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

March 22, 2018

Mr. John Dent, Jr.
Vice President-Nuclear and CNO
Nebraska Public Power District
72676 648A Avenue
Brownville, NE 68321

SUBJECT: COOPER NUCLEAR STATION – REQUEST NO. RI-21, REVISION 1 – REQUEST FOR RELIEF CONCERNING EXAMINATIONS FOR THE FOURTH 10-YEAR INSERVICE INSPECTION INTERVAL (CAC NO. MF9623; EPID L-2017-LLR-0026)

Dear Mr. Dent:

By letter dated March 29, 2017 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17109A071), as supplemented by letter dated November 30, 2017 (ADAMS Accession No. ML17345A150), Nebraska Public Power District (the licensee) submitted a request to the U.S. Nuclear Regulatory Commission (NRC) for relief from certain American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI requirements at the Cooper Nuclear Station (CNS).

Specifically, the licensee requested relief from certain examination requirements of ASME Code, Section XI, for specified Code Class 1 and 2 vessel and piping components due to the design configuration of the welds and/or access restrictions. Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) paragraph 50.55a(g)(5)(iii), the licensee requested relief and to use alternative requirements, if necessary, for inservice inspection items on the basis that the code requirement is impractical.

The NRC staff has reviewed the subject request and concludes, as set forth in the enclosed safety evaluation, that granting relief pursuant to 10 CFR 50.55a(g)(6)(i) is authorized by law, will not endanger life or property or the common defense and security, and is otherwise in the public interest, giving due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility. Furthermore, the staff concluded that the examinations performed, to the extent practical, provide reasonable assurance of structural integrity of the subject components. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(g)(5)(iii). Therefore, the NRC grants relief from the full-scope volumetric examination requirements of the ASME Code, Section XI, for the Class 1 and 2 components addressed in Request No. RI-21, Revision 1. This relief applies to the fourth 10-year inservice inspection program interval, which began on March 1, 2006, and ended on March 31, 2016.

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

If you have any questions, please contact Thomas Wengert at 301-415-4037 or by e-mail at Thomas.Wengert@nrc.gov.

Sincerely,

Robert J. Pascarelli, Chief
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-298

Enclosure:
Safety Evaluation

cc: Listserv

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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELIEF REQUEST NO. RI-21, REVISION 1 REGARDING

EXAMINATION COVERAGE FOR ASME CODE CLASS 1 AND 2 COMPONENTS

NEBRASKA PUBLIC POWER DISTRICT

COOPER NUCLEAR STATION

DOCKET NO. 50-298

1.0 INTRODUCTION

By letter dated March 29, 2017 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17109A071), as supplemented by letter dated November 30, 2017 (ADAMS Accession No. ML17345A150), Nebraska Public Power District (the licensee), submitted Request No. RI-21 (RI-21), Revision 1, to the U.S. Nuclear Regulatory Commission (NRC) for relief from certain American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (ASME Code), Section XI requirements at the Cooper Nuclear Station (CNS).

Specifically, pursuant to the requirements of Title 10 of the *Code of Federal Regulations* (10 CFR), paragraph 50.55a(g)(5)(iii), the licensee requested relief to use alternative requirements for inservice inspection (ISI) items on the basis that the code requirement is impractical. The licensee requested relief from the volumetric examination coverage requirements of the ASME Code, Section XI, for the fourth 10-year ISI interval at CNS due to the design configuration of the welds and/or access restrictions.

2.0 REGULATORY EVALUATION

Pursuant to 10 CFR 50.55a(g)(4), "Inservice inspection standards requirement for operating plants," ISI of 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 ISI interval and subsequent intervals comply with the latest edition and addenda of Section XI of the ASME Code, which was incorporated by reference in 10 CFR 50.55a(a)(1)(ii), 12 months prior to the start of the 120-month interval, subject to the limitations and modifications listed therein.

The regulation in 10 CFR 50.55a(g)(5)(iii), "ISI program update: Notification of impractical ISI Code requirements," states:

> If a licensee has determined that conformance with a Code requirement is impractical for its facility, the licensee must notify the NRC and submit, as specified in § 50.4, information to support the determinations. Determinations of impracticality in accordance with this section must be based on the demonstrated limitations experienced when attempting to comply with the Code requirements during the inservice inspection interval for which the request is being submitted. Requests for relief made in accordance with this section must be submitted to the NRC no later than 12 months after the expiration of the initial or subsequent 120-month inspection interval for which relief is sought.

The regulation in 10 CFR 50.55a(g)(6)(i), "Impractical ISI requirements: Granting of relief," states:

> The Commission will evaluate determinations under paragraph (g)(5) of [Section 50.55a] that Code requirements are impractical. The Commission may grant such relief and may impose such alternative requirements as it determines are authorized by law, will not endanger life or property or the common defense and security, and are otherwise in the public interest giving due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility.

Based on the above, and subject to the following technical evaluation, the NRC staff finds that regulatory authority exists for the licensee to request and the NRC to grant relief and impose such alternative requirements as it determines are authorized by law, will not endanger life or property or the common defense and security, and are otherwise in the public interest giving due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility.

3.0 TECHNICAL EVALUATION – CLASS 1 AND 2 VESSEL ITEMS

3.1 The Licensee's Relief Request for Class 1 and 2 Vessel Items

Code of Record for CNS

The Code of Record for the fourth 10-year ISI interval at CNS was the 2001 Edition through 2003 Addenda of the ASME Code, Section XI, as conditioned by 10 CFR 50.55a, "Codes and standards." The fourth 10-Year ISI interval began on March 1, 2006 and ended on March 31, 2016.

Reactor Pressure Vessel and Residual Heat Removal Heat Exchanger Components Covered by Request No. RI-21, Revision 1

The following tables list the ASME Code, Section XI, Code Class 1 reactor pressure vessel (RPV) and Class 2 residual heat removal (RHR) heat exchanger (HX) components that are addressed in RI-21, Revision 1. The components are listed based on the nomenclature in Tables IWB-2500-1 and IWC-2500-1, "Examination Categories" of the ASME Code, Section XI, for ASME Code Class 1 and 2 components, respectively, and include the plant-specific component identifications provided in the relief request. The limited-scope volumetric

examination coverages reported in the relief request are listed below and are specified as a percent of the full-scope volumetric exam required by the applicable Code Item Number listed in Tables IWB-2500-1 or IWC-2500-1. All limited-scope vessel exams were performed using ultrasonic testing (UT) method.

Table 1: Class 1, Table IWB-2500-1, Examination Category B-D, Full Penetration Welded Nozzles in Vessels, Item No. B3.90, RPV Nozzle-to-Vessel Welds, Item No. B3.100, RPV Nozzle Inside Radius Section (All RPV Nozzles)

ASME Code Item, Licensee Component	Description of Items with Limited Coverage (Section of RI-21, Revision 1, Describing Limitations and Coverage Calculations)	Examination Method, Reported Coverage	Examination Limitations
Item No. B3.90, NVE-BD-N1A	One RPV N1 Nozzle-to-Shell Weld, Recirculation Outlet, 28 inch (Section 2.0 of RI-21, Revision 1)	UT, 25.76 percent (%)	Geometric, Design Configuration
Item No. B3.90, NVE-BD-N2C NVE-BD-N2E NVE-BD-N2F NVE-BD-N2G NVE-BD-N2H NVE-BD-N2J NVE-BD-N2K	Seven RPV N2 Nozzle-to-Shell Welds, Recirculation Inlets, 12 inch (Section 3.0 of RI-21, Revision 1)	UT, 37.36%	Geometric, Design Configuration
Item No. B3.90, NVE-BD-N3A	One RPV N3 Nozzle-to-Shell Weld, Main Steam Outlet, 24 inch (Section 4.0 of RI-21, Revision 1)	UT, 27.85%	Geometric, Design Configuration
Item No. B3.90, NVE-BD-N4A NVE-BD-N4B NVE-BD-N4C NVE-BD-N4D	Four RPV N4 Nozzle-to-Shell Welds, Reactor Feedwater, 12 inch (Section 5.0 of RI-21, Revision 1)	UT, 36.8% for Nozzles A & C. UT, 39% for Nozzles B & D	Geometric, Design Configuration
Item No. B3.90, NVE-BD-N5A	One RPV N5 Nozzle-to-Shell Weld, Core Spray Inlet, 12 inch inside diameter (ID) (Section 6.0 of RI-21, Revision 1)	UT, 31.05%	Geometric, Design Configuration
Item No. B3.90, NVE-BD-N6B	One RPV N6B Nozzle-to-Head Weld, Top Head Spray, 5.75 inch ID (Section 7.0 of RI-21, Revision 1)	UT, 18.52%	Geometric, Design Configuration
Item No. B3.90, NVE-BD-N7	One RPV N7 Nozzle-to-Head Weld, Top Head Vent, 3.81 inch ID (Section 8.0 of RI-21, Revision 1)	UT, 59.09%	Geometric, Design Configuration
Item No. B3.90, NVE-BD-N9	One RPV N9 Nozzle-to-Shell Weld, Control Rod Drive (CRD) Return, 5 inch (Section 9.0 of RI-21, Revision 1)	UT, 37.48%	Geometric, Design Configuration
Item No. B3.100, NVIR-BD-N9	One RPV N9 Nozzle Inside Radius Section, CRD Return, 5 inch (Section 10.0 of RI-21, Revision 1)	UT, 78.46%	Geometric, Design Configuration

Table 2: Class 1, Table IWB-2500-1, Examination Category B-G-1, Pressure Retaining Bolted Connections Greater than 2-inch Diameter, Item No. B6.40, Threads in RPV Flange

ASME Code Item, Licensee Component	Description of Items with Limited Coverage (Section of RI-21, Revision 1 Describing Limitations and Coverage Calculations)	Examination Method, Reported Coverage	Examination Limitations
Item No. B6.40, PRE-BG1-1 through PRE-BG1-52	RPV Flange – 52 Threaded Stud Holes. Code-required exam volume includes 1-inch annular region surrounding each of 52 threaded stud holes. (Section 11.0 of RI-21, Revision 1)	UT, 82.54%	Geometric, Design Configuration

Table 3: Class 2, Table IWC-2500-1, Examination Categories C-A, Pressure Retaining Welds in Pressure Vessels, and C-B, Pressure Retaining Nozzle Welds in Pressure Vessels

ASME Code Item, Licensee Component	Description of Items with Limited Coverage (Section of RI-21, Revision 1 Describing Limitations and Coverage Calculations)	Examination Method, Reported Coverage	Examination Limitations
Exam. Category C-A, Item No. C1.10, RHR-CA-2A	One RHR HX No. 1A Shell-to-Distributor Ring End Plate Weld (Section 13.0 of RI-21, Revision 1)	UT, 40.52%	Geometric, Design Configuration
Exam. Category C-B, Item No. C2.21, RHR-CB-1A	One RHR HX No. 1A Nozzle-to-Top Head Weld, 20-inch Schedule 80 Pipe (Section 14.0 of RI-21, Revision 1)	UT, 65.14%	Geometric, Design Configuration

Code Requirements and NRC-Approved Code Cases

For Class 1 components, the ASME Code, Section XI, Table IWB-2500-1, Examination Category B-D, Item No. B3.90, requires essentially 100 percent volumetric examination of the RPV nozzle-to-vessel welds (RPV nozzle-to-shell and nozzle-to-head welds) based on the examination volume defined in Figure IWB-2500-7(a), (b), or (c) of the Code, as applicable for the nozzle design. The licensee reported that CNS performed the Item No. B3.90 RPV nozzle-to-vessel weld examinations addressed in RI-21, Revision 1, using the applicable alternative examination volume defined in ASME Code Case N-613-1, "Ultrasonic Examination of Penetration Nozzles in Vessels, Examination Category B-D, Item Nos. B.10 and B3.90, Reactor Nozzle-to-Vessel Welds, Figs. IWB-2500-7(a), (b), and (c), Section XI, Division 1," Figure 1 or 2. ASME Code Case N-613-1 is approved by the NRC staff for use without conditions in Table 1 of Regulatory Guide (RG) 1.147, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," Revision 18, March 2017 (ADAMS Accession No. ML16321A336). The ASME Code, Section XI, Table IWB-2500-1, Examination Category B-D, Item No. B3.100, requires essentially 100 percent volumetric examination of the RPV nozzle inside radius section; the examination volume for the inside radius section is shown in Figure IWB-2500-7(a), (b), or (c) of the ASME Code, as applicable for the nozzle design. Table IWB-2500-1, Examination Category B-G-1, Item No. B6.40, requires volumetric examination of the threads in the RPV flange, as shown in Figure IWB-2500-12 of the ASME Code.

For Class 2 components, which includes the RHR HXs at CNS, Table IWC-2500-1, Examination Category C-A, Item No. C1.10, requires volumetric examination of the vessel shell circumferential welds, as shown in Figure IWC-2500-1. Table IWC-2500-1, Examination Category C-B, Item No. C2.21, requires volumetric and surface examination of the vessel nozzle-to-shell or nozzle-to-head welds, as shown in Figure IWC-2500-4.

For all Class 1 and 2 components addressed in RI-21, Revision 1, the licensee stated that it applied ASME Code Case N-460, "Alternative Examination Coverage for Class 1 and Class 2 Welds, Section XI, Division 1," which is unconditionally approved by the NRC staff per Table 1 of RG 1.147, Revision 18. ASME Code Case N-460 specifies that when the entire examination volume or area cannot be examined due to interference by another component or part geometry, a reduction in examination coverage on any Class 1 or Class 2 weld may be accepted provided the reduction in coverage for that weld is less than 10 percent. Therefore, a volumetric or surface examination coverage of greater than 90 percent is considered acceptable for meeting Code requirements without the need for relief, based on the application of ASME Code Case N-460.

Licensee's Basis for Relief

In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee identified that the submittal of RI-21, Revision 1, was necessary based on its determination that compliance with Code requirements for achieving essentially 100 percent volumetric coverage of the items listed above is impractical for CNS, considering the actual demonstrated limitations experienced when attempting to comply with these requirements. The licensee noted that the construction permit for CNS was issued on June 4, 1968, prior to the effective implementation date for the ASME Code, Section XI ISI requirements; thus, the plant was not specifically designed to meet the 100 percent examination coverage requirements for ISI. The licensee provided detailed descriptions of component access restrictions and calculations of the limited examination coverages. In all cases, the limited coverages were due to component geometry and design configuration, which restricted scanning using qualified UT methods. However, the licensee noted that when this situation occurred, 100 percent of the accessible volume was examined.

For the RPV nozzle-to-vessel welds and the nozzle inside radius section addressed in RI-21, Revision 1, the licensee identified that the design of the nozzles, the design of the vessel insulation support rings and their attachments, location of nozzle access hatches, and other configurational issues prevented essentially 100 percent volumetric examination coverage.

For the threads in the RPV closure flange, where the ASME Code requires volumetric examination of the 1-inch annular region surrounding each of the 52 threaded stud holes, the licensee identified that the design of stainless steel step-up on the RPV flange surface prevents full examination coverage.

For the RHR HX No. 1A vessel shell-to-distributor ring end plate weld, the licensee stated that the design of this CNS weld joint is different from that shown in Figure IWC-2500-1 of the ASME Code. The licensee noted that this plant-specific design limits the examination coverage because it is a corner type of weld joint, and the inside surface is not accessible.

For the RHR HX No. 1A nozzle-to-head weld, the licensee stated the CNS design is a full penetration weld joint that is beveled on the inside and outside surfaces of the HX. This plant-specific design limits the volumetric examination from the outside surface of this weld, and

the inside surface is not accessible. The licensee reported that the Code-required surface examination was completed for 100 percent of this weld.

The licensee stated that the components addressed in this relief request would have to be physically modified beyond their design in order to satisfy the ASME Code requirement for obtaining essentially 100 percent (i.e., greater than 90 percent) volumetric examination coverage. The licensee noted that it is not possible to obtain ultrasonic interrogation of greater than 90 percent for the subject components without extensive design modifications, which would impose a significant burden. The licensee reported that the limited-scope volumetric examinations have been performed to the maximum extent possible. Therefore, the licensee determined that obtaining essentially 100 percent volumetric coverage of these components is impractical for CNS.

Licensee's Proposed Alternative and Basis for Use

The licensee identified that its proposed alternative consists of the following:

- Performing limited scope UT examinations to the maximum extent possible, and performing the Code-required 100 percent surface examination of the Class 2 RHR HX nozzle weld, as reported above.

- The licensee reported that periodic system pressure tests and associated VT-2 visual examinations for pressure boundary leakage are performed in accordance with the ASME Code, Section XI, Examination Category B-P, for Class 1 pressure retaining components each refueling outage; and Examination Category C-H for Class 2 pressure retaining components each inspection period (i.e., every 3 to 4 years).

The licensee reported that the limited-scope volumetric exams addressed in RI-21, Revision 1, were performed using UT procedures, equipment, and personnel that were qualified in accordance with the requirements of the 2001 Edition of the ASME Code, Section XI, Appendix VIII, "Performance Demonstration for Ultrasonic Examination Systems," and applicable Performance Demonstration Initiative requirements, as conditioned by 10 CFR 50.55a.

The licensee reported that there is no plant-specific or industry operating experience regarding potential degradation specific to the components addressed in this relief request. For the Class 1 RPV nozzles and threaded regions of the RPV flange, the licensee noted that even though the design restrictions described above precluded achieving essentially 100 percent volumetric examination coverage, there are systems in place to assure that early detection of any reactor coolant pressure boundary leakage is identified, such as leakage monitoring systems inside the drywell and associated technical specification surveillance requirements.

The licensee concluded that its proposed alternative, consisting of limited scope volumetric examinations with no relevant indications, as well as the Code-required system leakage tests and leakage monitoring systems as described in the relief request, provide for an acceptable level of quality and safety and reasonable assurance of component structural integrity at CNS.

3.2 NRC Staff Evaluation Concerning Class 1 and 2 Vessel Components

In accordance with 10 CFR 50.55a(g)(6)(i), the NRC staff independently evaluated the licensee's determination under 10 CFR 50.55a(g)(5)(iii) that the ASME Code, Section XI volumetric examination requirements are impractical for the subject ASME Code Class 1 and 2 components addressed in RI-21, Revision 1. The NRC staff's technical review specifically addressed information provided in the request regarding the following:

(a) Information describing component geometries and design configurations, which resulted in limited examination coverage;

(b) Component material specifications and product forms, including weld materials, base metals, and RPV inside surface cladding material, as applicable;

(c) Figures illustrating UT scan directions, beam angles, and calculation of the limited examination coverages; and

(d) Reporting of limited scope examination results (i.e., relevant indications or lack thereof).

The NRC staff's technical evaluation for each of the subject components follows the ASME Code, Section XI nomenclature (e.g., "Examination Category B-D, Item No. B3.90," etc.) for ASME Code Class 1 and 2 components and includes the plant-specific component identifications provided in the relief request, consistent with Tables 1, 2, and 3 in Section 3.1 of this safety evaluation (SE).

Limited Examination Coverages for Class 1 Examination Category B-D, Item No. B3.90, RPV Nozzle-to-Vessel Welds (Sections 2.0 through 9.0 of Request No. RI-21, Revision 1)

Item No. B3.90 requires essentially 100 percent volumetric examination for all full penetration RPV nozzle-to-vessel welds using the applicable examination volume specified in Figure IWB-2500-7(a), (b), or (c) of the ASME Code. The licensee reported significant limitations in the examination coverages for the RPV nozzle welds, as listed above in Table 1 of this SE. All of the RPV nozzle welded joints addressed in RI-21, Revision 1, were scanned manually from the outside of the RPV using conventional UT methods that were qualified in accordance with Appendix VIII of the ASME Code, Section XI.

The licensee described how the UT scans for the subject RPV nozzle welds were limited based on component design and plant configuration. The NRC staff reviewed this information and verified that the inherent geometry (i.e., curvature) of the welded joints and actual obstacles (i.e., other components) generally restricted nozzle weld coverage by the UT probe. For each of the subject RPV nozzle welds, the staff reviewed the licensee's figures depicting the limited coverages that were achieved for each of the UT scan directions and UT probe beam angles. The staff verified that these figures adequately identified the geometric restrictions or other obstacles that prevented full coverage in each scan direction.

The NRC staff verified that the CNS RPV, including the welded RPV nozzle joints, were not specifically designed to satisfy the ISI examination coverage requirements of the ASME Code, Section XI, because the ASME Code, Section III design-basis edition for the CNS RPV, predates the earliest ASME Code, Section XI requirements for ISI. Therefore, the staff determined that the ASME Code, Section XI requirement for essentially 100 percent examination coverage (equivalent to greater than 90 percent, per ASME Code Case N-460) is

impractical for the subject RPV nozzle welds at CNS, and it was necessary for the licensee to request relief from the volumetric examination coverage requirements of the ASME Code, Section XI, in accordance with 10 CFR 50.55a(g)(5)(iii).

The licensee reported that it used ASME Code Case N-613-1 for the limited-scope RPV nozzle weld exams addressed in RI-21, Revision 1. ASME Code Case N-613-1 allows for a reduction in the required RPV nozzle weld examination volume from that shown in ASME Code, Figure IWB-2500-7(a), (b), or (c), which corresponds to the weld plus base metal out to one-half of the RPV shell thickness on either side of the weld to the reduced volume shown in Figures 1, 2, or 3 of the Code Case, which corresponds to the weld plus base metal out to one-half inch on either side of the weld. For the RPV nozzle welds addressed in RI-21, Revision 1, the licensee stated that the limited-scope examination volumes were either "determined" or "redetermined" from ASME Code Case N-613-1. Based on some inconsistencies in the submittal associated with this statement, the NRC staff requested that the licensee explain how it applied ASME Code Case N-613-1 for calculating the limited-scope RPV nozzle weld exam volumes that are reported in RI-21, Revision 1. This issue was addressed in request for additional information (RAI) 4 and is documented below.

For several of the RPV nozzle welds addressed in RI-21, Revision 1, the licensee reported limited-scope examination coverages that had decreased from those that were previously approved by the NRC staff for an earlier version of this fourth ISI interval relief request. Specifically, in its January 12, 2010, SE (ADAMS Accession No. ML093521350) for Request No. RI-21, Revision 0, which was submitted by letter dated February 16, 2009 (ADAMS Accession No. ML090540420), the NRC staff previously granted relief for limited-scope weld exams for Nozzle N1A (recirculation outlet), Nozzles N2E, N2H, N2K (recirculation inlets), Nozzle N3A (main steam), and Nozzle N5A (core spray). The staff identified that these same RPV nozzle welds are now addressed again for the fourth ISI interval in RI-21, Revision 1. The NRC staff noted that both the 2009 submittal and the staff's 2010 SE for RI-21, Revision 0, identify that CNS performed these limited scope exams using the alternative examination volume defined in ASME Code Case N-613-1. However, the submittal for RI-21, Revision 1, states that the exams for Revision 0 were based on the full scope exam volume corresponding to one-half of the RPV shell thickness on either side of the weld, as defined in ASME Code, Figure IWB-2500-7.

Based on these inconsistencies, the NRC staff requested that the licensee document the reason for the decrease in the reported limited-scope exam coverages within the fourth interval. In addition, for the other RPV nozzle welds addressed in RI-21, Revision 1 that were not previously approved in RI-21, Revision 0, the staff determined that the licensee did not adequately address how the application of ASME Code Case N-613-1 for the fourth ISI interval would result in significantly lower exam coverages than those reported for the third ISI interval. Therefore, in RAI-4 the staff requested that the licensee resolve these issues for each of the RPV nozzle welds addressed in RI-21, Revision 1, as follows:

RAI-4, Part a (RAI-4a): For RPV nozzle weld exam limitations that were previously approved for RI-21, Revision 0, the NRC staff requested that the licensee identify whether the limited-scope UT exams that were performed for these nozzle welds, as reported and approved per RI-21, Revision 0, are the same limited exams documented in RI-21, Revision 1.

In response to RAI-4a by letter dated November 30, 2017, the licensee positively identified that the limited UT exams for these nozzle welds are the same for both RI-21, Revision 0 and RI-21, Revision 1. The licensee stated that the limited exam coverages for these RPV nozzle welds

were recalculated for RI-21, Revision 1, based on the UT exams that were conducted earlier in the fourth ISI interval and previously approved per RI-21, Revision 0. The licensee stated that the recalculated exam coverages for these nozzles were reported in RI-21, Revision 1, along with the limited exam coverages for the other RPV nozzles that were examined later in the interval.

RAI-4b: The NRC staff requested that the licensee explain how the changes to the limited exam coverages were determined for the nozzles that were previously approved for RI-21, Revision 0, taking into consideration the following:

1) Changes to the definition of the full scope (i.e., 100 percent) exam volume, as specified in Figure IWB-2500-7 of the ASME Code versus ASME Code Case N-613-1; or

2) Changes to the methodology used for crediting exam coverage based on the qualified UT techniques.

In its response to RAI-4b by letter dated November 30, 2017, the licensee stated that, due to questions regarding the definition of the full scope (100 percent) exam volumes specified in both ASME Code, Figure IWB-2500-7(a), and that provided in Figure 1 of ASME Code Case N-613-1, the licensee requested that ASME clarify the full exam volume requirements for the particular design of the CNS RPV nozzles. The licensee identified that ASME responded with Code Interpretation No. XI-1-10-40, which clarified that the full scope exam volumes defined in both the ASME Code and ASME Code Case N-613-1 figures, extend from the weld bevel on the RPV shell side of the weld, whereas the earlier CNS limited nozzle weld exam volumes reported in RI-21, Revision 0, were determined based on a full scope exam volume that extends from the weld toe on the RPV shell side.

The licensee also identified that there is a typographical error throughout the submittal for RI-21, Revision 1, where the discussion of RI-21, Revision 0, limited exam coverages for Nozzles N1A, N2E, N2H, N2K, N3A, and N5A incorrectly identified one-half of the RPV shell thickness (i.e., "1/2T") as the extent of the required full scope exam volume on either side of the weld. The licensee stated that this value should have been reported as "1/2 inch" for the required full scope exam volume on either side of the weld, based on the application of ASME Code Case N-613-1. The licensee explained that the changes to the way it applied the definition of the full-scope volume in ASME Code Case N-613-1 per ASME Code Interpretation No. XI-1-10-40 is the fundamental reason for the reduced coverages from RI-21, Revision 0 to RI-21, Revision 1.

RAI Response Figures: The licensee's RAI response includes three figures that illustrate how the different definitions of full scope exam volume were applied to the CNS RPV nozzle welds. Figure 1 of the RAI response shows how the full exam volume was defined in the third ISI interval (one-half of the RPV shell thickness (1/2T) beyond the weld bevel on both sides of the weld). Figure 2 shows how the full exam volume was defined for the RPV nozzles addressed in RI-21, Revision 0, per ASME Code Case N-613-1 prior to ASME Code Interpretation No. XI-1-10-40 (1/2 inch beyond the weld toe on the RPV shell side and 1/2 inch beyond the weld bevel on the nozzle side). Figure 3 shows how the full exam volume was defined for all the nozzles examined in the fourth ISI Interval, per ASME Code Case N-613-1 and after the clarification of ASME Code Interpretation No. XI-1-10-40 (1/2 inch beyond the weld bevel on both sides of the weld). The licensee identified that the reduction of the full scope exam volume from 1/2 inch beyond the weld toe on the RPV shell side (Figure 2) to 1/2 inch beyond the weld bevel on the RPV shell side (Figure 3) resulted in an 18 to 22 percent loss in total reported

coverage for the nozzle welds previously addressed in RI-21, Revision 0. However, the methodology used for determining the credible limited scope examination coverages as a percent of the different full scope exam volumes was not changed between the two versions of the relief request.

Based on its review of the licensee's RAI response, including the figures illustrating the different definitions of full scope exam volume for the particular CNS RPV nozzle design, the NRC staff was able to determine how the plant-specific RPV nozzle weld geometry would result in differing limited exam coverage calculations between Revision 0 and Revision 1 of RI-21. The RAI response figures show that the CNS RPV nozzle welds incorporate a weld toe that extends beyond the weld bevel on the shell side of the weld. This is significantly different from the configuration shown in the figures in the ASME Code, Section XI and ASME Code Case N-613-1, where the weld metal does not extend beyond the weld bevel on either side of the weld. Therefore, the NRC staff noted that it was necessary for the licensee to obtain the ASME Code interpretation in order to have a consistent definition of full scope exam volume for accurate calculation and reporting of limited exam coverages for the CNS RPV nozzle welds. For Nozzles N1A, N2E, N2H, N2K, N3A, and N5A, the staff verified that the reduction in the full scope exam volume based on ASME Code Interpretation No. XI-1-10-40 corresponds directly to the licensee's reported decrease in limited exam coverage from Revision 0 to Revision 1 of RI-21, since there is a lower amount of exam coverage that is considered on the RPV shell side of the weld. Accordingly, the staff finds that the licensee has adequately addressed the reason for the decrease in the limited exam coverages for Nozzles N1A, N2E, N2H, N2K, N3A, and N5A from Revision 0 to Revision 1 of RI-21.

RAI-4c: The NRC staff identified that relief for the fourth ISI interval was not previously requested in RI-21, Revision 0 for Nozzles N2C, N2F, N2G, N2J (recirculation inlets), Nozzles N4A, N4B, N4C, N4D (reactor feedwater), Nozzle N6B (top head spray), Nozzle N7 (top head vent), and Nozzle N9 (CRD return line). For these nozzle weld exams, which are newly addressed in RI-21, Revision 1, the staff requested that the licensee explain how the application of ASME Code Case N-613-1 would result in lower exam coverages than those reported for the third ISI interval (late 1990s and early 2000s, prior to publication of the ASME Code Case), given that the full scope (100 percent) exam volume per the ASME Code Case is lower than that required by Figure IWB-2500-7 of the ASME Code.

In its RAI response to RAI-4c by letter dated November 30, 2017, the licensee stated that the nozzles in question were not previously addressed in RI-21, Revision 0, because they were examined later in the fourth ISI interval. The licensee identified that these limited coverages were also calculated based on the definition of the full-scope volume in ASME Code Case N-613-1 and ASME Code Interpretation No. XI-1-10-40. The licensee stated that the differences between the third and fourth interval coverages are due to the change in the way CNS defined the full scope exam volume in the third interval, as illustrated in Figure 1 of the RAI response, compared to the fourth interval, as illustrated in Figure 3 of the RAI response. That is, because the different definition of full scope volume, as illustrated by these figures, is specifically associated with these particular nozzles (with the exception of Top Head Vent Nozzle N7). The licensee stated that Top Head Vent Nozzle N7 is a slightly different configuration from that associated with the ASME Code interpretation. Therefore, this nozzle allowed a slight increase in exam coverage from the third to the fourth Interval (i.e., 58.6 percent to 59.09 percent).

Based on its review of the licensee's RAI response, the NRC staff confirmed that the reduction in the full scope exam volume based on ASME Code Case N-613-1, in conjunction with ASME

Code Interpretation No. XI-1-10-40, corresponds directly to the licensee's reported decrease in limited exam coverage between the third and fourth ISI intervals. This is because there is a lesser amount of exam coverage that is considered on both the RPV nozzle and shell side of the weld. Accordingly, the staff finds that the licensee has adequately addressed the reasons for the decrease in the reported limited exam coverages from the third ISI interval to the fourth ISI interval for Nozzles N2C, N2F, N2G, N2J, N4A, N4B, N4C, N4D, N6B, and N9.

RAI-4d: For the top head vent nozzle (Nozzle N7), the NRC staff noted inconsistencies in the submittal dated March 29, 2017, regarding the licensee's discussion of the third ISI interval examination coverages. In one location, the submittal specifies a third ISI interval examination coverage of 58.6 percent in 1998, whereas another part of the submittal reports that the third ISI interval exams from 1995 and 2001 achieved a coverage of 92.25 percent. Therefore, the NRC staff requested that the licensee confirm the actual third ISI interval examination coverage and the corresponding calendar year when this exam was performed.

In its RAI response to RAI-4d by letter dated November 30, 2017, the licensee stated that the third ISI interval exam coverage of 92.25 percent and the 1995 and 2001 exam dates are typographical errors. The licensee stated that the correct third ISI interval exam coverage is 58.6 percent for the top head vent nozzle exam performed in 1998. The NRC staff determined that this response resolves the issue raised in RAI-4d.

Based on its review of the licensee's responses to RAI-4, Parts a through d, the NRC staff finds that the licensee has adequately addressed the staff's concerns regarding the inconsistencies in the reporting of limited exam coverages and associated changes to these coverages for the RPV nozzle welds. Accordingly, RAI-4, Parts a through d, are resolved.

Limited-Scope Examination Results

For all of the subject RPV nozzle welds, the licensee reported that no recordable indications were observed based on the limited-scope UT exams, with the exception of one indication of a slag inclusion located in the main steam line RPV nozzle weld NVE-BD-N3A, which was previously characterized during the third 10-year interval ISI exams in 1998. The licensee reported that this indication is located in the upper 85 percent of the weld (away from the inside wetted surface). The indication was reevaluated for the fourth ISI interval and found to be acceptable because it exhibited no change since 1998. Based on this information, the NRC staff confirmed that the embedded indication is not an aging concern and is not safety significant.

The licensee stated that there is no plant-specific or industry operating experience regarding age-related degradation for any of the subject RPV nozzle welds addressed in RI-21, Revision 1. Based on its review of plant-specific and industry operating experience with RPV material aging effects, the NRC staff verified that there is no history of new flaw initiation for these particular low alloy steel RPV welded components. The formation of new flaws within these low alloy steel RPV materials is considered highly unlikely because the components are below the design basis cumulative usage factors and are not susceptible to any form of stress corrosion cracking. Therefore, the staff determined that the limited examination coverages for the subject RPV nozzle welds with acceptable results will continue to provide reasonable assurance of structural integrity for the RPV and continued safe operation at CNS.

Limited Examination Coverage for Class 1 Examination Category B-D, Item No. B3.100, RPV Nozzle Inside Radius Section (Section 10.0 of Request No. RI-21, Revision 1)

Item No. B3.100 requires essentially 100 percent volumetric examination of the inside radius sections for all full penetration RPV nozzles using the examination volume specified in Figure IWB-2500-7 of the ASME Code. In addition, the reduced examination volume of the ASME Code Case N-613-1 is not applicable to the inside corner regions. The licensee reported scanning obstructions for the RPV CRD return line nozzle inside corner region that resulted in a limited examination coverage of 78.46 percent of the Code-required volume during the fourth ISI interval. There were no recordable indications.

The licensee stated that the third ISI interval examination of the inside corner region for the RPV CRD return line nozzle, conducted in 2005, reported a total coverage of 100 percent. According to the licensee, the insulation support ring "... may not have been accounted for in the [third interval] coverage calculation, which would have impacted the coverage reported in 2005." The licensee reported that the most recent fourth ISI interval exam did account for this scanning obstruction, which limited the examination coverage to below 90 percent. The NRC staff reviewed this information and determined that this is a reasonable explanation for the reduction in examination coverage. However, the staff requested additional information to identify whether the CNS ISI procedures have been updated to accurately account for such scanning obstructions when performing inservice examinations (see RAI-5, discussed below).

Consistent with RPV nozzle weld findings discussed above, there is no history of age-related degradation for the inside corner region of the RPV nozzles. Therefore, the NRC staff determined that the limited examination coverage with acceptable results for the inside corner region provides reasonable assurance of structural integrity for the RPV CRD return line nozzle at CNS.

Limited Examination Coverages for Class 1 Examination Category B-G-1, Item No. B6.40, Threads in the RPV Flange, 52 Threaded Stud Holes (Section 11.0 of RI-21, Revision 1)

Item No. B6.40 requires essentially 100 percent volumetric examination of the threads in all RPV closure flange stud holes using the examination volume specified in Figure IWB-2500-12 of the ASME Code. This is the 1-inch annular region surrounding each of the 52 threaded stud holes at CNS. The licensee reported scanning obstructions that resulted in a limited examination coverage of 82.54 percent of the Code-required volume during the fourth ISI interval. There were no recordable indications.

The licensee stated that the third ISI interval examination of the RPV flange thread regions, conducted in 1997, reported a total coverage of 100 percent. According to the licensee, these earlier exams did not account for the 1/4-inch stainless steel "step-up" (a continuation of the stainless steel cladding) on the low alloy steel flange surface, which causes scanning obstructions for a portion of the examination volume for each threaded stud hole. The licensee also identified that its UT systems could not adequately resolve calibration block "notches" (i.e., simulated indications used for qualifying UT systems) underneath this thickness of stainless steel cladding. Therefore, the licensee determined that the scans performed on the 1/4-inch cladded surface could not be credited, which limited the fourth interval examination coverage to below 90 percent. The NRC staff reviewed this information and determined that this is a reasonable explanation for the reduction in examination coverage. However, the staff requested additional information to identify whether the CNS ISI procedures have been updated

to accurately account for such scanning obstructions when performing inservice examinations (see RAI-5, discussed below).

Consistent with the findings discussed above, there is no history of age-related degradation of the threaded stud holes in the RPV flange. Therefore, the NRC staff determined that the limited volumetric examination coverage with acceptable results for the threaded regions in the RPV flange provides reasonable assurance of structural integrity at CNS.

Limited Examination Coverage for Class 2 Examination Category C-A, Item No. C1.10, Pressure Vessel Shell Weld (Section 13.0 of RI-21, Revision 1)

Item No. C1.10 requires essentially 100 percent volumetric examination of the pressure-retaining shell welds in all Class 2 pressure vessels using the examination volume specified in Figure IWC-2500-1 of the ASME Code. The licensee reported that the design for the RHR HX No. 1A vessel shell-to-distributor ring end plate weld (Weld No. RHR-CA-2A) is different from that shown in Figure IWC-2500-1, and this plant-specific configuration resulted in a substantial reduction in the examination coverage. The licensee reported a limited examination coverage of 40.52 percent of the Code-required volume during the fourth ISI interval. There were no recordable indications. The NRC staff reviewed the figures showing the scan limitations for each direction of coverage using several UT probe beam angles. The NRC staff verified that the plant-specific design of the RHR HX shell incorporates a corner-welded joint, which is substantially different from the simple shell geometry shown in Figure IWC-2500-1. This configuration would be expected to preclude full-scope examination coverage of the weld.

The licensee stated that the third ISI interval examination of this RHR HX vessel weld, conducted in 2001, reported a total coverage of 92.25 percent. Therefore, the fourth ISI interval exam coverage of 40.52 percent is a substantial reduction in coverage from that reported for the third ISI interval. According to the licensee, reviews of this and earlier (1990s) examination reports showed that "... examiners claimed excessive amounts of coverage on both the axial and circumferential scans" during the earlier ISI intervals. Specifically, the third ISI interval coverages did not adequately address scanning in two directions, and excessive coverage was determined based on crediting UT beam transmission (i.e., "skewing") into adjacent regions of the exam volume beyond the edge of the transducer. The licensee explained that similar UT beam "skewing" techniques were used during the fourth interval to fully interrogate the exam volume. However the fourth interval limited coverage calculation did not credit any UT exam volume beyond the edge of the transducer. The NRC staff reviewed this information and determined that this is a reasonable explanation for the reduction in examination coverage. However, the staff requested additional information to identify whether the CNS ISI procedures have been updated to ensure that examination coverage is accurately determined and credited for cases where plant design or configurational issues preclude achieving the full-scope exam coverage (see RAI-5, discussed below).

The NRC staff noted that there is no history of age-related degradation for the RHR HX vessel shell welds at CNS. Therefore, the staff determined that the limited volumetric examination coverage with acceptable results for Weld No. RHR-CA-2A provides reasonable assurance of structural integrity.

Limited Examination Coverage for Class 2 Examination Category C-B, Item No. C2.21, Pressure Vessel Nozzle Welds (Section 14.0 of RI-21, Revision 1)

Item No. C2.21 requires essentially 100 percent volumetric examination and 100 percent surface examination of the pressure retaining nozzle welds in Class 2 pressure vessels using the examination volume and examination area specified in Figure IWC-2500-4 of the ASME Code. The licensee reported that the plant-specific design for the RHR HX No. 1A nozzle-to-top head weld (Weld No. RHR-CB-1A) incorporates a bevel that precludes full volumetric examination coverage from the outside surface of the welded joint. For the fourth ISI interval, the licensee reported a limited volumetric exam coverage of 65.14 percent based on UT, and a weld surface examination coverage of 100 percent using the magnetic particle method. There were no recordable indications. The NRC staff reviewed the figures showing the scan limitations for each direction of coverage using several UT probe beam angles. The staff verified that the plant-specific design of this RHR HX nozzle weld joint is beveled, which would preclude full-scope volumetric examination coverage.

The licensee stated that the third ISI interval examination of this RHR HX nozzle weld, conducted in 2001, reported a total coverage of 90.3 percent. Therefore, the fourth ISI interval exam coverage of 65.14 percent is a significant reduction in coverage from that reported for the third ISI interval. According to the licensee, a review of the 2001 examination records showed that excessive coverage was determined based on crediting UT beam transmission (i.e., "skewing") into adjacent regions of the exam volume beyond the edge of the transducer. The licensee explained that similar UT beam "skewing" techniques were used during the fourth interval to fully interrogate the exam volume; however the fourth interval limited coverage calculation did not credit any UT exam volume beyond the edge of the transducer. The NRC staff reviewed this information and determined that this provides a reasonable explanation for the reduction in examination coverage. However, the NRC staff required additional information to identify whether the CNS ISI procedures have been updated to ensure that examination coverage is accurately determined and credited for cases where plant design or configurational issues preclude achieving the full-scope exam coverage (see RAI-5, discussed below).

The NRC staff noted that there is no history of age-related degradation for the RHR HX nozzle welds at CNS. Therefore, the staff determined that that the limited volumetric examination coverage and 100 percent surface examination coverage with acceptable results for Weld No. RHR-CB-1A provides reasonable assurance of structural integrity.

Licensee Corrective Action for Addressing Inservice Exam Limitations (RAI-5)

For several of the Class 1 RPV and Class 2 RHR HX items addressed in RI-21, Revision 1 and documented above, the licensee reported that the fourth ISI interval examination coverages had decreased from those reported for the third ISI interval because the third interval exam coverages did not properly account for certain scanning obstructions, access restrictions, or other issues, which resulted in excessive amounts of coverage credited during the third interval.

RAI-5a: The NRC staff requested that the licensee identify whether the CNS ISI procedures have been updated to provide for accurate accounting of scanning obstructions, access restrictions, and other design issues that result in limitations to exam coverages required by the ASME Code, Section XI, and which are reportable to the NRC under 10 CFR 50.55a(g)(5)(iii).

In its response to RAI-5a, by letter dated November 30, 2017, the licensee stated that CNS has updated its ISI and non-destructive examination (NDE) programs to include additional guidance

for documentation of limited coverage exams. The licensee stated that updates to field NDE implementation procedures now include guidance to properly document the limitations in exam coverage.

RAI-5b: The NRC staff requested additional information concerning ISI procedures for cases where plant design or configurational issues precluded achieving the full-scope exam coverage. In its response to RAI-5b by letter dated November 30, 2017, the licensee stated that CNS has procedures in place to ensure that exam coverage is accurately determined and credited based on the documented scan limitations and qualified UT techniques, including applicable Performance Demonstration Initiative requirements of the ASME Code, Section XI, Appendix VIII, as conditioned by 10 CFR 50.55a. The licensee also stated that CNS procedures require limited coverage exams to contain coverage plots that document the cause of the reduction in exam coverage and the percent of exam coverage that was achieved.

The NRC staff finds that the licensee's responses to RAI-5, Parts a and b, are acceptable because the RAI response adequately described updates to the CNS ISI procedures that include guidance for proper documentation of exam coverage limitations, and the licensee confirmed that these procedures would ensure an accurate determination of exam coverage. Accordingly, RAI-5, Parts a and b, are resolved.

3.3 Summary of NRC Staff Technical Evaluation Concerning Class 1 and 2 Vessel Items

Based on the foregoing evaluation, the NRC staff finds that the licensee's limited-scope volumetric examinations performed for the subject Class 1 and 2 vessel items, as reported in RI-21, Revision 1, provide reasonable assurance of structural integrity for these components. Additionally, based on its foregoing evaluation of the licensee's demonstrated limitations experienced when attempting to comply with the ASME Code, Section XI examination coverage requirements for the subject Class 1 and 2 vessel items, the NRC staff concludes that compliance with the ASME Code, Section XI requirements for essentially 100 percent examination coverage of these components would be impractical and a burden on the licensee.

4.0 TECHNICAL EVALUATION – CLASS 1 PIPING WELDS

4.1 The Licensee's Relief Request for Class 1 Piping Welds

Background

By letter dated November 3, 2006 (ADAMS Accession No. ML063040241), the NRC approved implementation of CNS's risk-informed ISI (RI-ISI) program for Class 1 piping welds (Examination Category B-F and B-J) and Class 2 piping welds (Examination Category C-F-I and C-F-2) in the fourth 10-year ISI interval. The licensee developed the RI-ISI program in accordance with the NRC-approved methodology of the Electric Power Research Institute (EPRI) Topical Report [TR]-112657, Revision B-A, "Revised Risk-Informed Inservice Inspection Evaluation Procedure" (ADAMS Accession No. ML013470102).

Components Affected

ASME Code Class 1 piping welds are affected. The licensee stated that the ISI of piping welds listed in Table 1-1 (Appendix 1 to RI-21, Revision 1, in the letter dated March 29, 2017) have been governed by the CNS RI-ISI program. The licensee described the piping welds as follows:

- RPV instrument penetration nozzle-to-safe end weld (Weld No. RVI-BJ-16B1) on a small bore line of 2 inches nominal pipe size (NPS). This weld is classified as Examination Category R-A, Item No. R1.20 (elements not subject to damage mechanism), Risk Category 4 (high consequence and low failure potential category), in accordance with EPRI TR-112657, Revision B-A (Table 1 and I-3.3.2 of ASME Code Case N-578-1 "Risk-Informed Requirements for Class 1, 2, or 3 Piping, Method B, Section XI, Division 1"). (Section 12.0 of RI-21, Revision 1).

  The licensee stated that the Reactor Vessel (RV) instrument penetration nozzle made of Inconel SB-166 is butt welded using Inconel Alloy 182 weld metal to the safe end made of stainless steel SA-182. This weld is subjected to an operating pressure of 990 pounds per square inch gauge (psig) and a temperature of 525 degrees Fahrenheit (°F).

- Valve to elbow weld (Weld No. CWB-BJ-27) of 4 inch NPS in the reactor water cleanup system. This weld is classified as Examination Category R-A, Item No. R1.20 (elements not subject to damage mechanism), Risk Category 4 (high consequence and low failure potential category), in accordance with EPRI TR-112657, Revision B-A (Table 1 and I-3.3.2 of ASME Code Case N-578-1). (Section 15.0 of RI-21, Revision 1).

  The licensee stated that the valve A-352 Grade LCB is butt welded to elbow A-333 Grade 1 with ER70S-2/-3 weld metal. This weld is subjected to an operating pressure of 1045 psig and a temperature of 425 °F.

Applicable Code Edition and Addenda

The Code of Record for the fourth 10-year ISI interval is the 2001 Edition through 2003 Addenda of the ASME Code.

Duration of Relief Request

The licensee submitted this relief request for the fourth 10-year ISI interval, which began on March 1, 2006, and ended on March 31, 2016.

ASME Code Requirement

The ASME Code requirements applicable to Class 1 pipe welds originate in Table IWB-2500-1 of Section XI. The CNS RI-ISI program that was developed by the licensee in accordance with the NRC-approved methodology in EPRI TR-112657, Revision B-A and was authorized by the NRC staff in an SE dated November 3, 2006, provides an alternative to the ASME Code requirements. In both the ASME Code and the NRC SE, the Class 1 pipe welds under this request are required to be volumetrically examined during each 10-year ISI interval, and 100 percent coverage of the required examination volume must be achieved. The extent of required examination coverage is reduced from 100 percent to essentially 100 percent by ASME

Code Case N-460. This code case has been incorporated by reference into 10 CFR 50.55a by inclusion in RG 1.147, Revision 18.

Impracticality of Compliance

The licensee stated that it was not possible to obtain greater than 90 percent of the ASME Code-required examination volume due to limitations imposed by component design, geometry, configuration, and materials of construction. The limitations are described below:

- For Weld No. RVI-BJ-16B1, combinations of the outside diameter (OD) taper at downstream of the weld toe on the safe end side and the UT procedure requirement (i.e., Performance Demonstration Initiative (PDI)-UT-10, Revision E, "PDI Generic Procedure for the Ultrasonic Examination of Dissimilar Metal Welds") for use of the contoured probes and the refracted longitudinal (RL) and shear waves were the cause of not achieving the required coverage. Generic Procedure PDI-UT-10, Revision E, required both the RL and shear waves be used. The footprint of the contoured RL transducers was a limiting factor adjacent to the OD taper where full contact was lost, thereby limiting two-direction coverage. The OD taper is shown in Photograph 12-1 and the sketches in Figures 12-1 through 12-3 of Appendix 1 to the relief request in the letter dated March 29, 2017.

- For Weld No. CWB-BJ-27, the design configuration of the weld and/or the associated components (valve to tight radius elbow) and metallurgical constraints limited the scanning to one side of the weld (single sided scan). Photograph 15-1 and the sketches in Figures 15-1 through 15-5 of Appendix 1 of the relief request in the letter dated March 29, 2017, show the limitations.

The licensee stated that the burden caused by compliance includes major modification of plant components, which would include redesign and replacement of the welds and associated components.

Licensee's Basis for Relief

The licensee stated that it performed the UT to the maximum extent possible utilizing personnel qualified and procedures demonstrated in accordance with Appendix VIII of the ASME Code, Section XI.

Weld No. RVI-BJ-16B1

The licensee stated that in 2005 during the third 10-year ISI interval, it volumetrically inspected Weld No. RVI-BJ-16B1 with the UT. The licensee used the UT procedure (Generic Procedure PDI-UT-10, Revision A) that was demonstrated and personnel that were qualified in accordance with Appendix VIII of the ASME Code, Section XI. Generic Procedure PDI-UT-10, Revision A, required that the shear wave transducers be used. The licensee achieved essentially 100 percent coverage of the required volume, and no unacceptable indications were detected. Thus, no relief was requested in the third 10-year ISI interval.

The licensee stated that in 2014, during the fourth 10-year ISI interval, the volumetric examinations of Weld No. RVI-BJ-16B1 were performed with the UT procedure (Generic Procedure PDI-UT-10, Revision E) that was demonstrated and personnel that were qualified in accordance with Appendix VIII of the ASME Code, Section XI. Generic Procedure PDI-UT-10,

Revision E, requires the use of both the shear and RL wave transducers. The RL wave transducer has a larger footprint, which became a limiting factor for the areas adjacent the OD taper, resulting in lift-off and reduced coverage. Therefore, a relief is required from essentially 100 percent coverage. In the volume scanned, the licensee did not detect any unacceptable indications.

The licensee stated that the inspection of Weld No. RVI-BJ-16B1 is governed by CNS's RI-ISI program. The licensee noted that, in accordance with Generic Letter (GL) 88-01, Supplement 1 "NRC Position on Intergranular Stress Corrosion Cracking (IGSCC) in BWR [Boiling-Water Reactor] Austenitic Stainless Steel Piping," this weld is excluded from CNS's IGSCC program. In addition, the licensee evaluated this weld against the criteria of GL 88-01 in accordance with Appendix I of ASME Code Case N-578-1, and determined that this weld is not within the scope of the generic letter. Therefore, the licensee assigned this weld as Item No. R1.20 (elements not subject to damage mechanism) in the RI-ISI program.

The licensee added that, by assigning Item No. R1.20 to Weld No. RVI-BJ-16B1 instead of Item No. R1.16 (elements subject to IGSCC or transgranular stress corrosion cracking (TGSCC)), the required examination volume C-D-E-F identified in Figure IWB-2500-8(c) of ASME Code, Section XI, has been extended out 1/2 inch beyond the weld bevel as required by Note (1) of ASME Code Case N-578-1 instead of 1/4 inch as required by Figure IWB-2500-8(c). With this 1/2 inch beyond the weld bevel in accordance with the RI-ISI program, the licensee has ultrasonically examined a larger volume, which includes the heat affected zone (HAZ) of the base materials.

Weld No. CWB-BJ-27

The licensee stated that, due to replacement of the valve, Weld No. CWB-BJ-27 was volumetrically inspected by the UT as part of the preservice inspection. Furthermore, Weld No. CWB-BJ-27 was also subjected to radiographic testing and surface inspection by the magnetic particle method after valve replacement as part of the Construction Code or Section III of the ASME Code requirements. No unacceptable indications were detected in any of the inspections performed.

The licensee stated that there are three additional 2-inch RV instrument penetration nozzle-to-safe end welds of similar configuration as Weld No. RVI-BJ-16B1 at CNS. During the third 10-year ISI (previous) interval, three of the four welds were inspected as follows:

- Prior to transition to the RI-ISI program and in the second period of the third 10-year ISI interval, two of the four welds (Weld Nos. RVI-BJ-16A1 and RVI-BJ-11A1) were examined by the liquid penetrant, and no unacceptable surface indications were identified.

- After transition to the RI-ISI program and in the third period of the third 10-year ISI interval, one of the four welds (Weld No. RVI-BJ-16B1 listed in this relief request) was examined by the UT as part of the CNS RI-ISI program, and no unacceptable indications were identified in the volume examined.

The licensee stated that the piping welds in this relief request have been subjected to the ASME Code-required system leakage test and associated VT-2 visual examination. No sign of through-wall leakage has been identified in any of the welds.

Licensee's Proposed Alternative

In Table 1-1 of Appendix 1 to the relief request by letter dated March 29, 2017, the licensee reported the percent coverage achieved for each piping weld examined, as summarized below.

- Weld No. RVI-BJ-16B1 88.56 percent
- Weld No. CWB-BJ-27 55 percent

The licensee proposed the above alternative coverage in lieu of the ASME Code-required essentially 100 percent coverage.

4.2 NRC Staff Evaluation Concerning Class 1 Piping Welds

The NRC staff evaluated the piping welds in this relief request pursuant to 10 CFR 50.55a(g)(6)(i). The NRC staff's evaluation focused on whether: (1) a technical justification exists to support the determination that the ASME Code requirement is impractical; (2) the imposition of the Code-required inspections would result in a burden to the licensee; and (3) the licensee's proposed alternative (accepting the reduced inspection coverage in this case) provides reasonable assurance of structural integrity and leak tightness of the subject welds.

The NRC staff finds that, if these three criteria are met, the requirements of 10 CFR 50.55a(g)(6)(i) (i.e., granting the requested relief will not "endanger life or property or the common defense and security, and is otherwise in the public interest giving due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility") will also be met.

Impracticality of Compliance

As described and demonstrated in the submittal dated March 29, 2017 (Photographs 12-1 and 15-1, sketches in Figures 12-1 through 12-3, and Figures 15-1 through 15-5 of Appendix 1), the predominant limitations that prevented the licensee's UT to achieve essentially 100 percent coverage of the ASME Code-required volume were the OD taper on the vessel side of Weld No. RVI-BJ-16B1, and the valve to tight radius elbow configuration for Weld No. CWB-BJ-27.

- For Weld No. RVI-BJ-16B1, the requirements to use both the RL and shear wave transducers in conjunction with the OD taper on the vessel side contributed to reduced coverage. The NRC staff confirms that combinations of the OD taper geometry and the RL probe's contoured footprint prevented the licensee from fully scanning the required volume.

- For Weld No. CWB-BJ-27, the licensee performed the UT from one side of the weld because scanning from the other side of the weld was not possible (single-sided scan). The NRC staff confirms that the weld's particular design configuration prevented the licensee from scanning the weld from both sides.

Therefore, the NRC staff finds that a technical justification exists to support the determination that achieving essentially 100 percent coverage is impractical.

Burden of Compliance

The licensee proposed that making the welds fully accessible for inspection from both sides would require replacement or significant design modification to the welds and their associated components. The NRC staff finds that replacing or reconfiguring the components of the subject welds is the only reasonable means to achieve full coverage of these welds and that replacement or reconfiguration of the weld, pipe, valve, and elbow constitutes a burden on the licensee.

Structural Integrity and Leak Tightness

The NRC staff considered whether the licensee's proposed alternative provided reasonable assurance of structural integrity and leak tightness of the subject weld based on: (1) the examination coverage achieved and (2) safety significance of unexamined volumes/unachievable coverage (e.g., the presence or absence of known active degradation mechanisms and essentially 100 percent coverage achieved for similar welds in similar environments subject to similar degradation mechanisms).

Examination Coverage Achieved

In evaluating the licensee's proposed alternative, the NRC staff assessed whether the licensee obtained as much coverage as reasonably possible and the manner in which the licensee reported the coverage achieved. From the staff's review of the submittal dated March 29, 2017, and the sketches (Figures 12-1 through 12-3 and Figures 15-1 through 15-5) in Appendix 1 to RI-21, Revision 1, the NRC staff determined that:

- The welds were examined using the appropriate equipment, ultrasonic modes of propagation, probe angles, frequencies, and scanning directions to obtain maximum coverage;
- The coverage was calculated in a reasonable manner;
- The UT procedures used were qualified, as required by the regulation;
- The coverage was limited by physical access (i.e., the configuration of one side of the weld limited access for scanning) and/or the component's geometry;
- No unacceptable indications were identified.

Therefore, the NRC staff found that the licensee made every effort to obtain as much coverage as reasonably possible with the ASME Code-required UT.

Safety Significance of Unexamined Volumes/Unachievable Coverage

In addition to the coverage analysis described above, the NRC staff evaluated the safety significance of the unexamined volumes of welds/unachievable coverage. From a review of the submittal and the sketches (Figures 12-1 through 12-3 and Figures 15-1 through 15-5) in Appendix 1 to RI-21, Revision 1, the NRC staff verified that:

- The licensee's UT has covered, to the extent possible, the regions (i.e., the weld root and the HAZ of the base materials near the ID surface of the joint) that are typically susceptible to higher stresses and, therefore, potential degradation.

- During the third (i.e., previous) 10-year ISI interval, inspections performed on Weld No. RVI-BJ-16B1 and two similar RV instrument penetration nozzle-to-safe end welds detected no unacceptable indications.

- In addition to the required preservice inspection, Weld No. CWB-BJ-27 was subjected to magnetic particle and radiographic testing as part of the requirements in the Construction Code or Section III of the ASME Code when the valve was replaced. No unacceptable indications were detected by the examinations performed.

- No through-wall leaks have been identified in any of the RV instrument penetration nozzle-to-safe end welds during the third and fourth 10-year ISI intervals.

Therefore, the NRC staff determined that, based on the coverage achieved by the qualified UT, the examination of the weld root and its HAZ to the extent possible, and surface examinations, if significant service-induced degradation had occurred, evidence of the degradation would have been detected by the examinations that the licensee performed.

In this analysis, the NRC staff also found that in addition to the required volumetric examinations, these welds have received the required system leakage testing in accordance with Table IWB-2500-1, Examination Category B-P. Despite the reduced coverage of the Code-required examination volume, the staff finds that these inspections will provide assurance that any pattern of degradation, if it were to occur, would be detected and will enable the licensee to take appropriate and timely corrective actions.

4.3 Summary of NRC Staff Technical Evaluation Concerning Class 1 Piping Welds

Based on the foregoing evaluation, the NRC staff finds that the volumetric examinations performed on the subject Class 1 piping welds provide reasonable assurance of structural integrity and leak tightness of the subject welds. Additionally, the staff concludes that compliance with the ASME Code requirements for these welds would be impractical and a burden on the licensee.

5.0 CONCLUSION

As set forth above, the NRC staff has determined that that granting relief pursuant to 10 CFR 50.55a(g)(6)(i) is authorized by law, will not endanger life or property or the common defense and security, and is otherwise in the public interest, giving due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility. Furthermore, the staff concluded that the examinations performed, to the extent practical,

provide reasonable assurance of structural integrity of the subject components. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(g)(5)(iii). Therefore, the NRC grants relief from the full-scope volumetric examination requirements of the ASME Code, Section XI, for the Class 1 and 2 components addressed in Request No. RI-21, Revision 1. This relief applies to the fourth 10-year ISI program interval, which began on March 1, 2006, and ended on March 31, 2016.

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

Principal Contributors: C. Sydnor, NRR
A. Rezai, NRR

Date: March 22, 2018

SUBJECT: COOPER NUCLEAR STATION – REQUEST NO. RI-21, REVISION 1 – REQUEST FOR RELIEF CONCERNING EXAMINATIONS FOR THE FOURTH 10-YEAR INSERVICE INSPECTION INTERVAL (CAC NO. MF9623; EPID L-2017-LLR-0026) DATED MARCH 22, 2018

DISTRIBUTION:
PUBLIC
PM File Copy
RidsACRS_MailCTR Resource
RidsNrrDorlLpl4 Resource
RidsNrrDmlrMphb Resource
CSydnor, NRR
ARezai, NRR
RidsNrrPMCooper Resource
RidsNrrLAPBlechman Resource
RidsRgn4MailCenter Resource
RidsNrrDmlrMvib Resource

ADAMS Accession No. ML18064A102 *via memorandum

OFFICE	NRR/DORL/LPL4/PM	NRR/DORL/LPL4/LA	NRR/DMLR/MVIB/BC(A)*	NRR/DMLR/MPHB/BC*	NRR/DORL/LPL4/BC
NAME	TWengert	PBlechman	SRuffin	DAlley	RPascarelli
DATE	3/20/18	3/19//18	1/23/18	1/23/18	3/22/18

OFFICIAL RECORD COPY