UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

May 10, 2018

ANO Site Vice President
Arkansas Nuclear One
Entergy Operations, Inc.
N-TSB-58
1448 S.R. 333
Russellville, AR 72802

SUBJECT: ARKANSAS NUCLEAR ONE, UNIT 2 – REQUEST FOR ADDITIONAL INFORMATION REGARDING LICENSE AMENDMENT REQUEST TO UPDATE THE REACTOR COOLANT SYSTEM PRESSURE-TEMPERATURE LIMITS (EPID L-2017-LLA-0396)

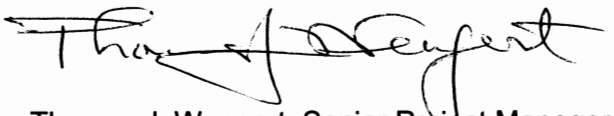
Dear Sir or Madam:

By application dated November 20, 2017, Entergy Operations, Inc. (Entergy, the licensee) submitted a license amendment request to revise the Arkansas Nuclear One, Unit 2 Technical Specifications concerning the Reactor Coolant System Pressure-Temperature (P-T) Limits. The proposed changes would replace the current reactor vessel P-T limits, applicable to 32 Effective Full Power Years (EFPY), with new P-T limits applicable to 54 EFPY (approximately 60 calendar years).

The U.S. Nuclear Regulatory Commission (NRC) staff has reviewed Entergy's application and, based upon this review, determined that additional information is needed, as set forth in the enclosure. On April 10, 2018, a draft version of the request for additional information (RAI) was sent to your staff to ensure that the request was understandable, the regulatory basis for the request was clear, and to determine if the requested information had been previously docketed. On May 2, 2018, the NRC staff conducted a conference call with the licensee staff to clarify the request. Subsequent to the call, Mr. David Bice of your staff agreed that Entergy would provide a response to this RAI within 90 days of the date of this letter.

If you have any questions, please contact me at (301) 415-4037 or by e-mail at Thomas.Wengert@nrc.gov.

Sincerely,



Thomas J. Wengert, Senior Project Manager
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-368

Enclosure:
RAI

cc: Listserv

REQUEST FOR ADDITIONAL INFORMATION

REGARDING LICENSE AMENDMENT REQUEST TO

UPDATE REACTOR COOLANT SYSTEM PRESSURE-TEMPERATURE LIMITS

ENTERGY OPERATIONS, INC.

ARKANSAS NUCLEAR ONE, UNIT 2

DOCKET NO. 50-368

By application dated November 20, 2017 (Reference 1), Entergy Operations, Inc. (the licensee), submitted a license amendment request (LAR) to revise the Arkansas Nuclear One, Unit 2 (ANO-2) Technical Specifications (TSs) by replacing the current Reactor Coolant System (RCS) Pressure-Temperature (P-T) Limits, applicable to 32 Effective Full Power Years (EFPY), with new P-T limits applicable to 54 EFPY (approximately 60 calendar years). The U.S. Nuclear Regulatory Commission (NRC) staff has determined that the following additional information is needed in order to complete its review.

(1) Vessels and Internals Branch (MVIB)

Request for Addition Information (RAI) MVIB-1

Background

The technical basis for ANO-2's proposed revised P-T limits is provided in Attachment 3 (Reference 2) of the LAR: Non-proprietary Westinghouse Report No. WCAP-18169-NP, Revision 0, "Arkansas Nuclear One Unit 2 Heatup and Cooldown Limit Curves for Normal Operation."

Issue

Regarding the calculation of the reference temperature (RT_{NDT}) values, Section 7 of WCAP-18169-NP cited NRC Technical Letter Report TLR-RES/DE/CIB-2013-01, "Evaluation of the Beltline Region for Nuclear Reactor Pressure Vessels," Office of Nuclear Regulatory Research [RES], dated November 14, 2014 (Reference 3), as a basis for not considering the shift due to irradiation for reactor pressure vessel (RPV) materials for which the predicted shift in the reference temperature (ΔRT_{NDT}) is less than 25 degrees Fahrenheit (°F). Section 4 of TLR-RES/DE/CIB-2013-01, recommends the following definition for the RPV beltline region:

> The beltline is defined as the region of the RPV adjacent to the reactor core that is projected to receive a neutron fluence level of $1x10^{17}$ n/cm^2 [neutrons per square centimeter] (E > 1.0 MeV [energy > 1 megaelectron-volt]) or higher at the end of the licensed operating period.
>
> Embrittlement effects may be neglected for any region of the RPV if either of the following conditions are met: (1) neutron fluence is less than $1x10^{17}$ n/cm^2 (E > 1.0 MeV) at EOL [End-of-License], or (2) the mean value of ΔT_{30} estimated using an ETC [Embrittlement Trend Curve] acceptable to the staff is less than

25 °F at EOL. The estimate of ΔT_{30} at EOL shall be made using best-estimate chemistry values. [Note: ΔT_{30} (°F) is the mean value of the shift in reference temperature at a Charpy V-notch impact energy of 30 foot-pounds (ft-lbs) caused by neutron radiation embrittlement]

Citing the TLR-RES/DE/CIB-2013-01 recommendation, the licensee did not add a shift due to irradiation for several extended beltline materials, including the upper shell plate, upper shell longitudinal welds, and upper-to-intermediate shell girth welds, and for surveillance capsule weld material Heat No. 83650, which is applicable to the intermediate-to-lower shell girth weld.

Discounting the shift in RT_{NDT} due to irradiation if the predicted shift is less than 25 °F does not meet the NRC regulation in Title of the *Code of Federal Regulations* (10 CFR) Part 50, Appendix G, "Fracture Toughness Requirements." Appendix G IV.A to 10 CFR Part 50 states that for reactor vessel beltline materials, including welds, plates, and forgings, the values of RT_{NDT} must account for the effects of neutron radiation. Regulatory Guide 1.99, "Radiation Embrittlement of Reactor Vessel Materials," Revision 2 (Reference 4), details how ΔRT_{NDT} is calculated. The NRC staff notes that Regulatory Issue Summary 2014-11, "Information on Licensing Applications for Fracture Toughness Requirements for Ferritic Reactor Coolant Pressure Boundary Components" (Reference 5), clarifies that 10 CFR Part 50, Appendix G and 10 CFR Part 50, Appendix H, "Reactor Vessel Material Surveillance Program Requirements," define the beltline as including all RPV materials that will receive a neutron fluence greater than or equal to $1x10^{17}$ n/cm^2 (E> 1 MeV).

The NRC staff also notes that TLR-RES/DE/CIB-2013-01 is not NRC guidance, and the recommendation that the shift due to irradiation can be discounted if it is less than 25 °F is not endorsed in any NRC guidance document or permitted by the regulations.

Request:

Revise the P-T limit evaluation to include RT_{NDT} values for all RPV beltline and extended beltline materials calculated in accordance with 10 CFR Part 50, Appendix G, so the NRC staff can verify that the calculations were performed in accordance with the regulations.

RAI MVIB-2

Background

In the application, the licensee requested changes to the TSs for ANO-2. The amendment would replace the current RPV P-T limits, applicable to 32 EFPY, with new P-T limits applicable to 54 EFPY (approximately 60 calendar years). As part of the updated P-T limits, the licensee also reevaluated its upper shelf energy (USE) analysis. The fracture toughness criteria in 10 CFR Part 50, Appendix G, requires that beltline materials maintain USE no less than 50 ft-lb throughout the life of the vessel, unless it is demonstrated in a manner approved by the NRC staff that lower values of Charpy USE will provide margins of safety against fracture equivalent to those required by Appendix G of Section XI of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code.

Issue

On page 6 of the Enclosure to the LAR, the licensee stated, in part:

> The limiting USE value for the ANO-2 RPV at 54 EFPY is 60.2 ft-lb. This value corresponds to the Upper Shell Plate C-8008-2. Section 5 of Attachment 3 presents the complete results of the USE evaluation. As can be seen in Section 5, all of the beltline and extended beltline materials in the ANO-2 RPV are projected to remain above the USE screening criteria value of 50 ft-lb through 54 EFPY.

In Section 5 of Attachment 3 of the application, the licensee provides the evaluation of chemistry factors. However, this section does not include the evaluation of USE.

Request

Provide the evaluation and the results for USE, based on 54 EFPY fluence values that are discussed in the amendment request.

(2) Reactor Systems Branch (SRXB)

RAI SRXB-1

Background

As part of this LAR, the licensee performed a reanalysis of the limiting low temperature overpressure events to address the effects of a higher system backpressure and a higher high-pressure safety injection (HPSI) flow rate, and assessed the impact of the reanalysis on the P-T limits in TS 3.4.9, "Pressure/Temperature Limits," and P-T limits related TS 3.4.12, "Low Temperature Overpressure Protection (LTOP) System."

Applicable Regulatory Requirements/Criteria:

The regulation, 10 CFR 50.36, "Technical specifications," identifies the requirements for the contents of TSs. Paragraph 50.36(c)(2) of 10 CFR requires that TSs include limiting conditions for operation (LCOs) to assure safe operation of a nuclear reactor.

General Design Criterion (GDC) 15, "Reactor coolant system design," of Appendix A to 10 CFR Part 50, requires that "[t]he reactor coolant system and associated auxiliary, control, and protection systems shall be designed with sufficient margin to assure that the design conditions of the reactor coolant pressure boundary are not exceeded during any conditions of normal operation, including anticipated operational occurrences."

In the original safety evaluation report (SER), the NRC staff stated that ANO-2 was designed and constructed on the proposed Atomic Energy Commission (AEC) GDCs that were published July 11, 1967. The staff further noted in the SER that, since July 15, 1971, when the AEC published the GDCs of Appendix A to 10 CFR Part 50, the licensee has attempted to comply with the newer GDCs to the extent practical. In Section 3.1 of the ANO-2 Final Safety Analysis Report, the licensee discussed the design of ANO-2 with respect to the GDCs of July 15, 1971. Based on its technical review results assessing the plant against the 1971 GDCs, the NRC staff previously concluded that the plant design conforms to the intent of the 1971 GDCs. The staff

has determined that GDC 15 of Appendix A to 10 CFR Part 50 is applicable to the review of this LAR.

Branch Technical Position (BTP) 5-2, Revision 3 (Reference 6), of NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR [Light-Water Reactor] Edition," provides guidance to the NRC staff in reviewing overpressurization protection of pressurized water reactors while operating at low temperatures. Paragraph B.1 of BTP 5-2 specifies that the LTOP system be capable of relieving pressure during all anticipated overpressurization events at a rate sufficient to prevent the RCS pressure from exceeding the applicable TSs and the 10 CFR Part 50, Appendix G limits while operating at low temperatures.

Issue

Section 5.2.2.4 of the ANO-2 Safety Analysis Report describes the design of the LTOP system, which includes redundant LTOP relief valves 2PSV-4732 and 2PSV-4742, and two LTOP isolation valves. The relief valve setpoint of less than or equal to 430 pounds per square inch gauge (psig) specified in TS LCO 3.4.12, was determined based on the results of the analysis of two events: (1) the most limiting energy addition event -- a single idle reactor coolant pump start with a secondary-to-primary temperature differential of 100 °F; and (2) the limiting mass addition event -- simultaneous injection to the RCS from one HPSI pump and three charging pumps resulting from an inadvertent safety injection actuation signal. TS LCO 3.4.12 requires LTOP to be enabled when any RCS cold leg temperature is less than or equal to 220 °F.

Page 5 of the Enclosure to the LAR states that the limiting LTOP events were reanalyzed to address a higher backpressure in the system and a higher HPSI flow rate. In support of the LAR, the licensee also reevaluated the LTOP enable temperature to determine its acceptability. However, the information in the LAR was not sufficient for the NRC staff to independently verify the adequacy of the licensee's LTOP reanalysis.

Request

Provide the following information, considering the new system backpressure and HPSI flow rates, used to support the proposed P-T limits in TS 3.4.9 and P-T limits related TS 3.4.12:

a) Provide the values of the system backpressure and HPSI rates used in the LTOP reanalysis and the analysis of record (AOR), and describe the causes (design change or changes in assumptions and methods used in the analysis) that result in a higher system backpressure and higher HPSI flow rates.

b) Discuss and justify any changes to the methodologies used in the LTOP reanalysis.

c) Discuss the results of the LTOP reanalysis for the most limiting energy addition event and mass addition event, and provide additional information to demonstrate that the RCS pressures are within the proposed P-T limits, and the required relief valve setpoint in TS LCO 3.4.12 remains valid. Provide justification for cases where the reanalyzed limiting events are different from those identified in the AOR.

d) Discuss the reevaluation of the LTOP enable temperature and justify that the required enable temperature in TS LCO 3.4.12 remains acceptable for the proposed P-T limits in in TS 3.4.9.

REFERENCES

1. Anderson, R. L., Entergy Operations, Inc., letter to U.S. Nuclear Regulatory Commission, "License Amendment Request Updating the Reactor Coolant System Pressure-Temperature Limits, Arkansas Nuclear One, Unit 2, Docket No. 50-368, License No. NPF-6, dated November 20, 2017 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17326A387).

2. Westinghouse, WCAP-18169-NP, Revision 0, "Arkansas Nuclear One Unit 2 Heatup and Cooldown Limit Curves for Normal Operation," dated December 2016 (ADAMS Accession No. ML17326A389).

3. U.S. Nuclear Regulatory Commission, "Evaluation of the Beltline Region for Nuclear Reactor Pressure Vessels," Technical Letter Report TLR-RES/DE/CIB-2013-01, dated November 14, 2014 (ADAMS Accession No. ML14318A177).

4. U.S. Nuclear Regulatory Commission, "Radiation Embrittlement of Reactor Vessel Materials," Regulatory Guide 1.99, Revision 2, dated May 1988 (ADAMS Accession No. ML003740284).

5. U.S. Nuclear Regulatory Commission, "Information on Licensing Applications for Fracture Toughness Requirements for Ferritic Reactor Coolant Pressure Boundary Components," Regulatory Issue Summary 2014-11, dated October 14, 2017 (ADAMS Accession No. ML14149A165).

6. U.S. Nuclear Regulatory Commission, "Overpressurization Protection of Pressurized-Water Reactors While Operating at Low Temperatures," NUREG-0800, Branch Technical Position 5-2, Revision 3, dated March 2007 (ADAMS Accession No. ML070850008).

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