



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

March 4, 2015

Vice President, Operations
Entergy Nuclear Operations, Inc.
Indian Point Energy Center
450 Broadway, GSB
P.O. Box 249
Buchanan, NY 10511-0249

SUBJECT: INDIAN POINT NUCLEAR GENERATING UNIT NO. 3 – SAFETY EVALUATION
RE: REVISION TO THE REACTOR VESSEL SURVEILLANCE CAPSULE
WITHDRAWAL SCHEDULE PER 10 CFR 50 APPENDIX H (TAC NO. MF5148)

Dear Sir or Madam:

By letter dated November 5, 2014, as supplemented by letter dated January 26, 2015, Entergy Nuclear Operations, Inc., the licensee, requested approval of proposed changes to the reactor vessel surveillance capsule withdrawal schedule for the Indian Point Nuclear Generating Unit No. 3. The proposed changes were submitted pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, Appendix H, "Reactor Vessel Material Surveillance Program Requirements," Section III.B.3, which requires that proposed withdrawal schedules be submitted and approved by the Nuclear Regulatory Commission (NRC) prior to implementation.

The NRC staff concludes that the proposed changes to the reactor pressure vessel surveillance capsule withdrawal schedule are consistent with the recommendations specified in American Society for Testing and Materials Standard Practice E185-82, "Standard Practice for Conducting Surveillance Tests for Light-Water Cooled Nuclear Power Reactor Vessels," as referenced by the requirements of 10 CFR Part 50, Appendix H. Furthermore, the proposed changes meet the guidance in NUREG-1801, "Generic Aging Lessons Learned (GALL) Report," Revision 1, Section XI.M31. Therefore, the proposed changes are acceptable. The NRC staff's evaluation is enclosed.

Sincerely,

A handwritten signature in black ink, reading "Benjamin G. Beasley".

Benjamin G. Beasley, Chief
Plant Licensing Branch I-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-286

Enclosure:
Safety Evaluation

cc w/encl: Distribution via Listserv



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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION
RELATED TO THE REACTOR VESSEL MATERIALS SURVEILLANCE PROGRAM

ENTERGY NUCLEAR OPERATIONS, INC.

INDIAN POINT NUCLEAR GENERATING UNIT NO.3

DOCKET NO. 50-286

1.0 INTRODUCTION

By letter dated November 5, 2014 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML14323A729), as supplemented by letter dated January 26, 2015 (ADAMS Accession No. ML15034A507), Entergy Nuclear Operations, Inc. (Entergy, or the licensee) requested to revise the reactor vessel (RV) surveillance capsule withdrawal schedule for Indian Point Nuclear Generating Unit No. 3 (IP3). The licensee's submittal requested to postpone the time at which they withdraw and test the next surveillance capsule from 25.2 to 37 effective full power years (EFPY) in order to address the additional twenty year period of extended operation (PEO) which is currently under review.

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 10^{17} n/cm² ($E > 1.0$ 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 states that:

The design of the surveillance program and the withdrawal schedule must meet the requirements of the edition of ASTM E 185 that is current on the issue date of the ASME [American Society of Mechanical Engineers Boiler and Pressure Vessel] Code to which the reactor vessel was purchased. Later editions of ASTM E 185 may be used, but including only those editions through 1982.

Section III(B)(3) of 10 CFR Part 50, Appendix H, requires that surveillance capsule withdrawal schedules be submitted to and approved by the Nuclear Regulatory Commission (NRC) staff prior to implementation

Enclosure

By letter dated April 23, 2007, and as supplemented by letters dated May 3 and June 21, 2007, Entergy submitted a license renewal application (LRA) for IP3 in accordance with 10 CFR Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants." The LRA was developed with guidance from NUREG-1801, "Generic Aging Lessons Learned (GALL) Report, Revision 1." Section XI.M31, "Reactor Vessel Surveillance," of the GALL Report includes recommended changes to the surveillance capsule withdrawal schedule to address the PEO. In addition, the GALL Report states, "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 licensee's LRA is still under review.

3.0 TECHNICAL EVALUATION

3.1 Summary Description of Licensee Evaluation

The IP3 surveillance capsule withdrawal schedule is based on the 1973 Edition of ASTM E185 and has been upgraded to the requirements of ASTM E185-82 to the extent practicable. As described in the licensee's submittal, the proposed changes revise the surveillance capsule withdrawal schedule for applicability from the original licensing period to the PEO.

Table 1 - Proposed Revised Withdrawal Schedule

Capsule	Location	Lead Factor	Withdrawal Date	Withdrawal EFPY	Capsule Fluence
T	40°	3.43	Removed 1978 Refueling Outage	1.4	2.63E+18
Y	40°	3.49	Removed 1982 Refueling Outage	3.2	6.92E+18
Z	40°	3.48	Removed 1987 Refueling Outage	5.5	1.04E+19
S	40°	3.46	Retired in place	N/A	N/A
X	4°	1.49	Removed 2003 Refueling Outage	15.5	8.74E+18
U	4°	1.52	RF023	Approx. 37 EFPY	Approx. 1.86E+19
V	4°	1.52	Spare	N/A	N/A
W	4°	1.52	Spare	N/A	N/A

The proposed schedule revises the withdrawal and testing of Capsule U to Refueling Outage 23, scheduled for March 2025. At that time, the surveillance capsule neutron fluence is projected to be 1.86×10^{19} n/cm². The proposed revision of the surveillance withdrawal schedule is provided in Table 1 above, and reflects a 60-year operating period. The licensee has previously removed and tested four surveillance capsules. There are four additional surveillance capsules remaining in the RV. The licensee predicts that following the adjusted withdrawal schedule, the projected neutron fluence

for Capsule U at the time of removal will be approximately 1.86×10^{19} n/cm² and the lead factor for the capsule is 1.52. Since the estimated peak vessel clad/base metal interface neutron fluence for IP3 is approximately 1.56×10^{19} n/cm² at 48 EFPY (corresponding to 60 calendar years of operation), the proposed withdrawal schedule would be acceptable per the requirements in ASTM E 185-82. Pulling this capsule would leave two remaining spare capsules with lead factors similar to capsule U; a third spare capsule is inaccessible due to equipment interference.

3.2 Staff Evaluation

Table 1 of ASTM E 185-82 lists the recommended number of capsules and the withdrawal schedule for three ranges of predicted temperature transition shift (ΔRT_{NDT}). The withdrawal schedule is defined in terms of EFPY for a vessel with a design life of 32 EFPY (corresponding to 40-years of operation). The peak ΔRT_{NDT} increase for IP3 due to neutron fluence for the original license period of 40 years exceeds 200°F. Therefore, according to ASTM E 185-82, five capsules must be withdrawn with the following requirements:

1. The first capsule must be withdrawn either at 1.5 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} of all encapsulated materials is approximately 50°C, whichever comes first.
2. The second capsule must be withdrawn either at 3 EFPY or at the time when the accumulated neutron fluence of the capsule corresponds to a value midway between that of the first and third capsules.
3. The third capsule must be withdrawn either at 6 EFPY or at the time when the accumulated neutron fluence of the capsule corresponds to the approximate EOL [end of life] fluence at the reactor vessel $\frac{1}{4}$ T location, whichever comes first.
4. The fourth capsule must be withdrawn either at 15 EFPY or at the time when the accumulated neutron fluence of the capsule corresponds to the approximate EOL fluence at the reactor vessel inner wall location, whichever comes first.
5. The fifth 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.

The licensee's submittal provided the proposed new RV surveillance capsule withdrawal schedule to reflect a renewed operating license, including the withdrawal EFPY and neutron fluence values of the capsules that were already removed and tested. Capsules T, Y, Z and X were removed at 1.4 EFPY, 3.2 EFPY, 5.5 EFPY and 15.5 EFPY, respectively, with corresponding neutron fluence values of 2.63×10^{18} n/cm², 6.92×10^{18} n/cm², 1.04×10^{19} n/cm² and 8.74×10^{18} n/cm², respectively. The decrease in fluence with increasing EFPY was due to the lower lead factor of Capsule X compared to the first three capsules. The NRC staff confirmed that these previous capsule withdrawals are consistent with the criteria in Table 1 of ASTM E185-82 for the current 40-year license term.

The GALL Report provides guidelines for LRAs. Section XI.M31 addresses RV surveillance programs. As previously stated, the licensee has submitted a LRA for IP3 which is currently under review. Section XI.M31 Item 5 states:

If an applicant has a surveillance program that consists of capsules with a projected fluence of less than the 60-year fluence at the end of 40 years, at least one capsule is to remain in the reactor vessel and is tested during the period of extended operation. The applicant may either delay withdrawal of the last capsule or withdraw a standby capsule during the period of extended operation to monitor the effects of long-term exposure to neutron irradiation.

Since the fifth (or "last") capsule of the surveillance capsule withdrawal schedule for the original operating period, Capsule U, will have a projected neutron fluence less than the 60-year neutron fluence at the end of 40 years, the licensee may delay withdrawal of the surveillance capsule and test it during the PEO. The projected neutron fluence for Capsule U will be between one and two times the peak RV clad/base metal interface neutron fluence at the end of the PEO.

Therefore, with respect to the requirements in Appendix H to 10 CFR Part 50, as supplemented by the GALL Report guidance, the NRC staff finds the proposed revision to the surveillance capsule withdrawal schedule acceptable.

4.0 CONCLUSION

The NRC staff has reviewed Entergy's proposed RV surveillance capsule withdrawal schedule for IP3 and has determined that the changes to the withdrawal schedule will continue to be in compliance with 10 CFR Part 50, Appendix H for the 60-year operating period, which is still under review, and concludes that the RV withdrawal schedule, as proposed in the licensee's submittal is acceptable for implementation.

Principal Contributor: Austin Young
Carolyn Fairbanks

Date: March 4, 2015

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Sincerely,

/RA/

Benjamin G. Beasley, Chief
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