

Oconee Proposed Alternative RA-22-0258 Pre-Submittal Meeting
Cold Leg High Pressure Injection (HPI) Nozzle Alloy 82/182 Welds
ASME Code Case (CC) N-770-7, Table 1 Item B-1

September 10, 2025



ASME Code Components Affected

ONS1 Alloy 82/182 Nozzle to Safe End Welds (NPS 2.5):

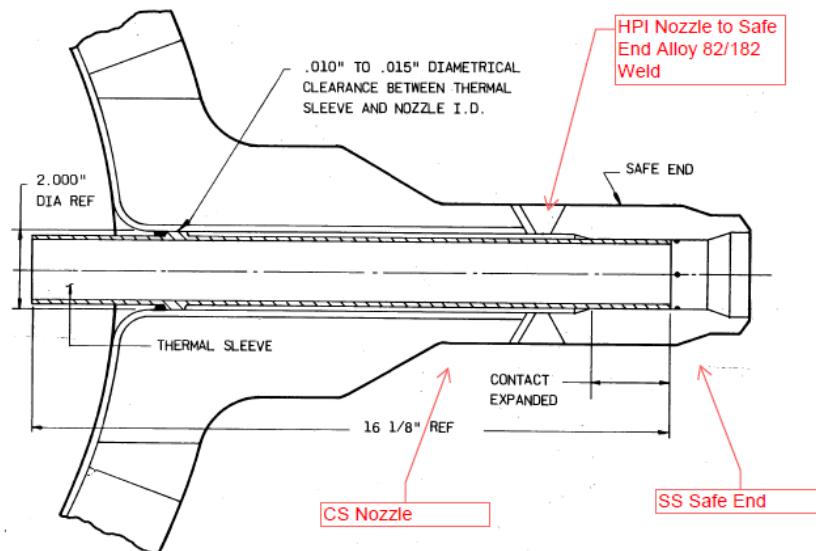
- 1A1 Cold Leg HPI (1-PDA1-11)
- 1A2 Cold Leg HPI (1-PDA2-11)
- 1B1 Cold Leg HPI (1-PDB1-11)
- 1B2 Cold Leg HPI (1-PDB2-11)

ONS2 Alloy 82/182 Nozzle to Safe End Welds (NPS 2.5):

- 2B2 Cold Leg HPI (2-PDB2-11)
- *Remaining (3) Unit 2 HPI welds replaced with Alloy 52/52M

ONS3 Alloy 82/182 Nozzle to Safe End Welds (NPS 2.5):

- 3B1 Cold Leg HPI (3-RC-212-53V)
- 3B2 Cold Leg HPI (3-PDB2-11)
- *Remaining (2) Unit 3 HPI welds replaced with Alloy 52/52M



Applicable Requirements and Background

- 10 CFR 50.55a(g)(6)(ii)(F)(1) requires use of CC N-770-7, subject to conditions
 - CC N-770-7 requires volumetric examination every 2nd inspection period (max 7 years) for Table 1 Inspection Item B-1
 - This is effectively a max of 6 years for Oconee due to 24-month fuel cycle
 - Condition 13 requires encoded ultrasonic testing (UT) method for unmitigated or cracked mitigated Alloy 82/182 DM butt welds
 - Includes Inspection Items B-1 (< NPS 14) and B-2 (\geq NPS 14)
- When an encoded method is required
 - A qualified outside UT vendor is contracted to perform each examination
 - The data generated by the UT probe is recorded along with probe positional information
- CC N-770-7 Table 1 Note (11)(d) allows volumetric examination of Inspection Item B-2 once per Code Interval (max 13 years)
 - The proposed alternative aligns the timing of the B-1 and B-2 examinations

Proposed Alternative and Basis for Use

- Duke Energy proposes an alternative under 10 CFR 50.55a(z)(1) to reduce the encoded UT examination frequency of the (7) HPI Alloy 82/182 welds from every 2nd inspection period (max 7 years) to once per Code Interval (max 13 years)
- Reduces the need to mobilize UT vendor personnel onsite and reduces personnel dose
- The basis includes a plant-specific crack growth calculation demonstrating that the time for a circumferential crack to grow to the allowable size limit for each of the welds identified is greater than 13 years
 - Axial primary water stress corrosion cracking (PWSCC) does not represent a credible rupture concern due to the critical size of an unstable through-wall axial crack being much greater than the axial extent of PWSCC-susceptible material
- Defense in depth is provided by the existing manual (unencoded) phased array UT examinations performed every other outage (every 4 years) to address the thermal fatigue degradation concern for thermal sleeves at branch connections (Generic Letter 85-20)

Proposed Alternative Schedule

Examination Schedule for Oconee Unit 1

Exam Requirements for ONS Unit 1: 1A1, 1A2, 1B1, and 1B2 HPI Nozzle-to-Safe End DM BW	6th Interval (7/15/2024 – 7/14/2036) ⁽¹⁾						7th Interval (7/15/2036 – 7/14/2048)						8th Interval (7/15/2048 – 2/6/2053) ⁽²⁾		Beyond License (Fall 2054)
	O1R33 (Fall 2024)	O1R34 (Fall 2026)	O1R35 (Fall 2028)	O1R36 (Fall 2030)	O1R37 (Fall 2032)	O1R38 (Fall 2034)	O1R39 (Fall 2036)	O1R40 (Fall 2038)	O1R41 (Fall 2040)	O1R42 (Fall 2042)	O1R43 (Fall 2044)	O1R44 (Fall 2046)	O1R45 (Fall 2048)	O1R46 (Fall 2050)	O1R47 (Fall 2052)
Visual Exam (VE) (N-722-1; N-770-7)	X						X						X		
Phased Array Encoded UT (N-770-5, -7, -X)	X			X			X			X			X		
Phased Array Encoded UT (Proposed Alt.)⁽³⁾	X						X						X		
Phased Array Manual UT (GL 85-20)		X		X		X		X		X		X		X	

Notes:

1. Based on Exemption Request RA-24-0291 (ML25128A041) to implement ASME Code Case N-921.
2. The renewed license end date for ONS Unit 1 is 02/06/2053.
3. ASME Code Case N-770-X, Item B-1 exams aligned with Item B-2 (Reactor Coolant Pump Suction and Discharge Nozzles).

- Proposed alternative RA-22-0258 will be submitted after approval of exemption request RA-24-0291 (ML25128A041), which permits a 12-year interval

Basis for the Proposed Alternative

- ***Cold Leg Alloy 82/182 Dissimilar Metal Butt Weld Operating Experience***
 - PWSCL has been infrequently reported to have affected Alloy 82/182 piping butt welds operating at reactor cold leg temperature (T_{cold}).
- ***Plant-Specific Circumferential Crack Growth Calculation***
 - In support of this relief request, a crack growth calculation was performed considering the specific geometry and loads applicable to the seven Oconee HPI nozzles with Alloy 82/182 welds, including plant-specific weld residual stress (WRS) analysis results. This calculation applied the standard flaw evaluation approach for Alloy 82/182 piping butt welds to model growth of a circumferential flaw due to PWSCL. This approach, which was performed in accordance with the procedure of IWB-3640 and Nonmandatory Appendix C of ASME Section XI under the assumption of an initial flaw at the assumed limit of UT detectability, has been applied in previous relief requests approved by NRC to extend the time between volumetric examinations of unmitigated and uncracked Alloy 82/182 piping butt welds.
- ***Maintenance of Structural Integrity***
 - The circumferential crack growth calculation shows that structural and leak tight integrity will be maintained for the possibility of circumferential PWSCL under the proposed alternative volumetric examination frequency. Axial PWSCL does not represent a credible rupture concern for the Affected Components regardless of the volumetric examination frequency.
- ***Maintenance of Defense in Depth***
 - On-going Manual Phased Array UT exams performed every other outage in conjunction with VT-2 per N-722-1 and N-770-7.

- The HPI nozzle Alloy 82/182 welds were last examined by a volumetric examination per NRC requirement 10 CFR 50.55a(g)(6)(ii)(F) and ASME Code Case N-770-2 or N-770-5 in Fall 2024 (O1R33), Fall 2021 (O2R30), and Spring 2022 (O3R31). There were no detections of PWSCC during these examinations.
- The next set of required encoded examinations is planned for Fall 2030 (O1R36), Fall 2025 (O2R32), and Spring 2026 (O3R33). These next encoded examinations for Units 2 and 3 are being coordinated with the UT examinations of the large-diameter Alloy 82/182 piping butt welds at the Reactor Coolant Pump suction and discharge nozzles per Inspection Item B-2 of ASME Code Case N-770-7.

Precedent

- Inspection Item B-1 (< NPS 14)
 - Arkansas Nuclear One (ANO), Unit 1 - Safety Evaluation dated 2/8/2021 (ML21026A260)
 - One-time extension for an unmitigated HPI nozzle Alloy 82/182 butt weld
 - Requested to align examination schedule with other HPI nozzles
 - Similar plant-specific circumferential crack growth calculation
 - Similar HPI nozzle configuration/size and B&W plant design
- Inspection Item B-2 (\geq NPS 14)
 - Oconee Nuclear Station, Units 2 and 3 - Safety Evaluation dated 4/13/2018 (ML18100A005)
 - Millstone Power Station, Unit 2 - Safety Evaluation dated 3/24/2020 (ML20080K508)
 - Similar plant-specific circumferential crack growth calculations
 - Item B-2 has since been generically approved for the once per Code Interval frequency via CC N-770-5

Duration of Proposed Alternative

- The alternative is requested to be implemented for the remainder of the 6th Inspection Interval and through the end of the current operating licenses
 - On-going Manual Phased Array UT exams performed every other outage in conjunction with VT-2 exams per N-722-1 and N-770-7 provide reasonable assurance to end of plant life. Also, the limiting case bounding the seven subject welds for the calculated time for a circumferential crack to grow from 10% through-wall to the maximum allowable size is 14.4 years, which is greater than the maximum of 13 calendar years between volumetric examinations permitted for Inspection Item B-2 in accordance with Note (11)(d) of Table 1 of Code Case N-770-7.
- The 6th Interval started on July 15, 2024 and is currently scheduled to end July 14, 2034*
 - *Exemption request RA-24-0291 (ML25128A041) submitted 5/8/2025 to allow a 12-year Inspection Interval per CC N-921 would extend the 6th Inspection Interval to July 14, 2036
 - Proposed alternative RA-22-0258 will be submitted after approval of exemption request RA-24-0291, which is currently projected October 30, 2025 (standard 1 year approval will be requested)

Current Plant Operating License Dates

	Docket Number	License Expires
Unit 1	05000269	02/06/2053
Unit 2	05000270	10/06/2053
Unit 3	05000287	07/19/2054