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AEP-NRC-2008-43
10 CFR Part 50.54(f)

Docket Nos.: 50-315
50-316

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
11555 Rockville Pike, Rockville, MD 20852

Subject: Donald C. Cook Nuclear Plant Unit 1 and Unit 2
Nine-Month Response to NRC Generic Letter 2008-01 issued pursuant to 10 CFR 50.54(f), "Managing Gas Accumulation in Emergency Core Cooling, Decay Heat Removal, and Containment Spray Systems"

References:

1. Nuclear Regulatory Commission (NRC) Generic Letter 2008-01 issued pursuant to 10 CFR 50.54(f), "Managing Gas Accumulation in Emergency Core Cooling, Decay Heat Removal, and Containment Spray Systems," dated January 11, 2008 (ML072910759).
2. Letter from J. N. Jensen, Indiana Michigan Power Company (I&M), to NRC Document Control Desk, Three-Month Response to NRC Generic Letter 2008-01, "Managing Gas Accumulation in Emergency Core Cooling, Decay Heat Removal, and Containment Spray Systems," AEP:NRC:8054-04, dated April 10, 2008 (ML081120235).
3. Letter from L. M. James, NRC, to M. W. Rencheck, I&M, "Donald C. Cook Nuclear Plant, Units 1 and 2 – Re: Generic Letter 2008-01, "Managing Gas Accumulation in Emergency Core Cooling, Decay Heat Removal, and Containment Spray Systems" Proposed Alternative Course of Action (TAC Nos MD7817 and MD7818)," dated September 19, 2008 (ML082490171).

Dear Sir or Madam,

The Nuclear Regulatory Commission (NRC) issued Generic Letter (GL) 2008-01 to request that each licensee evaluate the licensing basis, design, testing, and corrective action programs for the Emergency Core Cooling Systems (ECCS), Residual Heat Removal (RHR) system, and Containment Spray (CTS) system, to ensure that gas accumulation is maintained less than the amount that challenges operability of these systems, and that appropriate action is taken when conditions adverse to quality are identified.

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GL 2008-01 requested each licensee to submit a written response in accordance with 10 CFR 50.54(f) within nine months of the date of the GL to provide the information summarized below:

(a) A description of the results of evaluations that were performed pursuant to the requested actions;

(b) A description of all corrective actions, including plant, programmatic, procedure, and licensing basis modifications that were determined to be necessary to assure compliance with the quality assurance criteria in Sections III, V, XI, XVI, and XVII of Appendix B to 10 CFR Part 50 and the licensing basis and operating license as those requirements apply to the subject systems; and,

(c) A statement regarding which corrective actions were completed, the schedule for completing the remaining corrective actions, and the basis for that schedule.

Indiana Michigan Power Company (I&M) has concluded that the subject systems at the Donald C. Cook Nuclear Power Plant (CNP) are capable of performing their intended safety function and therefore, comply with the Technical Specification definition of operability. In addition, I&M has concluded that CNP is in conformance with its obligations to 10 CFR 50, Appendix B, Criterion III, V, XI, XVI, and XVII, as described in the Quality Assurance Program Description. In addition, I&M has made several commitments addressing various topic issues identified in this submittal. A listing of these commitments is now contained in our Corrective Action Program.

As committed in Reference 2, I&M will complete its assessments of the portions of these systems in Containment during the next Refueling Outages and provide a supplement to this report with the results of the assessments within 90 days from startup of each outage. New commitments are found in Enclosure 2 to this letter.

The enclosure to this letter contains I&M's nine-month response to NRC GL 2008-01. Should you have any questions, please contact John A. Zwolinski, Manager of Regulatory Affairs at (269) 466 2478.

Sincerely,

Lawrence J. Weber
Site Vice President

Enclosures: 1. Affirmation
2. Nine-Month Response to NRC Generic Letter 2008-01, Managing Gas Accumulation in Emergency Core Cooling, Decay Heat Removal, and Containment Spray Systems

c: T. A. Beltz - NRC Washington, DC
J. L. Caldwell - NRC Region III
K. D. Curry - AEP Ft. Wayne
J. T. King - MPSC
MDEQ - WHMD/RPS
NRC Resident Inspector

AFFIRMATION

I, Lawrence J. Weber, being duly sworn, state that I am Site Vice President of Indiana Michigan Power Company (I&M), that I am authorized to sign and file this request with the Nuclear Regulatory Commission on behalf of I&M, and that the statements made and the matters set forth herein pertaining to I&M are true and correct to the best of my knowledge, information, and belief.

Indiana Michigan Power Company

Lawrence J. Weber

Lawrence J. Weber
Site Vice President

SWORN TO AND SUBSCRIBED BEFORE ME

THIS 14th DAY OF October, 2008

Notary Public

My Commission Expires 6/10/2013

Nine-Month Response to NRC Generic Letter 2008-01, Managing Gas Accumulation in Emergency Core Cooling, Decay Heat Removal, and Containment Spray Systems

This enclosure contains the Donald C. Cook Nuclear Power Plant (CNP) nine-month response to Nuclear Regulatory Commission (NRC) Generic Letter (GL) 2008-01 "Managing Gas Accumulation in Emergency Core Cooling, Decay Heat Removal, and Containment Spray Systems," dated January 11, 2008. In GL 2008-01, the NRC requested that each addressee evaluate its Emergency Core Cooling System (ECCS), Decay Heat Removal (DHR) system, and Containment Spray (CTS) system licensing basis, design, testing, and corrective actions to ensure that gas accumulation is maintained less than the amount that challenges operability of these systems, and that appropriate action is taken when conditions adverse to quality are identified. Further, the NRC issued this GL pursuant to 10 CFR 50.54(f).

Consistent with the "Requested Information" section of GL 2008-01, the following information is provided in this response:

a) A description of the results of evaluations that were performed pursuant to the requested actions (see Section A of this enclosure);

b) A description of the corrective actions determined necessary to assure compliance with the quality assurance criteria in Sections III, V, XI, XVI, and XVII of Appendix B to 10 CFR Part 50 and the licensing basis and operating license with respect to the subject systems (see Section B of this enclosure); and,

c) A statement regarding which corrective actions have been completed, the schedule for the corrective actions not yet complete, and the basis for that schedule (see Section C of this enclosure).

The following systems were determined to be in the scope of GL 2008-01 for CNP:

- ECCS

  Each ECCS consists of three separate subsystems. Each subsystem consists of two redundant 100% capacity trains.

  - Charging – 2 trains
  - Safety Injection (SI) – 2 trains
  - Residual Heat Removal (RHR) – 2 trains

  The ECCS accumulators and the Refueling Water Storage Tank (RWST) are also part of the ECCS. The charging pumps used for high head ECCS injection are also used for normal charging and letdown. However, the charging pump flow path is realigned during ECCS injection where flow is injected through all four Reactor Coolant System (RCS) cold legs. During normal operations, the charging system discharges to the reactor coolant pump seals and one of two cold leg loops (one normal and one alternate).

- CTS System

  The CTS System also consists of two redundant 100% capacity trains.

A. EVALUATION RESULTS

Licensing Basis Evaluation

The CNP licensing basis was reviewed with respect to gas accumulation in the Charging, SI, RHR, and CTS systems. This review included the Technical Specifications (TS), TS Bases, Updated Final Safety Analysis Report (UFSAR), Technical Requirements Manual (TRM) and TRM Bases, responses to NRC generic communications, Regulatory Commitments, License Conditions, and Quality Assurance Program (QAPD). The following is a description of the results of the licensing evaluation.

Summary of Licensing Basis Review

<u>Quality Assurance Criteria</u>

The requirements of 10 CFR 50 Appendix B, Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants, are addressed in the CNP QAPD. In addition, Section 5.4.1.a of CNP TS describes the requirement to have established, implemented, and maintained written procedures that cover applicable procedures recommended in Regulatory Guide 1.33, Revision 2.

<u>TSs (including TS Bases)</u>

The requirements of 10 CFR 50.36 are addressed in Sections 3.5, 3.6, and 3.9 of the CNP TS which establish Limiting Conditions for Operation (LCO) and Surveillance Requirements (SR) for ECCS and CTS.

1) ECCS - LCOs 3.5.2 (applicable in Modes 1, 2, and 3) and 3.5.3 (applicable in Mode 4) establish operability requirements for ECCS subsystems during operating and shutdown conditions. CNP does not have a SR to verify that ECCS piping is full of water similar to Standard TS SR 3.5.2.3, as provided in NUREG-1431, Standard Technical Specifications Westinghouse Plants.

2) RHR – LCOs 3.4.6, 3.4.7, 3.4.8, 3.9.4, and 3.9.5 establish operability requirements for RHR for Modes 5 and 6.

3) CTS - LCO 3.6.6 establishes operability requirements for CTS while in Modes 1, 2, 3, and 4.

The RWST and Containment Recirculation Sump Water Level Post Accident Monitoring Instrumentation (PAM) is discussed in TS Table 3.3.3-1. These level instruments provide advance warning of potential air entrainment due to vortexing.

<u>UFSAR</u>

Entrainment of air in the ECCS is discussed in Chapters 6, 9, and 14 of the UFSAR. The following air entrainment mechanisms are discussed:

- Air in-leakage to the RHR system via the recirculation sump during the recirculation phase of Loss of Coolant Accident (LOCA) response.

- Air inleakage to the RHR system when the RCS is at a reduced inventory condition, including mid-loop operations.

Design features and mitigating strategies to preclude air entrainment from these sources are discussed in the Design Basis section of this enclosure.

Licensee Controlled Documents

The TRM and TRM Bases were reviewed. No information specific to this subject was identified.

Indiana Michigan Power Company (I&M) Commitments

The Commitment Tracking System was reviewed and the following information specific to this issue was identified:

Commitment 2297 – Ongoing

Procedures which govern the operation of the RHR system and RCS drain down evolutions during normal plant operations will be revised to address additional equipment and procedural guidelines for operation while at reduced RCS inventories. These procedures will ensure that containment closure capability, independent instrumentation, and support systems are in place, prior to entry into a reduced inventory condition with irradiated fuel in the vessel. In addition, these procedures contain guidance for the operation of the RHR system at varying loop levels to preclude air entrainment and subsequent loss of the RHR system.

Commitment 2309 – Ongoing

Procedures which govern the operation of the RHR system and RCS drain down evolutions during normal plant operations will be revised to address additional equipment and procedural guidelines for operation while at reduced RCS inventories. These procedures will ensure that containment closure capability, independent instrumentation, and support systems are in place, prior to entry into a reduced inventory condition with irradiated fuel in the vessel. In addition, these procedures contain guidance for the operation of the RHR system at varying loop levels to preclude air entrainment and subsequent loss of the RHR system.

These items are addressed in plant procedures.

Summary of Items to be Completed

To ensure the concerns regarding gas accumulation in GL 2008-01 are adequately addressed, I&M will create a Gas Accumulation Condition Monitoring Program document. This document will contain the following:

- Performance Monitoring–Description of the routine monitoring and trending of plant parameters that may indicate an increased potential for gas accumulation.

- Testing – Location and periodicity of ultrasonic testing (UT) performed to monitor ECCS piping for void formation.

- Evaluation–Methodology for evaluating identified voids, including acceptance criteria for operability.

A description of the Gas Accumulation Condition Monitoring Program will be added to the UFSAR.

TS improvements are being addressed by the Technical Specifications Task Force (TSTF) to provide an approved TSTF Traveler for making changes to individual licensee's TS related to the potential for unacceptable gas accumulation. The development of the TSTF Traveler relies on the results of the evaluations of a large number of licensees to address the various plant designs. I&M is continuing to support the industry and Nuclear Energy Institute (NEI) Gas Accumulation Management Team activities regarding the resolution of generic TS changes via the TSTF Traveler process. After NRC approval of the Traveler, I&M will evaluate its applicability to CNP and evaluate adopting the Traveler to either supplement or replace the current TS requirements.

Summary of Licensing Basis Evaluation Commitments
Create a Gas Accumulation Condition Monitoring Program document. This document will contain the following: • Performance Monitoring–Description of the routine monitoring and trending of plant parameters that may indicate an increased potential for gas accumulation. • Testing–Location and periodicity of UTs performed to monitor ECCS piping for void formation. • Evaluation–Methodology for evaluating identified voids, including acceptance criteria for operability.
Add a description of the Gas Accumulation Condition Monitoring Program to the UFSAR.
Evaluate the TSTF traveler for gas accumulation to either supplement or replace the current TS requirements.

Conclusion

Based on the licensing basis evaluation, I&M has determined that the CNP licensing basis adequately addresses the requirements of 10 CFR 50, Appendix A General Design Criteria, 10 CFR 50, Appendix B Quality Assurance Criteria, and 10 CFR 50.36, Technical Specifications.

Design Evaluation

The CNP design was reviewed with respect to gas accumulation in the ECCS, RHR, and CTS systems. This included a review of Design Basis Documents, Calculations, Design Drawings, Fill and Vent Procedures, Engineering Evaluations, and Vendor Technical Manuals. As part of this review, potential gas intrusion mechanisms were identified and evaluated. In addition, confirmatory plant walkdowns on accessible portions of system piping were conducted to assess as-built piping configurations and potential areas for gas accumulation. Lastly, UT was performed on a number of suspected areas to evaluate for the presence of gas. The following is a description of the results of the design evaluation at CNP.

Summary of Design Review

a. Calculation Reviews

With respect to the systems identified in the GL, it was determined through a review of site-specific analyses and calculations that calculations did not exist to support acceptance criteria for how much gas could be allowed and not impact system operability in all portions of ECCS, RHR, and CTS systems.

I&M has since utilized acceptance criteria to support operability in all these systems based on Boiling Water Reactor Owners' Group (BWROG) and Pressurized Water Reactor Owners' Group (PWROG) joint industry activities to locate, evaluate, and quantify gas in these systems. This includes the following considerations:

1) Pump Suction Piping

The interim allowable gas accumulation in pump suction piping is based on limiting the gas entrainment to the pump after a pump start. A PWROG program established interim pump gas ingestion limits to be employed by member utilities. The interim criteria are as follows:

	Single-Stage	Multi-Stage Flexible Shaft
Steady-State	2%	2%
Transient	5% for 20 seconds	10% for 5 seconds

The limits identified in the PWROG program specifically address mechanical integrity of the pumps. NUREG-2972 also identifies that when steady state limits of 2% are maintained as recommended, there is minimal impact to pump head or net positive suction head (NPSH) requirements. Transient limits are also expected to have minimal impact on pump performance since NPSH available for the charging, SI, RHR, and CTS pumps typically exceeds the required NPSH by a factor of two or more. Any impact to pump head as a result of gas transit will be of short duration and insignificant with respect to heat transfer capability.

I&M will use these criteria when evaluating potential operability concerns (identified gas) and will incorporate the interim criteria formally into the gas management program. CNP procedures and operating practices provide reasonable assurance that the volume of gas in the pump suction piping for the RHR, CTS, SI and charging systems is limited such that pump gas ingestion is within the above PWROG program established interim criteria.

The RHR, CTS, SI, and charging systems are designed to preclude vortex formation. RWST level limits (and associated automatic actions) are established to prevent low levels that could cause vortexing in the RWST. Additionally, the current design basis calculations for the ECCS recirculation sump strainers demonstrate that void formation would not occur as a result of recirculation water flashing to steam due to worst case differential pressure across the debris bed, accounting for the effect of containment overpressure. The Unit 1 and Unit 2 ECCS sump strainer design incorporates an atmospheric vent on the downstream side of the strainer screen. The configuration has been designed to ensure that the maximum postulated air pocket that could form downstream of the strainer screen would not be entrained into the flow stream. Calculations establish the maximum void volume that could occur under worst case design conditions. A minimum water level required within the vent structure has also been established.

2) Pump Discharge Piping Which is Susceptible to Pressure Pulsation after a Pump Start

A joint owners' group program evaluated pump discharge piping gas accumulation. Gas accumulation in the piping downstream of the pump to the first closed isolation valve or the RCS pressure boundary isolation valves will result in amplified pressure pulsations after a pump start. The subsequent pressure pulsation may cause relief valves in the subject systems to lift, or result in unacceptable pipe loads, i.e., axial forces that are greater than the design rating of the axial restraint(s). The joint owners' group program establishes a method to determine the limit for discharge line gas accumulation to be utilized by the member utilities.

The method uses plant-specific information for piping restraints and relief valve set points in the subject systems to determine a bounding gas volume accumulation such that relief valve lifting in the subject systems does not occur (or is minimized) and pipe loading is within acceptable limits, i.e., axial forces that are less than the design rating of the axial restraint(s).

CNP procedures limit the amount of gas that can accumulate in piping both through preventive actions such as full flow flushing and sequenced system restoration, and system monitoring. In the event of identified gas, the owner's group methodology may be employed to perform an operability determination. To support performance of these evaluations in a timely manner, a table generated in conjunction with review of system isometric drawings was completed that identifies each horizontal run of pipe, nominal pipe size and length for each of these sections, associated calculation and nodes, and the pipe restraint that supports the pipe in the axial direction. This would be used to quickly compare generated axial forces with those forces already evaluated. If the gas void were to be of such size that it could not pass the simplified criteria, the void could be analyzed via computational fluid dynamic analyses. A model of the Unit 1 ECCS was created to support such analyses.

3) Pump Discharge Piping With Minimal Susceptibility to Pressure Pulsation after a Pump Start

The PWROG methodology for CTS evaluates the piping response as the CTS header is filled and compares the potential force imbalances with the weight of the piping. The net force resulting from the pressurization of the CTS header during the filling transient is a small fraction of the dead weight of the filled piping, and therefore, the filling transient is well within the margin of the pipe hangers.

The CTS System discharge header piping was evaluated using the PWROG methodology described above. Using this methodology, it was determined that the force imbalances on the CTS System discharge header are within the capabilities of the pipe hangers.

A PWROG methodology has been developed to assess when a significant gas-water waterhammer could occur during switchover to hot leg injection. The methodology concludes that if the upstream valve has an opening time of approximately 10 seconds or greater and the downstream path to the RCS is only restricted by check valve(s), no significant waterhammer would occur, i.e., none of the relief valves in the subject systems would lift and none of the piping restraints would be damaged.

The CNP ECCS flow path for switchover to hot leg injection has an upstream valve with an opening time of greater than 10 seconds and the downstream path to the RCS is only restricted by check valves. Therefore, consistent with the PWROG program methodology, no significant waterhammer will occur, i.e., none of the relief valves in the subject systems would lift and none of the piping restraints would be damaged.

4) RCS Allowable Gas Ingestion

The PWROG qualitatively evaluated the impact of non-condensable gases entering the RCS on the post-accident core cooling functions of the RCS. This evaluation assumed that five cubic feet of non-condensable gas at 400 pounds per square inch gauge (psig) was present in the Charging and SI discharge piping concurrent with five cubic feet of non-condensable gas at 100 psig in the RHR discharge piping. The qualitative evaluation concluded that these quantities of gas will not prevent the ECCS from performing its core cooling function.

CNP procedures provide reasonable assurance that the gas accumulation in the RHR injection system cold leg and hot leg piping would be less than five cubic feet of non-condensable gas at 100 psig at any location. The procedures also provide reasonable assurance that the gas accumulation in the Charging cold leg injection and SI cold leg and hot leg piping would be less than five cubic feet of non-condensable gas at 400 psig at any location.

The UFSAR large-break LOCA transient analysis demonstrates that during the time period when the ECCS water initially enters the reactor vessel (RV) following a design basis event, the core is voided with steam. Therefore, the impact of any entrained air transported from the ECCS piping to the core would be negligible. An evaluation has been developed by the PWROG that formalizes this assessment for all postulated design basis scenarios.

The current design bases do not address the potential impact of gas transported to the RCS from the ECCS system on the fluid dynamics of natural circulation. An evaluation has been developed by the PWROG that shows the volume of the RV head is much larger than the expected volume of gas voids that can be tolerated in the ECCS based on gas binding and waterhammer limitations. Any gas that is transported to the RCS is likely to migrate to the RV head and as a result will have no impact on natural circulation flow. Likewise, the allowable ECCS gas void volume is a small fraction of the steam generator (S/G) u-tube volume. Thus, it will not interfere with the ability of the S/Gs to establish and maintain natural circulation flow. The PWROG evaluation also shows that the allowable volume of gas that could be transferred on startup of the shutdown cooling (SDC) system to the RCS would be much smaller than the volume of the RV head. Therefore, SDC operations will not be impacted by the transfer of accumulated gas.

b. <u>Drawing Reviews</u>

A detailed review of system flow and isometric drawings was completed to identify system horizontal runs, high points, vents, orifices, pipe diameter changes, valves in vertical sections of pipe, and pipe schedule changes in preparation for field walkdowns. These reviews, in conjunction with operational experience and system walkdowns, indicated the need for the following new vent valves:

- Centrifugal charging pump (CCP) Appendix R discharge crosstie - The CCP discharge headers in both units are tied together to allow either pump to support reactor coolant pump (RCP) seals in the opposite unit affected by a fire. This crosstie has not been equipped with a vent. An additional vent is required to ensure that seal flow would not be disturbed by a void should this portion of the system ever need to be placed into service.

- RCP seal line – The existing configuration of the piping for each RCP seal injection circuit does not permit the system to be filled completely after draining. The check valve downstream from each high point vent prevents air from reaching the vent during backfill. This can cause an air void to be trapped in the system. The presence of this void can disturb indications for required seal flow and jeopardize continued operation of the affected RCP. Another vent will be installed downstream of the check valve. Also, configuration of the return line does not include a high point vent near the containment penetration. Additional vents will be installed to minimize the probability of a void being transported into the CCP suction network.

- CCP Emergency Leak-off (ELO) piping downstream of the flow restricting orifice - Each CCP is equipped with vent and drain valves needed to support intrusive maintenance online. However, a drain valve for the ELO piping is located inside this clearance boundary. The ELO piping is currently not equipped with a vent; consequently, it cannot be restored online. An additional vent is required in the event that this drain valve is inadvertently mispositioned.

These modifications will require a refueling or extended outage to install. Design change packages will be prepared and the modifications will be installed during the U1C23 and U2C18 refueling outages (RFO) or during an extended outage of sufficient duration if one occurs sooner.

c. Confirmatory Walkdowns

Walkdowns were performed to confirm the slope of each horizontal run of piping in the subject systems and the exact locations for placement and orientation of high point vents identified by the system drawing review, and identify any additional locations that might require the installation of high point vents. Validation of slopes was completed using Zip-Level devices. Validated system slopes were found to be in accordance with applicable isometric drawings with one exception that was entered into the Corrective Action Program.

The outcome of the walkdowns and drawing reviews were used as input to identify locations where UT would be conducted to monitor for void size and to identify candidate locations for additional vent valves. The walkdown confirmed that piping was within construction tolerances. Potential vent and UT locations were screened and prioritized based on isometric review, walkdown data, and operational experience. UT locations identified by the walkdowns will be evaluated for incorporation into the Gas Accumulation Condition Monitoring Program for trending and assessment of surveillance method and frequency.

Ultrasonic inspection generally showed piping to be full. When voids were identified, the condition was entered into the Corrective Action Program and an operability evaluation was performed. In all cases, the associated piping systems were determined to be operable. The largest void in the ECCS was less than one cubic foot with the system depressurized in standby. A large void was found in the CVCS charging pump discharge cross-tie header. This piping is used during implementation of Appendix R procedures and has no effect on ECCS operability of either unit.

The RHR and CTS pump suction piping between motor operated valves in the Auxiliary Building that isolate the containment recirculation sump and each separate pump compartment has not been walked down to date. These segments of pipe for each train are located in the Auxiliary Building vestibule. The recirculation piping in this room is contained inside Leak Detection Enclosures (LDE). Access to the LDEs is limited due to radiation levels and by the fact that the LDEs must be disassembled to gain access to the piping. I&M will disassemble the LDEs and inspect this pipe. Delaying inspection can be justified by the slope of each horizontal run of pipe and the sequence of configuration alterations used to realign RHR and CTS for cold leg recirculation. The containment isolation motor operated valves are the highest point in the Auxiliary Building. All horizontal runs of pipe slope upward towards these valves which are maintained normally closed in standby. These valves must be opened before the RHR and CTS pumps can be restarted for cold leg recirculation. Any air trapped against the valve seats would escape into the recirculation sump in containment and not create a hazard for subsequent pump starts.

Isometric review was relied upon when physical walkdowns were not completed. Based on large scope of piping identified within tolerance during physical walkdowns, it is reasonable to assume that the piping for which isometrics were relied upon is within tolerance.

d. Procedure Reviews

The Unit 1 and Unit 2 fill and vent procedures were reviewed to determine whether additional guidance is necessary to ensure that the subject systems are adequately filled to support reliable system operation. The review found that fill and vent procedures are in place to ensure that the as-left condition of the subject systems is such that they will perform their intended functions. The procedures specify vent locations to support operations and maintenance activities, vent method, and acceptance criteria for successful system venting. The procedures incorporate lessons learned from internal and external operating experience.

Filling and venting of systems and subsequent flushing of systems during surveillance testing are the means used to ensure that system piping is filled. An exception is the CTS heat exchanger and its downstream piping which is maintained dry by design. The ECCS piping is drained, filled, and flushed during three distinct evolutions:

1. The systems are drained to perform maintenance during a planned RFO.

2. The ECCS systems are filled and vented in preparation for return to service.

3. The ECCS systems are dynamically flushed to remove entrained air. Froude number calculations performed for the systems at these system flush rates indicate that the fluid velocity is sufficient to sweep the voids.

The bulk of the ECCS maintenance performed during a planned RFO is completed before the refueling cavity is flooded up to reload the core. When it is time to begin restoring the master clearance for the RCS, which includes RHR and the ECCS piping network, the water level in the refueling cavity is at mid-loop and the RWST is full. Approved procedures align the system for a gravity fill from the RWST. The pump suction lines and their casings are vented to ensure they can start without being air-bound.

Procedures then direct Operations to place RHR in service in such a manner that all of the air trapped in the u-bends at the top of the heat exchangers is swept into the open RV. The procedure requires flow rates in excess of 3000 gallons per minute (gpm) for over 10 minutes and includes manipulation of the crossties on both sides of the heat exchangers.

After RHR has been restored, pump and valve Inservice Tests are performed at or near maximum design flow for RHR, SI, and Charging systems. This completes all of the dynamic flushes required to restore the system for standby readiness. The refueling cavity is now full for core reload to proceed.

When core reload is complete, the refueling cavity is drained back to the RWST in preparation for installation of the RV closure head. This evolution has caused dissolved gases to coming out of solution and collecting at high points in the pump suction network connected to the tank. The procedure for draining the cavity also includes steps to exercise the necessary vent valves on the RWST discharge header to remove these voids before the pumps are reconfigured to change modes.

RHR manual operation in the DHR mode is controlled by procedure to preclude void formation. Specific precautions and limitations ensure the system remains sufficiently full of water to prevent pump degradation caused by vortexing. When operating at reduced inventory levels between mid-loop and three feet below the RV flange, RHR flow is limited to no more than 4000 gpm. The most accurate instrumentation on the injection circuit is used to monitor this condition and motor operated valves are throttled to maintain sufficient impedance to ensure flow will not exceed this value assuming any air operated flow control valve were to fail open.

e. Gas Intrusion Mechanism Review

Historically, I&M has actively reviewed and modified ECCS systems to minimize gas intrusion and void formation accumulation within ECCS piping. Maintenance and operations procedures have been the subject of reviews that address the prevention of piping voids. Prior to the issuance of GL 2008-01, a number of plant modifications designed to preclude the adverse impact of void formation and gas entrainment within the ECCS suction piping were implemented. Some of the past modifications are described as follows:

- SI suction from RWST - During refueling, while draining the cavity to the RWST, RHR pumps water through an eight-inch pipe into the 24-inch RWST discharge header. A large quantity of non-condensable gases comes out of solution on the return to the tank due to the abrupt change in velocity. This flow through the RWST discharge header passes directly underneath the SI pump suction tap resulting in a void developing directly behind the SI motor operated isolation valve common to both trains. A vent was added in both Units 1 and 2, with the appropriate procedural controls to cycle this vent before opening the motor operated isolation valve.

- SI suction from RHR on recirculation - The SI pump suction header common to both trains is supplied by the west train of RHR during the recirculation mode. The pump suction header is located below grade while the RHR heat exchangers are located at ground level. This connection is the highest point in the SI pump suction header where non-condensable gases coming out of solution are most likely to collect.

Vents were added to both Units 1 and 2. The procedures for restoration from an outage use the vents to ensure this piping segment is filled. Online condition monitoring activities direct UTs every six months to detect void development.

- RHR suction from RWST - A vent was added to the vertical segment of pipe common to both trains of RHR. This allows the RWST discharge header to be drained without removing RHR from service during an RFO.

- RHR minimum flow - Each RHR pump is equipped with its own minimum flow protection circuit connecting the suction pipe located in the basement of the Auxiliary Building with the heat exchanger outlet motor operated isolation valve located three elevations higher. This miniflow line is isolable from the heat exchanger but not from the pump. Vents were added to the top of each miniflow line to support clearing the pump for internal maintenance online.

- CCP suction for each pump - The CCP suction header is located near the ceiling in each pump room. There is an isolation valve in the vertical run of pipe connecting the pump suction nozzle to the suction header. The segment of pipe between the pump and this isolation valve was not equipped with a vent making it impossible to clear/restore a CCP for intrusive maintenance online. A vent was added for each train in Unit 1 and Unit 2.

- CCP suction from RHR on recirculation - Similar to the SI suction from RHR on recirculation described above, both trains of Charging are supplied by the east RHR pump during recirculation. Vents were added to this high point connection in the heat exchanger compartment. They are utilized in the same manner and UTs are also performed at this location every six months.

I&M has identified the following as primary sources of gas intrusion to the ECCS system:

- RCS high/low pressure interface across the RCS pressure isolation check valves - RCS unidentified leakage and monitored pressure in the RHR and SI pump discharge header are aggressively tracked to monitor off-gassing.

- Accumulators - Water contained in an accumulator has nitrogen in solution at pressure. The pressure isolation valves between the accumulators and low pressure piping connected to the ECCS are seat-leakage tested. Should water leak past these isolation valves back into the low pressure piping network, nitrogen will come out of solution forming voids. Changes in accumulator level directly indicate the possibility of this occurring. Indicated level is verified within specification every 12 hours in accordance with TS SR 3.5.1.2. System Engineering trends this indication to detect the onset of void formation. Similarly, pressure within the piping network itself is used as an indicator of leakage entering the system from a high pressure source that may contain non-condensable gases in solution. Trending pressure is used to indicate the onset of void formation.

- CCP ELO restricting orifice – This orifice has stripped dissolved gases out of solution at other stations. Our 14-stage orifice is not susceptible to this condition. This has been confirmed by UT.

- RHR suction vortex – When operated at a relatively high rate of flow, RHR pumps can entrain air from a suction source with minimal net positive suction head available. To avoid this situation, the pump automatically trips on RWST low-low level if Operations has not realigned the system for cold leg recirculation. Normal SDC includes sufficient procedural controls over configuration and flow to ensure a vortex is not drawn from the RCS while operating in reduced inventory.

- Volume Control Tank (VCT) – A check valve was added to provide redundant isolation for the branch line from the VCT to the seal return / leak-off supply line to the charging pump suction header. This valve reduces the possibility of gas migration to the charging pump suction in the event of a failure of the manual isolation valve.

- RCP seal return – Operating history shows minimal impact from this source. However, since the potential exists for gas to accumulate, additional vent valves will be added to this piping as previously discussed.

- Maintenance – Operating experience has shown that maintenance has been the most significant contributor to gas intrusion events at CNP. To preclude gas intrusion during on-line maintenance, activities are reviewed to ensure that gas voids are not created as a result of system breach or return to service. The Work Management procedure will be revised to better describe the Work Assessment Group (WAG) role in preventing gas intrusion. In addition, a guideline for outage scheduling will be developed to assist in proper schedule sequencing of maintenance activities and system restoration to minimize the potential for void formation.

f. <u>Ongoing Industry Programs</u>

Ongoing industry programs are currently planned in the following areas which may impact the conclusions reached during the Design Evaluation of CNP relative to gas accumulation. The activities will be monitored to determine if additional changes to the design may be required or desired to provide additional margin.

- Gas Transport in Pump Suction Piping

  The PWROG has initiated testing to provide additional knowledge relative to gas transport in large diameter piping. One program performed testing of gas transport in 6-inch and 8-inch piping. Another program, currently planned, will perform additional testing of gas transport in 4-inch and 12-inch low temperature systems and 4-inch high temperature systems. This program will also integrate the results of the 4-inch, 6-inch, 8-inch, and 12-inch testing.

- Pump Acceptance Criteria

  Long-term industry tasks were identified that will provide additional tools to address GL 2008-01 with respect to pump gas void ingestion tolerance limits.

Summary of Design Evaluation Commitments
Incorporate interim criteria for operability into the Gas Accumulation Condition Monitoring Program.
Add a vent to the CCP Appendix R discharge crosstie.
Add vent valves to the RCP seal line.
Add a vent valve to the CCP ELO piping downstream of the flow restricting orifice.
Complete walkdown of piping inside the Auxiliary Building LDEs.
Modify Work Control procedure to better describe the role of the WAG in preventing gas intrusion.
Develop a guideline for outage scheduling to assist in the proper schedule sequencing of maintenance activities and system restoration.
Monitor ongoing industry programs for Gas Accumulation. • Gas transport in pump suction piping • Pump gas void ingestion tolerance limits

Testing Evaluation

CNP TS do not contain SRs to verify that ECCS and CTS piping are full of water. Systems are filled and vented following outages and online maintenance in accordance with approved procedures to establish a water filled condition sufficient to meet the design needs of the system. To ensure continued operability, piping segments connected to the SI and CCP suction headers most susceptible to gas accumulation are examined via UT at six month intervals to identify any voids. The scope of UTs will be expanded and incorporated into the Gas Accumulation Condition Monitoring Program

The UTs at high points in the SI and CCP suction header supplied by RHR during recirculation have identified the presence of a small void on several occasions since vents were installed at these locations. Typically, this condition was discovered during the first examination following an RFO, indicating the procedure used for restoration and venting these locations was completed before all of the non-condensable gases in RHR came out of solution. These conditions were entered into the Corrective Action Program. Evaluations of the conditions documented that none of the voids affected system operability.

In addition to the examinations and procedures described above, condition monitoring performed by System Engineering as part of their normal duties includes activities designed to detect the onset of voids forming in the ECCS discharge piping network. Trends in plant parameters such as RCS leakage and accumulator levels are monitored closely as they are predictive of operating conditions that can lead to void formation.

The Corrective Action Program is used to document gas intrusion/accumulation issues as potential nonconforming conditions. No threshold criteria are applied. As part of the Corrective Action Program, Action Requests related to plant equipment are evaluated for potential impact on operability and reportability.

Manual Operation of the RHR System in its DHR Mode of Operation

Existing procedures used to control the manual operation of RHR for normal DHR contain specific precautions and limitations that ensure the system remains sufficiently full of water to prevent pump degradation caused by vortexing. When operating at reduced inventory level between mid-loop and three feet below the RV flange, RHR flow is limited to no more than 4000 gpm. The most accurate instrumentation on the injection circuit is used to monitor this condition and motor operated valves are throttled to maintain sufficient impedance to ensure flow will not exceed this value assuming any air operated flow control valve were to fail open.

Testing Evaluation Corrective Actions

Commitment
Define added scope of UTs and document in the Gas Accumulation Condition Monitoring Program.

Corrective Actions Evaluation

The corrective action process was reviewed with respect to gas accumulation in the ECCS, RHR, and CTS. This included a review of the Corrective Action Program and trending performed by CNP staff.

The Corrective Action Program is used to document gas intrusion/accumulation issues as potential nonconforming conditions. Since they are uncommon, gas accumulation findings for ECCS, RHR, and CTS are entered into the Corrective Action Program for evaluation. No threshold criteria are applied. As part of the Corrective Action Program, Action Requests related to plant equipment are evaluated for potential impact on operability and reportability. The review concluded that issues involving gas intrusion/accumulation are properly prioritized and evaluated under the Corrective Action Program and that no Corrective Action Program changes are needed.

CONCLUSION

Based upon the above, I&M has concluded that CNP is in conformance with its obligations to 10 CFR 50, Appendix B, Criterion III, V, XI, XVI, and XVII, as described in the QAPD.

B. SUMMARY OF CORRECTIVE ACTIONS

COMMITMENTS
Commitments from the Licensing Basis Evaluation
Create a Gas Accumulation Condition Monitoring Program document. This document will contain the following: • Performance Monitoring – Description of the routine monitoring and trending of plant parameters that may indicate an increased potential for gas accumulation. • Testing – Location and periodicity of UTs performed to monitor ECCS piping for void formation. • Evaluation – Methodology for evaluating identified voids, including acceptance criteria for operability.
Add a description of the Gas Accumulation Condition Monitoring Program to the UFSAR.
Evaluate the TSTF Traveler for gas accumulation to either supplement or replace the current TS requirements.
Commitments from the Design Basis Evaluation
Incorporate interim criteria for operability into the Gas Accumulation Condition Monitoring Program.
Add a vent to the CCP Appendix R discharge unit crosstie.
Add vent valves to the RCP seal line.
Add a vent valve to the CCP ELO piping downstream of the flow restricting orifice.
Complete walkdown of piping inside the Auxiliary Building LDEs.
Modify the Work Control procedure to better describe the role of the WAG in preventing gas intrusion.
Develop a guideline for outage scheduling to assist in the proper schedule sequencing of maintenance activities and system restoration.
Monitor ongoing industry programs for Gas Accumulation. • Gas transport in pump suction piping • Pump gas void ingestion tolerance limits

COMMITMENTS
Commitments from the Testing Evaluation
Define added scope of UTs and document in the Gas Intrusion Condition Monitoring Program.

C. CORRECTIVE ACTION SCHEDULE

No corrective actions identified as a result of the evaluations performed for this GL have been completed as of the date of this submittal.

COMMITMENT	DATE
Create a Gas Accumulation Condition Monitoring Program document. This document will contain the following: • Performance Monitoring – Description of the routine monitoring and trending of plant parameters that may indicate an increased potential for gas accumulation. • Testing – Location and periodicity of UTs performed to monitor ECCS piping for void formation. • Evaluation – Methodology for evaluating identified voids, including acceptance criteria for operability. Completion date is set before the start of the Unit 2 RFO. Acceptable date as UT monitoring shows no operability concerns and condition monitoring is already in place.	March 14, 2009
Add a description of the Gas Accumulation Condition Monitoring Program to the UFSAR. Date allows sufficient time to prepare UFSAR change package.	March 31, 2009
Evaluate the TSTF Traveler for gas accumulation to either supplement or replace the current TS requirements.	60 days after the TSTF is approved by the NRC.
Incorporate interim criteria for operability into the Gas Accumulation Condition Monitoring Program. Date coincides with creation of Gas Accumulation Condition Monitoring Program document.	March 14, 2009
Add a vent to the CCP Appendix R discharge unit crosstie. Outage required for installation.*	Completion of Unit 2 RFO U2C18 - currently scheduled for Spring 2009
Add vent valves to the RCP seal line. Outage required for installation.*	Completion of Unit 1 RFO U1C23 - currently scheduled for Fall 2009 Completion of Unit 2 RFO U2C18 - currently scheduled

COMMITMENT	DATE
	for Spring 2009
Add a vent valve to the CCP ELO piping downstream of the flow restricting orifice. Outage required for installation.*	Completion of Unit 1 RFO U1C23 - currently scheduled for Fall 2009 Completion of Unit 2 RFO U2C18 - currently scheduled for Spring 2009
Complete walkdown of piping inside the Auxiliary Building LDEs. Time needed for job planning including ALARA.	January 15, 2009
Modify Work Control procedure to better describe the role of the Work Assessment Group in preventing gas intrusion. Target date before Unit 2 RFO.	March 14, 2009
Develop a guideline for outage scheduling to assist in the proper schedule sequencing of maintenance activities and system restoration.	March 14, 2009
Monitor ongoing industry programs for Gas Accumulation. • Gas transport in pump suction piping • Pump gas void ingestion tolerance limits	Ongoing
Define added scope of UTs and document in the Gas Intrusion Condition Monitoring Program. Date coincides with creation of Gas Accumulation Condition Monitoring Program document.	March 14 2009

COMMITMENTS FROM THE 90 DAY RESPONSE TO GENERIC LETTER 2008-01	
COMMITMENT	**DATE**
Perform system walkdowns in Unit 2 Containment as required for the response to GL 2008-01	Completion of Unit 2 RFO U2C18 - currently scheduled for Spring 2009
Perform system walkdowns in Unit 1 Containment as required for the response to GL 2008-01	Completion of Unit 1 RFO U1C23 - currently scheduled for Fall 2009
A supplemental evaluation for Unit 2 will be provided to the response to GL-2008-01	Three months following the completion of the Spring 2009 Unit 2 RFO.

A supplemental evaluation for Unit 1 will be provided to the response to GL-2008-01	Three months following the completion of the Fall 2009 Unit 1 RFO.

* In the event of a unit shutdown of extended duration, the modifications will be installed prior to startup if it is determined that there will be no impact on the unit return to service schedule.