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October 5, 2022

G02-22-104

10 CFR 50.55a

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

Subject: **COLUMBIA GENERATING STATION, DOCKET NO. 50-397**
FOURTH TEN-YEAR INTERVAL INSERVICE INSPECTION PROGRAM
RELIEF REQUEST 4ISI-11

Dear Sir or Madam:

Pursuant to 10 CFR 50.55a(z)(1), Energy Northwest hereby requests NRC approval of the attached relief request related to the fourth ten-year inservice inspection (ISI) program at Columbia Generating Station (Columbia). The details of the 10 CFR 50.55a request are included in the Enclosure.

Approval of this alternative is requested within one year of this submittal. Once approved, the relief request shall be implemented within 60 days.

There are no new commitments made in this submittal. If you have any questions or require additional information, please contact Mr. R.M. Garcia, Licensing Supervisor, at 509-377-8463.

Executed this 5th day of OCTOBER, 2022

Respectfully,

Jeremy S. Hauger
Vice President Engineering

Enclosure: As stated

cc: NRC Region IV Administrator
NRC NRR Project Manager
NRC Sr. Resident Inspector
CD Sonoda - BPA
EFSECutc.wa.gov – EFSEC
E Fordham – WDOH
R Brice – WDOH
L Albin – WDOH

10 CFR 50.55a Request Number 4ISI-11
Alternative Requirements for Reactor Pressure Vessel Circumferential Weld Examinations
Proposed Alternative In Accordance with 10 CFR 50.55a(z)(1)
--Alternative Provides Acceptable Level of Quality and Safety--

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

Code Class: 1
Examination Category: B-A
Item Number: B1.11
Component Description: Reactor Pressure Vessel (RPV) Circumferential Welds
Component Numbers: See Table 1

Table 1

Weld No.	Description	Code Category	Item No.
AA	Bottom head to #1 shell course	B-A	B1.11
AB	#1 shell course to #2 shell course	B-A	B1.11
AC	#2 shell course to #3 shell course	B-A	B1.11
AD	#3 shell course to #4 shell course	B-A	B1.11

2. Applicable Code Edition and Addenda

The Columbia Generating Station (Columbia) Inservice Inspection (ISI) is in its fourth ten-year interval. The applicable code is American Society of Mechanical Engineers (ASME) Code Section XI, Division 1, 2007 Edition with the 2008 Addenda.

3. Applicable Code Requirement

The ASME Section XI, Division 1, 2007 Edition with the 2008 Addenda (the Code), Table IWB-2500-1, Category B-A, Item No. B1.11, requires volumetric examination of essentially 100% of the weld length for RPV circumferential welds.

4. Reason for Request

Energy Northwest requests an alternative in accordance with 10 CFR 50.55a(z)(1) on the basis that this alternative provides an acceptable level of quality and safety. The alternative is relief from circumferential weld examinations required by the Code from the current fourth ISI interval through the period of extended operation (PEO). Columbia will continue to perform volumetric examinations of essentially 100 percent of the RPV axial shell welds and approximately two to three percent of circumferential welds will be volumetrically examined at their points of intersection with the RPV axial welds.

As documented in NUREG-2123, Volume 2, (Reference 1), Section 4.2.5 "Reactor Vessel Circumferential Weld Examination Relief", the Nuclear Regulatory Commission (NRC) has concluded that the evaluation for the Time Limiting Aging Analysis (TLAA) for Columbia's RPV circumferential welds is acceptable because 1) the 54 effective full power years (EFPY) conditional failure probability will remain bounded by the NRC analysis in the staff's safety evaluation report (SER) dated July 28, 1998 (Reference 2), and 2) the applicant will be using procedures and training to limit cold overpressure events during the period of extended operation. The NRC also stated that the analysis is consistent with the evaluation criteria in the staff's SER for Boiling Water Reactor (BWR) Vessel and Internals Project (BWRVIP) report BWRVIP-05 (Reference 3); however, the applicant is still required to request relief from RPV circumferential weld examination requirements for ISI intervals over the extended period of operation, in accordance with 10 CFR 50.55a.

5. Proposed Alternative and Basis for Use

The proposed alternative is the elimination of the RPV circumferential weld examinations, except for the intersection at the axial welds. Report BWRVIP-05 (Reference 3) provides the technical basis for eliminating inspections of RPV circumferential shell welds. This report was transmitted to the NRC in September 1995 and in their July 28, 1998 final safety evaluation (SE) the NRC staff concluded the failure frequency for RPV circumferential welds is sufficiently low to justify elimination of inservice inspection (Reference 2).

On November 10, 1998, the NRC issued Generic Letter (GL) 98-05 (Reference 5) informing BWR licensees that they may request permanent relief from the inservice inspection requirements of 10 CFR 50.55a(g) for the volumetric examination of RPV circumferential welds, Code Category B-A, Item Number B1.11 by demonstrating compliance with the following criterion:

1) At the expiration of their license, the circumferential welds will continue to satisfy the limiting conditional failure probability for circumferential welds in the staff's July 28, 1998 safety evaluation (Reference 2), and

2) Licensees have implemented operator training and established procedures that limit the frequency of cold over-pressure events to the amount specified in the staff's July 28, 1998, safety evaluation (Reference 2).

Criterion 1 - At the expiration of their license, the circumferential welds will continue to satisfy the limiting conditional failure probability for circumferential welds in the staff's July 28, 1998, safety evaluation.

Energy Northwest Response

The NRC evaluation of the BWRVIP-05 report included a Probabilistic Fracture Mechanics (PFM) analysis to estimate RPV failure probabilities. Three key assumptions in the PFM analysis are:

1) The neutron fluence was that estimated to be the end-of-license mean fluence;
2) The chemistry values are mean values based on vessel types; and
3) The potential for beyond design basis events is considered.

For Columbia's RPV, the single circumferential weld joint located between shell course 1 and shell course 2 within the beltline region (identified as weld AB) is the limiting circumferential weld. For plants such as Columbia, with RPVs fabricated by Chicago Bridge & Iron (CB&I), the mean end-of-license neutron fluence used in the NRC PFM analysis is 0.51E+19 n/cm^2 at 32 EFPY and 1.02E+19 n/cm^2 at 64 EFPY as shown in Table 2.6-4 and 2.6-5, respectively, of (Reference 2). The fluence value for the limiting circumferential weld at the expiration of Columbia's extended operating license (estimated at 54 EFPY) is 4.20E+17 n/cm^2. Thus, the fluence effect on embrittlement for Columbia is bounded by the fluence assumed for the corresponding weld in the NRC PFM analysis for both 32 and 64 EFPY.

Table 2 of this Enclosure presents a comparison of the chemistry related data for Columbia's RPV and the values assumed in the NRC's safety evaluation for the BWRVIP-05 report (Reference 2). The calculated embrittlement shift in RT_{NDT} (ΔRT_{NDT}) for the limiting circumferential weld at Columbia (weld AB) at the end of the extended license (54 EFPY) is 33 °F. By comparison, Table 2.6-5 of (Reference 2) indicates an allowable embrittlement shift of 135.6 °F at 64 EFPY for CB&I fabricated vessels. The values listed in Table 2 show that although the initial unirradiated reference temperature of -50°F is slightly above the NRC estimated value of -65°F for CB&I, all the remaining parameters either meet or are bounded by the NRC PFM assumptions. An additional margin of conservatism exists considering Columbia's fluence and ΔRT_{NDT} values at 54 EFPY are less than those of the 32 EFPY assumed in the Staff's analysis in Table 2.6-4 and well below those for 64 EFPY presented in Table 2.6-5.

For these reasons, the limiting circumferential weld at Columbia is less brittle than the corresponding weld in the NRC's PFM case study and is therefore bounded by the Staff's limiting conditional failure probability for CB&I circumferential welds. Thus, Criterion 1 of GL 98-05 is met.

Criterion 2 - Licensees have implemented operator training and established procedures that limit the frequency of cold over-pressure events to the amount specified in the staff's July 28, 1998, safety evaluation.

Energy Northwest Response

In GL 98-05, the NRC stated that beyond design-basis events occurring during plant shutdown could lead to Low Temperature Over-Pressure (LTOP) events that could challenge RPV integrity. The BWRVIP assessment indicated that the major contribution to LTOP event frequency results from unmitigated injections from condensate or control rod drive systems and a failure to properly realign the reactor water cleanup system following a reactor trip at low temperatures. For a BWR to experience such an event would require several operator errors. Although no LTOP events have occurred at a domestic BWR, the NRC identified several events that could be considered precursors to such an event and cited one actual LTOP event that occurred at a foreign BWR. Energy Northwest has initiated several actions intended to preclude a similar event at Columbia which include:

- Procedural Controls to Prevent LTOP Events
- Work Management Control
- Operator Training to Prevent RPV LTOP Events
- Industry Events Review

Procedural Controls to Prevent LTOP Events

Operating procedures at Columbia are barriers that make an LTOP event unlikely during low temperature evolutions such as RPV pressure testing at the conclusion of a refueling outage. These procedures require monitoring and control of reactor water level, pressure, and temperature during cold shutdown and refueling operations.

The Operations procedures governing control room activities require that operators continuously monitor indications and alarms, to detect abnormalities as early as possible, and immediately notify the control room supervisor of any changes or abnormalities in indications. Station procedures require that changes, which could affect reactor water level, pressure, or temperature, be performed only under the auspices of a Senior Reactor Operator (SRO). This ensures any deviations in reactor water level or temperature from specified parameters will be promptly identified and corrected. Additionally, at each shift brief, operators discuss plant status, major operational concerns, ongoing or planned Maintenance activities, changes to plant radiological conditions, shift assignments/goals, safety concerns, Night Orders, Operations Instructions, In-progress procedures, and any other items of concern or interest. This ensures that on-coming operators are aware of any activities that could adversely affect reactor water level, pressure, or temperature. These procedures minimize the

likelihood of an LTOP event from occurring and are reinforced through periodic operator training.

Work Management Control

A review of industry operating experience indicates that inadequate work management is a potential contributor to a cold over-pressure event. At Columbia, an outage management group schedules work performed during outages. All work activities are reviewed against a shutdown safety plan and coordinated through an outage control center, which provides operations oversight. In the control room, during plant maneuvering, an Operator is assigned key parameters to closely monitor during activities that can impact those parameters. Pre-job briefings are conducted for work activities that have the potential of affecting critical reactor parameters. The individuals involved in the work activity attend these briefings and discuss expected plant responses and contingency actions to address unexpected events or conditions that may be encountered.

Operator Training to Prevent RPV LTOP Events

Procedural controls for reactor temperature, level, and pressure are an integral part of operator training. Specifically, operators are trained in methods of controlling water level within specified limits, as well as responding to abnormal water level conditions outside the established limits.

Licensed operator training further reduces the possibility of an LTOP event. The initial licensed operator training curriculum covers brittle fracture and vessel thermal stress; operational transient procedures, including the operational transient on reactor high water level; technical specifications limiting conditions for operation, and simulator training of plant heat up and cool down including performance of surveillance tests which ensure pressure/temperature curve adherence. In addition, periodic operator training reinforces management's expectations for strict procedural compliance and conservative decision-making.

Industry Events Review

Energy Northwest continuously reviews operating experience to ensure Columbia's procedures and training are revised to benefit from lessons learned from industry events, including LTOP events. This is done with the objective of precluding similar events from occurring at Columbia.

Considering the operational and administrative barriers discussed above, the probability that the operator fails to take action to mitigate coolant injection is low enough to assure the frequency of an LTOP event at Columbia is bounded by the amount specified in the NRC's safety evaluation (Reference 2). Thus, Criterion 2 of GL 98-05 is met.

Conclusion

The BWRVIP-05 report provides the technical basis for eliminating inspection of BWR RPV circumferential shell welds. The BWRVIP-05 report concludes that the probability of failure of the BWR RPV circumferential shell welds is orders of magnitude lower than that of the axial shell welds. Based on an assessment of the materials in the limiting circumferential weld in the beltline of Columbia's RPV, the conditional probability of RPV failure is less than or equal to that estimated in the NRC's analysis through the end of the PEO. Based on established operator training, practices and procedural controls, the frequency of an LTOP event at Columbia is less than or equal to the frequency assumed in the NRC's July 28, 1998, safety evaluation.

Therefore, Energy Northwest herein requests approval to implement this alternative examination methodology for Columbia as allowed by the SE of BWRVIP-05 and proposes to modify Columbia's ISI schedule to perform volumetric examinations of essentially 100 percent of the RPV axial shell welds and only the approximate two to three percent of the circumferential welds at the points of intersection with the RPV axial welds.

6. Duration of Proposed Relief Alternative

The duration of this request is for the remainder of plant life including the period of extended operation ending on December 12, 2043.

7. Precedents

The NRC has authorized similar requests to adopt an alternative to the ASME Section XI, Table IWB-2500-1, Examination Category B-A, Item. No. B1 .11 criteria for permanent relief from the volumetric examination of RPV circumferential shell welds for the PEO operation. Similar relief requests have been granted to:

- Cooper Nuclear Station- Requests for Relief Associated with the Fifth 10-Year Inservice Inspection Interval Program (CAC Nos. MG0175 Through MG0179; EPIDS L-2017-LLR-0062 Through L-2017-LLR-0066), Accession No. ML18183A325, July 31, 2018.

- Brunswick Steam Electric Plant, Units 1 & 2 – Alternative for ISI-09 Regarding Reactor Pressure Vessel Shell Welds Fourth Ten-Year Inservice Inspection Interval (EPID L-2018-LLR-0001), Accession No. ML18124A305, May 9, 2018.

- Susquehanna Steam Electric Station, Units 1 and 2 - Relief Request 4RR-02, Regarding Extension of Permanent Relief from Ultrasonic Examination of Reactor Pressure Vessel Circumferential Shell Welds (EPID L-2020-LLR-0152), Accession No. ML21095A304, April 19, 2021.

8. References

1. NUREG-2123, "Safety Evaluation Report Related to the License Renewal of Columbia Generating Station" Volume 2, Docket Number 50-397, (Accession No. ML12139A302).

2. Letter, Gus C. Lainas (NRC) to Carl Terry, BWRVIP Chairman, "Final Safety Evaluation of the BWR Vessel and Internals Project BWRVIP-05 Report (TAC No. MA3925), dated July 28, 1998, (Accession Nos. ML20236V550 & ML20236V555).

3. EPRI Proprietary Report TR-105697, "BWR Vessel and Internals Project BWR Reactor Pressure Vessel Shell Weld Inspection Recommendations (BWRVIP-05)," dated September 1995, (Accession No. ML20098B288).

4. Letter, Jack R. Strosnider (NRC) to Carl Terry, BWRVIP Chairman, "Supplement to Final Safety Evaluation of the BWR Vessel and Internals Project BWRVIP-05 Report (TAC No. MA3395), dated March 7, 2000, (Accession No. ML003690281).

5. NRC Generic Letter 98-05, "Boiling Water Reactor Licensees Use of the BWRVIP-05 Report to Request Relief from Augmented Examination Requirements on Reactor Pressure Vessel Circumferential Shell Welds," November 10, 1998, (Accession No. ML03140368)

TABLE 2
Columbia Generating Station RPV
Circumferential Weld AB Information

	Columbia's Limiting Circumferential Weld Wire [2]	USNRC Limiting Plant Specific Analyses Parameters	
		32 EFPY	64 EFPY
Neutron fluence at the end-of-license [1] (n/cm^2)	4.20E+17	0.51E+19	1.02E+19
Initial (unirradiated) reference temperature (RT_{NDT})	-50°F	-65°F	-65°F
Weld chemistry factor (CF)	108°F	109.5°F	109.5°F
Weld copper content	0.08%	0.10%	0.10%
Weld nickel content	0.936%	0.99%	0.99%
Increase in reference temperature due to irradiation at 54 EFPY (ΔRT_{NDT})	33°F	109.5°F	135.6°F
Mean adjusted reference temperature (Mean ART = $RT_{NDT} + \Delta RT_{NDT}$)	-17°F	44.5°F	70.6°F

Notes:

1. The fluence at the end of extended life is projected for 54 EFPY
2. The weld wire data provided is for Heat No. 5P6756 of weld AB which is the limiting circumferential weld material in Columbia's RPV