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

May 5, 2010

Vice President, Operations
Arkansas Nuclear One
Entergy Operations, Inc.
1448 S.R. 333
Russellville, AR 72802

SUBJECT: ARKANSAS NUCLEAR ONE, UNIT NO. 1 – REQUEST FOR RELIEF NOS. ANO1-ISI-015, ANO1-ISI-016, ANO1-ISI-017, ANO1-ISI-018, ANO1-ISI-019, AND ANO1-ISI-020 FROM ASME CODE, SECTION XI, EXAMINATION REQUIREMENTS FOR THIRD 10-YEAR INSERVICE INSPECTION INTERVAL (TAC NOS. ME1439, ME1440, ME1441, ME1442, ME1443, AND ME1444)

Dear Sir or Madam:

By letter dated May 29, 2009, and supplemented by letters dated October 28, 2009, and February 9, 2010, Entergy Operations Inc. (Entergy, the licensee), submitted Request for Relief Nos. ANO1-ISI-015, ANO1-ISI-016, ANO1-ISI-017, ANO1-ISI-018, ANO1-ISI-019, and ANO1-ISI-020 from certain inservice inspection (ISI) requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, at Arkansas Nuclear One, Unit No. 1 (ANO-1). Specifically, the licensee requested relief from certain examination coverage requirements for selected components for the third 10-year ISI interval, which began in July 1997 and ended in October 2008.

The U.S. Nuclear Regulatory Commission (NRC) staff has completed its review as documented in the enclosed Safety Evaluation. Based on a review of the information provided in your application, the NRC staff determined that compliance with the ASME Code-required examination coverage is impractical and that the achieved coverage provides reasonable assurance of structural integrity of the selected components. Therefore, pursuant to paragraph 50.55a(g)(6)(i) of Title 10 of the *Code of Federal Regulations* (10 CFR), relief is granted for the third 10-year ISI interval. The NRC staff concludes that granting relief pursuant to 10 CFR 50.55a(g)(6)(i) is authorized by law and will not endanger life or property, or the common defense and security, and is otherwise in the public interest given due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility.

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

If you have any questions, please contact Kaly N. Kalyanam, Project Manager for ANO-1, at (301) 415-1480 or by e-mail at kaly.kalyanam@nrc.gov.

Sincerely,

CF Lyon for

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

Docket No. 50-313

Enclosure:
As stated

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

# THIRD 10-YEAR INTERVAL INSERVICE INSPECTION PROGRAM

# RELIEF REQUESTS NOS. ANO1-ISI-015, ANO1-ISI-016, ANO1-ISI-017, ANO1-ISI-018, ANO1-ISI-019, AND ANO1-ISI-020

# ENTERGY OPERATIONS, INC.

# ARKANSAS NUCLEAR ONE, UNIT NO. 1

# DOCKET NO. 50-313

## 1.0 INTRODUCTION

By letter dated May 29, 2009 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML091520610), and supplemented by letters dated October 28, 2009, and February 20, 2010 (ADAMS Accession Nos. ML093070060 and ML100470758, respectively), Entergy Operations Inc. (Entergy, the licensee), pursuant to paragraph 50.55a(g)(6)(i) of Title 10 of the *Code of Federal Regulations* (10 CFR), requested relief from the inservice inspection (ISI) requirements of the American Society of Mechanical Engineers, Boiler and Pressure Vessel Code (ASME Code), Section XI, pertaining to volumetric, surface, and visual examinations at Arkansas Nuclear One, Unit 1 (ANO-1) for selected components. Relief Requests (RRs) ANO1-ISI-015, ANO1-ISI-016, ANO1-ISI-017, ANO1-ISI-018, ANO1-ISI-019, and ANO1-ISI-020 are for the third 10-year ISI interval.

The U.S. Nuclear Regulatory Commission (NRC) staff, with technical assistance from its contractor, the Pacific Northwest National Laboratory (PNNL), has reviewed and evaluated the information provided by Entergy and adopts the evaluations and recommendations for granting relief contained in PNNL's Technical Letter Report (TLR) which has been incorporated into this safety evaluation (SE). The Attachment to this SE lists each relief request and the status of approval.

## 2.0 REGULATORY EVALUATION

Inservice inspection of the ASME Code, Class 1, 2, and 3 components is to be performed in accordance with Section XI of the ASME Code, and applicable addenda, as required by 10 CFR 50.55a(g), except where specific relief has been granted by the Commission pursuant to 10 CFR 50.55a(g)(6)(i). The regulation at 10 CFR 50.55a(a)(3) states that alternatives to the requirements of paragraph (g) may be used, when authorized by the NRC, if the licensee demonstrates that (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.

Pursuant to 10 CFR 50.55a(g)(4), 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, 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 Section XI of the ASME Code, which was 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 ASME Code of record for the ANO-1's third 10-year ISI program interval, which ended in October 2008, is the ASME Code, Section XI, 1992 Edition, with portions of the 1993 Addenda as approved by the NRC.

## 3.0 TECHNICAL EVALUATION

The information provided by the licensee in support of the requests for relief from ASME Code requirements has been evaluated and the bases for disposition are documented below. For clarity, the licensee's requests have been evaluated in according to ASME Code Examination Category and corresponding request for relief.

### 3.1 Request for Relief ANO1-ISI-015, ASME Code, Section XI, Examination Category B-A, Items B1.11 and B1.21, Pressure Retaining Welds in Reactor Vessel

#### 3.1.1 ASME Code Requirement

ASME Code, Section XI, Examination Category B-A, Items B1.11 and B1.21, require essentially 100 percent volumetric examination, as defined by ASME Code, Section XI, Figures IWB-2500-1 and IWB-2500-3, respectively, of the length of reactor pressure vessel (RPV) circumferential shell and head welds. "Essentially 100 percent," as clarified by ASME Code Case N-460, "Alternative Examination Coverage for Class 1 and Class 2 Welds," is greater than 90 percent coverage of the examination volume, or surface area, as applicable. ASME Code Case N-460 has been approved for use by the NRC in Regulatory Guide 1.147, Revision 15, "Inservice Inspection Code Case Acceptability" (RG 1.147, Revision 15).

#### 3.1.2 Licensee's ASME Code Relief Request

In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from the ASME Code-required essentially 100 percent volumetric examination of ASME Code, Class 1 RPV Circumferential Lower Shell-to-Lower Head Weld 01-005 and RPV Circumferential Bottom Head Weld 01-006.

3.1.3 Licensee's Basis for Relief Request (as stated)

> Examination of weld 01-005 was limited due to the core support lugs and flow diverters on the bottom head. Very limited perpendicular and parallel coverage was achievable due to geometrical interference of the lugs and diverters. Examination of the required weld volume of weld 01-006 was limited due to twelve (12) flow diverters located on the bottom head of the vessel.
>
> To perform the [ASME] Code-required examination would require modifying and/or replacing the flow diverters.

3.1.4 Licensee's Proposed Alternative Examination

The licensee did not propose any alternative examinations for the subject welds. However, the licensee's examinations were performed to the maximum extent practical.

3.1.5 NRC Staff Evaluation

The ASME Code requires essentially 100 percent volumetric examination of pressure retaining welds in the RPV. However, the design configuration of the RPV lower shell-to-lower head circumferential weld and bottom head circumferential weld limit complete examinations due to adjacent components such as flow diverters and support lugs. In order to effectively increase the examination coverage, the RPV and adjacent components would require design modifications or replacement.

As shown in the sketches and technical descriptions included in the licensee's submittals, examinations of RPV lower shell-to-lower head circumferential weld 01-005 and RPV bottom head circumferential weld 01-006 have been performed to the extent practical, with the licensee obtaining coverage of approximately 36.4 percent and 59.1 percent, respectively. Weld 01-005 was restricted by 13 core support lugs and 12 flow diverters located on the inside of the bottom head of the RPV. Weld 01-006 could only be scanned from a limited number of areas due to the 12 flow diverters located on the inside of the bottom head. All of the examinations were conducted with equipment, procedures, and personnel that were qualified by performance demonstration in accordance with ASME Code, Section XI, Appendix VIII. The ultrasonic (UT) examinations included a 45-degree shear wave and a 45-degree refracted longitudinal wave scan. No recordable indications were detected during these examinations.

Based on the above, the NRC staff concludes that the licensee has shown that it is impractical to meet the ASME Code-required 100 percent volumetric examination coverage for the subject welds due to the geometrical design of adjacent components. To require the licensee to perform the ASME Code-required examinations would place a burden on the licensee. In addition, based on the volumetric coverage obtained in addition to the full examination of other pressure retaining RPV welds, it is reasonable to conclude that if significant service-induced degradation had occurred, evidence of it would have been detected by the examinations that were performed. Furthermore, the NRC staff concludes that the examinations performed provide reasonable assurance of structural integrity of the subject welds.

3.1.6 Summary

The NRC staff has reviewed the licensee's submittal and based on the volumetric coverage obtained on the subject welds, the staff concludes that the examinations performed to the extent practical provide reasonable assurance of structural integrity of the subject welds and if significant service-induced degradation had occurred, evidence of it would have been detected. The NRC staff concludes that ASME Code examination coverage requirements are impractical for the subject welds listed in RR ANO1-ISI-015 and the ASME Code requirements would create a burden on the licensee. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(g)(6)(i), and is in compliance with the requirements of 10 CFR 50.55a with the granting of this Relief Request.

3.2 Request for Relief ANO1-ISI-016, ASME Code, Section XI, Examination Category B-D, Item B3.110, Full Penetration Welded Nozzles in Vessels

3.2.1 ASME Code Requirement

ASME Code, Section XI, Examination Category B-D, Item B3.110 requires 100 percent volumetric examination, as defined by ASME Code, Section XI, Figure IWB-2500-7 (a) through (d), as applicable, of full penetration Class 1 pressurizer (PZR) nozzle-to-vessel welds. ASME Code Case N-460, as an alternative approved for use by the NRC in RG 1.147, Revision 15, states that a reduction in examination coverage due to part geometry or interference for any Class 1 and 2 weld is acceptable provided that the reduction is less than 10 percent (i.e., greater than 90 percent examination coverage is obtained).

3.2.2 Licensee's ASME Code Relief Request

In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from the ASME Code-required volumetric examinations of ASME Code, Class 1 PZR nozzle-to-vessel welds listed in Table 3.2.1 below.

**Table 3.2.1 – ASME Code, Section XI, Examination Category B-D**

| ASME Code Item | Weld ID | Weld Type | Coverage Obtained |
|---|---|---|---|
| B3.110 | 05-014 | Pressurizer Relief Nozzle-to-Head Weld | 28.7% |
| B3.110 | 05-015 | Pressurizer Relief Nozzle-to-Head Weld | 28.7% |
| B3.110 | 05-021 | Pressurizer Surge Nozzle-to-Head Weld | 32.0% |

3.2.3 Licensee's Basis for Relief Request (as stated)

> Due to the geometric configuration of welds 05-014 and 05-015, which are located in the intersection (crotch area) of the pressurizer head and nozzles, the use of 45°, 60°, 70°, and 0° beam angles in the 45° axial direction and 60° in the circumferential direction were not able to achieve greater than 90% [ASME] Code required volume. Due to the outside diameter geometric configuration of weld 05-021, which is located in the crotch area between the pressurizer vessel head

and nozzle, the multi-angle [ASME] Code required coverage is very limited. No circumferential scan coverage was achievable, due to the weld location. To perform any additional [ASME] Code allowable ultrasonic examinations, modification and/or replacement of the component would be required.

3.2.4 Licensee's Proposed Alternative Examination

The licensee did not propose any alternative examinations for the subject welds. However, the licensee's examinations were performed to the maximum extent practical.

3.2.5 NRC Staff Evaluation

The ASME Code requires 100 percent volumetric examination of ASME Code, Class 1 PZR nozzle-to-vessel welds. In addition, the ASME Code requires that the volumetric examination be conducted from both sides of these pressure retaining welds. However, the design configurations of the subject nozzle-to-vessel welds limit access for UT scanning primarily to the vessel side of the welds.

The subject PZR nozzle-to-vessel welds shown in Table 3.2.1 above are constructed of carbon steel material, with stainless steel inside diameter (ID) cladding. The welds extend the full thickness of the PZR vessel. These nozzles are of the "set-in" design which essentially makes the welds concentric rings aligned parallel with the nozzle axes in the through-wall direction of the PZR vessel. This design geometry limits ASME Code-required ultrasonic angle beam examinations to be performed primarily from the vessel side of the welds. Additionally, the PZR nozzles listed in Table 3.2.1 above were also limited due to the close proximity of adjacent nozzles, welded lifting lugs, and the blend radii between the vessel head and the small bore nozzle. In order to effectively increase the examination coverage, the nozzle-to-head welds would require design modifications or replacement. Therefore, the NRC staff concludes that this would place a burden on the licensee.

As shown in the sketches and technical descriptions included in the licensee's submittals, examinations of the subject nozzle-to-vessel welds have been completed to the extent practical with aggregate coverage of the ASME Code-required volumes as listed in Table 3.2.1 above. Welds 05-014 and 05-015 were examined prior to the performance demonstration requirements outlined in ASME Code, Section XI, Appendix VIII; therefore, these examinations were conducted using ASME Code-required technical guidance at the time of the examinations. UT examinations included 0-degree longitudinal, and 45-, 60-, and 70-degree shear waves from the vessel side. The examinations for Weld 05-021 were also conducted using 45-, 60-, and 70-degree shear waves; however, equipment, procedures, and personnel that were qualified by performance demonstration according to ASME Code, Section XI, Appendix VIII, 1995 Edition with the 1996 Addenda.

The examination volumes included the weld and base materials near the inside surface of the weld joint, which are typically the highest regions of stress, and where one would expect degradation sources to be manifested should they occur. No indications were recorded during these examinations. Although UT scans were primarily limited to the vessel side only, recent studies have found that inspections conducted through carbon steel are equally effective whether the UT waves have only to propagate through the base metal, or have to also

propagate through the carbon steel weldment[1]. Therefore, due to the fine-grained carbon steel microstructures, it is expected that the UT techniques employed would have detected structurally significant flaws that may have occurred on either side of the subject welds.

Based on the above, the NRC staff concludes that the licensee has shown that it is impractical to meet the ASME Code-required 100 percent volumetric examination coverage for the subject PZR nozzle-to-vessel welds due to the nozzle designs and adjacent component obstructions. The NRC staff further concludes that to require the licensee to perform the ASME Code-required examinations would place a burden on the licensee. In addition, based on the volumetric coverage obtained for the subject welds and considering the licensee's performance of UT techniques employed to maximize this coverage, it is reasonable to conclude that if significant service-induced degradation had occurred, evidence of it would have been detected by the examinations that were performed. Furthermore, the NRC staff concludes that the examinations performed provide reasonable assurance of structural integrity of the subject welds.

3.2.6 Summary

The NRC staff has reviewed the licensee's submittal and based on the volumetric coverage obtained on the subject welds, the staff concludes that the examinations performed to the extent practical provide reasonable assurance of structural integrity of the subject welds and if significant service-induced degradation had occurred, evidence of it would have been detected. The NRC staff concludes that ASME Code examination coverage requirements are impractical for the subject welds listed in RR ANO1-ISI-016 and the ASME Code requirements would create a burden on the licensee. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(g)(6)(i), and is in compliance with the requirements of 10 CFR 50.55a with the granting of this Relief Request.

3.3 Request for Relief ANO1-ISI-017, ASME Code, Section XI, Examination Category B-G-1, Item B6.40, Pressure Retaining Bolting Greater than 2 Inches in Diameter

3.3.1 ASME Code Requirement

ASME Code, Section XI, Examination Category B-G-1, Item B6.40 requires 100 percent volumetric examination, as defined by ASME Code, Section XI, Figure IWB-2500-12, of Class 1 RPV threads-in-flange. ASME Code Case N-460, as an alternative approved for use by the NRC in RG 1.147, Revision 15, states that a reduction in examination coverage due to part geometry or interference for any Class 1 and 2 weld is acceptable provided that the reduction is less than 10 percent (i.e., greater than 90 percent examination coverage is obtained).

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[1] P. G. Heasler and S. R. Doctor, 1996. *Piping Inspection Round Robin*, NUREG/CR-5068, PNNL-10475, U.S. Nuclear Regulatory Commission, Washington, DC.

3.3.2 Licensee's ASME Code Relief Request

In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from the ASME Code-required 100 percent volumetric examination of ASME Code, Class 1 RPV threads-in-flange 01-F-01 through 01-F-60.

3.3.3 Licensee's Basis for Relief Request (as stated)

> During the [UT] examination of the threaded area in the upper [RPV] flange, 100% coverage of the required examination volume could not be obtained.
>
> Radiography [(RT)] is not practical due to the component configuration, which prevents effective placement of the film and exposure source. To perform any additional [ASME] Code allowable [UT] examination, modification and/or replacement of the component would be required.

3.3.4 Licensee's Proposed Alternative Examination

The licensee did not propose any alternative examinations for the subject welds. However, the licensee's examinations were performed to the maximum extent practical.

3.3.5 NRC Staff Evaluation

The ASME Code requires 100 percent volumetric examination of Class 1 RPV threads-in-flange. However, due to the interference of the reactor vessel head sealing surface, the coverage of the ASME Code inspection volume was limited. Achieving greater coverage on these threads would require that the RPV head sealing surface be redesigned and modified.

As shown in the sketch and technical descriptions included in the licensee's submittals, examination of RPV threads-in-flange, 01-F-01 through 01-F-60, have been performed to the extent practical, with the licensee obtaining approximately 79.0 percent of the ASME Code-required volume. The UT scanning is limited due to the raised seal surface obstructing portions of the 1-inch annular scan area of each side facing the inner diameter of the RPV. The licensee examined the subject threads using a 0 degree longitudinal wave from all unobstructed surfaces. No recordable flaw indications were observed during these examinations.

Based on the above, the NRC staff concludes that the licensee has shown that it is impractical to meet the ASME Code-required 100 percent volumetric examination coverage for RPV threads-in-flange due to the interference caused by the seal surface of the reactor vessel head. The NRC staff further concludes that to require the licensee to perform the ASME Code-required examinations would place a burden on the licensee. Based on the volumetric coverage obtained with the examination techniques applied, the staff concludes that if significant service-induced degradation had occurred, evidence of it would have been detected by the examinations that were performed. Furthermore, the NRC staff concludes that the examinations performed provide reasonable assurance of structural integrity of the subject welds.

3.3.6 Summary

The NRC staff has reviewed the licensee's submittal and based on the volumetric coverage obtained on the subject RPV threads-in-flanges, the staff concludes that the examinations performed to the extent practical provide reasonable assurance of structural integrity of the subject welds and if significant service-induced degradation had occurred, evidence of it would have been detected. The NRC staff concludes that ASME Code examination coverage requirements are impractical for the subject RPV threads-in-flanges listed in RR ANO1-ISI-017 and the of the ASME Code requirements would create a burden on the licensee. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(g)(6)(i), and is in compliance with the requirements of 10 CFR 50.55a with the granting of this Relief Request.

3.4 Request for Relief ANO1-ISI-018, Examination Category B-J, Items B9.11, B9.16, and B9.20, Class 1 Piping

3.4.1 ASME Code Requirement

The examination requirements for the subject piping welds at ANO-1 are governed by a Risk-Informed Inservice Inspection (RI-ISI) program that was approved by the NRC in a Safety Evaluation (SE) dated August 25, 1999 (ADAMS Legacy Accession No. 9908300332). The RI-ISI program was developed in accordance with Electric Power Research Institute (EPRI) Topical Report TR-112657, "Revised Risk-Informed Inservice Inspection Evaluation Procedure." As part of the NRC-approved program, the licensee has implemented inspection requirements listed in ASME Code Case N-560, "Alternative Examination Requirements for Class 1, Category B-J Piping Welds," with more detailed provisions contained in TR-112657. The topical report includes a provision for requesting relief from volumetric examinations if 100 percent of the required volumes cannot be examined.

Table 1 of ASME Code Case N-560 assigns the Examination Category B-J, Items B9.11, B9.16, and B9.20, to piping inspection elements subject to thermal fatigue, intergranular stress corrosion cracking (IGSCC), and elements not subject to a damage mechanism, respectively. This table requires 100 percent of the examination location volume, as described in Figures IWB-2500-8(c), 9, 10, or 11, as applicable, including an additional ½-inch of base metal adjacent to the ASME Code volume, be completed for selected Class 1 circumferential piping welds. ASME Code Case N-460, as an alternative approved for use by the NRC in RG 1.147, Revision 15, states that a reduction in examination coverage due to part geometry or interference for any Class 1 and 2 weld is acceptable provided that the reduction is less than 10 percent (i.e., greater than 90 percent examination coverage is obtained).

Note: By letters dated June 3, 1998 (1CAN069804) (ADAMS Legacy Accession No. 9806090341), and May 17, 1999 (1CAN059902) (ADAMS Legacy Accession No. 9905250077), Entergy requested the NRC to approve a risk-informed alternative to the 1992 Edition of the ASME Code, Section XI inspection requirements for Class 1, Category B-J piping welds. By letter and SE dated August 25, 1999, the licensee received the approval by NRC to implement an RI-ISI pilot program for the subject piping welds. In the licensee's response dated May 17, 1999, ANO-1 provided the NRC with a table which listed the weld identification number and the corresponding degradation mechanism(s). Using the damage mechanisms identified in the

table, the NRC staff has identified that the welds correspond to the following item numbers and degradation mechanisms as implemented by ASME Code Case N-560:

| Item No. | Weld ID | Degradation Mechanism |
|---|---|---|
| B9.20 | 09-001 | Elements Not Subject to Damage Mechanism |
| B9.11 | 18-010 | Elements Subject to Thermal Fatigue |
| B9.11 | 23-055 | Elements Subject to Thermal Fatigue |
| B9.16 | | Elements Subject to IGSCC |
| B9.11 | 09-006 | Elements Subject to Thermal Fatigue |

However, the examinations described in RR ANO1-ISI-018 were provided as Category B-J, Items B9.11, B9.21, and B9.31, "Pressure Retaining Welds in Piping."

For purposes of this evaluation, the item numbers and degradation mechanisms corresponding to ASME Code Case N-560 are used.

3.4.2 Licensee's ASME Code Relief Request

In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from the ASME Code-required 100 percent volumetric examination of the ASME Code, Class 1 piping welds listed below in Table 3.4.1.

**Table 3.4.1 – ASME Code, Section XI, Examination Category B-J**

| ASME Code Item | Weld ID | Weld Type | Coverage Obtained |
|---|---|---|---|
| B9.11 | 09-006 | Pipe to High Pressure Injection Nozzle Weld | 50.0% |
| B9.11 | 18-010 | Pressurizer Spray Valve-to-Pipe Weld | 50.0% |
| B9.11 or B9.16 | 23-055 | High Pressure Injection-to-B2 loop Elbow-to-Valve Weld | 41.0% |
| B9.20 | 09-001 | "D" Reactor Coolant Pump Pump-to-Pipe Weld | 50.0% |

3.4.3 Licensee's Basis for Relief Request (as stated)

> During [UT] examination of the piping welds listed in Table 1 [Table 3.4.1] above, 100% coverage of the required examination volume could not be obtained.
>
> [ASME Code,] Class 1 piping and components are often designed with welded joints such as nozzle-to-pipe, pipe-to-valve and pipe-to-pump which can physically obstruct a large portion of the required examination volume. Entergy has used the best available and EPRI [Electric Power Research Institute] approved techniques to examine the subject piping welds. To improve upon these examination coverage percentages, modification and/or replacement of the component would be required.

3.4.4 Licensee's Proposed Alternative Examination

The licensee did not propose any alternative examinations for the subject welds. However, the licensee's examinations were performed to the maximum extent practical.

3.4.5 NRC Staff Evaluation

The examination requirements for the subject ASME Code, Class 1 piping welds are governed by an RI-ISI program that was approved by the NRC in its SE dated August 25, 1999. This program requires that selected piping welds be volumetrically examined in accordance with the requirements of ASME Code Case N-560. However, the design configuration (including pump, valve, elbow, and pipe connections) of these welds limit volumetric examinations. In order to increase coverage, the welds would have to be redesigned and modified.

As shown in the sketches and technical descriptions included in the licensee's submittals, examinations of the subject welds have been performed to the extent practical with the licensee obtaining coverage ranging from 41.0 to 50.0 percent from at least one side of the weld (see Table 3.4.1 above). Various scan limitations were caused by the configuration of the welds and welded components such as pump, valve, elbow, and pipe connections. Weld 23-055 was limited further due to a welded name plate 180 degrees around the circumference of the pipe.

The UT examinations conducted by the licensee included 60-degree shear and 45-degree refracted longitudinal wave (L-wave) for Weld 09-001; 45-, 60-, and 70-degree shear wave for Weld 18-010; 70-degree shear wave for Weld 23-055; and 45-degree shear and 45-degree refracted longitudinal wave for Weld 09-006. The L-wave technique is believed capable of detecting planar ID surface-breaking flaws on the far-side of austenitic stainless steel welds. Studies[2],[3] reported in the technical literature recommend the use of both shear and L-waves to obtain the best detection results, with minimum false calls, in austenitic welds. Piping Weld 9-006 is constructed of carbon steel material with stainless steel cladding. Although UT scans were primarily limited to the pipe side, studies have found that inspections conducted through carbon steel are equally effective whether the ultrasonic waves have only to propagate through the base metal, or have to also propagate through the carbon steel weldment.[4] All of the examinations were conducted with equipment, procedures, and personnel that were qualified by performance demonstration in accordance with ASME Code, Section XI, Appendix VIII. No recordable indications were observed during these UT examinations.

Based on the above, the NRC staff concludes that the licensee has shown that it is impractical to meet the ASME Code-required volumetric examination coverage for the subject welds due to

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2 F.V. Ammirato, X. Edelmann, and S. M. Walker, 1987. "Examination of Dissimilar Metal Welds in BWR Nozzle-to-Safe End Joints," 8th International Conference on NDE in the Nuclear Industry, ASM International.

3 P. Lemaitre, T. D. Koble, and S. R. Doctor, 1995. "PISC III Capability Study on Wrought-to-Wrought Austenitic Steel Welds: Evaluation at the Level of Procedures and Techniques," Effectiveness of Nondestructive Examination Systems and Performance Demonstration, PVP-Volume 317, NDE-Volume 14, American Society of Mechanical Engineers.

4 P. G. Heasler and S. R. Doctor, 1996. *Piping Inspection Round Robin*, NUREG/CR-5068, PNNL-10475, U.S. Nuclear Regulatory Commission, Washington, DC.

the design geometry of the welds and to require the licensee to perform the ASME Code-required examinations would place a burden on the licensee. Based on the volumetric coverage obtained and considering the full examination of other pressure retaining piping welds, the NRC staff concludes that if significant service-induced degradation had occurred in the subject welds, evidence of it would have been detected by the examinations performed. Furthermore, the NRC staff concludes that the examinations performed provide reasonable assurance of structural integrity of the subject welds.

3.4.6 Summary

The NRC staff has reviewed the licensee's submittal and based on the volumetric coverage obtained on the subject welds, the staff concludes that the examinations performed to the extent practical provide reasonable assurance of structural integrity of the subject welds and if significant service-induced degradation had occurred, evidence of it would have been detected. The NRC staff concludes that ASME Code examination coverage requirements are impractical for the subject welds listed in RR ANO1-ISI-018 and the ASME Code requirements would create a burden on the licensee. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(g)(6)(i), and is in compliance with the requirements of 10 CFR 50.55a with the granting of this Relief Request.

3.5 Request for Relief ANO1-ISI-019, ASME Code, Section XI, Examination Category B-K, Item B10.20, Integral Attachments for Class 1 Vessels, Piping, Pumps, and Valves

3.5.1 ASME Code Requirement

ASME Code, Section XI, Examination Category B-K, Item B10.20 requires essentially 100 percent surface examination, as defined by ASME Code, Section XI, Figures IWB-2500-13, IWB-2500-14, and IWB-2500-15, as applicable, of selected integrally welded attachments to Class 1 components. "Essentially 100 percent", as clarified by ASME Code Case N-460, is greater than 90 percent coverage of the examination volume, or surface area, as applicable. ASME Code Case N-460 has been approved for use by the NRC in RG 1.147, Revision 15.

Note: During the third ISI interval, the licensee invoked ASME Code Case N-509, "Alternative Rules for the Selection and Examination of Class 1, 2, and 3 Integrally Welded Attachments," which replaces Category B-H, Integral Attachments for Vessels, and Category B-K-1, Integral Attachments for Piping, Pumps, and Valves, in Table IWB 2500-1 with Category B-K, Integral Attachments for Class 1 Vessels, Piping, Pumps and Valves. ASME Code Case N-509 has been approved for use by the NRC in RG 1.147, Revision 13 subject to the following condition in addition to those conditions specified in the Code Case: A minimum 10 percent sample of integrally welded attachments for each item in each code class per interval should be examined. ANO-1 has met this condition and, therefore, the subject request for relief has been evaluated using ASME Code Case N-509, Category B-K.

3.5.2 Licensee's ASME Code Relief Request

In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from the ASME Code-required 100 percent surface examination of Pipe Support Integral Attachment Weld 22-099W.

3.5.3 Licensee's Basis for Relief Request (as stated)

> During surface examination of the pipe support integral attachment weld, 100% coverage of the required examination area could not be obtained.
>
> The configuration of the subject component is a round piece of steel plate, which has been placed around a pipe and integrally welded in place. The plate is then placed within a box-type pipe support that is structurally anchored to a wall, serving to restrain the pipe from horizontal motion. [Due] to the configuration of this integral attachment, and associated pipe support, access to the weld and surrounding base material, for examination, is very limited. In order to perform any type of additional [ASME] Code examination, modification and/or replacement of the component would be required.

3.5.4 Licensee's Proposed Alternative Examination

The licensee did not propose any alternative examinations for the subject weld. However, the licensee's examination was performed to the maximum extent practical.

3.5.5 NRC Staff Evaluation

The ASME Code requires 100 percent surface examination of ASME Code, Class 1 piping integral attachment welds. However, surface examination for the subject weld is limited due to the configuration of the integral attachment and the piping support design. In order for the licensee to obtain 100 percent of the ASME Code-required surface examination coverage, the integral attachment weld would have to be redesigned and modified.

As shown in the sketch and technical descriptions included in the licensee's submittals, the liquid penetrant surface examination of Pipe Support Integral Attachment Weld 22-099W has been performed to the extent practical, with the licensee obtaining 38.5 percent of the ASME Code-required surface coverage. The box type piping support hanger physically limits access to the entire upstream side and portions of the downstream side of the weld and surrounding base materials. No reportable indications were detected during the surface examination.

Based on the above, the NRC staff concludes that it is impractical to meet the ASME Code-required surface examination coverage for the subject ASME Code, Class 1 piping integral attachment weld. The NRC staff further concludes that to require the licensee to perform the ASME Code-required examinations would place a burden on the licensee. In addition, based on the surface coverage obtained, it is reasonable to conclude that if significant service-induced degradation had occurred, evidence of it would be have been detected by the examinations that were performed. Furthermore, the NRC staff concludes that the

examinations performed provide reasonable assurance of structural integrity of the subject welds.

3.5.6 Summary

The NRC staff has reviewed the licensee's submittal and based on the surface coverage obtained on the subject welds, the staff concludes that the examinations performed to the extent practical provide reasonable assurance of structural integrity of the subject welds and if significant service-induced degradation had occurred, evidence of it would have been detected. The NRC staff concludes that ASME Code examination coverage requirements are impractical for the subject welds listed in RR ANO1-ISI-019 and the Code requirements would create a burden on the licensee. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(g)(6)(i), and is in compliance with the requirements of 10 CFR 50.55a with the granting of this Relief Request.

3.6 Request for Relief ANO1-ISI-020, ASME Code, Section XI, Examination Category F-A, Item F1.40, Supports (TAC No. ME1444)

3.6.1 ASME Code Requirement

ASME Code, Section XI, Examination Category F-A, Item F1.40 requires 100 percent visual VT-3 examination, as defined by ASME Code, Section XI, Figures IWF-1300-1 of selected Class 1, 2, 3, and MC supports other than piping supports. ASME Code Case N-460, as an alternative approved for use by the NRC in RG 1.147, Revision 15, states that a reduction in examination coverage due to part geometry or interference for any Class 1 and 2 weld is acceptable provided that the reduction is less than 10 percent (i.e., greater than 90 percent examination coverage is obtained).

3.6.2 Licensee's ASME Code Relief Request

In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from the ASME Code-required 100 percent visual examination of the RPV supports listed below in Table 3.6.1.

**Table 3.6.1 – ASME Code, Section XI, Examination Category F-A**

| ASME Code Item | Weld ID | Weld Type | Coverage Obtained |
|---|---|---|---|
| F1.40 | 01-032 | RPV Support Skirt Circumferential Weld | 0.0% |
| F1.40 | 01-033 | RPV Support Skirt-to-Flange Weld | 70.0% |
| F1.40 | 01-034 | RPV Support Skirt Flange Bolting | 70.0% |

3.6.3 Licensee's Basis for Relief Request (as stated)

> During visual examination of the [RPV] Support Skirt and associated welds and bolting listed in Table [3.6.1 above] of this relief request, 100% coverage of the required examination surface could not be obtained.

These components are located in an area that is very confining, congested with incore instrumentation piping and general area radiation dose rates are 500 to 600 millirem per hour (mr/hr). Access to the components is approximately 12 feet above the floor level. Limited access and high dose rates make it impractical to erect safe scaffolding to remove the insulation panels allowing better access to the components.

3.6.4 Licensee's Proposed Alternative Examination

The licensee did not propose any alternative examinations for the subject weld. However, the licensee's examination was performed to the maximum extent practical.

3.6.5 NRC Staff Evaluation

The ASME Code requires 100 percent visual examination of Class 1 RPV support skirt welds and flange bolting. However, visual examinations are limited due to inaccessibility caused by their design and surrounding environment. In order for the licensee to obtain 100 percent of the ASME Code-required examination coverage, the reactor vessel support skirt welds and bolting would have to be redesigned and modified.

The visual VT-3 examinations on the RPV support skirt flange weld and bolting have been performed to the extent practical, with the licensee obtaining approximately 70.0 percent of the ASME Code-required visual coverage. The support skirt flange weld and bolting were examined remotely using a fiberscope deployed through cut-outs in the support skirt. The fiberscope was negotiated between the insulation and the support skirt flange, sole plate and pedestal in a very narrow opening, as shown from the sketch provided in the licensee's submittal. No reportable indications were detected during these visual VT-3 examinations other than light rust on the bolting which is acceptable per the ASME Code.

As shown in the sketch and technical descriptions included in the licensee's submittals, the visual examination of the RPV Support Skirt Circumferential Weld 01-032 could not be performed due to insulation blocks surrounding the weld, which would require scaffold building and insulation removal in a high radiation area that is congested with incore instrumentation piping. The fiberscope was incapable of being deployed for Weld 01-032 due to the location being an additional 90-degree turn, and approximately 13 inches, above the narrow access hole. The positioning of the fiberscope relative to the weld would not have provided a satisfactory distance or viewing angle necessary to perform a qualified visual VT-3 examination.

Based on the above, the NRC staff concludes that the licensee has shown that it is impractical to meet the ASME Code-required visual VT-3 examination coverage for the subject RPV supports and to require the licensee to perform the ASME Code-required examinations would place a burden on the licensee. Based on the visual coverage obtained, the NRC staff concludes that if significant service-induced degradation had occurred, evidence of it would be have been detected by the examinations that were performed with the inspections that were performed being a surrogate for the inspection of Weld 01-032. Furthermore, the NRC staff concludes that the examinations performed provide reasonable assurance of structural integrity of the subject welds.

3.6.6 Summary

The NRC staff has reviewed the licensee's submittal and based on the visual coverage obtained, the staff concludes that the examinations performed to the extent practical provide reasonable assurance of structural integrity of the RPV supports and if significant service-induced degradation had occurred, evidence of it would have been detected. The NRC staff concludes that ASME Code examination coverage requirements are impractical for the subject welds listed in RR ANO1-ISI-020 and the ASME Code requirements would create a burden on the licensee. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(g)(6)(i), and is in compliance with the requirements of 10 CFR 50.55a with the granting of this Relief Request.

4.0 CONCLUSIONS

The NRC staff has reviewed the licensee's submittal and concludes that ASME Code examination coverage requirements are impractical for the subject welds listed in RRs ANO1-ISI-015, ANO1-ISI-016, ANO1-ISI-017, ANO1-ISI-018, ANO1-ISI-019, and ANO1-ISI-020. Furthermore, imposition of these ASME Code requirements would create a burden on the licensee. The NRC staff further concludes that based on the volumetric and surface coverage obtained on the subject welds, it is reasonable to conclude that if significant service-induced degradation had occurred, evidence of it would have been detected by the examinations that were performed. Furthermore, the NRC staff concludes that examinations performed to the extent practical provide reasonable assurance of structural integrity of the subject welds.

Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(g)(6)(i), and is in compliance with the requirements of 10 CFR 50.55a with the granting of these reliefs. Therefore, the NRC staff grants relief for the subject examinations of the components contained in RRs ANO1-ISI-015, ANO1-ISI-016, ANO1-ISI-017, ANO1-ISI-018, ANO1-ISI-019, and ANO1-ISI-020 for ANO-1 for the third 10-year ISI interval, which began in July 1997 and ended in October 2008. The staff has further concluded that granting relief pursuant to 10 CFR 50.55a(g)(6)(i) is authorized by law and will not endanger life or property, or the common defense and security, and is otherwise in the public interest given due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility.

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

Principal Contributors: T. McLellan
C. Nove

Date: May 5, 2010

Attachment

**TABLE 1**
**SUMMARY OF RELIEF REQUESTS**
**Arkansas Nuclear One, Unit No. 1**
**Third 10-Year ISI Interval**

| Relief Request Number | TLR RR Sec. | System or Component | Exam. Category | Item No. | Volume or Area to be Examined | Required Method | Licensee Proposed Alternative | Relief Request Disposition |
|---|---|---|---|---|---|---|---|---|
| ANO1-ISI-015 | 3.1 | Pressure Retaining Welds in Reactor Vessel | B-A | B1.11<br>B1.21 | 100 percent of Class 1 RPV circumferential shell and head welds | Volumetric | Use volumetric coverage achieved | Granted<br>10 CFR<br>50.55a(g)(6)(i) |
| ANO1-ISI-016 | 3.2 | Full Penetration Welded Nozzles in Vessels | B-D | B3.110 | 100 percent of Class 1 PZR nozzle-to-vessel welds | Volumetric | Use volumetric coverage achieved | Granted<br>10 CFR<br>50.55a(g)(6)(i) |
| ANO1-ISI-017 | 3.3 | Pressure Retaining Bolting, Greater Than 2 Inches in Diameter | B-G-1 | B6.40 | 100 percent of Class 1 RPV Threads in Flange | Volumetric | Use volumetric coverage achieved | Granted<br>10 CFR<br>50.55a(g)(6)(i) |
| ANO1-ISI-018 | 3.4 | Class 1 Piping | B-J | B9.11<br>B9.16<br>B9.20 | 100 percent of Class 1 piping welds subject to a thermal fatigue, IGSCC, and elements not subject to a damage mechanism, respectively | Volumetric | Use volumetric coverage achieved | Granted<br>10 CFR<br>50.55a(g)(6)(i) |
| ANO1-ISI-019 | 3.5 | Integral Attachments for Class 1 Vessels, Piping, Pumps, and Valves | B-K | B10.20 | 100 percent of Class 1 Integrally Welded Attachment for Piping | Surface | Use surface coverage achieved | Granted<br>10 CFR<br>50.55a(g)(6)(i) |
| ANO1-ISI-020 | 3.6 | Supports | F-A | F1.40 | 100 percent of Class 1, 2, 3 and MC Supports Other Than Piping Supports | Visual | Use visual coverage achieved | Granted<br>10 CFR<br>50.55a(g)(6)(i) |

Attachment

If you have any questions, please contact Kaly N. Kalyanam, Project Manager for ANO-1, at (301) 415-1480 or by e-mail at kaly.kalyanam@nrc.gov.

Sincerely,

/RA by Carl F. Lyon for/

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

Docket No. 50-313

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