



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

June 27, 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 – REVISION TO THE REACTOR VESSEL SURVEILLANCE CAPSULE WITHDRAWAL SCHEDULE (CAC NO. MG0244; EPID L-2017-LLL-0020)

Dear Sir or Madam:

By letter dated September 14, 2017 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17257A121), as supplemented by letters dated November 1, 2017, and March 13, 2018 (ADAMS Accession Nos. ML17305B616 and ML18072A229, respectively), Entergy Operations, Inc. (the licensee) submitted a request for U.S. Nuclear Regulatory Commission (NRC) staff review and approval to revise the reactor vessel surveillance capsule withdrawal schedule for Arkansas Nuclear One, Unit 2 (ANO-2). Specifically, the licensee requested NRC approval to revise the removal intervals for capsule number 4 (W-284) and capsule number 6 (W-277).

The NRC staff has reviewed the licensee's submittals and concludes that it is acceptable because it will continue to meet the surveillance capsule withdrawal schedule criteria in the American Society for Testing and Materials Standard Practice E185-82 and Appendix H to Title 10 of the *Code of Federal Regulations* Part 50 for the period of extended operation.

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

Sincerely,

A handwritten signature in black ink, appearing to read "R. Pascarelli".

Robert J. Pascarelli, Chief
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-368

Enclosure:
Safety Evaluation

cc: Listserv



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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REGARDING CHANGES TO THE REACTOR VESSEL

MATERIAL SURVEILLANCE PROGRAM

ENTERGY NUCLEAR OPERATIONS, INC.

ARKANSAS NUCLEAR ONE, UNIT 2

DOCKET NO. 50-368

1.0 INTRODUCTION

By letter dated September 14, 2017 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17257A121), as supplemented by letters dated November 1, 2017, and March 13, 2018 (ADAMS Accession Nos. ML17305B616 and ML18072A229, respectively), Entergy Operations, Inc. (Entergy, the licensee) submitted a request to revise the surveillance capsule withdrawal schedule for the reactor vessel (RV) material surveillance program for Arkansas Nuclear One, Unit 2 (ANO-2). The submittal proposed to make two changes to the capsule removal schedule: (1) revise the "Removal Interval" of the previously pulled surveillance capsule from the estimated 30 effective full power years (EFPY) to the actual measured interval, and (2) revise the withdrawal schedule of capsule number 6 from its status as standby capsule to one being withdrawn and tested at a minimum of 40 EFPY, to support the additional 20-year period of extended operation (PEO).

2.0 REGULATORY EVALUATION

Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, Appendix H, "Reactor Vessel Material Surveillance Program Requirements," requires that RVs that will exceed a neutron fluence of 1×10^{17} neutrons per square centimeter (n/cm^2) ($E > 1.0$ MeV) at the end of their design life must have their beltline materials monitored by a surveillance program complying with American Society for Testing and Materials (ASTM) E185, "Standard Practice for Conducting Surveillance Tests for Light-Water Cooled Nuclear Power Reactor Vessels." Specifically, Appendix H to 10 CFR Part 50 requires that the design of the surveillance program and the withdrawal schedule meets the requirements of the edition of ASTM E185 that was current on the issue date of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code to which the RV was purchased. However, later editions, up to and including the 1982 Edition of ASTM E185 (ASTM E185-82), may be used instead. Section III(B)(3) of 10 CFR Part 50, Appendix H requires that surveillance capsule withdrawal schedules be submitted to and approved by the NRC staff prior to implementation.

Enclosure

In 2003, pursuant to NUREG-1801, "Generic Aging Lessons Learned (GALL) Report," the licensee applied for an additional 20-year period of extended operation beginning on July 17, 2018. The NRC reviewed the submittal and issued the renewed license in June 2005. Revision 2 of the GALL Report states, in part:

The plant-specific or integrated surveillance program shall have at least one capsule with a projected neutron fluence equal to or exceeding the 60-year peak reactor vessel wall neutron fluence prior to the end of the period of extended operation.

The fluence value for capsule W-284, the most recently pulled capsule at ANO-2, is below the predicted fluence for 60 years of operation. Therefore, the licensee proposes to adjust the withdrawal schedule to remove a standby surveillance capsule during the PEO and testing it in accordance with the guidance in the GALL Report.

3.0 TECHNICAL EVALUATION

ANO-2 is following the requirements of ASTM E185-82 to comply with the surveillance capsule withdrawal requirements of 10 CFR Part 50, Appendix H. Table 1 of ASTM E185-82 defines the minimum number of capsules required to be withdrawn and tested, based on the predicted transition temperature shift at the inner surface of the RV. The withdrawal schedule initially assumed a design life of 40 EFPY and was developed using the column for 3 specimen capsules with the following requirements:

1. The first capsule must be withdrawn either at 6 EFPY or at the time when the accumulated neutron fluence of the capsule exceeds 5×10^{18} n/cm², or at the time when the highest predicted ΔRT_{NDT} (the shift in the reference temperature nil ductility transition) of all encapsulated materials is approximately 50 degrees Fahrenheit (°F), whichever comes first.
2. The second capsule must be withdrawn either at 15 EFPY or at the time when the accumulated neutron fluence of the capsule corresponds to the approximate end of life (EOL) fluence at the reactor vessel inner wall location, whichever comes first.
3. The third capsule must be withdrawn at a time where the accumulated neutron fluence exceeds the limiting fluence of the reactor vessel at the EOL but not exceeding twice the peak EOL vessel fluence.

Table 1, "Current Capsule Removal Schedule," of the licensee's submittal provides the current RV surveillance capsule withdrawal schedule, as well as the removal intervals (EFPY) and location of the capsules that were previously removed and tested. Capsules W-97, W-104 and W-284 were removed at 1.69 EFPY, 15.7 EFPY, and 30 EFPY, respectively with corresponding fluence values of 3.4×10^{18} n/cm², 2.937×10^{19} n/cm², and 3.67×10^{19} n/cm², respectively. Three other capsules were designated as STANDBY for future testing. The NRC staff reviewed the licensee's previous capsule withdrawal schedule and determined that it complies with the withdrawal schedule set forth in ASTM E185-82 for 40 years of operation.

In its submittal, the licensee proposed three modifications to the previously approved withdrawal schedule, which are listed in Table 2, "Proposed Revision to Capsule Removal Schedule," as discussed below:

- (1) The licensee proposed to change the removal interval for capsule W-284 from 30 to 29.24 EFPY, which represents the measured interval from the capsule summary report. The NRC staff determined that this is solely an editorial change and is, therefore, acceptable.
- (2) The licensee proposed to revise the interval of capsule W-277 from STANDBY to a minimum of 40.00 EFPY. ANO-2 is currently licensed to operate for 60 years (approximately 54 EFPY) and revised pressure-temperature (P-T) limits are being developed from the results of capsule W-284 to cover the PEO. The fluence value measured from that surveillance capsule is less than the predicted value at 60 years of operation and, as a result, is not valid for the current life of the plant. Therefore, the withdrawal and testing of capsule W-277 is in accordance with the guidance in the GALL report. All three capsules have the same lead factor of 1.35, however only capsule W-263 contains Standard Reference Materials in place of ANO-2 specific RV material, as contained in both capsules W-83 and W-277. Capsule W-277 was chosen to be withdrawn and tested arbitrarily. The NRC staff concludes that the choice of withdrawing this capsule is acceptable because the two remaining capsules provide a wider array of materials to be irradiated for further testing. At 40 EFPY, Capsule W-277 will accumulate the projected 60-year peak vessel fluence of 4.98×10^{19} n/cm².
- (3) As a result of the above discussion, the licensee revised Note (a) at the bottom of Table 2 of the licensee's submittal dated September 14, 2017, from 48 EFPY to 54 EFPY to accurately represent 60 calendar years of operation. The NRC staff concludes that this change is consistent with the currently-licensed PEO and therefore is acceptable.

The NRC staff concludes that the proposed changes to the ANO-2 withdrawal schedule for:

(1) capsule W-277 from STANDBY to 40 EFPY, (2) capsule W-284 from 30 to 29.24 EFPY, and (3) Table 2 Note (a) from 48 to 54 EFPY are acceptable for continued operation, do not result in a decrease in safety or security, and are consistent with ASTM E185-82, as supplemented by the GALL Report guidance.

4.0 CONCLUSION

The NRC staff reviewed Entergy's proposed withdrawal schedules for ANO-2 and determined that the changes to the schedule will continue to meet the RV surveillance capsule withdrawal schedule criteria in ASTM E185-82, as supplemented by the GALL Report guidance, and 10 CFR Part 50, Appendix H for ANO-2's period of extended operation. The staff, therefore, concludes that the RV withdrawal schedule, as proposed in the licensee's letter dated September 14, 2017, is acceptable for implementation.

Principal Contributor: A. Young

Date: June 27, 2018

SUBJECT: ARKANSAS NUCLEAR ONE, UNIT 2 – REVISION TO THE REACTOR VESSEL SURVEILLANCE CAPSULE WITHDRAWAL SCHEDULE (CAC MG0244; EPID L-2017-LLL-0020) DATED JUNE 27, 2018

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AYoung, NRR

ADAMS Accession No.: ML18173A019

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