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

March 15, 2010

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. 2 - REACTOR VESSEL SURVEILLANCE CAPSULE WITHDRAWAL SCHEDULE CHANGE (TAC NO. ME3477)

Dear Sir or Madam:

By letter dated March 4, 2010, as supplemented by letter dated March 8, 2010, Entergy Nuclear Operations, Inc., (the licensee), requested approval of the proposed changes to the reactor vessel surveillance capsule withdrawal schedule for the Indian Point Nuclear Generating Unit No. 2 (IP2). The proposed changes were submitted pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, Appendix H, Section III.B.3, which requires that: (1) withdrawal schedules be submitted, as specified in 10 CFR 50.4, and (2) the proposed schedule must be approved by the Nuclear Regulatory Commission (NRC) prior to implementation.

The NRC staff has reviewed the changes proposed by the licensee and finds that the 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, as referenced by the requirements of 10 CFR Part 50, Appendix H. Therefore, the proposed changes are acceptable and are approved. The NRC staff's evaluation is enclosed.

Please contact John Boska at (301) 415-2901 if you have any questions on this issue.

Sincerely,

Nancy L. Salgado

Nancy L. Salgado, Chief
Plant Licensing Branch I-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-247

Enclosure:
As stated

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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. 2

DOCKET NO. 50-247

1.0 INTRODUCTION

By letter dated March 4, 2010, as supplemented by letter dated March 8, 2010, Entergy Nuclear Operations, Inc., (the licensee), requested approval of the proposed changes to the reactor vessel surveillance capsule withdrawal schedule for the Indian Point Nuclear Generating Unit No. 2 (IP2). The proposed changes were submitted pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, Appendix H, Section III.B.3, which requires that: (1) withdrawal schedules be submitted, as specified in 10 CFR 50.4, and (2) the proposed schedule must be approved by the Nuclear Regulatory Commission (NRC) prior to implementation.

2.0 REGULATORY EVALUATION

2.1 Section 50.60 of Part 50 of Title 10 of the *Code of Federal Regulations* (10 CFR 50.60) and Appendix H to 10 CFR Part 50

The NRC has established requirements and criteria in 10 CFR 50.60 for protecting the reactor vessels of light-water reactors (LWRs) against fracture. The rule requires light-water nuclear power reactors to meet the reactor vessel (RV) materials surveillance program requirements set forth in Appendix H to 10 CFR Part 50.

Appendix H to 10 CFR Part 50 provides the NRC staff's criteria for the design and implementation of RV material surveillance programs for operating LWRs. The rule, in part, requires RV surveillance program designs and withdrawal schedules to meet the requirements of the edition of American Society for Testing and Materials (ASTM) Standard Practice E185 that is current on the issue date of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) to which the RV was purchased, although later editions of ASTM E185 may be used inclusive of the 1982 Edition of ASTM E185 (ASTM E185-82). The rule also requires proposed RV surveillance programs to be submitted to the NRC and approved prior to implementation. The applicable criteria in ASTM E185-82 are discussed in Section 3.1 of this safety evaluation (SE).

2.2 NRC Administrative Letter (AL) 97-004 and NRC Memorandum and Order CLI-96-13

On September 30, 1997, the NRC issued AL 97-004, "NRC Staff Approval for Changes to 10 CFR Part 50, Appendix H, Reactor Vessel Surveillance Specimen Withdrawal Schedules," to all holders of operating licenses for domestic nuclear power plants (with the exception of those who have ceased operations of their facilities or have certified that fuel has been permanently removed from the reactor). In this AL, the NRC staff summarized the Commission's decision promulgated in a Commission Memorandum and Order, which was issued In the Matter of the Cleveland Electric Illuminating Company (Perry Nuclear Power Plant, Unit 1), CLI-96-13, 44 NRC 315 (1996). In this Memorandum and Order, the Commission found that, while 10 CFR Part 50, Appendix H, II.B.3 requires prior NRC approval for all withdrawal schedule changes, only certain changes require the NRC staff to review and approve the changes through the NRC's license amendment (10 CFR 50.90) process. Specifically, only those changes that are not in conformance with the ASTM standard referenced in 10 CFR Part 50, Appendix H (ASTM E-185, "Standard Practice for Conducting Surveillance Tests for Light-Water Cooled Nuclear Power Reactor Vessels") are required to be approved through the license amendment process, whereas changes that are determined to conform to the ASTM standard only require that the NRC staff document its review and verification of such conformance.

3.0 TECHNICAL EVALUATION

3.1 Evaluation Criteria of ASTM Standard Practice E185-82

For IP2, the edition of ASTM E185 that was current on the issue date of the ASME Code to which the RV was purchased was the 1966 Edition. So for IP2, the surveillance capsule withdrawal schedule is based on ASTM E185-66, although the licensee stated that it has upgraded the schedule to meet the requirements of ASTM E185-82 to the extent practicable. Table 1 of ASTM E185-82 requires that either a minimum of three, four, or five surveillance capsules be removed from the vessels, based on the limiting amount of the shift in the reference transition of the nil-ductility temperature (limiting ΔRT_{NDT}) that is projected to occur at the clad-vessel interface location of the RV at the end-of-licensed plant life (EOL). ASTM E185-82 establishes the following criteria for determining the minimum number of capsules that are to be removed in accordance with a withdrawal schedule and the number of capsules that are to be tested:

- For plants with projected RT_{NDT} shifts (i.e., ΔRT_{NDT}) less than 100 °F (56 °C), three capsules are required to be removed from the RV and the first two capsules are required to be tested (for dosimetry, tensile-ductility, Charpy-V impact toughness, and alloying chemistry).

- For plants with projected ΔRT_{NDT} between 100 °F (56 °C) and 200 °F (111 °C), four surveillance capsules are to be removed from the RV and the first three capsules are required to be tested.

- For plants with projected ΔRT_{NDT} above 200 °F (111 °C), five surveillance capsules are required to be removed from the RV and the first four capsules are required to be tested.

- Standard Practice ASTM E185-82 permits the last scheduled surveillance capsules in three, four, or five capsule withdrawal schedules to be removed without the

implementation of testing. However, licensees who opt to pull their final required capsules without the implementation of testing are required by the Standard Practice to hold the capsules in storage.

Table 1 of ASTM Standard Practice E185-82 also provides specific criteria for removal of surveillance capsules. The removal times are based on criteria that the surveillance capsules be removed after a certain amount of power operation has elapsed or at various times when the RV shell is projected to achieve certain levels of neutron fluence. The intent of the Standard Practice is to achieve a set of testing data over a range of neutron fluences for the RV that bounds the current life of the plant. Of key importance here are the removal criteria for the final capsule required for capsule withdrawal. For the final capsule that is required for removal, ASTM E185-82 requires that the capsule be removed at a time when the neutron fluence projected for the capsule is between the limiting fluence value projected for the RV at the EOL and two times that value.

With respect to the current operating term, the IP2 RV has a limiting ΔRT_{NDT} value greater than 200 °F. As stated above, since the ΔRT_{NDT} value is greater than 200 °F, ASTM E185-82 requires that the licensee, at a minimum, remove five capsules from the reactor during the current operating period and test the first four capsules. The licensee has already removed four capsules and at least one more capsule will be removed, as specified by its proposed new withdrawal schedule. This proposed schedule meets the requirements of the 1982 Edition of ASTM E185 for the RV surveillance program for IP2, and is acceptable to the NRC staff.

3.2 Changes Proposed to the Withdrawal Schedule for IP2

Proposed Withdrawal Schedule

Capsule	Location	Lead Factor	Withdrawal Date
T	320 degrees	3.42	End of Cycle 1
Y	220 degrees	3.48	End of Cycle 2
Z	40 degrees	3.53	End of Cycle 5
V	4 degrees	1.18	End of Cycle 8
S	140 degrees	3.5	Retired in Place**
U*	176 degrees	1.2	Spare
W*	184 degrees	1.2	End of Life***
X*	356 degrees	1.2	Spare

* The withdrawal schedule of these capsules is interchangeable due to common materials and lead factors.
** Capsule S may be withdrawn during the RFO19 if modified tooling capable of removing the capsule is available. If not withdrawn, no capsule is required. If withdrawn, testing will be coordinated with the industry to optimize the usefulness of the test data.
*** At end of life as currently licensed, Capsule W (or U or X) will be withdrawn.

The licensee's March 8, 2010, letter provides the updated RV surveillance capsule withdrawal schedule for IP2. The letter indicated that Capsules T, Y, Z, and V were removed from IP2 at 1.42 EFPY, 2.34 EFPY, 5.17 EFPY, and 8.6 EFPY, respectively, and that the neutron fluences reported for capsules T, Y, Z, and V at the time of withdrawal are 2.53×10^{18} n/cm^2, 4.55×10^{18} n/cm^2, 1.02×10^{19} n/cm^2, and 4.92×10^{18} n/cm^2, respectively, as reported in Westinghouse letter IPP-01-079, dated April 26, 2001. The neutron fluences are for neutrons with energies greater

than 1.0 million electron-volts (E>1.0 MeV). Note that the fluences did not necessarily increase with increasing EFPY because the lead factors varied from capsule to capsule. The final capsule required to be removed in accordance with ASTM E185-82 is scheduled to be removed at the end of the 40-year license for IP2. The NRC staff notes that the licensee has applied for a 20-year license renewal, but the NRC has not yet competed its review of that application. In its currently approved withdrawal schedule, the licensee planned to withdraw Capsule U in March 2010, at the end of Cycle 19, and Capsule W at the end of the 40-year license in 2013 (which corresponds to about 32 EFPY). However, the licensee is now requesting approval to revise that schedule, and withdrawal only capsule W, or another one of the spare interchangeable capsules (Capsules U or X), at the end of the 40-year license. The licensee notes that capsules U, W, and X are identical and interchangeable, and can be substituted for each other if desired. This can sometimes be necessary for reasons such as a capsule may be found to be unremoveable from the RV. The NRC staff finds that the revised withdrawal schedule conforms to the guidance of ASTM E185-82, and that any of the interchangeable capsules, Capsules U, W, and X, can be withdrawn to meet the requirements of ASTM E185-82 if necessary without further NRC approval, inasmuch as those capsules' lead factor is equivalent to that of capsule W. The withdrawal schedule for the EOL capsule may be adjusted if the IP2 license is extended beyond the current 40 years, but that will require additional NRC review.

The licensee also noted that it had tried to remove Capsule S from the RV in a previous refueling outage. This was done since Capsule S has a high lead factor (it is accumulating neutron fluence faster than the RV due to its position and limited shielding) and has a neutron fluence which exceeds twice the predicted neutron fluence of the vessel at the end of the 40-year license. However, Capsule S was not removed as it was stuck and would not move with maximum tool removal load. Westinghouse has now increased the capacity of the tool removal load, and the licensee plans to attempt the removal of Capsule S at the end of Cycle 19. The predicted vessel fluence at about 32 EFPY is 1.5×10^{19} n/cm^2 (E>1.0 MeV). If a 20-year license extension is granted, the predicted vessel fluence at the end of the 60-year license (about 48 EFPY) is 1.9×10^{19} n/cm^2 (E>1.0 MeV). The current fluence for Capsule S is about 3.8×10^{19} n/cm^2 (E>1.0 MeV). The NRC staff notes that the removal of Capsule S has no effect on the new capsule withdrawal schedule or the conformance to ASTM E185-82.

The limiting neutron fluence projected for the IP2 RV is approximately 1.5×10^{19} n/cm^2 (E>1.0 MeV) at EOL (32 EFPY). Capsules T, Y, Z, and V have been withdrawn and tested. The current withdrawal schedule was approved by the NRC in 2004 (ADAMS Accession No. ML043200233). The NRC staff verified that the four capsules that have been withdrawn to date comply with the withdrawal schedule of ASTM E185-82. The licensee's proposed change to the surveillance capsule withdrawal schedule is based on the requirements of the 1982 Edition of ASTM E185, to the extent practicable, as required by Appendix H to 10 CFR Part 50.

As stated above, ASTM E185-82 requires that a fifth capsule be removed at a time when the neutron fluence projected for the capsule is between the limiting fluence value projected for the RVs at the EOL and two times that value. This criterion will be met by one of the interchangeable capsules (U, W, or X) for the current operating term for IP2, therefore, the NRC staff finds that the licensee's proposed withdrawal schedule meets ASTM E185-82 for the remaining capsules in its program.

4.0 CONCLUSION

The NRC staff has reviewed Entergy's proposed withdrawal schedule for IP2, and has determined that the changes to the schedule will continue to meet the RV surveillance capsule withdrawal schedule criteria in ASTM E185-82, and is in compliance with 10 CFR Part 50, Appendix H. The NRC staff, therefore, concludes that the RV withdrawal schedule, as proposed in the licensee's March 8, 2010, letter and repeated in Section 3.2 above, is acceptable for implementation.

This evaluation does not provide acceptance of a withdrawal schedule for any period of extended operation for IP2. The licensee should submit a revised withdrawal schedule for NRC review for an extended period of operation should the licensee receive a renewed license for IP2.

Principal Contributors: M. Mitchell, NRR
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Date: March 15, 2010

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Nancy L. Salgado, Chief
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