Omaha Public Power District
1946 - 2006

Fort Calhoun Station
P.O. Box 550
Fort Calhoun, NE 68023

April 10, 2008
LIC-08-0044

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

References:
1. Docket No. 50-285
2. Letter from OPPD (D. J. Bannister) to NRC (Document Control Desk), "Fort Calhoun Station Unit No. 1 License Amendment Request (LAR), Modifications of the Containment Spray System Actuation Logic," dated July 30, 2007 (LIC-07-0052) (ML072150293)
3. Email from NRC (M. T. Markley) to OPPD (T. C. Matthews), "Request for Additional Information," dated March 27, 2008 (ML0808800092)
4. Letter from OPPD (R. P. Clemens) to NRC (Document Control Desk), "Fort Calhoun Station Response to Request for Additional Information License Amendment Request Re: Dampers in Containment Air Cooling (MD7043)," dated April 3, 2008 (LIC-08-0040)

SUBJECT: Fort Calhoun Station Response to Request for Additional Information License Amendment Request Re: Modification of Containment Spray Actuation Logic (MD6204)

The Omaha Public Power District's (OPPD) response to Reference 3 is attached. Please note that OPPD has already responded (Reference 4) to Questions 4 and 5 of Reference 3, and thus those questions and responses are not included in the attachment. In a teleconference held on April 1, 2008, the NRC indicated that those two questions could be answered separately as they are not related to approval of Reference 2.

A table containing the regulatory commitments being made in the attachment is found on page 3.

If you should have any questions regarding this submittal or require additional information, please contact Mr. Thomas C. Matthews at (402) 533-6938.

I declare under penalty of perjury that the foregoing is true and correct. Executed on April 10, 2008.

R. P. Clemens
Division Manager – Nuclear Engineering

RPC/mle

Attachment: Fort Calhoun Station Response to Request for Additional Information
License Amendment Request Re: Modification of Containment Spray Actuation Logic (MD6204)

Table of Commitments

Commitment	Due Date
Replace the containment air cooling and filtering (CACF) unit HEPA filters not previously replaced in 2006	During the 2008 RFO
Ensure all CACF unit HEPA filters meet the 2" wc differential pressure limitation;	During the 2008 RFO
Implement and maintain the newly created HEPA filter replacement criteria in procedure PE-RR-VA-0209 unless superseded by other criteria via the license amendment process; and	During the 2008 RFO (This is an ongoing commitment)
Submit a license amendment request (LAR) that will add the HEPA filter testing and replacement criteria to the FCS Technical Specifications.	October 31, 2008
Perform the surveillance operability testing of the containment cooling unit relief ports	During the 2008 RFO
Submit a LAR that will add surveillance operability testing of the containment cooling unit relief ports to the FCS Technical Specifications.	October 31, 2008

OMAHA PUBLIC POWER DISTRICT (OPPD)

FORT CALHOUN STATION (FCS), UNIT NO. 1

DOCKET NO. 50-285

FORT CALHOUN STATION
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION
LICENSE AMENDMENT REQUEST RE:
MODIFICATION OF CONTAINMENT SPRAY ACTUATION LOGIC (MD6204)

FORT CALHOUN STATION
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION
LICENSE AMENDMENT REQUEST RE:
MODIFICATION OF CONTAINMENT SPRAY ACTUATION LOGIC (MD6204)

HVAC

1. **Please describe the capacity of the high efficiency particulate air (HEPA) filter system in terms of particle accumulation vs. pressure drop and the particle accumulation/pressure drop predicted to occur as a result of the design basis loss-of-coolant accident (LOCA).**

OPPD Response:

The containment air cooling and filtering (CACF) units are safety-related engineered safeguards systems. The CACF units have been credited with the mitigation of post-LOCA radiation dose effects in containment since the unit was licensed in 1973, as a part of a system fully redundant in function to the containment spray system until 2001 (approval of Alternate Source Term), when fission product removal was conservatively credited only by the containment spray system. However, accumulation of fission products in the filters was acknowledged for purposes of estimating direct shine contribution to the control room in the Alternate Source Term calculations.

The original design analysis for the HEPA filters did not determine a debris accumulation vs. pressure drop analysis to predict how much debris would be generated or would be collected by the HEPA filters. Instead, the HEPA filters were designed, fabricated and subjected to the quality assurance inspection tests of Atomic Energy Commission (AEC) Health and Safety Information Issue No. 212., dated June 25, 1965, "Minimal Specifications for the Fire Resistant High Efficiency Filter Unit," which is obsolete and was replaced by ASME N509, "Nuclear Power Plant Air Cleaning Units and Components." Per Regulatory Guide (RG) 1.52, ASME N509 is the acceptable design and testing standard. Testing of the HEPA filters consisted of verification of the following attributes:

- Design air flow test can be achieved with less than 1" water column (wc) pressure drop.
- The filter element was required to pass a National Bureau of Standards (NBS) dust capacity test with 4 lbs. of dust loading without exceeding 2" wc pressure drop.
- The ultimate strength of the filter was verified by maintaining a 6" wc pressure drop across the dust loaded filter for 10 minutes.
- After passing all previous tests, the filter was required to pass a dioctyl phthalate (DOP) penetration test with no more than 0.03% penetration for 0.3 micron diameter particles.

OPPD has recently performed a HEPA filter loading engineering evaluation, which models the accumulation of non-radioactive debris from a LOCA event and an analysis of the fan and filter performance post-LOCA accounting for all debris accumulated on the filters.

The HEPA filter loading study was based upon the existing Generic Letter (GL) 2004-02 debris generation calculation for Fort Calhoun Station (FCS) (Reference 1). Only those debris sources that were considered fines were calculated to be released to the upper containment atmosphere where the intakes to the CACF units are located. The amount instantaneously released to the upper containment is 69% of the total fines calculated in the debris generation calculation. Releasing all of these fines instantaneously to the upper containment atmosphere (i.e., above 1060' elevation) is considered extremely conservative, as the break location would be roughly near the 1013' elevation.

The total amount of entrained debris on the HEPA filters will depend on the RCS break location and the "jet time," which is the time the high-velocity jet flows into the containment building before stopping. For this event, 440 pounds mass (lbm) of debris would be entrained. Fully saturated debris-laden air enters the CACF units at 288°F and 60 psig. To maximize debris loading on the HEPA filters, only one of the two CACF units was assumed to run throughout the LOCA scenario.

The calculation was broken down into two parts for each type of debris: entrainment and settling. Entrainment is the time between the start of the jet-flow and the time the overall turbulent kinetic energy (TKE) drops below the entrainment TKE of the debris type. Settling is the time after debris begins to settle. During entrainment, the debris concentrations are conservatively treated as equally distributed throughout the upper containment building, and any debris removed by the HEPA filters results in a decrease in the overall debris concentration. During settling, only debris in the HEPA filters' zone of influence (ZOI) will be removed, while the rest will settle on surfaces in the containment building. The ZOI was calculated using a force balance on the debris and a momentum calculation on the HEPA filters. The force balance determines the debris terminal velocity, which is then used to determine the ZOI using a momentum balance.

Based on this conservative model, it was estimated that most of the TempMat and Nukon fibers (~93%) will settle to the containment building surfaces. This occurs because their respective terminal velocities are large, so they settle quickly. On the other hand, none of the CalSil or paint particulate is predicted to settle because their ZOIs are larger than the upper containment building volume.

This analysis shows that 116 lbm or 26.4% of the total debris will settle on surfaces in the containment building. All of the settled debris is TempMat and Nukon fibers along with dirt and dust. None of the smaller debris (CalSil and paint) is predicted to settle, so the HEPA filters will collect all debris of these types. Therefore, it was conservatively estimated, with the entrainment and settling model, that 324 lbm of non-radioactive material debris would be trapped by the HEPA filters.

If consideration were given for addressing potential agglomeration from condensation in the containment building, the amount of debris that would settle out in containment would be significantly larger. However, 324 lbm is conservatively assumed to be trapped by the HEPA filters.

The total accumulation of debris on the HEPA filters post-LOCA is the combination of the debris loading at the beginning of the event plus the radioactive and non-radioactive debris generated during the event that is transported to the filters.

The analysis of the CACF unit performance assumed the combination of the revised surveillance test, IC-ST-VA-0013, "Verification Of Containment Air Cooling and Filtering Units Flow and Pressure Drop," limit (i.e., 2" wc for the HEPA filters) for loading plus the maximum accumulation of debris over the course of an operating cycle based on historical data as the starting point for the event, which is equivalent to 342.7 pounds. The fan and filter performance analysis adds the loading from the LOCA debris generation analysis described above and 52.3 pounds of radioactive debris from a conversion of the core inventory of Reference 2. The FCS core inventory source term was provided in Reference 2, Table 4.1-1. Reference 2, Table 7.1-1 identified the fuel activity release fractions per RG 1.183. The RG 1.183 release fractions were applied to the core equilibrium table values (in curies) to obtain the amount released into the containment atmosphere. This value is then converted into a mass value. The HEPA loading uses the full core inventory with RG 1.183 release fractions and no credits for any plateout, depositions, etc. The total accumulation equals 719 pounds of debris trapped by the HEPA filters, which includes the 324 pounds of LOCA generated non-radioactive debris, 52.3 pounds of radioactive debris, and 342.7 pounds of filter preload.

The post-LOCA differential pressure was calculated to be 4.15" wc across the HEPA filters. This pressure drop was then included in the system performance analysis to determine the fan operating conditions at 24 hours post-LOCA and 30 days post-LOCA. The fan is not predicted to stall under post-LOCA conditions. The predicted minimum fan flow post-LOCA is approximately 118% above the stall speed of 65,000 CFM for the duration of the event.

In summary, OPPD has performed a conservative analysis of the particulate accumulation on the HEPA filters and determined they will perform their design basis function post-LOCA, and the containment cooling function of the CACFs will be maintained.

2. (a) Please discuss the ability of the HEPA filter to withstand the moist containment environment during a LOCA without falling apart or sagging to the point where its efficiency is less than that assumed in calculations (e.g., the strength and particulate removal capability).

OPPD Response:

In accordance with USAR Section 6.4, all components in this Class 1 system were designed to withstand the rapid pressure increase at the commencement of the design basis accident (DBA). All materials and components are suitable for sustained operation at the DBA environmental pressure, temperature, and humidity and are resistant to boric acid at the anticipated concentrations. The design criterion for the HEPA filters was continuous operation during accident conditions in a moisture-saturated atmosphere. Moisture separators and mist eliminators with adequate drains are provided in the system to protect the HEPA filters in accordance with RG 1.52 and ASME N509. Mist eliminators were designed with proven type media that was accepted by the AEC for the application. The HEPA filters were also subjected to a moisture resistance test as part of the initial vendor acceptance tests. Additional information regarding the operability of the mist eliminators under LOCA environmental conditions is contained in American Air Filters (AAF) Test Report, "Moisture Separator Study NYO-3250-6." The study tested the demisters and HEPA filters at 10, 20, 30, and 40 psi with temperatures ranging from 183°F to 261°F. The filters did not show any degradation of efficiency due to temperature or pressure. Therefore, the HEPA filters will operate in conditions for which they have been designed and are adequately protected from water damage.

(b) Please discuss if the filters are changed-out only on a differential pressure or if there is an age limit. If there is no age limit please discuss what assurance is provided that the filters will not become brittle and fail at the onset of a LOCA (for example due to the initial pressure pulse).

(c) If there is an age limit for the HEPA filters please discuss why this is not addressed in the technical specification (TS) surveillance requirements.

OPPD Response to (b) and (c):

Recommended HEPA filter change-out frequencies vary among applicable guidance documents. OPPD has added administrative controls as defined below for filter change-out. The filters will be changed if the projected pressure differential during the next operating cycle is higher than the specified limit of 2" wc, or if the age of the filters is 10 years. These requirements are stated on Page 11 of Attachment 4 to Reference 2. The 2" wc differential pressure limitation will be controlled by surveillance test IC-ST-VA-0013, "Verification Of Containment Air Cooling and Filtering Units Flow and Pressure Drop." This is the same procedure used to meet the TS 3.6(3)e requirement to verify a pressure drop of less than 6" of wc at system design flow for the entire CACF unit.

The 10-year replacement of the HEPA filters is controlled under a newly created preventive maintenance task, which will prompt replacement of the filters in accordance with the existing maintenance procedure PE-RR-VA-0209, "Replacement of Containment Air Cooling and Filtering HEPA Filters VA-5."

The HEPA filters on one of the two CACF units were changed out during the Spring of 2006, and thus those filters meet the replacement criteria by a wide margin. OPPD plans to replace the HEPA filters on the other CACF unit during the 2008 RFO, which starts on April 19, 2008.

However, prior to adding the differential pressure limitation and an age limit for the HEPA filters into the Technical Specifications, OPPD needs additional time to determine (1) the specific differential pressure limitations appropriate for the TS, (2) if the 10-year replacement criterion noted above is consistent with applicable industry standards, and (3) the most appropriate method of revising the Technical Specifications (e.g., creation of a Ventilation Filter Testing Program per NUREG-1432, *Standard Technical Specifications for Combustion Engineering Plants*).

Therefore, OPPD is making a regulatory commitment to:

(a) During the 2008 RFO, replace the CACF unit HEPA filters not previously replaced during 2006;
(b) During the 2008 RFO, ensure all CACF unit HEPA filters meet the 2" wc differential pressure limitation;
(c) Implement and maintain the newly created HEPA filter replacement criteria in procedure PE-RR-VA-0209 unless superseded by other criteria via the license amendment process; and
(d) Submit a license amendment request (LAR) by October 31, 2008 that will add the HEPA filter testing and replacement criteria to the FCS Technical Specifications.

OPPD agrees that the NRC can make the above commitment actions part of a license condition.

3. Please discuss the basis for the 50% filter efficiency assumed in the dose calculations.

OPPD Response:

The 50% filter efficiency is a highly conservative assumption used for the dose consequence analysis. The 50% filter efficiency is supported by a calculation that estimates that the maximum potential bypass leakage following a DBA does not exceed 25% (then a conservative factor of 2 is applied). In calculating the 25% bypass value, both the leakage around/through the HEPA filters at LOCA conditions, and the reduction of flow due to the increased head requirements across the fan were factored into the analysis. The calculation concludes that a filter efficiency greater than 50% can be achieved with an equivalent hole diameter of approximately 1.5" in each of the filter media or half of the gasket missing on all the filter elements in the HEPA filter, at filter dp as high as 5.5" wc. (See also Reference 2, Attachment 4, Page 11). HEPA filter elements, dampers, pressure relief ports and other associated

components are visually inspected during each refueling outage (References 3 and 4). Therefore any source of significant bypass would be identified and corrected prior to start-up from the outage.

6. **USAR Section 6.4, Engineering Safeguards Containment Air Cooling and Filtering System (CACFS), states that the unit housing was designed to withstand 2 pounds per square inch (psi) pressure differential (dp). Pressure relief valves or ports have been installed to limit the pressure differential across the housing to 1.5 psi. The relief valves or ports are required to close to prevent bypassing of the HEPA filters. The staff understands that as part of this license amendment the CACFS is to be the primary success path to mitigate the consequence of a LOCA.**

   Please discuss relative to 10CFR50.36(d)(2)(ii)(C) and 10CFR50.36(d)(3) why there are no Technical Specifications or Surveillance on these relief valves/ports to ensure the relief valves/ports open to reduce the maximum pressure drop and close to prevent bypass leakage.

   OPPD Response:

   USAR Section 6.4.5 notes that:

   > *The number of pressure relief valves to be provided was based on limiting the pressure differential across the housing to 1.5 psi. The housing was designed to withstand 2 psi; the difference being allowance for the failure of some relief ports to open. Testing of the pressure relief ports is performed periodically by pushing them open manually.*

   OPPD has historically tested the pressure ports for operability using a surveillance test each refueling outage, and plans to continue this practice. However, OPPD has not been able to locate a detailed analytical basis for the USAR statements; for example, the number of relief ports that fail to open and could significantly affect operability of a CACFS is not specified.

   OPPD needs additional time to (1) verify the analytical and design bases for the relief ports, and (2) determine the most appropriate place in the Technical Specifications to add operability and/or surveillance requirements for the relief ports.

   Therefore, OPPD is making a regulatory commitment to:

   1. During the 2008 RFO, perform the surveillance operability testing of the containment cooling unit relief ports; and
   2. Submit a LAR by October 31, 2008, that will add surveillance operability testing of the containment cooling unit relief ports to the FCS Technical Specifications.

   OPPD agrees that the NRC can make the above commitment actions part of a license condition.

7. Please discuss the increase of the post-LOCA (dp) across the HEPA filter if the TS dp limit is reached immediately prior to the LOCA.

OPPD Response:

The analysis performed in response to Question 1 assumes that at the start of the LOCA, the HEPA filters have a dp equivalent to the revised surveillance test (IC-ST-VA-0013, "Verification Of Containment Air Cooling and Filtering Units Flow and Pressure Drop") limit of 2" wc. This inspection is performed during every refueling outage and the 2" dp across the HEPA filters will be the highest differential pressure acceptable for continued operation for another cycle. The fan and filter performance analysis then assumes additional dp is added to the filter over the course of the operating cycle, which is equivalent to the historical worst case increase. These initial conditions assure the analysis performed by OPPD accurately accounts for the highest debris loading that would occur at the start of the LOCA event.

8. USAR Section 6.3 states "The function of the containment spray system is to limit the containment pressure rise and reduce the leakage of airborne radioactivity from the containment by providing a means for cooling the containment following a loss-of-coolant accident (LOCA). This system reduces the leakage of airborne radioactivity by effectively removing radioactive particulates from the containment atmosphere." The license amendment request states "The proposed modification changes containment pressure control during a LOCA from containment spray (CS) to the containment air coolers and mitigates the control room and offsite doses by the use of containment high efficiency particulate air (HEPA) filters." Containment spray will no longer remove particulate from the containment atmosphere. The CACFS will be the only mechanism to remove airborne particulate. In 2001 FCS requested and received a license amendment to use the Alternate Source Term (AST) which revised the amounts of particulate released into the containment atmosphere during a LOCA. FCS decided not to take credit for the CACFS filters (license amendment No. 198).

Using the proposed new licensing basis (containment air-cooling and filter system with no containment spray) and beginning with the CACFS filters at the TS differential pressure limit at the onset of a LOCA, please discuss how OPPD determined that the additional pressure drop from particulate deposition on the filters in the CACFS will not cause the fan performance to drop below the minimum acceptable limit over the duration of the event.

Please discuss if the evaluation includes the pressure drop across the moisture separator, mist eliminator, and pre-filter (if installed) and if the fan will operate in stall or surge condition.

OPPD Response:

The CACF unit fan and filter performance analysis is described in detail in the response to Question 1. OPPD evaluated the performance of the fans at peak LOCA containment conditions, 24 hours post-LOCA and 30 days post-LOCA to assure operability for the duration of the event. The fan is not predicted to stall under post-LOCA conditions. This evaluation includes the pressure drop across the moisture separator, mist eliminator, (HEPA) prefilter and charcoal absorbers. The predicted minimum fan flow post-LOCA is approximately 118% above the stall speed of 65,000 CFM for the duration of the event.

9. Please describe where in the Fort Calhoun Station (FCS) plant where CACF filter dp may be read

(a) during normal operation, and

(b) post-LOCA?

OPPD Response to (a) and (b):

HEPA filter dp can be read on panel AI-44 in the control room for both conditions.

10. (a) Please discuss how leakage around bypass dampers and relief ports accounted for in your analysis?

(b) Please discuss how you verify that leakage around bypass dampers and relief ports does not exceed what is assumed in your analyses?

OPPD Response to (a) and (b):

Use of the 50% efficiency is sufficiently conservative to account for any potential leakage around the bypass damper and/or the relief ports. Leakage assumed by either half the gasket on all filters or by a 1.5" (approximate) hole in each filter results in a calculated bypass leakage of 8.5% when the filter has a 2" wc dp across it.

Of the 92 relief ports, 52 would bypass the HEPA filters if failed open. Based on the design evaluation in USAR Section 6.4.5, it is concluded that if all relief ports failed open, only ~20% of the flow would bypass the HEPA filters. The relief ports were tested by the manufacturer to establish the flow characteristics and opening times. Therefore, the 50% efficiency remains bounding for such a highly unlikely scenario.

As stated in the response to Question 6, OPPD has tested the pressure ports each refueling outage and plans to continue this practice. The Question 6 response also contains a commitment for future actions concerning the relief ports.

11. In section 6.4.7.3 of Fort Calhoun USAR it is stated that "the HEPA filter banks were initially in-place tested for leakage...." However, on Page 11 of 32 of Attachment 4 of the FSC implementation of GSI 191 Sump Modification – Dose Consequences, provided by LIC-07-0052 and prepared for Omaha Public Power District by Stone and Webster (ADAMS accession number ML072150295) it is stated that the existing containment recirculation fan coolers (CRFC) HEPA filter/filter housing configuration at FCS does not support the use of dioctyl-phthalate (DOP) testing for bypass leakage. Prior to license amendment 198 (4/4/2001) FCS was performing technical specification required halide bypass leakage tests on the CACFS charcoal adsorbers located immediately after the HEPA filters. (There is a similarity in techniques between the halide and the DOP test regarding the injection of the challenge chemical, the collection of the upstream concentration, and the collection of the downstream concentration).

Please reconcile the discrepancy between the statement that the HEPA filter banks were tested in place, the fact that prior to amendment 198 (4/4/01) FCS could successfully perform in-place halide tests on the charcoal adsorbers and the statement that the CRCF does not support the use of DOP for bypass testing of the HEPA filter banks.

OPPD Response:

The statement that the existing containment recirculation fan coolers (CRFC) do not support the use of DOP testing for bypass leakage is correct. An integrated test would verify the overall performance of the HEPA filter bank by injecting DOP in the upstream airflow to allow some mixing prior to the filter bank and measuring the DOP concentration downstream at a representative location. Based on the CRFC configuration at FCS, an integrated test is not practical.

In-situ testing of individual HEPA filters was originally done at FCS (OPPD has the original AAF procedure discussing testing of each individual filter). This testing was performed in April 1975. License Amendment 15, as approved by the NRC on September 3, 1976, changed the TS surveillance requirements of the HEPA filters to visual inspection and pressure drop measurement. The basis for the change was that the system is a 100% recirculating system and the requirements of Table 1 of ANSI N510-1975, listed below were applied in its place:

- Visual inspections of the HEPA filters and charcoal filters are performed each outage.
- Pressure drop of the HEPA filter bank is limited to ensure performance throughout the operating cycle.

Prior to Amendment 198, iodine removal efficiency testing of the CRFC charcoal filters was performed in the laboratory via removable sample canisters for each filter bed. Amendment 198 deleted this requirement.

12. In accordance with your regulatory evaluation as provided by letter dated December 12, 2007 (LIC-07-0104), Fort Calhoun Station (FCS) is committed to the draft General Design Criteria. As such Draft Criterion 64 "Testing of Air Cleanup Systems", states that capability shall be provided for in situ periodic testing and surveillance of the air cleanup systems to ensure (a) filter bypass path has not developed and (b) filter and trapping materials have not deteriorated beyond acceptable limits.

Please discuss how FCS complies with Draft Criterion 64.

OPPD Response:

Technical Specification 3.6(3)d requires visual examination of the HEPA and charcoal filters each refueling outage to ensure that leak paths do not exist. Technical Specification 3.6(3)e requires a measurement of pressure drop across the combined HEPA and charcoal adsorber banks be performed at least once per plant operating cycle to verify a pressure drop of less than 6" of wc at system design flow. Plant surveillance tests implement these requirements.

References:

1. Calculation FC06985, Revision 1, "Fort Calhoun Station Debris Generation Post-LOCA"
2. Letter from OPPD (D. J. Bannister) to NRC (Document Control Desk), "Fort Calhoun Station Unit No. 1 License Amendment Request (LAR), Modifications of the Containment Spray System Actuation Logic," dated July 30, 2007 (LIC-07-0052) (ML072150293)
3. Surveillance Test, SE-ST-VA-0001, "Containment HEPA Filter Banks VA-5A/VA-5B Refueling Inspection"
4. Surveillance Test, SE-ST-VA-0011, "Containment Recirculating Air Cooling and Filtering Damper Refueling Operability Test"