



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

August 10, 2011

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 USE OF NON-ASME CODE REPAIR TO SERVICE WATER PIPING IN ACCORDANCE WITH GENERIC LETTER 90-05, RELIEF REQUEST ANO1-R&R-016 (TAC NO. ME6107)

Dear Sir/Madam:

On June 23, 2010, Entergy Operations, Inc. (Entergy, the licensee), identified on Arkansas Nuclear One, Unit 1 (ANO-1), operating at 100 percent power, a through-wall leak of approximately two to four drops per minute in a section of service water (SW) system piping. Entergy performed ultrasonic testing (UT) non-destructive examinations to characterize the affected area and prepared evaluations in accordance with U.S. Nuclear Regulatory Commission (NRC) Generic Letter (GL) 90-05, "Guidance for Performing Temporary Non-Code Repair of ASME [American Society of Mechanical Engineers Boiler and Pressure Vessel] Code Class 1, 2, and 3 Piping," dated June 15, 1990. By letter dated March 29, 2011, Entergy submitted Relief Request ANO1-R&R-015 in which the licensee requested relief in accordance with paragraph 50.55a(a)(3)(i) of Title 10 of the *Code of Federal Regulations* (10 CFR) for a temporary non-Code repair to the ANO-1 SW system. The NRC staff granted the verbal authorization of this request on April 1, 2011.

As the licensee was preparing to perform the repair, a UT of the area of the proposed attachment weld identified an additional pit, approximately 2.7 inches away from the leaking pit. Since this new pit was in the area to be welded and the wall thickness was measured to be 0.089 inches, the repair process was stopped and the plan was re-evaluated. Verbal authorization of the additional repair for Relief Request ANO1-R&R-016 was granted on April 21, 2011.

As a result of the re-evaluation, the licensee determined that the March 29, 2011, relief request needed to be revised, and by letter dated April 20, 2011, submitted to the NRC for approval, Relief Request ANO1-R&R-016 with the revised weld pad thickness calculation and the latest non-destructive examination report.

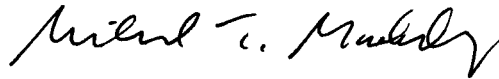
The NRC staff concludes that Entergy has demonstrated that compliance with performing an ASME Code repair of the subject degraded pipe during the current operating cycle would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. The staff also concludes that the proposed temporary non-Code repair provides reasonable assurance that the structural integrity of the subject pipe will be maintained. In accordance with GL 90-05, temporary non-Code repairs are applicable until the next scheduled outage exceeding 30 days, but no later than the next scheduled refueling outage. Therefore, pursuant to

10 CFR 50.55a(a)(3)(ii), the staff authorizes the use of Relief Request ANO1-R&R-016 for the temporary non-Code repair of degraded service water supply line to the reactor building cooling coils at ANO-1. Relief Request ANO1-R&R-016 is authorized for use up to the next scheduled outage exceeding 30 days, but no later than the next refueling outage, which is currently scheduled for the fall of 2011.

All other requirements in ASME Code, Sections III and XI; United States of America Standards (USAS) B31.1; American National Standards Institute (ANSI) B31.1; Code Case N-661-1; and GL 90-05 for which relief was not specifically requested and approved in this relief request remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

The NRC staff's safety evaluation is enclosed. If you have any questions, please contact Kaly Kalyanam at (301) 415-1480 or via e-mail at [kaly.kalyanam@nrc.gov](mailto:kaly.kalyanam@nrc.gov).

Sincerely,

A handwritten signature in black ink, appearing to read "Michael T. Markley".

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

Docket No. 50-313

Enclosure:  
Safety Evaluation

cc w/encl.: Distribution via Listserv



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

SAFETY EVALUATION BY THE OFFICE NUCLEAR REACTOR REGULATION

RELIEF REQUEST ANO1-R&R-016

TEMPORARY NON-CODE REPAIR OF SERVICE WATER PIPING

ENTERGY OPERATIONS, INC.

ARKANSAS NUCLEAR ONE, UNIT 1

DOCKET NO.50-313

1.0 INTRODUCTION

By letter dated April 20, 2011 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML11111A195), Entergy Operations, Inc. (the licensee), submitted Relief Request ANO1-R&R-016 for the U.S. Nuclear Regulatory Commission (NRC) review and approval. This request addresses a temporary non-Code repair of a 10-inch diameter service water (SW) supply line (HBD-45-10") to the reactor building cooling coils at Arkansas Nuclear One, Unit 1 (ANO-1). The licensee requested relief from the requirements of IWA-4000 of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code. The licensee proposed to install a steel plate over a small pinhole area of the degraded pipe. Relief Request ANO1-R&R-016 is a revision of Relief Request ANO1-R&R-015 the licensee submitted on March 29, 2011 (ADAMS Accession No. ML110950446). Relief Request ANO1-R&R-016 supersedes Relief Request ANO1-R&R-015 in its entirety. The difference between the two submissions is a revision to the design of the temporary non-Code repair.

On April 21, 2011, the NRC staff verbally authorized the use of Relief Request ANO1-R&R-016, which was documented in a memorandum dated May 10, 2011 (non-publicly available). This safety evaluation documents the NRC staff's basis for the verbal authorization.

2.0 REGULATORY EVALUATION

Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) paragraph 50.55a(g)(4), ASME Code Class 1, 2, and 3 components (including supports) must 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 of Nuclear Power Plant Components," to the extent practical within the limitations of design, geometry, and materials of construction of the components.

Pursuant to 10 CFR 50.55a(a)(3), alternatives to requirements may be authorized by the NRC if the licensee demonstrates that: (i) the proposed alternatives provide an acceptable level of

Enclosure

quality and safety, or (ii) compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

The regulations in 10 CFR 50.55a(b)(2)(xx)(B) are applicable to the proposed relief request and require that the nondestructive examination (NDE) provisions in IWA-4540(a)(2) of the ASME Code, Section XI, 2002 Addenda, be applied when performing system leakage tests after repair and replacement activities performed by welding or brazing on a pressure retaining boundary using the 2003 Addenda through the latest edition and addenda incorporated by reference in 10 CFR 50.55a.

NRC Generic Letter (GL) 90-05, "Guidance for Performing Temporary Non-Code Repair of ASME Code Class 1, 2, and 3 Piping," is applicable to the proposed relief request as it provides requirements of root cause determination, flaw characterization and evaluation, and inspections for the temporary non-Code repair of degraded piping.

The Code of record for the fourth inservice inspection (ISI) interval at ANO-1 is the ASME Code, Section XI, 2001 Edition with the 2003 Addenda of ASME Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components."

### 3.0 RELIEF REQUEST ANO1-R&R-016

#### 3.1 ASME Code Component(s) Affected

The degraded pipe is the SW supply line, HBD-45-10", to the reactor building cooling coils VCC-2C/D. This is classified as American National Standards Institute (ANSI) B31.1 piping; however, the licensee treated it as ASME Code Class 3 piping for the purpose of applying the inspection, repair/replacement and pressure testing requirements of ASME Code, Section XI.

#### 3.2 Applicable Code Edition and Addenda

1. ASME Code, Section XI, 2001 Edition with the 2003 Addenda (ISI Code of record)
2. Piping Construction Code United States of American Standards (USAS) B31.1, 1967 and Summer Addenda of B31.1.b 1973 (Original Construction Code)
3. ASME Code, B31.1, 1989 Edition (Installation Code of record)
4. ASME Code Section III, 1992 Edition / No Addenda (NDE)
5. ASME Code Case N-661-1, "Alternative Requirements for Wall Thickness Restoration of Class 2 and 3 Carbon Steel Piping for Raw Water Service," Section XI, Division 1

### 3.3 Applicable Code Requirement

The following ASME Code, Section XI, requirements are applicable to this relief request.

IWA-4411, which requires, in part, that "...Welding, brazing, and installation shall be performed in accordance with the Owner's Requirements and...in accordance with Construction Code of the item...".

IWA-4412, which requires, in part, that "...[d]efect removal shall be accomplished in accordance with IWA-4420.

IWA-4422.1, which requires, in part, that "...[a] defect is considered removed when it has been reduced to an acceptable size..."

### 3.4 Proposed Alternative and Basis for Use

The licensee proposes to weld a reinforcing plate over the degraded area of the pipe to include all locations where the minimum wall thickness is less than 0.280 inches. The design drawing is shown in Attachment 3 of the licensee's letter dated April 20, 2011. The attachment weld will be installed using the methodology of Code Case N-661-1, "Alternative Requirements for Wall Thickness Restoration of Class 2 and 3 Carbon Steel Piping for Raw Water Service, Section XI, Division 1." As stated by the licensee in its letter dated April 20, 2011,

Minor surface conditioning will be required on an original construction code weld in order to obtain as near as practical metal to metal contact between the reinforcing plate and existing base material. [During the welding process, to] keep the weld area dry and moisture from encroaching near the reinforcing plate weld, sealant will be utilized around and/or over the leakage location to form a leakage barrier.

### 3.5 Duration of Proposed Alternative

The duration of the temporary repair is limited, in accordance with GL 90-05, until the next scheduled outage exceeding 30 days, but no later than the next refueling outage, which is currently scheduled for the fall of 2011.

## 4.0 NRC Staff Evaluation

### 4.1 Background

On June 23, 2010, while at 100 percent power, the licensee identified a leakage of approximately two to four drops per minute through a flaw in a horizontal section of the SW supply line. The leak rate has not changed appreciably since that time.

By letter dated March 31, 1999 (ADAMS Legacy Accession No. 9904020241), the licensee obtained a generic relief request that allows application of GL 90-05 without a specific relief request on certain SW lines, including HBD-45-10". As a result of the current leak, the licensee

examined the pipe wall thickness of the affected area using ultrasonic testing (UT) and evaluated the results in accordance with GL 90-05 as part of its operability evaluation. The licensee also expanded its inspection to five additional pipe locations in accordance with GL 90-05 and did not find any unacceptable degradation at those five locations. Based on these results, and in accordance with GL 90-05 and the previously granted relief request, the licensee's temporary repair consisted of monitoring the leak through the use of UT inspections every 90 days. During the third 90-day reinspection, the licensee used a smaller grid and a 0.2-inch diameter ultrasonic transducer and observed a change in the data pertaining to the thickness of the flawed area. As a result of the change in the inspection results, the licensee proposed to perform the temporary non-Code repair of the degraded pipe described below.

The licensee requested relief from IWA-4411, IWA-4412, and IWA-4422.1 of the ASME Code, Section XI, to allow the defect not to be removed. In lieu of performing an ASME Code repair, the licensee proposed to perform a temporary non-Code repair by welding a reinforcing plate to the affected area of the degraded pipe.

#### 4.2 Design Specifications

The degraded pipe is Schedule 40 (0.365-inch wall thickness), seamless, A-53 Grade B carbon steel. The repair plate will be constructed from a section of seamless pipe fabricated with either A-106 Grade B, or A-53 Grade B material. These materials are P-No. 1 carbon steel and have an allowable stress of 15,000 pounds per square inch up to 650 degrees Fahrenheit.

The licensee will design the welded plate repair in accordance with USAS B31.1, 1967 Edition and the Summer Addenda to ANSI B31.1, 1973. The minimum plate thickness is calculated based on requirements of ANSI B31.1 and Code Case N-661-1. The attachment weld is designed using the methodology of Code Case N-661-1.

The licensee attributed the root cause of the subject degradation to microbiological corrosion (MIC) based on the location of the defect and the UT inspections of the degraded area. MIC is typically a pitting corrosion mechanism that grows outward (vertically) and not in the circumferential direction. The minimum plate thickness is designed considering the MIC corrosion rate. Historical data collected for MIC rates in SW piping at ANO-1 indicates that the maximum corrosion pit rate is 0.012-inch per year. The minimum required wall thickness included a corrosion allowance of 0.011-inch prior to replacement activities (i.e., from April 2011 to the fall 2011). The licensee used a 0.011-inch corrosion allowance to ensure that the growth of the flawed area will not encroach on the edges of the repair pad. In addition, the plate is sized to cover the entire thinned area, plus an additional ½-inch in length and width. The plate and attachment weld were sized to bound the growth of degradation. The new pressure boundary will be located at the reinforcing plate attachment weld.

The reinforcing plate is welded to the degraded pipe using the shielded metal arc welding process with low-hydrogen E7018-covered electrodes in accordance with ASME Code Case N-661-1. If rejectable indications are identified during installation, the indications will be removed and the attachment weld repaired in accordance with applicable provisions of Code Case N-661-1, ASME Code, Section XI, and ASME B31.1. The licensee will implement welding requirements specified for fabrication, installation, and repair of affected piping in accordance

with ASME B31.1, 1989 Edition. All welders and welding procedure specifications will be qualified for groove welding in accordance with the ASME Code, Section XI.

The NRC staff notes that Code Case N-661-1 is accepted with two conditions in NRC Regulatory Guide 1.147, Revision 16, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," October 2010 (ADAMS Accession No. ML101800536). The two conditions are (1) if the cause of the degradation has not been determined, the repair is only acceptable until the next refueling outage, and (2) when through-wall repairs are made by welding on surfaces that are wet or exposed to water, the weld overlay repair is only acceptable until the next refueling outage. The licensee satisfies these two conditions because the proposed temporary non-Code repair is effective up to the fall 2011 refueling outage. The licensee will repair the degraded pipe per the ASME Code, Section XI, during the fall 2011 refueling outage. The NRC staff concludes that the design of the repair plate and the attachment weld is based on the requirements of Code Case N-661-1, ANSI B31.1, and GL 90-05. The plate is welded to the degraded pipe in accordance with ASME B31.1, ASME Code, Section XI, and Code Case N-661-1. The proposed design specifications are, therefore, acceptable.

#### 4.3 Non-Destructive Examinations

Before installation, the licensee will examine the affected area using straight-beam UT to ensure that the attachment weld for the reinforcing plate is located in areas of sound base metal with wall thickness of 0.28-inch or greater. After installation, the licensee will examine the attachment weld surrounding the reinforcing plate using the magnetic particle (MT) or liquid penetrant (PT) method in accordance with Code Case N-661-1. Nondestructive examination will comply with ASME Code, Section III, Division 1, 1992 Edition, Subsection ND, and, therefore, comply with 10 CFR 50.55a(b)(2)(xx)(B). The licensee will also perform a system leakage test in accordance with the ASME Code, Section XI, IWA-5000, before returning the subject pipe to service.

After the repaired pipe is placed in service, the licensee will perform monthly UT over the first 3 months and, if no unexpected degradation is identified, UTs will then be performed at least once every 3 months for the balance of the duration of this relief request. The licensee will visually examine the repaired pipe during daily walk-downs. This piping is not insulated and is accessible for visual inspection.

The inservice examination will include the repair plate, attachment weld, and surrounding base material using UT. The licensee will examine a maximum 2-inch by 2-inch grid over the affected area, which will cover the reinforcing plate and the flat portion of the attachment weld. The licensee will inspect the intersection points in the grid using straight-beam UT and an initial baseline UT data will be established. Subsequent UT results will be evaluated to verify that the structural integrity of the repaired pipe is maintained through the remainder of the current operating cycle.

The licensee will calculate an average corrosion rate based on the point-to-point comparison between the current and the previous inspections. If (1) the average corrosion rate exceeds the predicted corrosion rate (i.e., 0.011-inch prior to replacement activities), (2) the results indicate

that the structural margins required by Code Case N-661-1 will be exceeded before the end of the current fuel cycle, or (3) an unacceptable weld anomaly during reinforcing plate installation is detected, the licensee will implement additional repair and/or replacement activities before reaching the limits of the Code Case. These repair and/or replacement activities will be consistent either with the requirements of this relief request, or the requirements of the ASME Code, Section XI, Subsection IWA-4000. The licensee stated that it will request NRC approval before performing any additional non-Code repair.

The NRC staff concludes that the licensee's NDE for the temporary non-Code repair is consistent with the examination requirements of Code Case N-661-1 and GL 90-05 to ensure the structural integrity of the subject piping and is, therefore, acceptable.

#### 4.4 Hardship

The SW system consists of two independent, full-capacity, 100-percent redundant loops. Each SW loop is capable of supplying cooling water to the required components during normal and emergency conditions. This redundancy allows continued plant operation when a single component failure occurs. ANO-1 Technical Specification (TS) 3.7.7, "Service Water System (SWS)," requires that two SW loops be operable and powered from independent essential buses to provide redundant and independent flow paths.

The licensee stated that implementing an ASME Code repair during the current operating cycle would require removing the degraded section of piping from service, which is not desired because it does not result in a compensating increase in the level of quality or safety. The affected piping section would require the entire SW loop to be secured and drained. While the ANO-1 TS permits 72 hours to effect repairs to the system, doing so would result in the loss of an entire train of emergency core cooling components during the 72-hour repair window. In addition, isolation and draining of an SW loop during power operation is complex and would expend a significant portion of the 72-hour allowed outage period. The NRC staff concludes that the basis for hardship is, therefore, acceptable.

#### 5.0 CONCLUSION

The NRC staff concludes that the licensee has demonstrated that compliance with performing an ASME Code repair of the subject degraded pipe during the current operating cycle would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. The staff concludes also that the proposed temporary non-Code repair provides reasonable assurance that the structural integrity of the subject pipe will be maintained until the fall of 2011. Pursuant to 10 CFR 50.55a(a)(3)(ii), the staff authorizes the use of Relief Request ANO1-R&R-016 for the temporary non-Code repair of degraded SW supply line to the reactor building cooling coils at ANO-1. Relief Request ANO1-R&R-016 is authorized for use up to the next scheduled refueling outage exceeding 30 days, but no later than the next refueling outage, which is scheduled for the fall of 2011.



All other requirements in ASME Code, Sections III and XI; USAS B31.1; ANSI B31.1; Code Case N-661-1; and GL 90-05 for which relief was not specifically requested and approved in this relief request remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

Principal Contributor: J. Tsao

Date: August 10, 2011

10 CFR 50.55a(a)(3)(ii), the staff authorizes the use of Relief Request ANO1-R&R-016 for the temporary non-Code repair of degraded service water supply line to the reactor building cooling coils at ANO-1. Relief Request ANO1-R&R-016 is authorized for use up to the next scheduled outage exceeding 30 days, but no later than the next refueling outage, which is currently scheduled for the fall of 2011.

All other requirements in ASME Code, Sections III and XI; United States of America Standards (USAS) B31.1; American National Standards Institute (ANSI) B31.1; Code Case N-661-1; and GL 90-05 for which relief was not specifically requested and approved in this relief request remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

The NRC staff's safety evaluation is enclosed. If you have any questions, please contact Kaly Kalyanam at (301) 415-1480 or via e-mail at [kaly.kalyanam@nrc.gov](mailto:kaly.kalyanam@nrc.gov).

Sincerely,

/RA/

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

Docket No. 50-313

Enclosure:  
Safety Evaluation

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**ADAMS Accession No. ML111710798**

\*SE memo date with minor editorial changes

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