10 CFR 50.54(f)

A subsidiary of Pinnacle West Capital Corporation

Palo Verde Nuclear
Generating Station

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102-05910-JHH/DLK
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References:
1. NRC Generic Letter 2008-01, "Managing Gas Accumulation in Emergency Core Cooling, Decay Heat Removal, and Containment Spray Systems," dated January 11, 2008
2. APS Letter 102-05857, "Three-Month Response to NRC Generic Letter 2008-01, 'Managing Gas Accumulation in Emergency Core Cooling, Decay Heat Removal, and Containment Spray Systems'," dated May 9, 2008
3. NRC Letter to APS forwarding NRR's evaluation of APS' three-month response to Generic Letter 2008-01, dated July 25, 2008

Dear Sirs:

Subject: PVNGS Nuclear Generating Station (PVNGS)
Units 1, 2 and 3
Docket Nos. STN 50-528/529/530
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 Reference 1 to request that each licensee evaluate the licensing basis, design, testing, and corrective action programs for the Emergency Core Cooling System (High Pressure and Low Pressure Safety Injection), Decay Heat Removal System (Shutdown Cooling), 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.

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Reference 1 requested each licensee to submit a written response in accordance with 10 CFR 50.54(f) within nine months of the date of the GL to provide the information summarized below:

> "(a) A description of the results of evaluations that were performed pursuant to the requested actions;
>
> (b) A description of all corrective actions, including plant, programmatic, procedure, and licensing basis modifications that were determined to be necessary to assure compliance with the quality assurance criteria in Sections III, V, XI, XVI, and XVII of Appendix B to 10 CFR Part 50, 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."

In summary, APS has concluded that the subject systems/functions at the Palo Verde Nuclear Generating Station (PVNGS) are in compliance with the Technical Specification definition of Operability, i.e., they are capable of performing their intended safety functions. Section B in the enclosure identifies corrective actions to assure compliance with 10 CFR 50 Appendix B, Criterion III, V, XI, XVI and XVII, with respect to the issues outlined in GL 2008-01 regarding gas accumulation. As committed in Reference 2 and clarified in Reference 3, APS will finalize its evaluation upon completion of walkdowns during the current Unit 1 Refueling Outage (1R14) and the next scheduled Unit 2 and Unit 3 refueling outages (2R15 and 3R14, respectively), and will supplement this report with those results within 90 days of startup from those outages.

The enclosure to this letter contains APS' nine-month response to Reference 1.

This letter contains commitments described in Section B of the enclosure. If you have any questions or if additional information is needed, please contact Russell A. Stroud, Licensing Section Leader at (623) 393-5111.

I declare under penalty of perjury that the foregoing is true and correct.
Executed on 10-14-2008.
DATE

Sincerely,

JHH/RAS/DLK/gat

Enclosure – Nine-Month Response to NRC Generic Letter 2008-01

cc:	E. E. Collins	NRC Region IV Regional Administrator
	B. K. Singal	NRC NRR Project Manager
	R. I. Treadway	NRC Senior Resident Inspector for PVNGS

ENCLOSURE

NINE-MONTH RESPONSE TO GL 2008-01

Introduction

Section A – Evaluation Results

1. Licensing Basis Evaluation
2. Design Review
3. Testing Evaluation
4. Corrective Action Evaluation

Section B – Description of Corrective Actions and Schedule

Introduction

This enclosure contains Arizona Public Service Company's (APS) nine-month response to Nuclear Regulatory Commission (NRC) Generic Letter (GL) 2008-01, "Managing Gas Accumulation in Emergency Core Cooling, Decay Heat Removal, and Containment Spray Systems," dated January 11, 2008. The GL requested "that each addressee evaluate its Emergency Core Cooling System (ECCS), Decay Heat Removal (DHR) System, and Containment Spray (CS) System licensing basis, design, testing, and corrective actions to ensure that gas accumulation is maintained less than the amount that challenges operability of these systems, and that appropriate action is taken when conditions adverse to quality are identified."

As requested, the following information is provided in this response:

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

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

c) A statement regarding which corrective actions have been completed, the schedule for the corrective actions not yet complete, and the basis for that schedule (Enclosure Section B).

The following Palo Verde Nuclear Generating Station (PVNGS) sub-systems were determined to be within the scope of GL 2008-01:

- ECCS (High Pressure Safety Injection [HPSI] and Low Pressure Safety Injection [LPSI])
- DHR (Shutdown Cooling [SDC])
- CS

Collectively these sub-systems will be referred to as Safety Injection (SI) unless specifically identified otherwise.

Section A - EVALUATION RESULTS

1. Licensing Basis Evaluation

The PVNGS licensing basis was reviewed with respect to gas accumulation in the SI System. This review included the Technical Specifications (TS), TS Bases, Updated Final Safety Analysis Report (UFSAR), the Technical Requirements Manual (TRM), TRM Bases, responses to NRC generic communications, NRC Commitments, and License Conditions. Pertinent sections and aspects of the PVNGS licensing basis and results of the GL 2008-01 requested evaluation are discussed below:

1.1 Summary of the results of the review of Licensing Basis:

APS' licensing basis evaluation of regulatory requirements and the technical considerations discussed in, and attached to, the GL support the following conclusions:

a) TS Surveillance Requirement (SR) 3.5.3.2 requires verification that the ECCS piping is full of water every 31 days. The corresponding TS basis section states that the method of ensuring that any voids or pockets of gas are removed from the ECCS piping is to vent the accessible discharge piping high points, an activity controlled by APS procedures. Maintaining the piping from the ECCS pumps to the Reactor Coolant System (RCS) 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 noncondensible gas (e.g., air, nitrogen, or hydrogen) into the reactor vessel following a Safety Injection Actuation Signal (SIAS) or during SDC. The 31-day surveillance frequency takes into consideration the gradual nature of gas accumulation in the ECCS piping and the adequacy of the procedural controls governing system operation.

   APS' evaluation of this SR has confirmed that the SR Bases does not specifically define "full of water." However, "full of water" implies that the associated piping is "sufficiently full of water" to ensure that the system will reliably perform the intended safety function, since the SR does not require verification that the ECCS piping is water solid. APS has determined that the TS Bases is not required to be revised at this time to clarify or to reflect verification that the subject piping is "sufficiently" full of water. Similarly, a TS Bases clarification that ultrasonic measurements or other suitable methods may be used for verification that the piping systems are sufficiently full of water was also determined to not be necessary. The current TS Bases specify a method for removal of voids,

but does not specify how to detect voids or verify the pipe is full. Therefore use of ultrasonic measures and other methods are not precluded. APS considered these clarifications, but concluded it more appropriate to monitor and adopt, as appropriate, the Technical Specifications Task Force (TSTF) effort to provide an industry approved TSTF traveler for NRC review and approval making changes related to the potential for unacceptable gas accumulation.

b) TS SR 3.6.6.2 requires verification that the CS piping is full of water to the 113 ft elevation in the CS header. The corresponding TS Bases section states that verifying that the CS header piping is full of water to the 113 ft level minimizes the time required to fill the header. This ensures that spray flow will be admitted to the containment atmosphere within the time frame assumed in the containment analysis. The 31-day frequency is based on the static nature of the fill header and the low probability of a significant degradation of water level in the piping occurring between surveillances.

Similar to the evaluation of SR 3.5.3.2, APS' evaluation of SR 3.6.6.2 has confirmed that the SR Bases is not required to be revised at this time to clarify "full" versus "sufficiently full" or to reflect that the use of ultrasonic measurement or other suitable methods is acceptable.

c) TRM Surveillance Requirements (TSR) 3.5.202.4 requires verification that containment sump SI recirculation piping is full of water every 31 days. The corresponding TRM Basis section states that maintaining the containment sump SI recirculation piping full of water ensures that the system will perform properly by minimizing the potential for degraded pump performance. The 31-day frequency takes into consideration the adequacy of the procedural controls governing system operation. This requirement applies to the sump SI recirculation piping between the inboard containment isolation valves (SIA-UV673/SIB-UV675) and the respective associated train containment sump outlet check valves (SIA-V205/SIB-V206).

APS' evaluation of TSR 3.5.202.4, and TRM sections T3.6, "Containment Systems" and T3.5.201, "Shutdown Cooling System" for the CS and SDC systems respectively, revealed that these TRM sections should be revised to require verification that the entire SI system (ECCS, CS and SDC) suction piping is sufficiently full of water to reliably perform the intended safety functions. As detailed in Section A 3.1.g of this enclosure, surveillance test procedures will be revised to add requirements to surveil SDC suction vent valves as a result of this Licensing Basis Evaluation. Operating procedures currently contain requirements to vent the SDC suction piping and provide assurance these piping sections are full pending completion of this corrective action. This TRM change will not require any surveillance test procedure changes for ECCS or CS, because

the current surveillance test procedure ensures the high points on these sections of suction piping are surveilled. Clarification of "full" versus "sufficiently full" or the use of ultrasonic measurement is not required to be made at this time as previously explained.

d) UFSAR Section 6.3.1.3.M.2, "CESSAR [Combustion Engineering Standard Safety Analysis Report] Interface Requirements" states that for each safeguards train, the top of the piping junction between the Refueling Water Tank (RWT) discharge and the containment sump must be located at a minimum of 16 feet below the minimum containment sump water level during recirculation. The purpose of this requirement is to preclude the possibility of drawing air from the RWT to the safeguard pumps suction during recirculation should the RWT isolation valves remain open during recirculation.

A previously completed APS evaluation[1] of this CESSAR Interface Requirement revealed that this interface requirement is not sufficient to preclude the possibility of drawing air from the RWT to the safeguard pump suction during recirculation. The corresponding Interface Evaluation (UFSAR Section 6.3.1.4.M.2) should be revised to describe the additional design requirements necessary to accomplish this function. UFSAR Section 6.3.2.7, "Required Manual Actions" should be revised to describe the required control room operator's actions to close the RWT outlet valves within a prescribed condition. Additionally associated TSs should be revised to reflect a change in the Recirculation Actuation Signal (RAS) setpoint.

The current PVNGS design and Licensing Basis has been evaluated for Operability in accordance with Regulatory Issues Summary (RIS) 2005-20 (Operability Determinations and Functional Assessments for Resolution of Degraded or Nonconforming Conditions Adverse to Quality or Safety). Detailed dynamic hydraulic evaluations have also been performed which demonstrate that during the transfer to recirculation, sufficient air is not transported to either the CS or HPSI pumps to degrade their performance. This RIS evaluation provides the technical justification for the acceptability of operation until the corrective actions are completed.

e) UFSAR Table 3.9-10, "Design Loading Combinations for ASME Section III Code Class 2 and 3 Components and Supports Outside the Combustion Engineering Scope of Supply," provides the design loading combinations for the SI piping systems. The applicable combinations for a Faulted Plant Condition such as a Loss of Coolant Accident (LOCA) include the direct addition of seismic loads and water hammer loads associated with gas accumulation in SI piping. This Table should be clarified to denote that

[1] Significant CRDR 2835132

water hammer loads from gas accumulation are not required to be added to seismic loads for SI piping and pipe support design.

1.2 Summary of the changes to licensing basis documents (Corrective Actions):

To date, APS has not made changes to the licensing basis documents with respect to the GL. See the following section for changes that have been identified but not yet been completed.

1.3 List of Licensing Basis changes that have not been completed, a schedule for their completion, and the basis for that schedule.

a) Technical Specifications will be revised to reflect a change in the RAS setpoint. This revision will provide for sufficient time for Operators to close the RWT outlet valves upon receipt of the RAS to preclude the possibility of air entrainment from the RWT into SI system suction piping during the transfer to recirculation. This will require NRC approval of a License Amendment Request (LAR). (COM-2)

b) The TS Bases will be revised to reflect that proper initiation of recirculation is required to preclude excessive air entrainment from either the RWT or the containment sump. (COM-2)

c) The UFSAR will be revised to describe the additional design requirements necessary to preclude the possibility of drawing air from the RWT to the safeguard pump suction during recirculation and to describe the required closure of the RWT outlet valves by control room operators within a prescribed condition. (COM-2)

(The above three corrective actions are the results of a previous evaluation described in Design Evaluation Section A 2.1 of this enclosure. These actions are necessary to make the PVNGS design consistent with its Licensing Basis. These actions will be performed in conjunction with design change SI-1057. Development and implementation of this modification is on-going. Submittal of the associated LAR is scheduled for November 30, 2009. The actual completion of these changes is dependent on the design change implementation and the NRC issuance of the associated License Amendment. As described in Design Evaluation Section A 2.3 of this enclosure, the current PVNGS design has been evaluated for Operability in accordance with RIS 2005-20. Detailed dynamic hydraulic evaluations have been performed which demonstrate that during the transfer to recirculation, sufficient air is not transported to either the CS or HPSI pumps to degrade their performance. This evaluation provides the technical justification for the acceptability of operation until the corrective actions are completed.)

d) The basis for TSR 3.5.202.4 and TRM Sections T3.6 and T3.5.201 will be revised to require the entire SI system (ECCS, CS and SDC) suction

piping to be verified full of water. This Corrective Action will be completed by January 15, 2009. This timeframe allows for development of suction side acceptance criteria and the revision of surveillance test procedures. Operating procedures already contain requirements to vent the SDC suction piping and provide assurance these piping sections are full upon completion of this action. This Licensing Basis change will not require additional suction piping to be verified full for ECCS or CS, since current surveillance test procedures already contain provisions for verifying the suction piping is full for these two systems. (COM-3)

e) UFSAR Table 3.9-10 will be revised to reflect the appropriate combination of the water hammer loads associated with gas accumulation in SI piping and seismic loads for design of piping and pipe supports. The corrective action will be completed March 31, 2009. This timeframe allows for completion of UFSAR change documentation. (COM-4)

f) In addition to the above described Corrective Actions to the PVNGS Licensing Basis, TS improvements are being considered by the 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. APS 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. APS will evaluate the resolution of TS issues with respect to the changes contained in the TSTF traveler, and submit a LAR based on this evaluation within one year following NRC approval of the Consolidated Line Item Improvement Process (CLIIP) Notice of Availability of the TSTF traveler. The basis changes associated with the TS changes will also be made. (COM-1)

2. Design Evaluation

The PVNGS design basis was reviewed with respect to gas accumulation in the SI Systems. This review included Design Basis Documents, Calculations, Engineering Evaluations, and Vendor Technical Manuals.

2.1 Discussion of the results of the review of the design basis documents.

The above documents were evaluated for compliance with applicable regulatory requirements and the technical considerations described in and attached to the GL. The following describe existing plant specific evaluations that concern the acceptability of gas accumulation in the SI piping.

a) The PVNGS design basis (prior to or independent from the Design Evaluation required by the GL) included plant specific evaluations of the acceptability of gas accumulation in the containment sump ECCS pump suction penetration piping and the CS discharge header piping downstream of the normally closed containment isolation valves. The evaluation of the containment sump penetration piping (APS study 13-MS-A108, "Determination of Allowable Void Size and Venting Criteria for the PVNGS ECCS and CSS Pump Suctions") was based on the PVNGS ECCS suction piping configuration and specific knowledge and understanding of gas transport in the suction piping obtained from previously performed scale model testing. A gas accumulation limit was conservatively determined that would limit ingestion into the ECCS pumps' suction to zero or negligible amounts such that HPSI or CS pump performance would not be affected. The evaluation of the CS header piping (APS study 13-MS-B067, "Containment Spray System Evaluation for Minor Amount of Air Remaining in Piping Following Normal Venting Activities") determined a gas accumulation limit that would have no effect on the CS function based on such technical considerations as impact to CS initiation and delivery to containment atmosphere delay time, spray header coverage, nozzle performance and water hammer. Neither of the plant evaluations were utilized as acceptance criteria for surveillance tests that verify the corresponding sections of piping are full of water. The acceptance criteria for surveillance tests, as described in the Testing Evaluation Section of this enclosure, have been a clear stream of water from high point vent valves. The only exception is a section of CS header "A" piping for which the piping is verified to be full utilizing ultrasonic measurements because of its unique configuration.

b) Combustion Engineering (CE) calculation MISC-PEC-249, "ECCS Piping Interface Requirement per Outstanding CESSAR Review Matter Number 38" determines the required elevation difference between the top of the piping junction between the RWT discharge and the containment sump

and the minimum containment water level (minimum flood level) to preclude the possibility of drawing air from the RWT to the safeguard pumps suction during recirculation. Related Bechtel calculation 13-MC-CH-201, "Refueling Water Tank, Hold-up Tank and Reactor Makeup Water Tank Sizing" also evaluates the potential for drawing air from the RWT into SI pump suction piping during the transfer to recirculation. A previous APS evaluation[2] determined that the PVNGS design did not preclude air entrainment from the RWT during transfer to recirculation during postulated small break LOCA scenarios resulting in low containment pressure at the time of RAS. Based on that evaluation, a design change (SI-1057) to the RWT RAS setpoint was initiated to provide the required preclusion of air entrainment during the transfer to recirculation. The current PVNGS design has been evaluated for Operability in accordance with RIS 2005-20. Detailed dynamic hydraulic evaluations have been performed which demonstrate that during the transfer to recirculation, sufficient air is not transported to either the CS or HPSI pumps to degrade their performance.

2.2 Discussion of new applicable gas volume acceptance criteria for each piping segment in each system where gas can accumulate and summary of Corrective Actions, and schedule for completion of any Corrective Actions.

a) Pump Suction Piping

Gas volume acceptance criteria for each segment of SI suction piping are being developed based on plant specific evaluations of the suction piping configurations. These criteria limit ingestion by the associated pumps to 2 percent air void fraction or less at the pump inlet. Limiting air ingestion at the pump inlet to 2 percent air void fraction provides assurance that any performance degradation experienced during the short time frame of air ingestion would be negligible. The evaluations consider the impact on required NPSH during the air ingestion.

Similar to APS study 13-MS-A108 the acceptance criteria for suction piping from the containment sump and the RWT has been developed based on an evaluation of the PVNGS ECCS suction piping configuration and specific knowledge and understanding of gas transport in the suction piping obtained from previously performed scale model testing.

The acceptance criteria for SDC suction piping is based on the evaluation of the PVNGS specific piping configuration and internal operating experience that demonstrate that the presence of the 16-inch diameter cross over pipe from the LPSI to CS pump suctions effectively strips air or

[2] Significant CRDR 2835132

gas in a manner equivalent to an air void header installed in certain Westinghouse-designed plants.

A recent Pressurized Water Reactor Owners Group (PWROG) program established interim pump gas ingestion limits to be employed by the member utilities. The PVNGS specific suction piping acceptance criteria are consistent with and/or conservative with respect to the limits developed by the PWROG program.

The PVNGS-specific evaluations to develop gas volume acceptance criteria for SI suction piping are scheduled to be completed on October 30, 2008. Current acceptance criteria, surveillance test procedures, and operating procedures are adequate to ensure the SI suction piping systems are sufficiently full to reliably perform the intended safety functions pending completion of these evaluations. (COM-5)

b) Discharge piping between the pump and the normally closed containment isolation valves.

PVNGS specific evaluations are being performed to develop gas volume acceptance criteria for each segment of SI discharge piping upstream of the normally closed containment isolation valves. Gas accumulation in these sections of piping may result in amplified pressure pulsations after a pump start. The subsequent pressure pulsation may cause relief valves in the subject systems to lift, or result in unacceptable pipe loads, i.e., axial forces that are greater than the design rating of the axial restraint(s). This effort was initiated prior to the issuance of the GL; however the evaluations utilize a methodology subsequently developed by a joint Owner's Group program to evaluate pump discharge piping gas accumulation. The method uses plant specific information for piping restraints and relief valve set points in the subject systems to determine the acceptable gas volume accumulation such that relief valve lifting in the subject systems does not occur and pipe loading is within acceptable limits, i.e., axial forces that are less than the design rating of the axial restraint(s).

APS is in the process of implementing this methodology and establishing the applicable limits for gas accumulation in the discharge piping of the SI systems. Surveillance testing procedures, as described in the Testing Evaluation Section of this enclosure, will provide assurance that any gas in the SI discharge piping is limited to within the acceptance criteria. The PVNGS specific evaluations to determine acceptance criteria for discharge piping upstream of the containment isolation valves are scheduled to be completed by March 31, 2009. This time frame allows for completion of the water hammer calculations and pipe stress and support evaluations, and reconciliation of the Licensing Basis load combinations to be used in these evaluations described in Section A 1.1.e of this

enclosure. Current acceptance criteria and surveillance test procedures are adequate to ensure the SI piping systems are sufficiently full to reliably perform the intended safety functions. (COM-6)

c) Pump discharge piping downstream of the normally closed containment isolation valves (which is not susceptible to water hammer or pressure pulsation following a pump start).

Piping downstream of the normally closed containment isolation valves has been evaluated to determine the piping response in the presence of accumulated gas. The downstream piping includes the CS piping downstream of the isolation valve that is normally closed during power operation and opens on receipt of a Containment Spray Actuation Signal (CSAS), the hot leg injection piping downstream of the isolation valve that is normally closed during power operation and opens following switchover to simultaneous hot and cold leg injection, and cold leg injection piping downstream of the isolation valves that are normally closed and open upon receipt of a SIAS.

1. The PVNGS design basis includes a water hammer analysis (calculation 13-MC-SI-A06) of the CS system and evaluates the piping response as the CS header is filled. The methodology and results of this analysis have been compared to the recently developed PWROG methodology which compares the potential force imbalances with the weight of the piping. The net force resulting from the pressurization of the CS header during the filling transient was verified to be a small fraction of the dead weight of the filled piping, and, therefore, the filling transient is well within the margin of the pipe hangers. In addition, the potential effects of a water hammer caused by a void upstream of the spray riser was investigated (Westinghouse/Fauske and Associates calculation FAI/08-134) and determined to have no deleterious effects. Design calculation 13-MC-SI-A06, APS study 13-MS-B067, and calculation FAI/08-134 form the basis for acceptance criteria for the CS piping downstream of the normally closed containment isolation valves. These evaluations are all completed.

2. A PWROG methodology has been developed to assess when a significant water hammer could occur during switchover to hot leg injection. The methodology concludes that if the upstream valve has an opening time of approximately 10 seconds and the downstream path to the RCS is only restricted by check valve(s), no significant water hammer would occur.

   The PVNGS flow path for switchover to hot leg injection has been evaluated (Westinghouse/Fauske and Associates calculation FAI/08-136) applying the PWROG methodology. The evaluation

determined that the PVNGS design and configuration are not consistent with the conditions stipulated in the PWROG methodology. As a result, APS will determine the need to either change the valve opening sequence for aligning hot leg injection in the applicable Emergency Operating procedures or perform a specific water hammer analysis for this line. Following this determination, gas volume acceptance criteria for hot leg injection piping downstream of the normally closed isolation valves will be developed. This corrective action is scheduled to be completed by March 31, 2009. (COM-7)

3. A methodology has been developed (calculation FAI/08-137) that assesses when significant water hammer could occur downstream of the normally closed cold leg injection isolation valves during the cold leg injection phase for the typical CE ECCS design. Considering ECCS pump spin-up time and the relatively slow opening time of the normally closed injection valves, conditions which would preclude significant water hammer can be determined. These conditions can then be used to set acceptance criteria for potential gas accumulation points downstream of the normally closed injection valves. The PVNGS design is consistent with the conditions stipulated in this methodology. PVNGS specific evaluations being performed to develop the corresponding gas volume acceptance criteria for each segment of SI cold leg discharge piping downstream of the normally closed isolation valves are scheduled to be completed by March 31, 2009. (COM-7)

d) RCS Allowable Gas Injection

The PWROG qualitatively evaluated the impact of non-condensable gases entering the RCS on the performance of the post-accident core cooling functions of the RCS. This evaluation assumed that 5 cubic feet of non-condensable gas at 400 psig was present in the HPSI discharge piping concurrent with 5 cubic feet of non-condensable gas at 100 psig in the LPSI discharge piping. The qualitative evaluation concluded that these quantities of gas will not prevent the ECCS from performing its core cooling function and these considerations are not limiting with respect to gas accumulation acceptance criteria.

PVNGS procedures when revised will provide assurance that the total gas accumulation in the LPSI injection system piping is verified to be less than 5 cubic feet of non-condensable gas at 100 psig and the total gas accumulation in the HPSI cold leg and hot leg piping is verified to be less than 5 cubic feet of non-condensable gas at 400 psig. (Specific corrective actions associated with these procedure revisions are discussed in the Testing Evaluation Section of this enclosure – refer to COM-11.)

2.3 Summary of changes to the design basis documents (Corrective Actions) and the schedule for completion of the Corrective Actions.

a) Design change SI-1057 and associated design basis document changes will be implemented to preclude the possibility of air entrainment from the RWT into SI system suction piping during the transfer to recirculation. This change includes raising the RAS setpoint and associated design calculations and requires NRC approval of the LAR discussed in Sections A 1.3.a, A 1.3.b and A 1.3.c. The LAR will include a revision to the UFSAR describing the required closure of the RWT outlet valves by control room operators within a prescribed condition. The schedule for the submittal of the LAR to the NRC is November 30, 2009. The schedule for completion of design and implementation is in each Unit's refueling outage that starts no sooner than one year following NRC approval of the LAR. The current PVNGS design has been evaluated for Operability in accordance with RIS 2005-20. Detailed dynamic hydraulic evaluations have been performed which demonstrate that during the transfer to recirculation, sufficient air is not transported to either the CS or HPSI pumps to degrade their performance. This evaluation provides the technical justification for the acceptability of operation until the corrective actions are completed. The time frame for completion of the corrective actions is justified due to the time required to complete and implement the design change and implement the corresponding License Amendment. (COM-2 and COM-8)

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

Review of the SI system Piping and Instrumentation Drawings P&ID and isometric drawings have been completed. All system vents and high points have been identified. Additionally, one-line elevation drawings of the SI systems were developed. These drawings describe in a scaled vertical axis the piping network elevation changes in order to highlight local inverted U shaped sections that would require venting. The drawings also describe the relative positioning of components in the piping network to reveal potential obstructions in horizontal runs of piping that would block the flow of trapped gas from an installed vent location.

These drawings were used to assess the potential for gas accumulation in the SI piping. This evaluation confirmed the improvements previously made under design change SI-155 which installed vent valves at all SI system local high points not provided for in the original plant design.

2.5 Identification of new vent valve locations, modifications to existing vent valves, or utilization of existing vent valves that were previously considered to be in inaccessible areas, based on the drawing review, and summary of Corrective Actions, and schedule for completion of the Corrective Actions.

No new vent valve locations, modifications or other corrective actions were identified from this review.

2.6 Discussion of 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.

Design level walkdowns of all accessible SI system piping outside of containment have been completed in all three PVNGS units. These design level walkdowns were completed with the units at-power. The primary objective of the walkdowns was to assure the proper design of the in-scope system piping with regard to assurance of establishing and maintaining the piping sufficiently full of water. Actions to support this objective included:

- Verification that vents are in the proper location along horizontal (nominal) runs of pipe
- Verification that vents are in the proper location on the circumference of the pipe
- Verification that any piping described in the drawings as having an intended slope is sloped in the proper direction (limited by visual confirmation)
- Verification that horizontal (nominal) runs of pipe do not contain local highpoints (limited by visual confirmation)

The walkdowns observed the piping without removing the piping insulation, and did not measure the piping for levelness or confirm a described slope angle. Detailed walkdowns consisting of laser scanning, or equivalent, to measure piping for levelness or slope angles, will be performed during each unit's upcoming refueling outage, beginning with current Unit 1 refueling outage, as described in the APS three-month response to the GL (APS Letter 102-05857, dated May 9, 2008).

The walkdowns were also used in conjunction with the drawing review to ensure that the P&ID and isometric drawings accurately convey the piping as it exists in the plant. This walkdown activity was limited to determining that components shown on the isometric drawings were located in the plant, the relative

positioning of components in the plant are accurately reflected in the isometric drawings, and that piping geometry is accurately shown in the isometric drawings (limited by visual confirmation).

2.7 Identification of new vent valve locations, modifications to existing vent valves, or utilization of existing vent valves that were previously considered to be in inaccessible areas, that resulted from the confirmatory walkdowns, and summary of 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 APS' three-month response to GL 2008-01 [APS Letter 102-05857, dated May 9, 2008]).

The drawing reviews and design level walkdowns performed have not identified any new necessary vent valve locations or modifications.

Any additional corrective actions identified during the upcoming pipe slope measurement walkdowns will be described in supplemental evaluations provided to the NRC within 90 days after completion of each unit's next refueling outage as previously committed to in the APS three-month response to the GL (APS Letter 102-05857, dated May 9, 2008).

2.8 Discussion of 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 enclosure).

A review of fill and vent activities and procedures has been completed for all 3 PVNGS units. The primary objectives of this review included:

- Verification that all venting activities are controlled by an approved procedure.
- Verification that all locations where unacceptable amounts of air or gas could collect have a vent valve and venting at that location is contained within a procedure.
- Verification that fill and vent procedures provide instruction to modify restoration guidance to address changes in maintenance work scope or to reflect different boundaries from those assumed in the procedures and to assure the proper design of the in-scope system piping with regard to establishing and maintaining the piping sufficiently full of water.
- Verification that procedures incorporate appropriate techniques to validate those systems are sufficiently full of water based on quantification of any remaining gas void against established acceptance criteria.

The review concluded there are clear procedures for performing and completing venting. There are clear acceptance criteria for venting a given location. As

described in Section A 2.2 of this enclosure, new acceptance criteria are being developed and will need to be incorporated into the fill and vent procedures. The review identified two current practices that should be incorporated into station procedures.

a) PVNGS Engineering performs confirmatory ultrasonic inspections (UTs) of selected SI piping high points to monitor or confirm the adequacy of the initial system fill and vent during each refueling outage. These UTs are specified by the System Engineer based on consideration of specific outage evolutions and activities and executed under the standard PVNGS work order process. The design level walkdowns and fill and vent procedure reviews have identified specific locations that should be included in these confirmatory UTs. These confirmatory UTs should be proceduralized to better ensure consistency and performance of the UTs.

b) PVNGS outage schedules routinely include high velocity system and pump performance tests and surveillances. These activities would flush residual accumulations of gas remaining after the initial system fill. The design level walkdowns and fill and vent procedure reviews have identified specific locations that should be included in or verified to be subject to these flushes to minimize the likelihood of gas accumulations. APS should develop a procedure or process that controls the performance of system and pump performance tests or other high velocity flushes to ensure these activities are performed as necessary to preclude gas accumulation potentially resulting from an incomplete initial system fill.

2.9 Identification of procedure revisions, or new procedures resulting from the fill and vent activities and procedure reviews that need to be developed, and summary of 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 enclosure).

a) APS will develop a procedure or written instructions that will specify requirements for performance of confirmatory UTs. This corrective action will be completed by March 31, 2009. This is currently a routine Engineering activity performed every refueling outage that is adequate pending incorporation into a procedure. (COM-9)

b) APS will develop a procedure or process that controls the performance of system and pump performance tests or other high velocity flushes to ensure these activities are performed as necessary to preclude gas accumulation potentially resulting from an incomplete initial system fill. This corrective action will be completed by August 1, 2009. These pump and system performance tests are performed every refueling outage and current outage scheduling is adequate pending completion of this action. (COM-10)

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

The following potential gas intrusion mechanisms have been identified as potential vulnerabilities at PVNGS. Each mechanism was considered during the design evaluations and walkdowns described in the preceding sections.

During the transfer from injection mode to recirculation from the containment sump, air ingestion into the SI piping is possible if the water level in the RWT gets too low before the RWT is isolated. This mechanism and associated corrective actions to mitigate this mechanism are discussed in Sections A 2.1.b and A 2.3.a of this enclosure.

During maintenance activities typically performed during refueling outages, all or sections of SI piping systems may be drained. Upon completion of the maintenance, the piping systems are re-filled and vented. Gas accumulations can remain following the fill and vent if the fill and vent is not performed correctly, if sections of piping cannot be completely vented due to sloping of nominally horizontal piping, if air is trapped in valve bonnets, behind orifices and reducers, or if a system flush is not performed. Several enhancements to PVNGS procedures are described in Sections A 2 and A 3 of this enclosure to further minimize or detect the occurrence of this mechanism.

Nitrogen can come of out solution if nitrogen-saturated water from the Safety Injection Tanks (SIT), which are maintained at approximately 600 psig during normal plant operations, leaks past two check valves and a closed containment isolation valve into the upstream low pressure SI system piping. This mechanism can be detected by monitoring of SIT levels and surveillance of SI piping upstream of the closed containment isolation valves. Several enhancements to PVNGS procedures are described in Sections A 2 and A 3 of this enclosure to further minimize or detect the occurrence of this mechanism.

Hydrogen can come out of solution if reactor coolant leaks past three check valves and a closed containment isolation into the low pressure SI system piping. This mechanism can be detected by pressure instrumentation upstream of the first check valve off the RCS on each cold and hot leg injection line. Several enhancements to PVNGS procedures are described in Sections A 2 and A 3 of this enclosure to further minimize or detect the occurrence of this mechanism.

Following the transition from SDC operation to stand-by alignment for LPSI or CS, gas can come out of solution due to the de-pressurization and cool down of the system piping. This mechanism is discussed in Section A 3.3 of this enclosure. Procedures to vent the system piping over a period of several days have proven effective at minimizing the occurrence of this mechanism.

Operation of the SDC system at reduced inventory (i.e. mid-loop operations) can result in air entrainment due to the formation of surface vortices at the reduced

water level above the operating SDC train suction nozzle on the hot leg. Strict operating procedures developed from vortex tests performed on each of the three Units control water level and SDC flow rate to ranges that minimize to the degree possible the amount of air entrained due to these surface vortices. Air that is entrained is effectively stripped from the suction fluid due to the presence of this 16-inch diameter cross over pipe from the LPSI to CS pump suctions. The cross over pipe functions as a gas void header and operating procedures require the cross over pipe to be vented every two hours while in reduced inventory to ensure air does not accumulate.

Air entrainment could occur following transfer to recirculation from the containment sump if water level in the containment were too low or accumulation of debris on the sump strainers caused vortexing to occur. Containment sump performance, including debris laden suction screens, has been addressed and reported to the NRC in response to GL 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation during Design Basis Accidents at Pressurized-Water Reactors." Surveillance tests to verify minimum water level in the RWT ensures adequate water level in the containment following transfer to recirculation.

Air entrainment or accumulation could occur in the containment sump penetration piping if the in-board containment isolation valve were to leak and drain or partially drain this section of piping. This section of piping is verified to be full every 31 days by performance of surveillance test procedure 40ST-9SI04, "RAS Line Fill Check" thereby minimizing this accumulation mechanism.

2.11 Ongoing Industry Programs

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

2.12 Detailed list of Design Evaluation items that have not been completed, a schedule for their completion, and the basis for that schedule.

The design evaluation has been completed with the exception of detailed walkdowns to measure or confirm pipe slopes, and corresponding supplemental design evaluations. As delineated in the APS three-month response, the walkdowns will be completed during each Units next refueling outage (beginning with Unit 1's on-going 1R14 refueling outage and completing with Unit 2 2R15 refueling outage scheduled for the Fall of 2009). Supplemental evaluation responses will be provided to the NRC within 90 days of the completion of each Unit's refueling outage.

3. Testing Evaluation

3.1 Discussion of the results of the periodic venting or gas accumulation surveillance procedure review.

The PVNGS periodic surveillance test procedures utilized for verification that the systems within the scope of GL 2008-01 are full were reviewed and evaluated. The following venting procedures are executed every 31 days:

40ST-9SI04, "RAS Line Fill Check"

40ST-9SI07, "High Pressure Safety Injection System Alignment Verification"

40ST-9SI13, "LPSI and CS System Alignment Verification"

The monthly surveillance test procedures are used to ensure that each ECCS and CS piping system is sufficiently full of water by venting gas in the system every 31 days. The acceptance criteria in the existing procedures ensure sufficiently full piping by issuance of a clear stream of water from the vent valves. The venting guidance requires that the vent valves be maintained in the throttled position for 2 - 3 minutes once a solid stream of water is observed. The vent valves in each section of piping are systematically vented and are required to be vented in the same order every time the procedure is performed. The piping is generally vented starting with the vent valve at the lowest elevation and continuing to the valve at the highest elevation.

SI pump performance surveillance tests are performed quarterly. In these tests, each SI pump is aligned for minimum recirculation from the RWT. In this alignment, the containment isolation valve on each injection or spray line is closed. The alignment represents a bounding condition with respect to potential water hammer effects resulting from gas accumulation in pump discharge piping upstream of the closed isolation valves. Accordingly, these surveillance tests also provide assurance that the SI discharge piping is being maintained sufficiently full to ensure the SI can reliably perform its intended safety functions.

The following changes were determined to be necessary to address weaknesses or deficiencies in meeting regulatory requirements or commitments or technical considerations discussed in or attached to the GL:

a) A quantitative determination of the amount of gas present or vented is not performed in the current revision of the procedures. The procedures should be revised to utilize ultrasonic measurements or other quantitative means to identify the quantity of gas present or vented during surveillances.

b) The acceptance criteria in the existing procedures ensure sufficiently full piping by issuance of a clear stream of water from the vent valves. Since the existing procedures do not currently quantify the amount of gas present in the system, the procedures currently do not include acceptance criteria for an allowable amount of gas. The procedures should be modified to include acceptance criteria for the amount of gas and issuance of a corrective action when an acceptance criterion is exceeded.

c) The SI system piping inside containment is currently considered to be inaccessible and, therefore, not subject to periodic verification that the piping is full. The procedures should be revised to redefine accessibility of inside containment piping and add periodic verification that the piping is sufficiently full, as appropriate.

d) The monthly venting procedures do not currently require chemical analysis of gas voids, since the presence of gas is not detected prior to venting the system and the gas released during the vent is not collected. The need for sampling and analysis of gas will be determined through the Corrective Action Program (CAP) when abnormal conditions are detected.

e) Of the three monthly venting procedures, only procedure 40ST-9SI04 requires entry into the CAP if a specific amount of gas or gas/water mixture is observed. The remaining two procedures would require the Operations or Engineering staff to recognize a potential condition adverse to quality or abnormal condition based on experience or judgment with entry into the CAP accordingly. The procedures should be clarified to define abnormal conditions and require entry into the CAP when abnormal conditions are encountered.

f) Trends in the SIT level are monitored on a weekly basis per Appendix SI003, "STA's SIT Level Monitoring" of procedure 40DP-9OP06, "Operations Department Repetitive Task Program." This procedure requires notification of the SI System Engineer of unexplained or abnormal changes in the SIT levels or Cold Leg re-pressurization trends. The procedure does not provide guidance on the amount of change that constitutes abnormal. Appendix SI003 of the procedure should be revised to include an acceptance criteria threshold for SIT level and Cold Leg re-pressurization changes. The procedure should also require initiation of a corrective action to assess the cause of the leak and the potential for void formation when the acceptance criteria threshold is exceeded.

g) The SDC suction vent valves are not currently included in the 31-day surveillance test procedure, although they are included in operating procedures. Procedure 40ST-9SI13 should be revised to include verification that the SDC suction line is full of water. Operating procedures already contain requirements to vent the SDC suction piping and provide

assurance these piping sections are full pending completion of this corrective action.

3.2 Identify procedure revisions, or new procedures resulting from the periodic venting or gas accumulation surveillance procedure review that need to be developed, and summarize the Corrective Actions, and schedule for completion of the Corrective Actions.

The following procedure revisions will be made as a result of the evaluation of the current PVNGS Testing practices and procedures. Some of these procedure changes were previously identified and discussed in the above Licensing Basis and Design evaluations:

a) Applicable surveillance test procedures will be revised to include periodic ultrasonic inspection of the piping to identify and, if necessary, quantify the size of the voids in the piping. Acceptance criteria for each high point location will be specified. The procedures will require entry into the CAP when the acceptance criteria are exceeded. The need for sampling and analysis of gas will be determined through the CAP when abnormal conditions are detected. This corrective action will be phased in as acceptance criteria for each sub-system is developed. Full implementation of this corrective action will be completed by April 30, 2009. Current surveillance tests and the current acceptance criteria of a clear stream of water from accessible high point vent valves are adequate to ensure unacceptable gas accumulation does not occur pending completion of this corrective action. (COM-11)

b) Surveillance test procedures will be revised to redefine accessibility of piping inside containment based on actual expected radiation exposure and scaffolding requirements. This corrective action will be completed by March 31, 2009. Evaluations of the consequences of gas accumulation in discharge side piping inside containment have been completed by a PWROG program and by Westinghouse for certain CE-designed plants (including PVNGS), which demonstrate that voids in this piping will typically not cause a water hammer effect because of the slow-opening containment isolation valves and lack of downstream flow restrictions. In addition, delays in injecting flow to the RCS due to voids in the discharge piping have been determined in the PWROG program to be inconsequential. The only gas accumulation mechanism identified following successful initial fill and vent following maintenance is leakage from either the SI Tanks or the RCS into the low pressure upstream SI piping. This mechanism can be monitored with installed plant instrumentation and verified by surveillance of upstream piping. Considering the reduced consequences associated with gas accumulation in piping inside containment, and the ability to detect and verify the conditions necessary to promote gas accumulation in these piping

sections, current practices are considered adequate pending completion of this action. (COM-12)

c) Procedure 40DP-9OP06 will be revised to provide guidance on the amount of SIT level change that should be considered abnormal and require entry into the CAP to assess the cause of the leak and the potential for void formation when the threshold is exceeded. This corrective action will be completed by January 15, 2009. This time frame allows for determination of the appropriate threshold and specification of the appropriate response. The current procedure and practices at PVNGS have been adequate to ensure unacceptable gas accumulation does not occur pending completion of this corrective action. (COM-13)

d) Surveillance test procedure 40ST-9SI13 will be revised to include verification that the SDC suction piping is sufficiently full of water. This corrective action will be completed by January 15, 2009. Operating procedures already contain requirements to vent the SDC suction piping and provide assurance these piping sections are full pending completion of this action. (COM-14)

3.3 Discussion of how procedures adequately address the manual operation of the SDC system in its decay heat removal mode of operation. Include how the procedures assure that the SDC 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).

PVNGS procedures ensure the SDC system is sufficiently full of water during and following the transition from SDC operation to stand-by alignment for LPSI and CS. While restoring from SDC operation, procedure 40OP-9ZZ01, "Cold Shutdown To Hot Standby Mode 5 To Mode 3," directs the use of procedure 40OP-9SI02, "Recovery from Shutdown Cooling to Normal Operating Lineup," to transfer the idle SDC loop to the normal operation stand-by line-up and to flush (if necessary) and vent the idle SDC piping. Then the procedure transfers the active SDC loop to the normal operation stand-by line-up and similarly flushes and vents the SDC piping.

Procedure 40OP-9SI02 requires a flush of the SDC system (including the SDC heat exchanger) with alignment to the RWT if the train was in service on the RCS during the RCS fill and vent, the train was in service with RCS temperature greater than 170°F, or the Radiation Protection or the CRS/Shift manager requests a flush. The flush will assist in lowering the gas entrainment in the SI train. Procedure 40OP-SI02 also requires up to three vents of the SDC system at approximately 24-hour intervals to prevent gas accumulation due to de-gassing as the SDC system is depressurized and cooled down. Following completion of procedure 40OP-9SI02, procedure 40OP-9ZZ01 directs the

performance of procedure 40ST-9SI04 and procedure 40ST-9SI13. These procedures sufficiently vent the system to remove gas that may have entered the system due to maintenance or de-gassing following SDC operation.

Procedure 40OP-9SI01,"Shutdown Cooling Initiation" is used to take the unit from normal operating line up to SDC. The procedure directs the various valve re-alignments, venting of the LPSI pump cavity, start up and monitoring of the LPSI pumps, and warm-up of the SDC loop prior to placing it in service. Parameters monitored include pump discharge pressure, motor current draw, process temperature and flow rate.

Review of these procedures determined the need for periodic verification of the SDC suction to be full of water as discussed in the preceding Section A 3.2.d of this enclosure.

3.4 Summary of 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.

Maintenance or testing activity that occurs in Mode 5 or 6 may cause gas intrusion, however, the operating procedures require venting of an SI train prior to declaring it operable and entering Mode 4. Operating procedure 40OP-9ZZ01 is performed in conjunction with operating procedure 40OP-9SI02 to bring the plant up to normal operation. Both of these procedure direct venting of the SI piping using operating procedure 40OP-9SI04, "Safety Injection System Venting." This procedure is also used to vent piping that may be drained during infrequently performed on-line maintenance. Performance of the three surveillance tests described in Section A 3.1 of this enclosure further minimizes the likelihood of occurrence.

3.5 Discussion of 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.

Gas accumulations in the SI piping as identified during venting activities are currently recorded in an Operation's database. The System Engineer is provided auto-notification whenever a database entry is made denoting when gas is vented from the system, and the database captures a record of all gas accumulations found in the system. However, venting results are not currently trended on a regular schedule. A more formalized trending process (or procedure) should be developed to document the results of the monthly surveillance tests and ensure Operability to the next surveillance test. This trending process will include acceptance criteria which trigger more in depth

investigation of the source of gas if increasing trends are identified. The trending process/procedure will also include the measured quantities of gas identified during the monthly venting procedures once the required acceptance criteria are developed and surveillance test procedures are modified to measure the quantity of gas in the piping using ultrasonic measurements or other methods. This corrective action will be completed by April 15, 2009. This action proceduralizes trending activities recommended by the GL and industry practices, but does not have a direct impact on Operability. (COM-15)

3.6 Detailed list of Testing Evaluation items that have not been completed, a schedule for their completion, and the basis for that schedule.

a) Applicable surveillance test procedures will be revised to include periodic ultrasonic inspection of the piping to identify and if necessary quantify the size of the voids in the piping. Acceptance criteria for each high point location will be specified. The procedures will require entry into the CAP when the acceptance criteria are exceeded. The need for sampling and analysis of gas will be determined through the CAP when abnormal conditions are detected. This corrective action will be phased in as acceptance criteria for each sub-system is developed. Full implementation of this corrective action will be completed by April 30, 2009. Current surveillance tests and the current acceptance criteria of a clear stream of water from accessible high point vent valves are adequate to ensure unacceptable gas accumulation does not occur pending completion of this corrective action. (COM-11)

b) The surveillance test procedures will be revised to redefine accessibility of piping inside containment based on actual expected radiation exposure and scaffolding requirements. This corrective action will be completed by March 31, 2009. Evaluations of the consequences of gas accumulation in discharge side piping inside containment have been completed by a PWROG program and by Westinghouse for certain CE-designed plants (including PVNGS), which demonstrate that voids in this piping will typically not cause a water hammer effect because of the slow-opening containment isolation valves and lack of downstream flow restrictions. In addition, delays in injecting flow to the RCS due to voids in the discharge piping have been determined in the PWROG program to be inconsequential. The only gas accumulation mechanism identified following successful initial fill and vent following maintenance is leakage from either the SITs or the RCS into the low pressure upstream SI piping. This mechanism can be monitored with installed plant instrumentation and verified by surveillance of upstream piping. Considering the reduced consequences associated with gas accumulation in piping inside containment, and the ability to detect and verify the conditions necessary to promote gas accumulation in these piping sections, current practices are considered adequate pending completion of this action. (COM-12)

c) Procedure 40DP-9OP06 will be revised to provide guidance on the amount of SIT level change that should be considered abnormal and require entry into the CAP to assess the cause of the leak and the potential for void formation when the threshold is exceeded. This corrective action will be completed by January 15, 2009. (COM-13)

d) Surveillance test procedure 40ST-9SI13 will be revised to include verification that the SDC suction piping is sufficiently full of water. This corrective action will be completed by January 15, 2009. Operating procedures already contain requirements to vent the SDC suction piping and provide assurance these piping sections are full pending completion of this action. (COM-14)

e) A formalized trending process (or procedure) will be developed to document the results of the monthly surveillance tests and ensure Operability to the next surveillance test. This trending process will include acceptance criteria which trigger more in depth investigation of the source of gas if increasing trends are identified. The trending process/procedure will also include the measured quantities of gas identified during the monthly venting procedures once the required acceptance criteria are developed and surveillance test procedures are modified to measure the quantity of gas in the piping using ultrasonic measurements or other methods. This corrective action will be completed by April 15, 2009. This action proceduralizes trending activities recommended by the GL and industry practices, but does not have a direct impact on Operability. (COM-15)

4. Corrective Actions Evaluation

4.1 Summary of the results of the reviews regarding how gas accumulation has been addressed at PVNGS.

TS SRs 3.5.3.2 and 3.6.6.2 and TSR 3.5.202.4 all contain a similar surveillance requirement to verify applicable sections of SI piping to be full of water at a specified interval of 31 days. The corresponding bases sections state that the method of ensuring that any voids or pockets of gases are removed from the ECCS piping is to vent the accessible discharge piping high points, which is controlled by PVNGS procedures. PVNGS surveillance test procedures 40ST-9SI04, 40ST-9SI13 and 40ST-9SI07 currently do not employ or contain as-found acceptance criteria. Inherent in the bases statements is the consideration that any accumulation vented during the 31 day surveillance is "gradual" and normal. The CAP is utilized to identify and correct conditions that reflect possible abnormal or non-gradual accumulation of air or gas. For example, APS' evaluation[3] of an abnormal hydraulic transient identified a small gas accumulation upstream of a LPSI flow transmitter orifice. The condition was entered into the CAP and the system was declared inoperable and a vent valve was installed to remove the accumulated gas. The root cause extent of condition resulted in the development of design change SI-155. This design change installed several vent valves per unit at other susceptible locations were gas could accumulate.

The three above discussed surveillance test procedures were revised on September 18, 2008 to include a record of each vent valve opening and the duration and characterization of any air/gas or gas/water mixture observed using standardized venting practices. Any observation other than the expected essentially air-free vent requires auto-notification of system engineering, entry into the CAP and Operability assessment. This change was made to ensure evaluation of any potentially degrading conditions or abnormal gas accumulations.

As discussed in the Testing Evaluation Section of this enclosure, the existing procedures do not currently quantify the amount of gas present in the system. Therefore, the procedures do not require entry into the CAP for gas quantities that exceed the acceptance criteria. The one exception is procedure 40ST-9SI04 which verifies the containment sump penetration piping is full and requires entering the CAP if the amount of gas exceeds a pre-established limit. The surveillance test procedures should be modified to include acceptance criteria for the amount of gas and entry into the CAP for amounts of gas that exceed the acceptance criteria.

[3] Significant CRDR 2735052

The following corrective action is being made that involves the CAP. This action has been identified in a previous Section of this enclosure, but is repeated here for completeness:

a) Applicable surveillance test procedures will be revised to include acceptance criteria for the amount of gas and entry into the CAP for amounts that exceed the acceptance criteria.

4.2 Detailed list of Corrective Action Evaluation items that have not been completed, a schedule for their completion, and the basis for that schedule.

The Corrective Actions Evaluation has been completed. The only corrective actions have been previously discussed in Section A 3.6 of this enclosure.

Section B - DESCRIPTION OF CORRECTIVE ACTIONS AND SCHEDULE

No.	Commitments - Corrective Actions to be completed including the scope and basis for the schedule	Due
COM-1	APS 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. APS will evaluate the resolution of TS issues with respect to the changes contained in the TSTF traveler, and submit a LAR based on this evaluation within one year following NRC approval of the CLIIP Notice of Availability of the TSTF traveler. The basis changes associated with the TS changes will also be made. (Reference Sections: A 1.3.f)	One year following NRC approval of the CLIIP Notice of Availability
COM-2	Design change SI-1057 and associated design basis document changes will be developed to support a proposed TS amendment to preclude the possibility of air entrainment from the RWT into SI system suction piping during the transfer to recirculation. This change includes raising the RAS set point and associated design calculations and requires NRC approval of an LAR. The LAR will include a revision to the UFSAR describing the required closure of the RWT outlet valves by control room operators within a prescribed condition. Associated Licensing Bases changes include a revision to reflect that proper initiation of recirculation is required to preclude excessive air entrainment from either the RWT or the containment sump and to the UFSAR to describe the additional design requirements necessary to preclude the possibility of drawing air from the RWT to the safeguard pump suction during recirculation. The LAR will be submitted by 11/30/2009. The time frame for completion of this corrective action is justified due to the time required to develop the design modification and corresponding LAR. The condition associated with this corrective action has been evaluated for Operability in accordance with RIS 2005-20. Detailed dynamic hydraulic evaluations have been performed which demonstrate that during the transfer to recirculation, sufficient air is not transported to either the CS or HPSI pumps to degrade their performance. This evaluation provides the technical justification for the acceptability of operation until the corrective actions are completed. (Reference Sections: A 1.3.a, A 1.3.b, A 1.3.c, A 2.3.a)	11/30/2009

No.	Commitments - Corrective Actions to be completed including the scope and basis for the schedule	Due
COM-3	The basis for TSR 3.5.202.4 and TRM Sections T3.6 and T3.5.201 will be revised to require the entire SI system suction piping to be verified full of water. This Corrective Action will be completed by January 15, 2009. This timeframe allows for the development of suction side acceptance criteria and the revision of surveillance test procedures. Operating procedures already contain requirements to vent the shutdown cooling suction piping and provide assurance these piping sections are full upon completion of this action. This Licensing Basis change will not require any additional suction piping needing to be verified full for ECCS or CS, since current surveillance test procedures already contain provisions for verifying the suction piping is full for these two systems. (Reference Sections: A 1.3.d)	1/15/2009
COM-4	UFSAR Table 3.9-10 will be revised to reflect the appropriate combination of the water hammer loads associated with gas accumulation in SI piping and seismic loads for design of piping and pipe supports. The corrective action will be completed March 31, 2009. This timeframe allows for completion of UFSAR change documentation. (Reference Sections: A 1.3.e)	3/31/2009
COM-5	Complete the PVNGS-specific evaluations to develop gas volume acceptance criteria for SI suction piping. This corrective action will be completed by October 30, 2008. Current acceptance criteria and surveillance test procedures are adequate to ensure the SI piping systems are sufficiently full to reliably perform the intended safety functions pending completion of these evaluations. (Reference Section: A 2.2.a)	10/30/2008

No.	Commitments - Corrective Actions to be completed including the scope and basis for the schedule	Due
COM-6	Complete PVNGS-specific evaluations to develop gas volume acceptance criteria for each segment of SI discharge piping upstream of the normally closed containment isolation valves. This Corrective Action is scheduled to be completed by March 31, 2009. This timeframe allows for completion of detailed water hammer calculations of potential gas accumulations at all discharge piping high point locations, including resolution of the UFSAR Table 3.9-10 Loading Combinations, and subsequent revision to surveillance test procedures. Current surveillance test procedures that require opening of all pump discharge vent valves at the specified 31-day interval are adequate to ensure unacceptable gas accumulation does not occur pending completion of this corrective action. (Reference Section: A 2.2.b)	3/31/2009
COM-7	Complete PVNGS specific evaluations to develop gas volume acceptance criteria for each segment of SI discharge piping downstream of the normally closed isolation valves. The downstream piping includes the CS piping downstream of the isolation valve that is normally closed during power operation and opens on receipt of a Containment Spray Actuation Signal (CSAS), the hot leg injection piping downstream of the isolation valve that is normally closed during power operation and opened following switchover to this injection location, and cold leg injection piping downstream of the isolation valves that are normally closed and open upon receipt of a SIAS or CSAS. This Corrective Action is scheduled to be completed by March 31, 2009. Acceptance criteria for the hot leg injection piping may have an associated change to applicable Emergency Operating procedures to specify a different valve alignment sequence than currently prescribed. Current practices to fill and vent the piping inside containment, the low consequences associated with gas accumulation in piping inside containment, and the lack of current indication of on-going gas accumulation mechanisms such as SIT leakage past the containment isolation valves make the schedule for this action acceptable. (Reference Section: A 2.2.c)	3/31/2009

No.	Commitments - Corrective Actions to be completed including the scope and basis for the schedule	Due
COM-8	Design modification SI-1057 will be implemented in each Unit's refueling outage that starts no sooner than one year following NRC approval of the associated LAR. The time frame for completion of this corrective action is justified due to the time required to develop the design modification and corresponding LAR. The condition associated with this corrective action has been evaluated for Operability in accordance with RIS 2005-20. Detailed dynamic hydraulic evaluations have been performed which demonstrate that during the transfer to recirculation, sufficient air is not transported to either the CS or HPSI pumps to degrade their performance. This evaluation provides the technical justification for the acceptability of operation until the corrective actions are completed. (Reference Section: A 2.3.a)	During scheduled refueling outages beginning with the first unit at least year after NRC approval of the associated LAR
COM-9	Develop a procedure or written instructions that will specify requirements for performance of confirmatory ultrasonic measurements that monitor or confirm the adequacy of system fill and vent. This corrective action is scheduled to be completed by March 31, 2009. This is currently a routine Engineering activity performed every refueling outage that is adequate pending incorporation into a procedure. (Reference Section: A 2.9)	3/31/2009
COM-10	Develop a procedure or process that controls the performance of system and pump performance tests or other high velocity flushes to ensure these routine activities are performed as necessary to preclude gas accumulation potentially resulting from an incomplete initial system fill. This corrective action is scheduled to be completed by August 1, 2009. These pump and system performance tests are performed every refueling outage and current outage scheduling is adequate pending completion of this action. (Reference Section: A 2.9)	8/1/2009

No.	Commitments - Corrective Actions to be completed including the scope and basis for the schedule	Due
COM-11	Applicable surveillance test procedures will be revised to include periodic ultrasonic inspection of the piping to identify and if necessary quantify the size of the voids in the piping. Acceptance criteria for each high point location will be specified. The procedures will require entry into the CAP when the acceptance criteria are exceeded. The need for sampling and analysis of gas will be determined through the CAP when abnormal conditions are detected. This corrective action will be phased in as acceptance criteria for each sub-system is developed. Full implementation of this corrective action is scheduled to be completed by April 30, 2009. This timeframe allows for completion of acceptance criteria evaluations and subsequent revision to surveillance test procedures. Current surveillance tests and the current acceptance criteria of a clear stream of water from accessible high point vent valves are adequate to ensure unacceptable gas accumulation does not occur pending completion of this corrective action. (Reference Sections: A 2.2.d, A 3.2.a, A 3.6.a)	4/30/2009
COM-12	Surveillance test procedures will be revised to redefine accessibility of piping inside containment based on actual expected radiation exposure and scaffolding requirements. This corrective action is scheduled to be completed by March 31, 2009. Evaluations of the consequences of gas accumulation in discharge side piping inside containment have been completed by a PWROG program and by Westinghouse for certain CE-designed plants, which demonstrate that voids in this piping will typically not cause a water hammer effect because of the slow-opening containment isolation valves and lack of downstream flow restrictions. In addition, delays in injecting flow to the RCS due to voids in the discharge piping have been determined in the PWROG program to be inconsequential. The only gas accumulation mechanism identified following successful initial fill and vent following maintenance is leakage from either the SI Tanks or the RCS into the low pressure upstream SI piping. This mechanism can be monitored with installed plant instrumentation and verified by surveillance of upstream piping. Considering the reduced consequences associated with gas accumulation in piping inside containment, and the ability to detect and verify the conditions necessary to promote gas accumulation in these piping sections, current practices are considered adequate pending completion of this action. (Reference Sections: A 3.2.b, A 3.6.b)	3/31/2009

No.	Commitments - Corrective Actions to be completed including the scope and basis for the schedule	Due
COM-13	Procedure 40DP-9OP06 will be revised to provide guidance on the amount of SIT level change that should be considered abnormal and require entry into the CAP to assess the cause of the leak and the potential for void formation when the threshold is exceeded. This corrective action is scheduled to be completed by January 15, 2009. This time frame allows for determination of the appropriate threshold and specification of the appropriate response. The current procedure and practices at PVNGS have been adequate to ensure unacceptable gas accumulation does not occur pending completion of this corrective action. (Reference Sections: A 3.2.c, A 3.6.c)	1/15/2009
COM-14	Revise surveillance test procedure 40ST-9SI13 to include verification that the SDC suction piping is sufficiently full of water. This corrective action is scheduled to be completed by January 15, 2009. This time frame allows for completion of acceptance criteria and subsequent procedure revision. Current procedures for restoring from SDC operations to standby SI alignment have been adequate to prevent unacceptable gas accumulation or formation. Operating procedures already contain requirements to vent the SDC suction piping and provide assurance these piping sections are full pending completion of this action. (Reference Sections: A 3.2.d, A 3.6.d)	1/15/2009
COM-15	A formalized trending process (or procedure) will be developed to document the results of the monthly surveillance tests and ensure Operability to the next surveillance test. This action is scheduled to be completed by April 15, 2009. This action proceduralizes trending activities recommended by the GL and industry practices, but does not have a direct impact on Operability. (Reference Sections: A 3.5, A 3.6.e)	4/15/2009