Omaha Public Power District

444 South 16th Street Mall
Omaha NE 68102-2247

March 13, 2006
LIC-06-0021

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

Reference:
1. Docket No. 50-285
2. Letter from Harry J Faulhaber to Document Control Desk (NRC) dated November 18, 2005, Request for an Extension to the Completion Date for Corrective Actions Taken in Response to Generic Letter 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors" and Information Regarding Actions taken as a Result of Information Notice 2005-26 (LIC-05-0131) (ML053220535)
3. Letter from Alan Wang (NRC) to Ross Ridenoure (OPPD) dated February 7, 2006, Request for Additional Information Related to Extension Date for Corrective Actions Regarding Generic Letter 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors" (NRC-06-0011)
4. Letter from Sudesh Gambhir (OPPD) to Document Control Desk (NRC) dated February 17, 2006, Submittal of Revision 1 to Engineering Analysis Supporting Compensatory Measures Implemented as a Result of GSI-191 (LIC-06-0014)

SUBJECT: Response to Request for Additional Information Related to Extension Date for Corrective Actions Regarding Generic Letter 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors"

Reference 2 provided the Omaha Public Power District's request for an extension of time to comply with the requirements of Generic Letter 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors." In Reference 3, the NRC requested additional information regarding Reference 2. Attachment 1 provides the response to the request of Reference 3. Reference 4 provided the engineering analysis (EA-FC-04-010, Revision 1) which supports the answers provided in Attachment 1.

I declare under penalty of perjury that the foregoing is true and correct. (Executed on March 13, 2006.)

If you have additional questions, or require further information, please contact Thomas R. Byrne at (402) 533-7368.

Sincerely,

David J. Bannister
Manager – Fort Calhoun Station

DJB/TRB/trb

Attachment 1 - Response to Request for Additional Information Related to Extension Date for Corrective Actions Regarding Generic Letter 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors"

ATTACHMENT 1

Response to Request for Additional Information Related to Extension Date for Corrective Actions Regarding Generic Letter 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors"

Response to Request for Additional Information Related to Extension Date for Corrective Actions Regarding Generic Letter 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors"

NRC Request #1

What are the physical stresses on the containment building as a result of the higher water levels using this approach?

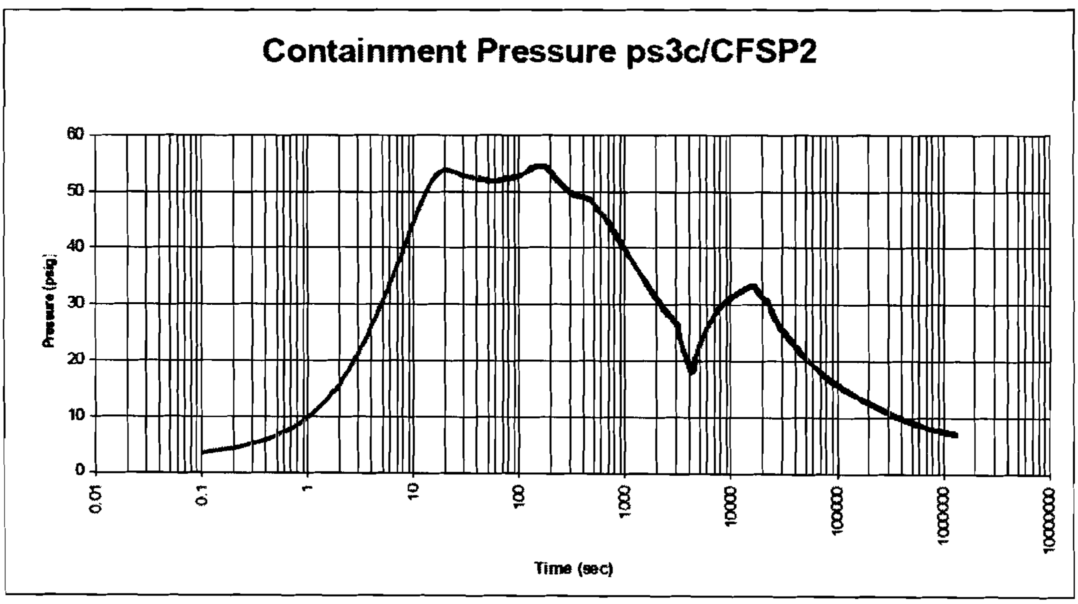
OPPD Response:

The current design basis physical stresses on the containment building are discussed in Section 5.6 of the Fort Calhoun Station Unit No. 1 (FCS) Updated Safety Analysis Report (USAR). As discussed in Section 5.1.B.4.e of EA-FC-04-010, Revision 1, the method chosen to evaluate the stresses on the containment building was to compare the pressure resulting from the higher water level to the design pressure of the containment. The FCS containment design pressure is 60 psig. Two factors associated with the physical stresses applied by the injection of additional water were considered:

- Hydraulic pressure applied by the increased elevation head of the water in containment
- Increased containment atmospheric pressure due to the compression of the containment free air volume.

The analysis discussed in Section 5.1.B.4.e of EA-FC-04-010, Revision 1, conservatively assumed constant post Recirculation Actuation Signal (RAS) pressure of 40 psig and showed acceptable physical stress on containment. Recently, OPPD has completed a re-analysis of the long-term containment pressure analysis in preparation for the replacement of the steam generators and pressurizer in the fall of 2006. This analysis reflects the larger steam generator and pressurizer water volumes of the replacement components. The following figure shows the results of this analysis:

Figure 1



Using Figure 8.5-1 and the methodology discussed in Section 5.1.B.4.e of EA-FC-04-010, Revision 1, the hydraulic pressure and increased containment atmospheric pressure were calculated and added to the post accident pressure from Figure 1. Figure 2 shows a comparison of the calculated containment pressure without implementation of any compensatory measures with the pressure on the containment floor with implementation of the compensatory measures.

Figure 2

Post RAS Containment Pressure

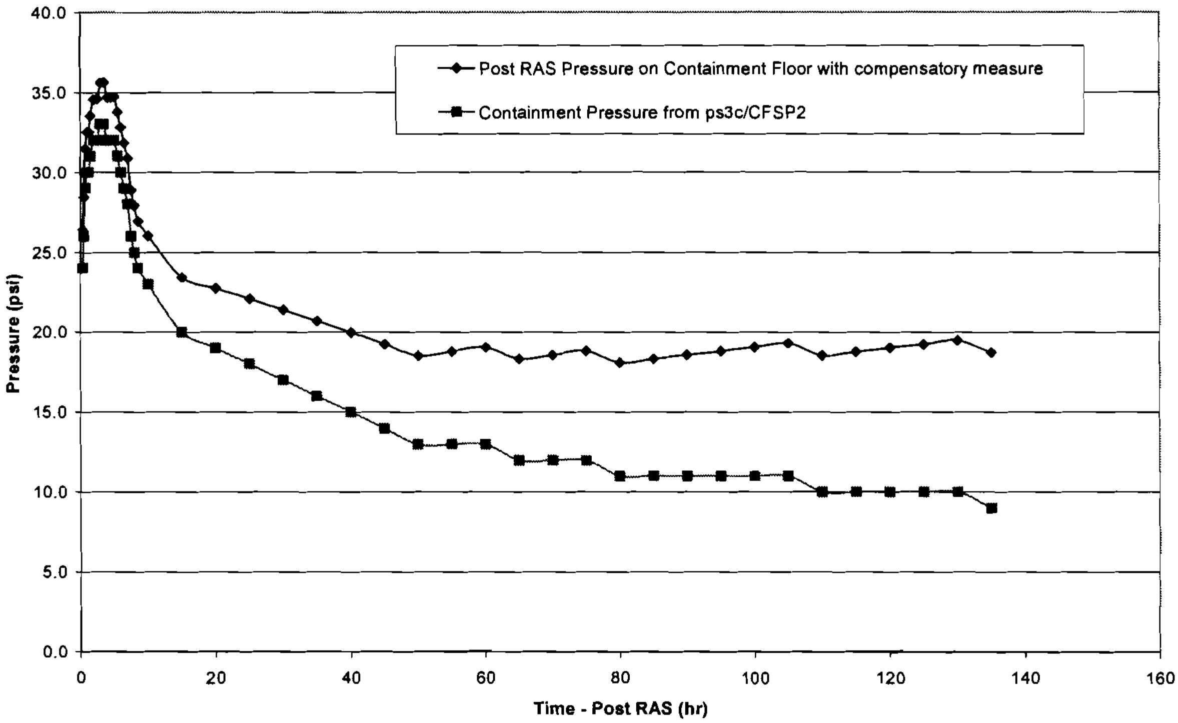


Figure 2 demonstrates that the containment pressure would remain well below the 60 psig design pressure of the containment throughout the event, both before and after the Fall 2006 outage, with the implementation of the compensatory measures.

NRC Request #2

OPPD stated that it would "enhance procedures to identify equipment and instrumentation that could be affected by flooding in containment above the flood level assumed for equipment qualification", but did not list this equipment and instrumentation, and any measures to preserve their functionality or deal with their malfunction.

OPPD Response:

The Emergency Operating Procedures (EOPs) provide guidance to ensure critical components needed for implementation of the strategy have been placed in their desired position and de-energized prior to being submerged. Additionally, a guidance document is available to the Technical Support Center (TSC) staff to address technical issues that may arise during the course of the event, and assist the control room in dealing with those effects. In particular, mission critical equipment and indications have been identified, and guidance on alternative methods of accomplishing those components' functions is provided in this document.

Section 5.1.B.4.f) and Attachment 8.2 of EA-FC-04-010, Revision 1, identify the affected equipment. Attachment 8.2 discusses strategies for preserving component functionality and dealing with their potential malfunction. Section 6.1.B.4 summarizes conclusions from Section 5.1.B.4 and provides status of actions to address this issue (development of the TSC guidance). Section 7.3 provides more detail on the guideline.

NRC Request #3

OPPD should describe its methods for measuring water level "above the maximum water level at the start of recirculation".

OPPD Response

Containment water level indication is available until the level exceeds Elevation 1,004.5 ft. At that point, an alternate means of water level indication must be used. The lowest detector in the Reactor Vessel Level Monitoring System (RVLMS) begins detecting water level at Elevation 1,005 ft. (near the top of the core). The RVLMS is qualified by the Equipment Qualification program for accident and post accident conditions, but not for submergence. However, reasonable assurance exists that the RVLMS will remain operational even though it is submerged. A review of the Equipment Qualification files shows that the RVLMS is qualified for 100% humidity environment and qualification was conducted using a boric acid spray for the first 24 hours testing and then one and one half hours every 24 hours for the remainder of the 30-day test. For level indication between Elevations 1,004.5 and 1,005 ft., or if RVLMS fails to operate above Elevation 1,005 ft., water level can be estimated by determining the volume of water that has been added (either by use of curves developed to show volume change per unit time at the flow rate directed by the EOPs, or by flow rate over time). Water level can also be estimated by measuring the elevation head shown at the discharge of the Containment Spray (CS) pumps.

Section 5.1.B.4.f) discusses that water level indication is available until Elevation 1,004.5 ft., and that alternate methods of level measurement must be used after that. Attachment 8.2 provides those alternative methods. Because the RVLMS is not credited in the Environmental Qualification (EQ) analysis for submergence, EA-FC-04-010, Revision 1, does not establish RVLMS as an assumed alternative method. Because it is likely to survive submergence, RVLMS is provided as an alternative in the guideline that is being placed in the TSC.

NRC Request #4

List the hierarchy of water sources for [Safety Injection and Refueling Water Tank] SIRWT refill, or discuss the flow paths and flow rates which could be achieved in accomplishing refill.

OPPD Response

Water sources for SIRWT refill have been prioritized, based on availability, transfer rate, boron concentration and cleanliness. The sources are broken loosely into two groups:

- Short term sources
- Long term sources

An assessment was performed to ensure that adequate short term sources of water borated to at least 1,000 ppm were available at a transfer rate of at least 250 gpm, which is sufficient to make up for decay heat removal needs for approximately the first 24 hours post-RAS. These sources, in order of preference, are the Fuel Transfer Canal (FTC) and the Spent Fuel Pool (SFP). The FTC, which is normally maintained full as a specific interim compensatory measure, contains enough water to sustain approximately 5 hours of injection at the flow rate required for adequate decay heat removal. The physical configuration of the SFP prevents drawing the volume in the SFP as a short term source beyond that required to cool the fuel in the SFP (water cannot be drawn from below the lower SFP suction level). This remaining level has been analyzed to be sufficient to cool the fuel in the SFP.

The long term sources, which would supply makeup water to the SIRWT from approximately 24 hours until the direct injection mode of cooling is secured, consist of the normal SIRWT makeup water method (Chemical and Volume Control System (CVCS)), Boric Acid Storage Tanks (BASTs) and finally demineralized water or fire water, added directly to the FTC or SIRWT via fire hoses. Although the normal SIRWT makeup method technically carries a lower priority than the SFP because the makeup flow rate may not be adequate for short term makeup needs, it is likely that this method will be employed immediately after transfer of the FTC water to augment that source and avoid the use of SFP water if possible.

Included in the long term sources section is an evaluation of the on-site sources of water that could supply the demineralized water system, which is used as a water source for all of the long term flow paths except fire water. This evaluation shows that there is adequate volume stored on site (in the event of a Loss of Offsite Power that disables the use of the Reverse Osmosis system) to fill containment above the level necessary to establish Shutdown Cooling.

Section 5.4 of EA-FC-04-010, Revision 1, discusses water sources for refill of the SIRWT. Section 5.4 A establishes required makeup volumes. The sources of makeup water are broken down into short term (Section 5.4.B) and long term (Section 5.4.C), and the discussion includes the hierarchy in terms of boron concentration and immediacy of use (FTC, SFP then CVCS, finally hose fill from demineralized or fire water), but explains that early initiation of CVCS makeup may obviate the need to use the SFP. Attachments 8.7 and 8.8 identify makeup water flowpaths to the demineralized water systems and ultimately to the SIRWT, as well as the means of boration. Conclusions for the various Sections of 5.4 state the key considerations for each of the sections. Section 6.4 summarizes the conclusions provided in 5.4 and provides status for each of the recommendations. Sections 7.2 and 7.3 provide more detail on how enhancements to the EOPs and the TSC guideline will support the SIRWT refill process.

NRC Request #5

Discuss the actual refill flow rates versus the required refill flow rates, and resultant SIRWT water levels at the various times during which this direct injection lineup would be used in lieu of the recirculation mode (e.g., does OPPD show that the SIRWT does not go empty while High Pressure Safety Injection (HPSI) pump suction is required).

OPPD Response

The required injection flow rate from the SIRWT drops from 215 gpm to approximately 115 gpm over the first 24 hours of a Loss of Coolant Accident (LOCA). Sufficient volume exists from the FTC, SFP and Primary Water Storage Tank (PWST) to provide makeup water to the SIRWT at greater than the required rate (the FTC and SFP can transfer in excess of 250 gpm and the PWST in excess of 120 gpm). Thereafter, the demineralized water system would supply makeup to the PWST, which would continue to supply the SIRWT at 120 gpm (or as necessary). Makeup sources to the demineralized water system are rapidly refilled, then maintained at a level sufficient to support HPSI injection flow until the plant can be placed on Shutdown Cooling (SDC).

Many disparate evaluations are required to address question 5. The results of these evaluations feed into sections 5.1 and 5.4 of EA-FC-04-010, Revision 1.

- Section 5.1.B.4.b) addresses flow rate from the SIRWT and hence makeup water flow requirements to the SIRWT. Flow requirements for the first 24 hours, and for longer than 24 hours are shown.
- Section 5.1.B.4.d) discusses water volumes required for refill of the SIRWT.
- Section 5.4.B discusses the available short term water sources (those with flow capabilities in excess of 250 gpm), and determines that they have adequate volume to provide approximately 23 hours worth of makeup water. Addition of the PWST volume, which would be available for immediate makeup at approximately 120 gpm, results in the total volume of short term sources allowing for approximately 25.5 hours of injection capabilities.
- Section 5.4.C discusses the available long term water sources. The demineralized water system is necessary to supply these sources, with the exception of fire water, which is an essentially unlimited source using the Missouri river, if necessary. The use of fire water, however, is not desirable; this section shows that on-site water sources can be made available to replenish the demineralized water system with clean (although not necessarily demineralized) water at a rate of greater than 120 gpm (which is the flow rate required for decay heat removal 24 hours post-trip). These on-site sources are capable of providing more than enough water to raise containment water level above the top of the hot legs.

When combined, these evaluations show that, during the direct injection lineup, FCS has adequate inventory at an adequate flow capacity to raise containment water level above Elevation 1,008 ft. which allows for initiation of shutdown cooling without allowing the SIRWT to empty at any time. This is indicated in the conclusions section for 5.1.B.4 of EA-FC-04-010, Revision 1. Section 6.4 summarizes the conclusions and provides status of actions to address the issue. Inputs for this determination come from section 5.4 and attachments 8.4, 8.5, 8.7 and 8.8 of EA-FC-04-010, Revision 1.

NRC Request #6

Do the Fort Calhoun procedures contain guidance on methods to prevent boron precipitation following a LOCA?

OPPD Response

The Emergency Operating Procedures (EOPs) provide guidance to ensure boric acid build up is terminated well before the potential for boric acid precipitation occurs. The implementation of the interim compensatory measures to fill containment to the top of the hot legs reduces the probability of boron precipitation since the boron concentration of the containment pool will be reduced below the concentration of the SIRWT.

EOP-03, "Loss of Coolant," and EOP-20, "Functional Recovery Procedure," contain the following caution statement: "Simultaneous hot and cold leg injection must be implemented between eight and one half and eleven hours of the start of a LOCA if SDC can not be established." EOP-3 and EOP-20 also contain the following guidance: "IF between eight and one half and eleven hours may elapse before SDC can be established, THEN IMPLEMENT Attachment 9, Simultaneous Hot and Cold Leg Injection." In addition, the EOPs contain guidance to cooldown the Reactor Coolant System (RCS) in accordance with the Technical specification limits.

Attachment 9 of the EOPs contains guidance for establishing simultaneous hot and cold leg injection using the HPSI and charging pumps. Attachment 9 transfers the operator to Attachment 11 if only one HPSI pump is available. Attachment 11 contains guidance for establishing alternate hot leg injection using a Low Pressure Safety Injection (LPSI) pump.

The following is the basis for these actions as discussed in the EOP Technical Basis Document:

When an unisolated LOCA event exists, simultaneous hot and cold leg injection should be implemented between eight and one half and eleven hours if SDC cannot be established per EOP Attachment 9. If the RCS is refilled, boric acid dispersion is achieved via natural circulation, or if SDC is established prior to the eight and one half hour limit, simultaneous hot and cold leg injection is unnecessary.

- Injection to each side of the reactor vessel ensures that coolant of a higher boron concentration flows out the break, regardless of break location, and is replenished with a dilute solution of borated water entering from the other side of the reactor vessel. Initiating simultaneous hot and cold leg injection at a time between eight and one half and eleven hours into the event ensures boric acid build up is terminated well before the potential for boric acid precipitation occurs.
- A minimum injection rate of 140 gpm is required to both hot and cold legs to prevent boric acid precipitation.

When an unisolated LOCA event exists, alternate hot leg injection should be implemented between eight and one half and eleven hours if SDC cannot be established and only one HPSI pump is available per EOP Attachment 11.

- Injection of at least 140 gpm of a dilute solution of borated water to the hot and cold legs will flush coolant of a higher boron concentration from the reactor vessel and preclude boric acid precipitation, when injection is initiated between the eight and one half and eleven hour limit.
- With RCS pressure less than 140 psia, the output of the one available HPSI pump will exceed the 140 gpm flow to the cold leg. The flow from the LPSI pump to the hot leg will exceed the 140 gpm required to prevent boron precipitation and satisfy the minimum flow requirement to prevent LPSI pump damage.

The required flow rates were determined by Westinghouse using the Westinghouse methodology. OPPD understands that the NRC has sent a letter to Westinghouse questioning some aspects of that analysis. OPPD is working with the Westinghouse Owners Group (WOG) to resolve these issues.