



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

May 20, 2015

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

SUBJECT: COOPER NUCLEAR STATION – RELIEF REQUEST NO. RI-08, REVISION 0
APPLICABLE TO FOURTH 10-YEAR INSERVICE INSPECTION INTERVAL
(TAC NO. MF4429)

Dear Mr. Limpias:

By letter dated July 15, 2014, as supplemented by letter dated March 11, 2015, Nebraska Public Power District (NPPD, the licensee) submitted a request to the U.S. Nuclear Regulatory Commission (NRC) for the use of an alternative to certain American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code), Section XI requirements at Cooper Nuclear Station. The proposed alternative in Relief Request RI-08 would revise the inspection requirements for certain reactor pressure vessel (RPV) nozzle-to-vessel welds and nozzle inner radii from those based on ASME Code, Section XI, Subarticle IWB-2500, to an alternative based on ASME Code Case N-702, "Alternative Requirements for Boiling Water Reactor (BWR) Nozzle Inner Radius and Nozzle-to-Shell Welds."

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, paragraph 50.55a(a)(3)(i), NPPD requested to use the proposed alternative on the basis that the alternative provides an acceptable level of quality and safety. The paragraph headings in 10 CFR 50.55a were changed by *Federal Register* notice dated November 5, 2014 (79 FR 65776), which became effective on December 5, 2014 (e.g., 10 CFR 50.55a(a)(3)(i) is now 50.55a(z)(1), and 50.55a(a)(3)(ii) is now 50.55a(z)(2)). The cross-reference tables, which are cited in the notice, can be found in the Agencywide Documents Access and Management System (ADAMS) Accession No. ML14015A191 and ADAMS package Accession No. ML14211A050.

The NRC staff has reviewed the subject request and concludes, as set forth in the enclosed safety evaluation, that NPPD has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(z)(1). Therefore, the NRC authorizes the licensee's proposed alternative for inspection of the nozzle-to-vessel shell welds and nozzle inner radii sections of RPV nozzles listed in the enclosed safety evaluation for the duration of the fourth 10-year inservice inspection interval at Cooper Nuclear Station ending February 29, 2016.

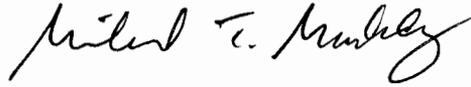
All other ASME Code requirements for which relief was not specifically requested and approved in the subject request for relief remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

O. Limpias

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If you have any questions, please contact the NRC project manager, Siva Lingam, at 301-415-1564 or via e-mail at Siva.Lingam@nrc.gov.

Sincerely,

A handwritten signature in black ink, appearing to read "Michael T. Markley". The signature is fluid and cursive, with a large, sweeping "M" at the beginning.

Michael T. Markley, Chief
Plant Licensing Branch IV-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-298

Enclosure:
Safety Evaluation

cc w/encl: Distribution via Listserv



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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION
REGARDING REQUEST FOR ALTERNATIVE RI-08 REGARDING INSPECTION
REQUIREMENTS FOR REACTOR VESSEL NOZZLE WELDS AND NOZZLE INNER RADII

NEBRASKA PUBLIC POWER DISTRICT

COOPER NUCLEAR STATION

DOCKET NO. 50-298

1.0 INTRODUCTION

By letter dated July 15, 2014, as supplemented by letter dated March 11, 2015 (Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML14202A081 and ML15078A041, respectively), Nebraska Public Power District (NPPD, the licensee) requested U.S. Nuclear Regulatory Commission (NRC) approval of an alternative (RI-08) to the inspection requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code) for reactor pressure vessel (RPV) nozzle-to-vessel welds and nozzle inner radii to apply ASME Code Case N-702, "Alternative Requirements for Boiling Water Reactor (BWR) Nozzle Inner Radius and Nozzle-to-Shell Welds, Section XI, Division 1," dated February 20, 2004, without the visual (VT-1) examination specified in the Code Case. The duration of the alternative would be for the fourth 10-year inservice inspection (ISI) interval for Cooper Nuclear Station (CNS), which ends on February 29, 2016.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Section 50.55a(a)(3)(i), the proposed alternative would apply ASME Code Case N-702, which requires a minimum of 25 percent of the RPV nozzle-to-vessel welds and inner radius sections be inspected during each 10-year ISI interval, including at least one nozzle from each type and nominal pipe size, in lieu of the 100 percent inspection requirements of ASME Code, Section XI, Subarticle IWB-2500.

The paragraph headings in 10 CFR 50.55a were changed by *Federal Register* notice dated November 5, 2014 (79 FR 65776), which became effective on December 5, 2014 (e.g., 10 CFR 50.55a(a)(3)(i) is now 50.55a(z)(1), and 50.55a(a)(3)(ii) is now 50.55a(z)(2)). The cross-reference tables, which are cited in the notice, can be found in the ADAMS Accession No. ML14015A191 and ADAMS package Accession No. ML14211A050.

2.0 REGULATORY REQUIREMENTS

In accordance with 10 CFR 50.55a(g)(4), the licensee is required to perform ISI of ASME Code Class 1, 2, and 3 components and system pressure tests during the first 10-year interval and

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subsequent 10-year intervals that comply with the requirements in the latest edition and addenda of Section XI of the ASME Code, incorporated by reference in 10 CFR 50.55a(a)(1), subject to the limitations and modifications listed therein. The applicable ISI Code of record for the fourth 10-year ISI for CNS is the 2001 Edition through the 2003 Addenda of the ASME Code Section XI. The fourth 10-year ISI interval for CNS is projected to end on February 29, 2016.

The regulation in 10 CFR 50.55a(z) states, in part, that the Director of the Office of Nuclear Reactor Regulation may authorize an alternative to the requirements of 10 CFR 50.55a(b)-(h). There are two justifications for an alternative to be authorized. First, per 10 CFR 50.55a(z)(1), the licensee must demonstrate that the proposed alternative would provide an acceptable level of quality and safety. For the second possible justification for an alternative to be authorized, described in 10 CFR 50.55a(z)(2), the licensee must show that following the ASME Code requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

3.0 TECHNICAL EVALUATION

3.1 Background

For all RPV nozzle-to-vessel shell welds and nozzle inner radii, ASME Code, Section XI requires 100 percent inspection during each 10-year ISI interval. However, ASME Code Case N-702 proposes an alternative, which reduces the inspection of RPV nozzle-to-vessel shell welds and nozzle inner radii from 100 percent to 25 percent of the nozzles for each nozzle type during each 10-year interval.

The NRC approved the Electrical Power Research Institute (EPRI) Boiling Water Reactor Vessel Internals Project (BWRVIP)-108 proprietary report, "Technical Basis for the Reduction of Inspection Requirements for the Boiling Water Reactor Nozzle-to-Vessel Shell Welds and Nozzle Inner Radii," dated October 2002, in an safety evaluation (SE) dated December 19, 2007 (ADAMS Accession No. ML073600374). The NRC also approved the EPRI BWRVIP-241 report, "Probabilistic Fracture Mechanics Evaluation for the Boiling Water Reactor Nozzle-to-Vessel Shell Welds and Nozzle Blend Radii," dated October 2010 (ADAMS Accession No. ML11119A043), which contains the technical basis supporting ASME Code Case N-702, in an SE dated April 19, 2013 (ADAMS Accession No. ML13071A240). The BWRVIP-241 report contains additional probabilistic fracture mechanics (PFM) results supporting revision of the evaluation criteria in the NRC SE for the BWRVIP-108 report.

The NRC staff's SE for the BWRVIP-241 report specified plant-specific requirements, which must be met for applicants proposing to use this alternative. The licensee's request for alternative RI-08 intended to demonstrate that the relevant CNS RPV nozzle-to-vessel welds and the inner radii meet these plant-specific requirements. Licensees can demonstrate the plant-specific applicability of the BWRVIP-241 report by meeting the following general and nozzle-specific criteria specified in the NRC staff SE for the BWRVIP-241 report:

- (1) the maximum RPV heat-up/cool-down rate is limited to less than 115 °F/hour;

For recirculation inlet nozzles

(2) $(pr/t)/C_{RPV} \leq 1.15$

p = RPV normal operating pressure (psi),
 r = RPV inner radius (inch),
 t = RPV wall thickness (inch), and
 $C_{RPV} = 19332$;

(3) $[p(r_o^2 + r_i^2) / (r_o^2 - r_i^2)] / C_{NOZZLE} \leq 1.47$

p = RPV normal operating pressure (psi),
 r_o = nozzle outer radius (inch),
 r_i = nozzle inner radius (inch), and
 $C_{NOZZLE} = 1637$;

For recirculation outlet nozzles

(4) $(pr/t)/C_{RPV} \leq 1.15$

p = RPV normal operating pressure (psi),
 r = RPV inner radius (inch),
 t = RPV wall thickness (inch), and
 $C_{RPV} = 16171$; and

(5) $[p(r_o^2 + r_i^2) / (r_o^2 - r_i^2)] / C_{NOZZLE} \leq 1.59$

p = RPV normal operating pressure (psi),
 r_o = nozzle outer radius (inch),
 r_i = nozzle inner radius (inch), and
 $C_{NOZZLE} = 1977$.

This plant-specific information is required by the NRC staff to ensure that the PFM analysis documented in the BWRVIP-241 report applies to the RPV of the licensee's plant.

The BWRVIP-241 report documents additional PFM results supporting revision of the five evaluation criteria in the BWRVIP-108 report. Since the objective of the BWRVIP-241 report is limited (i.e., revision of the limitations and conditions specified in the December 19, 2007, SE for the BWRVIP-108 report), it is considered as a supplement to the BWRVIP-108 report, not a replacement. Nonetheless, the conditions and limitations specified in the SE for the BWRVIP-241 report supersede those in the SE for the BWRVIP-108 report.

The BWRVIP-108 NRC staff SE concluded, in part, that (1) the fracture toughness-related reference temperature (RT_{NDT}) used in the PFM analyses were based on data from the entire fleet of BWR RPVs, making the PFM analyses bounding with respect to fracture resistance and leaving the driving force of the underlying PFM analyses the only item to be evaluated, and (2) except for the RPV heatup/cooldown rate, the plant-specific criteria are for the recirculation inlet and outlet nozzles only because the probabilities of failure for other nozzles are an order of

magnitude lower. Based on the above, the BWRVIP-241 report documents additional PFM analyses on the recirculation inlet and outlet nozzles having the highest driving force among the BWR fleet to demonstrate that the associated vessel failure probability for the normal operation is still consistent with the NRC safety goal, thus supporting the proposed revision of the five evaluation criteria. The SE for the BWRVIP-241 report accepted the proposed revision of the five evaluation criteria in the BWRVIP-108 report.

3.2 Licensee's Request for Alternative RI-08

ASME Code Class 1 Components Affected:

Table 3.1.1 - ASME Code, Section XI, Examination Category B-D		
Code Item	Component ID	Item Description
B3.90	NVE-BD-N2A	12" Recirculation Inlet Nozzle-to-Vessel Shell Weld
B3.90	NVE-BD-N2B	12" Recirculation Inlet Nozzle-to-Vessel Shell Weld
B3.90	NVE-BD-N2C	12" Recirculation Inlet Nozzle-to-Vessel Shell Weld
B3.90	NVE-BD-N2D	12" Recirculation Inlet Nozzle-to-Vessel Shell Weld
B3.90	NVE-BD-N2F	12" Recirculation Inlet Nozzle-to-Vessel Shell Weld
B3.90	NVE-BD-N2G	12" Recirculation Inlet Nozzle-to-Vessel Shell Weld
B3.90	NVE-BD-N2J	12" Recirculation Inlet Nozzle-to-Vessel Shell Weld
B3.100	NVIR-BD-N2A	12" Recirculation Inlet Nozzle Inner Radius Section
B3.100	NVIR-BD-N2B	12" Recirculation Inlet Nozzle Inner Radius Section
B3.100	NVIR-BD-N2C	12" Recirculation Inlet Nozzle Inner Radius Section
B3.100	NVIR-BD-N2D	12" Recirculation Inlet Nozzle Inner Radius Section
B3.100	NVIR-BD-N2F	12" Recirculation Inlet Nozzle Inner Radius Section
B3.100	NVIR-BD-N2G	12" Recirculation Inlet Nozzle Inner Radius Section
B3.100	NVIR-BD-N2J	12" Recirculation Inlet Nozzle Inner Radius Section

Applicable ASME Code Edition and Addenda

This request applies to the fourth 10-year ISI interval, in which CNS adopted the 2001 Edition through the 2003 Addenda of ASME Code Section XI as the Code of record.

ASME Code Requirement

ASME Code, Section XI, Examination Category B-D, Items B3.90 and B3.100 require 100 percent volumetric examination, as defined by Figures IWB-2500-7 (a) through (d), as applicable, of all full penetration Class 1 RPV nozzle-to-shell welds and nozzle inside radius sections.

Licensee's Proposed Alternative and Basis for Use

The licensee proposed an alternative to ASME Code-required volumetric examinations for the ASME Code, Class 1 RPV nozzle-to-shell welds and nozzle inner radius sections listed above in Table 3.1.1 on the basis that it provides an acceptable level of quality and safety. The proposed alternative reduces the ASME Code-required volumetric examinations of all RPV nozzle-to-shell welds and inner radii, to a minimum of 25 percent of the nozzle inner radii and nozzle-to-shell welds, including at least one nozzle from each system and nominal pipe size during each inspection interval. This alternative is contained in ASME Code Case N-702. The required examination volume for the reduced set of nozzles remains at 100 percent of that depicted in Figures IWB-2500-7 (a) through (d), as applicable.

Three of the Reactor Recirculation inlet nozzle assemblies listed in Table 3.1.2 below will be credited towards meeting the 25 percent inspection requirement in accordance with ASME Code Case N-702. These three nozzles, NVE-BD-N2E, NVE-BD-N2H, and NVE-BD-N2K, are not listed in Table 3.1.1 above as the subject nozzles will meet the 100 percent volumetric examination ASME Code requirement.

Group/Component ID	Total Number Nozzles	No. to be Examined
Recirculation Inlet (N2)	10	3

The BWRVIP-241 report provides the technical basis for use of Code Case N-702. BWRVIP-241 was developed to propose a relaxation of the criteria in the NRC SE for the BWRVIP-108 report, which would subsequently allow BWRs to obtain inspection relief for RPV nozzles. In its request dated July 15, 2014, the licensee stated that:

The [BWRVIP-241] evaluation found that failure probabilities at the nozzle blend radius region and nozzle-to-vessel shell welds due to a Low Temperature Overpressure event are very low (i.e., $< 1 \times 10^{-6}$ for 40 years) with or without inservice inspection. The report concludes that inspection of 25% of each nozzle type is technically justified.

3.1 NRC Staff Evaluation

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

On April 19, 2013, the NRC issued an SE approving the use of BWRVIP-241, which revised Criterion 3 and Criterion 5 that were previously approved in the NRC staff's SE for

BWRVIP-108. The BWRVIP performed additional PFM analyses for the BWRVIP-241 report using the bounding recirculation inlet and outlet nozzles instead of the typical recirculation inlet and outlet nozzles of the BWRVIP-108 report. The BWRVIP's additional PFM analyses demonstrated that the limits can be higher than 1.15 and the corresponding probability of failures are still below $5 \times 10^{-6}/\text{yr}$. Specifically, the additional PFM results support modification of Criterion 3 to be less than or equal to 1.47 and Criterion 5 to be less than or equal to 1.59. In its SE for BWRVIP-241, the NRC staff concluded that these criterion changes result in probabilities of failure that are at least two orders of magnitude lower than the NRC safety goal of $5 \times 10^{-6}/\text{yr}$ for pressurized thermal shock concerns. As stated above, the PFM results in BWRVIP-241 are best considered as a supplement to those in BWRVIP-108; however, the conditions and limitations specified in Section 5.0 of the BWRVIP-241 NRC staff SE supersede those of the NRC staff SE for the BWRVIP-108 report.

In its letter dated July 15, 2014, the licensee stated that Criterion 1 is met because it maintains a maximum heat-up/cool-down rate of less than or equal to 100 degrees Fahrenheit per hour ($^{\circ}\text{F}/\text{hr}$) (averaged over any 1-hour period), as required by Technical Specification Surveillance Requirement 3.4.9.1, which is well below the $115^{\circ}\text{F}/\text{hr}$ criterion limit. The NRC staff determined that the 1-hour average is not of concern since Criterion 1 refers to normal operations, not transient conditions. Therefore, the NRC staff concludes that the licensee provided information to assure that Criterion 1 of BWRVIP-241 is met.

For Criteria 2 and 3, the licensee provided and confirmed, in letters dated July 15, 2014, and March 11, 2015, its plant-specific data evaluation of the driving force factors, or ratios, against the criteria established in the NRC staff's SE for BWRVIP-241. The licensee's calculated results demonstrated that Criteria 2 and 3 are satisfied, that is, that the plant-specific ratios are less than the generic ratios. As part of its review, the NRC staff requested that Pacific Northwest National Laboratory (PNNL) perform the calculations independently with the licensee-provided radius and thickness values. The PNNL independent calculations verified the licensee's ratio values. Therefore, the NRC staff concludes that the licensee meets Criteria 2 and 3 of the NRC staff's SE for BWRVIP-241.

Criteria 4 and 5 of the NRC staff's SE for BWRVIP-241 were not evaluated due to the licensee only requesting relief for the recirculation inlet nozzles at CNS.

ASME Code Case N-702 stipulates that the VT-1 visual examination method may be used in lieu of the volumetric examination method for the RPV nozzle inner radius sections. Despite this allowance, in its letter dated March 11, 2015, the licensee stated that volumetric examinations of the nozzle inner radius sections of the selected recirculation inlet nozzles will be performed. Also, in its letter dated March 11, 2015, the licensee provided a table of the most recent volumetric examinations performed on the recirculation inlet nozzle-to-shell welds and the inner radius sections, which indicated that no recordable indication were found in any of the assemblies.

4.0 CONCLUSION

The NRC staff has reviewed the request for alternative RI-08, as supplemented, regarding the licensee's evaluation of the five plant-specific criteria specified in the April 19, 2013, NRC SE for the BWRVIP-241 report, which provides technical bases for use of ASME Code Case N-702 to

examine RPV nozzle-to-vessel welds and nozzle inner radii at CNS. Based on the evaluation in this SE, the NRC staff concludes that the licensee's proposed alternative provides an acceptable level of quality and safety because the licensee has met the conditions required for ASME Code Case N-702 to be applicable at CNS.

Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(z)(1). Therefore, the NRC authorizes the licensee's proposed alternative for inspection of nozzle-to-vessel shell welds and nozzle inner radii sections of RPV nozzles listed in Section 3.2 of this SE for the fourth 10-year ISI interval at CNS.

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

Principal Contributor: T. McLellan, NRR

Date: May 20, 2015

O. Limpias

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If you have any questions, please contact the NRC project manager, Siva Lingam, at 301-415-1564 or via e-mail at Siva.Lingam@nrc.gov.

Sincerely,

/RA/

Michael T. Markley, Chief
Plant Licensing Branch IV-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-298

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Safety Evaluation

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***via e-mail**

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