Ryan Treadway
General Manager (Acting)
Nuclear Regulatory Affairs, Policy &
Emergency Preparedness

Duke Energy
526 South Church St., EC08F
Charlotte, NC 28202

980-373-5873
Ryan.Treadway@duke-energy.com

Serial: RA-23-0154 10 CFR 50.55a
July 20, 2023

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

Catawba Nuclear Station, Unit Nos. 1 and 2
Docket Nos. 50-413, 50-414 / Renewed License Nos. NPF-35 and NPF-52

Shearon Harris Nuclear Power Plant, Unit 1
Docket No. 50-400 / Renewed License No. NPF-63

McGuire Nuclear Station, Unit Nos. 1 and 2
Docket Nos. 50-369, 50-370 / Renewed License Nos. NPF-9 and NPF-17

Oconee Nuclear Station, Unit Nos. 1, 2, and 3
Docket Nos. 50-269, 50-270, and 50-287 / Renewed License Nos. DPR-38, DPR-47, and DPR-55

H. B. Robinson Steam Electric Plant, Unit No. 2
Docket No. 50-261 / Renewed License No. DPR-23

SUBJECT: Response to Request for Additional Information Regarding Proposed Alternative for Pressurizer Welds in Accordance with 10 CFR 50.55a(z)(1)

REFERENCES:

1. Duke Energy letter, *Proposed Alternative for Pressurizer Welds in Accordance with 10 CFR 50.55a(z)(1)*, dated February 17, 2023 (ADAMS Accession No. ML23048A148)
2. NRC email, *Duke Fleet - Request for Additional Information RE: Proposed Alternative for Pressurizer Welds in Accordance with 10 CFR 50.55a(z)(1) (EPID L-2023-LLR-0020)*, dated May 30, 2023 (ADAMS Accession No. ML23151A348)

Ladies and Gentlemen:

In Reference 1, Duke Energy Carolinas, LLC and Duke Energy Progress, LLC (collectively referred to as Duke Energy) requested U.S. Nuclear Regulatory Commission (NRC) approval of a proposed alternative to certain requirements of the American Society of Mechanical Engineers (ASME) Code, Section XI for certain Pressurizer Pressure-Retaining Welds and Full-Penetration Welded Nozzles at Catawba Nuclear Station Units 1 and 2 (CNS), McGuire Nuclear Station Units 1 and 2 (MNS), Oconee Nuclear Station Units 1, 2, and 3 (ONS), Shearon Harris Nuclear Power Plant, Unit 1 (HNP), and H. B. Robinson Steam Electric Plant, Unit 2 (RNP).

In Reference 2, the NRC staff provided a request for additional information (RAI) regarding Reference 1. Enclosure 1 provides Duke Energy's response to the Reference 2 RAI.

Should you have any question concerning this letter and its enclosure, please contact Ryan Treadway, Director – Nuclear Fleet Licensing at (980) 373-5873.

No new regulatory commitments have been made in this submittal.

Sincerely,

Ryan Treadway
General Manager (Acting) - Nuclear Regulatory Affairs, Policy & Emergency Preparedness

Enclosure:
1. Response to Request for Additional Information

cc:

L. Dudes, USNRC, Region II Regional Administrator
N. Jordan, USNRC NRR Project Manager for Duke Fleet
M. Mahoney, USNRC NRR Project Manager for HNP
J. Klos, USNRC NRR Project Manager for MNS
S. Williams, USNRC NRR Project Manager for ONS and CNS
L. Haeg, USNRC NRR Project Manager for RNP
D. Rivard, USNRC Senior Resident Inspector for CNS
P. Boguszewski, USNRC Senior Resident Inspector for HNP
C. Safouri, USNRC Senior Resident Inspector for MNS
J. Nadel, USNRC Senior Resident Inspector for ONS
J. Zeiler, USNRC Senior Resident Inspector for RNP

Enclosure 1
Response to Request for Additional Information

Request for Additional Information (RAI)-1

Issue

The licensee referenced probabilistic and deterministic analyses in the above EPRI report to estimate potential fatigue crack growth in the subject PZR welds and to justify application of these analyses to the proposed examination deferral for the welds. The licensee presented plant-specific information to demonstrate that the referenced analyses in the EPRI report would bound the subject PZR welds, including the ISI history of the welds.

Leveraging PFM analyses to define the basis for risk-informing inspection requirements requires knowledge of both the current and future behavior of the material degradation and the associated uncertainties applicable to the subject PZR welds. Confidence in the results of these analyses hinges on the assurance that the PFM model adequately represents, and will continue to represent, the degradation behavior in the subject PZR welds. The NRC staff has determined that, when considering proposed deferral of examinations, adequate performance monitoring through inspections is needed to ensure that the assumptions of the PFM model remain valid, and that novel or unexpected degradation is detected and dispositioned in a timely fashion. Further, the staff has communicated concepts that licensees can implement on a fleet-wide basis to develop a performance monitoring plan and bolster the technical basis for alternative requests (see slide packages dated January 30, 2023, and April 27, 2023, at ML23033A667 and ML23114A034, respectively). In Section 5.0 of the enclosure to the submittal, the licensee described the various plant-specific examination scenarios and the proposed deferral of examinations. The licensee stated that the proposed alternative results in a maximum time period of approximately 20 years from the end of the interval in which the Section XI requirements were met in full until the end of the proposed alternative. The licensee did not provide a performance monitoring schema for the subject PZR welds.

The licensee discusses the system leakage test as “providing further assurance of safety” for the proposed alternative. However, the NRC staff notes that the visual examinations performed during system leakage tests may not provide sufficient information to ensure that the PFM model continues to predict the material behavior and that emergent degradation is discovered and dispositioned in a timely fashion. Specifically, visual examinations may not directly detect the presence or extent of degradation; may not provide direct detection of aging effects prior to potential loss of structure or intended function; and do not provide sufficient validating data necessary to confirm the modeling of degradation behavior in the subject PZR welds.

Request

a. Describe the performance monitoring that will be implemented with this proposed alternative to ensure that the PFM model adequately represents, and will continue to represent the degradation behavior in the subject components commensurate with the duration of the requested alternative.

b. Explain how this performance monitoring will provide, over the extended examination interval, (1) direct evidence of the presence and extent of degradation, (2) validation and confirmation of the continued adequacy of the PFM model; and (3) timely detection of novel or unexpected degradation.

c. If through this performance monitoring indications are detected that exceed the acceptance standards of ASME Code, Section XI, IWB-3500, confirm that they will be evaluated as required by ASME Code, Section XI (which includes requirements for successive inspections and additional examinations) and describe other actions (if any) specified in the plant's corrective action program to ensure that the integrity of the component is adequately maintained.

d. If through this performance monitoring indications are detected that exceed the acceptance standards of ASME Code, Section XI, IWB-3500, then scope expansion may be appropriate to assess extent of condition. Furthermore, if this performance monitoring plan or industry-wide operating experience indicates that a new or novel degradation mechanism is possible in SG welds or nozzle inner radii, scope expansion may be appropriate to ensure that no such mechanism is occurring in the subject plants. Discuss the detailed scope expansion plans for these scenarios.

<u>Duke Energy Response to RAI-1:</u>

a. Performance monitoring supporting this Alternative Request began with the Fourth Inspection Intervals for Catawba, Units 1 & 2, McGuire, Units 1 & 2, and Shearon Harris, Unit 1 and with the Fifth Inspection Intervals for H.B. Robinson, Unit 2 and Oconee, Units 1, 2, & 3. As documented in Table 1-2 below, the requested deferral lengths for Catawba, Units 1 & 2, McGuire, Units 1 &2, and Shearon Harris, Unit 1 range from 13.7 years up to 26.7 years. Therefore, a performance monitoring plan for these plants is described in detail below. All ASME code required exams have been completed for the 5th Intervals at H.B. Robinson, Unit 2 and Oconee, Units 1 & 2. Oconee Unit 3 has completed all required exams except for one B2.11 and one B2.12 exam scheduled for the upcoming Spring 2024 refueling outage (last outage of the 5th Interval). The requested deferral lengths for H.B. Robinson, Unit 2 and Oconee, Units 1, 2, & 3 range from 7.7 years to 18 years. Therefore, requested deferrals for all welds and components associated with H.B. Robinson, Unit 2 and Oconee, Units 1, 2, & 3 are below 20 years between examinations and as such do not require any performance monitoring. This is consistent with prior precedent where U.S. licensees have sought examination relief from prescriptive ASME Section XI requirements.

   As shown in the Inspection History Tables from Reference 1, a significant number of 4th Interval examinations have been completed across Catawba, Units 1 & 2 and Shearon Harris, Unit 1. Specifically, 14 of the required 30 Pressurizer Welds for the 4th interval have been inspected with no rejectable indications identified. These 4th Interval examinations utilized phased array ultrasonic testing (UT) techniques with component specific Non-Destructive Examination (NDE) modeling (when available) to maximize coverage. These modern UT techniques are far superior at detecting near surface or surface breaking flaws and in most cases obtained greater coverage compared to earlier interval preservice/inservice exams. These completed examinations (14/30 ≈ 47% of the total number of required code exams) across all three units satisfies the performance monitoring requirement for the remainder of the current 4th Intervals at Catawba, Units 1 & 2 and Shearon Harris, Unit 1.

   The performance monitoring plan covering the 5th Interval for Catawba, Units 1 & 2, and Shearon Harris, Unit 1 and the 5th/6th Intervals at McGuire, Units 1 & 2 will examine one weld from each Item Number across all five Units. Specifically, over a given inspection interval a total of five (5) Pressurizers would be examined comprised of 50 weld exams (each Pressurizer has 10 welds subject to ISI examination requirements each inspection interval). The proposed performance monitoring plan is to inspect a total of ten (10) different Pressurizer welds across all five Units that covers each Item Number and weld configuration equivalent to one complete Pressurizer. Two welds at each unit are selected for examination for even distribution. This ensures a diverse sampling across the Duke PWR Fleet rather than monitoring individual welds on a repetitive basis or examination of all the welds on a single Pressurizer at a particular Unit. The proposed performance monitoring plan selects the most time-limited welds since the last inspection, to the extent practical. The components to be examined are described in Table 1-1 below. Additionally, a visual calendar representation of the past inspection history including the proposed schedule of performance monitoring exams is shown in Figure 1-1.

Table 1-1: Proposed Performance Monitoring Plan

Station/Unit	ASME Category	ASME Item No.	Component ID Description	Number and Exam Method	Proposed Schedule (Year)[1]	Approximate Length of Time Since Last Exam (Years)
Catawba / Unit 1	B-D	B3.110	1PZR- W4A Safety Nozzle-to-Upper Head	1 Volumetric (UT)	Interval 5, Period 1 (Spring 2029)	18
Catawba / Unit 1	B-D	B3.110	1PZR-W4B Safety Nozzle-to-Upper Head	1 Volumetric (UT)	Interval 5, Period 1 (Spring 2029)	18
Catawba / Unit 2	B-B	B2.11	2PZR-W8E Circumferential Upper Shell-to-Head	1 Volumetric (UT)	Interval 5, Period 3 (Fall 2034)	16.5
Catawba / Unit 2	B-B	B2.12	2PZR-W9D Longitudinal Upper Shell-to-Head	1 Volumetric (UT)	Interval 5, Period 3 (Fall 2034)	16.5
McGuire / Unit 1	B-B	B2.11	1PZR-1 Circumferential Lower Shell-to-Head	1 Volumetric (UT)	Interval 5, Period 3 (Spring 2031)	15
McGuire / Unit 1	B-B	B2.12	1PZR-6 Longitudinal Lower Shell-to-Head	1 Volumetric (UT)	Interval 5, Period 3 (Spring 2031)	15
McGuire / Unit 2	B-D	B3.110	2PZR-10 Surge Nozzle-to-Lower Head	1 Volumetric (UT)	Interval 5, Period 3 (Spring 2032)	13.5
McGuire / Unit 2	B-D	B3.110	2PZR-15 Safety Nozzle-to-Upper Head	1 Volumetric (UT)	Interval 5, Period 3 (Spring 2032)	10.5
Shearon Harris / Unit 1	B-D	B3.110	II-PZR-01NTHW-09 Spray Nozzle-to-Upper Head	1 Volumetric (UT)	Interval 5, Period 2 (Spring 2031)	19
Shearon Harris / Unit 1	B-D	B3.110	II-PZR-01NTHW-13 Relief Nozzle-to-Upper Head	1 Volumetric (UT)	Interval 5, Period 3 (Fall 2034)	22

Notes:

1. The proposed year is subject to change in accordance with IWA-2430(c)(1) or ± one outage from the proposed schedule not to exceed the overall end date of 2035. This allows for possible unit transitions from an 18-month fuel cycle to a 24-month fuel cycle or other unforeseen plant radiation exposure limits or exam support issues. The proposed performance monitoring plan will be completed by the end of 2035.

<table>
<tr><th>Year / Plant</th><th>2012</th><th>2013</th><th>2014</th><th>2015</th><th>2016</th><th>2017</th><th>2018</th><th>2019</th><th>2020</th><th>2021</th><th>2022</th><th>2023</th><th>2024</th><th>2025</th><th>2026</th><th>2027</th><th>2028</th><th>2029</th><th>2030</th><th>2031</th><th>2032</th><th>2033</th><th>2034</th><th>2035</th><th>2036</th><th>2037</th><th>2038</th><th>2039</th><th>2040</th><th>2041</th><th>2042</th><th>2043</th><th>2044</th><th>2045</th><th>2046</th></tr>
<tr><td>Catawba 1</td><td colspan="3">3rd Interval</td><td colspan="8">4th Interval</td><td colspan="2">4th Interval</td><td colspan="4">5th Interval</td><td>X[1]</td><td colspan="6"></td><td colspan="7">6th Interval - ASME Code PZR Requirements Resume</td><td>12/5/2043</td><td colspan="3"></td></tr>
<tr><td>Catawba 2</td><td colspan="3">3rd Interval</td><td colspan="8">4th Interval</td><td colspan="4">4th Interval</td><td colspan="7">5th Interval</td><td>X[1]</td><td></td><td colspan="7">6th Interval - ASME Code PZR Requirements Resume</td><td>12/5/2043</td><td colspan="3"></td></tr>
<tr><td>H.B Robinson 2</td><td colspan="11">5th Interval</td><td colspan="7">6th Interval</td><td>7/31/2030</td><td colspan="16"></td></tr>
<tr><td>McGuire 1</td><td colspan="9">4th Interval</td><td colspan="10">5th Interval</td><td>X[1]</td><td colspan="9">6th Interval</td><td>6/12/2041</td><td colspan="5"></td></tr>
<tr><td>McGuire 2</td><td colspan="2">3rd Interval</td><td colspan="10">4th Interval</td><td colspan="8">5th Interval</td><td>X[1]</td><td colspan="2"></td><td colspan="8">6th Interval</td><td>3/3/2043</td><td colspan="3"></td></tr>
<tr><td>Oconee 1, 2, 3</td><td colspan="2">4th Interval</td><td colspan="10">5th Interval</td><td colspan="9">6th Interval</td><td colspan="2">#</td><td colspan="12"></td></tr>
<tr><td>Shearon Harris 1</td><td colspan="5">3rd Interval</td><td colspan="6">4th Interval</td><td colspan="5">4th Interval</td><td colspan="3">5th Interval</td><td>X</td><td colspan="2"></td><td>X</td><td colspan="3"></td><td colspan="8">6th Interval - ASME Code PZR Requirements Resume</td><td>10/24/2046</td></tr>
</table>

Notes:

1. Two separate exam item numbers are scheduled for the same refueling outage to minimize radiation exposure for related or adjacent exams. (i.e., Pressurizer circumferential (B2.11) and longitudinal (B2.12) welds are scheduled for the same outage since these welds intersect or a Pressurizer Safety and Relief nozzle are scheduled in the same outage due to their proximity to each other.)

LEGEND	
(green)	Inspection Interval prior to Alternative RA-22-0257
X	Scheduled Performance Monitoring Exam
(orange)	Deferral Period per RA-22-0257
(blue)	Subsequent Inspection Interval: Reverts Back to ASME Code Requirements
(red)	Current License Period End Date
#	Oconee Current License Period End Date: Unit 1 - 2/6/2033; Unit 2 - 10/6/2033; Unit 3 - 7/19/2034

Figure 1-1: Inservice Inspection Interval History and Performance Monitoring Schedule

The proposed performance monitoring plan for Duke Energy, will be performed by the end of 2035. This will ensure that no more than 22 years elapses between the performance of an ASME Code, Section XI, examination for each weld Item Number on a Pressurizer subject to examination requirements. Following completion of the proposed performance monitoring plan by 2035, none of the Duke Energy units covered by the proposed alternative will have operated more than 22 years between exams of each item number being performed at least once amongst the fleet. Following completion of the performance monitoring plan and the Fifth Inspection Intervals at Catawba, Units 1 & 2 and Shearon Harris, Unit 1, ASME Section XI Code required Pressurizer examinations for these plants will resume with the start of the Sixth Inspection Intervals as required per 10 CFR 50.55a(g)(4)(ii). These code required examinations satisfy the performance monitoring for McGuire, Units 1 & 2 thru the end of its current operating license.

Table 1-2: Summary of Inspection Deferrals in Proposed Alternative RA-22-0257

Station	Unit	ASME Category	Item No.	Component ID Component Description	Date of Last Inspection	End of Proposed Alternative	Length of Time[1] (Years)
Catawba	1	B-B	B2.11	1PZR-W8A Circumferential Lower Shell-to-Head	5/14/2014	End of 5th Interval, Scheduled to End 06/28/2035	21.1
		B-B	B2.11	1PZR-W8E Circumferential Upper Shell-to-Head	10/20/2021		13.7
		B-B	B2.12	1PZR-W9A Longitudinal Lower Shell-to-Head	5/14/2014		21.1
		B-B	B2.12	1PZR-W9D Longitudinal Upper Shell-to-Head	10/20/2021		13.7
		B-D	B3.110	1PZR-W1 Surge Nozzle-to-Lower Head	4/28/2011		25.3
		B-D	B3.110	1PZR-W2 Spray Nozzle-to-Upper Head	5/1/2017		18.2
		B-D	B3.110	1PZR-W3 Relief Nozzle-to-Upper Head	5/1/2017		18.2
		B-D	B3.110	1PZR-W4A Safety Nozzle-to-Upper Head	4/29/2011		24.2
		B-D	B3.110	1PZR-W4B Safety Nozzle-to-Upper Head	4/29/2011		24.2
		B-D	B3.110	1PZR-W4C Safety Nozzle-to-Upper Head	4/29/2011		24.2

Station	Unit	ASME Category	Item No.	Component ID Component Description	Date of Last Inspection	End of Proposed Alternative	Length of Time[1] (Years)
Catawba	2	B-B	B2.11	2PZR-W8A Circumferential Lower Shell-to-Head	9/28/2010	End of 5th Interval, Scheduled to End 08/18/2036	25.9
		B-B	B2.11	2PZR-W8E Circumferential Upper Shell-to-Head	3/27/2018		18.4
		B-B	B2.12	2PZR-W9A Longitudinal Lower Shell-to-Head	9/28/2010		25.9
		B-B	B2.12	2PZR-W9D Longitudinal Upper Shell-to-Head	3/27/2018		18.4
		B-D	B3.110	2PZR-W1 Surge Nozzle-to-Lower Head	4/6/2021		15.4
		B-D	B3.110	2PZR-W2 Spray Nozzle-to-Upper Head	3/23/2018		18.4
		B-D	B3.110	2PZR-W3 Safety Nozzle-to-Upper Head	3/16/2012		24.4
		B-D	B3.110	2PZR-W4A Safety Nozzle-to-Upper Head	3/16/2012		24.4
		B-D	B3.110	2PZR-W4B Safety Nozzle-to-Upper Head	3/16/2012		24.4
		B-D	B3.110	2PZR-W4C Relief Nozzle-to-Upper Head	3/23/2018		18.4
H.B Robinson	2	B-B	B2.11	103/05 Circumferential Upper Shell-to-Head	11/28/2022	End of Current Licensed Period, 07/31/2030	7.7
		B-B	B2.11	103/09 Circumferential Lower Shell-to-Head	10/8/2018		11.8
		B-B	B2.12	103/01 Longitudinal Upper Shell-to-Head	11/28/2022		7.7
		B-B	B2.12	103/04 Longitudinal Lower Shell-to-Head	10/8/2018		11.8

Station	Unit	ASME Category	Item No.	Component ID Component Description	Date of Last Inspection	End of Proposed Alternative	Length of Time[1] (Years)
McGuire	1	B-B	B2.11	1PZR-1 Circumferential Lower Shell-to-Head	3/26/2016	End of Current Licensed Period, 06/12/2041	25.2
		B-B	B2.11	1PZR-5 Circumferential Upper Shell-to-Head	9/21/2014		26.7
		B-B	B2.12	1PZR-6 Longitudinal Lower Shell-to-Head	3/26/2016		25.2
		B-B	B2.12	1PZR-9 Longitudinal Upper Shell-to-Head	9/28/2020		20.7
		B-D	B3.110	1PZR-10 Surge Nozzle-to-Lower Head	3/30/2019		22.2
		B-D	B3.110	1PZR-12 Spray Nozzle-to-Upper Head	9/28/2020		20.7
		B-D	B3.110	1PZR-13 Safety Nozzle-to-Upper Head	9/29/2017		23.7
		B-D	B3.110	1PZR-14 Safety Nozzle-to-Upper Head	9/29/2017		23.7
		B-D	B3.110	1PZR-15 Safety Nozzle-to-Upper Head	9/28/2020		20.7
		B-D	B3.110	1PZR-16 Relief Nozzle-to-Upper Head	9/28/2020		20.7
McGuire	2	B-B	B2.11	2PZR-1 Circumferential Lower Shell-to-Head	9/24/2021	End of Current Licensed Period, 03/03/2043	21.5
		B-B	B2.11	2PZR-5 Circumferential Upper Shell-to-Head	4/3/2017		25.9
		B-B	B2.12	2PZR-6 Longitudinal Lower Shell-to-Head	9/24/2021		21.5
		B-B	B2.12	2PZR-9 Longitudinal Upper Shell-to-Head	4/3/2017		25.9
		B-D	B3.110	2PZR-10 Surge Nozzle-to-Lower Head	9/26/2018		24.4
		B-D	B3.110	2PZR-12 Spray Nozzle-to-Upper Head	9/21/2021		21.5

Station	Unit	ASME Category	Item No.	Component ID Component Description	Date of Last Inspection	End of Proposed Alternative	Length of Time[1] (Years)
		B-D	B3.110	2PZR-13 Safety Nozzle-to-Upper Head	9/21/2021		21.5
		B-D	B3.110	2PZR-14 Safety Nozzle-to-Upper Head	9/21/2021		21.5
		B-D	B3.110	2PZR-15 Safety Nozzle-to-Upper Head	9/21/2021		21.5
		B-D	B3.110	2PZR-16 Relief Nozzle-to-Upper Head	9/21/2021		21.5
Oconee	1	B-B	B2.11	1-PZR-WP76 Circumferential Upper Shell-to-Head	11/21/2016	End of Current Licensed Period, 02/06/2033	16.2
		B-B	B2.11	1-PZR-WP28 Circumferential Lower Shell-to-Head	11/8/2022		10.3
		B-B	B2.12	1-PZR-WP1-1 Longitudinal Upper Shell-to-Head	11/21/2016		16.2
		B-B	B2.12	1-PZR-WP7-1 Longitudinal Lower Shell-to-Head (Y-Z Quadrant)	11/8/2022		10.3
		B-D	B3.110	1-PZR-WP15 Surge Nozzle-to-Lower Head	11/16/2016		16.2
		B-D	B3.110	1-PZR-WP34 Spray Nozzle-to-Upper Head	11/19/2016		16.2
		B-D	B3.110	1-PZR-WP33-1 Relief Nozzle-to-Upper Head (W-X Quadrant)	11/19/2016		16.2
		B-D	B3.110	1-PZR-WP33-2 Relief Nozzle-to-Upper Head (X-Y Quadrant)	11/19/2016		16.2
		B-D	B3.110	1-PZR-WP33-3 Relief Nozzle-to-Upper Head (Z-W Quadrant)	11/19/2016		16.2

Station	Unit	ASME Category	Item No.	Component ID Component Description	Date of Last Inspection	End of Proposed Alternative	Length of Time[1] (Years)
Oconee	2	B-B	B2.11	2-PZR-WP76 Circumferential Upper Shell-to-Head	10/25/2015	End of Current Licensed Period, 10/06/2033	18.0
		B-B	B2.11	2-PZR-WP28 Circumferential Lower Shell-to-Head	11/20/2019		13.9
		B-B	B2.12	2-PZR-WP1-1 Longitudinal Upper Shell-to-Head	10/25/2015		18.0
		B-B	B2.12	2-PZR-WP7-1 Longitudinal Lower Shell-to-Head (Y-Z Quadrant)	11/20/2019		13.9
		B-D	B3.110	2-PZR-WP15 Surge Nozzle-to-Lower Head	11/7/2017		15.9
		B-D	B3.110	2-PZR-WP34 Spray Nozzle-to-Upper Head	11/18/2019		13.9
		B-D	B3.110	2-PZR-WP33-1 Relief Nozzle-to-Upper Head (W-X Quadrant)	11/18/2019		13.9
		B-D	B3.110	2-PZR-WP33-2 Relief Nozzle-to-Upper Head (X-Y Quadrant)	11/18/2019		13.9
		B-D	B3.110	2-PZR-WP33-3 Relief Nozzle-to-Upper Head (Z-W Quadrant)	11/18/2019		13.9
Oconee	3	B-B	B2.11	3-PZR-WP76 Circumferential Upper Shell-to-Head	5/1/2018	End of Current Licensed Period, 07/19/2034	16.2
		B-B	B2.11	3-PZR-WP28 Circumferential Lower Shell-to-Head	5/1/2014, Scheduled for O3R32 (Spring 2024)[2]		10.2
		B-B	B2.12	3-PZR-WP1-1 Longitudinal Upper Shell-to-Head	5/1/2018		16.2

Station	Unit	ASME Category	Item No.	Component ID Component Description	Date of Last Inspection	End of Proposed Alternative	Length of Time[1] (Years)
		B-B	B2.12	3-PZR-WP7-1 Longitudinal Lower Shell-to-Head (Y-Z Quadrant)	5/1/2014, Scheduled for O3R32 (Spring 2024)[2]		10.2
		B-D	B3.110	3-PZR-WP15 Surge Nozzle-to-Lower Head	5/3/2018		16.2
		B-D	B3.110	3-PZR-WP34 Spray Nozzle-to-Upper Head	4/30/2018		16.2
		B-D	B3.110	3-PZR-WP33-1 Relief Nozzle-to-Upper Head (W-X Quadrant)	4/30/2018		16.2
		B-D	B3.110	3-PZR-WP33-2 Relief Nozzle-to-Upper Head (X-Y Quadrant)	4/30/2018		16.2
		B-D	B3.110	3-PZR-WP33-3 Relief Nozzle-to-Upper Head (Z-W Quadrant)	4/30/2018		16.2
Shearon Harris	1	B-B	B2.11	II-PZR-01STHW-01 Circumferential Lower Shell-to-Head	4/22/2015	End of 5th Interval, Scheduled to End 05/01/2037	22
		B-B	B2.11	II-PZR-01STHW-04 Circumferential Upper Shell-to-Head	10/24/2019		17.5
		B-B	B2.12	II-PZR-01LSW-05 Longitudinal Lower Shell-to-Head	4/22/2015		22
		B-B	B2.12	II-PZR-01LSW-07 Longitudinal Lower Shell-to-Head	10/24/2019		17.5
		B-D	B3.110	II-PZR-01NTHW-08 Surge Nozzle-to-Lower Head	5/2/2012		25
		B-D	B3.110	II-PZR-01NTHW-09 Spray Nozzle-to-Upper Head	4/30/2012		25
		B-D	B3.110	II-PZR-01NTHW-10 Safety Nozzle-to-Upper Head	10/23/2019		17.5

Station	Unit	ASME Category	Item No.	Component ID Component Description	Date of Last Inspection	End of Proposed Alternative	Length of Time[1] (Years)
		B-D	B3.110	II-PZR-01NTHW-11 Safety Nozzle-to-Upper Head	10/23/2019		17.5
		B-D	B3.110	II-PZR-01NTHW-12 Safety Nozzle-to-Upper Head	10/23/2019		17.5
		B-D	B3.110	II-PZR-01NTHW-13 Relief Nozzle-to-Upper Head	5/3/2012		25

Notes:

1. This column represents the length of time between the date of the last completed code inspection and the end of the proposed alternative.

2. These B2.11 and B2.12 exams are scheduled for O3R32 (Spring 2024) and required to be completed for ASME 5th Interval code compliance (last outage of the 5th Interval for ONS Unit 3). This alternative is only applicable to Oconee 6th Interval exams through the current licensed period for Oconee Units 1, 2, and 3.

b. (1) The performance monitoring plan provided in the response above includes sampled inspections using volumetric examination methods that will provide direct evidence of the presence and extent of any degradation over the extended examination interval for these welds.

(2) The components in the proposed alternative have operated for a minimum of 36 years and up to a maximum of 52 years without the identification through inspection of any service-induced degradation. This excellent operating history is validation and confirmation of the conservative nature of the PFM and DFM models used in the EPRI Technical Report 3002015905 (Reference 2). This also shows that the models will predict future behavior conservatively. The proposed performance monitoring plan includes sampling of examinations across different weld types equivalent to one Pressurizer divided evenly across Catawba, Units 1 & 2, McGuire, Units 1 & 2, and Shearon Harris, Unit 1. This ensures the inspection data is representative of the Duke PWR Fleet and is sufficient to demonstrate continued adequacy of the modeling.

(3) The performance monitoring schedule described above will provide timely detection of any novel or unexpected degradation in these components.

c. If during the performance monitoring schedule described above, indications are detected that exceed the applicable ASME Code, Section XI acceptance standards of IWB-3500, then the indications will be addressed as required by ASME Code Section XI, and the Duke Energy Corrective Action Program. The additional examination and successive inspection requirements of ASME Code, Section XI, also apply during the current outage. The number of additional exams shall be the number of performance monitoring exams included in the inspection item number that were scheduled to be performed during the present inspection period. If additional examinations reveal indications exceeding acceptance standards of IWB-3500, the examinations shall be further extended to include all remaining welds/components in the inspection item number.

d. Additionally, any unacceptable indication(s) identified as part of the performance monitoring plan will result in the same number of weld(s) to be examined at all the remaining plants (Catawba, Units 1 & 2, McGuire, Units 1 & 2, and Shearon Harris, Unit 1). The expanded scope shall include the same rejected weld[1] and any additional welds of the same item number to meet the equivalent number of exams performed at the unit with the initial rejectable indication. These exams shall be completed no later than the first or second refueling outage following discovery of the initial indication(s). This expanded scope is performed in addition to the established performance monitoring plan and cannot be dual credited. Additional and successive inspection requirements of ASME Code, Section XI apply for all newly identified unacceptable indications.

In addition to the direct evidence provided by the proposed Duke Energy performance monitoring plan, examination of pressurizer welds is expected to continue to be performed by other units across the domestic and international PWR fleet. Any new unacceptable

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[1] The same rejected weld shall be examined at each of the remaining plants. For example, if a B3.110 Surge nozzle-to-shell weld at CNS1 was found with a rejectable indication exceeding the acceptance standard of IWB-3500, then the same Surge nozzle-to-shell weld at CNS2, MNS1 & 2, and HNP1 shall be examined in either the 1st or 2nd outage following the initial indication. Also, if the number of performance monitoring exams for the period of the initial indication included two B3.110 exams, then one additional B3.110 weld would be required to be inspected at all Units.

indications identified as part of the performance monitoring plan described above will be entered into the Duke Energy Corrective Action Program to evaluate operating experience and determine if additional examinations are required across the Duke Fleet. If a new degradation mechanism is identified during continued industry examinations, Duke Energy will follow the industry guidance to address the new degradation mechanism.

RAI-1 References:

1. Letter from K.M. Ellis (Duke Energy) to the U.S. NRC, “Proposed Alternative for Pressurizer Welds in Accordance with 10 CFR 50.55a(z)(1),” Serial No. RA-22-0257, dated February 17, 2023, ADAMS Accession No. ML23048A148.

2. ADAMS Accession No. ML21021A271, EPRI Technical Report 3002015905, "Technical Bases for Inspection Requirements for PWR Pressurizer Head, Shell-to-Head, and Nozzle-to-Vessel Welds," Palo Alto, California, 2019.

RAI-2

Issue

Section 7.1.2.2 of EPRI Report 3002015905 describes the application of piping interface loads due to thermal stratification for the surge nozzle stress analysis. However, in the plant-specific stress analysis for Oconee Nuclear Station Units 1, 2, and 3 in Attachment 7 to the submittal (Structural Integrity Associates [SIA] calculation 2100561.302, Revision 1), piping interface loads due to thermal stratification appear to have not been applied.

Request

Justify not applying piping interface loads due to thermal stratification in the stress analysis in SIA calculation 2100561.302, Revision 1.

Response

The effect of the piping interface loads on the stresses at the bottom head welds has been evaluated and found to be relatively small at the bottom head welds at Oconee Nuclear Station Units 1, 2 and 3 (ONS1/2/3).

A previously developed finite element analysis (FEA) model of the ONS1/2/3 pressurizer surge nozzle and bottom head was used to perform an evaluation to determine the stresses due to thermal stratification interface loads. The model shown in Figure 1 (developed using ANSYS (Reference 1)) includes a portion of the pressurizer bottom head, the surge nozzle, safe end, weld overlay repair and a portion of the surge line piping. A unit moment of 1,000 in-lb (1.0 in-kip) was applied to the free end of the modeled surge piping. The resulting stresses at the nozzle-to-bottom head weld were then scaled to the ONS1/2/3 plant specific maximum thermal stratification moment of M = 2,002 in-kip.

Two separate calculations were performed for the two pressurizer bottom head welds.

Surge Nozzle-to-Bottom Head Weld (Paths 1 through 3 in SI Calculation 2100561.302, Revision 1 (Reference 2, Attachment 7))

This corresponds to Path 1 of the current analysis in Figure 1. The resulting through-thickness stresses (from ID to OD) for the applied 1 in-kip unit moment are shown in Figure 2 and are tabulated in Table 1. Table 1 also shows the scaled stresses to the actual moment of 2,002 in-kip. For the applied moment of 2,002 in-kip, the stresses in the hoop direction vary from -1.81 ksi to approximately 3.0 ksi at 80% of through thickness where the fracture mechanics model is applicable. The stresses in the radial direction vary from -2.39 ksi to approximately 3.2 ksi at 80% of through thickness. A review of the stress distributions of the surge nozzle-to-bottom head weld shown in Figures 14 through 16 of SI Calculation 2100561.302, Rev. 1 (Stress Paths 1 through 3 in Figure 13 (Attachment 7 to the Reference 2 Request for Alternative)), indicates that the typical inside surface stress is on the order of -50 to -59 ksi and outside surface stress is on the order of 1 to 10 ksi. Thus, the added stress from the thermal stratification interface load is relatively small. Furthermore, as shown in Table 8 of SI Calculation 2100561.303, Rev. 2 (Attachment 8 to the Reference 2 Request for Alternative), when a stress multiplier of 1.4 is applied to the evaluated stresses at this location, the probabilities of rupture and leakage are three orders of magnitude below the acceptance criteria of 1.0E-06. Hence the relatively small increase in stress at this location due to the thermal stratification interface load will not change the conclusion of the analysis.

Bottom Head-to-Cylindrical Shell Weld (Paths 4 through 7 in SI Calculation 2100561.302, Revision 1 (Reference 2, Attachment 7))

The model in Figure 1 did not extend to this weld location and therefore a hand calculation was used to determine the stresses. The stresses were estimated by dividing the stratification moment by the section modulus of the pressurizer shell.

Inside surface stress σ_i:

$$\sigma_i = \frac{M \cdot ID}{2I} = 46.948psi$$

Outside surface stress σ_o:

$$\sigma_o = \frac{M \cdot OD}{2I} = 53.865psi$$

These stresses are less than 0.1 ksi. Compared to the stress distributions of this weld in Figures 17 through 20 of SI Calculation 2100561.302, Rev. 1 (Stress Paths 4 through 7 in Figure 13) (Attachment 7 to the Reference 2 Request for Alternative), where typical inside surface stress is on the order of -50 to -70 ksi and outside surface stress is on the order of 1 to 18 ksi, this added stress distribution from the thermal stratification interface load is very negligible. Per Table 8 of SI Calculation 2100561.303, Rev. 2 (Attachment 8 to the Reference 2 Request for Alternative), a stress multiplier of 1.4 can be applied to the evaluated stresses and the acceptance criteria will still be met at this location indicating the large extra margin that exists in the analysis. Therefore, the slight increase in stress resulting from the thermal stratification interface load can be accommodated at this weld location and will not change the conclusion of the analysis.

REFERENCES

1. *ANSYS Mechanical APDL (UP20170403) and Workbench (March 31, 2017), Release 18.1, SAS IP, Inc.*
2. Letter Serial No. RA-22-0257 from K. Ellis (Duke Energy) to USNRC, “Proposed Alternative for Pressurizer Welds in Accordance with 10 CFR 50.55a(z)(1),” dated February 17, 2023, ADAMS Accession No. ML23043A148.

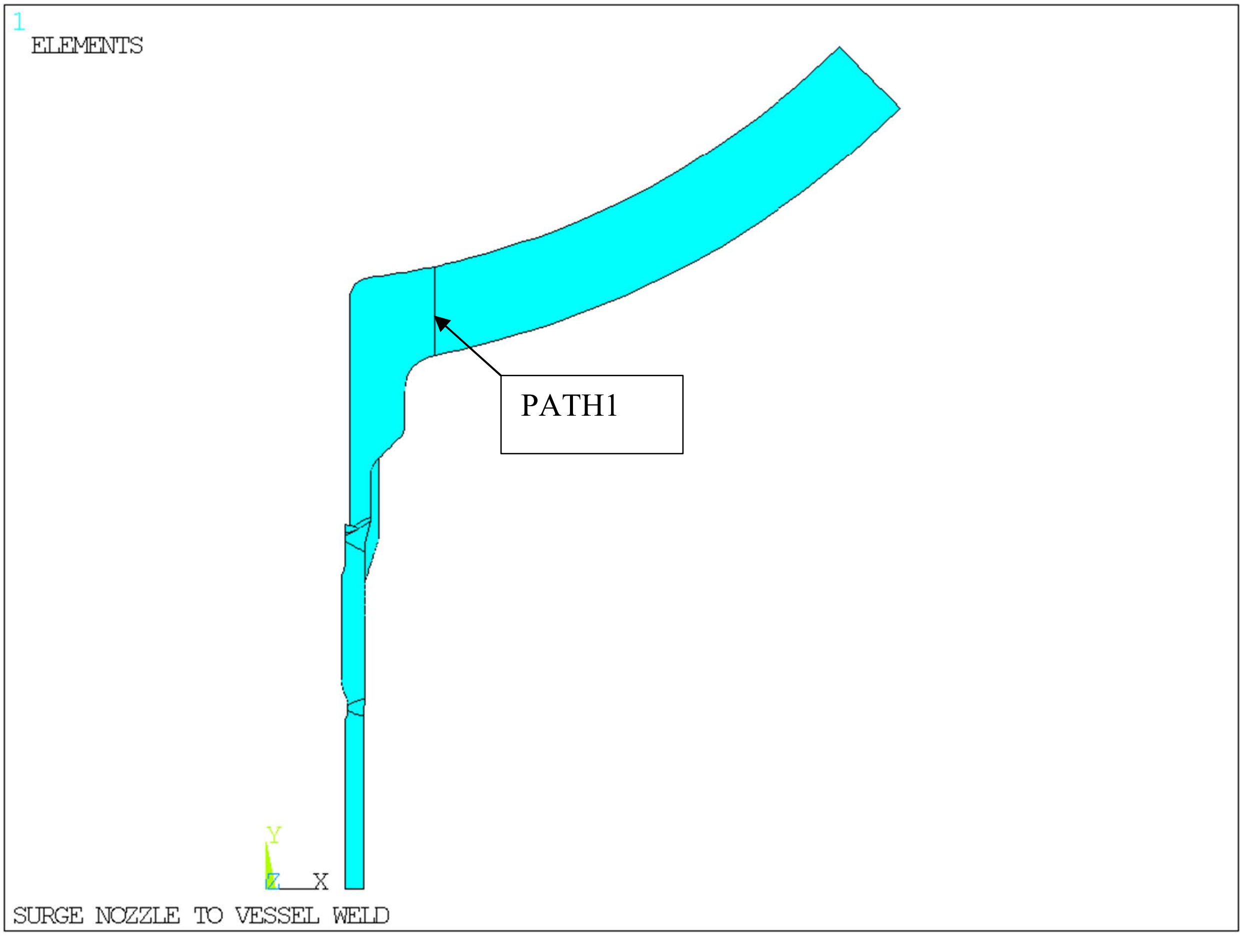

Figure 1 Finite Element Model

(The pressurizer lower head and surge nozzle cladding not shown.)

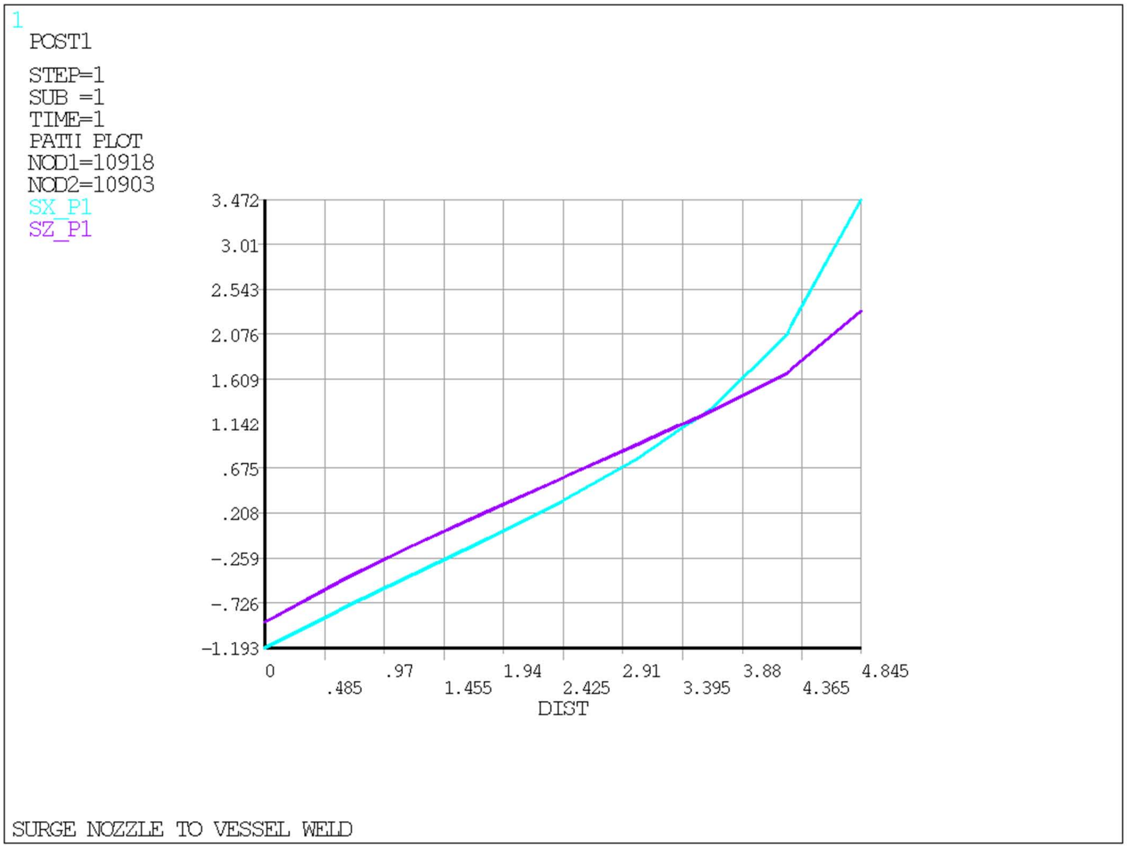

Figure 1. Path 1 Stress Distribution Due to Application of 1 in-kip Piping Interface Moment

(SX is the normal (radial) stress while SZ is the hoop stress relative to the nozzle centerline.)

Table 1: Path 1 Stress Distribution Due to Application of 1 in-kip Piping Interface Moment

	(1 in-kip)		(2,002 in*kip)	
S	SX_P1	SZ_P1	SX_P1(scaled)	SZ_P1(scaled)
0	-1.193	-0.924	-2389	-1851
0.60563	-0.799	-0.503	-1600	-1007
1.2113	-0.427	-0.123	-854	-246
1.8169	-0.053	0.233	-106	467
2.4225	0.338	0.578	676	1156
3.0281	0.774	0.923	1550	1847
3.6338	1.311	1.284	2624	2570
4.2394	2.074	1.669	4151	3342
4.845	3.473	2.316	6952	4636

Table notes:

1. S is distance along path from inside node 10918 (inches).
2. All stresses are in terms of psi.
3. SX is the normal (radial) stress while SZ is the hoop stress relative to the nozzle centerline.

RAI-3

Issue

It is not clear whether the information provided regarding ISI program results includes indications that may have been dispositioned during the earlier 10-year ISI intervals for the Duke units in the request (for example, there is no information prior to the 4th 10-year ISI interval at the ONS units provided in Attachment 5 to the submittal).

Request

Please confirm that the tables detailing inspection history in the submittal include all indications detected by the listed inspections regardless of whether they were dispositioned prior to the intervals cited (e.g., detected during 1st interval and dispositioned then).

Duke Energy Response to RAI-3:

The plant specific inspection history provided in Tables 1-5, 1-6, 2-5, 2-6, 3-5, 4-5, 5-5, 5-6, and 5-7 of Relief Request RA-22-0257 (Reference 1) include all indications detected and evaluated for continued service. Any previously identified indications were re-identified and dispositioned to have remained the same with no new indications during the most recent code exam. All identified indications were characterized as subsurface and dispositioned as acceptable in accordance with ASME Section XI code requirements. The current Inservice Inspection Interval examinations utilized phased array UT techniques with component specific NDE modeling (when available) to maximum coverage obtained. These modern UT exam techniques are far superior at detecting near surface or surface breaking flaws and in most cases obtained greater coverage compared to earlier interval preservice/inservice exams. Additionally, characterization of previously identified indications was greatly improved using enhanced UT techniques often allowing previously recorded indications to be dispositioned as below recordable acceptance criteria.

RAI-3 References:

1. Letter from K.M. Ellis (Duke Energy) to the U.S. NRC, “Proposed Alternative for Pressurizer Welds in Accordance with 10 CFR 50.55a(z)(1),” Serial No. RA-22-0257, dated February 17, 2023, ADAMS Accession No. ML23048A148.