Omaha Public Power District
444 South 16th Street Mall
Omaha, NE 68102-2247

LIC-10-0062
August 10, 2010

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

REFERENCES:
1. Docket No. 50-285
2. NRC Generic Letter 2008-01, "Managing Gas Accumulation in Emergency Core Cooling, Decay Heat Removal, and Containment Spray Systems," dated January 11, 2008 (ML072910759)
3. Letter from OPPD (J. A. Reinhart) to NRC (Document Control Desk), "Omaha Public Power District, Fort Calhoun Station, Response to Generic Letter 2008-01," dated October 14, 2009 (LIC-08-0106) (ML082890096)

SUBJECT: Response to NRC Request for Status of Corrective Actions Contained in the Omaha Public Power District (OPPD) Response to Generic Letter 2008-01

During a teleconference on July 16, 2010, the NRC requested the status of corrective actions from Section B of the OPPD response (Reference 3) to Generic Letter (GL) 2008-01 (Reference 2).

The status is contained in Attachment 1, which shows the corrective actions from Reference 3, Section B in bold font followed by their status. The NRC also requested information on two additional items, which is contained in Attachment 2.

No regulatory commitments are contained in this submittal. However, Attachment 3 lists two actions required to complete certain enhancements. The first involves the completion of an engineering change (EC) to allow an operating instruction to be revised and the second requires the completion of two ECs that will install new vent valves. Both actions are scheduled to be completed during the 2011 Refueling Outage beginning in April 2011.

If you should have any questions regarding this submittal, please contact Mr. Bill Hansher at (402) 533-6894.

H. J. Faulhaber
Division Manager-Nuclear Engineering

HJF/NKB/mle

Attachments:
1. Status of Corrective Actions
2. Response to Request for Additional Information
3. List of Actions Required to Complete Enhancements

c: E. E. Collins, NRC Regional Administrator, Region IV
L. E. Wilkins, NRC Project Manager
J. C. Kirkland, NRC Senior Resident Inspector

Status of Corrective Actions from Section B of OPPD Response (LIC-08-0106) to Generic Letter 2008-01

Regulatory Commitments Made in Response to Generic Letter (GL) 2008-01:

1. **New surveillance test procedures for managing gas accumulation in safety systems will be instituted. These new surveillance test procedures will be issued by January 23, 2009.**

   Status:
   This action is complete. Initially, five separate surveillance test (ST) procedures (one for each system) were issued to meet this commitment. Since then, Fort Calhoun Station (FCS) merged these five ST procedures into the following two ST procedures for managing gas accumulation in safety systems:

   - QC-ST-ECCS-0001, *Quarterly ECCS Gas Accumulation Detection*
   - QC-ST-ECCS-0002, *Refueling ECCS Gas Accumulation Detection*

   These procedures provide instructions for performing ultrasonic examination of pre-specified piping locations to determine the volume of gas present. The locations selected for monitoring of gas voids are based on review of detailed system grade maps produced from laser scanning performed as part of the system walk downs required by GL 2008-01. The locations chosen were based on the piping sections that had the greatest potential for significant gas accumulation. These locations were typically piping sections that would trap gas by virtue of negative pipe slope (pipe sloping away from vent valves or vertical risers) over a significant piping run or loop seals in the system.

   The acceptance criteria for the monitoring locations can be found in various FCS calculations. The acceptance criterion for emergency core cooling system (ECCS) pump suction piping is found in FCS calculation FC07500. This calculation determines the acceptable gas void volumes at possible gas accumulation locations in the pump suction piping based on the allowable pump inlet gas void fraction. All of the void fractions calculated are based on available test data contained in Westinghouse WCAP-16631-P, *Testing and Evaluation of Gas Transport to the Suction of ECCS Pumps*. Void fractions calculated for a 2% allowable pump inlet void fraction are conservative. For pipe sections with gas transport times less than 5 seconds (or 20 seconds for suction to a single stage pump), a value of 5% for the pump inlet void fraction was used for void fraction calculations.

   The acceptance criteria for the containment spray system (CSS) discharge piping are found in FCS calculation FC07504. The acceptance criteria for the high-pressure safety injection system (HPSI) discharge piping are found in FCS calculation FC07503. The acceptance criteria for the low-pressure safety Injection system (LPSI) discharge piping is found in FCS calculation FC06941. These calculations document the evaluations for the FCS piping with respect to

the dynamic loads generated in the discharge piping when a gas volume exists at the time that pump flow is initiated.

2. **PBD-32, "Managing Gas Accumulation in Safety Systems," the program basis document to manage gas accumulation in safety systems, will be developed and issued by January 23, 2009.**

   Status:
   This action is complete. Revision 0 of PBD-32, *Managing Gas Accumulation in Safety Systems*, was issued on January 22, 2009.

Planned Enhancements or Corrective Actions in Support of the Response to GL 2008-01 that are not Considered Regulatory Commitments:

1. **Descriptive text will be incorporated into applicable sections of the USAR on managing gas accumulation in safety systems. The USAR changes will be completed by January 23, 2009.**

   Status:
   This action is complete. Section 6.2.8 of the Updated Safety Analysis Report (USAR) was updated for the emergency core cooling system, and Section 6.3.8 of the USAR was updated for the containment spray system.

2. **Develop gas volume acceptance criteria for ECCS pump suction piping. This evaluation will be documented in calculation FC07500 by December 30, 2008.**

   Status:
   This action is complete. This calculation determines the acceptable gas void volumes at possible gas accumulation locations in the pump suction piping based on the allowable pump inlet gas void fraction. All of the void fractions calculated are based on available test data contained in Westinghouse WCAP-16631-P, *Testing and Evaluation of Gas Transport to the Suction of ECCS Pumps*. Void fractions calculated for a 2% allowable pump inlet void fraction are conservative. For pipe sections with gas transport times less than 5 seconds (or 20 seconds for suction to a single stage pump), a value of 5% for the pump inlet void fraction was used for void fraction calculations.

3. **Develop water hammer exclusion criteria for CS piping downstream of the containment isolation valves. This evaluation will be documented in calculation FC07501 by December 30, 2008.**

   Status:
   This action is complete. Calculation FC07501 addresses the potential for significant water hammer events to occur during the filling of the containment

spray headers under accident conditions. The containment spray (CS) evaluation considers both filling of the spray header as well as the response of an arbitrary gas volume that could be accumulated in the horizontal piping upstream of the riser to the header.

This calculation shows that the water hammer forces are all less than the deadweight forces. In addition, the potential effect of a water hammer caused by a void upstream of the spray riser was investigated. While the normal condition of the ECCS is dry, it is postulated that some coolant may be left in the piping between the valves and the riser thus creating a void. The void was analyzed although its presence is considered highly unlikely. For the given flow rate and pipe sizes, the only potential location of a void (upstream of check valves SI-175 and SI-176) does not present any potential water hammer effects.

4. **Develop gas volume acceptance criteria for water hammer exclusion [in] cold leg header piping downstream of the containment isolation valves. This evaluation will be documented in calculation FC07502 by December 30, 2008.**

   Status:
   This action is complete. Calculation FC07502 uses the methodology for cold leg injection piping exclusion in Combustion Engineering (CE) plants to address the likelihood of gas-water water hammer occurring during the onset of cold leg injection following a loss of coolant accident (LOCA) signal.

   The design of the HPSI system is a configuration with each of two pumps injecting borated water into each of the four cold legs, with a distance of approximately one foot (or less) between the injection valve and the check valve to the piping connected to the safety injection tank (SIT) injection piping. Two imposed water flow rates were evaluated; one is the minimum flow to compress the gas volume while the other is the maximum flow that could be imposed. The methodology concludes that there is no potential for gas-water water hammer to occur with the minimum flow rate and that a water hammer would be highly unlikely even at the maximum imposed flow rate. Furthermore, even if a water hammer occurred, it would be very weak.

   Evaluations for the LPSI system show that there is no potential for any water hammer induced force imbalance as represented by the cold injection methodology. Additional calculations show that there is considerable margin in this conclusion.

5. **Develop gas volume acceptance criteria for HPSI discharge piping. This evaluation will be documented in calculation FC07503 by December 30, 2008.**

Status:
This action is complete. Calculation FC07503 documents the evaluation for the HPSI pump discharge piping upstream of the eight closed safety injection (SI) isolation valves (excluding the vents and drains) with respect to the dynamic loads that could be generated if a gas volume exists in the piping at the time that pump flow is initiated. The voids would form because of gas coming out of solution in the stagnant water in the SI lines and migrate upwards over time to the highpoints. These loads have been evaluated through a parametric variation of the gas volume sizes at the local piping highpoints.

The results show that the dynamic loads on the discharge piping resulting from an accumulated gas volume do not exceed the design limit of the axial restraint on the pipe. If the gas volume were less than the acceptance criteria, the water hammer loads would not result in damage to the piping and associate pipe restraints.

6. **Develop gas volume acceptance criteria for CS discharge piping. This evaluation will be documented in calculation FC07504 by December 30, 2008.**

Status:
This action is complete. Calculation FC07504 documents the evaluation for the CS piping with respect to the dynamic loads generated in the discharge piping when a gas volume exists in the piping at the time that pump flow is initiated. These loads have been evaluated through a parametric variation in the size of the gas volume collected in the local highpoints.

The results show that the dynamic loads on the discharge piping resulting from an accumulated gas volume do not exceed the design limit of the axial restraint on the pipe. If the gas volume were less than the acceptance criteria, the water hammer loads would not result in damage to the piping.

7. **Develop gas volume acceptance criteria for water hammer exclusion in hot leg injection. This evaluation will be documented in calculation FC07505 by December 30, 2008.**

Status:
This action is complete. Calculation FC07505 applies the cold leg injection methodology to the conditions and configuration for hot leg injection.

Application of considerations from the cold leg methodology were applied to the FCS design for hot leg injection and shows that there is no potential for water hammer to occur in this system configuration principally as a result of the pressurization of the locations where gas could be accumulated. While not needed for the basic conclusion, the limited flow rate and comparatively slow

actuation intervals for the valve manipulations, combined with the parallel flow paths, also add to the depth of the conclusion.

8. **Training requirements as outlined in response to GL 2008-01 will be completed by March 30, 2009.**

   Status:
   This action is complete. Engineering support personnel (i.e., design, program, and system engineers) receive training every 5 years on Institute of Nuclear Power Operations (INPO) Significant Operating Event Report (SOER) 97-1, *Potential Loss of High Pressure Injection and Charging Capability from Gas Intrusion*. During the second quarter of 2009, the issues addressed by GL 2008-01 were covered during training on SOER 97-1. In addition, the program engineer responsible for managing gas accumulation in safety systems receives initial training encompassing SOER 97-1, GL 2008-01, and OPPD's response thereto.

   Operations personnel receive initial training followed by requalification training every 6 years on INPO SOER 97-1. In Cycle 2 of 2010 (February 15th thru April 10th) operations personnel received requalification training covering both INPO SOER 97-1 and INPO Significant Event Report 2-05, *Gas Intrusion in Safety Systems*.

   Maintenance personnel (i.e., instrument & control technicians, steam fitter mechanics, mechanical maintenance) receive initial training on INPO SOER 97-1. Steam fitter mechanics who perform tasks more likely to introduce gas voids if performed incorrectly also receive continuing training at a frequency based on ongoing operating experience review.

9. **Provide guidance in operating instruction [OI] OI-SI-1 to fill the ECCS recirculation piping located between valves HCV-383-3 and SI-160 and HCV-383-4 and SI-159 by January 23, 2009.**

   Status:
   This action could not be completed by the specified date. Additional reviews of the ECCS recirculation piping design, drawings, and walk downs of the system determined that there is no feasible method to incorporate venting of that portion of the ECCS recirculation piping located between valves HCV-383-3 and SI-160 and HCV-383-4 and SI-159 into OI-SI-1, *Safety Injection - Normal Operation*. OI-SI-1, Attachment 17 provides the methodology for venting of the ECCS suction header from the safety injection refueling water tank (SIRWT) up to check valves, SI-159 and SI-160. OI-SI-1, Attachment 17 utilizes SIRWT head pressure from the nominal "full level" of the SIRWT to ensure a water solid ECCS suction header, venting through vent valves, SI-370, SI-371, and SI-382.

With the "close function" of the recirculation check valves, SI-159 and SI-160, in the opposite flow direction, the venting method in OI-SI-1, Attachment 17 cannot effectively vent the ECCS recirculation piping located between valves HCV-383-3 and SI-160 and HCV-383-4 and SI-159 via the containment sump recirculation test connection valves, SI-161 and SI-162. However, credit is taken for filling these sections of piping through SI-161 and SI-162 when hydrostatic test, SE-ST-SI-3027 is performed every refueling outage.

In order to do an "on-line" venting of this section of ECCS recirculation piping, Engineering Change (EC) 45266 has been generated to install a venting bypass line around each of the recirculation check valves, SI-159 and SI-160, with an isolation valve installed in the vent line. With such a configuration, "on-line" venting of this section of ECCS recirculation piping can be accomplished utilizing the methodology in Attachment 17 of OI-SI-1 by opening the bypass vent valves and the containment sump recirculation test connection valves, SI-161 and SI-162. SIRWT head pressure could then effectively vent the entire ECCS suction and recirculation piping. This could be done any time the plant is online without requiring entry into a Technical Specification Limiting Condition of Operation (LCO).

EC 45266 is scheduled to be installed during the 2011 Refueling Outage (RFO) scheduled to begin in April 2011. The installation of EC 45266 will allow OI-SI-1 to be revised to complete this action.

10. **Evaluate the ECCS discharge header locations that warrant consideration for installation of new vent valves. Pending completion of void volume acceptance criteria, a determination of the final vent valve locations will be made by January 23, 2009.**

Status:
Actions are continuing. Originally, EC 45428 was generated with a list of recommended locations for installation of new high point vent valves. The list was determined from field walk downs and review of the laser templating grade maps.

The scope of EC 45428 has changed over time. Because of Condition Report (CR) 2009-2069, another thorough review was completed of all system grade maps to determine if vents were available at all high points that could potentially hold an unacceptable quantity of gas. From this review a longer list of necessary vents was developed. Those locations that had no means to vent or flush were included in EC 47407, and the remaining locations that have Swagelok caps or can be flushed were included in EC 45428. Per EC 47407, 11 new vent valves were installed during the 2009 RFO. Because of CR 2010-1450, 2 locations were moved from EC 45428 and covered in EC 48955. The 2 locations in EC

48955 and the 18 locations in EC 45428 are scheduled to be installed during the 2011 RFO, which will complete this item.

11. **As an enhancement, the system design basis documents SDBD-SI-HP-132 (HPSI), SDBD-SI-LP-133(LPSI), SDBD-SI-CS-131 (CSS), and SDBD-SDC-130 [Shutdown Cooling] (SDC) will be updated to reconcile GL 2008-01 response and action items by January 23, 2009.**

    Status:
    This action is complete. The design basis documents have been updated.

12. **As discussed in Section A2.8, the ECCS venting procedures, OI-SI-1 and OI-CS-1, will be revised to incorporate necessary venting duration and acceptance criteria by January 23, 2009.**

    Status:
    This action is complete. ECCS venting procedures, OI-SI-1 and OI-CS-1, have been revised to incorporate necessary venting duration and acceptance criteria into the appropriate attachments.

13. **Evaluate the SDC system for: (a) Potential trap of gas in the piping along the top of the long horizontal run of pipe between HCV-348 and the containment penetration; (b) SDC discharge piping cross-tie piping between the LPSI and CS system where the isolation boundary between the two systems is isolation valve HCV-335; and (c) Changes to operating procedure OI-SC-1 associated with this review. This item will be completed by January 23, 2009.**

    Status:
    This action is complete.
    - Location (a) was evaluated, and it was decided a vent valve should be installed at this location. This location is incorporated in EC 45428, and a vent valve will be installed during the 2011 RFO.
    - Location (b) was evaluated, and it was decided a vent valve should be installed at this location. Vent valve SI-471 was installed during the 2009 RFO per EC 47407.
    - Changes to OI-SC-1 were not required.

14. **OPPD plans to evaluate the merits of vacuum fill for these evolutions. This item will be completed by June 23, 2009.**

    Status:
    Use of a vacuum pump to vent locations above the nominal SIRWT level (i.e., 1005' elevation) has been evaluated. A suitable portable vacuum pump has not

been located at this time. The purchase of a suitable vacuum pump will be evaluated on a continuing basis.

15. **A procedure change to OP-1, Attachment 1, "Checklist for Plant Startup from Mode 4/5 to Mode 1," has been initiated to ensure both ECCS suction headers are vented in accordance with OI-SI-1, Attachment 17 prior to the plant exceeding 210°F. This item will be completed by January 23, 2009.**

    Status:
    This action is complete. The revision to OP-1 is complete.

16. **SI-382, the LCV-383-1 outlet line vent valve, is at a slightly higher elevation than SI-371. This valve will be added to OI-SI-1, Attachment 17. This item will be completed by January 23, 2009.**

    Status:
    This action is complete. The revision to OI-SI-1 is complete.

17. **Review of OI-SI-1 identified that restoration of LPSI pump to service has steps that vent the pump casing but do not provide direction on venting the suction or discharge piping. No similar guidance exists for removing or restoring a HPSI or CS pump for maintenance. Procedural enhancements will be completed by January 23, 2009.**

    Status:
    This action is complete. The revision to OI-SI-1 is complete.

18. **Long-term industry actions were identified that will provide additional tools to address GL 2008-01 with respect to pump gas void ingestion tolerance limits. The program results will be reviewed for applicability to FCS and should be completed by June 1, 2010.**

    Status:
    This action is continuing. The System Engineering Subcommittee of the Pressurized Water Reactor Owners Group (PWROG) has considered the performance of pump testing to develop pump void acceptance criteria. However, no formal plans to complete the testing have been developed yet.

    Meanwhile, Section 1.4 of “Guidance to NRC/NRR/DSS/SRXB Reviewers for Writing TI Suggestions for the Region Inspections,” (ML100350656) is being used to review the acceptance criteria in calculation FC07500, “Evaluation of Allowable Suction Piping Gas Void Volumes for Fort Calhoun to Address GL 2008-01.”

19. **Surveillance test procedures will include acceptance criteria to ensure that gas accumulation in the LPSI and HPSI system piping meets the PWROG criteria for injected gas into the RCS [Reactor Coolant System]. This will be completed by January 23, 2009.**

    Status:
    This action is complete. Initially, five separate ST procedures (one for each system) were issued containing appropriate acceptance criteria. As stated previously, these five ST procedures were combined such that now there are two ST procedures, (QC-ST-ECCS-0001, QC-ST-ECCS-0002) containing the appropriate acceptance criteria.

Response to Request for Additional Information

NRC Request

Discuss the surveillance intervals for the monitored locations, including justification for surveillance intervals greater than 31 days for emergency core cooling, decay heat removal, and containment spray systems.

OPPD Response

OPPD has developed program basis document (PBD)-32, *Managing Gas Accumulation in Safety Systems*, which describes the periodic and conditional monitoring frequency for each local high point location. Monitoring for the existence of gas voids in FCS safety systems through surveillance testing is initially performed on a quarterly basis (with exceptions for locations inside containment). PBD-32 permits adjustment of the monitoring frequency based on surveillance test results, which is consistent with the industry approach for managing gas accumulation.

OPPD has identified 22 locations in the auxiliary building that are vulnerable to void formation. These locations are inspected quarterly, with provisions to increase the frequency if voids are found. To minimize radiation dose, 10 locations in containment are inspected on an 18-month frequency.

Proceduralized requirements for system filling and venting minimize the potential to introduce gas voids into susceptible systems. In addition, ultrasonic void detection instrumentation is installed at the most susceptible ECCS locations (high points of LPSI header piping). This instrumentation is configured to alarm if a gas void of 0.3 cubic foot or larger is registered. Following an alarm, the gas void would be vented.

In conclusion, procedural requirements, combined with the installed vent valves and void detection equipment are adequate to justify surveillance intervals in excess of 31 days. These controls ensure that gas voids are not introduced or are detected and eliminated promptly. Should a particular system or location show a trend of gas formation where the void volume would exceed acceptance criteria before the next normally scheduled surveillance test, then the surveillance interval will be re-evaluated at that time as required by PBD-32.

NRC Request

Training was not identified in the GL 2008-01 but is considered to be a necessary part of applying procedures and other activities when addressing the issues identified in GL 2008-01. Briefly discuss the training involved to ensure the compliance of emergency core cooling, decay heat removal, and containment spray systems with the NRC requirements as addressed in GL 2008-01.

OPPD Response

GL 2008-01 did not require discussion of training to satisfy the 10 CFR 50.54(f) request and therefore none was provided in the OPPD response. However, when any station procedure is modified, an assessment for training needs and change management is required in accordance with FCS procedure SO-G-30, *Procedure Changes and Generation*. The determination is typically a function of the nature of the change and the perceived impact on the organization. Training (if required), is generally accomplished prior to, or in parallel with procedure issuance. For fill and vent procedure revisions, the changes have generally been minor and have been considered enhancements. The procedures that direct the periodic examination of selected piping for the presence of air were created to draw upon pre-existing procedures that provide guidance for the ultrasonic inspection of piping to verify that it is full of water.

As part of the response to INPO SOER 97-1, OPPD provided training for station personnel who design, operate, or maintain systems and components that are susceptible to, or may cause, gas intrusion. In addition, OPPD is an active participant in the Nuclear Energy Institute (NEI) Gas Accumulation Team, which has coordinated with INPO in the development of generic training modules for gas accumulation and management. These training modules target the Engineering, Operations, and Maintenance disciplines. OPPD intends to evaluate these modules for applicability to FCS, and may implement a version tailored to meet station needs.

List of Actions Required to Complete Enhancements

Action	Scheduled Date
As specified in Attachment 1, Item 9, OPPD will install EC 45266 during the 2011 RFO and revise operating instruction, OI-SI-1 to permit venting of ECCS recirculation piping.	End of 2011 RFO
As specified in Attachment 1, Item 10, OPPD will install vent valves in accordance with EC 48955 and EC 45428 during the 2011 RFO.	End of 2011 RFO