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Serial: RA-19-0447 10 CFR 50.55a
June 23, 2020

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Brunswick Steam Electric Plant, Unit Nos. 1 and 2
Docket Nos. 50-325 and 50-324
Renewed License Nos. DPR-71 and DPR-62

Subject: Proposed Alternative for RPV Nozzle-to-Vessel Weld and Inner Radii Examination Requirements in Accordance with 10 CFR 50.55a(z)(1)

Ladies and Gentlemen:

In accordance with 10 CFR 50.55a(z)(1), Duke Energy Progress, LLC (Duke Energy), is proposing an In-service Inspection (ISI) alternative for the Brunswick Steam Electric Plant (BSEP), Units 1 and 2. The proposed alternative will allow reduced requirements for reactor pressure vessel nozzle-to-vessel weld and inner radius examinations. The alternative is requested for the remainder of the ISI fifth ten-year intervals of BSEP, Units 1 and 2 (ending on May 10, 2028 for both units), and through the period of extended operation (PEO) which ends on September 8, 2036, for BSEP, Unit 1, and December 27, 2034, for BSEP, Unit 2. This request is proposed on the basis that the alternative provides an acceptable level of quality and safety.

The Relief Request is provided as Enclosure 1 to this letter. Enclosure 2 contains the applicable Unit 1 nozzles. The applicable Unit 2 nozzles are provided in Enclosure 3. Enclosure 4 contains a Probabilistic Fracture Mechanics Evaluation for the N1 type nozzles for Units 1 and 2.

The technical basis supporting the implementation of American Society of Mechanical Engineers (ASME) Code Case N-702, “Alternative Requirements for Boiling Water Reactor (BWR) Nozzle Inner Radius and Nozzle-to-Shell Welds” is addressed by BWRVIP-108: BWR Vessel and Internals Project, “Technical Basis for the Reduction of Inspection Requirements for the Boiling Water Reactor Nozzle-to-Vessel Shell Welds and Nozzle Blend Radii,” EPRI Technical Report 1003557, October 2002 (ML023330203) and BWRVIP-241: BWR Vessel and Internals Project, “ Probabilistic Fracture Mechanics Evaluation for the Boiling Water Reactor Nozzle-to-Vessel Shell Welds and Nozzle Blend Radii, “EPRI Technical Report 1021005, October 2010 (ML11119A041). Duke Energy has performed an evaluation to demonstrate the plant-specific applicability of the reports as the technical basis for the proposed alternative for BSEP, Units 1 and 2. The plant-specific applicability evaluation is provided in the Enclosures to this letter.

To support the scheduled Spring 2021, Unit 2 Refueling Outage (B2R25), Duke Energy requests approval of this relief request by February 1, 2021.This letter contains no new regulatory commitments. Should you have any questions concerning this letter, or require additional information, please contact Art Zaremba, Director – Nuclear Fleet Licensing, at 980-373-2062.

Sincerely,

John A. Krakuszeski

John A. Krakuszeski
Site Vice President
Brunswick Steam Electric Plant

Enclosures:

1. Request for Relief RA-19-0447 to Implement an Alternative Concerning Nozzle-to-Vessel Weld and Inner Radii Examination Requirements in Accordance with 10 CFR 50.55a(z)(1)
2. Applicable BSEP, Unit 1 Nozzles
3. Applicable BSEP, Unit 2 Nozzles
4. BSEP, Units 1 and 2, N1 Nozzle Probabilistic Fracture Mechanics Evaluation

cc: L Dudes, USNRC Regional Administrator, Region II
G. Smith, USNRC Sr. Resident Inspector - BSEP
A. Hon, USNRC NRR Project Manager – BSEP
C. Dautrich – NC Department of Labor Bureau Chief

Enclosure 1

Duke Energy Carolinas, LLC

Brunswick Steam Electric Plant, Units 1 and 2

Relief Request Serial No. RA-19-0447

Request for Relief RA-19-0447 to Implement an Alternative Concerning Nozzle-to-Vessel Weld and Inner Radii Examination Requirements in Accordance with 10 CFR 50.55a(z)(1)

1. American Society of Mechanical Engineers (ASME) Code Component(s) Affected

Component Numbers:	Reactor Vessel Nozzles: N1, N2, N3, N5, N6, N8, N11, N12 (See Enclosures 2 and 3 for complete list of nozzle identifications)
Code Class:	Class 1
Examination Category:	B-D
Reference:	IWB-2500, Table IWB-2500-1
Item Number:	**Description**
B3.90 and B3.100	Alternative to IWB-2500, Table IWB-2500-1 for Nozzle-to-Vessel Weld and Inner Radii Examination Requirements in accordance with ASME Code Case N-702

2. Applicable Code Edition and Addenda

The fifth ten-year interval of the Brunswick Steam Electric Plant (BSEP), Units 1 and 2 Inservice Inspection (ISI) Program is based on the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (B&PV) code, Section XI, 2007 Edition with Addenda through 2008.

3. Applicable Code Requirement

The applicable requirement is contained in Table IWB-2500-1, “Examination Category B-D, Full Penetration Welded Nozzles in Vessels.” Class 1 Reactor Vessel nozzle-to-vessel weld and nozzle inner radii examinations requirements are delineated in Item Number B3.90, “Nozzle-to-Vessel Welds,” and B3.100, “Nozzle Inside Radius Section.” The required method of examination is volumetric. All nozzles with full penetration welds to the vessel shell (or head) and integrally cast nozzles are examined each interval.

All of the nozzle assemblies identified in Enclosures 2 and 3 are full penetration welds.

4. Reason for the Request

NRC Regulatory Guide 1.147, Revision 19, conditionally accepts the use of ASME Code Case N-702. This code case provides an alternative to performing examination of 100% of the nozzle-to-vessel welds and inner radii for Examination Category B-D nozzles with the exception of the Feedwater and Control Rod Drive Return Line (CRDRL) Nozzles.

The alternative is to perform examination of 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, excluding the Feedwater and CRDRL Nozzles.

Code Case N-702 has been approved for use in Regulatory Guide 1.147, Revision 19, with conditions as noted below:

> The applicability of Code Case N-702 for the first 40 years of operation must be demonstrated by satisfying the criteria in Section 5.0 of NRC Safety Evaluation regarding BWRVIP-108 dated December 18, 2007 (ML073600374) or Section 5.0 of

NRC Safety Evaluation regarding BWRVIP-241 dated April 19, 2013 (ML13071A240). The use of Code Case N-702 in the period of extended operation is not approved.

If VT-1 is used, it shall utilize Code Case N-648-2, “Alternative Requirements for Inner Radius Examination of Class 1 Reactor Vessel Nozzles, Section XI Division 1,” with associated required conditions specified in RG 1.147.

For Revision 19 of Regulatory Guide 1.147, the NRC revised the conditions on Code Case N-702 (ref.: 85 FR 14736; published March 16, 2020). For the period of extended operation, the application of Code Case N–702 is not approved. Licensees that wish to use Code Case N–702 in the period of extended operation must submit relief requests based on BWRVIP–241, Appendix A, ‘‘BWR Nozzle Radii and Nozzle-to-Vessel Welds Demonstration of Compliance with the Technical Information Requirements of the License Renewal Rule (10 CFR 54.21),’’ approved on April 26, 2017, or plant-specific probabilistic fracture mechanics analyses. Consistent with this regulation, BSEP is submitting a relief request complying with BWRVIP-241, Appendix-A. For BSEP Recirculation Outlet Nozzle (N1) that does not meet the criteria from BWRVIP-241 Appendix-A, a plant specific Probabilistic Fracture Mechanics (PFM) evaluation was performed to demonstrate that the outlet nozzle meets the probability of failure limits.

The analyses in BWRVIP-108 and BWRVIP-241 were based on predicted fatigue crack growth over the initial licensed operating period and assumed additional fatigue cycles in evaluating fatigue crack growth. Previous BWRVIP studies have demonstrated that stress corrosion crack (SCC) growth represents the majority of the crack growth and that crack growth due to additional mechanical/thermal fatigue cycles introduced by the extended operation time is insignificant compared to hypothetical SCC growth. Thus, the amount of thermal cycle driven fatigue crack growth due to extended operation to 60 years is not a controlling factor in the probability of failure of the BWR reactor vessel nozzles. BWRVIP-241-A, Appendix A, Sections A.3 and A.4 give guidance on demonstrating the applicability of the 40-year evaluation for 60 years.

The proposed alternative provides an acceptable level of quality and safety based on the technical content of BWRVIP-108 and BWRVIP-241, as endorsed by the NRC Safety Evaluations.

5. Proposed Alternative and Basis for Use

In accordance with 10CFR50.55a(z)(1), relief is requested from performing the required examinations on 100 percent of the nozzle assemblies identified in Tables 5-1 and 5-2 below (see Enclosures 2 and 3 for a list of RPV Examination Category B-D nozzles applicable to this relief request). As an alternative, for all welds and inner radii identified in Tables 5-1 and 5-2, BSEP, Units 1 and 2 proposes to examine a minimum of 25 percent of the nozzle-to-vessel welds and inner radii sections, including at least one nozzle from each system and nominal pipe size, in accordance with ASME Code Case N-702. For nozzle assemblies identified in Enclosures 2 and 3, this would mean 25 percent from each of the groups identified in Tables 5-1 and 5-2 during the 120-month interval.

Table 5-1
BSEP, Unit 1
RPV Examination Category B-D Nozzle Summary

Group	Total Number	Minimum Number to be Examined	Comments Results[1]
Recirculation Outlet (N1)	2	1	Two (2) nozzles were inspected in the fourth ISI interval. No recordable indications.
Recirculation Inlet (N2)	10	3	Three (3) nozzles were inspected in the fourth ISI interval. No recordable indications.
Main Steam (N3)	4	1	One (1) nozzle was inspected in the fourth ISI interval. No recordable indications.
Core Spray (N5)	2	1	Two (2) nozzles were inspected in the fourth ISI interval. No recordable indications.
Head Spray (N6)	2	1	Two (2) nozzles were inspected in the fourth ISI interval. No recordable indications.
Jet Pump Instrument (N8)	2	1	One (1) nozzle was inspected in the fourth ISI interval. No recordable indications.
Instrumentation (N11 & N12)	4	1	Three (3) nozzles were inspected in the fourth ISI interval. No recordable indications.

Note:
1. Includes both nozzle-to-vessel weld and inner radius examinations.

Table 5-2
BSEP, Unit 2
RPV Examination Category B-D Nozzle Summary

Group	Total Number	Minimum Number to be Examined	Comments Results[1]
Recirculation Outlet (N1)	2	1	Two (2) nozzles were inspected in the fourth ISI interval. No recordable indications.
Recirculation Inlet (N2)	10	3	Three (3) nozzles were inspected in the fourth ISI interval. No recordable indications.
Main Steam (N3)	4	1	One (1) nozzle was inspected in the fourth ISI interval. No recordable indications.
Core Spray (N5)	2	1	One (1) nozzle was inspected in the fourth ISI interval. No recordable indications.
Head Spray (N6)	2	1	One (1) nozzle was inspected in the fourth ISI interval. No recordable indications.
Jet Pump Instrument (N8)	2	1	One (1) nozzle was inspected in the fourth ISI interval. No recordable indications.
Instrumentation (N11 & N12)	4	1	Two (2) nozzles were inspected in the fourth ISI interval. No recordable indications.

Note:
1. Includes both nozzle-to-vessel weld and inner radius examinations.

The examinations in Tables 5-1 and 5-2 will be scheduled in accordance with ASME Section XI, IWB-2411, "Inspection Program."

ASME Code Case N-702 stipulates that a VT-1 visual examination may be used in lieu of the volumetric examination for the inner radii (i.e., Item Number B3.100, "Nozzle Inside Radius Section"). This VT-1 examination is outlined in Code Case N-648-2 ("Alternative Requirements for Inner Radius Examinations of Class 1 Reactor Vessel Nozzles Section XI, Division 1"). BSEP will perform either volumetric examination or VT-1 examination of the inner radius as required by ASME Code Case N-702.

Electric Power Research Institute (EPRI) Technical Report (TR) 1003557, "BWRVIP-108: Boiling Water Reactor Vessel and Internals Project Technical Basis for the Reduction of Inspection Requirements for the Boiling Water Reactor Nozzle-To-Vessel Shell Welds and Nozzle Blend Radii," found that failure probabilities at the nozzle blend radius region and nozzle-to-vessel shell weld due to a Low Temperature Overpressure (LTOP) 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 percent of each nozzle type is technically justified.

EPRI Report BWRVIP-241 received a final NRC Safety Evaluation Report on April 19, 2013 (ML13071A240). In the NRC Safety Evaluation Report, Section 5.0, "Conditions and Limitations," indicates that each licensee who plans to request relief from ASME Section XI requirements for RPV nozzle-to-vessel shell welds and nozzle inner radii sections may reference the BWRVIP-241 report as the technical basis for the use of ASME Code Case N-702 as an alternative. However, each licensee should demonstrate the plant-specific applicability of the BWRVIP-241 report to their units in the relief request by demonstrating that the following general and nozzle-specific criteria are satisfied:

In the case of BSEP, Units 1 and 2, the single set of values (e.g., nozzle radii, nozzle thicknesses, etc.) used in the following equations are correct and applicable to BSEP, Units 1 and 2.

1. The maximum RPV heatup/cooldown rate is limited to less than 115°F/hour.

   BSEP, Units 1 and 2 Technical Specifications (TS) 3.4.9, "RCS Pressure and Temperature (P/T) Limits," provides a Reactor Coolant System (RCS) heatup/cooldown rate as specified in the Pressure Temperature Limits Report. This report limits the RCS heatup/cooldown rate to less than or equal to 100°F in any 1-hour period.

2. For the Recirculation Inlet Nozzles (N2), the following criteria must be met:

   a. $(pr/t)/C_{RPV} \leq 1.15$;

$p = RPV_{\text{Normal Operating Pressure}}$	1035 psig
$r = RPV_{\text{inner radius}}$	110.2 in.
$t = RPV_{\text{wall thickness}}$	5.68 in.
$C_{RPV} =$	19332

   $(pr/t)/C_{RPV} = 1.039 \leq 1.15$

   The calculation for the BSEP, Units 1 and 2, N2 Nozzle results in a maximum value of 1.039, which satisfies this criteria.

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

$p=RPV_{Normal\ Operating\ Pressure}$	1035 psig
$r_o=_{nozzle\ outer\ radius}$	14.125 in.
$r_i=_{nozzle\ inner\ radius}$	7.0625 in.
$C_{NOZZLE}=$	1637

$[p(r_o^2+r_i^2)/(r_o^2-r_i^2)]/C_{NOZZLE} = 1.054 \leq 1.47$

The calculation for the BSEP, Units 1 and 2, N2 Nozzle results in a maximum value of 1.054, which satisfies this criteria.

3. For the Recirculation Outlet Nozzles (N1), the following criteria must be met:

a. $(pr/t)/C_{RPV} \leq 1.15$;

$p=RPV_{Normal\ Operating\ Pressure}$	1035 psig
$r=RPV_{inner\ radius}$	110.2 in.
$t=RPV_{wall\ thickness}$	5.68 in.
$C_{RPV}=$	16171

$(pr/t)/C_{RPV} = 1.242 \leq 1.15$

The calculation for the BSEP, Units 1 and 2, N1 Nozzle results in a maximum value of 1.242, which is higher than 1.15 and does not meet the criteria. Therefore, a plant specific probabilistic fracture mechanics evaluation for the N1 Nozzle was performed (see Enclosure 4).

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

$p=RPV_{Normal\ Operating\ Pressure}$	1035 psig
$r_o=_{nozzle\ outer\ radius}$	24.375 in.
$r_i=_{nozzle\ inner\ radius}$	13.0625 in.
$C_{NOZZLE}=$	1977

$[p(r_o^2+r_i^2)/(r_o^2-r_i^2)]/C_{NOZZLE} = 0.945 \leq 1.59$

The calculation for the BSEP, Units 1 and 2, N1 Nozzle results in 0.945, which is less than 1.59.

Based upon the above information, all BSEP RPV nozzle-to-vessel shell full penetration welds and nozzle inner radii sections, with the exception of the Recirculation Outlet Nozzles, meet the general and nozzle-specific criteria in BWRVIP-241. The Recirculation Outlet (N1) Nozzles are addressed with a plant specific probabilistic fracture mechanics evaluation (see Enclosure 4).

The analyses for the nozzles in BWRVIP-108NP and BWRVIP-241 are based on the assumption that fluence at the nozzles is negligible because the analysis is for the initial 40 years of plant operation and do not address an extended operating period. Pressure-Temperature Limits reports applicable to BSEP, Units 1 and 2, concluded that peak fluence over the period of extended operation (54 effective full power years) is expected to be less

than the fluence criteria of 1.0E+17 n/cm^2, as contained in 10CFR50, Appendix H for all nozzles and welds for which this relief request is applied. Therefore, the fluence criteria is satisfied and use of BWRVIP-108 and BWRVIP-241 remain applicable to the BSEP nozzles contained in this relief request.

BWRVIP-241-A, Appendix A, A.3 and A.4 are demonstrated to show that the 40 year evaluation is acceptable for 60 years:

A.3 Management of Aging Effects (54.21 [a] [3])

(a) Assessment of Aging Effects and Inspection Programs

The representative nozzle geometry and the evaluation of the safety consequence of the nozzle failures described in BWRVIP-241 are directly applicable to BSEP, Units 1 and 2. BWRVIP-05 noted that there was no material degradation mechanism and that only neutron fluence requires monitoring for the material fracture toughness. All nozzles included in Enclosures 2 and 3 of this relief request are outside of the beltline region and not exposed to fluence values > 1.0x10^{17} n/cm^2. There are no unique inspection requirements for the nozzles identified in Enclosures 2 and 3 of this relief request due to vessel irradiation. The BSEP, Units 1 and 2 UFSAR 18.1.14 (“Reactor Vessel Surveillance Program”) will ensure continued monitoring of vessel irradiation. The BSEP, Units 1 and 2 UFSAR 18.1.28 (“Reactor Coolant Pressure Boundary Fatigue Monitoring Program”) addresses the station requirements for fatigue management. UFSAR 18.1.1 (“ASME Section XI, Inservice Inspection, Subsections IWB, IWC, and IWD Program”) and 18.1.30 (“Reactor Vessel and Internals Structural Integrity Program”) identify and implement the various inspection requirements to satisfy 10 CFR 54.21.

(b) Demonstration that the Effects of Aging are Adequately Managed

With regards to demonstrating that the effects of aging are adequately managed, all nozzles included in Enclosures 2 and 3 of RA-19-0447 are outside of the beltline region and not exposed to fluence values > 1.0x10^{17} n/cm^2. There are no unique inspection requirements for the nozzles in Enclosures 2 and 3 of this relief request due to vessel irradiation. The BSEP, Units 1 and 2 UFSAR 18.1.14 (“Reactor Vessel Surveillance Program”) will ensure continued monitoring of vessel irradiation. Inspection methodologies and frequencies are prescribed and implemented via the requirements of UFSAR 18.1.1 (“ASME Section XI, Inservice Inspection, Subsections IWB, IWC, and IWD Program”) and 18.1.30 (“Reactor Vessel and Internals Structural Integrity Program”).

A.4 Time Limited Aging Analyses (54.21 [c] [1])

The BSEP, Units 1 and 2 UFSAR 18.2 (“Evaluation of Time Limited Aging Analyses”) addresses time limited aging analyses. Section 18.2.2 (“Metal Fatigue”) addresses the station requirements for fatigue management. Section UFSAR 18.1.1 (“ASME Section XI, Inservice Inspection, Subsections IWB, IWC, and IWD Program”) and 18.1.30 (“Reactor Vessel and Internals Structural Integrity Program”) implement the various inspection requirements to satisfy 10 CFR 54.21.

Therefore, the use of ASME Code Case N-702 provides and acceptable level quality and safety in accordance with 10CFR50.55a(z)(1) for all applicable full penetration RPV nozzle-to-vessel shell welds and nozzle inner radii sections for the Fifth 10-Year ISI Interval.

6. Duration of Proposed Alternative

Typically, the duration for requests approved under the provisions of 10 CFR 50.55a(z) are limited to the active inservice inspection ten-year interval for which they are submitted. However, there are instances where the NRC approved requests under the provisions of 10 CFR 50.55a(z) for durations longer than the 10 years associated with an inservice inspection interval. For example, licensee's requests to reduce examinations of BWR reactor vessel circumferential welds based on BWRVIP-05 (Reference 3). In an NRC internal memorandum (Reference 7), among other topics related to Code Case N-702, the NRC concluded that their approval for multiple intervals is appropriate if the licensee uses bounding values for fluence up to 60 years.

As stated herein, the bounding fluence for up to 60 years for the reactor vessel nozzles and inner radii subject to this request is less than 1E+17 n/cm^2. Therefore, BSEP requests approval of this proposed alternative for the remainder of the fifth ISI intervals of BSEP, Units 1 and 2 (ending May 10, 2028 for both units), and through the period of extended operation (PEO) which ends on September 8, 2036, for BSEP, Unit 1, and December 27, 2034, for BSEP, Unit 2.

7. Precedents

1. BSEP, Units 1 and 2, Fourth ISI interval Relief Request ISI-05 was authorized by NRC Safety Evaluation dated January 31, 2011 (ADAMS Accession No. ML110060504). Relief Request ISI-05 for the BSEP, Units 1 and 2, fourth ten-year ISI interval utilizes a similar approach to apply the proposed alternative in accordance with ASME Code Case N-702.
2. BSEP Unit 1 and 2 – Fifth ISI Interval Relief Request ISI-09 was authorized by NRC Safety Evaluation dated May 9, 2018, (ADAMS Accession No. ML18124A305). Relief Request ISI-09 for the BSEP, Unit 1 and 2, utilizes a similar approach to apply proposed alternative through the period of extended operation (PEO) which ends on September 8, 2036, for BSEP Unit 1, and December 27, 2034, for BSEP Unit 2.
3. Browns Ferry Nuclear Plant, Units 1, 2, and 3 – Relief From the Requirements of American Association of Mechanical Engineers Code Section XI Inservice Inspection Program, Request for An Alternative ISI-46 (EPID L-2018-LLR-0074), Dated: February 28, 2019 (ADAMS Accession No. ML19016A215).
4. Fermi 2 Power Plant - Submittal of the Inservice Inspection / Nondestructive Examination Program Relief Requests for the Fourth Ten-Year Interval, Relief Request RR-A37, Alternative Requirements for Examination of Boiling Water Reactor (BWR) Nozzle Inner Radius Sections and Nozzle-to-Shell Welds, Dated: August 19, 2019 (ADAMS Accession No. ML19183A472).
5. Hatch Nuclear Plant, Unit 1 and 2 - Alternative HNP-181-ALT -05-05, ASME Section XI, 2007 Edition with 2008 Addenda, Code Case N-702, Dated: June 05, 2017 (ADAMS Accession No. ML18102B016).

8. References

1. ASME Section XI Code Case N-702, “Alternative Requirements for Boiling Water Reactor (BWR) Nozzle Inner Radius and Nozzle-to Shell Welds, Section XI, Division 1.”

2. NRC Regulatory Guide 1.147, “Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," Revision 19. (ADAMS Accession No. ML19128A244)

3. BWRVIP-05; “BWR Vessel and Internals Project, BWR Reactor Pressure Vessel Shell Weld Inspection Recommendations”, EPRI TR-105697, September 1995 (ADAMS Accession No. ML032200246)

4. BWRVIP-108NP-A; “BWR Vessel and Internals Project Technical Basis for the Reduction of Inspection Requirements for Boiling Water Reactor Nozzle-to-Vessel Shell Welds and Nozzle Blend Radii”, EPRI TR-3002013092, October 2018. (ADAMS Accession No. ML19297F806)

5. BWRVIP-241NP-A: “BWR Vessel Internal Project, Probabilistic Fracture Mechanics Evaluation for the Boiling Water Reactor Nozzle-to-Vessel Shell Welds and Nozzle Blend Radii”, EPRI TR-3002013093, October 2018. (ADAMS Accession No. ML19297G738)

6. NRC SER: Safety Evaluation for the License Renewal Appendix A for BWRVIP-241-A and BWRVIP-108NP-A, Document Date: March 24, 2017 (ADAMS Accession No. ML17003A014)

7. Memorandum dated August 21, 2017 from Michael L. Marshall, Jr., Senior Project Manager Plant Licensing Branch I Division of Operating Reactor Licensing Office of Nuclear Reactor Regulation to James G. Danna, Chief Plant Licensing Branch I Division of Operating Reactor Licensing Office of Nuclear Reactor Regulation, “Summary of Internal NRC Staff Meetings Concerning ASME Code Case N-702, Alternative Requirements for Boiling Water Reactor (BWR) Nozzle Inner Radius and Nozzle-to-Shell Welds, Section XI, Division”. (ADAMS Accession No. ML17215A512)

Enclosure 2
Applicable BSEP, Unit 1 Nozzles

Component ID	Examination Category	Item Number	System	Nominal Pipe Size
N1A	B-D	B3.90	Recirc Outlet**	28"
N1A-IRS	B-D	B3.100	Recirc Outlet**	28"
N1B	B-D	B3.90	Recirc Outlet**	28"
N1B-IRS	B-D	B3.100	Recirc Outlet**	28"
N2A	B-D	B3.90	Recirc Inlet	12"
N2A-IRS	B-D	B3.100	Recirc Inlet	12"
N2B	B-D	B3.90	Recirc Inlet	12"
N2B-IRS	B-D	B3.100	Recirc Inlet	12"
N2C	B-D	B3.90	Recirc Inlet	12"
N2C-IRS	B-D	B3.100	Recirc Inlet	12"
N2D	B-D	B3.90	Recirc Inlet	12"
N2D-IRS	B-D	B3.100	Recirc Inlet	12"
N2E	B-D	B3.90	Recirc Inlet	12"
N2E-IRS	B-D	B3.100	Recirc Inlet	12"
N2F	B-D	B3.90	Recirc Inlet	12"
N2F-IRS	B-D	B3.100	Recirc Inlet	12"
N2G	B-D	B3.90	Recirc Inlet	12"
N2G-IRS	B-D	B3.100	Recirc Inlet	12"
N2H	B-D	B3.90	Recirc Inlet	12"
N2H-IRS	B-D	B3.100	Recirc Inlet	12"
N2J	B-D	B3.90	Recirc Inlet	12"
N2J-IRS	B-D	B3.100	Recirc Inlet	12"
N2K	B-D	B3.90	Recirc Inlet	12"
N2K-IRS	B-D	B3.100	Recirc Inlet	12"
N3A	B-D	B3.90	Main Steam	24"
N3A-IRS	B-D	B3.100	Main Steam	24"
N3B	B-D	B3.90	Main Steam	24"
N3B-IRS	B-D	B3.100	Main Steam	24"
N3C	B-D	B3.90	Main Steam	24"
N3C-IRS	B-D	B3.100	Main Steam	24"
N3D	B-D	B3.90	Main Steam	24"
N3D-IRS	B-D	B3.100	Main Steam	24"
N5A	B-D	B3.90	Core Spray	10"
N5A-IRS	B-D	B3.100	Core Spray	10"
N5B	B-D	B3.90	Core Spray	10"

Component ID	Examination Category	Item Number	System	Nominal Pipe Size
N5B-IRS	B-D	B3.100	Core Spray	10"
N6A	B-D	B3.90	Head Spray	6"
N6A-IRS	B-D	B3.100	Head Spray	6"
N6B	B-D	B3.90	Head Spray	6"
N6B-IRS	B-D	B3.100	Head Spray	6"
N8A	B-D	B3.90	Jet Pump Instrumentation	4"
N8A-IRS	B-D	B3.100	Jet Pump Instrumentation	4"
N8B	B-D	B3.90	Jet Pump Instrumentation	4"
N8B-IRS	B-D	B3.100	Jet Pump Instrumentation	4"
N11A	B-D	B3.90	Instrumentation	2"
N11A-IRS	B-D	B3.100	Instrumentation	2"
N11B	B-D	B3.90	Instrumentation	2"
N11B-IRS	B-D	B3.100	Instrumentation	2"
N12A	B-D	B3.90	Instrumentation	2"
N12A-IRS	B-D	B3.100	Instrumentation	2"
N12B	B-D	B3.90	Instrumentation	2"
N12B-IRS	B-D	B3.100	Instrumentation	2"

*IRS – Inner Radius Section

** - See Enclosure 4 for plant specific justification

Enclosure 3
Applicable BSEP, Unit 2 Nozzles

Component ID	Examination Category	Item Number	System	Nominal Pipe Size
N1A	B-D	B3.90	Recirc Outlet**	28"
N1A-IRS	B-D	B3.100	Recirc Outlet**	28"
N1B	B-D	B3.90	Recirc Outlet**	28"
N1B-IRS	B-D	B3.100	Recirc Outlet**	28"
N2A	B-D	B3.90	Recirc Inlet	12"
N2A-IRS	B-D	B3.100	Recirc Inlet	12"
N2B	B-D	B3.90	Recirc Inlet	12"
N2B-IRS	B-D	B3.100	Recirc Inlet	12"
N2C	B-D	B3.90	Recirc Inlet	12"
N2C-IRS	B-D	B3.100	Recirc Inlet	12"
N2D	B-D	B3.90	Recirc Inlet	12"
N2D-IRS	B-D	B3.100	Recirc Inlet	12"
N2E	B-D	B3.90	Recirc Inlet	12"
N2E-IRS	B-D	B3.100	Recirc Inlet	12"
N2F	B-D	B3.90	Recirc Inlet	12"
N2F-IRS	B-D	B3.100	Recirc Inlet	12"
N2G	B-D	B3.90	Recirc Inlet	12"
N2G-IRS	B-D	B3.100	Recirc Inlet	12"
N2H	B-D	B3.90	Recirc Inlet	12"
N2H-IRS	B-D	B3.100	Recirc Inlet	12"
N2J	B-D	B3.90	Recirc Inlet	12"
N2J-IRS	B-D	B3.100	Recirc Inlet	12"
N2K	B-D	B3.90	Recirc Inlet	12"
N2K-IRS	B-D	B3.100	Recirc Inlet	12"
N3A	B-D	B3.90	Main Steam	24"
N3A-IRS	B-D	B3.100	Main Steam	24"
N3B	B-D	B3.90	Main Steam	24"
N3B-IRS	B-D	B3.100	Main Steam	24"
N3C	B-D	B3.90	Main Steam	24"
N3C-IRS	B-D	B3.100	Main Steam	24"
N3D	B-D	B3.90	Main Steam	24"
N3D-IRS	B-D	B3.100	Main Steam	24"
N5A	B-D	B3.90	Core Spray	10"
N5A-IRS	B-D	B3.100	Core Spray	10"
N5B	B-D	B3.90	Core Spray	10"

Component ID	Examination Category	Item Number	System	Nominal Pipe Size
N5B-IRS	B-D	B3.100	Core Spray	10"
N6A	B-D	B3.90	Head Spray	6"
N6A-IRS	B-D	B3.100	Head Spray	6"
N6B	B-D	B3.90	Head Spray	6"
N6B-IRS	B-D	B3.100	Head Spray	6"
N8A	B-D	B3.90	Jet Pump Instrumentation	4"
N8A-IRS	B-D	B3.100	Jet Pump Instrumentation	4"
N8B	B-D	B3.90	Jet Pump Instrumentation	4"
N8B-IRS	B-D	B3.100	Jet Pump Instrumentation	4"
N11A	B-D	B3.90	Instrumentation	2"
N11A-IRS	B-D	B3.100	Instrumentation	2"
N11B	B-D	B3.90	Instrumentation	2"
N11B-IRS	B-D	B3.100	Instrumentation	2"
N12A	B-D	B3.90	Instrumentation	2"
N12A-IRS	B-D	B3.100	Instrumentation	2"
N12B	B-D	B3.90	Instrumentation	2"
N12B-IRS	B-D	B3.100	Instrumentation	2"

*IRS – Inner Radius Section

** - See Enclosure 4 for plant specific justification

Enclosure 4
BSEP, Units 1 and 2, N1 Nozzle Probabilistic Fracture Mechanics Evaluation

As noted in Enclosure 1, the BSEP Recirculation Outlet Nozzle (N1) does not meet the criteria from BWRVIP-241. Therefore, a plant specific probabilistic fracture mechanics (PFM) evaluation was performed to demonstrate that the outlet nozzle meets the probability of failure (PoF) limits and can apply the inspection coverage of BWRVIP-241.

Table 4-1 provides the PoF values for the low temperature over pressure (LTOP) condition from the plant specific N1 PFM evaluation for 60 years. No failures occurred in one million simulations of the LTOP condition, and thus the conditional PoF is <1 failure / 1 million simulations / 60 years = 1.67×10^{-8} /year. The LTOP PoF values per year (25% inspection, 60 years) have been calculated using the conditional PoF per year from the PFM evaluation and the LTOP event frequency of 1×10^{-3} /year (BWRVIP-241, Section 5.5). For all stress paths (i.e. Paths 1 through 4), the LTOP PoF values (25% inspection, 60 years) are below the allowable PoF of 5.0×10^{-6} in NUREG-1806, Volume 2, "Technical Basis for Revision of the Pressurized Thermal Shock (PTS) Screening Limit in the PTS Rule (10 CFR 50.61)."

Table 4-1
Probability of Failure, 25% Inspection Coverage (LTOP Event)

Location	PoF per year due to LTOP Event (25% Inspection, 60 Years)	Allowable PoF per year (NUREG-1806)
Nozzle Blend Radius (Path 1)	$< 1.67 \times 10^{-11}$ (NF)	5.0×10^{-6}
Nozzle Blend Radius (Path 2)	$< 1.67 \times 10^{-11}$ (NF)	
Nozzle-to-Shell Weld (Path 3)	$< 1.67 \times 10^{-11}$ (NF)	
Nozzle-to-Shell Weld (Path 4)	$< 1.67 \times 10^{-11}$ (NF)	

Note: NF = no failure in one million simulations

Table 4-2 provides the PoF values for normal operation from the plant specific N1 PFM evaluation for 60 years. No failures occurred in one million simulations of normal operation, and thus the PoF is < 1 failure / 1 million simulations / 60 years = 1.67×10^{-8} /year. For all stress paths (i.e. Paths 1 through 4), the normal operation PoF values (25% inspection, 60 years) are below the allowable PoF of 5.0×10^{-6} in NUREG-1806.

Table 4-2 Probability of Failure, 25% Inspection Coverage (Normal Operation)		
Location	**PoF per year due to Normal Operation (25% Inspection, 60 Years)**	**Allowable PoF per year (NUREG-1806)**
Nozzle Blend Radius (Path 1)	$< 1.67 \times 10^{-8}$ (NF)	5.0×10^{-6}
Nozzle Blend Radius (Path 2)	$< 1.67 \times 10^{-8}$ (NF)	
Nozzle-to-Shell Weld (Path 3)	$< 1.67 \times 10^{-8}$ (NF)	
Nozzle-to-Shell Weld (Path 4)	$< 1.67 \times 10^{-8}$ (NF)	

Note: NF = no failure in one million simulations

For both LTOP (Table 4-1) and normal operation (Table 4-2), the PoFs for Paths 1 and 2 in the nozzle blend radius and Paths 3 and 4 in nozzle-to-shell weld are below the NUREG-1806 allowable PoF. Therefore, the proposed change for the BSEP, Units 1 and 2, Recirculation Outlet Nozzle (N1) is acceptable for the remainder of the period of extended operation based on the guidance provided in NUREG-1806.