



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

December 21, 2011

Mr. Robert J. Duncan II, Vice President  
H. B. Robinson Steam Electric Plant,  
Unit No. 2  
Carolina Power & Light Company  
3581 West Entrance Road  
Hartsville, South Carolina 29550

SUBJECT: H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2 – REQUEST FOR  
REVISION TO REACTOR VESSEL MATERIAL SURVEILLANCE CAPSULE  
WITHDRAWAL SCHEDULE (TAC NO. ME7533)

Dear Mr. Duncan:

In accordance with Appendix H to Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, "Reactor Vessel Material Surveillance Program Requirements," requires, in part, a surveillance program to monitor changes in the fracture toughness properties of ferritic materials used in the reactor vessel beltline region of light water nuclear power reactors resulting from exposure to neutron irradiation and the thermal environment. Under the program, fracture toughness test data are obtained from material specimens exposed in surveillance capsules, which are withdrawn periodically from the reactor vessel. Paragraph IV.A of Appendix H states that, "Each capsule withdrawal and the test results must be the subject of a summary technical report to be submitted, as specified in § 50.4, within one year of the date of capsule withdrawal, unless an extension is granted by the Director, Office of Nuclear Reactor Regulation."

By letter dated September 28, 2011, Carolina Power & Light Company, the licensee for H.B Robinson Steam Electric Plant, Unit No. 2 (HBRSEP, Unit 2), doing business as Progress Energy Carolinas, Inc., submitted a request for revision to the reactor vessel (RV) material surveillance capsule withdrawal schedule for HBRSEP, Unit 2. The proposed changes were submitted pursuant to 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 proposed changes to the schedule and concludes that it will continue to meet the RV surveillance capsule withdrawal schedule criteria in ASTM E185-82, "Standard Practice for Conducting Surveillance Tests for Light-Water Cooled Nuclear Power Reactor Vessels," and is in compliance with 10 CFR Part 50, Appendix H. The Nuclear Regulatory Commission (NRC) staff, therefore, concludes that the RV withdrawal schedule, as proposed in the licensee's September 28, 2011 letter, is acceptable for implementation. The staff's evaluation of the subject is enclosed.

R. Duncan

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Please contact Brenda Mozafari, Senior Project Manager, at (301) 415-2020, if you have questions or comments on this letter.

Sincerely,

A handwritten signature in black ink, appearing to read "Doug Broaddus". The signature is fluid and cursive, with a large initial "D" and a long horizontal stroke at the end.

Douglas A. Broaddus, Chief  
Plant Licensing Branch II-2  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

Docket No. 50-261

Enclosure: As stated

cc: Distribution via ListServ



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION  
REACTOR VESSEL SURVEILLANCE CAPSULE WITHDRAWAL SCHEDULE REVISION

CAROLINA POWER AND LIGHT COMPANY

H.B. ROBINSON STEAM ELECTRIC PLANT UNIT NO. 2

DOCKET NO. 50-261

1.0 INTRODUCTION

By letter dated September 28, 2011, Carolina Power and Light Company (CP&L), the licensee for H.B Robinson Steam Electric Plant, Unit No. 2 (HBRSEP, Unit 2), doing business as Progress Energy Carolinas, Inc., submitted a request for revision to the reactor vessel (RV) material surveillance capsule withdrawal schedule for HBRSEP, Unit 2 (Reference 1).

The proposed changes were submitted pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, Appendix H, paragraph 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. Reference 1 indicates that the motivation for this change is to conform with the Coordinated Reactor Vessel Surveillance Program (CRVSP) for PWRs currently under development by the Electric Power Research Institute (EPRI) Materials Reliability Program (MRP) for the purpose of increasing the population of higher-fluence surveillance data ( $>3 \times 10^{19}$  n/cm<sup>2</sup>, E > 1 MeV). Reference 1 also indicates that the general premise of the program is to defer the withdrawal of certain capsules (e.g., those capsules which can provide high-fluence data for specific materials of interest before 2025) while maintaining compliance with 10 CFR 50 Appendix H and Revision 2 of NUREG-1801, "Generic Aging Lessons Learned (GALL) Report." The licensee stated in Reference 1 that Revision 2 of the GALL Report is cited because it recommends license renewal capsule testing be performed between one and two times the 60-year peak RV neutron fluence, as compared to guidance in Revision 1 of the GALL Report to test the capsule at the 60-year fluence.

The licensee stated in Reference 1 that the CRVSP is a program of capsule deferrals (schedule changes) but it does not alter any plant's overall surveillance program or its technical bases and that the changes that will be recommended by the CRVSP are within the original licensing basis for every PWR. Reference 1 indicated that a report summarizing the CRVSP is in the course of preparation and review but has not been completed yet. Several plants with scheduled surveillance capsule withdrawals in 2011 and 2012 will require modification to their surveillance capsule withdrawal schedules prior to the time that the CRVSP report can be approved, published, and implemented.

Enclosure

## 2.0 REGULATORY EVALUATION

The NRC has established requirements and criteria in 10 CFR 50.60 for protecting the RVs of light-water reactors (LWRs) against fracture. The rule requires LWRs to meet the 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, "Standard Practice for Conducting Surveillance Tests for Light-Water Cooled Nuclear Power Reactors," 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 HBRSEP, Unit 2 surveillance program was based on ASTM E185-66. 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.

For plants applying for license renewal, the GALL Report, Section XI.M31 provides guidance for RV surveillance programs for the period of extended operation. Revision 2 of the GALL Report recommends that the program withdraw one capsule at an outage in which the capsule receives a neutron fluence of between one and two times the peak RV wall neutron fluence at the end of the period of extended operation (PEO) and tests the capsule in accordance with the requirements of ASTM E 185-82. GALL Report, Revision 2 also recommends that the program retain additional capsules within the RV to support additional testing if, for example, the data from the required surveillance capsule turn out to be invalid or in preparation for operation beyond 60 years. The GALL Report, Revision 2 further recommends that if the projected neutron fluence for these additional capsules is expected to be excessive if left in the RV, the program may propose to withdraw and place one or more untested capsules in storage for future reinsertion and/or testing.

The staff notes that the GALL Report, Revision 0, which was the current guidance at the time of submittal of the HBRSEP, Unit 2 license renewal application, has slightly different requirements for the capsule withdrawal schedule during the PEO. Specifically, the GALL Report, Revision 0 recommended withdrawal of one capsule at an outage in which the capsule receives a neutron fluence equivalent to the 60-year fluence, with testing of the capsule in accordance with the requirements of ASTM E 185. The GALL Report, Revision 0 further recommended that any capsules that are left in the RV provide meaningful metallurgical data (i.e., the capsule fluence does not significantly exceed the vessel fluence at an equivalent of 60 years). The GALL Report, Revision 0 stated that other standby capsules are removed and placed in storage, so that these standby capsules (and archived test specimens available for reconstitution) would be available for reinsertion into the reactor if additional license renewals are sought (e.g., 80 years of operation).

### 3.0 TECHNICAL EVALUATION

#### 3.1 Evaluation Criteria of ASTM Standard Practice E185-82

Table 1 of ASTM E185-82 requires that either a minimum of three, four, or five surveillance capsules be removed from the RVs, based on the limiting amount of the shift in the reference transition of the nil-ductility temperature (limiting  $\Delta RT_{NDT}$ ) 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.,  $\Delta RT_{NDT}$ ) less than 100 degrees Fahrenheit ( $^{\circ}F$ ) (56 degrees Celsius ( $^{\circ}C$ )), 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  $\Delta RT_{NDT}$  between 100  $^{\circ}F$  (56  $^{\circ}C$ ) and 200  $^{\circ}F$  (111  $^{\circ}C$ ), four surveillance capsules are to be removed from the RV and the first three capsules are required to be tested.
- For plants with projected  $\Delta RT_{NDT}$  above 200  $^{\circ}F$  (111  $^{\circ}C$ ), 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 (Standard Practice) 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 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.

The most recent evaluation of  $\Delta RT_{NDT}$  through EOL is from WCAP-15828, Revision 0, "Evaluation of Pressurized Thermal Shock for H.B. Robinson, Unit 2," (Reference 2), which was submitted in support of the License Renewal Application for HBRSEP, Unit 2. Reference 2 provides a maximum  $\Delta RT_{NDT}$  of 287.8  $^{\circ}F$  at 50 effective full-power years (EFPY) for upper-to-intermediate shell plate circumferential weld seam 10-273. Therefore, since the

maximum  $\Delta RT_{NDT}$  is greater than 200 °F for HBRSEP, Unit 2, the ASTM E185-82 criteria require five surveillance capsules to be removed, with four of the five tested.

### 3.2 Changes Proposed to the Withdrawal Schedule for HBRSEP, Unit 2

Table 1 provides the current surveillance capsule withdrawal schedule along with the proposed surveillance capsule withdrawal schedule. The current schedule was included in Reference 3, and approved by the staff in Reference 4.

Table 1 – HBRSEP, Unit 2 Current and Proposed Withdrawal Schedule

Capsule	Withdrawal EFPY (actual/current planned)	Fluence (n/cm <sup>2</sup> ) (E >1.0 MeV) (current)	Withdrawal EFPY (proposed)	Fluence (n/cm <sup>2</sup> ) (E >1.0 MeV) (proposed)
S	1.28	$0.479 \times 10^{19}$	n/a	n/a
V	3.18	$0.530 \times 10^{19}$	n/a	n/a
T	7.27	$3.87 \times 10^{19}$	n/a	n/a
X	20.39	$4.49 \times 10^{19}$	n/a	n/a
U	29.8	$6.0 \times 10^{19}$	38	$7.84 \times 10^{19}$
Y	reserve	n/a	reserve	n/a
W	reserve	n/a	reserve	n/a

The HBRSEP, Unit 2 current and proposed surveillance capsule withdrawal schedules both require five capsules to be removed and tested, which meets the ASTM E185-82 requirement for a plant having a  $\Delta RT_{NDT}$  greater than 200 °F, as is the case for HBRSEP, Unit 2. Four capsules (S, V, T, X) have been removed and tested to date. The only change in the revised schedule is that the Capsule U will be removed at 38 EFPY, rather the 29.8 EFPY. The new withdrawal EFPY for Capsule U is the EFPY at which the capsule will have received fluence equivalent to the peak RV inner surface fluence<sup>1</sup> at 80 calendar years (66 EFPY). The current withdrawal time of 29.8 EFPY for Capsule U represents the RV inner surface fluence at the current end of life of 50 EFPY (60 calendar years). For Capsules Y and W, the licensee included Note 3 indicating that these capsules would be repositioned after 40 calendar years to accelerated flux positions. In a teleconference on November 17, 2011 (Reference 5), the licensee indicated that a submittal would be made in the future to modify the capsule withdrawal schedule to include the details of the repositioning and the withdrawal schedule for capsules Y and W, and also indicated that the reference to Note 2 in the updated schedule should actually refer to Note 3.

Since the proposed capsule withdrawal fluence of  $7.84 \times 10^{19}$  n/cm<sup>2</sup> is more than once but less than twice the EOL RV fluence of  $6.0 \times 10^{19}$  n/cm<sup>2</sup>, the proposed withdrawal fluence meets the requirement from ASTM E185-82 for the last capsule withdrawn. The proposed schedule is also consistent with the recommendations of the GALL Report, Revision 2, for the PEO of plants that have renewed their licenses. The staff also notes that the licensee's plans to reposition two capsules to higher flux locations to support potential additional license renewals is consistent

<sup>1</sup> The 66 EFPY RV inner surface peak fluence is  $7.79 \times 10^{19}$  n/cm<sup>2</sup>

with the recommendation of the GALL Report, Revision 2; however, the staff will need to review and approve the specific schedule for these capsules when this information is provided in a future submittal. Therefore, the staff finds that the licensee's proposed change to the surveillance capsule withdrawal schedule is consistent with the requirements of ASTM E185-82, to the extent practicable, as required by Appendix H to 10 CFR Part 50.

#### 4.0 REGULATORY COMMITMENTS

HBRSEP, Unit 2, makes the following regulatory commitment:

Capsule U will be withdrawn at 38.0 EFPY or during the scheduled outage after the 80-year peak vessel fluence is reached.

The NRC staff finds that reasonable controls for the implementation and for subsequent evaluation of proposed changes pertaining to the above regulatory commitment are best provided by the licensee's administrative processes, including its commitment management program. The above regulatory commitment does not warrant the creation of regulatory requirements (i.e., a license condition requiring prior NRC approval of subsequent changes).

#### 5.0 CONCLUSION

The NRC staff has reviewed the licensee's proposed surveillance capsule withdrawal schedule for HBRSEP, Unit 2, 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 surveillance capsule withdrawal schedule, as proposed in Reference 1 and repeated in Section 3.2 of this safety evaluation, is acceptable for implementation.

#### 6.0 REFERENCES

1. Letter from Rich Rogalski of CP&L to the NRC dated September 28, 2011, Serial: RNP-RA/11-0038 Subject: H. B. Robinson Steam Electric Plant, Unit No. 2 Docket No. 50-261/Renewed License No. DPR-23, "Revision to Reactor Vessel Surveillance Capsule Removal Schedule" (Agencywide Documents Access and Management System (ADAMS) Accession No. ML11276A0022)
2. WCAP-15828, Revision 0, "Evaluation of Pressurized Thermal Shock for H.B. Robinson Unit 2," March 2003, Westinghouse Electric Company LLC; submitted as attachment to letter from C. T. Baucom to NRC dated May 7, 2003, Subject: H.B. Robinson Steam Electric Plant, Unit No. 2, Docket No. 50-261/License No. DPR-23, Submittal of Proprietary Documents in Support of License Renewal Application (ADAMS Accession No. ML031320378)
3. Analysis of Capsule X from the Carolina Power & Light Company H.B. Robinson Unit 2 Radiation Surveillance Program (WCAP-15805), transmitted by letter from B. L. Fletcher III to NRC dated April 25, 2002, Subject: H.B. Robinson Steam Electric Plant, Unit No. 2

Docket No. 50-261/License No. DPR-23 (ADAMS Accession Nos. ML021190313 (Part 1) and ML021190357 (Part 2))

4. Safety Evaluation Report Related to the License Renewal of H.B. Robinson Steam Electric Plant, Unit 2 (NUREG-1785) March 2004, (ADAMS Accession No. ML040200981)
5. Email from Jeffrey Poehler (NRC) to Brenda Mozafari (NRC) dated November 30, 2011; Subject "Summary of Conference Call," (ADAMS Accession No. ML11334A151)

Principal Contributor: Jeffrey C. Poehler

Date: December 21, 2011



R. Duncan

- 2 -

Please contact Ms. Brenda Mozafari, Senior Project Manager, at (301) 415-2020, if you have questions or comments on this letter.

Sincerely,

*/RA/*

Douglas A. Broaddus, Chief  
Plant Licensing Branch II-2  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

Docket No. 50-261

Enclosure: As stated

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