VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

October 14, 2008

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738

Serial No.	08-0013B
NLOS/TJS	R6
Docket Nos.	50-280/281
	50-338/339
License Nos.	DPR-32/37
	NPF-4/7

VIRGINIA ELECTRIC AND POWER COMPANY (DOMINION)
SURRY POWER STATION UNITS 1 AND 2
NORTH ANNA POWER STATION UNITS 1 AND 2
NINE-MONTH RESPONSE TO NRC GENERIC LETTER 2008-01, MANAGING GAS ACCUMULATION IN EMERGENCY CORE COOLING, DECAY HEAT REMOVAL, AND CONTAINMENT SPRAY SYSTEMS

The Nuclear Regulatory Commission (NRC) issued Generic Letter (GL) 2008-01 on January 11, 2008, 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 (CS) System to ensure that gas accumulation is maintained less than the amount that could challenge operability of these systems, and that appropriate action is taken when conditions adverse to quality are identified.

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

(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 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 of the GL; and,

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

Additionally, GL 2008-01 required a three-month written response if a licensee proposed an alternative course of action, including schedule extensions. Dominion submitted a request for schedule extension on May 8, 2008, (Serial No. 08-0013A) which identified the need for additional time to complete walkdowns for the inaccessible (e.g., impractical due to subatmospheric containments, industrial safety considerations and/or dose rates) portions of the ECCS, RHR System, and CS System at Surry Power Station Unit 1 and North Anna Power Station Units 1 and 2 until the next scheduled refueling outages. The NRC approved the extension request via letter dated July 23, 2008, with submittal dates of January 15, 2009 for North Anna Unit 2 and July 15, 2009 for Surry Unit 1 and North Anna Unit 1.

In summary, Dominion has concluded that: 1) the ECCS, RHR and CS systems at Surry and North Anna Power Stations are in compliance with their TS definitions of operability, i.e., capable of performing their intended safety functions, and 2) Surry and North Anna Power Stations are in compliance with 10 CFR 50, Appendix B, Criterion III, V, XI, XVI, and XVII, with respect to the concerns outlined in GL 2008-01 regarding gas accumulation in the accessible portions of applicable systems. As committed in our May 8, 2008 letter, Dominion will complete its assessments of those inaccessible portions of applicable systems during the next refueling outage for Surry Unit 1 and North Anna Unit 1 and provide a supplemental report with those results per the NRC approved schedule. The North Anna Unit 2 walkdowns were completed in the fall 2008 refueling outage and the evaluations are in progress. A supplemental report with those results will be provided per the NRC approved schedule.

Attachments 1 and 2 contain the Dominion nine-month responses to the requested information in GL 2008-01 for Surry and North Anna Power Stations, respectively.

Please contact Mr. David A. Sommers at (804) 273-2823 if you have any questions or require additional information.

Sincerely,

J. Alan Price
Vice President – Nuclear Engineering

COMMONWEALTH OF VIRGINIA)
)
COUNTY OF HENRICO)

The foregoing document was acknowledged before me, in and for the County and Commonwealth aforesaid, today by J. Alan Price, who is Vice President – Nuclear Engineering of Virginia Electric and Power Company. He has affirmed before me that he is duly authorized to execute and file the foregoing document in behalf of that company, and that the statements in the document are true to the best of his knowledge and belief.

Acknowledged before me this 14th day of October, 2008.

My Commission Expires: My Commission Expires March 31, 2010

Angela B. Fitzgerald
Notary Public

ANGELA B FITZGERALD
NOTARY PUBLIC
MY COMMISSION NUMBER 7022016
COMMONWEALTH OF VIRGINIA

Commitments made in this letter: Section C of Attachments 1 and 2 contain the regulatory commitments for Surry and North Anna Power Stations, respectively

Attachments:
1. Surry Power Station Units 1 and 2, Response to GL 2008-01
2. North Anna Power Station Units 1 and 2, Response to GL 2008-01

cc: U. S. Nuclear Regulatory Commission
Region II
Sam Nunn Atlanta Federal Center
61 Forsyth Street, S.W., Suite 23T85
Atlanta, GA 30303-8931

NRC Senior Resident Inspector
Surry Power Station

NRC Senior Resident Inspector
North Anna Power Station

Mr. J. E. Reasor, Jr.
Old Dominion Electric Cooperative
Innsbrook Corporate Center
4201 Dominion Blvd.
Suite 300
Glen Allen, Virginia 23060

Mr. J. F. Stang, Jr.
NRC Project Manager
U. S. Nuclear Regulatory Commission
One White Flint North
Mail Stop O8 G9A
11555 Rockville Pike
Rockville, MD 20852-2738

Ms. D. N. Wright
NRC Project Manager
U. S. Nuclear Regulatory Commission
One White Flint North
Mail Stop O8 H4A
11555 Rockville Pike
Rockville, MD 20852-2738

ATTACHMENT 1

SURRY POWER STATION UNITS 1 AND 2

RESPONSE TO GL 2008-01

VIRGINIA ELECTRIC AND POWER COMPANY
(DOMINION)

NINE-MONTH RESPONSE TO GL 2008-01

SURRY POWER STATION UNITS 1 AND 2

A. EVALUATION RESULTS

Licensing Basis Evaluation

1. Summarize the results of the review of these documents:

The Surry Power Station (SPS) Units 1 and 2 licensing basis was reviewed with respect to managing gas accumulation in the Emergency Core Cooling, Residual Heat Removal, Recirculation Spray, and Containment Spray Systems. This review included the Technical Specifications (TS), TS Bases, Updated Final Safety Analysis Report (UFSAR), the Technical Requirements Manual (TRM) and TRM Bases (if applicable), responses to NRC generic communications, regulatory commitments, and License Conditions. The review of the licensing basis identified that gas accumulation is discussed in the following documents:

- TS 3.5 Basis states, "The Residual Heat Removal System is required to bring the Reactor Coolant System from conditions of approximately 350°F and pressures between 400 and 450 psig to cold shutdown conditions. Heat removal at greater temperatures is by the Steam and Power Conversion System. The Residual Heat Removal System is provided with two pumps and two heat exchangers. If one of the two pumps and/or one of the two heat exchangers is not operative, safe operation of the unit is not affected; however, the time for cooldown to cold shutdown conditions is extended."

- TS 4.5 Basis states, "The inside containment recirculation spray pumps are capable of being operated dry for approximately 60 seconds without significantly overheating and/or degrading the pump bearings."

- UFSAR 6.3.1.5.2, Recirculation Spray Subsystem, states, "The inside and outside recirculation spray pumps were designed to be operated dry for a short period of time (one minute) to verify operability."

The licensing basis documents for SPS do not reference or require a verification of piping systems for the Emergency Core Cooling, Containment Spray, Recirculation Spray or Residual Heat Removal Systems to determine if gas accumulation is present. In addition, the TRM and TRM Bases do not reference or require verification of these piping systems. Based upon Dominion's review of these documents, the SPS TS and UFSAR do not sufficiently document the bases and surveillance requirements needed for the Emergency Core Cooling System (ECCS).

2. Summarize the changes to licensing basis documents (Corrective Actions):

The UFSAR will be revised as detailed below.

3. Provide a detailed list of items that have not been completed, a schedule for their completion, and the basis for that schedule:

The following changes are planned to the SPS UFSAR:

- Following equipment maintenance or refueling outages where an ECCS subsystem is opened, some entrained non-condensable gases remain. Each ECCS subsystem is filled and vented in a manner deemed appropriate for removal of gases. Each ECCS subsystem is demonstrated operable prior to return to service by verifying that the ECCS piping is sufficiently full of water through Ultrasonic Test (UT), venting or other means.

- Accessible portions of ECCS subsystems that are susceptible to gas sources are demonstrated operable periodically by verifying that the ECCS piping outside of containment is sufficiently full of water through Ultrasonic Test (UT), venting or other means. Maintaining the piping in the ECCS sufficiently full of water as determined by engineering analysis ensures that the system will perform properly when required to inject into the RCS. Specifically, this will prevent gas-water hammer, degraded system performance, and cavitation and gas binding of the ECCS pumps due to gas accumulation in the piping. It will also reduce the potential for pumping of non-condensable gases (e.g., air, nitrogen, or hydrogen) into the reactor vessel following an SI signal or during shutdown cooling. The ECCS discharge piping within containment is inaccessible during reactor operations due to subatmospheric conditions, safety concerns, and radiological concerns. The ECCS discharge piping inside containment is filled and vented upon system return to service.

These changes will be completed as identified in the corrective action schedule provided in Section C below.

Rationale: While the bases are not documented in the UFSAR, appropriate vent surveillances are in place to assure that the systems will perform their design functions.

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. Dominion is continuing to support the industry and NEI Gas Accumulation Management Team activities regarding the resolution of generic TS changes via the TSTF Traveler process. After NRC approval of the TSTF Traveler, Dominion will evaluate its applicability to Surry and whether to adopt the TSTF Traveler to either supplement or replace the current TS requirements.

Design Evaluation

The SPS design basis was reviewed with respect to GL 2008-01 for the susceptibility of the ECCS, RHR and CS systems to gas accumulation. This review included the Design Basis Documents, Calculations, Engineering Evaluations, and Vendor Technical Manuals, as well as the design and operation of the applicable systems.

1. **Discuss the results of the review of the design basis documents. This discussion should include a description of any plant specific calculations or analyses that were performed to confirm the acceptability of gas accumulation in the piping of the affected systems, including any acceptance criteria if applicable.**

This section evaluates the design and operation of the SPS systems identified in GL 2008-01 for the susceptibility of the ECC, RHR and CS systems to gas accumulation. The high head safety injection (HHSI), low head safety injection (LHSI), containment spray (CS) (including the chemical addition subsystem), outside recirculation spray (ORS), inside recirculation spray (IRS), and residual heat removal (RHR) systems were evaluated.

The evaluation considered the effect of gas accumulation on both the suction and discharge side piping of the pumps for each evaluated system. Gas accumulation in the pump suction piping has the potential to impact pump operation, while gas accumulation in discharge piping has the potential to impact the piping due to the potential for gas-water hammer. The total amount of gas in the system can potentially impact the required flow assumption in the accident analysis, as well as the accident analysis assumptions for gas volume in the Reactor Coolant System (RCS). Each system was evaluated for applicable sources of gas accumulation or intrusion, including sources such as: 1) residual gas left in the piping after returning the system to service, 2) degassing of stagnant lines due to changing ambient conditions, 3) gas entrainment due to vortexing from tank or containment sump discharges, 4) degassing of gas saturated external leakage into system boundaries, and 5) gas stripping from pressure reduction during operation (e.g., charging (CH) pump mini-flow orifice). Safety Injection (SI) accumulator leakage is not a concern for the SPS SI piping. The SI accumulator piping connects directly to the RCS piping; consequently, it does not have a boundary interface with either the HHSI or the LHSI discharge piping.

The evaluation determined that the suction piping of the CS (including the chemical addition subsystem), ORS, IRS, LHSI systems, and the discharge piping of the HHSI system are not susceptible to gas accumulation. The CS pump suction lines are procedurally filled and vented prior to return to service, then further ensured to be full by the quarterly inservice testing (IST) of the pumps, which flow "sweeps" their suction lines at near design flow. The chemical addition subsystem piping is procedurally filled and vented prior to return to service and, since the system is a gravity flow system without a pump, was determined to not be susceptible to gas accumulation. The LHSI pump suction line from the Refueling Water Storage Tank (RWST) (for SI injection mode operation) is procedurally filled and vented, then flow "swept" prior to return to service. The LHSI pump suction line from the containment sump (for SI recirculation mode operation), the ORS pump suction line from the containment sump, and the IRS pump suction can are all full during normal operation due to the normal water level maintained in the containment sump. The suction lines from the containment sump to the pump suction cans are all self-venting and have no sources of external gas accumulation. Additionally, the design of the LHSI, ORS, and IRS pumps' suction cans prevents any significant amount of gas transported to the suction cans from entering the pumps' suction. The discharge piping of the HHSI system is procedurally filled and vented, then flow "swept" prior to return to service and is subject to boundary pressure from the operating CH system that is greater than RCS pressure, which eliminates the potential for external gas sources from RCS boundary in-leakage. Further, once the piping in these systems is procedurally filled and placed in service for normal operation, no external sources of gas accumulation or intrusion are applicable to these systems. Consequently, when the piping in these systems is placed in service after being properly filled, it will remain sufficiently full during normal operation. Additionally, since the CS, IRS, ORS, LHSI, and RHR pumps have been determined to not be susceptible to gas intrusion from their suction lines, gas accumulation does not impact their performance requirements (i.e., delivered flow or net positive suction head (NPSH)).

The discharge piping/spray rings of the CS, ORS, and IRS systems are designed to be essentially dry during normal operation and are consequently not subject to gas accumulation. During normal operation, no external sources of external gas accumulation or intrusion are applicable to the piping in these systems.

The evaluation identified potential susceptibility for gas accumulation in the suction piping of the HHSI system and the discharge piping of the LHSI system. Acceptance criteria, as well as operability criteria, for the amount of gas accumulation that could be present in the susceptible piping were determined. Maintaining gas accumulation in the HHSI pump suction lines within the acceptance criteria, and within the limiting criteria for reasonable assurance of operation, has been determined to have insignificant impact on the HHSI pumps' performance requirements (delivered flow or NPSH). Regular periodic monitoring assures that these systems, which are susceptible to gas accumulation, are sufficiently full and will therefore perform their required safety functions.

Neither the suction nor the discharge piping of the RHR system is detrimentally impacted by gas accumulation as discussed in detail below.

A. Recirculation Spray System

1. Although the containment sumps, the RS pump suction cans and the suction piping to the ORS pumps would fill and self vent during a Design Basis Accident (DBA) prior to pump starts, water is maintained above the bottom of the RS sumps, which ensures the suction piping remains filled during normal operation. The RS pump suction cans and the ORS pump suction piping are open to the containment atmosphere and, as such, are self-venting.

2. The RS pumps are not susceptible to gas entrainment due to vortexing, as flow testing has proven that the Surry strainer design inhibits the formation of vortexing in the strainer inlet ducts and suction piping (ORS) to the RS pumps.

3. Any small amounts of gas that could potentially accumulate in local high point irregularities of the containment sump strainer ducts or the horizontal ORS pump suction piping would be transported to the IRS and ORS pumps' suction cans upon flow initiation at pump start. The can design, in conjunction with the low N_{Fr} (Froude number) downward flow in the can annulus for both the IRS and the ORS pumps, prevents any significant amount of gas entering the suction can from being transported downward to the pump suction bell, even at the maximum flow rates of the pumps.

4. The CS pump bleed line piping is dry during normal operation. The evaluation showed that actuation of the CS system on a Hi-Hi Consequence Limiting Safeguards (CLS) signal occurs prior to ORS pump start, and the initial gas in the CS bleed lines will be transported out of the bleed line piping into the ORS pump suction plenum of the containment strainer. Thus, the gas initially in the bleed line piping will be discharged into the containment via communication of the ORS pump plenum with the containment sump strainers prior to the start of the ORS pumps. Additionally, no external source for gas accumulation exists in the CS pump discharge lines. Therefore, the gas initially in the bleed line lines does not contribute to gas accumulation in the ORS pump suction lines. The IRS pump bleed lines are also dry during normal operation. When the IRS pumps are started, water from the sump passes through the associated RS heat exchangers and begins to fill the bleed lines. Gas in the bleed lines will be discharged into the IRS pump suction plenum and will either migrate back to the containment or remain in the top of the IRS pump can extension.

5. Based on the evaluations summarized in 1, 2, 3, and 4 above, in conjunction with there being no additional sources for gas to be introduced into the IRS or ORS system on either the pump suction or discharge side, it is concluded that neither the IRS nor the ORS pumps' suction is susceptible to gas intrusion.

6. The discharge piping and spray headers of the IRS and ORS systems are essentially dry during normal operation. There are no external sources for gas to be introduced into either the IRS or the ORS system on either the pumps' suction or discharge side. Therefore, upon initiation of IRS and ORS flow, the gas initially

present in the discharge piping will be transported out of the system through the spray nozzles, thus ensuring that the piping is totally full during fulfillment of the IRS/ORS safety function. The discharge piping fill time delay is accounted for in the accident analyses. The discharge system piping and pipe supports are designed for the loads generated by the filling process. In conclusion, neither the IRS nor the ORS discharge piping is susceptible to gas accumulation.

B. Containment Spray System

1. The CS pumps are not susceptible to gas entrainment due to vortexing, as sufficient submergence exists in the RWST to prevent vortex gas entrainment in the CS suction piping. Also, CS suction piping is not subject to vortexing at the 0% RWST level, which corresponds to the non-usable volume.

2. During normal operation the entire CS pump suction line and the discharge line up to the normally closed isolation motor-operated valve (MOV) are maintained sufficiently full of water at RWST head. Return to service and/or quarterly IST of the pumps at design basis flow further ensures that the CS pump suction piping is maintained full immediately following return to service and/or quarterly IST flow testing. There are no external sources for gas to be introduced into the CS system on either the pump suction or discharge side during normal operation. In conclusion, the CS pump suction lines are not susceptible to gas accumulation or entrainment, and the CS pumps are not susceptible to gas intrusion.

3. The CS pump discharge piping from the pump(s) to the normally closed discharge header isolation MOV(s) is full of water at RWST head during normal unit operation. The CS pump discharge piping down stream of the discharge isolation MOV(s), which includes all CS piping inside containment, is dry during normal unit operation. Upon initiation of CS flow, the gas initially present in the discharge piping will be transported out of the system through the spray nozzles, thus ensuring that the piping is totally full during fulfillment of the CS safety function. The discharge piping fill time delay is accounted for in the accident analyses, and the discharge system piping and pipe supports are designed for the loads generated by the filling process. Since there are no external sources for gas to be introduced into the CS system on either the pump suction or discharge side, the CS discharge piping is not susceptible to gas accumulation.

4. The Chemical Addition Subsystem evaluation for gas accumulation concluded that the potential for gas accumulation in the Chemical Addition Tank (CAT) piping has insignificant impact on the CS system. A potential for gas void in the horizontal 3-inch piping at the CS pump suction exists due to limited vent valve configuration. The potential void was evaluated, and it was determined that the injection of a void (approximately 0.6 ft^3) in that section of pipe would not significantly impact CS pump performance. Additionally, the vortexing evaluation of the CAT determined that, at the on-set of vortexing in the CAT, flow from the CAT passively stops due to the depletion of the CAT inventory. At this point, the RWST is approximately 12% full and the CS pumps will continue to reduce the RWST inventory. The design of the CAT piping creates a loop seal between the CAT and the CS pump suction that prevents the ingestion of gas from the piping into the CS pump. Since there are no external sources for gas to be introduced into the Chemical Addition Subsystem, the piping is not susceptible to gas accumulation.

C. Safety Injection System

<u>LHSI System</u>

1. SI accumulator leakage is not a concern for the SPS SI piping. The SI accumulator piping connects directly to the RCS piping; consequently, it does not have a boundary interface with either the HHSI or the LHSI discharge piping.

2. At Recirculation Mode Transfer (RMT) initiation, there is sufficient water level in the RWST to prevent vortexing resulting in gas entrainment in the LHSI and HHSI pumps. Flow testing has proven that the Surry containment sump strainer design inhibits the formation of vortexing and gas injection in the strainer inlet ducts and suction piping to the LHSI pumps during SI recirculation mode.

3. The normal water level elevation in the RWST ensures that the SI injection mode LHSI pump suction piping from the RWST, the LHSI pump can, and all of the discharge piping is initially full of water and vented after system check valve testing. Additionally, the LHSI pump suction piping from the RWST to the pump suction can has no potential for degassing while it is in its standby condition during normal operation and has no potential for gas intrusion from other external sources.

4. Although the containment sump and the LHSI sump RMT suction piping would fill during a DBA, the containment sump is maintained

partially full of water during normal operation. One potential exception is a small volume between the disc of the normally closed isolation MOV(s) upstream of the check valve that is directly attached end-to-end to the MOV and the bonnets of these closed valves. Any gas that may have been trapped in this volume has been evaluated as not having an effect on LHSI system performance. Note that the suction piping downstream of the isolation MOV and the check valve is common with the suction piping from the RWST and is also maintained full during normal unit operation at RWST head. Additionally, any gas that might degas from the water in the LHSI pump suction piping from the containment sump during standby operation, due to small potential temperature increases of the sump water, would tend to have the majority of the degassed volume self-vented into the containment via the sump strainer since the piping is horizontal with a vertical upward run to the sump.

5. An insignificant amount of gas accumulation may exist in the horizontal run of the LHSI pump suction piping from the containment sump due to localized high point irregularities in the piping. Only negligible gas accumulation is plausible in the portion of the suction piping from the RWST to the pump suction can. At low LHSI flow conditions [Small Break Loss of Coolant Accident (SBLOCA)], any small amount of gas that might have accumulated in the local high point irregularities of the SI injection mode suction piping from the RWST, or the SI recirculation mode suction piping from the containment sump, may transport to the pump suction can. If this small amount of gas is transported, it will not impact the performance or operation of the LHSI pump at low flows. Any gas that could potentially accumulate either in the LHSI pump suction piping from the RWST or in the suction piping from the containment sump would be transported to the LHSI pump suction can with the flow in the respective suction line during high LHSI flow conditions [Large Break Loss of Coolant Accident (LBLOCA).] The LHSI pump suction can design, in conjunction with the low N_{Fr} downward flow in the can annulus, prevents large bubbles of gas transported into the can by the suction piping flow from entering the pump suction even at the maximum LHSI pump flow rate. Any small bubbles transported to the pump suction would have no impact on the pump performance (developed head or NPSH). Thus, gas intrusion at the pump suction will have no detrimental impact during accident operation. No external sources of gas exist for the suction piping from the RWST, and degassing in the suction piping from the containment sump is insignificant. Therefore, the LHSI pump suction is evaluated to be not susceptible to gas intrusion from gas accumulation in the suction piping. Further, since the LHSI pumps

have been evaluated to be not susceptible to gas intrusion from their suction lines, gas accumulation has no impact on their performance requirements (delivered flow or NPSH).

The LHSI pumps were originally provided with an air/vapor ejector to remove small amounts of gas coming out of solution in the pump suction can. The ejector arrangement was subsequently removed. Dominion has determined that the LHSI pumps will continue to perform their intended design function without the air/vapor ejectors installed. A hydraulic analysis concluded that, for the maximum design flow, gas will not come out of solution at the entrance to the pump, and both adequate submergence and NPSH are maintained. At this flow, the water level in the LHSI pump suction can will reach equilibrium above the suction can inlet piping. This water level provides adequate submergence and NPSH.

6. The LHSI pump discharge piping for the paths to both the RCS hot legs and the RCS cold legs is procedurally filled and vented and full flow "swept" prior to returning the system to service during each refueling outage. This ensures the LHSI pump discharge piping is sufficiently full prior to returning the LHSI system to service. As described in item 7 below, during a test procedure review, it was determined that a potential small void could be left in the LHSI piping inside the containment following venting. This is being resolved as described in item 7 below. Since the LHSI pump discharge headers to the RCS hot legs are isolated from the RCS by closed isolation MOVs outside of containment, the LHSI pump discharge piping to the RCS hot legs inside of containment is not susceptible to gas accumulation. The LHSI pump discharge piping to the RCS cold legs is isolated from the RCS by multiple check valves during normal operation, as the discharge piping isolation MOVs are normally open. Consequently, even though this piping has assurance of being initially full for start of normal operation, it must be evaluated for gas accumulation because of the potential for RCS back leakage through the RCS isolation check valves.

7. The calculated allowable gas void volume for the LHSI discharge piping, which includes the "piggyback" lines to the HHSI pump suction headers, is 0.8 ft^3 during normal operating conditions (i.e., pressure from normal RWST head) to preclude the potential for momentary lifting of thermal relief valves. However, as a result of the discharge piping configuration, available vents and the current check valve testing methodology, the LHSI piping inside containment could contain voids in excess of 0.8 ft^3, but less than the allowable gas limit for injection to the RCS (5 ft^3 at 100 psia and 68°F – see paragraph below). Specifically, the procedure used for

performing cold shutdown Inservice Inspection Leak Testing on the RCS check valves was identified as having the potential of incompletely refilling the LHSI piping. This test procedure will be further reviewed and revised as necessary to minimize the presence of gas voids following these tests. There is currently no operational indication that a gas void greater than 0.8 ft^3 exists in the LHSI discharge piping. However, there is a possibility that a LHSI thermal relief valve will momentarily lift as a result of a pump start if a void in the piping exceeds 0.8 ft^3. After LHSI system return to service testing, periodic online verification of acceptable gas accumulation volume in discharge piping shall be performed. Verification shall be performed using methods such as pump start pressure transient recording, thermal relief valve monitoring, pump discharge header temperature monitoring, and RWST level trending.

Westinghouse evaluated a maximum injected gas void size of 5 ft^3 at 100 psia and 68°F in the LHSI piping for impact on the RCS during accident conditions. The Westinghouse evaluation concluded that this amount of non-condensable gas would have no impact on the conclusions of the applicable LBLOCA, SBLOCA, long term core cooling, or LOCA force analyses. Similarly, there is no impact on the conclusions of the Main Steam Line Break (MSLB), Feedwater Line Break (FLB), and Steam Generator Tube Rupture (SGTR) analyses related to SI flow degradation and injection delay. The presence of this amount of non-condensable gas volume would have no appreciable effect on heat transfer degradation, including natural circulation situations.

Additionally, the potential for transient pressure waves, generated in the LHSI pump discharge piping due to gas voids in the discharge piping at pump start, to transfer through the pump and into the pump suction piping is not a concern. The LHSI pump's design with the open suction bell submerged in the suction can is similar to an open pit suction design, as the pump's suction source is not contained by the suction piping. The peak transient pressures in the discharge piping would be no greater than the LHSI discharge piping relief valves' setpoint for acceptable gas void volumes in the discharge piping and only on the order of twice that peak pressure for the maximum injected gas void size of 5 ft^3 discussed above. Thus, the relatively low peak pressures in conjunction with the suction can design would ensure that any transient pressure waves transmitted from the discharge piping back through the pump would be greatly dissipated in the suction can and have virtually no impact on the suction piping.

8. Comparison of transient analyses results for a single LHSI pump start versus a two LHSI pump start for the case having 0.75 ft^3 of air void in the discharge piping showed that the transient peak pressures were basically the same for either a single or a two pump start. Therefore, it can be concluded that the results from the transient analyses for a single LHSI pump start are applicable to that for a two pump start.

<u>HHSI System</u>

1. Even though only limited gas accumulation is expected in the HHSI pump suction line from the RWST to the pumps (for the SI injection mode), it is periodically monitored for gas accumulation in addition to periodically monitoring the HHSI suction lines through the "piggyback" lines for SI recirculation mode operation. Gas accumulation is possible in the "piggyback" lines due to their interface with the LHSI discharge piping. Installation of additional system highpoint vent valves in the mid-1990s has proven to be successful in removing voids during fill and vent operations and in removing accumulated gases from the system. However, since the normal suction header is the CH pump suction header, it is in service during normal operation and subject to potential external gas sources such as the VCT and CH pump mini-flow recirculation orifices. Periodic venting procedures performed on the charging and HHSI pump suction header remove potential gas accumulation and ensure the system remains sufficiently filled.

   The current system periodic venting procedures ensure that the accumulated gas volumes are well below the Westinghouse evaluated acceptable maximum injected gas void size of 5 ft^3 at 400 psia and 68°F in the HHSI piping for impact on the RCS during accident conditions.

2. The discharge piping of the HHSI system is procedurally filled and vented prior to return to service and is subject to boundary pressure from the operating CH system that is greater than RCS pressure, which eliminates the potential for external gas sources from RCS boundary inleakage. Therefore, the HHSI pumps' discharge piping is maintained full during normal operation and is not susceptible to in-leakage from the RCS, or any other sources, that could cause gas accumulation in the piping. Upon SI operation, any acceptable gas void fraction in the HHSI suction piping would be compressed by the pump to an insignificant void fraction in the discharge piping that would not impact HHSI flow delivery time or the accident analyses once the gas void from the suction was delivered to the

RCS. Thus, the HHSI pump discharge piping is not susceptible to gas accumulation issues.

D. Residual Heat Removal System

1. The RHR system, which is located entirely inside of containment, has a safety classification of NSQ (Non-safety Related with Regulatory Significance) and does not serve the dual function of a low pressure safety injection pump. The RHR system is used during plant startup, shutdown, and refueling (Condition I events) when the RCS temperature is 350°F or less. It is not in service during normal operation or during hot standby operation. As such RHR system function is not assumed in the safety analyses for any Condition II, III, or IV events.

2. The RHR system is placed in service during the plant cooldown phase that follows a period of initial heat removal by the Main Steam system following reactor shutdown. Generally, during startup conditions, residual heat from the reactor core is being removed by the RHR system. The RHR system is placed in operation when the RCS pressure and temperature are reduced to a pressure low enough to prevent lifting the RHR pump discharge relief valves and a temperature less than the design temperature of the RHR system. Initially, the flow through the heat exchangers is throttled to control the rate of cooldown of the RCS. The inlet to the RHR system is located in the hot leg of one reactor coolant loop while the return line is connected to the cold leg of the other two loops. If the RCS is drained below the top of the hot leg (e.g., mid-loop operation), the RHR system procedurally operates by at a reduced flow rate to remove decay heat. The reduced flow rate is established as a precaution to prevent vortexing in the partially drained hot leg and to prevent air ingestion into the operating RHR pump. The RHR system remains in service throughout the shutdown and startup periods, which may include a refueling operation. The RHR system is shut down and isolated when the temperature of the RCS reaches 350°F.

3. The RHR system is filled and vented by procedure whenever the system is drained for maintenance. System velocities during operation of the RHR system for normal RCS cooldown are sufficient to sweep any small gas voids that might have remained in local piping high points after fill and vent of the piping. Many years of successful operation of the RHR system during RCS cooldown have demonstrated that the fill and vent procedures and operating procedures are effective with no observed detrimental performance in operation of the RHR pumps and system. Thus, control of system operating flow rates with consideration to limiting inlet conditions

ensures that the entire RHR piping system is sufficiently full of water during system operation. Two MOVs (part of the RCS pressure boundary) in series isolate the RHR system inlet line from the RCS while the discharge lines are isolated by a check valve (part of the RCS pressure boundary in the SI accumulator discharge line) and an MOV. If the RCS pressure exceeds the normal operating pressure of the RHR system, an interlock between the RCS hot-leg pressure channels and the two inlet isolation valves prevents the valves from opening.

4. The RHR system has system boundary interfaces with two systems which could result in inleakage into the RHR system. The system boundaries with the RCS system via the SI accumulator discharge lines and the CH letdown system both are potential sources of inleakage to the RHR system through leaking system boundary isolation valves. The operating pressure in the CH letdown system is less than the RHR system relief valve set pressure and high enough to prevent degassing of the letdown water, so inleakage from the letdown system would not be a source or mechanism for gas intrusion. RCS system leakage into the RHR system could potentially result in a lift of an RHR relief valve if the system boundary with the letdown system is tight, but would not be a source of degassing since the RHR system would be pressurized by the postulated RCS leakage. However, leakage of SI accumulator water into the RHR system could be a source of gas accumulation from degassing of the accumulator water, since it is N_2 gas saturated at approximately 600 psig and would initially be at a lower pressure after leaking into the RHR system. The SI accumulator level is monitored, and thus any leakage out of the accumulators is immediately identified and corrective actions are taken. This condition would only occur with the RHR system in the standby mode of operation. This condition would result in a prompt assessment of its impacts on system operability via the corrective action system.

5. Therefore, when the RHR system is not in operation, it is isolated with both its suction and discharge piping full of water from the RCS. The temperature of the water in the RHR suction and discharge in the non-flowing shutdown condition does not increase enough to cause degassing of the water. Once isolated during unit normal or hot standby operation, the RHR system piping remains sufficiently full of water as the only mechanism for gas intrusion or accumulation in either the RHR system suction or discharge piping is potential SI accumulator water system inleakage which would be identified and mitigated prior to operating the RHR system.

E. Design Evaluation Conclusion

A technical evaluation has been completed that documents the system analyses for gas intrusion mechanisms. As described above, once the systems are properly filled and vented by procedure, including the system "sweeps", the only potential gas intrusion mechanism is leakage through the RCS check valves on the cold leg injection from the LHSI system. The applicable gas volume acceptance criterion has been identified for each affected piping segment. These acceptance criteria will be incorporated into the applicable SPS test procedures. The industry is developing a program to further analyze the effects of gas intrusion on the suction criteria of pumps in the affected systems. Dominion will monitor this program as it develops for any potential impact on SPS system performance and take appropriate actions if deemed necessary.

2. Discuss new applicable gas volume acceptance criteria for each piping segment in each system where gas can accumulate where no acceptance criteria previously existed and summarize the Corrective Actions, and schedule for completion of any Corrective Actions.

a) Pump Suction Piping

The interim allowable gas ingestion in the pump suction piping is based on limiting the gas ingestion to the pump after a pump start. A Pressurized Water Reactor Owners' Group (PWROG) program established interim pump gas ingestion limits to be employed by its member utilities. The interim criteria address pump mechanical integrity only and are as follows:

	Single-Stage	***Multi-Stage***	***Multi-Stage***
		Stiff Shaft	Flexible Shaft
Steady-State	2%	2%	2%
Transient*	5% for 20 sec.	20% for 20 sec.	10% for 5 sec.
$Q_{B.E.P.}$ Range	70%-120%	70%-140%	70%-120%
Pump Type (transient data)	WDF	CA	RLIJ, JHF
* The transient criteria are based on pump test data and vendor supplied information.			

SPS procedures provide assurance that the volume of gas in the pump suction piping for the HHSI system is limited such that pump gas ingestion is within the above PWROG program established interim criteria. Even though limited gas accumulation is expected in the HHSI suction line from the RWST to the pumps (for the SI injection mode), it is included in the gas accumulation monitoring program along with the HHSI pump suction lines through the "piggyback" lines for SI recirculation mode operation. Gas accumulation is possible in the "piggyback" lines due to their interface with the LHSI discharge piping. Installation of additional system highpoint vent valves in the mid-1990s has proven to be successful in removing voids during fill and vent operations and in removing accumulated gases from the system. However, since this header also serves as the CH pump suction header, it is in service during normal operation and subject to potential external gas sources such as the Volume Control Tank (VCT) and the CH pump mini-flow recirculation orifices. The calculated allowable gas void volume in the HHSI system suction piping is less than 1.8 ft^3 of gas for the normal HHSI suction header and less than 0.75 ft^3 of gas for either the normal or alternate RMT "piggyback" headers.

b) Pump discharge piping which is susceptible to pressure pulsation after a pump start

Only the LHSI pump discharge headers are susceptible to pressure pulsation. To preclude the potential for momentary lifting of a thermal relief valve, voids in the LHSI discharge piping must be maintained at 0.8 ft^3 or less. Maintaining the void below this value prevents momentary thermal relief valve lift. In order to avoid relief valve actuation during a pump start, the system is flushed at high flow and/or vented following maintenance.

A review of the as designed piping configuration, available vents and the current check valve testing methodology, indicates the LHSI piping inside containment could contain voids in excess of 0.8 ft^3, but less than the allowable gas limit for injection into the RCS (5 ft^3 at 100 psia and 68°F). Specifically, the procedure used for performing cold shutdown Inservice Inspection Leak Testing on the RCS check valves was identified as having the potential of incompletely refilling the LHSI piping. This test procedure will be further reviewed and revised as necessary to minimize the presence of gas voids following these tests. There is currently no operational indication that a gas void greater than 0.8 ft^3 exists in the LHSI discharge piping. However, there is a possibility that a LHSI thermal relief valve could momentarily lift as a result of a pump start if voids in the piping exceed 0.8 ft^3. After LHSI system return to service testing, periodic online verification of acceptable gas accumulation volume in discharge piping shall be performed. Verification shall be performed using methods such as pump start pressure transient recording, thermal relief valve monitoring, pump discharge header temperature monitoring, and RWST level trending.

c) Pump discharge piping not susceptible to water hammer or pressure pulsation following a pump start

The SPS CS system discharge header piping was evaluated using the PWROG methodology described above. Using this methodology, it was determined that the force imbalances on the CS system discharge header piping are well within the margin of the pipe hangers.

d) RCS allowable gas ingestion

The PWROG qualitatively evaluated the impact of non-condensable gases entering the RCS on the ability of the post-accident core cooling functions of the RCS. This evaluation assumed that 5 ft^3 of non-condensable gas at 400 psia was present in the HHSI discharge piping concurrent with 5 ft^3 of non-condensable gas at 100 psia in the LHSI discharge piping. A qualitative evaluation concluded that these quantities of gas will not prevent the ECCS from performing its core cooling function.

SPS procedures provide assurance that the gas accumulation in any section of the LHSI injection system cold leg and hot leg piping is less than 5 ft^3 of non-condensable gas at 100 psia at any location. Procedures also provide assurance that the gas accumulation in any section of the HHSI cold leg injection is less than 5 ft^3 of non-condensable gas at 400 psia at any location.

3. Summarize the changes, if any, to the design basis documents (Corrective Actions) and the schedule for completion of the Corrective Actions.

No changes to design basis documents were identified.

4. Discuss the results of the system P&ID and isometric drawing reviews to identify all system vents and high points.

The system P&IDs and isometric drawings were reviewed to identify system vents and high points. Numerous vent valves are installed in key locations of the evaluated systems. The drawing review evaluated system high points including branch lines, valve bodies, pump casings, and as-installed sloped piping. In addition, pipe diameter transitions in horizontal lines that could trap gas, such as pipe reducers and orifices, were reviewed. Screening criteria were applied to the system high points to eliminate locations that could accumulate only an insignificant amount of gas. Each high point that did not screen out was reviewed to determine if it could be effectively vented with an existing system vent.

Analytical assessments were performed on the unventable high points to determine if the quantity of unventable gas could adversely impact system function. Physical walkdowns and/or analytical assessments were performed for those high points warranting additional consideration.

Gas accumulation within valve bonnets has been evaluated for valves within the subject systems. Dominion concluded that unventable gas accumulations within valve bonnets do not challenge operability. Only a small fraction of the accumulated gas in valve bonnets can be drawn down into the active flow stream at any given time as small bubbles. The basis for this conclusion is as follows:

- Unventable gas accumulations within valve bonnets are located above the active flow stream.
- Flow through valve bonnets are limited by the relatively small exposed flow area. The valve disc blocks a significant portion of the exposed flow area in check valves. The bonnet entrance area is smaller than the bonnet diameter in gate valves.
- Globe, ball, and diaphragm valves within the subject systems have negligible internal volumes (if any) susceptible to gas accumulation.
- Retracted discs in gate valves reduce the bonnet volume available for gas accumulation and hinder flow within the bonnet.
- Only a portion of the accumulated gas within tall bonnets such as those common on gate valves can be drawn out due to the nonexistent direct flow path through the dead space in the upper bonnet region.
- Relatively slow stroke times for large motor operated valves.

Instrument lines were reviewed and found not to represent a source of gas intrusion. Any gas in the lines would be small in volume and would not be swept into the main flow path. Additionally, these lines are kept full through procedures related to calibration of the individual instrumentation.

Applicable system P&IDs were reviewed for the purpose of identification of unvented high points. Results confirm that vents exist at the high points of each of the three LHSI cold leg injection lines in the Unit 2 containment building. These same vents were confirmed not to be installed on the equivalent Unit 1 containment piping. Walkdowns will be conducted during the 2009 Unit 1 refueling outage to facilitate future vent valve installation on all three Cold Leg LHSI loops. The location of the Unit 2 vents does not allow for safe access at power, and SPS will evaluate the need to improve the configuration (i.e., routing the vent discharge and valve operator away from the RCP motor cube). See section C.7 above for an assessment of not venting at these locations.

5. **Identify new vent valve locations, modifications to existing vent valves, or utilization of existing vent valves based on the drawing review, and summarize the Corrective Actions, and schedule for completion of the Corrective Actions.**

New vent valves are not required for Unit 2 LHSI system piping. As discussed above, the need for vent valve additions in the LHSI piping inside the SPS Unit 1 containment will be determined following confirmatory walkdowns. This activity will be addressed in a supplemental response for SPS Unit 1.

6. **Discuss the results (including the scope and acceptance criteria used) of the system confirmation walkdowns that have been completed for the**

portions of the systems that require venting to ensure that they are sufficiently full of water.

Walkdowns of piping systems evaluated for GL 2008-01 were performed to provide assurance that the corresponding systems have appropriate vent valves at necessary locations with the exception of confirmation of system piping inside the containments. The detailed walkdowns to date were performed using a computerized water level instrument and have been focused on the critical areas identified in the HHSI suction and LHSI discharge lines located outside of containment. High points in the system have been identified and required vent valves are installed. Any discrepancy of greater than one degree in the piping slope has been identified and evaluated. The volume of the cylinder segment was used to establish the maximum gas void that could occur. No additional vent valves are required in the accessible piping outside of containment.

Confirmatory walkdowns and laser scanning were performed for Unit 2 LHSI piping inside containment. The slope reports were assessed for high points of greater than one degree. Due to the availability of currently installed vent valves and the fill (sweep) procedures used on the system, no additional vents are required on Surry Unit 2.

Detailed walkdowns of the RS, CS and RHR systems were not conducted since it was determined that there is no active source of gas intrusion. The suction piping configuration for the LHSI pumps was evaluated as having high points that would vent to the RWST or the containment sump, and, since no additional sources of gas intrusion have been identified, detailed walkdowns were not performed.

Confirmatory walkdowns inside Surry Unit 1 containment will be performed and documented in a subsequent submittal to the NRC in July 2009.

7. **Identify new vent valve locations, modifications to existing vent valves, or utilization of existing vent valves that resulted from the confirmatory walkdowns, and summarize the Corrective Actions, and the schedule for completion of the Corrective Actions, i.e., the walkdowns that have been completed, and the walkdowns not yet complete (refer to Reference [5] Three-Month Response to NRC Generic Letter 2008-01).**

New vent valve locations have not been identified at this time. Confirmatory walkdowns inside Surry Unit 1 containment are scheduled for the 2009 refueling outage and will identify the locations for new vent valve installation, if required.

8. **Discuss the results of the fill and vent activities and procedure reviews for each system. (Note that routine periodic surveillance testing is addressed in the "Testing Evaluation" section of this template).**

The following system fill and vent procedures and full flow “sweep” procedures were reviewed during this evaluation to provide assurance that corresponding systems sufficiently full were reviewed.

- 1/2-OSP-SI-001, Venting SI Piping
- 1/2-OPT-SI-002, Refueling Test Operation of LHSI Check Valves to the Cold Legs
- 1/2-OPT-SI-003, Quarterly Test of SI MOVs and RWST Cross-tie Valves
- 1/2-OPT-SI-005, LHSI Pump Test
- 1/2-OPT-SI-006, SI Accumulator Check Valve Full Open Test
- 1/2-OPT-SI-007, Refueling Test Operation of HHSI Check Valves to the Cold Legs
- 1/2-OPT-SI-008, Refueling Test Operation of HHSI Check Valves to the Hot Legs
- 1/2-OPT-SI-009, Refueling Test of LHSI Check Valves to Hot Legs
- 1/2-OPT-SI-014, Cold Shutdown Test of SI Check Valves to RCS Cold Legs
- 1/2-OPT-SI-012, Refueling Test of LHSI Lines to Charging Pumps
- 1/2-OPT-SI-022, SI Accumulator Discharge Check Valve Test with Reactor Head Removed
- 1/2-OPT-SI-024, Charging Pump Head Curve Verification
- 1/2-MOP-SI-001, LHSI Pump Removal from and/or Return to Service
- 1/2-MOP-SI-002, HHSI Removal from and/or Return to Service
- 1/2-MOP-CH-002, RWST Suction Header Maintenance
- 1/2-MOP-CS-001, CS Pump Removal and Return to Service
- 1/2-MOP-CS-002, CAT Removal and Return to Service
- 1/2-MOP-CS-003, Removal and Return to Service of the RWST

As previously discussed, the IRS, ORS, and RHR systems were evaluated as not being susceptible to gas accumulation. Therefore, review of the fill and vent procedures for these systems was not required.

The fill and vent procedures reviewed currently incorporate dynamic venting and vacuum fill considerations. An evaluation verifying adequate flow for gas "sweeping" was completed. Fill procedures were found to provide adequate assurance that systems are sufficiently full upon return to service. Station procedure 2-OPT-SI-014 will be revised to use the installed high point vents on the three LHSI system injection lines to the RCS cold legs upon refill. A similar change to station procedure 1-OPT-SI-014 will be addressed in the supplemental response. No procedure changes for outside containment procedures were required.

9. Identify procedure revisions, or new procedures resulting from the fill and vent activities and procedure reviews that need to be developed, and summarize the Corrective Actions, and schedule for completion of the Corrective Actions. (Note that routine periodic surveillance testing is addressed in the "Testing Evaluation" section of this template).

Dominion will revise current fill and vent procedures to assure "sufficiently full" acceptance criteria, based upon the technical criteria developed for this response, by adding Ultrasonic Testing (UT), venting or other confirmation means at select locations. These changes will be completed by the end of spring 2009 Unit 1 refueling outage.

Rationale: UT, venting or other means are simply a confirmation of the successful completion of the venting and dynamic "sweeps" being performed. The earliest that this effort can be planned and successfully conducted in a controlled manner will be during the Unit 1 refueling outage in 2009.

10. Discuss potential gas intrusion mechanisms into each system for each piping segment that is vulnerable to gas intrusion.

Potential gas intrusion mechanisms are limited to back leakage through the RCS check valves to the LHSI system and from post-maintenance fill and vent activities. Maintenance activities that require lines to be drained are followed by procedurally controlled fill and vent activities that include post-maintenance flushing to eliminate gas pockets.

11. Ongoing Industry Programs

Ongoing industry programs are planned in the following areas, which may affect the conclusions reached during the Design Evaluation of SPS relative to gas accumulation. The activities will be monitored to determine if additional changes to the SPS 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 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.

12. Provide a detailed list of items that have not been completed, a schedule for their completion, and the basis for that schedule.

Confirmatory walkdowns and associated evaluations will be completed in Unit 1 containment during the spring 2009 refueling outage.

Testing Evaluation

1. Discuss the results of the periodic venting or gas accumulation surveillance procedure review.

Surveillance procedures are used to conduct periodic venting of the HHSI and LHSI system piping outside of containment, although no trending of the volume of gas accumulation is performed. If gas is detected, the gas volume is quantified and evaluated, and the venting frequency is increased to ensure piping is maintained gas free. However, based upon operational history, insignificant gas accumulation has been detected since the mid-1990s when additional vent valves were installed and the periodic system venting procedures were upgraded. Based on this information, Dominion concludes that the installed vent locations are highly effective and that the system remains sufficiently full during unit operations. No periodic UT of either the HHSI or the LHSI system piping is currently being performed.

Since a significant portion of the LHSI pump discharge piping is inside a subatmospheric containment and is extremely difficult to monitor for gas using the traditional means of UT inspection or high point venting, an alternate monitoring methodology is being developed. The alternate monitoring will be performed using methods such as pump start pressure transient recording, thermal relief valve monitoring, pump discharge header temperature monitoring, and RWST level trending. These monitoring methods are a potential indicator of RCS leakage into the LHSI system, which is the only external source of gas accumulation in the LHSI discharge piping.

The CS and RS systems are not periodically vented since the design of the system precludes gas accumulation that can affect pump operation or result in water hammer.

2. Identify procedure revisions or new procedures resulting from the periodic venting or gas accumulation surveillance procedure review that need to be developed.

Dominion will develop a quarterly monitoring and trending program for susceptible high points located in accessible areas of the ECCS lines outside of containment including acceptance criteria based upon the technical criteria developed for this response and corrective action requirements. This program will be used to enhance the current venting program. This change will be completed prior to the end of the Unit 1 spring 2009 refueling outage.

Rationale: The development of the quarterly monitoring and trending program will require the generation of new procedures, the formalization of data trending and documentation requirements, and training of engineers and operators in the performance of the program.

3. **Discuss how procedures adequately address the manual operation of the RHR system in its decay heat removal mode of operation. Include how the procedures assure that the RHR system is sufficiently full of water to perform its decay heat removal safety function (high point venting or UT) and how pump operation is monitored by plant personnel (including a description of the available instrumentation and alarms).**

For SPS, the RHR system does not support any safety related function. RHR is used for normal cooldown of the RCS for unit shutdown. The accident mitigation function is performed by the CS and RS systems and the ECCS. A RHR train is filled and vented following maintenance and then placed into service. Upon leaving a cold shutdown condition, the system is isolated and remains sufficiently full. The system is physically located inside of containment and is not accessible during plant operation. Design features and water level setpoints are controlled by design and operating procedures to prevent vortex effects that can potentially ingest gas into the system during operation. Restrictions in maximum flow rates also help prevent vortex effects during shutdown cooling operations at reduced RCS inventory.

4. **Summarize the results of the procedure reviews performed to determine that gas intrusion does not occur as a result of inadvertent draining due to valve manipulations specified in the procedures, system realignments, or incorrect maintenance procedures.**

The fill and vent procedures reviewed currently incorporate dynamic venting and vacuum fill considerations. An evaluation verifying adequate flow for gas "sweeping" was completed. Fill procedures were found to provide adequate assurance that systems are sufficiently full upon return to service. Station procedure 2-OPT-SI-014 will be revised to use the installed high point vents on the three LHSI system injection lines to the RCS cold legs upon refill. A similar change to station procedure 1-OPT-SI-014 will be addressed in the supplemental response. No procedure changes for outside containment procedures were required. The procedure revisions, if necessary, will be completed prior to the end of the Unit 1 spring 2009 refueling outage.

Rationale: The applicable maintenance and operating procedures have been reviewed. No gas intrusion mechanism resulting from inadvertent draining, valve misalignments or incorrect maintenance practices have been identified. Furthermore, there is no operational indication that a gas void currently exists in the area of these check valves.

5. **Describe how gas voids are documented (including the detection method such as venting and measuring or UT and void sizing and post venting checks), dispositioned (including method(s) used such as static or dynamic venting), and trended, if found in any of the subject systems.**
   Explain here or in the "Corrective Actions Evaluation" section the threshold (acceptance criteria) for entry into the Corrective Action Program (CAP) and how the CAP addresses disposition and trending. For gas voids less than the CAP threshold, if applicable, describe how these gas voids

are documented and trended as a means to detect system changes that may be indicative of degradation leading to future gas voiding.

HHSI and LHSI system venting surveillance procedures require that any gas discovery be quantified and entered into the Corrective Action Program including an evaluation of operability and reportability.

6. **Provide a detailed list of items that have not been completed, a schedule for their completion, and the basis for that schedule.**

As noted above, the procedure used for performing Inservice Inspection Leak Testing on the RCS check valves was identified as having the potential of incompletely refilling the LHSI piping. This test procedure will be further reviewed and revised if necessary to minimize the presence of gas voids following these tests. This procedure revision, if necessary, will be completed prior to the end of the Unit 1 spring 2009 refueling outage.

Corrective Actions Evaluation

1. **Summarize the results of the reviews regarding how gas accumulation has been addressed at your site.**

Dominion's Corrective Action Program is used to document gas intrusion/accumulation issues as potential degrading conditions. Existing procedures for the affected systems require a Condition Report to be initiated, and the Shift Manager notified, if any accumulated gas volume is detected. As part of Dominion's Corrective Action Program, Condition Reports related to plant equipment are evaluated for potential impact on operability and reportability. Therefore, Dominion's review concluded that issues involving gas intrusion/accumulation are properly prioritized and evaluated under the Corrective Action Program.

2. **Provide a detailed list of items that have not been completed, a schedule for their completion, and the basis for that schedule.**

No changes to the Corrective Action Program have been identified.

Conclusion

Based upon the above, Dominion has concluded that SPS is in conformance with its commitments to 10 CFR 50, Appendix B, Criterion III, V, XI, XVI, and XVII, as described in the Dominion Quality Assurance Program. Any remaining corrective actions have been entered into the SPS Corrective Action Program for tracking and final resolution, as described in Sections B and C of this attachment.

B. DESCRIPTION OF NECESSARY CORRECTIVE ACTIONS

The following corrective actions were identified:

1. Revise the SPS UFSAR to add:
    a. "Following equipment maintenance or refueling outages where an ECCS subsystem is opened, some entrained non-condensable gases remain. Each ECCS subsystem is filled and vented in a manner deemed appropriate for removal of gases. Each ECCS subsystem is demonstrated operable prior to return to service by verifying that the ECCS piping is sufficiently full of water through Ultrasonic Test (UT), venting or other means.
    b. Accessible portions of ECCS subsystems that are susceptible to documented gas sources are demonstrated operable periodically by verifying that the ECCS piping outside of containment is sufficiently full of water through Ultrasonic Test (UT), venting or other means. Maintaining the piping in the ECCS sufficiently full of water as determined by engineering analysis ensures that the system will perform properly when required to inject into the RCS. Specifically, this will prevent gas-water hammer, degraded system performance, and cavitation and gas binding of the ECCS pumps due to gas accumulation in the piping. It will also reduce the potential for pumping of non-condensable gases (e.g., air, nitrogen, or hydrogen) into the reactor vessel following an SI signal or during shutdown cooling. The ECCS discharge piping within containment is inaccessible during reactor operations due to subatmospheric conditions, safety concerns, and radiological concerns. The ECCS discharge piping inside containment is filled and vented upon system return to service."

2. Dominion will monitor the status of the industry/NRC Technical Specifications Task Force (TSTF) Traveler that will be developed as a follow-up to GL 2008-01. Following NRC approval of this TSTF, Dominion will evaluate its applicability to Surry and whether to adopt the TSTF to either supplement or replace current TS and TRM requirements.

3. Dominion will monitor the results of industry testing and analytical programs related to gas accumulation and pump suction acceptance criteria. Dominion will evaluate the results of the industry testing and analytical efforts to determine if any additional changes to any licensing basis documents are required.

4. Dominion will revise current fill and vent and test procedures as appropriate to assure full acceptance criteria, based upon the technical criteria developed for this response, by adding Ultrasonic Testing (UT), venting or other confirmation means at select locations.

C. CORRECTIVE ACTION SCHEDULE

1. Summarize the corrective actions that have been completed as a result of the evaluations discussed above.

None required.

2. Summarize the corrective actions to be completed including the scope, schedule, and a basis for that schedule.

Corrective actions that have not been completed are as follows:

- The SPS UFSAR revisions noted in Section B above will be completed by the end of the spring 2009 Unit 1 refueling outage.

  Rationale: While the bases are not sufficiently documented in the UFSAR, appropriate vent surveillances are in place to assure that the systems will perform their intended design function.

- Regarding evaluation of the industry/NRC Technical Specifications Task Force (TSTF) Traveler that will be developed as a follow-up to GL 2008-01, the completion date for this corrective action is dependent on the approval of the TSTF. Dominion is continuing to support the industry and NEI Gas Accumulation Management Team activities regarding the resolution of generic TS changes via the TSTF Traveler process. After NRC approval of the Traveler, Dominion will evaluate its applicability to SPS and evaluate adopting the Traveler to either supplement or replace the current TS requirements.

  Rationale: This corrective action will likely require a protracted interface between the industry and NRC. Until such time as the results can be reviewed, no definite corrective action date can be established.

- Dominion will monitor the results of industry testing and analytical programs related to gas accumulation and pump suction acceptance criteria and determine if any additional changes to any licensing basis documents are required. The completion date for this corrective action is dependent on the completion of industry testing and analytical programs.

  Rationale: This corrective action will require an extended period and significant industry funding to complete. While it may provide additional information, the existing acceptance criteria in place for Surry is conservative and based upon historical results and empirical testing that has been documented as meeting design requirements.

- Dominion will revise current fill and vent and test procedures as appropriate to assure sufficiently full acceptance criteria, based upon the technical criteria developed for this response, by adding Ultrasonic Testing

(UT), venting or other confirmation means at select locations. These changes will be completed prior to the completion of the Unit 1 spring 2009 refueling outage.

Rationale: The addition of UT testing is simply a confirmation of the successful completion of the venting and dynamic "sweeps" being performed. The earliest that this effort can be planned and successfully conducted in a controlled manner will be just prior to the completion of the spring 2009 Unit 1 refueling outage.

CONCLUSION

Dominion has evaluated the accessible portions of the SPS systems that perform the functions described in this GL and has concluded that these systems are operable, as defined in the SPS TS, and are in conformance to our commitments to the applicable General Design Criteria (GDC), as stated in the SPS UFSAR.

The open actions cited above are considered to be enhancements to the existing programs/processes/procedures for assuring continued operability of these subject systems.

Dominion will complete its evaluation of the inaccessible portions of these systems by startup from the Surry Unit 1 spring 2009 refueling and will provide a supplement to this response as committed in the extension letter (08-0013A).

ATTACHMENT 2

NORTH ANNA POWER STATION UNITS 1 AND 2

RESPONSE TO GL 2008-01

Virginia Electric and Power Company
(Dominion)

NINE-MONTH RESPONSE TO GL 2008-01

NORTH ANNA POWER STATION UNITS 1 AND 2

A. EVALUATION RESULTS

Licensing Basis Evaluation

1. Summarize the results of the review of these documents:

The North Anna Power Station (NAPS) Units 1 and 2 licensing basis was reviewed with respect to gas accumulation in the Emergency Core Cooling System (ECCS), Residual Heat Removal (RHR) System, Quench Spray (QS) System, and Recirculation Spray (RS) System. This review included the Technical Specifications (TS), TS Bases, Updated Final Safety Analysis Report (UFSAR), the Technical Requirements Manual (TRM) and TRM Bases (if applicable), responses to NRC generic communications, Regulatory Commitments, and License Conditions. The results of which are described below:

- TS Surveillance Requirement (SR) 3.5.2.3 requires verification that the ECCS piping is sufficiently full of water every 92 days.

- The Bases for SR 3.5.2.3 is as follows:

  With the exception of the operating charging pump, the ECCS pumps are normally in a standby non-operating mode. As such, some flow path piping has the potential to develop pockets of entrained gases. Plant operating experience and analysis has shown that after proper system filling (following maintenance or refueling outages), some entrained non-condensable gases remain. These gases will form small voids, which remain stable in the system in both normal and transient operation. Mechanisms postulated to increase the void size are gradual in nature, and the system is operated in accordance with procedures to preclude growth in these voids. To provide additional assurances that the system will function, verification is performed every 92 days that the system is sufficiently full of water. The system is sufficiently full of water when the voids and pockets of entrained gases in the ECCS piping are small enough in size and number so as to not interfere with the proper operation of the ECCS. Verification that the ECCS piping is sufficiently full of water can be performed by venting the necessary high point ECCS vents outside containment, using NDE, or using other Engineering-justified means. Maintaining the piping from the ECCS pumps to the RCS sufficiently full of water ensures that the system will perform properly, injecting its full capacity into the RCS upon demand. This will also prevent water hammer, pump cavitation, and pumping of excess non-condensable gas (e.g., air, nitrogen, or hydrogen) into the reactor vessel following an SI signal or during shutdown cooling. The 92 day frequency takes into consideration the gradual nature of the postulated void generation mechanism.

- UFSAR Section 6.2.2.4.1 states that "Each QS subsystem is maintained full of water from the RWST to the containment isolation valves to ensure that water is immediately available for the QS pumps in the event that a [Containment Depressurization Actuation] (CDA) signal activates the QS subsystems."

- UFSAR Section 6.3.2.1.4.3 "*Vent Valves*" states that "High point vents have been installed at critical points in the suction lines of the charging (HHSI) pumps, and the discharge lines of the LHSI pumps where gases could collect during plant operation. These vents have been installed to allow venting during plant operations to minimize the possibility of gas binding of the HHSI pumps. These vents are also used to reduce the potential for pressure surges, which may challenge the thermal relief valves upon LHSI pump starts. Following maintenance, the vents can be used to ensure the piping is adequately filled. (Reference 7)."

The Licensing Basis documents for NAPS do not reference or require a verification of piping systems for the RS, QS or RHR Systems. The TRM and TRM Bases do not reference or require verification of any of the piping systems addressed in GL 2008-01. Based upon Dominion's review of these documents, the NAPS TS and UFSAR adequately describe the bases and surveillance requirements needed for the ECCS system and are consistent with industry practices.

2. Summarize the changes to licensing basis documents (Corrective Actions):

No changes have been made or are currently planned to the NAPS Licensing Basis documents.

3. Provide a detailed list of items that have not been completed, a schedule for their completion, and the basis for that schedule.

TS improvements are being addressed by the TS 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. Dominion is continuing to support the industry and NEI Gas Accumulation Management Team activities regarding the resolution of generic TS changes via the TSTF Traveler process. After NRC approval of the Traveler, Dominion will evaluate its applicability to NAPS, and evaluate adopting the Traveler to either supplement or replace the current TS requirements.

Design Evaluation

The NAPS design basis was reviewed with respect to gas accumulation in the Emergency Core Cooling, RHR, QS, and RS Systems identified in GL 2008-01 for their susceptibility to gas accumulation. This review included the Design Basis Documents, Calculations, Engineering Evaluations, and Vendor Technical Manuals and evaluates the design and operation of the NAPS systems. The High Head Safety Injection (HHSI), Low Head Safety Injection (LHSI), Quench Spray (QS) (including the chemical addition subsystem), Outside Recirculation Spray (ORS) (including the casing cooling subsystem), Inside Recirculation Spray (IRS), and Residual Heat Removal (RHR) systems were evaluated.

1. **Discuss the results of the review of the design basis documents. This discussion should include a description of any plant specific calculations or analyses that were performed to confirm the acceptability of gas accumulation in the piping of the affected systems, including any acceptance criteria if applicable.**

The evaluation considered the effect of gas accumulation on both the suction and discharge side piping of the pumps for each respective evaluated system. Gas accumulation in the pump suction piping has the potential to impact pump operation primarily; while gas accumulation in discharge piping has the potential to impact the piping due to the potential for gas-water hammer. The total amount of gas in the system can potentially impact the flow delivery time assumption in the accident analysis, as well as the accident analysis assumptions for gas volume in the RCS. Each system was evaluated for applicable sources of gas accumulation or intrusion, including sources such as: residual gas left in the piping after returning the system to service; degassing of stagnant lines due to changing ambient conditions; air entrainment due to vortexing from tank or containment sump discharges; degassing of gas saturated external leakage into system boundaries; and gas stripping from pressure reduction during operation (e.g. CH pump mini-flow orifice). Safety Injection (SI) accumulator leakage is not a concern for the NAPS SI piping. The SI accumulator piping connects directly to the RCS piping; consequently, it does not have a boundary interface with either the HHSI or the LHSI discharge piping.

The evaluation determined that the QS system suction piping (including the chemical addition subsystem), the ORS system suction piping (including the casing cooling subsystem), the IRS system suction piping, the LHSI system suction piping, the LHSI system discharge piping to the RCS hot legs, the HHSI system discharge piping, and the RHR system suction and discharge piping are not susceptible to gas accumulation. The QS and casing cooling pump suction lines are procedurally filled and vented prior to return to service, then further ensured to be full by the quarterly IST of the pumps, which flow "sweeps" their suction lines at near design flow. The chemical addition subsystem piping is procedurally filled and vented prior to return to service, and it was determined to be not susceptible to gas accumulation. The LHSI pump suction line from the RWST (for safety injection (SI) injection mode operation) is procedurally filled and vented, and/or flow "swept" prior to return to service. The suction lines from the containment sump to the pump suction cans are self-venting and have no sources of external gas accumulation. Additionally, the design of the LHSI, ORS, and IRS pumps' suction prevents any significant amount of gas transported to the suction cans from entering the pumps' suction. The LHSI system discharge piping to the RCS hot legs is procedurally filled and vented, and/or flow "swept" prior to return to service and is isolated from the RCS by closed MOVs in addition to the RCS isolation check valves. The HHSI system discharge piping is procedurally filled and vented, then flow "swept" prior to return to service and is isolated from the RCS by closed MOVs, which except for the BIT outlet isolation MOVs, are subject to boundary pressure from the operating CH system that is greater than RCS pressure. Consequently, the potential for external gas sources from RCS boundary inleakage is eliminated from the HHSI discharge piping and the LHSI discharge piping to the RCS hot legs. Further, once the piping in these systems is procedurally filled and then placed in service for normal operation, no external sources of external gas accumulation or intrusion are applicable to these systems. Therefore, when the piping in these systems is placed in service after being properly filled, it will remain sufficiently full during normal operation. Additionally, since the QS, IRS, ORS, casing cooling, LHSI, and RHR pumps have been evaluated to be not susceptible to gas intrusion from their suction lines, gas accumulation does not impact their performance requirements (delivered flow or NPSH).

The discharge piping and spray rings of the QS, ORS, and IRS systems are designed to be essentially dry during normal operation and are consequently not subject to gas accumulation. The casing cooling pump discharge piping is designed to be partially dry during normal operation, but was evaluated to be unaffected by gas accumulation and to have no potential for producing gas accumulation in the ORS pump suction piping. The QS bleed line is partially full of air during normal operation, but the analysis shows that upon QS pump start the flow in the bleed line will transport all of the air initially in the bleed line into the IRS pump suction can, where it will be vented to the containment atmosphere prior to start of the IRS pumps. During normal operation no external sources of external gas accumulation or intrusion are applicable to the piping in these systems. Consequently, the piping in these systems is not subject to gas accumulation during normal operation.

The evaluation identified potential susceptibility for gas accumulation in the HHSI system suction piping and the LHSI system discharge piping to the RCS cold legs. Acceptance criteria, as well as operability criteria, for the amount of gas accumulation that could be present in the susceptible piping were determined by this evaluation. Gas accumulation in the HHSI pump suction lines within this acceptance criteria and limiting criteria for reasonable assurance of operation has been evaluated to have insignificant impact on the HHSI pumps' performance requirements (delivered flow or NPSH).

Historically, NAPS has been active in addressing gas accumulation in these areas. In the 1990's, a number of vent valves were installed to reduce gas in the system. The potential effects of gas on thermal relief valves in the discharge of the LHSI pumps and on the HHSI pumps were thoroughly analyzed and documented. It was found that due to pressure impulse of gas in the system, the LHSI thermal relief valve setpoint could be reached at a gas accumulation volume of approximately 1 ft^3. This could lead to the momentary lifting of the relief valves. The Pressurized Water Reactor Owners Group (PWROG) has recently issued conservative guidance on gas injection acceptance criteria into the RCS of not greater then 5 ft^3. The acceptance criteria, for the amount of gas accumulation that could be present in the susceptible piping segments, have been determined below and are well within the PWROG guidance.

A. Recirculation Spray System

1. During a Design Basis Accident (DBA), the containment sumps would fill and RS spray pump suction cans and suction piping would fill and self vent prior to pump starts. The ORS cans and the pump suction piping are open to the containment atmosphere, and as such the suction piping is self venting. The QS bleed line provides approximately 150 gpm to the IRS suction via its strainer connection. The QS bleed line is partially full of air during normal operation, but the analysis shows that upon QS pump start the flow in the bleed line will transport all of the air initially in the bleed line into the IRS pump suction can, where it will be vented to the containment atmosphere prior to start of the IRS pumps.

2. Gas entrainment due to vortexing in the suction flow – The RS pumps are not susceptible to gas entrainment due to vortexing, as flow testing has proven that the NAPS strainer design inhibits the formation of vortexing in the strainer inlet headers and suction piping to the RS pumps.

3. Any small amounts of gas that could potentially accumulate in the local high point irregularities of the containment sump strainer headers or the horizontal ORS pump suction piping would be transported to the IRS and ORS pumps' suction cans upon flow initiation at pump start. The can design in conjunction with the low N_{FR} (Froude number) downward flow in the can annulus for both the IRS and the ORS pumps prevents any significant amount of gas entering the suction can from being transported downward to the pump suction bell, even at the maximum flow rates of the pumps.

4. The geometry of the casing cooling pump suction piping configuration, in conjunction with IST quarterly testing of the pumps at flow rates that are sufficient to transport any potential air left in the piping upon completion of vent and fill after system maintenance out of the suction lines, ensures that the suction piping will be sufficiently full following return to service and/or quarterly IST flow testing. In addition, the fact that the water in the casing cooling pump suction piping has no potential for degassing during its standby condition during normal unit operation, and that there are no external sources (including vortexing in the suction piping) for gas to be introduced into the Casing Cooling System on either the pump suction or discharge side, ensures that the casing cooling pump suction has no source mechanism for gas accumulation or entrainment in the suction piping. Therefore, the

casing cooling pump suction piping is not susceptible to gas accumulation and the casing cooling pump is not susceptible to gas intrusion.

5. The casing cooling pump discharge piping upstream of the isolation MOV is essentially full during normal unit operation, while the piping downstream of the MOV is dry. The evaluation showed that, actuation of the casing cooling system on a CDA signal occurs prior to ORS pump start, and the initial air in the casing cooling pump discharge lines will be transported out of the discharge piping into the ORS pump suction lines by the casing cooling pump flow. Thus, the air initially in the discharge piping will be discharged into the containment via communication of the ORS suction piping with the containment sump strainers prior to the start of the ORS pumps. Additionally, no external source for gas accumulation exists in the casing cooling pump discharge lines. Therefore, the casing cooling pump discharge lines are not susceptible to gas accumulation and the air initially in the discharge lines does not contribute to gas accumulation in the ORS pump suction lines.

6. Based on the evaluations summarized in 1, 2, 3, 4 and 5 above, in conjunction with there being no additional sources for gas to be introduced into the IRS or ORS system on either the pump suction or discharge side, it is concluded that neither the IRS nor the ORS pumps' suction is susceptible to gas intrusion during accident operation.

7. The discharge piping and spray headers of the IRS and ORS systems are essentially dry during normal operation. There are no external sources for gas to be introduced into either the IRS or the ORS system on either the pump suction or discharge side. Therefore, upon initiation of IRS and ORS flow, the air initially present in the discharge piping will be transported out of the system through the spray nozzles, thus ensuring that the piping is sufficiently full during fulfillment of the IRS/ORS safety function. The discharge piping fill time delay is accounted for in the accident analyses. The discharge system piping and pipe supports are designed for the loads generated by the filling process. In conclusion, neither the IRS nor the ORS discharge piping is susceptible to gas accumulation.

B. Quench Spray System

1. The QS pumps are not susceptible to gas entrainment due to vortexing, as sufficient submergence exists in the RWST to prevent vortex air entrainment in the QS suction piping. The vortex breaking baffle "box" (weir) that surrounds the QS and the chemical addition suction piping inside the RWST provides additional assurance that the QS suction piping is not subject to vortexing at the 0% RWST level, which corresponds to the non-usable volume.

2. During normal unit operation the entire QS pump suction line and the discharge line up to the normally closed isolation MOV are maintained sufficiently full of water at RWST head. Return to service and/or quarterly IST testing of the pumps at near design flow further ensures that the QS pump suction piping is maintained full immediately following return to service and/or quarterly IST flow testing. There are no external sources for gas to be introduced into the QS system on either the pump suction or discharge side during normal unit operation. In conclusion, the QS pump suction lines are not susceptible to gas accumulation or entrainment, and the QS pumps are not susceptible to gas intrusion during accident operation.

3. The QS pump discharge piping from the pump(s) to the normally closed discharge header isolation MOV(s) is essentially full of water at RWST head during normal unit operation. The QS pump discharge piping down stream of the discharge isolation MOV(s), which includes all QS piping inside containment, is dry during normal unit operation. Upon initiation of QS flow, the air initially present in the discharge piping will be transported out of the system through the spray nozzles, thus ensuring that the piping is sufficiently full during fulfillment of the QS safety function. The discharge piping fill time delay is accounted for in the accident analyses and, the discharge system piping and pipe supports are designed for the loads generated by the filling process. Since there are no external sources for gas to be introduced into the QS system on either the pump suction or discharge side, the QS discharge piping is not susceptible by gas accumulation.

   The chemical addition subsystem evaluation for gas accumulation concluded that potential gas accumulation in the chemical addition subsystem piping has insignificant impact on the QS system operation.

C. Safety Injection System

LHSI System

1. SI accumulator leakage is not a concern for the NAPS SI piping. The SI accumulator piping connects directly to the RCS piping, and consequently does not have a boundary interface with either the HHSI or the LHSI discharge piping.

2. The RWST level at automatic switchover from SI injection mode to SI recirculation mode provides for substantial water level margin above the common SI suction line from the RWST to the HHSI and LHSI pumps to prevent air entrainment due to vortexing into the HHSI and the LHSI pumps during SI injection mode operation. Flow testing has proved that the NAPS containment sump strainer design inhibits the formation of vortexing and air injection in the strainer inlet ducts and suction piping to the LHSI pumps during SI recirculation mode.

3. The normal water level elevation in the RWST ensures that the LHSI pump suction piping from the RWST, the LHSI pump can, and all of the discharge piping is initially sufficiently full of water after proper procedural venting and/or full flow system "sweeping" during system return to service operability testing. The LHSI pump suction piping from the RWST to the pump suction can is not susceptible to gas accumulation because the full flow system "sweep" ensures that any significant amount of air potentially left in the piping during initial filling after a drain down would be swept out of the piping. Additionally, the water in the LHSI pump suction piping from the RWST has no potential for degassing while it is in its standby condition during normal unit operation, and has no potential for gas intrusion from other external sources.

4. During a DBA the containment sumps would fill and the LHSI SI Recirculation Mode suction piping upstream of the isolation MOV would fill and self vent prior to pump starts. One potential exception is a small volume between the disc of the normally closed isolation MOV(s) upstream of the check valve that is directly attached end-to-end to the MOV. Any gas that may have been trapped in this volume has been evaluated as not having an effect on LHSI system performance. Note that the suction piping downstream of the isolation MOV and the check valve is common with the suction piping from the RWST and is maintained full during normal unit operation at RWST head. Additionally, any air that might degas from the water in the LHSI pump suction piping from the containment sump prior to SI Recirculation Mode of operation

would tend to have the majority of the degassed volume self-vented into the containment via the sump strainer since the piping is horizontal with a vertical upward run to the sump.

5. An insignificant amount of gas accumulation in the local high point irregularities of the horizontal portion of the suction piping from the containment sump to the pump suction can, and no more than negligible gas accumulation is plausible in the portion of the suction piping from the RWST to the pump suction can. At low LHSI flow conditions (SB LOCA) any small amount of gas that might have accumulated in the local high point irregularities of the suction piping from the RWST or the suction piping from the containment sump may transport to the pump suction can. This small amount of gas if transported will not impact the performance or operation of the LHSI pump at low flows. Any gas that could potentially accumulate either in the LHSI pump suction piping from the RWST or in the suction piping from the containment sump would be transported to the LHSI pump suction can with the flow in the respective suction line during high LHSI flow conditions (LB LOCA). The LHSI pump suction can design, in conjunction with the low N_{FR} downward flow in the can annulus, prevents large bubbles of gas transported into the can from entering the pump suction even at the maximum LHSI pump flow rate and any small bubbles transported to the pump suction would have no impact on the pump performance (developed head or NPSH). Thus, gas intrusion at the pump suction will have no detrimental impact during accident operation. No external sources of gas exist for the suction piping from the RWST and degassing in the suction piping from the containment sump is insignificant. Therefore, the LHSI pump suction is evaluated to be not susceptible to gas intrusion from gas accumulation in the suction piping. Further, since the LHSI pumps have been evaluated to be not susceptible to gas intrusion from their suction lines, gas accumulation has no impact on their performance requirements (delivered flow or NPSH).

6. The LHSI pump discharge piping for the paths to both the RCS hot legs and the RCS cold legs is procedurally filled and vented and full flow “swept” prior to returning the system to service during each refueling outage. This ensures that all of the LHSI pump discharge piping is sufficiently full prior to returning the LHSI system to service. Since the LHSI pump discharge headers to the RCS hot legs are isolated from the RCS by closed isolation MOVs outside of containment in addition to the RCS isolation check valves, the LHSI pump discharge piping to the RCS hot legs inside of containment is not susceptible to gas accumulation caused by RCS backleakage. The LHSI pump discharge piping to the RCS cold legs are isolated

from the RCS by multiple check valves during normal operation, as the discharge piping isolation MOVs are normally open. Consequently, even though this piping has assurance of being initially sufficiently full for start of normal operation, it must be evaluated for gas accumulation because of the potential for RCS back leakage through the RCS cold leg isolation check valves.

7. The acceptance criterion for gas void volume in the LHSI discharge piping to the RCS cold legs, which includes the "piggyback" lines to the HHSI pump suction headers, is 1 ft^3 during normal operating conditions (i.e., pressure from normal RWST head). This will keep the LHSI discharge piping relief valves from lifting during pump starts and precludes any gas-water hammer impact on the piping system. This void acceptance criterion also easily meets the requirements for LHSI flow delivery time and injected gas void impact on the RCS.

   Westinghouse evaluated a maximum injected gas void size of 5 ft^3 at 100 psia and 68°F in the LHSI piping for impact on the RCS during accident conditions. The Westinghouse evaluation concluded that this amount of non-condensable gas would have no impact on the conclusions of the applicable LB LOCA, SB LOCA, long term core cooling, or LOCA force analyses. Similarly, there is no impact on the conclusions of the MSLB, FLB, and SGTR analyses related to SI flow degradation and injection delay. The presence of this amount non-condensable gas volume would have no appreciable effect on heat transfer degradation, including natural circulation situations.

   Additionally, the potential for transient pressure waves generated in the LHSI pump discharge piping due to gas voids in the discharge piping at pump start to transfer through the pump and into the pump suction piping is not a concern. The LHSI pump's design with the open suction bell submerged in the suction can is similar to an open pit suction design, as the pump's suction source is not contained by the suction piping. The peak transient pressures in the discharge piping would be no greater than the LHSI discharge piping relief valve's setpoint for acceptable gas void volumes in the discharge piping and only on the order of twice that peak pressure for the gas void volume evaluated for operability. Thus, the relatively low peak pressures in conjunction with the suction can design would ensure that any transient pressure waves transmitted from the discharge piping back through the pump would be greatly dissipated in the suction can and have virtually no impact on the suction piping.

8. Since a significant portion of the LHSI pump discharge piping is inside of containment and is extremely difficult to monitor for gas using the traditional means of UT inspection or high point venting, an alternate monitoring methodology is recommended. The methodology will be a combination of monitoring of the identified piping high points in the LHSI discharge piping outside of containment by venting or UT inspection, and the additional monitoring of the LHSI pump discharge piping to RCS cold leg isolation check valves by monitoring the RCS isolation check valve leakage, monitoring the RWST for increasing level, and monitoring the LHSI pump discharge header entering the containment for temperature increases. Each of these items is a potential indicator of RCS leakage into the LHSI system, the only external source of gas accumulation in the LHSI discharge piping. Should any of the monitored parameters increase, then a confirmation of gas volume can be obtained through use of the LHSI pump IST quarterly testing procedure in conjunction with recording of the pressure transient at the LHSI pump discharge header. If the transient peak pressure during LHSI pump start is less than the relief valve setpoint and the peak pressure occurs immediately after pump start, then the LHSI discharge piping to RCS cold legs has an acceptable gas void volume of approximately 1 ft^3 or less at pressure from the RWST head. If the transient peak pressure recorded during this test exceeds the relief valve setpoint and/or if the transient peak pressure occurs several seconds after the pump start, then the LHSI discharge piping has a larger volume of gas accumulation, which must be assessed and potentially removed.

   Recording the LHSI pump transient pressure during IST cannot show with full certainty that voids are not present in the LHSI piping inside of containment. If the piping inside containment is pressurized from leakage through the first RCS isolation check valve off of the RCS, then any voids in the pressurized piping would have no impact on the pump discharge pressure transient. However, if the piping inside containment is pressurized, above VCT pressure (saturation pressure for gases in solution in the RCS), then no degassing in this piping section will occur; thus, if an initial end of outage venting was successful, no significant gas would accumulate in this section of pipe. If the pipe section pressurizes, which makes void detection by pump surge pressure test no longer possible, the potential for gas inleakage has also been removed so undetected gas accumulation in this section of piping is no longer a concern.

   Consequently, recorded pressure transient information from the quarterly IST for the LHSI pump strengthened by the information which would indicate the potential for leakage (or lack of leakage) from the RCS into the LHSI system, in combination with the continuation of the currently performed monitoring of the LHSI discharge piping high points outside containment, provides an appropriate methodology for determining acceptable accumulated gas void volume in the LHSI discharge piping during standby for accident operation.

9. Comparison of transient analyses results for a single LHSI pump start versus a two LHSI pump start for the case having 0.75 ft^3 of air void in the discharge piping showed that the transient peak pressures were essentially the same for either a single or a two pump start. Therefore, it can be concluded that the results from the transient analyses for a single LHSI pump start are applicable to that for a two pump start.

HHSI System

1. Even though only limited gas accumulation is expected in the HHSI pump suction line from the RWST to the pumps (for the SI injection mode), it is periodically monitored for gas accumulation in addition to periodically monitoring the HHSI suction lines through the "piggyback" lines for SI recirculation mode operation. Gas accumulation is possible in the "piggyback" lines due to their interface with the LHSI discharge piping. Installation of additional system high point vent valves in the mid-1990s has proven to be successful in removing voids during fill and vent operations and in removing accumulated gases from the system. However, since the normal suction header is the CH pump suction header, it is in service during normal operation and subject to potential external gas sources such as the VCT and CH pump mini-flow recirculation orifices. Periodic venting procedures performed on the charging and HHSI pump suction header remove potential gas accumulation and ensure the system remains sufficiently filled.

   The current periodic venting procedures ensure the accumulated volumes are well below the Westinghouse evaluated acceptable maximum injected gas void size of 5 ft^3 at 400 psia and 68°F in the HHSI piping for impact on the RCS during accident conditions.

2. The discharge piping of the HHSI system is procedurally filled and vented, and/or flow "swept" prior to return to service and is subject to boundary pressure from the operating CH system that is greater than RCS pressure, which eliminates the potential for external gas sources from RCS boundary inleakage. Therefore, the HHSI pump discharge piping is maintained full during normal operation and is

not susceptible to inleakage from the RCS, or any other sources, that could cause gas accumulation in the piping. Upon SI operation any acceptable gas void fraction in the HHSI suction piping would be compressed by the pump to an insignificant void fraction in the discharge piping that would not impact HHSI flow delivery time or the accident analyses once the gas void from the suction was delivered to the RCS. Thus, the HHSI pump discharge piping is not susceptible to gas accumulation issues.

D. Residual Heat Removal System

1. The RHR system, which is located entirely inside of containment, has a safety classification of NSQ (non-safety related with regulatory significance) and does not serve the dual function of a low pressure safety injection pump. The RHR system is used during plant startup, shutdown, and refueling (Condition I events) when the RCS temperature is 350°F or less. It is not in service during normal operation or during hot standby operation. As such, RHR system function is not assumed in the safety analyses for any Condition II, III, or IV events.

2. The RHR system is placed in service during the plant cooldown phase that follows a period of initial heat removal by the Main Steam System following reactor shutdown. Generally, during startup conditions, residual heat from the reactor core is being removed by the RHR system. The RHR system is placed in operation when the RCS pressure and temperature are reduced to a pressure low enough to prevent lifting the RHR pump suction relief valves and a temperature less than the design temperature of the RHR system. Initially, the flow through the heat exchangers is throttled to control the rate of cooldown of the RCS. The inlet to the RHR system is located in the hot leg of one reactor coolant loop while the return line is connected to the cold leg of the other two loops. If the RCS is drained below the top of the hot leg (e.g., midloop operation), the RHR system procedurally operates at a reduced flow rate to remove decay heat. The reduced flow rate is established as a precaution to prevent vortexing in the partially drained hot leg and to prevent air ingestion into the operating RHR pump. The RHR system remains in service throughout the shutdown and startup periods, which may include a refueling operation. The RHR system is shut down and isolated prior to the temperature of the RCS exceeding 350°F.

3. The RHR system is filled and vented by procedure whenever the system is drained for maintenance. System velocities during operation of the RHR system for normal RCS cooldown are

sufficient to sweep any small gas voids that might have remained in local piping high points after fill and vent of the piping. Many years of successful operation of the RHR system during RCS cooldown have demonstrated that the fill and vent procedures and operating procedures are effective with no observed detrimental performance in operation of the RHR pumps and system. Thus, control of system operating flow rates with consideration to limiting inlet conditions ensures that the entire RHR piping system is sufficiently full of water during system operation. Two motor-operated valves (MOVs) (part of the RCS pressure boundary) in series isolate the RHR system inlet line from the RCS while the discharge lines are isolated by a check valve (part of the RCS pressure boundary) and a MOV. If the RCS pressure exceeds the design pressure of the RHR system, an interlock between the RCS pressure channels and the two inlet isolation valves prevents the valves from opening.

4. The RHR system has system boundary interfaces with two systems which could result in inleakage into the RHR system. The system boundaries with the RCS system via the SI accumulator discharge lines and the CH letdown system both are potential sources of inleakage to the RHR system through leaking system boundary isolation valves. The operating pressure in the CH letdown system is less than the RHR system relief valve set pressure and high enough to prevent degassing of the letdown water, so inleakage from the letdown system would not be a source or mechanism for gas intrusion. Typically during normal power operation the isolation valve between the letdown system and the RHR system is cracked open, so that the RHR system is at letdown system pressure. This configuration also provides a relief path for any potential RCS or SI accumulator water leakage through the system boundary valves from the RCS system to the RHR system. RCS system leakage into the RHR system could potentially result in a lift of an RHR relief valve if the system boundary with the letdown system is tight, but would not be a source of degassing since the RHR system would be pressurized by the postulated RCS leakage. However, leakage of SI accumulator water into the RHR system would be a source of gas accumulation from degassing of the accumulator water since it is saturated with nitrogen gas at approximately 600 psig and would be at a lower pressure after leaking into the RHR system. SI accumulator leakage into the RHR system did occur previously at NAPS. The SI accumulator level is monitored and, thus, any leakage out of the accumulators is identified and corrective actions are identified. This condition would only occur with the RHR system in the standby mode of operation. This condition would result in a prompt assessment of its impacts on system operability via the corrective action system.

5. Therefore, when the RHR system is shutdown, it is isolated with both its suction and discharge piping full of water from the RCS. The temperature of the water in the RHR suction and discharge in the non-flowing shutdown condition does not increase enough to cause degassing of the water. Once isolated during normal unit or hot standby operation, the RHR system piping remains sufficiently full of water as the only mechanism for gas intrusion or accumulation in either the RHR system suction or discharge piping is potential SI accumulator water system inleakage which would be identified and mitigated prior to operating the RHR system.

   In conclusion, neither the suction nor the discharge piping of the RHR system is impacted by gas accumulation.

E. **Design Evaluation Conclusion**

A technical evaluation has been completed that documents the system analyses for gas intrusion mechanisms. As described above, once the systems are properly filled and vented by procedure including the system "sweeps", the only potential gas intrusion mechanism is leakage through the RCS check valves on the cold leg injection from the LHSI system. The applicable gas volume acceptance criteria have been identified for each affected piping segment. These criteria will be added to the NAPS test procedures. The industry is developing a program to further analyze the effects of gas intrusion on the suction criteria of pumps in the system. Dominion will monitor this program as it develops.

2. Discuss new applicable gas volume acceptance criteria for each piping segment in each system where gas can accumulate where no acceptance criteria previously existed and summarize the Corrective Actions, and schedule for completion of any Corrective Actions.

a) Pump Suction Piping

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

	Single-Stage	***Multi-Stage***	***Multi-Stage***
		Stiff Shaft	Flexible Shaft
Steady-State	2%	2%	2%
Transient*	5% for 20 sec.	20% for 20 sec.	10% for 5 sec.
$Q_{B.E.P.}$ Range	70%-120%	70%-140%	70%-120%
Pump Type (transient data)	WDF	CA	RLIJ, JHF
* The transient criteria are based on pump test data and vendor supplied information.			

NAPS procedures provide assurance that the volume of gas in the pump suction piping for the HHSI system is limited such that pump gas ingestion is within the above PWROG program established interim criteria. Even though limited gas accumulation is expected in the HHSI pump suction line from the RWST to the pumps (for the SI injection mode), it is included in the gas accumulation monitoring program along with the HHSI suction lines through the "piggyback" lines for SI recirculation mode operation. Gas accumulation is possible in the "piggyback" lines due to their interface with the LHSI discharge piping. Installation of additional system high point vent valves in the mid-1990s has proven to be successful in removing voids during fill and vent operations and in removing accumulated gases from the system. However, being the CH pump suction header, it is in service during normal operation and subject to potential external gas sources such as the VCT and CH pump mini-flow recirculation orifices. The calculated allowable gas void volume for gas in the HHSI system is less than 1.83 cubic feet of gas for the normal HHSI suction header and less than 0.77 cubic feet of gas for either the normal or alternate Recirculation Mode Transfer "piggyback" headers.

b) Pump discharge piping susceptible to pressure pulsation after a pump start

Only the LHSI pump discharge headers are susceptible to pressure pulsation. To prevent thermal relief valve lift, an acceptable void on the LHSI discharge piping is 1 ft^3 or less. Maintaining the void below this value prevents momentary thermal relief valve lift. In order to avoid relief valve actuation during a pump start, the system is flushed at high flow and/or vented following maintenance.

c) Pump discharge piping not susceptible to water hammer or pressure pulsation following a pump start

The NAPS QS and Recirculation System discharge header piping was evaluated using the PWROG methodology described above. Using this methodology it was determined that the force imbalances on the QS and RS discharge header piping are well within the margin of the pipe hangers.

d) RCS allowable gas ingestion

The PWROG qualitatively evaluated the impact of non-condensable gases entering the RCS on the ability on the post-accident core cooling functions of the RCS. This evaluation assumed that 5 cubic feet of non-condensable gas at 400 psia was present in the HHSI discharge piping concurrent with 5 cubic feet of non-condensable gas at 100 psia in the LHSI discharge piping. The qualitative evaluation concluded that the quantities of gas that will not prevent the ECCS from performing its core cooling function.

NAPS procedures provide assurance that the gas accumulation in any section of the LHSI injection system cold leg and hot leg piping is less than 5 cubic feet of non-condensable gas at 100 psia at any location. Procedures also provide assurance that the gas accumulation in any section of the HHSI cold leg injection is less than 5 cubic feet of non-condensable gas at 400 psia at any location.

3. Summarize the changes, if any, to the design basis documents (Corrective Actions) and the schedule for completion of the Corrective Actions.

No changes to design basis documents have been identified

4. Discuss the results of the system P&ID and isometric drawing reviews to identify all system vents and high points.

The system P&IDs and isometric drawings were reviewed to identify system vents and high points. Numerous vents have been installed in key locations of the systems evaluated The drawing reviews evaluated the system high points including branch lines, valve bodies, pump cans, and improperly sloped piping. In addition, pipe diameter transitions in horizontal lines that could trap gas such as pipe reducers and orifices were reviewed. Screening criteria were applied to the system high points to eliminate locations that could accumulate only an insignificant amount of gas. Each high point that did not screen out was reviewed to determine if it could be effectively vented with an existing system vent.

Analytical assessments were performed on the unventable high points to determine if the quantity of unventable gas could adversely impact system function. Physical walkdowns and/or analytical assessments were performed for those high points warranting additional consideration.

Gas accumulation within valve bonnets have been evaluated for valves within the subject systems. Dominion has concluded that unventable gas accumulations within valve bonnets do not challenge operability. Only a small fraction of the accumulated gas in valve bonnets can be drawn down into the active flow stream at any given time as small bubbles. The following are the bases:

- Unventable gas accumulations within valve bonnets are located above the active flow stream.
- Flow through valve bonnets is limited by the relatively small exposed flow area. The valve disc blocks a significant portion of the exposed flow area in check valves. The bonnet entrance area is smaller than the bonnet diameter in gate valves.
- Globe, ball, and diaphragm valves within the subject systems have negligible internal volumes (if any) susceptible to gas accumulation.
- Retracted discs in gate valves reduce the bonnet volume available for gas accumulation and hinder flow within the bonnet.
- Only a portion of the accumulated gas within tall bonnets such as those common on gate valves can be drawn out due to the nonexistent direct flow path through the dead space in the upper bonnet region.
- Relatively slow stroke times for large motor operated valves.

Instrument lines were reviewed and found not to represent a source of gas intrusion. Any gas in the lines would be small in volume and would not be swept into the main flow path. Additionally, these lines are procedurally kept full through procedures related to calibration of the individual instrumentation.

Given the NAPS operating history, since the addition of vents in the LHSI and HHSI systems, the systems are sufficiently full upon completion of the fill and vent procedures. Since the only viable gas intrusion mechanism is RCS check valve back-leakage, a potential point of concern may be at the high points of each LHSI cold leg piping inside of containment downstream of the RCS check valves.

5. Identify new vent valve locations, modifications to existing vent valves, or utilization of existing vent valves based on the drawing review, and summarize the Corrective Actions, and schedule for completion of the Corrective Actions.

Vent valve additions to the LHSI piping inside containment will be considered, if required, once confirmatory walkdowns are completed. This will be addressed in a supplemental response for both units.

6. Discuss the results (including the scope and acceptance criteria used) of the system confirmation walkdowns that have been completed for the portions of the systems that require venting to ensure that they are sufficiently full of water.

Walkdowns of associated piping systems evaluated for GL 2008-1 have been performed to provide assurance that the corresponding systems have appropriate vent valves at all necessary locations with the exception of confirmation of system piping inside the containments.

The detailed walkdowns were performed using a computerized water level instrument and have been focused on the critical areas identified in the HHSI suction and LHSI discharge lines located outside of containment. All high points in the system have been correctly identified and vent valves provided. Any discrepancy of greater than one degree in the piping slope has been identified and evaluated. The result is that no additional vent valves have been identified in the accessible piping outside of containment.

Confirmatory laser scanning has been performed for Unit 2 LHSI piping inside containment. Slope reports on the piping will be developed and high points will be evaluated and reported in a supplemental submittal in January 2009.

Detailed walkdowns of the RS, QS and RHR systems were not conducted since it was determined that there is no active source of gas intrusion. The suction piping configuration for the LHSI was evaluated as having high points that would vent to the RWST or the containment sump and since no additional sources of gas intrusion have been identified, detailed walkdowns were not performed.

7. **Identify new vent valve locations, modifications to existing vent valves, or utilization of existing vent valves that resulted from the confirmatory walkdowns, and summarize the Corrective Actions, and the schedule for completion of the Corrective Actions, i.e., the walkdowns that have been completed, and the walkdowns not yet complete (refer to Reference [5] Three-Month Response to NRC Generic Letter 2008-01).**

The need for new vent valves was not identified by the walkdowns and evaluations of the accessible portions of the piping systems included in GL 2008-01. However, Dominion will continue to evaluate the need for relocating vent valve 2-SI-307 on the RWST to the HHSI pump suction piping (line 10"-SI-408-153A-Q3) as an enhancement.

8. **Discuss the results of the fill and vent activities and procedure reviews for each system. (Note that routine periodic surveillance testing is addressed in the "Testing Evaluation" section of this template).**

The following system fill and vent procedures and full flow "sweep" procedures credited in this evaluation to provide assurance that corresponding systems sufficiently full were reviewed.

- 1/2-MOP-7.01, LOW HEAD SAFETY INJECTION PUMP 1/2-SI-P-1A (Section 5.3, Venting of the Low Head SI Discharge Piping)

- 1/2-MOP-7.02, LOW HEAD SAFETY INJECTION PUMP 1/2-SI-P-1B (Section 5.3, Venting of the Low Head SI Discharge Piping)
- 1/2-MOP-7.90, DEPRESSURIZING LHSI PUMP DISCHARGE PIPING FOR STROKING MOVs AND NO FLOW WORK
- 1/2-PT-138, VALVE INSERVICE INSPECTION — LHSI SYSTEM FUNCTIONAL VERIFICATION (Sections 6.13 High Flow Flush Of Train B Piping Using 1/2-SI-P-1A & 6.14 High Flow Flush Of Train A Piping Using 1/2-SI-P-1B)
- IRSPs - 1/2-MOP-7.03 and 7.04. No venting in these procedures since the system is left dry.
- ORSPs - 1/2-MOP-7.05 and 7.06. No venting in these procedures since the system is left dry.
- CASING COOLING PUMPS - 1/2-MOP-7.10 and 7.11. (Vents pump strainer, discharge pressure indicators, discharge header pressure transmitter, and discharge flow switch). Quarterly PT is then performed to validate system operability (1/2-PT-64.4A/B) to flush the system.
- QS PUMPS - 1/2-MOP-7.07 and 7.08. (Vents pump strainer, discharge pressure indicators, discharge header pressure transmitter, and discharge flow switch). Quarterly PT is then performed to validate system operability (1/2-PT-63.1A/B) to flush the system.
- CH Pumps - 1/2-MOP-8.01, 8.02, and 8.03 (1/2-CH-P-1A, 1B, 1C)
- Normal Charging header 1/2-MOP-8.90
- Alternate Charging header 1/2-MOP-8.91
- CVCS Filters
    - 1/2-CH-FL-1 (1/2-MOP-8.20)
    - 1/2-CH-FL-2 (1/2-MOP-8.21)
    - 1/2-CH-FL-3 (1/2-MOP-8.22)
    - 1/2-CH-FL-4A/B (1/2-MOP-8.23 AND 24)
    - 1/2-CH-FL-5 (1/2-MOP-8.25)
- LETDOWN Piping - 1/2-MOP-8.26

The review also considered dynamic venting and vacuum fill considerations. Calculations verifying adequate flow for gas "sweeping" were formalized and documented. No procedure changes were required. The fill and vent procedures were also reviewed to ensure that methods used provide adequate assurance that systems are sufficiently full of water. NAPS currently does not perform UT to confirm the piping to be sufficiently full. However, the current procedures have been determined to be adequate based upon historic performance and recent past results of 1) LHSI pump testing and 2) periodic venting surveillances where no air has been documented.

9. Identify procedure revisions, or new procedures resulting from the fill and vent activities and procedure reviews that need to be developed, and summarize the Corrective Actions, and schedule for completion of the Corrective Actions. (Note that routine periodic surveillance testing is addressed in the "Testing Evaluation" section of this template).

Dominion will revise current fill and vent procedures, as necessary, to assure sufficiently full acceptance criteria, based upon the technical criteria developed for this response, by adding Ultrasonic Testing (UT), venting or other confirmation means at select locations.

Rationale: Additional testing is considered a confirmation of the successful completion of the venting and dynamic “sweeps” being performed. This effort can be planned and conducted in a controlled manner prior to the end of the Unit 1 refueling in 2009.

10. Discuss potential gas intrusion mechanisms into each system for each piping segment that is vulnerable to gas intrusion.

Potential gas intrusion mechanisms at NAPS are limited to back leakage through the RCS check valves to the LHSI system and from post maintenance fill and vent activities. Maintenance activities that drain any system have fill and vent procedures that include post-maintenance flushing that eliminates gas pockets.

11. Ongoing Industry Programs

Ongoing industry programs are planned in the following areas which may impact the conclusions reached during the Design Evaluation of the NAPS relative to gas accumulation. The activities will be monitored to determine if additional changes to the NAPS 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 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.

12. Provide a detailed list of items that have not been completed, a schedule for their completion, and the basis for that schedule.

Confirmatory walkdowns for the subject piping will be complete during the spring 2009 refueling outage. Unit 2 confirmation walkdowns are completed, and the evaluations are ongoing. Results of the walkdowns and subsequent evaluation will be provided as detailed in our 3 month response (Serial No. 08-013A).

Testing Evaluation

1. Discuss the results of the periodic venting or gas accumulation surveillance procedure review.

NAPS currently conducts periodic venting of locations in the HHSI and LHSI piping outside of containment. Trending of the volume of gas accumulation through venting and pump testing has indicated that there is no appreciable gas buildup. Therefore, Dominion has concluded that the vents in place are highly effective and that little gas accumulation remains in the system during operations. Periodic venting procedures specify vent points that are used to ensure the subject system piping is sufficiently full of water for each system. The procedures were reviewed to verify that systems were not preconditioned by other surveillance tests prior to performing the periodic venting procedures.

Since a significant portion of the LHSI pump discharge piping is inside a subatmospheric containment and is extremely difficult to monitor for gas using the traditional means of UT inspection or high point venting, an alternate monitoring methodology is being developed. The alternate monitoring will be performed using methods such as pump start pressure transient recording, thermal relief valve monitoring, pump discharge header temperature monitoring, and RWST level trending. These monitoring methods are a potential indicator of RCS leakage into the LHSI system, which is the only external source of gas accumulation in the LHSI discharge piping. See detailed discussion of additional pressure testing in Design Section LHSI C.8.

The RS and QS systems are not included in the periodic testing since the design of the system precludes gas accumulation that can affect pump operation or result in water hammer.

2. **Identify procedure revisions or new procedures resulting from the periodic venting or gas accumulation surveillance procedure review that need to be developed.**

Current venting procedures fulfill this requirement. New revisions and procedures are therefore not required. Dominion will continue its monitoring and trending program for susceptible high points located in accessible areas of the ECCS lines outside of containment including acceptance criteria based upon the technical criteria developed for this response and corrective action requirements.

3. **Discuss how procedures adequately address the manual operation of the RHR system in its decay heat removal mode of operation. Include how the procedures assure that the RHR system is sufficiently full of water to perform its decay heat removal safety function (high point venting or UT) and how pump operation is monitored by plant personnel (including a description of the available instrumentation and alarms).**

For NAPS, the RHR system does not support any safety related function. The function is performed by the recirculation spray and QS systems. A RHR train is filled and vented following maintenance and then placed into service. Upon leaving a cold shutdown condition, the system is isolated and remains full. The system physically is located inside of containment and is not practical to access during plant operation. Design features and water level set points are controlled by design and operating procedures to prevent vortex effects that can potentially ingest gas into the system during operation. Additional restrictions in maximum flow rates also help prevent vortex effects during shutdown cooling operations at reduced RCS inventory.

4. **Summarize the results of the procedure reviews performed to determine that gas intrusion does not occur as a result of inadvertent draining due to valve manipulations specified in the procedures, system realignments, or incorrect maintenance procedures.**

The maintenance and operating procedures have been reviewed. No gas intrusion mechanism resulting from inadvertent draining, valve misalignments or incorrect maintenance practices have been identified.

5. **Describe how gas voids are documented (including the detection method such as venting and measuring or UT and void sizing and post venting checks), dispositioned (including method(s) used such as static or dynamic venting), and trended, if found in any of the subject systems.**

   Explain here or in the "Corrective Actions Evaluation" section the threshold (acceptance criteria) for entry into the Corrective Action Program (CAP) and how the CAP addresses disposition and trending. For gas voids less than the CAP threshold, if applicable, describe how these gas voids

are documented and trended as a means to detect system changes that may be indicative of degradation leading to future gas voiding.

Current LHSI and HHSI venting procedures require that any gas discovery be quantified and entered into the Corrective Action Program and addressed, including an evaluation of operability and reportability.

6. **Provide a detailed list of items that have not been completed, a schedule for their completion, and the basis for that schedule.**

None Identified.

<u>Corrective Actions Evaluation</u>

1. **Summarize the results of the reviews regarding how gas accumulation has been addressed at your site.**

Dominion's Corrective Action Program is used to document gas intrusion/accumulation issues as potential degrading conditions. Existing procedures for the affected systems require a Condition Report to be initiated, and the Shift Manager notified, if the accumulated gas volume acceptance criteria specified in the procedures are exceeded. As part of Dominion's Corrective Action Program, Condition Reports related to plant equipment are evaluated for potential impact on operability and reportability. Therefore, Dominion's review concluded that issues involving gas intrusion/accumulation are properly prioritized and evaluated under the Corrective Action Program.

2. **Provide a detailed list of items that have not been completed, a schedule for their completion, and the basis for that schedule.**

No changes to the Corrective Action Program have been identified.

<u>Conclusion</u>

Based upon the above, Dominion has concluded that NAPS is in conformance with its commitments to 10 CFR 50, Appendix B, Criterion III, V, XI, XVI, and XVII, as described in the Dominion's Quality Assurance Program. Any remaining corrective actions have been entered into the NAPS Corrective Action Program for tracking and final resolution, as described in Sections B and C of this Enclosure.

B. DESCRIPTION OF NECESSARY CORRECTIVE ACTIONS

The following corrective actions were identified:

1. Dominion will monitor the status of the industry/NRC TS Task Force (TSTF) Traveler that will be developed as a follow-up to GL 2008-01. Following NRC

approval of this TSTF, Dominion will evaluate adopting the TSTF to either supplement or replace current TS and TRM requirements.

2. Dominion will monitor the results of industry testing and analytical programs related to gas accumulation and pump suction acceptance criteria. Dominion will evaluate the results of the industry testing and analytical efforts to determine if any additional changes to any licensing basis documents are required.

3. Dominion will revise current fill and vent procedures, as necessary, to assure sufficiently full acceptance criteria, based upon the technical criteria developed for this response, by adding Ultrasonic Testing (UT), venting or other confirmation means at select locations.

C. CORRECTIVE ACTION SCHEDULE

1. Summarize the corrective actions that have been completed as a result of the evaluations discussed above.

Periodic test procedures are used to assure sufficiently full criteria by monitoring and trending the pump discharge pressure to measure the gas accumulation in the cold leg piping inside the Unit 2 containment.

2. Summarize the corrective actions to be completed including the scope, schedule, and a basis for that schedule.

Corrective actions that have not been completed are as follows:

- Dominion will monitor the status of the industry/NRC TS Task Force (TSTF) Traveler that will be developed as a follow-up to GL 2008-01. Following NRC approval of this TSTF, Dominion will evaluate adopting the TSTF to either supplement or replace current TS and TRM requirements. The completion date for this corrective action is dependent on the approval of the TSTF.

  Rationale: This corrective action will require several years of effort by both the industry and the NRC. Until such time as the TSTF is issued such that it can be reviewed for any potential impact, no formal defined corrective action completion date can be made.

- Dominion will monitor the results of industry testing and analytical programs related to gas accumulation and pump suction acceptance criteria. Dominion will evaluate the results of the industry testing and analytical efforts to determine if any additional changes to any licensing basis documents are required. The completion date for this corrective action is dependent on the completion of the industry testing and analytical programs.

Rationale: This corrective action will require an extended period of time and significant industry funding to complete. While it may provide additional information, the existing acceptance criteria in place for NAPS is conservative and based upon historical results and empirical testing that has been documented as meeting the design requirements.

- Dominion will revise current fill and vent procedures, as necessary, to assure sufficiently full acceptance criteria, based upon the technical criteria developed for this response, by adding Ultrasonic Testing (UT), venting or other confirmation means at select locations.

  Rationale: The addition of UT testing is simply a confirmation of the successful completion of the venting and dynamic “sweeps” being performed. The earliest that this effort can be planned and successfully conducted in a controlled manner will be prior to the end of the spring Unit 1 refueling outage in 2009.

CONCLUSION

Dominion has evaluated the accessible portions of those NAPS systems that perform the functions described in this GL and has concluded that these systems are operable, as defined in the NAPS TS, and are in conformance to our commitments to the applicable General Design Criteria (GDC), as stated in the NAPS UFSAR.

The open actions cited above are considered to be enhancements to the existing programs/processes/procedures for assuring continued operability of these subject systems.

Dominion will complete its evaluation of the inaccessible (e.g., impractical due to subatmospheric containments, industrial safety considerations and/or dose rates) portions of these systems by startup from the next NAPS Units 1 and 2 refueling outages and will provide a supplement to this response within 90 days thereafter.