the subject piping and that complying with the specified ASME Code requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. Accordingly, the NRC staff concludes that Entergy has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(z)(2). Therefore, the NRC staff authorizes the use of relief request RR EN-15-2 for the repair of ASME Code Class 2 and 3 moderate energy carbon steel piping at Arkansas Nuclear One, Unit 1, for the fourth and fifth 10-year inspection intervals; Arkansas Nuclear One, Unit 2, for the fourth 10-year inspection interval; Grand Gulf Nuclear Station, for the third and fourth 10-year inspection intervals; Indian Point Energy Center, Unit 2, for the fourth and fifth 10-year inspection intervals; Indian Point Energy Center, Unit 3, for the fourth 10-year inspection interval; James A. Fitzpatrick Nuclear Power Plant, for the fourth and fifth 10-year inspection intervals; Palisades Nuclear Plant, for the fourth and fifth 10-year inspection intervals; Pilgrim Nuclear Power Station, for the fifth 10-year inspection interval; River Bend Station, Unit 1, for the third and fourth 10-year inspection intervals; and Waterford Steam Electric Station, Unit 3, for the third and fourth 10-year inspection intervals.

The authorization of relief request RR EN-15-2 does not imply or infer NRC approval of ASME Code Case N-786-1.

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

Principal Contributor: J. Tsao

Date: June 6, 2016

the NRC staff authorizes the use of relief request RR EN-15-2 for the repair of ASME Code Class 2 and 3 moderate energy carbon steel piping at Arkansas Nuclear One, Unit 1, for the fourth and fifth 10-year inspection intervals; Arkansas Nuclear One, Unit 2, for the fourth 10-year inspection interval; Grand Gulf Nuclear Station, for the third and fourth 10-year inspection intervals; Indian Point Energy Center, Unit 2, for the fourth and fifth 10-year inspection intervals; Indian Point Energy Center, Unit 3, for the fourth 10-year inspection interval, James A. Fitzpatrick Nuclear Power Plant, for the fourth and fifth 10-year inspection intervals; Palisades Nuclear Plant, for the fourth and fifth 10-year inspection intervals; Pilgrim Nuclear Power Station, for the fifth 10-year inspection interval; River Bend Station, Unit 1, for the third and fourth 10-year inspection intervals; and Waterford Steam Electric Station, Unit 3, for the third and fourth 10-year inspection intervals

The authorization of relief request RR EN-15-2 does not imply or infer NRC approval of ASME Code Case N-786-1. All other ASME Code, Section XI, requirements for which relief was not specifically requested and authorized by the NRC staff will remain applicable including third-party review by the Authorized Nuclear Inservice Inspector.

If you have any questions, please contact Richard V. Guzman, Senior Project Manager, at (301) 415-1030 or Richard.Guzman@nrc.gov.

Sincerely,

/RA/

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Docket Nos. 50-313, 50-368, 50-255,
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