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0CAN062501 10 CFR 50.55a

June 24, 2025

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

Subject: Response to Request for Additional Information - Proposed Alternatives ANO1-ISI-24-02 and ANO2-ISI-24-02 for Examinations of Pressurizer Circumferential and Longitudinal Shell-to-Head Welds and Nozzle-to-Vessel Welds

Arkansas Nuclear One – Units 1 and 2
NRC Docket Nos. 50-313 and 50-368
Renewed Facility Operating License Nos. DPR-51 and NPF-6

In accordance with 10 CFR 50.55a(z)(1), Entergy Operations, Inc. (Entergy), requested Nuclear Regulatory Commission (NRC) approval of proposed alternatives for Arkansas Nuclear One, Units 1 and 2 (ANO-1 and ANO-2, respectively) (Reference 1). Specifically, the proposed alternatives are to defer the in-service inspection (ISI) examinations for select examination categories and item numbers for the pressurizers (PZRs) at ANO-1 and ANO-2 from the current American Society of Mechanical Engineers (ASME) Code, Section XI 10-year requirements to the end of licensed operating life, which is scheduled to end on May 20, 2034, and July 17, 2038, respectively.

Entergy received a Request for Additional Information (RAI) from the NRC (Reference 2). The Enclosure to this letter provides Entergy's response to the RAI.

This letter contains one new regulatory commitment. This commitment is summarized in the attachment to the enclosure.

If there are any questions or if additional information is needed, please contact Riley Keele, Manager, Regulatory Assurance, Arkansas Nuclear One, at 479-858-7826.

Respectfully,

Philip Couture

Digitally signed by Philip Couture
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Enclosure: Response to Request for Additional Information

Attachment: Summary of Regulatory Commitments

References:

1. Entergy letter to NRC, "Proposed Alternatives ANO1-ISI-24-02 and ANO2-ISI-24-02 for Examinations of Pressurizer Circumferential and Longitudinal Shell-to-Head Welds and Nozzle-to-Vessel Welds," (ML25013A293), (0CAN012502), dated January 13, 2025

2. NRC email to Entergy, "Request for Additional Information – Alternative Requests ANO1-ISI-24-02 and ANO2-ISI-24-02 Related to Pressurizer Weld Examination," (ML25132A310), (0CNA052501), dated May 12, 2025

cc: NRC Region IV Regional Administrator
NRC Senior Resident Inspector – Arkansas Nuclear One
NRC Project Manager – Arkansas Nuclear One

Enclosure

0CAN062501

Response to Request for Additional Information

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

BACKGROUND

By letter dated January 13, 2025 (Agencywide Documents and Access Management System (ADAMS) Accession No. ML25013A293), Entergy Operations, Inc. (Entergy, the licensee) requested approval of proposed alternatives for Arkansas Nuclear One Units 1 and 2 (ANO-1 and ANO-2, respectively). Specifically, the proposed Alternative Requests ANO1-ISI-24-02 and ANO2-ISI-24-02 are related to alternative examination of pressurizer welds under Examination Category B-B, Item Numbers B2.11 and B2.12, and Examination Category B-D, Item Number B3.110 of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, Table IWB-2500-1.

REGULATORY BASIS

The pressurizer pressure-retaining welds and nozzles are ASME Code Class 1 components, with Inservice Inspections (ISIs) performed in accordance with the applicable edition of Section XI, of ASME Code as required by 10 CFR 50.55a(g). The regulations in 10 CFR 50.55a(g)(4) state, in part, components that are classified as ASME Code Class 1, 2, and 3 must meet the requirements, except the design and access provisions and the preservice examination requirements, set forth in the ASME Code, Section XI, to the extent practical within the limitations of design, geometry, and materials of construction of the components. The regulations in 10 CFR 50.55a(z) state, in part, that alternatives to the requirements in paragraphs (b) through (h) of 10 CFR 50.55a may be used when authorized by the NRC if the licensee demonstrates that: (1) the proposed alternative would provide an acceptable level of quality and safety, or (2) compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

To complete its review, the U.S. Nuclear Regulatory Commission (NRC) staff requests for additional information.

Question 1 - RAI-1

Background

The proposed alternative references probabilistic fracture mechanics (PFM) to support the deferral of the pressurizer weld ISI examinations. The NRC staff notes that 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 pressurizer 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 pressurizer welds.

The NRC staff has determined that, when considering the 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 NRC 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 presentation slide packages dated January 30, 2023, and April 27, 2023, at ML23033A667 and ML23114A034, respectively). In its public meeting on June 27, 2024, the NRC staff discussed its position regarding the need for adequate performance monitoring of components as part of the risk-informed materials assessment project (ML24193A005).

The staff's position is that the number of welds that are proposed to be examined and the required number of welds to be examined for the ISI intervals should have been converted to the pressurizer Equivalent that would result in inspections of at least 25% of the number of pressurizers required to be inspected by the ASME Code. The examples of an adequate inspection sample size based on similar alternative requests that the staff has approved in the past are documented in NRC safety evaluations such as ML23256A088 and ML24179A326, respectively. The NRC staff noted that although the referenced submittals are related to the steam generator weld examinations, the concept of the 25% sample examination is the same as for the pressurizer weld examinations.

To address performance monitoring, Section 5.1.6 of the proposed alternatives state that ANO-1 has performed five examinations on a total population of ten components in the current fifth 10-year ISI interval as discussed in Enclosure, Attachment 1 of the proposed alternatives. The licensee stated that ANO-1 has performed 50% of the pressurizer weld examinations in the current fifth 10-year ISI. Section 5.1.6 further states that ANO-2 has performed one examination on a total population of seven components in the current fifth 10-year ISI interval as discussed in Enclosure, Attachment 2. Section 5.1.6 explains that ANO-2 is scheduled to examine weld 05-002 during the sixth 10-year ISI interval, third period, as shown in Enclosure, Attachment 6.

The NRC staff noted that for the ASME B-B and B-D Examination Category, ANO-1 has examined 5 out of 10 (50%) of its of weld population in the fifth ISI interval, and ANO-2 has examined only 1 of the 7 (~14%) of its weld population in the fifth ISI interval, plus a commitment to exam one more weld in the sixth ISI interval, equating to ~28% weld examination across fifth and sixth intervals for ANO-2. The weld population of ANO-1 and ANO-2 may be combined to determine the minimum number of examinations necessary for

adequate performance monitoring. ANO-1 and ANO-2 pressurizers are fabricated using similar low-alloy steels, utilizing ASME qualified weld material and welding techniques, therefore the weld examinations for ANO-1 and ANO-2 can be combined for a sample population. The ASME Code requirement is that during an inservice inspection interval for one pressurizer, 100% of the welds as specified in the Code be inspected. Given that ANO-1 and ANO-2 are distinct pressurizers, and the alternative extends across the fifth and sixth interval, the ASME Code requirement mandates examination of pressurizers over the fifth and sixth ISI intervals at ANO-1 and ANO-2, equating to four total pressurizer examinations. The staff position is that licensees are permitted to inspect 25% of the total pressurizer examination, which equates to inspecting one pressurizer across both ISI intervals for ANO-1 and ANO-2.

Based on the information in Section 5.1.6 of the proposed alternatives, the staff determined that the number of proposed inspections would be less than the staff's position of 25% of the total Code-required pressurizer examinations (the equivalent of 100% of one pressurizer, i.e., = 1 Pressurizer Equivalent) required to be conducted over the duration of the requested alternatives at ANO-1 and ANO-2. The equivalent total inspected sample size across ANO-1 (50%) and ANO-2 (~28%) over the 5th and 6th ISI interval is currently committed to inspect only a total of seven welds, which is equivalent to 0.78 of 1 Pressurizer Equivalent, which does not meet the staff position of 1 Pressurizer Equivalent.

Request

(a) Provide a technical justification describing the minimum sample size, utilizing calculations for a number of examinations greater than or equal to 1 Pressurizer Equivalent according to the staff position, or other methodology as least as conservative as the staff position, in the proposed performance monitoring plan that is necessary to provide a 25% or greater sampling of the entire population of pressurizer welds. Include a description of how the sample size is consistent with, or if using a different methodology, at least as conservative as, the documented staff position for acceptable levels of performance monitoring demonstrated by the above NRC-approved precedents.

(b) Explain how the proposed 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.

RAI-1 Response

(a)

The performance monitoring (PM) plan for ANO-1 and ANO-2 begins with the ongoing 5th interval inspections. Table 1 below provides the number of Class 1 PZR components inspected in the 5th interval at ANO-1 and ANO-2 broken down by ASME Item Number. Table 1 also provides the number of components to be examined in the 6th interval inspections at ANO-1 and ANO-2 as part of the PM plan proposed by Entergy.

Table 1. PZR PM Examinations at ANO-1 and ANO-2

ASME Cat.	ASME Item No.	ANO-1 (B&W)		ANO-2 (CE)	
		Current 5th Interval	6th Interval	Current 5th Interval	6th Interval
B-B	B2.11	1	0	0	1
B-B	B2.12	1	0	N/A per design	N/A per design
B-D	B3.110	3	0	1	2
Total Number of PM Examinations		5	0	1	3
ASME Code Required Examinations		10	10	7	7

Table 2 shows the determination of the PZR Equivalent examinations at both ANO-1 and ANO-2 using an approach similar to that used by the NRC as stated above in ML23033A667 and ML23114A034 (Reference 1 and 2).

Table 2. ASME Code Required PZRs for ANO-1 and ANO-2

Plant	Unit(s)	#PZR required per unit	ISI Intervals	ASME Code Required PZRs = Unit(s) x Intervals
ANO-1	1	1	2 (5^{th} and 6^{th})	2
ANO-2	1	1	2 (5^{th} and 6^{th})	2

Through binomial statistics and Monte Carlo methods, the NRC staff determined that a 25% sample of the ASME Code required number of PZRs would be an adequate sample size for PM purposes over the subject alternative period. Table 3 shows the determination of this sample size for all units:

Table 3. Required PZR Equivalent Examinations Based on 25% Sampling for ANO-1 and ANO-2

Plant	Required PZR Equivalent Examinations = 0.25 x (ASME Code Required PZRs from Table 2)
ANO-1	0.5
ANO-2	0.5

Table 4 below shows the number of PM PZR Equivalent examinations for ANO-1 and ANO-2.

Table 4. PM PZR Equivalent Examinations for ANO-1 and ANO-2

Plant	ASME Code Required Examinations	PM Examinations (From Table 1)	PM PZR Equivalent Examinations = PM Exams/ASME Code Required Examinations
ANO-1	10	5	0.5
ANO-2	7	4	0.57

Table 5 provides the PM PZR Equivalent examinations compared to the required PZR Equivalent examinations for various scenarios.

Table 5. PM and Required PZR Equivalent Examinations for Various Cases

Case	PM PZR Equivalent Examinations (from Table 4)	Required PZR Equivalent Examinations Based on 25% Sampling (from Table 3)
ANO-1	0.5	0.5
ANO-2	0.57	0.5
ANO-1 & ANO-2	1.07	1

It can be seen from Table 5 that ANO-1 and ANO-2 PM PZR Equivalent examinations exceed those required by the binomial distribution 25% sampling criterion. This approach is consistent with NRC approved requests ML23033A667 and ML23114A034 (Reference 1 and 2). Therefore, the proposed monitoring plan for the ANO-1 and ANO-2 pressurizer components is acceptable.

In summary, the revised Entergy PM plan consists of the examinations already completed at the start of the 5th interval for both ANO-1 and ANO-2, plus one ANO-2 B2.11 weld and two B3.110 welds to be examined in the 6th interval per Table 1 above. This constitutes a new commitment as documented in the Enclosure Attachment.

(b)

(1) The PM plan provided includes sample inspections using ASME Section XI examination methods that will provide direct evidence of the presence and extent of any degradation over the extended examination interval for the ANO-1 and ANO-2 PZR welds.

(2) The ANO-1 and ANO-2 operating history is validation and confirmation of the conservative nature of the PFM and deterministic fracture mechanics (DFM) models used in the EPRI Technical Reports 3002015906 (Reference 3) and 3002014590 (Reference 4) which were referenced in Entergy letter to the NRC (Reference 5). This also shows that the models will predict future behavior conservatively. The proposed PM plan includes sampling of examinations across the remainder of the ANO-2 current operating license.

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

Question 2 - RAI-2

Background

If through the proposed performance monitoring, indications are detected in subject pressurizer welds that exceed the acceptance standards of the ASME Code, Section XI, IWB-3500, 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 pressurizer welds, scope expansion may be appropriate to ensure that no such mechanism is occurring in the subject plants. Section 5.1.6 of the proposed alternatives discuss the additional examinations if unacceptable indications are detected in the ANO pressurizer welds. However, Section 5.1.6 does not mention the sample expansion beyond the reactor unit in question. Examples of previously approved inspection sample expansion scope beyond the reactor unit in question can be found in the following references (1). Duke Energy response to staff's RAI-1 (c) and (d) in its letter dated July 20, 2023 (ML23201A140), (2) NRC safety evaluation for Duke Energy fleet (ML23256A088), (3) NRC safety evaluation for Vogtle nuclear plant (ML20352A155), and (4) NRC safety evaluation for Constellation fleet (ML24179A326). These examples are related to steam generator weld examinations, but the additional examination strategy is applicable to the pressurizer weld examination at ANO-1 and ANO-2.

Request

Clarify whether the licensee intends to perform additional examinations of the pressurizer welds beyond the reactor unit where unexpected degradation was found as part of the proposed alternative examination schedules. If the licensee does intend to expand scope to other reactor units, describe the timing and number of additional examinations. If the licensee does not intend to expand scope of inspection to other reactor units, provide justification on how the proposed alternative requests address extent of condition for unexpected degradation.

RAI-2 Response

If a flaw is found as a part of this PM plan provided in this clarification, Entergy will enter the adverse condition into the ANO Corrective Action Program (CAP) and expand scope to the other unit for the Category and Item Number, as applicable, within 1-2 refueling outages. Scope expansion will be performed in accordance with IWB-2430 and IWB-3500, as applicable.

Question 3 - RAI-3

Background

Enclosure, Attachment 1, "ANO-1 Plant-Specific Applicability." of the proposed alternatives provide Table 1-3, "ANO-1 Inspection History." This table details the previous inspections that ANO-1 received for the relevant ASME Code Class 1, Examination Categories B-B and B-D components. The NRC staff noted that two different ASME Item numbers are assigned to the same weld Component Item in Table 1-3. For example, for Component ID 05-002, row 6 indicates Item No. B2.11, whereas row 7 indicates B2.12. For Component ID 05-012, row 11 indicates Item No. B2.12, whereas row 12 indicates B3.110.

Request

Please clarify the (a) ASME Examination Category and (b) the ASME item for Component IDs 05-002 and 05-012 in row 6/row 7 and row 11/row 12 of Table 1-3 in Attachment 1.

RAI-3 Response

There was a typographical error in the original submittal. Component 05-002 is a Category B-B, Item Number B2.12. Component 05-012 is a Category B-D, Item Number B3.110. The updated ANO-1 Inspection History Table 1-3 from the original submittal (Reference 5) is provided below.

ASME Category	Item No.	Component ID	Exam Date	Interval/Period/Outage	Examination Results (1)	Coverage	Relief Request
B-B	B2.11	05-001	11/8/2008	4th / 1st / 1R21	NRI	97%	na
B-B	B2.11	05-001	4/7/2018	5th / 1st / 1R27	NRI	>90%	na
B-B	B2.11	05-008	4/28/2007	3rd / 3rd / 1R20	NRI	>90%	na
B-B	B2.11	05-008	10/18/2016	4th / 3rd / 1R26	NRI	100%	na
B-B	B2.12	05-002	11/8/2008	4th / 1st / 1R21	NRI	>90%	na
B-B	B2.12	05-002	4/7/2018	5th / 1st / 1R27	NRI	100%	na
B-B	B2.12	05-010	4/28/2007	3rd / 3rd / 1R20	NRI	>90%	na
B-B	B2.12	05-011	4/28/2007	3rd / 3rd / 1R20	NRI	>90%	na
B-B	B2.12	05-011	10/18/2016	4th / 3rd / 1R26	NRI	100%	na
B-D	B3.110	05-012	3/27/2010	4th / 1st / 1R22	AI	37%	na
B-D	B3.110	05-012	05/09/2024	5th / 2nd / 1R31	NRI	70.74%	na
B-D	B3.110	05-013	3/26/2010	4th / 1st / 1R22	AI	42%	na
B-D	B3.110	05-013	4/4/2018	5th / 1st / 1R27	AI	40%	na
B-D	B3.110	05-014	10/28/2011	4th / 2nd / 1R23	NRI	51%	na
B-D	B3.110	05-014	05/09/2024	5th / 2nd / 1R31	NRI	69.94%	na
B-D	B3.110	05-015	10/27/2011	4th / 2nd / 1R23	AI	51%	na
B-D	B3.110	05-021	4/28/2007	3rd / 3rd / 1R20	NRI	<90%	na

Notes:

1. NRI = no recordable indications; AI = indications identified but determined to be acceptable.

Question 4 - RAI-4

Background

Enclosure, Attachment 1, "ANO-1 Plant-Specific Applicability," provides Table 1-3 titled "ANO-1 Inspection History." This table details the previous inspections that ANO-1 received for the relevant ASME Code Class 1, B-B and B-D ASME category components. The item contained in row 18, "Item No.: B3.110, Component ID: 05-021, Exam Date: 4/28/2007, interval/Period/Outage: 3rd/3rd/1R20," includes an inspection coverage of "< 90%."

Request

Please clarify if the examination coverage was > 90%, or if it was < 90%. If the coverage was < 90%, please provide how much coverage was achieved during the inspection of the item found in row 18 of Table 1-3 in Attachment 1.

RAI-4 Response

The information previously provided was correct in that it was < 90% coverage. The examination coverage achieved was 32% during the examination of Item No.: B3.110, Component ID: 05-021, that was completed on April 28, 2007, as documented in the ANO-1 Third 10-year ISI Interval Relief Request ML091520610 and NRC Safety Evaluation Report ML101170119 (References 6 and 7).

REFERENCES

1. Constellation slides on Performance Monitoring from NRC Meeting, (ML23033A667), dated January 30, 2023
2. NRC slides – "Probabilistic Fracture Mechanics and Performance Monitoring," (ML23114A034), dated April 27, 2023
3. EPRI Technical Report 3002015906, "Technical Bases for Inspection Requirements for PWR Steam Generator Class 1 Nozzle-to-Vessel Welds and Class 1 and Class 2 Vessel Head, Shell, Tubesheet-to-Head and Tubesheet-to-Shell Welds," ML20225A141, EPRI, Palo Alto, CA: 2019
4. EPRI Technical Report 3002014590, "Technical Bases for Inspection Requirements for PWR Steam Generator Feedwater and Main Steam Nozzle-to-Shell Welds and Inside Radius Sections," ML19347B107, EPRI, Palo Alto, CA: 2019
5. Entergy letter to NRC, "Proposed Alternatives ANO1-ISI-24-02 and ANO2-ISI-24-02 for Examinations of Pressurizer Circumferential and Longitudinal Shell-to-Head Welds and Nozzle-to-Vessel Welds," (ML25013A293), (0CAN012502), dated January 13, 2025
6. Entergy Letter to NRC – "Requests for Relief from ASME Section XI Volumetric, Surface and Visual Examination Requirements – Third 10-year Interval," (ML091520610) dated May 29, 2009
7. NRC Letter to Entergy – "Arkansas Nuclear One, Unit No. 1 – Request for Relief Nos. ANO-ISI-015, ANO1-ISI-016, ANO1-ISI-017, ANO1-ISI-018, ANO1-ISI-019 and ANO1-ISI-020 from ASME Code, Section XI, Examination Requirements for Third 10-year Inservice Inspection Interval," (ML101170119), dated May 5, 2010

Enclosure, Attachment

0CAN062501

Summary of Regulatory Commitments

SUMMARY OF REGULATORY COMMITMENTS

This table identifies actions discussed in this letter for which Entergy commits to perform. Any other actions discussed in this submittal are described for the NRC's information and are **not** commitments.

COMMITMENT	TYPE (Check one)		SCHEDULED COMPLETION DATE (If required)
	ONE-TIME ACTION	CONTINUING COMPLIANCE	
Entergy will select one ANO-2 B2.11 weld and two B3.110 welds to be examined in the 6th inspection interval.	X		This is currently scheduled to occur during the 6th inspection interval.