



May 10, 2022

# **ANO-1 RVCH Penetration No.1 Relief Request**

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# Agenda

- Opening Statement and Meeting Objectives
- Background
- Basis for Request
- Conclusions and Next Steps
- Closing Remarks

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## Opening Statement and Meeting Objective

# Meeting Objectives

- The purpose of the call is to provide the NRC Staff with the licensee's planned approach to a request for a one-time extension of the schedule for the in-service examination of the Control Rod Drive Mechanism (CRDM) Penetration No. 1 in the ANO-1 Reactor Vessel Closure Head (RVCH).
- The requested alternative would permit extension of the schedule for the volumetric or surface examination of Penetration No. 1 until the time that the second B4.40 Inservice examination is required for the other head penetrations.

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**Background**

# Background

- The ANO-1 RVCH was replaced in 1R19 (Fall 2005).
- The replacement RVCH contains penetrations fabricated from Alloy 690 (wrought material) and Alloy 52 and Alloy 152 weld materials.
- 10 CFR 50.55a(g)(6)(ii)(D) requires augmented examinations of RVCHs in accordance with ASME Code Case N-729-6 as conditioned by the regulation.
- The ANO-1 replacement RVCH and its penetrations are categorized under Item Nos. B4.30 and B4.40 of Table 1 of Code Case N-729-6.
- Table 1 of Code Case N-729-6 requires a volumetric or surface examination per Item B4.40 of all nozzles, not to exceed two inspection intervals (nominally 20 calendar years).

# Background (continued)

- Entergy performed a volumetric examination of the ANO-1 RVCH during the spring 2021 refueling outage (1R29) that satisfied the B4.40 examination requirement for 68 out of the 69 penetrations in the RVCH.
- No evidence of Primary Water Stress Corrosion Cracking (PWSCC) was detected during the 1R29 examination.
- Penetration No. 1 at the center of the head contains the post-accident reactor vessel water level (RADCAL) instrument, this penetration was not included in the spring 2021 B4.40 examinations.
  - The adapter flange/closure extension guide assembly of the RADCAL instrument tightly fits inside Penetration No. 1 and is bolted directly to the Penetration No. 1 nozzle housing adapter flange.
  - This assembly provides guidance and protection for the RADCAL gamma thermometer (RGT) manometer tubes, provides protection for the instrument leads, and forms a portion of the primary pressure boundary.
  - This bolted joint is intended to be a permanent mechanical connection.

# Background (continued)

- Without removing the instrument, the tight gap between the RADCAL instrument guide assembly and the inside of Penetration No. 1 precludes UT or ET using existing blade probes.
- To obtain access to perform a volumetric or surface examination, the RADCAL instrument would need to be removed and subsequently reinstalled, entailing significant worker dose (multiple person-rem) and considerable risks.
- Due to the uniqueness of the RADCAL instrument, spare parts would need to be fabricated as none exist.



# Background (continued)

- The removal of the RADCAL would result in a hardship without a compensating increase in the level of quality and safety as specified in 10 CFR 50.55a(z)(2).
- Entergy plans to request approval of a one-time extension of the B4.40 volumetric or surface examination of this penetration until the time that the second B4.40 Inservice examination is required for the other head penetrations as an alternative to address this unique hardship.
- Approval of this alternative would correspond to an extension of about 15.4 calendar years beyond the nominal frequency not to exceed two Code inspection intervals (nominally 20 calendar years) for this single penetration, i.e., a total period of about 35.4 calendar years.
- Note that this alternative future inspection outage (in 2041) would be beyond the May 2034 expiration of the current ANO-1 renewed license.

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**Basis for Request**

# Basis for Request

- Operating experience demonstrates that the susceptibility of Alloy 690 nozzles to PWSCC is very low.
- A PWSCC crack growth analysis specific to this penetration demonstrates the effectiveness of the proposed alternative examination frequency to prevent pressure boundary leakage due to conservatively postulated PWSCC affecting the nozzle base metal.
- The proposed alternative will provide reasonable assurance of structural integrity of the CRDM penetrations and RVCH, considering the potential concerns for circumferential nozzle cracking and boric acid corrosion.
- The hardship affects only a single penetration out of the population of 69.
- Defense in depth is maintained under the alternative through the performance of periodic bare metal visual examinations for evidence of head penetration leakage (in accordance with Item No. B4.30 of Code Case N-729-1, Table 1) and through the enhanced leakage detection capability.

# PWSCC Crack Growth Analysis

- A plant-specific PWSCC crack growth analysis has been performed applying the same type of deterministic fracture mechanics procedure that has commonly been applied in the industry for this and similar purposes.
- Conservatively assumes PWSCC flaws on nozzle ID and nozzle OD below the weld, each having an initial depth of 10% of the nozzle wall thickness at the time of head replacement.
- Applies the common factor of improvement (FOI) approach to specify the crack growth rate for Alloy 690 wrought material in comparison to that for Alloy 600 calculated using the MRP-55 crack growth rate equation incorporated within versions of the ASME Code, Section XI approved by NRC.
- The analysis shows that a FOI of 8.2 applied to the crack growth analysis specific to ANO-1 RVCH Penetration No. 1 shows a time to leakage exceeding the operating period under the proposed alternative (32.7 effective full power years and 35.4 calendar years).

# Precedents

- In 2017, NRC (ML17018A283) found that Entergy's use of an FOI value of 9.5 with regards to the ANO-1 replacement RVCH was justified and bounded by relevant available laboratory crack growth rate data.
- Similar crack growth calculations of hypothetical PWSCC flaws were applied as part of the basis for a recent relief request to delay volumetric or surface examination of the Byron Unit 2 RVCH for one cycle of operation.
  - In 2020, NRC (ML20245E506) approved the request.

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## Conclusions and Next Steps

# Conclusions

- Removal of the RADCAL instrument to permit volumetric or surface examination of Penetration No. 1 in accordance with 10 CFR 50.55a(g)(6)(ii)(D) and ASME Code Case N-729-6 would result in a hardship without a compensating increase in the level of quality and safety as specified in 10 CFR 50.55a(z)(2).
- The proposed alternative would provide reasonable assurance of structural and leak tight integrity of the CRDM penetrations and RVCH.

# Next Steps

- Entergy to submit the relief request prior to the end May 2022.
- Entergy will request approval prior to December 31, 2023.
  - Provide time to plan for the 1R32 refueling outage scheduled to occur in fall 2025.



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## **Closing Remarks**