May 2, 2002

Mr. R. T. Ridenoure
Division Manager - Nuclear Operations
Omaha Public Power District
Fort Calhoun Station FC-2-4 Adm.
Post Office Box 550
Fort Calhoun, NE 68023-0550

SUBJECT: FORT CALHOUN STATION, UNIT NO. 1 - REACTOR VESSEL SURVEILLANCE CAPSULE REMOVAL SCHEDULE CHANGE (TAC NO. MB3422)

Dear Mr. Ridenoure:

By letter dated November 8, 2001, pursuant to 10 CFR Part 50, Appendix H, Section III.B.3, Omaha Public Power District (OPPD) requested the staff to approve the schedule for the removal of the reactor pressure vessel (RPV) surveillance capsules associated with the Fort Calhoun Station (FCS) reactor vessel integrity program. The purpose of the licensee's submittal was to modify the surveillance capsule withdrawal schedule to reflect the renewal license period of 60 years. The RPV surveillance capsule removal schedule is currently described in the FCS Updated Safety Analysis Report. The staff has concluded that the proposed withdrawal and testing schedule for the RPV surveillance capsules associated with the FCS are in accordance with the recommendations of the American Society for Testing and Materials (ASTM) E 185-82 Code. The staff has independently verified that the proposed withdrawal schedules of the capsules of the integrated RPV surveillance program, comply with the requirements of 10 CFR Part 50, Appendix H. In addition, the staff found that the revised withdrawal schedule for FCS addresses the criteria found in NUREG-1705, "Safety Evaluation Report Related to the License Renewal of Calvert Cliffs Nuclear Power Plant, Units 1 and 2." Therefore, the staff found that OPPD's revised withdrawal schedule for the FCS is acceptable and satisfies the commitments of NUREG-1705 for the renewed license period of 60 years.

The staff's safety evaluation is enclosed. If you have any questions or comments regarding our review, please contact Alan Wang, the NRC Project Manager, at (301) 415-1445.

Sincerely,
/RA/

Stephen Dembek, Chief, Section 2
Project Directorate IV
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-285

Enclosure: Safety Evaluation

cc w/encl: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REACTOR VESSEL SURVEILLANCE CAPSULE WITHDRAWAL SCHEDULE

FORT CALHOUN STATION

DOCKET NO. 50-285

1.0 INTRODUCTION

By letter dated November 8, 2001, Omaha Public Power District (OPPD/the licensee) submitted for NRC approval, its revised surveillance capsule withdrawal schedule for the Fort Calhoun Station (FCS), which is based on the American Society for Testing and Materials (ASTM) E 185-82 recommendations. The purpose of the licensee's submittal was to modify the surveillance capsule withdrawal schedule to reflect the renewal license period of 60 years. The FCS license renewal application (LRA) is currently under review by the staff. However, the safety evaluation report (SER) for the Calvert Cliffs LRA, "Safety Evaluation Report Related to the License Renewal of Calvert Cliffs Nuclear Power Plant, Units 1 and 2," (hereinafter referrred to as NUREG-1705) addresses the commitments that are recommended for the surveillance program with respect to license renewal.

2.0 BACKGROUND

The surveillance program for FCS was implemented to monitor the radiation-induced changes in the mechanical and impact properties of the pressure vessel materials. These surveillance programs were established in accordance with Appendix H to 10 CFR Part 50, "Reactor Vessel Material Surveillance Program Requirements." Appendix H to 10 CFR Part 50 requires licensees to monitor changes in the fracture toughness properties of ferritic materials in the reactor vessel beltline region of light water nuclear power reactors. 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 Code to which the reactor vessel was purchased. Later editions of ASTM E 185 may be used including those editions through 1982.

The reactor pressure vessel (RPV) surveillance program for FCS was initially determined per ASTM E 185-66. This was the edition of the ASTM standard that was in effect on the issue date of Section III of the ASME Boiler and Pressure Vessel Code (1965 through Winter 1967 Addenda), to which the FCS reactor vessel was designed. However, the licensee chose to use a later edition of the ASTM standard (ASTM E 185-82) in establishing their surveillance capsule withdrawal schedules for the FCS. The withdrawal schedule recommended in ASTM E 185-82 is for a vessel with a design of 32 effective full power years (EFPYs), which corresponds to 40 years of operation with an 80 percent capacity factor.

The surveillance capsule withdrawal schedule and testing criteria for ASTM E 185-82 depends upon the predicted transition temperature shift at the vessel inside surface. For FCS, the predicted transition temperature shift at the vessel inside surface is greater than 200°F; therefore, ASTM E 185-82 recommends that sets of specimens be withdrawn at five separate times. It specifically recommends that the first capsule be withdrawn when the accumulated neutron fluence of the capsule exceeds 5 X 10^{18} n/cm^2, or when the highest predicted delta RT_{NDT} (nil-ductility transition reference temperature) of all encapsulated materials is approximately 28°C, whichever comes first. The second capsule is recommended to be withdrawn at a time when the accumulated neutron fluence of the capsule corresponds to a value midway between the first and third capsules. The third capsule is recommended to be withdrawn at a time when the accumulated neutron fluence on the capsule corresponds to the approximate end of life (EOL) fluence at the 1/4 thickness location of the vessel wall. The fourth capsule is recommended to be withdrawn at a time when the accumulated neutron fluence on the capsule corresponds to the approximate EOL fluence at the reactor vessel inner wall location. The fifth capsule is recommended to be withdrawn at not less than once or greater than twice the peak EOL vessel fluence. This capsule may be held without testing following withdrawal.

In order to monitor changes in the reactor vessel material due to neutron irradiation during the license extension period, the current reactor vessel surveillance program, which was based on a 40-year license, needed to be modified to accommodate a 60-year license. As stated above, the FCS LRA is currently under review by the staff. However, NUREG-1705 addresses the commitments that are recommended for the surveillance program with respect to license renewal. Accordingly, in light of NUREG-1705, the applicant needs to modify the surveillance capsule withdrawal schedule if it pursues license renewal.

Specifically, Item 69 in Appendix E of NUREG-1705 contains the following commitments:

1. *The capsule withdrawal schedule will be revised to provide data at neutron fluences equal to or greater than the projected peak neutron fluence at the end of the period of extended operation.*

2. *If the last capsule is withdrawn before the 55th year, the applicant will establish reactor vessel neutron environment conditions (fluence, spectrum, temperature, and neutron flux) applicable to the surveillance data and the Unit's pressure-temperature curves. If the plant operates outside the limits established by these conditions, the applicant must inform the NRC and determine the impact of the condition on RPV integrity.*

3. *If the last capsule is withdrawn before the 55th year, the applicant will install neutron dosimetry to permit tracking of the fluence to the RPV.*

3.0 EVALUATION

The staff evaluated OPPD's revised withdrawal schedule for FCS with respect to the requirements of Appendix H to 10 CFR Part 50 and the commitments of NUREG-1705 for the renewed license period of 60 years.

To develop a 60-year surveillance program, OPPD applied the guidance provided in ASTM E 185-82 for the withdrawal schedule. The licensee has opted to use the ASTM E 185-82 standard in determining the number of capsules to be withdrawn and the schedule of withdrawing and testing the capsules of the FCS RPV surveillance program. The recommendations of ASTM E 185-82 are discussed in Section 2.0. Therefore, the proposed revisions to the reactor vessel surveillance capsules withdrawal schedules are based on ASTM E 185-82 recommendations.

To meet the commitments of Item 69 in Appendix E of NUREG-1705, for a capsule containing dosimetry to be available for withdrawal in the final five years of vessel operation, the proposed schedule includes the availability of standby capsules and the ability to expose the fifth capsule for the full length of the 60 calendar year service lifetime. In addition, OPPD is utilizing a staff-approved integrated surveillance program. The integrated surveillance program for FCS as described in CEN-636, Revision 2, was approved by the staff in a safety evaluation dated June 6, 2001. Details of the FCS capsule surveillance withdrawal program are provided below.

The estimated peak extended EOL (60-year license) inner wall fluence for FCS is 2.4×10^{19} n/cm^2. Currently, OPPD has withdrawn three capsules for FCS. The first capsule was removed and tested from the vessel with an accumulated neutron fluence of 5.1×10^{18} n/cm^2, which is before any of the encapsulated materials are predicted to have a delta RT_{NDT} of 28°C. This meets the recommendation of ASTM E 185-82 for the first capsule to be withdrawn and tested. As stated previously, ASTM E 185-82 recommends that the first capsule shall be withdrawn when the accumulated neutron fluence of the capsule exceeds 5×10^{18} n/cm^2 or when the highest predicted delta RT_{NDT} for all encapsulated materials is approximately 28°C, whichever comes first. The second capsule was removed and tested from the vessel with an accumulated neutron fluence of 9.0×10^{18} n/cm^2, which meets the ASTM E 185-82 recommendation of the second capsule to be withdrawn and tested, since this capsule was withdrawn at a time when the fluence was between that of the first and third capsule.

The third capsule was removed and tested from the vessel with an accumulated neutron fluence of 1.6×10^{19} n/cm^2, which meets the recommendation of ASTM E 185-82 for the third capsule, since that corresponds to the projected fluence at the 1/4 thickness location of the vessel wall at EOL. The fourth capsule is scheduled to be withdrawn and tested at 33.6 EFPYs, which will meet the ASTM E 185-82 recommendation of the fourth capsule to be withdrawn and tested, since this capsule will be withdrawn at a time when it has approximately attained the fluence at the extended EOL at the inner wall of the vessel. The fifth capsule is scheduled to be withdrawn and available for testing at 48 EFPYs, which will meet the ASTM E 185-82 recommendation of the fifth capsule to be withdrawn and available for testing, since this capsule will be withdrawn at a time when it has approximately attained not less than 2.4×10^{19} n/cm^2 or greater than twice (4.8×10^{19} n/cm^2) the peak end of extended life vessel fluence at the vessel inner wall. OPPD also has two standby capsules and two supplemental capsules at FCS.

The three considerations for the license renewal period, as listed in Section 2.0 above, are met by the surveillance capsule removal schedule for FCS. The availability of standby capsules and the ability to expose the fifth capsule for the full length of the 60 calendar year service lifetime provides this capability. In addition to meeting the general considerations for the license renewal period, the FCS reactor vessel integrated surveillance program will also include the use of the W-275S capsule and the integrated surveillance program, which are discussed below.

The W-275S capsule was fabricated and installed in 1993. The capsule contains 24 Charpy V-notch specimens from two weldments and nine uniaxial tension test specimens. One weldment had been made using weld wire heat 27204, and a second weldment had been made using weld wire heats 12008 and 13253. The average fluence to the W-275S capsule is $8.63E^{17}$ n/cm^2 per EFPY. After 20 EFPYs, the accumulated fluence on W-275S will be approximately $1.719E^{19}$ n/cm^2. This fluence will correspond approximately to the calculated fluence of the limiting material of the FCS vessel (weld 3-410 A/C) at the end of extended life (2033).

The integrated surveillance program for FCS as described in CEN-636, Revision 2, was approved by the staff in a safety evaluation dated June 6, 2001. The use of the integrated surveillance program allows OPPD to utilize data originating from the surveillance programs at Mihama 1, Palisades, and Diablo Canyon. The data from future analyses of surveillance welds from Mihama Unit 1, the second supplemental capsule from Palisades, and Diablo Canyon Unit 1 will be reviewed against the CEN-636, Revision 2 analysis. The purpose of the review is to verify that the future measurements do not exhibit any anomalous behavior. The attached Tables 1 and 2 list the capsules that are included in the FCS surveillance program and integrated surveillance program, respectively, and provides information regarding the capsule identification and location, fluence received or scheduled withdrawal in EFPYs, and the material in the capsule.

The staff independently verified that the proposed capsule withdrawal and testing schedule for the capsules of the FCS RPV surveillance program is in accordance with the recommendations of ASTM E 185-82. The staff has independently verified that the proposed withdrawal schedule for the capsules of the FCS RPV surveillance program complies with the requirements of 10 CFR Part 50, Appendix H, and satisfies the commitments of Item 69 in Appendix E of NUREG-1705.

4.0 CONCLUSION

Based on the staff's review of OPPD's submittal, the staff found that the revised withdrawal schedule for the FCS RPV satisfies the requirements of Appendix H to 10 CFR Part 50. In addition, the staff found that the revised withdrawal schedule for FCS addresses the criteria found in NUREG-1705. Therefore, the staff concludes that OPPD's revised withdrawal schedule for FCS is acceptable and satisfies the commitments of NUREG-1705 for the renewed license period of 60 years.

5.0 REFERENCES

1. Letter from R.L. Phelps, OPPD, "Reactor Vessel Surveillance Capsule Removal Schedule Change Request," dated November 8, 2001.

2. Letter from W.G. Gates, OPPD, "Supplemental Information to Support an Application for Amendment of Operating License," CEN-636, Revision 2, dated November 17, 2000.

3. Letter from A. Wang, NRC, "Fort Calhoun Station, Unit No. 1 - Issuance of Amendment - Deletion of Section 3.D, License Term," dated June 6, 2001.

4. Code of Federal Regulations, Title 10, Part 50, Appendix H, "Reactor Vessel Material Surveillance Program Requirements," dated January 1998.

5. American Society for Testing and Materials, "Standard Recommended Practice for Surveillance Tests for Nuclear Reactor Vessels," ASTM E 185-66 and ASTM E 185-82.

6. NUREG-1511, "Reactor Pressure Vessel Status Report," dated December 1994.

Attachment:
1. Table 1 - Fort Calhoun Surveillance Program
2. Table 2 - Fort Calhoun Integrated Surveillance Program

Principal Contributor: M. Khanna

Date: May 2, 2002

Table 1 - Fort Calhoun Surveillance Program

Capsule ID	Capsule Identification Reactor Vessel/Capsule Location	Fluence Received by Capsule or Scheduled Capsule Withdrawal in EFPYs	Weld Material in Capsule Weld Wire Heat Identification
1	Fort Calhoun W-225	5.1×10^{18} n/cm^2 2.5 EFPYs	305414
2	Fort Calhoun W-265	9.0×10^{18} n/cm^2 5.9 EFPYs	305414
3	Fort Calhoun W-275	1.6×10^{19} n/cm^2	305414
6	Fort Calhoun W-275S	33.6 EFPYs	27204 12008/13253
7	Fort Calhoun W-95	48 EFPYs	305414
8	Fort Calhoun W-45	Standby	305414
9	Fort Calhoun W-85	Standby	305414
10	Fort Calhoun W-225S	Standby	305414
11	Fort Calhoun W-265S	Standby	305414

Table 2 - Fort Calhoun Integrated Surveillance Program

Capsule ID	Capsule Identification Reactor Vessel/Capsule Location	Fluence Received by Capsule or Scheduled Capsule Withdrawal in EFPYs	Weld Material in Capsule Weld Wire Heat Identification
1	Mihama Unit 1	6.0×10^{18} n/cm^2	12008/27204
3	Mihama Unit 1	1.2×10^{19} n/cm^2	12008/27204
4	Mihama Unit 1	2.1×10^{19} n/cm^2	12008/27204
5	Palisades SA-240	3.0×10^{19} n/cm^2	27204