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L-08-313

10 CFR 50.54(f)

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

SUBJECT:
Beaver Valley Power Station, Unit Nos. 1 and 2
BV-1 Docket No. 50-334, License No. DPR-66
BV-2 Docket No. 50-412, License No. NPF-73
Nine Month Response to NRC Generic Letter 2008-01, "Managing Gas Accumulation in Emergency Core Cooling, Decay Heat Removal, and Containment Spray Systems" (TAC Nos. MD7795 and MD7796)

The Nuclear Regulatory Commission (NRC) issued Generic Letter (GL) 2008-01, dated January 11, 2008, to request that each licensee evaluate the licensing basis, design, testing, and corrective action programs for the Emergency Core Cooling Systems, Decay Heat Removal system, and Containment Spray system, to ensure that gas accumulation is maintained less than the amount that challenges operability of these systems, and that appropriate action is taken when conditions adverse to quality are identified.

The Generic Letter requested each licensee to submit a written response in accordance with 10 CFR 50.54(f) within nine months of the date of the GL, to provide the following (summarized) information:

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

(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; and

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

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The Generic Letter also stated that if a licensee could not meet the requested nine month response date, the licensee was to provide a response within three months of the date of the GL describing the alternative course of action that it proposed to take, including the basis for the acceptability of the proposed alternative course of action.

The three month response for the Beaver Valley Power Station (BVPS) was provided by letter dated April 11, 2008 (L-08-131). The NRC staff's review of the three month response was provided in a letter dated September 15, 2008, which requested that clarifications be provided in the nine month response to the Generic Letter.

The nine month response to NRC GL 2008-01 is included as Attachment 1, including the clarifications requested in the NRC letter dated September 15, 2008.

In summary, based on the information reviewed to date, it is concluded that the subject systems/functions at BVPS are capable of performing their intended safety function, and that for BVPS, FirstEnergy Nuclear Operating Company (FENOC) is currently in compliance with 10 CFR 50 Appendix B, Criteria III, V, XI, XVI and XVII, with respect to the concerns outlined in GL 2008-01. A number of enhancements have been identified by the evaluations and have been entered into the FENOC Corrective Action Program.

The regulatory commitments contained in this submittal are listed in Attachment 2. If there are any questions or if additional information is required, please contact Mr. Thomas A. Lentz, Manager - Fleet Licensing, at (330) 761-6071.

I declare under penalty of perjury that the foregoing is true and correct. Executed on October 14, 2008.

Sincerely,

Peter P. Sena III

Attachments:
1. BVPS Nine Month Response to NRC Generic Letter 2008-01
2. Regulatory Commitment List

cc: NRC Region I Administrator
NRC Resident Inspector
NRC Project Manager
Director BRP/DEP
Site BRP/DEP Representative

This attachment provides the Beaver Valley Power Station (BVPS) nine month response requested in Generic Letter (GL) 2008-01, "Managing Gas Accumulation in Emergency Core Cooling, Decay Heat Removal, and Containment Spray Systems," dated January 11, 2008. It provides:

- A description of the results of evaluations that were performed pursuant to the requested actions,
- A description of the corrective actions determined necessary to ensure compliance with the quality assurance criteria in Sections III, V, XI, XVI, and XVII of Appendix B to 10 CFR Part 50 and the licensing basis and operating license with respect to the subject systems, and
- A statement regarding which corrective actions have been completed, the schedule for the corrective actions not yet complete, and the basis for that schedule.

In addition, this attachment responds to the September 15, 2008, NRC request for clarification of information that was previously provided in the BVPS three month response dated April 11, 2008.

Scope

In the initial BVPS response to GL 2008-01, the following systems were determined to be within the scope of the Generic Letter evaluations:

- High Head Safety Injection (HHSI) system
- Low Head Safety Injection (LHSI) system
- Quench Spray (QS) system
- Recirculation Spray (RS) system
- Residual Heat Removal (RHR) system

The portions of the system piping included in the evaluation are those providing the Emergency Core Cooling System (ECCS), Quench Spray, and Recirculation Spray primary piping flow paths required for system operability, including interconnecting piping such as recirculation flow test piping, to the first normally closed isolation valve.

Specifically, for HHSI, the piping boundary includes the piping from the ECCS suction source (i.e., the Refueling Water Storage Tank (RWST)), connections with the LHSI system up to the associated pumps, and the pump discharge flow path to the Reactor Coolant System (RCS) cold or hot leg piping. Normally operating portions of the Charging/High Head Safety Injection (CH/HHSI) piping that perform the charging and chemical and volume control functions of the system were not included in the scope of the evaluation, since the system maintains constant flow.

The normal minimum recirculation flow paths are defined to be from each HHSI pump discharge piping connection back to the RWST. These flow paths include multi-stage flow orifices that were previously found to be stripping non-condensable gases from the recirculation flow and were major sources of gas in the ECCS system. By 1998, these flow orifices were redesigned and replaced to eliminate them as a source of gas. A site procedure, 3BVT 01.11.04, "Void Monitoring," is periodically performed to identify gas voids in portions of the ECCS systems.

The LHSI system piping boundary includes the piping from the ECCS suction sources (i.e., the RWST for both units and the Containment Emergency Sump for Unit 1), to the associated pumps and the pump discharge flow path up to the RCS cold or hot leg piping or the HHSI suction piping.

The Quench Spray system piping includes the piping from the suction source (RWST) to the associated pumps and the pump discharge flow path to the normally closed containment isolation motor-operated valves. The discharge lines downstream of the isolation valves at BVPS-1 are filled up to the piping Loop Seal, downstream of that point they are dry until an emergency signal. At BVPS-2, all the piping downstream of the discharge isolation valves is dry until the QS pumps start on an emergency signal. Water hammer on the startup of the QS system [including the automatic start in response to an Engineered Safety Feature (ESF) signal during a Design Basis Accident (DBA)] was considered in the original BVPS system design calculations.

The Chemical Addition subsystem of the Quench Spray flow path was determined to be outside the scope of this review. An existing analysis for the Unit 1 QS system used vendor information that a void of 10% of impeller swept volume for a 10 second transient would not degrade QS pump operation. The Unit 1 Chemical Addition discharge lines, being of smaller diameter than the connecting QS lines, could be fully voided (void volume less than void of 10% analyzed above) and the QS system impeller sweep criterion would not be exceeded, given the high QS flow rates. No calculation was performed for the Unit 2 Chemical Addition flow path. There is no required acceptance criterion because the system is filled by the Chemical Addition tank's static head and no voids are expected.

The Recirculation Spray system piping providing the ECCS flow path is also designed to be maintained in a dry condition. Water hammer on the startup of the RS systems (including the automatic start in response to an ESF signal during a DBA) was considered in the original BVPS system design calculations. Therefore, no additional evaluations of the RS systems were necessary.

Evaluations performed since the date of the three-month response determined that the Residual Heat Removal system is not credited as part of the design basis for the removal of decay heat as described below; therefore, evaluation of the non-credited RHR system for gas accumulation issues was determined not to be necessary in order to show that BVPS Units 1 and 2 can reliably remove decay heat from the core.

The RHR systems at both Unit 1 and Unit 2 are not credited with accident mitigation and do not act as ECCS systems. The RHR systems at BVPS have no automatic functions and receive no ESF start signals. Furthermore, the BVPS RHR systems are not the decay heat removal system credited with meeting General Design Criterion (GDC)-34 during accident conditions.

The decay heat removal function during limiting Design Basis Accidents (DBAs) is provided by recirculating Safety Injection and Recirculation Spray system water from the Containment Sump. These systems are fully redundant, single-failure proof safety-related systems and are discussed as part of the GL 2008-01 review scope.

In normal operating shutdowns and non-limiting DBAs, the decay heat removal function at the BVPS units can be provided by RHR if it is available, though not credited for accident mitigation. The function can also be provided by the plant power conversion system (specifically, the safety-related Atmospheric Steam Dump sub-system of the Main Steam system), which is not subject to voiding since it does not employ pumps or use subcooled water. The source of water for this method of decay heat removal is the Auxiliary Feedwater system, which has suction piping filled by static pressure head from the Primary Plant Demineralized Water Storage Tank at each unit.

BVPS-1 is not licensed as a cold shutdown plant. The Residual Heat Removal Heat Exchangers use Reactor Plant Component Cooling Water (CCR) to remove heat. As discussed in the NRC Questions and Answers to the original BVPS-1 Final Safety Analysis Report (FSAR), Question 9.1-10, upon a postulated "loss of the component cooling water, the reactor would be brought to safe shutdown, or hot standby condition, with all reactor coolant pumps tripped. Residual heat removal and control of the primary system temperature, pressure, and volume can be achieved in this shutdown mode for an indefinite period during which time restoration of the component cooling water flow can be accomplished. Decay heat will be removed by the normal means (i.e., using the main condenser and main feed pumps). If necessary, the auxiliary feed system and the atmospheric dump valves are also available for feeding and bleeding the steam generators to remove decay heat." Thus, the BVPS-1 licensing basis only required maintenance of Hot Standby, which represents an RCS temperature above 350°F (RHR can only be placed into service below this temperature).

BVPS-2 is considered to be an "Approach to Cold Shutdown Plant". As stated in Appendix 5A "Cold Shutdown Capability" of the BVPS-2 Updated Final Safety Analysis Report (UFSAR), Section 5.A.2 "Design Approach," "While the safe shutdown design basis for BVPS-2 is hot standby, the cold shutdown capability of the plant has been evaluated in order to demonstrate how the plant can achieve cold shutdown conditions following a safe shutdown earthquake, assuming loss-of-offsite power and the most limiting single failure." Note that Design Basis accident conditions are not mentioned. Section 7.4 contains a similar statement. Section 9.5.A "Fire Hazards Analysis" discusses use of RHR extensively, but only in the context of post-fire safe shutdown.

Since, as discussed above, RHR is not an automatic system at BVPS, any degradation of RHR due to voiding would not degrade decay heat removal capacity credited in the licensing bases. A reduction of decay heat removal cooling from RHR could be restored through the use of abnormal operating procedures, which have the operator observe pump current, flow and other symptoms, then stop, vent and restart the RHR pumps. Such action is permissible since the loss of cooling transient is not a rapid transient, and manual actions can be taken. In addition, the RHR system is designed to be operated in a reduced inventory condition (no keep-fill requirements). Therefore, no further evaluation of the RHR systems was performed as part of this GL 2008-01 review. However, procedure reviews were performed to ensure the RHR system is filled and vented prior to being placed in service manually.

A. EVALUATION RESULTS

The evaluations performed covered the following four major topics, as requested in the Generic Letter:

1. Licensing Basis Evaluation
2. Design Evaluation (Including Reviews of Initial Fill and Vents)
3. Testing Evaluation (Including Reviews of Periodic Verifications)
4. Corrective Action Program Evaluation

Corrective actions resulting from each of the following evaluations are compiled and summarized in Section C, "Compilation Of Corrective Actions, Schedules, And Basis."

1. Licensing Basis Evaluation

A summary of the BVPS Licensing Basis Evaluation information that establishes the foundation for the subsequent Design, Testing, and Corrective Action Evaluations is provided below for the following Licensing Basis documents:

a) Updated Final Safety Analysis Report (UFSAR),
b) Technical Specifications (TS) and TS Bases,
c) Licensing Requirements Manual (LRM) and LRM Bases (as applicable),
d) Responses to NRC Generic Communications,
e) NRC Commitments, and
f) Operating License.

1a) Updated Final Safety Analysis Report (UFSAR)

The BVPS UFSARs for Units 1 and 2 contain discussions relevant to managing gas accumulation in ECCS systems. The introduction of non-condensable gases such as those that may be present in the Emergency Core Cooling Systems (ECCS) into a Pressurized Water Reactor (PWR) such as BVPS has already been addressed through the resolution of a Three Mile Island (TMI) Action Plan Item No. II.B.1, "Reactor Coolant System Vents," as discussed in both UFSARs. This included addition of Reactor Coolant System Head Vents at both units, and for Unit 2, credit for the Pressurizer Power Operated Relief Valves (PORVs) to remove any non-condensable gases that might get swept into the reactor vessel. (Reference Unit 1 UFSAR Section 4.2.11; Unit 2 Sections 5.4.13, 5.4.15, and 7.8.4)

Discussions about conformance to the General Design Criteria (GDCs) listed in GL 2008-01 (GDC 1, 34, 35, 36, 37, 38, 39, and 40) are included in the BVPS Unit 1 and 2 UFSARs. For Unit 1, the plant was not designed and constructed to the 1971 GDCs, but to earlier 1967 criteria as discussed in UFSAR Section 1.3.2. One notable point about these earlier criteria is that they did not explicitly address decay heat removal in the same fashion as GDC-34 later did. Simply for reference, the BVPS-1 UFSAR does include a cross-reference to the 1971 GDCs, in Appendix 1A. For Unit 2, discussions about the GDCs are found in Section 3.1.2, "Criterion Conformance" along with information provided in other system-specific sections. Information on which GDCs apply to each of the subject systems is provided in Section 2a, "Design Basis Document Review," below.

No changes to the BVPS UFSARs are required.

1b) <u>Technical Specifications (TS) and TS Bases</u>

The BVPS Technical Specifications and their Bases contain several items related to precluding introduction of gas into the ECCS systems.

Engineered Safety Features Actuation System (ESFAS) Specification 3.3.2 contains requirements for the Refueling Water Storage Tank (RWST) level instruments at the Low and at the Extreme Low level points in order to prevent ingestion of air if the tank level was to be drawn down too low (see Table 3.3.2 -1 Items 2.b (2) and 7.b, and the Bases for these Functions).

Other relevant TS requirements are found in Specification 3.5.4, "Refueling Water Storage Tank," which places a limit on the available water volume in the RWST. This specification ensures that the RWST contains a sufficient initial supply of borated water to support the Quench Spray system and the ECCS systems during the injection phase.

The BVPS Technical Specifications do not contain a surveillance requirement to perform periodic checks for gas accumulation. As part of the conversion to the improved Technical Specifications, an extensive periodic verification program that was incorporated into plant procedures following a previous gas intrusion occurrence was described on the docket and accepted by the NRC in lieu of a Surveillance Requirement in the Technical Specifications. These periodic ultrasonic tests (UT), which are performed on portions of the ECCS piping per the Corrective Action Program to determine if voids are present in portions of the ECCS piping, are controlled by site procedure 3BVT 01.11.04, entitled "Void Monitoring."

Technical Specification (TS) improvements are being addressed by the Technical Specification Task Force (TSTF) to provide an approved TSTF Traveler for making changes to individual licensee's TS related to managing 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. FirstEnergy Nuclear Operating Company (FENOC) is continuing to support the industry Gas Accumulation Management Team activities regarding the resolution of generic TS changes via the TSTF Traveler process. After NRC approval of the Traveler, FENOC will evaluate its applicability to the Beaver Valley Power Station, and evaluate adopting the Traveler.

1c) Licensing Requirements Manual (LRM) and LRM Bases

The administrative requirements that maintain the functionality of the Reactor Coolant System Vents (see the UFSAR discussion above) are contained in the Unit 1 and Unit 2 LRMs in Section 3.4.5. No changes to the BVPS LRMs are required.

Appropriate periodic checks of the ECCS piping for voids are accomplished through procedures established as a result of previous evaluations. As discussed in Section 3, "Testing Evaluation," additional accessible locations on both the suction and discharge side piping of the ECCS and Quench Spray systems are being added to the site Void Monitoring procedure.

1d) Responses to NRC Generic Communications

The BVPS Unit 1 and 2 responses to Generic Letter 88-17, "Loss of Decay Heat Removal," and Generic Letter 97-04, "Assurance of Sufficient Net Positive Suction Head for Emergency Core Cooling and Containment Heat Removal Pumps," were provided to the NRC and were determined to be acceptable through the NRC inspection process and/or NRC review and approval of the submitted information.

These responses were reviewed, and no necessary changes were identified.

1e) NRC Commitments

Regulatory commitments were made in the three-month response to GL 2008-01. The Unit 1 commitment states that "Any piping segments that are determined to need in-field verification, but have not received it prior to the nine month GL 2008-01 response, will be in-field verified no later than restart from the next refueling outage, which for Unit 1 is currently scheduled for the spring of 2009." This commitment is still in effect.

The Unit 2 commitment states that "Any piping segments that are determined to need in-field verification, but have not received it prior to the nine month GL 2008-01 response, will be in-field verified no later than restart from the next refueling outage after the nine month response, which for Unit 2 is currently scheduled for the fall of 2009." This commitment is being closed with this submittal, because the necessary Unit 2 in-field verifications have been completed and the evaluation of the Unit 2 information is summarized within this attachment.

As requested by the NRC in a letter dated September 15, 2008, and as clarified in subsequent discussions with the NRC staff, a summary of the results of the evaluations of the remaining BVPS-1 in-field piping segment verifications will be submitted to the NRC within 90 days after startup from the next Unit 1 refueling outage.

1f) Operating License

The BVPS-1 and BVPS-2 operating licenses, including license conditions, were reviewed and no issues were identified.

2. Design Evaluation (Including Reviews of Initial Fill and Vents)

A summary of the information from the BVPS Design Evaluation is provided below for the following topics:

a) Design Basis Document Review
b) Acceptance Criteria Review
c) Drawing Review
d) Fill and Vent Review
e) Gas Intrusion Review
f) Ongoing Industry Programs
g) System In-Field Verifications

2a) Design Basis Document Review

Design basis documents were reviewed, including calculations, engineering evaluations, and vendor technical manuals, with respect to gas accumulation for the systems within the scope of the review.

Note that one generic industry issue currently being addressed per an initiative separate from this GL is Generic Safety Issue 191(GSI-191), "Assessment of Debris Accumulation on PWR Sump Performance." Resolution of this issue is ongoing, and includes sump strainer head loss testing for the specific BVPS sump configurations. With respect to gas intrusion/vortexing issues, the BVPS-1 sump strainer test report has documented that no vortexing occurred during the test, and the BVPS-1 analysis concludes that enough sump strainer submergence would exist to ensure void fractions well under the 2% continuous acceptance criterion discussed in Section 2b, "Acceptance Criteria Review," below. The BVPS-2 sump strainer testing is ongoing. The BVPS-2 analysis will be completed following the performance of the BVPS-2 specific sump strainer testing. These issues will continue to be pursued through industry leadership organizations and will not be addressed further herein.

Each of the 10CFR50 Appendix A General Design Criteria listed in Generic Letter 2008-01, along with 10 CFR 50.46, was examined to identify the in-scope systems that apply to each:

- HHSI: The BVPS-1 High Head Safety Injection systems meet the intent of General Design Criteria (GDC) 1, 35, 36 and 37. BVPS-2 High Head Safety Injection systems meet General Design Criteria (GDC) 1, 35, 36 and 37. The core cooling criteria of 10CFR50.46 are met by the Safety Injection (SI) systems, according to the BVPS analyses of record. These criteria include the removal of decay heat (the subject of GDC 34) as explained in Section 6.3.1 of the BVPS-1 UFSAR and Sections 3.1.2.34 and 6.3.3 of the BVPS-2 UFSAR.
- LHSI: The BVPS-1 Low Head Safety Injection systems meet the intent of GDC 1, 35, 36 and 37. BVPS-2 Low Head Safety Injection systems meet GDC 1, 35, 36 and 37. The core cooling criteria of 10CFR50.46 are met by the SI systems, according to the BVPS analyses of record.
- QS: The BVPS-1 Quench Spray system meets the intent of GDC 38, 39 and 40. The BVPS-2 Quench Spray system meets GDC 38, 39 and 40.Air entrainment degrading this function is unlikely, given the high QS velocities and spray delay allowances.
- RS: The BVPS-1 Recirculation Spray system meets the intent of GDC 38, 39 and 40. The BVPS-2 Recirculation Spray system meets GDC 38, 39 and 40. In a DBA loss-of-coolant accident (LOCA), the system also provides decay heat removal (the subject of GDC 34).

Many plants in the industry utilize 'keep-fill" systems. However, none of the BVPS systems within the scope of this review utilize an active pumping mechanism in order to keep the piping sufficiently full of water. The RWST provides a head source that passively fills the suctions of the LHSI and Quench Spray pumps. The RWST also provides a head source that passively fills the suction piping of the HHSI/Charging system from the RWST to the normally closed isolation valves between the RWST and HHSI pumps.

Several of the systems within the scope of the review are designed such that all or a portion of the piping is normally voided, with no water in the piping section. For these sections, the GL concept of filling, venting, and ensuring the piping remains sufficiently full of water is not applicable. This applies to the following systems:

- QS: The Quench Spray system at each BVPS unit has water in the suction lines from the RWST through the normally open suction valves and the QS pump casing to the discharge isolation valves. The discharge lines downstream of the isolation valves at BVPS-1 are filled up to the piping loop seal; downstream of that point they are dry until an emergency signal is received. At BVPS-2 all the piping downstream of the discharge isolation valves is dry until the QS pumps start on an emergency signal.
- RS: The RS systems at both units are designed to be dry on suction and discharge sides until an emergency signal coincident with an RWST Low Level signal starts the system during a DBA.

System realignments during design basis actuations were examined to ensure that the piping would remain full during such evolutions. The realignments were reviewed to ensure the proper sequencing of suction isolation valves to maintain the piping full of water. Also, resulting system flow paths were reviewed to ensure affected piping segments would be acceptably full of water once the realignment occurs.

The following issues were addressed as part of the realignment review.

- At BVPS-1, this review identified one issue to be investigated by in-field verifications. The in-field verifications showed that a small section of piping leading from the Containment Sump to the LHSI Pump Suctions contained a void immediately upstream of the normally closed Sump Suction Isolation valves in each train. The system was filled and vented, which reduced the void to an acceptable size. This issue has been entered into the FENOC Corrective Action Program for determination of additional actions.
- At BVPS-2, when transferring to Safety Injection Recirculation Mode, some gas may be present in the RS to HHSI/Charging cross-connect piping in each train. However, these locations are directly connected to the RS spray header lines and any voids present in the cross connect piping would be swept out of that piping segment through the RS spray rings approximately four minutes before the Transfer To Recirculation signal would occur. Therefore, the injection piping is full of water by the time the RS to HHSI cross-connect flowpath realignment actually occurs. The overall conclusion of the realignment reviews was that the piping would remain acceptably full during such evolutions.

An important parameter to ensure gas is not introduced into system piping is the vortex correlation used to establish minimum water level setpoints or manual actions credited in the design basis LOCA. For the HHSI and LHSI systems, Technical Specification-controlled setpoints were found to initiate transfers at appropriate suction source levels in tanks such as the Refueling Water Storage Tank (RWST), to ensure adequate Net Positive Suction Head (NPSH) and no vortexing.

The LHSI pumps at BVPS-1 also take suction from the containment sumps, and BVPS-1 has specific documented vortex testing for the Containment Sump Strainer, which concluded no vortexing would occur when drawing suction through the sump strainers. BVPS-2 reviews of the sump are ongoing, as discussed above.

For the QS system, the tank levels at which the Emergency Operating Procedures direct shutdown of the system were found to be acceptable. For RS, the pumps are automatically started when RWST level reaches a Technical Specification controlled setpoint. These pumps then take suction from the containment sump. No vortexes are expected, as documented in the BVPS-1 sump testing referenced above.

As illustrated by industry operating experience (OE), one method of introducing gas into piping is from interconnecting tanks or systems that operate at a higher pressure than the injection system itself. The QS and RS systems do not have such interfaces with other high pressure systems. LHSI only interfaces with the Reactor Coolant System (RCS). At both Unit 1 and Unit 2, at least two check valves in every pathway to the RCS are periodically leak tested per the Inservice Testing Program (IST) to ensure leakage from the Reactor Coolant System to the LHSI does not occur. For the HHSI system, due to the suction piping interface with the Volume Control Tank (VCT), which results in the possibility of gas intrusion, BVPS has developed a void-monitoring program which periodically (monthly) monitors for potential gas in the suction piping of the ECCS systems. Like LHSI, the HHSI discharge piping that interfaces with the RCS also has multiple check valves that are periodically leak tested per the IST program.

The mission time for pump operation is considered in the acceptance criteria discussions in Section 2b, below. For the purposes of the gas intrusion reviews, with one exception, the mission time was considered to be 30 days, as set by the duration of the post-DBA dose analyses of record, and mentioned in certain sections of the BVPS-1 and BVPS-2 UFSARs, specifically in relation to DBA LOCA discussions. The exception is Quench Spray, which is manually stopped upon reaching an RWST low level signal within one hour after a large LOCA at BVPS-1, and within approximately 2.6 hours at BVPS-2.

Potential effects of a void on the safety analyses for the core and the containment pressures and temperatures were evaluated.

- HHSI & LHSI: The Pressurized Water Reactor Owners' Group (PWROG) qualitatively evaluated the impact of non-condensable gases entering the RCS on the ability to maintain the post-accident core cooling functions. This evaluation assumed that 5 cubic feet of non-condensable gas at 400 psig was present in the HHSI discharge (or suction) piping concurrent with 5 cubic feet of non-condensable gas at 100 psig in the LHSI discharge piping. The qualitative evaluation concluded that these quantities of gas will not prevent the ECCS from performing its core cooling function. The study also concluded RCS natural circulation would not be degraded if the amount of voiding evaluated collected in the steam generator U-tubes.

  Note that this gas would compress when at higher pressures than those postulated by the PWROG. This compression concept is relevant because in a large LOCA at BVPS the HHSI system begins injecting into the RCS at approximately 1850 psig, while the LHSI system would begin injection at 250 psig, which means a 5 cubic foot void at the baseline pressures assumed by the PWROG would be even smaller at BVPS when actually injected and, therefore, would have even less of an impact on injection time than was assumed.

- QS: This system does not interact with the fuel. The system already contains sections of empty pipe, and the safety analyses accommodate the time to fill pipe prior to start of the spray. The Quench Spray system suction piping was not previously included within the site Void Monitoring procedure. However, accessible Quench Spray piping is being added to the scope of a corrective action that has been created to ensure locations that are considered to be vulnerable to air entrapment in the piping on the suction and discharge side of the systems within the scope of GL 2008-01 remain full of water.

- RS: This issue is not applicable to Recirculation Spray at BVPS-1. For BVPS-2, the system is also normally empty. However, the BVPS-2 system is employed in the long term SI recirculation mode, in which two of the Recirculation Spray pumps are aligned to the suction of the HHSI/Charging pumps. The Recirculation Spray pumps would take suction from the containment sump and a continuous void may be introduced. In that case, the GSI-191 evaluation mentioned in Section 2b (Acceptance Criteria Review, below) would be applicable.

Existing BVPS evaluations of void size acceptability were also reviewed.

- HHSI: Analyses exist for HHSI/Charging Pump suction piping voids, based on pump operability considerations. These analyses were developed as a result of various gas intrusion events at BVPS between 1997 and 2002, which were individually addressed in the BVPS Corrective Action Program. These analytical values were translated into the periodic Ultrasonic Test

(UT) inspection acceptance criteria. These acceptance criteria are based on the "5% void fraction at the pump suction for transient conditions not expected to be greater than 5 seconds" criteria discussed below in Section 2b, "Acceptance Criteria Review."

- LHSI: There have been no analyses performed for the BVPS-1 or 2 Low Head SI pumps as regards system voids on the LHSI pump suction or discharge lines themselves. Only the piping that cross connects to the HHSI/Charging system suction has an established void criteria. As a result of a previous event, the fill and vent procedures for LHSI were revised to use vacuum fill as a primary option. The fill and vent also requires an ultrasonic test of selected piping after the evolution is completed.
- QS: An analysis for BVPS-1 was developed as a result of a previous event due to a maintenance evolution, which employed information supplied from the pump vendor. This analysis has not been translated into any test acceptance criterion, since no similar events have occurred. At BVPS-2, no evaluations have been performed.
- RS: Recirculation spray has no such evaluations at either unit.

The design control program was reviewed to ensure that the Design Interface Review Checklists (DIRCs) have an explicit line item to determine if the design change introduces or increases the potential for gas accumulation. These checklists and the overall Design Control Program were found to properly address this issue.

2b) <u>Acceptance Criteria Review</u>

As detailed below, specific acceptance criteria have been developed for certain portions of the subject piping systems, based on pump vendor input and industry/consultant information. In these piping sections, if voids are discovered during the periodic UT verifications that are being performed (see Section 3, Testing), the established acceptance criteria can be applied. In other piping segments for which specific acceptance criteria have not been developed, a void that would be discovered would be evaluated under the Corrective Action Program (CAP) to determine the appropriate actions.

- HHSI: Specific sizing acceptance criteria for discovered voids (which translate to a 5% void fraction at the pump suction for transient conditions) were established for the known vulnerable locations (i.e., HHSI/Charging suction piping and the portion of the LHSI to HHSI cross-connect piping downstream of the normally closed LHSI cross connect isolation valves). This acceptance criteria is documented in design calculations.
- LHSI: As discussed above, there is a portion of the LHSI system to which the 5% void fraction (at the HHSI pump suction) for transient conditions

acceptance criterion described above applies. Also, for Unit 1, during a portion of the response to postulated events, the LHSI pumps draw suction from the containment sumps. Therefore, theoretically, a potential for continuous gas ingestion may exist, so an acceptance limit of a maximum 2% continuous void fraction is placed on this suction from the containment sump. See the discussion of this 2% limit in the RS discussion below (RS also takes suction from the containment sump, for both units). This 2% limit does not apply to the Unit 2 LHSI, since LHSI on Unit 2 only takes suction from the RWST, which is not a possible source for a continuous ingestion due to the substantial head provided by that tank and its Technical Specification controlled setpoints.

- QS: There is no required acceptance criterion because the system is filled by RWST static head and no voids are expected. An existing analysis for the BVPS-1 QS system performed in 2003 (see Section 2a above) concluded that a void of 10% of impeller swept volume for a 10 second transient would not degrade pump operation. These values were based on vendor information. As noted in Section 2a above, this analysis has not been translated into any acceptance criterion. For Unit 2, no calculations have been performed; however, as noted above, they are not necessary.
- RS: No BVPS-1 or -2 criteria have been established. The system does not require analysis for an acceptable void size, since it is normally dry. However, once the system begins running in an event, it draws from the containment sump, so it is possible that some form of continuous ingestion could occur. Therefore, the 2% continuous void fraction discussed in NRC Regulatory Guide (RG) 1.82, Revision 3, is being employed in the BVPS-1 analysis for GSI-191. Incorporation of this acceptance criterion into design calculations is being addressed through the GSI-191 effort.

  The BVPS-1 analysis performed for the GSI-191 sump modifications for debris laden strainers concludes that the RS pumps will have minimal void fractions, while testing of the BVPS-1 Containment Sump Strainer indicated that vortexes will not develop. BVPS-2 sump strainer testing is to be performed and is expected to provide similar results and conclusions. Therefore, void formation is not foreseen as a likely concern. In addition, the RS system piping at both units has been analyzed for water hammer concerns, which were performed due to previous operating experience.

  The GL acceptance criteria reviews verified that the acceptance criteria for pump suction voiding that have been established account for pump operability under flowing conditions, representing both normal operating flow and post-DBA flow for the worst case design basis accident postulated.

The established acceptance criteria for voiding were reviewed to confirm the criteria would address the concern of water hammer in the discharge portion of the piping.

- HHSI: The UT acceptance criteria that are being applied at BVPS on the suction side of the pumps are sufficient to ensure that significant water hammer is prevented after the voids are swept through the pump impeller into the discharge piping. BVPS-1 and 2 have experienced significant HHSI/Charging suction piping voiding in the past, which in one case led to pump damage (Institute of Nuclear Power Operations (INPO) Significant Operating Experience Report (SOER) 97-01). Those events, however, did not cause piping damage in the suction or discharge piping. Therefore, the establishment of void acceptance criteria at BVPS-1 and 2 that were set to ensure operability of the pump also ensures that pipe loadings caused by future air ingestion would remain bounded by the loading experienced during the previous events. Furthermore, air drawn into the HHSI/Charging pumps would be dispersed into an air/water mixture after passing through the multi-stage impellers. The resulting entrained air, with smaller voids, is not judged to pose a water hammer concern. Operating experience has demonstrated that such small entrained air bubbles in the fluid stream actually act to reduce fluid dynamic loading. As identified in the Testing Evaluation in Section 3, to ensure that the piping on the suction and the discharge side of the systems within the scope of GL 2008-01 remain sufficiently full of water, locations considered to be vulnerable to air entrapment will be included within the site Void Monitoring procedure.

- LHSI: The LHSI system is filled and vented with vacuum-assisted fill in accordance with procedures. Water hammer is, therefore, not expected, except possibly as a result of gas that might accumulate in the portion of the BVPS-2 LHSI cross connect piping between the BVPS-2 RS pumps and the HHSI/Charging suction discussed above in the "System Realignment" discussion. A fluid dynamics analysis was performed for that section of piping (due to its potential to trap air) and the downstream piping that could potentially be impacted, concluding that the piping and its supports are qualified for resulting loadings.

- QS: Portions of the Quench Spray piping at both BVPS-1 and BVPS-2 are initially empty by design. The dynamic fill of these lines during spray actuation in a DBA has been analyzed and incorporated in the piping loading and support design calculations.

  The BVPS-2 Quench Spray system was identified per NUREG-0582, "Water Hammer in Nuclear Power Plants," as having potential for significant water hammer. Of the nine mechanisms identified in NUREG-0582, five were identified as being applicable to the Quench Spray system.

The piping calculations for the system evaluated each of these five mechanisms and they were all found to be adequate.

- RS: The Recirculation Spray piping at both BVPS-1 and BVPS-2 is initially empty by design. The dynamic forces created by the fill of these lines during spray actuation in a DBA have been analyzed for both BVPS-1 and 2 and incorporated in the piping loading and support design calculations.

  The BVPS-2 RS system was identified per NUREG-0582 as having potential for significant water hammer. Of the mechanisms discussed in the NUREG, five were identified as being applicable to the Recirculation Spray system. The piping calculations for the system evaluated these mechanisms. Normal pump startup into empty lines and the full flow pump test are analyzed in fluid transient calculations.

As noted in the Section 2a Design Basis Document Review above, the PWROG performed a qualitative analysis to illustrate that the ECCS fuel analysis would not be significantly impacted by gas intrusion. That analysis included assumptions about void sizes that might get swept into the vessel from the ECCS systems. It is considered a conservative action to adopt those assumptions as acceptance criteria for future void analysis, unless larger voids are later analyzed to be acceptable on a plant-specific basis. A corrective action will track incorporation of the void sizes specified by the final version of the PWROG RCS Allowable Gas Intrusion Report into design calculations, for use in future design evaluations.

2c) <u>Drawing Review</u>

Isometric drawings, flow diagrams and Valve Operating Number Diagrams (VONDs) for the systems within the scope of Generic Letter 2008-01 were reviewed for horizontal pipe runs and vent locations on high points. Simplified one line isometric drawings were developed and used to identify potential high points where gas accumulation may occur.

Acceptance criteria were established to screen out sections of piping that are not vulnerable to potential air entrapment. High points and inverted U areas that may trap air in the systems within scope were identified. Locations considered potentially vulnerable to air entrapment were evaluated using Froude numbers and ultrasonic testing. Once the high point or inverted U was identified, an evaluation was performed to determine the Froude number for that particular section of piping (HHSI/LHSI) to assess whether a potential gas void would remain in the piping or would be flushed out to the vessel during full flow tests. The High Head and Low Head Full Flow tests are performed during an outage at the end of the HHSI and LHSI work window. An ultrasonic test (UT) of the specific locations with air entrapment vulnerability was also performed to verify the piping is acceptably full of water. If the Froude number was large enough to sweep a void and the ultrasonic test identified the piping to be full of water, then the specific location identified to be vulnerable to air entrapment was not considered for a future vent valve installation. The evaluation concluded that the Froude numbers were high enough to sweep voids to the vessel; therefore, the discharge side of the ECCS pumps to the vessel will be sufficiently full of water after the HHSI/LHSI Full Flow tests performed every outage.

The results of the ultrasonic testing for the Unit 1 discharge side of the ECCS and Quench Spray system up to the containment penetrations and the Unit 2 discharge side of the ECCS and Quench Spray system including piping in Containment did not identify gas voids. The piping accessible at the high points and inverted U's were full of water. Design engineering confirmed accessible and inaccessible piping locations have Froude numbers large enough to sweep a void; therefore, a void would be flushed out to the vessel or the spray rings.

2d) <u>Fill and Vent Review</u>

The following fill and vent discussions address initial fill and vents following system outages or maintenance that may involve introduction of gas into the system as an expected part of the evolution. Such voids, intentionally introduced as part of a maintenance activity, are not quantified or tracked, because the amount of gas released will vary depending on the amount that was introduced during the work on the system. Periodic checks that ensure the piping remains full after such initial fill and vents are discussed in Section 3, "Testing Evaluation."

As a result of industry operating experience, BVPS venting procedures were previously revised. Alternatives to venting, such as vacuum assist rigs to evacuate the system, were also provided. In addition, procedural guidance and valve lineup verifications are used extensively during maintenance of plant components to prevent gas intrusion. When appropriate, fill and vent procedures require a UT inspection to confirm no gas void exists in the applicable piping at the completion of the filling process.

Procedure reviews were performed for each of the systems within the scope of the GL review. The reviews examined site procedures for filling and venting for the following concepts:

- venting activities are controlled by an approved operating procedure
- procedures exist to vent all locations where gas may accumulate using existing vent valves
- venting procedures and practices utilize effective sequencing of steps, adequate venting durations, and acceptance criteria for the completion of venting

- dynamic venting methods are effective at locations where dynamic venting is used (adequate flowrates/fluid velocities)
- vacuum fill operations are used for piping sections which are difficult to fill and vent following maintenance
- fill and vent procedures default to NOP-LP-2601, "Procedure Use and Adherence", if the maintenance work scope or boundaries change from those assumed in the procedure
- incorporate verification techniques to validate that systems are sufficiently full of water following fill and vent, based on quantification of any remaining gas void against the established acceptance criteria. Unvented gas that remains after an initial system fill and vent is quantified, trended and justified.
- venting of instrument lines, including the backfilling of level and flow transmitters, is included in venting procedures

The above reviews concluded that the existing procedures were adequate; however, a number of enhancements were identified, and have been entered into the Corrective Action Program.

Unit 1 and 2 RHR system procedures were reviewed to ensure the RHR system is filled and vented prior to manually being placed in service. The review concluded that the RHR startup procedures address voids adequately, and system operating experience reviews indicate that this practice has been effective. No further action is required for this issue.

2e) <u>Gas Intrusion Review</u>

Areas of potential gas intrusion into each system and each piping segment vulnerable to subsequent gas accumulation were assessed.

A site "Void Monitoring" procedure is performed monthly to ensure a gas void does not affect the operability of susceptible portions of the ECCS systems. The following possible leak paths would be identified during performance of the Void Monitoring procedure.

- Leakage from the accumulators or other high-pressure sources
- Dissolved gas coming out of solution due to a pressure reduction through control valves, orifices and ECCS sump screens or because of elevation changes or venting
- Leakage through isolation valves or check valves
- Leakage through vent valves during plant outages or maintenance activities when the local system pressure is less than normal atmospheric pressure

The possibility of gas being introduced as a result of inadvertent draining, system realignments and incorrect maintenance and testing procedures was also considered. Because BVPS does not utilize keep-fill systems, that part of this area of concern does not apply. For planned maintenance, the proper fill and vent of the system after work is complete is addressed in Section 2d, "Fill and Vent Review."

The potential for leakage through check valves from the Reactor Coolant Hot/Cold Legs into the HHSI and the LHSI was evaluated. At both Unit 1 and Unit 2, at least two check valves in every pathway are periodically leak tested per the Inservice Testing Program (IST) to ensure leakage from the Reactor Coolant system to the HHSI/LHSI does not occur. The BVPS response to INPO SOER 97-01 concluded that there are no vulnerabilities with respect to backleakage from the RCS. Therefore, thermocouple monitoring is not required.

Air in-leakage through system pathways which allow drainback to the system has been addressed at some plants. At BVPS, however, none of the systems in the scope of Generic Letter 2008-01 allow for drainback.

Another industry issue is that gas can be introduced from suction sources due to formation of air entraining vortices or by not isolating the suction source before it is completely drained. The setpoints for the RWST Transfer to Recirculation are based on ensuring the Recirculation Spray Pumps and the Low Head SI Pumps (at BVPS-1) have adequate NPSH. An assessment found that the BVPS-1 setpoint value of 14 feet above tank bottom is sufficient to prevent vortex formation. The equivalent BVPS-2 RWST setpoint is 31 feet 9 inches. The suction of the BVPS-2 HHSI and LHSI connection to the RWST would be adequately protected from vortex formation based on the conclusions of the BVPS-1 assessment, since the BVPS-2 RWST minimum level is even greater.

Air operated valve designs were reviewed for potential to leak air into the system. The actuator designs used at Beaver Valley provide no flow path between the compressed air and the process pipe. Anticipated wear and tear or anticipated part failures will not provide a leak path for compressed air to enter the process piping.

Finally, failure of level instruments to indicate the correct level for tanks used as a pump suction source can result in gas intrusion. The ECCS systems were reviewed for potential gas intrusion from a single failure of a level sensing element in the Volume Control Tank (VCT), Boric Acid Tanks (BAT), Boric Acid Batch Tank (BABT), and the Refueling Water Storage Tank (RWST). For the VCT, BAT and RWST instruments, multiple channels provide indication in the Control Room. Upon a failure of one channel, at least one channel remains available to provide accurate indication. Additionally, there is no common reference leg between the level transmitters, providing assurance that a single failure at either unit will not result in gas intrusion. For the BABT, only one level instrument exists to monitor level. If the instrument would fail with the BABT in operation, the tank is only feeding the Boric Acid Transfer pump which recirculates through the BAT. In this mode, there is not a path for gas intrusion into the ECCS.

2f) Ongoing Industry Programs

Ongoing industry programs may impact the conclusions reached during the design evaluation of BVPS relative to managing gas accumulation. These activities are being monitored to determine if additional changes to the BVPS design may be required or desired to provide additional margin or reduce vulnerability to gas intrusion.

2g) System In-Field Verifications

In 2002, a review was performed to evaluate each of the points that were being ultrasonically tested (UT) on a periodic basis in accordance with the BVPS Void Monitoring procedure. The purpose of the review was to validate that the points being UT-checked were the high points.

For Unit 1, in-field observations were performed and combined with reviews of the isometric drawings. Information from this evaluation was incorporated into the periodic Void Monitoring procedure.

For Unit 2, the piping isometric drawings include Quality Control (QC) verified dimensions that have proven to be accurate; therefore, an engineering evaluation determined that in-field verification was not required. A review of the piping isometrics for Unit 2 piping within the scope of the Void Monitoring procedure was completed and did not identify the need for changes to the monitoring points.

Due to the experience that has been obtained from the ongoing performance of the Void Monitoring procedure and the reviews of the program that were performed in 2002, it was determined that the portions of the ECCS systems that were already included in the Void Monitoring program did not require additional in-field verification.

The remainder of the piping segments that are within the scope of the GL 2008-01 response were reviewed in 2008, except for areas that were determined not to be accessible during this period or areas that were evaluated to not need in-field verification. Piping segments that are vertical or were otherwise known/evaluated to have acceptable slopes to a high point did not require detailed in-field verification.

BVPS-1 Sections of Piping Inside Containment

BVPS-1 piping for HHSI and LHSI from the Containment penetrations in to the RCS Hot/Cold leg connection could not be walked down since it is located in the Unit 1 Containment building, and Unit 1 did not have an outage during the evaluation period for GL 2008-01. The piping has been evaluated by the Design Review, Drawing Review, and Fill & Vent Review sections of this report, which did not identify areas of concern. Experience has shown that methods used to fill and vent the HHSI/LHSI systems have been adequate. Per the regulatory commitments established in the letter dated April 11, 2008 (L-08-131), this piping will be in-field-verified during the next refueling outage in spring 2009 (1R19). A summary of the results of the evaluations of the remaining in-field piping segment verifications will be submitted to the NRC within 90 days after startup from the next Unit 1 refueling outage.

BVPS-2 Sections of Piping Inside Containment

Laser scanning of the High/Low Head Safety Injection piping located in the Unit 2 Containment was performed during the spring 2008 refueling outage (2R13). The inspections ended at the connections for the Hot/Cold legs of the Reactor Coolant System. The piping configuration was found to be consistent with the QC verified isometric drawings. Numerous localized changes in slope within a horizontal piping run were identified by the laser scans. These locations have the potential for minor local void accumulation at the top of the pipe at the high point. Also, nominally horizontal piping segments that slope up toward a riser and thus have potential for a void in the horizontal pipe run to migrate up the riser and accumulate in the fitting or pipe at the top of the riser were identified. Accessible high points/inverted U locations were ultrasonically tested at the end of 2R13 and found to be full of water. Also, evaluations of the High/Low Head Safety Injection piping located in the Unit 2 Containment confirmed that it has Froude numbers greater than 1.1; therefore, if a localized void were to be present, it would be flushed out to the vessel during the High Head Full Flow operating surveillance test and the Low Head Full Flow operating surveillance test performed during an outage at the end of the HHSI/LHSI work window.

Reviews of Piping Located Outside of Containment Buildings

For piping outside of the scope of the Void Monitoring program and outside of the containment buildings, a Zip Level® was used to check discrete points on the piping in the accessible areas at Units 1 and 2. The verified piping was 1) the discharge side of the HHSI Pumps for both units, 2) the Quench Spray system for both units, and 3) the discharge side of the LHSI pumps outside of containment for both units. The in-field verifications verified the axial and circumferential locations of the vent valves were in the proper position to fill and vent the system. The in-field verifications did not identify major discrepancies when compared to the isometric drawings - the largest differences in elevation noted were less than 1.1 inches. Numerous localized changes in slope within a horizontal piping run were identified by the walkdowns. These locations have the potential for minor local void accumulation at the top of the pipe at the high points. Also, nominally horizontal piping segments that slope up toward a riser and thus have potential for a void in the horizontal pipe run to migrate up the riser and accumulate in the fitting or pipe at the top of the riser were identified. Such high points/inverted U locations were ultrasonically tested and found to be full of water except for the piping associated with the Unit 1 Containment sump suction valves to the LHSI pumps in each train, as discussed above in Section 2a, "Design Basis Document Review." The system was filled and vented, which reduced the void to an acceptable size. This issue has been entered into the FENOC Corrective Action Program for determination of additional actions.

For the remaining areas that were ultrasonically tested, no voids were identified. Additionally, design engineering has confirmed that piping on the discharge side of the HHSI/LHSI pumps has Froude numbers that are large enough to flush a void through the system; therefore, if a localized void were to be present, it would be flushed out to the vessel during the High Head Full Flow operating surveillance test and the Low Head Full Flow operating surveillance test performed during an outage at the end of the HHSI/LHSI work window.

During the in-field verifications done outside of the Containment building, several areas were inaccessible with a Zip Level® due to insulation, floor plugs, pipe trenches and physical restrictions. The sections of piping have been evaluated against the simplified one-line isometric drawings and found mostly to be the low points of the systems. Instead of removing insulation, floor plugs and accessing piping trenches, ultrasonic exams were performed at accessible high points of the piping runs. For inaccessible high points, evaluations concluded that a void would not exist. Certain of these areas are being added into the periodic Void Monitoring procedure, as determined appropriate during the evaluation.

Necessary BVPS-2 In-Field Verifications For GL 2008-01 Are Complete

With the completion of the Unit 2 in-field verifications and evaluations of the results, as summarized above, BVPS-2 has completed the necessary work to respond to this portion of GL 2008-01. Additional laser scanning was performed in September 2008, and more is planned in the future; however, this is only being performed as an independent verification of the physical in-field verifications done with the Zip Level® discussed above. Evaluation of the scanning results is not necessary for response to the Generic Letter.

3. Testing Evaluation (Including Reviews of Periodic Verifications)

A summary of the BVPS Testing Evaluation is provided below, addressing the procedure review of gas accumulation periodic tests/verification checks.

The Void Monitoring procedure discussed previously includes periodic UT monitoring of portions of the piping for the ECCS, although it is not required by Technical Specifications. Also, both units have procedure requirements to vent the RHR pumps daily when operating in a reduced inventory condition.

The Void Monitoring procedure was reviewed to determine its effectiveness. The procedure is performed monthly and as directed by the system engineer (e.g., mode changes); however, the procedure allows for adjustment of test frequency by the system engineer. The procedure provides instructions for monitoring and, if necessary, venting gas voids to maintain those portions of the ECCS free of gas migration that could challenge availability/operability.

The procedure provides instructions for measuring and tracking void spaces in the ECCS piping. Per this procedure, BVPS engineering personnel track void sizes, and voids discovered during the checks are addressed through the Corrective Action Program. The detection of larger or unexpected voids requires additional evaluation to determine the impact on the system and may also require that additional piping be tested (depending on the location of the void) and that more frequent testing be performed. The Void Monitoring procedure addresses the appropriate method for venting sections of piping (vacuum or atmospheric) and provisions for collecting and analyzing a gas sample when possible. Unexpected voids identified are documented in the Corrective Action Program. The procedure has a sign off step to ensure a condition report is written for every unexpected void. The performance of this procedure has proven adequate to ensure the ECCS system on the suction side is sufficiently full of water to maintain system operability. However, the procedure is being expanded to incorporate periodic verifications in additional areas of the ECCS piping, primarily in discharge piping.

Currently, the Void Monitoring procedure is performed monthly entirely independent of maintenance or operation activities; therefore, there is no pre-conditioning of the system prior to the UT exams.

As part of the review of periodic, ongoing operating cycle activities that could affect gas accumulation, a review was performed to verify that gas intrusion does not occur as a result of inadvertent draining and system realignments. This procedural review was performed on a variety of periodic operational procedures, such as periodic valve leakage tests, penetration water tests, quarterly pump tests, procedures that change suction sources, and procedures that start pumps. Instrument and Control (I&C)/maintenance procedures were also considered. Due to experience gained with the Void Monitoring UT inspections, it has been seen that some procedures can move small voids along the piping; therefore, improvements have been made to those procedures to perform a fill and vent after performance, or to have a follow-up UT inspection performed. Testing procedures that attach hoses to the piping were reviewed to ensure the hoses were filled and vented prior to use so gas intrusion would not occur. Also, the order in which test valves are opened and re-isolated was verified to be correct. Tests that involved draining or application of pressurized gas sources were verified to require a final fill and vent process. A sampling of I&C/maintenance procedures was completed and determined that instrumentation fill and vent methods employed at BVPS are adequate; little to no introduction of air into system piping or instrument sensing lines. The conclusion was that the I&C/maintenance procedures were adequate. When additional industry guidance is provided on instrument line fill and vent, additional reviews are scheduled to be performed, as tracked in the corrective action program.

4. <u>Corrective Action Program Evaluation</u>

The FENOC Corrective Action Program was determined to be effectively utilized in concert with the Void Monitoring procedure at BVPS, to address management of gas accumulation.

The Void Monitoring procedure is performed on a monthly basis and as directed by the system engineer (e.g., mode changes); however, the procedure allows for adjustment of test frequency by the system engineer. The procedure provides instructions for monitoring gas voids using UT exams to maintain the ECCS free of gas that could challenge the availability/operability of the ECCS systems.

The Void Monitoring procedure has a sign-off step to ensure a condition report is written for every unexpected void. As part of the FENOC Corrective Action Program, condition reports related to plant equipment are evaluated for potential impact on OPERABILITY. Therefore, the conclusion of the Corrective Action Program Evaluation is that issues involving gas intrusion/accumulation are properly prioritized and evaluated under the Corrective Action Program.

BVPS identified one potential non-conforming issue as a result of the GL 2008-01 review. There were voids discovered on the suction side of the Unit 1 LHSI pumps from the containment. The system was filled and vented, which reduced the void to an acceptable size. Additional actions are described in Section C. The other items identified as corrective actions as a result of the review of the GL also do not challenge the operability/design basis of the ECCS systems or the Containment Depressurization systems.

Conclusion of the Above Evaluations

In summary, based on the information reviewed to date, it has been concluded that the subject systems/functions at BVPS are capable of performing their intended safety function, and that for BVPS, FENOC is currently in compliance with 10 CFR 50 Appendix B, Criteria III, V, XI, XVI and XVII, with respect to the concerns outlined in GL 2008-01. A number of enhancements have been identified by the evaluations and have been entered into the Corrective Action Program. These are summarized in Section C below.

B. DESCRIPTION OF NECESSARY CORRECTIVE ACTIONS

There were no corrective actions determined to be necessary to ensure compliance with the applicable regulations. See Section C below for the enhancement corrective actions that have been entered into the Corrective Action Program.

C. ADDITIONAL ACTIONS

Actions That Have Been Completed

- Provide Prompt Operability Determination (POD) in accordance with NOP-OP-1009 for LHSI (A&B trains) suction from the containment sump at Unit 1. (This corrective action was completed on September 26, 2008.)
- Operations performed a vacuum fill and vent of the suction lines to LHSI Pumps A & B to reduce the air void from the pipes. Following the fill and vent, UT measurements were taken to determine the amount of air remaining. The small voids remaining were considered acceptable. (This corrective action was completed on October 4, 2008.)

Actions To Be Completed, Their Schedules, And Basis

Basis for the identified completion schedule: The procedure and monitoring changes listed in the table below have been recommended to improve management of gas accumulation at Beaver Valley. Because current practices have been determined to be effective at preventing equipment damage caused by voids, and no actions are required for compliance with existing regulatory requirements, the additional proposed actions are considered enhancements. The schedule for completion is based on resource and plant availability, and the actions are managed in accordance with the FENOC Corrective Action Program or other appropriate action tracking mechanisms.

	Description	Current Schedule
Findings Identified During the Section 2a Design Basis Document Review		
1.	Complete evaluation of gas void identified at the Unit 1 containment sump suction to the (LHSI) 1SI-P-1A/B.	10/23/08
Findings Identified During the Section 2b Acceptance Criteria Review		
2.	Incorporate the void size in the final version of the PWROG RCS Allowable Gas Intrusion report into the BVPS Void Acceptance Criteria design calculations for the relevant analysis, for use in future design evaluations.	2/27/09
Findings Identified During the Section 2c Drawing Review		
3.	Identify ultrasonic exam locations for 1R19 for currently inaccessible locations associated with the discharge side of the ECCS in Containment for Unit 1.	4/18/09
Findings Identified During the Section 2d Fill and Vent Review		
4.	1OM-50.4L, "Plant Heatup from Mode 6 to Mode 3," instructions to fill and vent the Reactor Coolant Pump seal leakoff lines need revised to require 3 of the valves in the flowpath (MOV-1CH-378, MOV-1CH-381 and 1CH-214) to be verified open or to be opened in other sections of the procedure.	11/20/08
5.	Revise 1OM-7.4.AA, "Fill and Vent the Chemical and Volume Control System" and 1OM-7.4.AN, to have fill and vents of the 6" and 8" Charging Suction Headers performed first instead of last as currently performed.	12/9/08
6.	Regarding the SI System Fill & Vent Procedures:	
	• Write a procedure similar to 1OM-11.4.W, "Filling and Venting The [1SI-P-1A] LHSI Pump After Maintenance", for 1SI-P-1B.	1/2/09
	• During the performance of Part B, C & D of 1OM-11.4.V," Filling and Venting the Hydro Test Pump and Safety Injection Accumulators ", the sample line is valved in at 1SI-75, 76, & 77, but not purged of air at the primary sample panel. Revise procedure to purge air.	12/19/08
	• The following issues need addressed for 1OM-11.4.J, "Filling and Venting the Safety Injection System", Rev 17: • LHSI venting sequence starts downstream of the pumps and then the pumps are vented. • LHSI pumps are bumped with no discharge flowpath, mini flow shut, no path to sweep gas to the RWST. • Part L, the very last step of the procedure refers to Attachment 2 for manual venting; this attachment is a good list of the available ECCS vents. Need a caution to ensure before venting from any of the listed vent valves to ensure that there is a pressure source flowpath aligned for makeup. If Attachment 2 is performed as written it could easily cause voiding/draining to occur when the intent is to fill and vent.	1/9/09
7.	The following issues should be addressed for 2OM-11.4.H, "Filling and Venting the Safety Injection System": 1. LHSI venting sequence starts downstream of the pumps and then the	12/5/08

<table>
<tr><td></td><td>pumps are vented.
2. The vacuum fill option does not vent at 2SIS-325.
3. Revise procedure to address that the section of HHSI piping to the RCS is filled with an LHSI pump running. The piping is associated with the HHSI discharge to cold leg injection valves (2SIS-HCV868A/B) and the High Head to cold leg injection isolation valve (2SIS-MOV840).</td><td></td></tr>
<tr><td>8.</td><td>For 2OM-13.4.J, "Quench Spray Pump and Line Fill and Vent," revise procedure to vent the pump first and then verify the discharge piping is sufficiently full</td><td>11/13/08</td></tr>
<tr><td colspan="3">Findings Identified During the Section 2g System In-Field Verifications</td></tr>
<tr><td>9.</td><td>Analyze laser scanning results for piping that was scanned outside of the Unit 1 and Unit 2 buildings</td><td>2/14/09</td></tr>
<tr><td colspan="3">Findings Identified During the Section 3 Testing Evaluation</td></tr>
<tr><td>10.</td><td>To ensure that the piping on the suction and the discharge side of the systems within the scope of GL 2008-01 remain sufficiently full of water, locations considered to be vulnerable to air entrapment will be included within the site Void Monitoring procedure</td><td>12/12/08</td></tr>
<tr><td>11.</td><td>Further guidance is expected from NEI in the form of good practices for instrument isolation and restoration action. This information may prove to be useful to enhance the existing (currently acceptable) procedures. If the industry information proves valuable, review Unit 1 I&C Maintenance Procedure beginning on April 30, 2009 and finishing by July 30, 2009. Similarly, review the Unit 2 I&C Maintenance Procedures beginning November 13, 2009 and finishing by February 13, 2010. The procedures captured in the CAP program will be reviewed against these good practices.
1. The review will address the ECCS systems and Containment Depressurization Systems.
2. I&C procedures to be reviewed for impact have been determined by identifying instruments connected to ECCS and Containment Depressurization system piping, and then identifying the procedures that control maintenance and testing performed on these instruments. Subject instruments will include level, pressure and differential pressure (flow) instruments.
3. Procedure review focus will be to evaluate for procedural actions' potential to introduce air into system piping and for these actions to introduce air into sensing lines such that the instrument function would be impaired. Further guidance is expected from NEI in the form of good practices for instrument isolation and restoration actions.
4. Particular procedure actions to be reviewed include:
• Instrument removal from service.
• Test equipment installation/removal.
• Instrument return to service.
• When backfilling is required.</td><td>Unit 1 – 7/30/09

Unit 2 – 2/13/10</td></tr>
</table>

Regulatory Commitment List

The following list identifies the new Regulatory Commitments committed to by FirstEnergy Nuclear Operating Company (FENOC) for the Beaver Valley Power Station in this document. Any other actions discussed in the submittal represent intended or planned actions by FENOC. They are described only as information and are not Regulatory Commitments. Please notify Mr. Thomas A. Lentz, Manager - Fleet Licensing, at (330) 761-6071 of any questions regarding this document or associated Regulatory Commitments.

Regulatory Commitments

1. A summary of the results of the evaluations of the remaining BVPS-1 in field piping segment verifications will be submitted to the NRC within 90 days after startup from the next Unit 1 refueling outage.
2. Technical Specification (TS) improvements are being addressed by the Technical Specification Task Force (TSTF) to provide an approved TSTF Traveler for making changes to individual licensee's TS related to managing 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. FirstEnergy Nuclear Operating Company (FENOC) is continuing to support the industry Gas Accumulation Management Team activities regarding the resolution of generic TS changes via the TSTF Traveler process. After NRC approval of the Traveler, FENOC will evaluate its applicability to the Beaver Valley Power Station, and evaluate adopting the Traveler.