



Serial: HNP-11-034  
10 CFR 50, App H

AUG 16 2011

U.S. Nuclear Regulatory Commission  
ATTENTION: Document Control Desk  
Washington, DC 20555

SHEARON HARRIS NUCLEAR POWER PLANT, UNIT NO. 1  
DOCKET NO. 50-400/RENEWED LICENSE NO. NPF-63  
REVISION TO REACTOR VESSEL SURVEILLANCE CAPSULE  
WITHDRAWAL SCHEDULE

Ladies and Gentlemen:

Pursuant to Appendix H of Title 10 of the Code of Federal Regulation (10 CFR), Part 50, Carolina Power & Light Company (CP&L) doing business as Progress Energy Carolinas, Inc. (PEC), is requesting Nuclear Regulatory Commission (NRC) review and approval of the enclosed revision to the reactor vessel (RV) surveillance capsule withdrawal schedule for Shearon Harris Nuclear Power Plant, Unit No. 1 (HNP).

The proposed RV surveillance capsule withdrawal schedule was developed to address the need for RV property data at fluences representative of 60 years of operation and beyond for HNP and the industry. The requested change has been prepared in accordance with recommendations from the Electric Power Research Institute (EPRI) Materials Reliability Program (MRP) draft of the Coordinated U.S. PWR Reactor Vessel Surveillance Program dated September 2010. The requested change to the Appendix H program for HNP satisfies the requirements and guidance of American Society for Testing and Materials (ASTM) E185-82, "Standard Practice for Conducting Surveillance Tests for Light-Water Cooled Nuclear Power Reactor Vessels", dated July 1, 1982.

This document contains the following regulatory commitment:

Capsule Y or Z will be removed at the end of Cycle 21 and tested per ASTM E185-82.

The above commitment replaces the existing commitment to test Capsule W, which was withdrawn during HNP refueling outage 16 (fall 2010). Capsule W will be stored for future inspection and reinsertion.

Approval of this proposed change is requested no later than September 30, 2011.

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Please refer any questions regarding this submittal to me at (919) 362-3137.

Sincerely,

A handwritten signature in black ink, appearing to read "Dave H. Corlett". The signature is fluid and cursive, with the first name "Dave" and last name "Corlett" clearly distinguishable.

Dave H. Corlett  
Supervisor – Licensing/Regulatory Programs

DHC/kab

Enclosure:    1. Description and Evaluation of the Proposed Change  
                  2. Regulatory Commitment

cc:             Mr. J. D. Austin, NRC Sr. Resident Inspector, HNP  
                  Mr. V.M McCree, NRC Regional Administrator, Region II  
                  Mrs. B. L. Mozafari, NRC Project Manager, HNP

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## 1.0 SUMMARY DESCRIPTION

This evaluation supports a request from Carolina Power & Light Company (CP&L), doing business as Progress Energy Carolinas, Inc. (PEC), to revise the reactor vessel surveillance program (RVSP) capsule withdrawal schedule for the Shearon Harris Nuclear Power Plant, Unit No. 1 (HNP).

The proposed revision would align the HNP withdrawal schedule with the projections of neutron fluence for the unit at the end of life for extended operations while still satisfying the requirements of American Society for Testing and Materials (ASTM) E185-82, *Standard Practice for Conducting Surveillance Tests for Light-Water Cooled Nuclear Power Reactor Vessels*. The HNP RV surveillance capsule withdrawal schedule presently includes removal and testing of surveillance Capsule W, during the refueling outage 16 (RFO-16) in fall 2010. Table 1 of this document shows the current approved withdrawal schedule for the HNP RVSP per the HNP Final Safety Analysis Report (FSAR). Capsule W was removed as scheduled but has not been tested. The proposed change would revise the RV surveillance capsule withdrawal schedule for HNP to defer testing of Capsule W, and allow for the withdrawal and testing of Capsule Y or Z in refueling outage 21 (RFO-21), currently planned for the spring of 2018.

Renewed License NPF-63 Condition 2.K states that:

“All capsules in the reactor vessel that are removed and tested must meet the test procedures and reporting requirements of American Society for Testing and Materials E185-82 to the extent practicable for the configuration of the specimens in the capsule. Any changes to the capsule withdrawal schedule, including spare capsules, must be approved by the NRC prior to implementation. All capsules placed in storage must be maintained for future inspection. Any changes to storage requirements must be approved by the NRC, as required by 10 CFR Part 50, Appendix H.”

Per this license condition, Capsule W will be placed in storage and maintained for future inspection or reinsertion.

This submittal is made in accordance with the provision of 10 CFR 50, Appendix H, *Reactor Vessel Material Surveillance Program Requirements*. Paragraph (III)(B)(3) specifies that a proposed withdrawal schedule must be submitted with a technical justification as specified by 10 CFR 50.4, and that the proposed schedule must be approved prior to implementation.

## 2.0 BACKGROUND

HNP has reviewed the current site RV surveillance capsule withdrawal schedule to assess the need identified by the Industry to generate higher-fluence surveillance data while maintaining

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compliance with existing regulations and commitments of Appendix H to 10 CFR 50 and ASTM E185-82. HNP has determined that a change to the 10 CFR 50 Appendix H schedule is appropriate.

The Electric Power Research Institute (EPRI) Materials Reliability Program (MRP) is currently developing a Coordinated Reactor Vessel Surveillance Program (CRVSP) for PWRs for the purpose of increasing the population of higher-fluence surveillance data ( $>3E+19$  n/cm<sup>2</sup>,  $E > 1$  MeV). 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*. Revision 2 of the GALL Report is cited because it recommends license renewal capsule testing be performed between one to two times the 60-year peak reactor pressure vessel (RPV) fluence, as compared to the guidance in GALL Revision 1 to test the capsule at the 60-year fluence.

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; the changes that will be recommended by the CRVSP are within the original licensing basis for every PWR. NRC Staff were briefed on this program in an MRP/PWROG Meeting on January 6, 2011. A report is in preparation but is not ready for submission to cognizant MRP committees for approval; the report is expected to be submitted by the end of 2011. However, several plants have plans for withdrawal and testing of surveillance capsules in 2011 and 2012, and require alteration to their Appendix H capsule withdrawal schedule prior to the time that the final report can be approved, published, and implemented. The EPRI MRP is coordinating with plants that have near-term withdrawals scheduled to identify cases where a deferral of their current withdrawal schedule date (in 2011 or 2012) to a later date or the test of a different capsule in the future would significantly contribute to the overall program's goal of increasing the amount of higher-fluence surveillance data. HNP's Capsule W has been identified as such a case.

Current RVSP Withdrawal Schedule for HNP

The current HNP FSAR states that the RV surveillance program must be enhanced prior to the extended period of operation to:

- (1) include a provision that tested and untested specimens from all capsules pulled from the RV must be kept in storage to permit future reconstitution use, and that the identity, traceability, and recovery of the capsule specimens shall be maintained throughout testing and storage,
- (2) include a provision that withdrawal of the next capsule (i.e., Capsule W) will occur during RFO-16, at which time the capsule fluence is projected to be equivalent to the

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60-year maximum vessel fluence of  $6.8 \times 10^{19}$  n/cm<sup>2</sup> in accordance with ASTM E185-82,

- (3) include a provision that analysis of Capsule W be used to evaluate neutron exposure for remaining Capsules Y and Z, as required by 10 CFR 50, Appendix H. The withdrawal schedule for one of the remaining capsules (i.e. Capsule Y or Z) will be adjusted, based on the analysis of Capsule W, so that the capsule fluence will not exceed twice the 60-year maximum vessel fluence in accordance with ASTM E185-82. The neutron exposure and withdrawal schedule for the last capsule will be optimized to provide meaningful metallurgical data. If the last capsule is projected to significantly exceed a meaningful fluence value, it will either be relocated to a lower flux position or withdrawn for possible testing or re-insertion. The remaining Capsules Y and Z (and archived test specimens available for reconstitution) will be available for the monitoring of neutron exposure if additional license renewals are sought, and
- (4) include a provision that, if future plant operations exceed the limitations in Section 1.3 of Regulatory Guide 1.99, Revision 2, or the applicable bounds, e.g., cold leg operating temperature and neutron fluence, as applied to the surveillance capsules, the impact of these plant operation changes on the extent of reactor vessel embrittlement will be evaluated, and the NRC will be notified. Following enhancement, the Program will be consistent with the corresponding program described in NUREG-1801. Additional requirements regarding surveillance capsule management are provided in Section 2.K of Renewed License No. NPF-63, dated October 24, 2008 (NRC Accession Number ML083120237).

The HNP reactor vessel surveillance program is designed to comply with the requirements of ASTM E185-82. ASTM E185-82 recommends a minimum number of three to five surveillance capsules based on the predicted transition temperature shift at the vessel inside surface. One of these capsules corresponds to end of life (Note that, at the time of issuance of E185-82, the assumed life of HNP was 40 years). Appendix H to 10 CFR 50 requires that capsules be tested, to the extent practicable, to the requirements of ASTM E185-82.

Six capsules were originally assembled and installed in the Harris reactor vessel. Each capsule includes specimens manufactured from the limiting material in the Harris vessel (intermediate shell plate B4197-2). Three of the capsules, U, V, and X, have been removed and tested. The fourth capsule, Capsule W, has been removed but not tested.

HNP received approval of license renewal in 2008. The HNP license renewal application (LRA) referenced GALL Revision 1, which recommends that the plant "withdraws one capsule at an outage in which the capsule receives a neutron fluence equivalent to the 60-year fluence and tests

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the capsule in accordance with the requirements of ASTM E185.” Capsule W was identified as the capsule to be tested to meet the recommendations.

As a result, the current capsule withdrawal schedule is based on withdrawing Capsule W at Refueling Outage 16 (RFO-16). This schedule is shown in Table 1.

**Table 1. Current HNP RV Surveillance Capsule Withdrawal Schedule**

Capsule Identity	Vessel Location	Lead Factor	Withdrawal Time (EFPY)	Estimated Capsule Fluence (n/cm2)	Actual Capsule Fluence (n/cm2)
U	343°	2.9	1	$0.8 \times 10^{19}$	$0.55 \times 10^{19}$
V	107°	3.3	3	$1.9 \times 10^{19}$	$1.32 \times 10^{19}$
X	287°	2.68	9	$3.4 \times 10^{19}$	$3.25 \times 10^{19}$
W	110°	2.38 <sup>a</sup>	18*	$6.8 \times 10^{19}$	-
		2.68 <sup>b</sup>		-	-
Y	290°	2.38 <sup>a</sup>	standby	-	-
		2.68 <sup>b</sup>		-	-
Z	340°	2.38 <sup>a</sup>	standby	-	-
		2.68 <sup>b</sup>		-	-
(a) Factor by which the capsule leads the vessel's maximum inner wall fluence for cycles 1 through 10					
(b) Factor by which the capsule leads the vessel's maximum inner wall fluence for cycles 11 through 55 EFPY. Lead factor updated based on operation at an uprated core power level of 2900 Mwt and due to the equilibrium loading pattern near the periphery for uprated power conditions.					
* Nominal values only, a range of withdrawal times and fluences are applicable. A withdrawal time range of 13.66 to 21.32 EFPY is permitted.					

### Proposed Schedule Change

Capsule W was withdrawn as scheduled in RFO-16 (Fall 2010); the capsule has not been tested. HNP proposes not to test Capsule W, but rather to store the capsule in a manner which maintains it in a condition which would permit its future use, including during the period of extended operation, if necessary.

As a replacement to fulfill the commitment to test Capsule W, HNP proposes to withdraw Capsule Y or Z during RFO-21, at which time the Capsule Y or Z is estimated to have reached the projected 80-year, 73 Effective Full Power Years (EFPY), peak RPV fluence of

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approximately  $9.15\text{E}+19$  n/cm<sup>2</sup>. At the end of Cycle 21, the capsule will have received an estimated fluence of  $9.39\text{E}+19$  n/cm<sup>2</sup>. The capsule contents will be tested and analyzed in accordance with ASTM E185-82 and Appendix H to 10 CFR 50. The remaining capsule will serve as a standby capsule. Since Capsule Y, at the 290° location, and Capsule Z, at the 340° location, have identical capsule contents, receive approximately equal fluence, and have the same lead factor, either of the two may be withdrawn during RFO-21. This proposed change meets the requirements of Appendix H to 10 CFR Part 50. The proposed capsule withdrawal schedule is shown in Table 2.

**Table 2. Proposed HNP RV Capsule Withdrawal Schedule**

Capsule Identity	Vessel Location	Lead Factor	Withdrawal Time (EFPY)	Estimated Capsule Fluence (n/cm2)	Actual Capsule Fluence (n/cm2)
U	343°	2.9	1	$0.8 \times 10^{19}$	$0.55 \times 10^{19}$
V	107°	3.3	3	$1.9 \times 10^{19}$	$1.32 \times 10^{19}$
X	287°	2.68	9	$3.4 \times 10^{19}$	$3.25 \times 10^{19}$
W	110°	2.38 <sup>a</sup>	18	$6.8 \times 10^{19}$	-
		2.68 <sup>b</sup>		-	-
Y	290°	2.38 <sup>a</sup>	27.2 or standby	$9.39 \times 10^{19*}$	-
		2.68 <sup>b</sup>		-	-
Z	340°	2.38 <sup>a</sup>	27.2 or standby	$9.39 \times 10^{19*}$	-
		2.68 <sup>b</sup>		-	-
(a) Factor by which the capsule leads the vessel's maximum inner wall fluence for cycles 1 through 10					
(b) Factor by which the capsule leads the vessel's maximum inner wall fluence for cycles 11 through 55 EFPY. Lead factor updated based on operation at an uprated core power level of 2900 Mwt and due to the equilibrium loading pattern near the periphery for uprated power conditions.					
* $9.39 \times 10^{19}$ is the projected capsule fluence at the end of Cycle 21					

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### 3.0 REGULATORY EVALUATION

#### 3.1 *10 CFR 50.60 Acceptance Criteria for Fracture Prevention Measures for Lightwater Nuclear Power Reactors for Normal Operation & 10 CFR 50, Appendix H Reactor Vessel Material Surveillance Program Requirements*

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 RV fracture toughness and material surveillance program requirements set forth in Appendices G and H to 10 CFR 50.

Appendix H to 10 CFR 50 provides the NRC staff's criteria for the design and implementation of RV material surveillance programs for operating LWRs. Paragraph (III)(B)(1) requires that surveillance program design and withdrawal schedule meet the requirements of the ASTM E185 that is current on the issue date of the ASME Code to which the RV was purchased. Later editions of ASTM E185 may be used, but including only those editions through 1982 (ASTM E185-82). The rule, in Paragraph (III)(B)(3), requires that a proposed withdrawal schedule be submitted with a technical justification and approved prior to implementation.

#### 3.2 *NRC Administrative Letter (AL) 97-004, "NRC Staff Approval for Changes to 10 CFR Part 50, Appendix H, Reactor Vessel Surveillance Specimen Withdraw Schedules"*

In AL 97-004, the NRC found that while 10 CFR 50, Appendix H 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 50, Appendix H (ASTM E185) 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.

#### 3.3 *Precedent*

The following approved changes to licensee surveillance specimen withdrawal schedules:

1. Letter from the NRC to Virginia Electric and Power Company, "Surry Power Station, Unit Nos. 1 and 2 -- Safety Evaluation for Revision to Reactor Vessel Surveillance Capsule Withdrawal Schedule," dated January 31, 2011, ADAMS Accession Number ML103000386.
2. Letter from the NRC to Entergy Nuclear Operations, Inc, "Indian Point Nuclear Generating Unit No. 2 -- Reactor Vessel Surveillance Capsule Withdrawal Schedule Change," dated March 15, 2010, ADAMS Accession Number ML100640409.



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3. Letter from the NRC to Calvert Cliffs Nuclear Plant, LLC, "Calvert Cliffs Nuclear Power Plant, Unit No. 1 – Reactor Vessel Surveillance Capsule Withdrawal Schedule Change," dated March 12, 2010, ADAMS Accession Number ML100690393.
4. Letter from the NRC to STP Nuclear Operating Company, "South Texas Project 1 and 2: Safety Evaluation for Revision to Reactor Vessel Surveillance Capsule Withdrawal Schedules," dated August 5, 2009, ADAMS Accession Number ML091900724.

#### 4.0 TECHNICAL EVALUATION

NUREG-1801, GALL Report, Rev. 2 recommends that:

- "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 program withdraws one capsule at an outage in which the capsule receives a neutron fluence of between one and two times the peak reactor vessel wall neutron fluence at the end of the period of extended operation and tests the capsule in accordance with the requirements of ASTM E 185-82," and
- "Plant-specific and fleet operating experience should be considered in determining the withdrawal schedule for all capsules..."

The proposed withdrawal date for Capsule Y or Z meets both of these recommendations. The operating experience of both HNP and the U.S. PWR fleet were considered in the development of the revised capsule withdrawal schedule. The operating experience of the fleet and the plant is that the average peak RPV fluence for the U.S. PWR fleet will average  $\sim 4.1\text{E}+19$  n/cm<sup>2</sup> (E > 1 MeV) for 60 year licenses and  $\sim 5.6\text{E}+19$  n/cm<sup>2</sup> (E > 1 MeV) for 80 year licenses; however, there is a limited amount of U.S. PWR surveillance data above  $3\text{E}+19$  n/cm<sup>2</sup> (E > 1 MeV).

Surveillance data representative of the extended license fluence levels is desirable for both HNP and the PWR fleet because that data can better inform future embrittlement trend curve development. The capsule fluence at the proposed withdrawal date will meet the guidance that the license renewal capsule should achieve a fluence between one and two times the peak reactor vessel wall neutron fluence at the end of the period of extended operation.

GALL Revision 2 is cited as it represents the latest guidance provided by the NRC Staff. No request to revise the licensing basis of the HNP renewed operating license is implied by this citation; it is offered only as a reference and objective evidence to support the Technical Justification for the deferral.

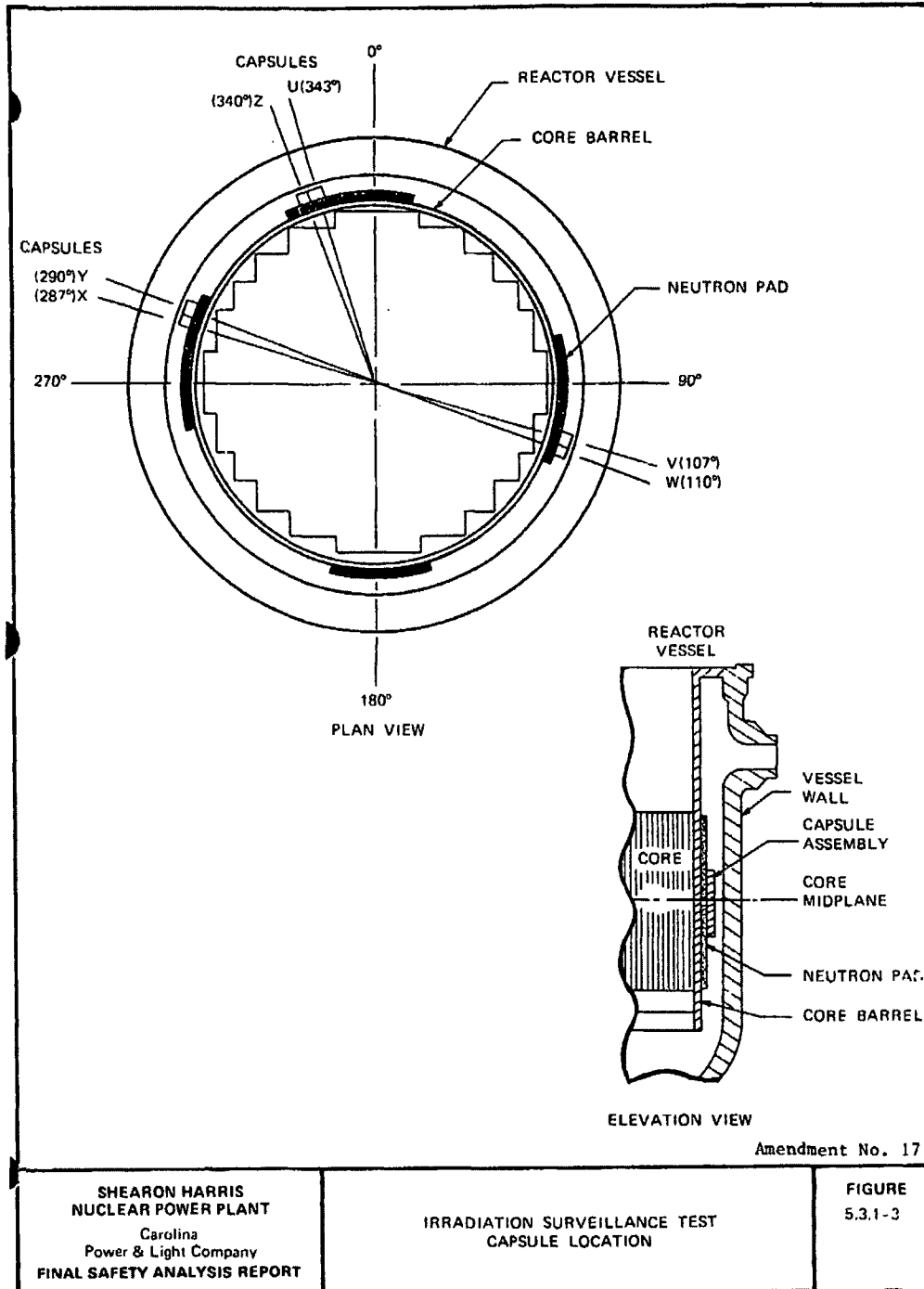
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**5.0 REFERENCES**

1. 10 CFR 50.60, "Acceptance Criteria for Fracture Prevention Measures for Lightwater Nuclear Power Reactors for Normal Operation."
2. 10 CFR 50 Appendix H, "Reactor Vessel Material Surveillance Program Requirements."
3. NRC Administrative Letter 97-004, "NRC Staff Approval for Changes to 10 CFR 50, Appendix H, Reactor Vessel Surveillance Specimen Withdrawal Schedules," dated September 30, 1997.
4. ASTM-E-185-82, "Standard Practice for Conducting Surveillance Tests for Light-Water Cooled Nuclear Power Reactor Vessels."
5. NUREG-1801, "Generic Aging Lessons Learned (GALL) Report"

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Attachment 1. HNP RPV Surveillance Capsule Orientation



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REGULATORY COMMITMENT

The action in this document committed to by Harris Nuclear Plant (HNP) is identified in the following table. Statements in this submittal, with the exception of those in the table below, are provided for information purposes and are not considered regulatory commitments. Please direct any questions regarding this document or any associated regulatory commitments to the HNP Supervisor - Licensing/Regulatory Programs.

Item	Commitment	Completion Date
1	Remove Capsule Y or Capsule Z at the end of Cycle 21 and test per ASTM E185-82.	One year after capsule removal date during Refueling Outage 21.