Exelon Generation

Order No. EA-12-050

RS-13-115

February 28, 2013

U.S. Nuclear Regulatory Commission
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Peach Bottom Atomic Power Station, Units 2 and 3
Renewed Facility Operating License Nos. DPR-44 and DPR-56
NRC Docket Nos. 50-277 and 50-278

Subject: Overall Integrated Plan in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Reliable Hardened Containment Vents (Order Number EA-12-050)

References:

1. NRC Order Number EA-12-050, "Issuance of Order to Modify Licenses with Regard to Reliable Hardened Containment Vents," dated March 12, 2012
2. NRC Interim Staff Guidance JLD-ISG-2012-02, "Compliance with Order EA-12-050, Reliable Hardened Containment Vents," Revision 0, dated August 29, 2012
3. Exelon Generation Company, LLC's Initial Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents (Order Number EA-12-050), dated October 25, 2012

On March 12, 2012, the Nuclear Regulatory Commission ("NRC" or "Commission") issued an order (Reference 1) to Exelon Generation Company, LLC (EGC). Reference 1 was immediately effective and directs EGC to require BWRs with Mark I and Mark II containments to take certain actions to ensure the operability of reliable hardened containment vent (RHCV) systems to remove decay heat and maintain control of containment pressure following events that result in loss of active containment heat removal capability or prolonged Station Blackout (SBO). Specific requirements are outlined in Attachment 2 of Reference 1.

Reference 1 requires submission of an Overall Integrated Plan by February 28, 2013. The interim staff guidance (Reference 2) was issued August 29, 2012 which provides direction regarding the content of this Overall Integrated Plan. The purpose of this letter is to provide the Overall Integrated Plan pursuant to Section IV, Condition C.1, of Reference 1. This letter confirms EGC has received Reference 2 and has an Overall Integrated Plan complying with the guidance for the purpose of ensuring the functionality of reliable hardened containment vent (RHCV) systems to remove decay heat and maintain control of containment pressure following events that result in loss of active containment heat removal capability or prolonged Station Blackout (SBO) as described in Attachment 2 of Reference 1. Reference 3 provided the EGC initial status report regarding reliable hardened containment vents, as required by Reference 1.

Reference 2, Section 4.0 contains the specific reporting requirements for the Overall Integrated Plan. The information in the enclosure provides the Peach Bottom Atomic Power Station, Units 2 and 3 Overall Integrated Plan pursuant to Section 4.0 of Reference 2. The enclosed Integrated Plan is based on conceptual design information. Final design details and associated procedure guidance, as well as any revisions to the information contained in the Enclosure, will be provided in the 6-month Integrated Plan updates required by Reference 1.

Peach Bottom Units 2 and 3, in response to NRC Generic Letter 89-16, installed a hardened vent path that allowed venting from the torus. For the purposes of compliance with NRC Order EA-12-050, Order Modifying Licenses with Regard to Requirements for Reliable Hardened Containment Vents, Peach Bottom Atomic Power Station, Units 2 and 3 plans to credit the torus vent path.

This letter contains no new regulatory commitments. If you have any questions regarding this report, please contact David P. Helker at 610-765-5525.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 28th day of February 2013.

Respectfully submitted,

Michael D. Jesse
Director - Licensing & Regulatory Affairs
Exelon Generation Company, LLC

Enclosure:

1. Peach Bottom Atomic Power Station, Units 2 and 3 Hardened Containment Vent System (HCVS) Overall Integrated Plan

cc: Director, Office of Nuclear Reactor Regulation
NRC Regional Administrator - Region I
NRC Senior Resident Inspector - Peach Bottom Atomic Power Station, Units 2 and 3
NRC Project Manager, NRR - Peach Bottom Atomic Power Station, Units 2 and 3
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Enclosure 1

Peach Bottom Atomic Power Station, Units 2 and 3

Hardened Containment Vent System (HCVS)

Overall Integrated Plan

(28 pages)

Peach Bottom Atomic Power Station, Units 2 and 3
HCVS Overall Integrated Plan

Table of Contents:

References:

1. Generic Letter 89-16, Installation of a Hardened Wetwell Vent, dated September 1, 1989
2. Order EA-12-049, Mitigation Strategies for Beyond-Design-Basis External Events, dated March 12, 2012
3. Order EA-12-050, Reliable Hardened Containment Vents, dated March 12, 2012
4. JLD-ISG-2012-02, Compliance with Order EA-12-050, Reliable Hardened Containment Vents, dated August 29, 2012
5. NRC Responses to Public Comments, Japan Lessons-Learned Project Directorate Interim Staff Guidance JLD-ISG-2012-02: Compliance with Order EA-12-050, Order Modifying Licenses with Regard to Reliable Hardened Containment Vents, ADAMS Accession No. ML12229A477, dated August 29, 2012
6. NEI 12-06, Diverse and Flexible Coping Strategies (FLEX) Implementation Guide, Revision 0, dated August 2012.
7. JLD-ISG-2012-01, compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events
8. IEEE Standard 344-2004, IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations

Section 1: System Description

ISG Criteria:

Licensees shall provide a complete description of the system, including important operational characteristics. The level of detail generally considered adequate is consistent with the level of detail contained in the licensee's Final Safety Analysis Report.

Response:

System Overview:

Peach Bottom (PB) Atomic Power Station Units 2 and 3 each have a torus hardened vent (THV) installed in response to Generic Letter (GL) 89-16 that can provide a direct path from the torus vapor space to a release point above the reactor building. A wetwell THV provides assurance of pressure relief through a path with significant scrubbing of fission products and can result in lower releases. Each unit's THV flow path is fully independent of the other unit's THV.

This existing vent is designed to respond to an overpressure condition that is beyond the current plant licensing basis. The overpressure condition is the result of the long term loss of decay heat sequence (TW Sequence) as defined in the BWR Owner's Group criteria issued on 03/30/90. To prevent and mitigate this sequence, the THV was designed with the following design inputs:

a) vent size sufficient to prevent pressure increase with inputs of 1% of rated thermal power, and pressure at Primary Containment Pressure Limit (PCPL),
b) means to prevent inadvertent actuation,
c) vent up to and including second containment isolation barrier consistent with design basis of the plant, and
d) dedicated radiation monitoring system.

Each PB THV is a 16" line that originates from the 18" line that connects the torus to the Standby Gas Treatment System (SGTS). Upstream (torus side) of the tee is the inboard Primary Containment Isolation Valve (PCIV), common for the SGTS and the THV. Downstream of the tee is the SGTS outboard PCIV. The THV is independent of the SGTS because the closed SGTS outboard PCIV isolates the THV from the common-unit SGTS. The THV has its own outboard PCIV (to the outside atmosphere). The final isolating component in the THV line is a rupture disc, located downstream of the THV outboard PCIV. The rupture disc precludes the occurrence of secondary containment bypass leakage. The rupture disc has a burst pressure of 30 psig, which is above the maximum calculated pressure that could result from leakage through the PCIV, but below the maximum torus design pressure rating.

For the purposes of this Integrated Plan, the new Hardened Containment Ventilation System (HCVS) will utilize the existing THV, plus new modifications in accordance with NRC Order EA-12-050 and JLD-ISG-2012-02. The HCVS is intended for use as one element of several core damage prevention strategies. Venting the containment to remove decay heat and limit containment pressurization supports core cooling strategies during a prolonged Station Blackout (SBO) event.

The HCVS design will evaluate replacing the rupture disc with a variable setpoint pressure control valve (PCV). The HCVS design will analyze and select the best option from: 1) leave existing rupture disc as-is; 2) replace with lower set-pressure rupture disc; and 3) replace rupture disc with a PCV. Each option has benefits and disadvantages related to achieving the design function of this isolating component. The HCVS flow path (with the PCV option) is shown in the simplified piping and instrumentation diagram in Section 8 of this report.

The THV exhausts saturated steam to keep the containment pressure from exceeding the PCPL of 60 psig, with a constant heat input equal to 1% of the rated thermal power (3514 MWt). Per review of the THV flow calculation, there appears to be sufficient margin to keep the containment pressure from exceeding the lower of the PCPL or design pressure, with a constant heat input equal to 1% of the Extended Power Uprate (EPU) thermal power (3951MWt). This will be validated during the HCVS design.

Equipment and components:

The following equipment and components exist as part of the THV. Additions or modifications as part of the HCVS will be noted:

i. Mechanical –
   a) There are no changes planned to the existing 16" THV piping, except for potential replacement of the existing rupture disc with a PCV. The THV Piping is safety-related and complies with ASME Section III Class 2 for the portion inside the Torus Room (reactor building secondary containment) up to and including the Torus Room penetration anchor. The piping outside the Torus Room is non-safety related, and complies with ANSI B31.1. All piping is Seismic Class I.
   b) There are no changes planned to the existing PCIV's. As shown on the figure in Section 8, there is a common inboard PCIV for the SGTS and THV flow paths, but a separate outboard PCIV for each flow path. Separate downstream PCIV's allow opening the THV flow path and the SGTS independently of each other.
   c) The flow path to the SGTS is closed during normal operation, post-accident, and LOCA. It can be open to support Shutdown and Startup. The Torus Purge Exhaust Line PCIV's isolate on a Group III primary containment isolation signal.
   d) The THV outboard PCIV is normally closed in all reactor modes. The THV PCIV's have Safety Grade Instrument Gas (SGIG) as a backup to the normal IA pneumatic supply.
   e) The HCVS design will validate the backup, common SGIG system has 24-hour supply capability, or the design will include a stand-alone, seismic, pneumatic supply with 24-hour capability. If required, the HCVS detailed design will include portable pneumatic equipment to sustain operation after 24 hours, and pre-engineered connections for the portable equipment to minimize manpower efforts.

ii. Instrumentation and Controls -
   a) The THV PCIV's control and indication, located in the Main Control Room (MCR), will not be modified. The THV PCIV's have position switch indication

directly to the MCR. The THV inboard PCIV has a containment isolation signal since it may be open to support SGTS operation. The ability to bypass certain containment isolation lines for torus venting is under administrative control via Emergency Operating Procedures (EOP's), and continuous alarm indication of the bypassed line is provided in the MCR. The inboard PCIV will retain its containment isolation function. The THV outboard PCIV does not receive a containment isolation signal, but is operated remotely from the MCR with a keylock switch. The THV outboard PCIV control circuit fuses are removed during normal operation and administratively controlled, although its indication circuit is maintained with a separate set of fuses.

b) The HCVS will add a separate, dedicated control panel with direct indication of HCVS valve position, effluent temperature, and effluent pressure; and indication for support systems such as pneumatic supply pressure and DC battery voltage. The HCVS design will determine the location of the HCVS control panel (in the MCR, or in a remote but readily accessible location). The HCVS instrumentation is shown in the simplified schematic in Section 8 of this report.

c) The HCVS design will add a separate, dedicated control circuit that will also open the THV inboard and outboard PCIV's in a Beyond Design Basis External Event (BDBEE). Each of the added control circuits will control a second DC SV on its respective PCIV. The original SV and the new SV will be arranged so that energizing either will allow the motive air to open the AOV's.

   1. As with the existing control circuit for the outboard PCIV, the new HCVS control circuits will not receive a Group III isolation signal. The new HCVS control circuit will have a key-lock switch and fuses will be pulled from the circuit, to guard against inadvertent operation and ensuring the HCVS remains isolated anytime the design basis requires containment integrity.
   2. The existing SV's are DC powered. The new HCVS SV's also will be DC powered from a separate, dedicated 24-hour power supply.
   3. The existing SV's control IA pneumatic supply, with SGIG backup. The new HCVS SV's also will control IA pneumatic supply with SGIG backup. SGIG is continually in operation and no electrical power is required for this pneumatic supply.

d) The existing THV is monitored at the MCR Process Radiation Monitor Panel, 2(3)0C010. This existing radiation monitor is dedicated to the THV. The HCVS design will evaluate if this existing instrumentation meets the applicable HCVS design criteria.

iii. Electrical –

a) The existing PCIV SV's are powered by safeguard DC power supplies. The scope of the Fukushima FLEX response to BDBEE includes making the DC power source more reliable in the event of an Extended SBO, also known as Extended Loss of AC Power (ELAP). The HCVS design will provide a dedicated

DC power source for the new SV's, and dedicated power to the HCVS instrumentation. The HCVS design will provide a new DC source self-

sustainable for 24 hours of operation, and accessible to BDBEE temporary power after 24 hours.

Section 2: A description of how the design objectives contained in Order EA-12-050 Attachment 2, Requirements 1.1.1, 1.1.2, and 1.1.3, are met.

Order EA-12-050 1.1.1 Requirement:

The HCVS shall be designed to minimize the reliance on operator actions.

ISG 1.1.1 Criteria:

During events that significantly challenge plant operations, individual operators are more prone to human error. In addition, the plant operations staff may be required to implement strategies and/or take many concurrent actions that further places a burden on its personnel. During the prolonged SBO condition at the Fukushima Dai-ichi units, operators faced many significant challenges while attempting to restore numerous plant systems that were necessary to cool the reactor core, including the containment venting systems. The difficulties faced by the operators related to the location of the HCVS valves, ambient temperatures and radiological conditions, loss of all alternating current electrical power, loss of motive force to open the vent valves, and exhausting dc battery power. The NRC staff recognizes that operator actions will be needed to operate the HCVS valves; however, the licensees shall consider design features for the system that will minimize the need and reliance on operator actions to the extent possible during a variety of plant conditions, as further discussed in this ISG.

The HCVS shall be designed to be operated from a control panel located in the main control room or a remote but readily accessible location. The HCVS shall be designed to be fully functional and self sufficient with permanently installed equipment in the plant, without the need for portable equipment or connecting thereto, until such time that additional on-site or off-site personnel and portable equipment become available. The HCVS shall be capable of operating in this mode (i.e., relying on permanently installed equipment) for at least 24 hours during the prolonged SBO, unless a shorter period is justified by the licensee. The HCVS operation in this mode depends on a variety of conditions, such as the cause for the SBO (e.g., seismic event, flood, tornado, high winds), severity of the event, and time required for additional help to reach the plant, move portable equipment into place, and make connections to the HCVS.

When evaluating licensee justification for periods less than 24 hours, the NRC staff will consider the number of actions and the cumulative demand on personnel resources that are needed to maintain HCVS functionality (e.g., installation of portable equipment during the first 24 hours to restore power to the HCVS controls and/or instrumentation) as a result of design limitations. For example, the use of supplemental portable power sources may be acceptable if the supplemental power was readily available, could be quickly and easily moved into place, and installed through the use of pre-engineered quick disconnects, and the necessary human actions were identified along with the time needed to complete those actions. Conversely, supplemental power sources located in an unattended warehouse that require a qualified electrician to temporarily wire into the panel would not be considered acceptable by the staff because its installation requires a series of complex, time-consuming actions in order to achieve a successful outcome. There are similar examples that could apply to mechanical systems, such as pneumatic/compressed air systems.

Response (ref. ISG Item 1.1.1):

A new panel will provide initiation, control, and monitoring for the HCVS. With the new control panel, operator proximity to the HCVS valves will not be required, minimizing reliance on operator actions.

The HCVS design will provide procedure changes or creation of new procedures to remotely control the PCIV's (and PCV, if applicable). The revised or new procedures will address the steps required to initiate the HCVS flow. These steps will include, as applicable:

- Installing fuses and operating key-locked switches for the HCVS
- Opening the PCV and adjusting the pressure setpoint (if required).

The HCVS design will coordinate with the BDBEE modifications for Spent Fuel Pool Level Instrumentation and FLEX response strategies. The HCVS design will consider and integrate these modifications to minimize operator actions by eliminating overlap in various BDBEE coping responses. The necessary human actions and time line to complete are expected to be addressed under the FLEX response strategies because that modification ensures the portable equipment and supplemental power is readily available, can be quickly and easily moved into place, and installed through the use of pre-engineered quick disconnects.

The HCVS design will minimize the reliance on operator actions. Each PB unit's THV PCIV's are located in the Torus Room. In lieu of adding (remote) manual operators to these PCIV's, the HCVS design will make the PCIV's more reliable, which precludes reliance on operator actions in the Torus Rooms. The existing THV PCIV's have DC powered SV's that control the pneumatic supply. The HCVS design will add a SV control circuit to each PCIV; and a stand-alone, 24-hour DC power supply to the SV's, as applicable. The existing pneumatic supply is IA, with SGIG backup. The SV's also will incorporate IA and backup SGIG supply. The HCVS design will validate the backup common SGIG system has 24-hour supply capability, or the design will include a stand-alone, seismic, pneumatic supply with 24-hour capability.

The existing THV has a rupture disc downstream of the outboard PCIV. The rupture disc prevents any radioactivity release which could be caused by valve path leakage through the vent during design basis plant operation. The HCVS design will evaluate replacing the rupture disc with a PCV, which would automatically maintain torus pressure at a pre-determined setpoint below the containment design pressure. Replacing the existing rupture disc with a PCV would allow for early venting, although a replacement rupture disc with a lower setpoint would serve the same purpose. A self-actuating PCV would minimize operator actions by automatically maintaining containment pressure at a predetermined setpoint, after opening the PCIV's. A PCV with an adjustable controller would minimize the need and reliance on operator actions to operate the HCVS valves.

Permanently installed DC power and a pneumatic supply will be available to support operation and monitoring of the HCVS for the first 24 hours. The HCVS design will coordinate with the BDBEE modifications for connections to supplemental electrical power. Connections to electrical supply (and pneumatic supply if required) will be located in accessible areas with reasonable protection from assumed hazards to minimize personnel exposure to adverse conditions following a prolonged SBO and venting. Connections will use pre-engineered quick disconnects to minimize manpower and reliance on operator actions.

Order EA-12-050 1.1.2 Requirement:

The HCVS shall be designed to minimize plant operators' exposure to occupational hazards, such as extreme heat stress, while operating the HCVS system.

ISG 1.1.2 Criteria:

During a prolonged SBO, the drywell, wetwell (torus), and nearby areas in the plant where HCVS components are expected to be located will likely experience an excursion in temperatures due to inadequate containment cooling combined with loss of normal and emergency building ventilation systems. In addition, installed normal and emergency lighting in the plant may not be available. Licensees should take into consideration plant conditions expected to be experienced during applicable beyond design basis external events when locating valves, instrument air supplies, and other components that will be required to safely operate the HCVS system. Components required for manual operation should be placed in areas that are readily accessible to plant operators, and not require additional actions, such as the installation of ladders or temporary scaffolding, to operate the system.

When developing a design strategy, the NRC staff expects licensees to analyze potential plant conditions and use its acquired knowledge of these areas, in terms of how temperatures would react to extended SBO conditions and the lighting that would be available during beyond design basis external events. This knowledge also provides an input to system operating procedures, training, the choice of protective clothing, required tools and equipment, and portable lighting.

Response (ref. ISG Item 1.1.2):

The HCVS design will provide the initiation, operation, and monitoring of the HCVS from a dedicated control panel. This location of the HCVS panel will minimize plant operators' exposure to occupational hazards, such as heat stress. The location of the new panel will minimize plant operator's exposure to radiological conditions, and will be protected from the hazards expected under SBO conditions. The HCVS panel location design will consider applicable environmental conditions such as temperature, humidity, and radiation; and support systems, such as ventilation and lighting.

In order to minimize operator exposure to occupational hazards due to the impact of the prolonged SBO (i.e., loss of normal and emergency building ventilation systems and/or containment temperature changes), HCVS valve operation will not require access to the Torus Rooms. HCVS initiation, operation, and monitoring will not require access to plant areas that are expected to have elevated temperature, humidity, or radiation levels.

The HCVS design, coordinated with BDBEE strategies, will drive changes to operational procedures, training, protective clothing, tools and equipment, and portable lighting. Temporary ladders or scaffold are not expected to be required to access these connections or storage locations. Similarly, DC power and pneumatic supply and the connections to these support systems required for sustained operation will be located in accessible areas reasonably protected from severe natural phenomena, and which minimize exposure to occupational hazards. Tools required for sustained operation, such as portable headlamps and connection specific tooling, will be pre-staged in the NEI 12-06 storage locations.

Order EA-12-050 1.1.3 Requirement:

The HCVS shall also be designed to minimize radiological consequences that would impede personnel actions needed for event response.

ISG 1.1.3 Criteria:

The design of the HCVS should take into consideration the radiological consequences resulting from the event that could negatively impact event response. During the Fukushima event, personnel actions to manually operate the vent valves were impeded due to the location of the valves in the torus rooms. The HCVS shall be designed to be placed in operation by operator actions at a control panel, located in the main control room or in a remote location. The system shall be designed to function in this mode with permanently installed equipment providing electrical power (e.g., dc power batteries) and valve motive force (e.g., N2/air cylinders). The system shall be designed to function in this mode for a minimum duration of 24 hours with no operator actions required or credited, other than the system initiating actions at the control panel. Durations of less than 24 hours will be considered if justified by adequate supporting information from the licensee. To ensure continued operation of the HCVS beyond 24 hours, licensees may credit manual actions, such as moving portable equipment to supplement electrical power and valve motive power sources.

In response to Generic Letter (GL) 89-16, a number of facilities with Mark I containments installed vent valves in the torus room, near the drywell, or both. Licensees can continue to use these venting locations or select new locations, provided the requirements of this guidance document are satisfied. The HCVS improves the chances of core cooling by removing heat from containment and lowering containment pressure, when core cooling is provided by other systems. If core cooling were to fail and result in the onset core damage, closure of the vent valves may become necessary if the system was not designed for severe accident service. In addition, leakage from the HCVS within the plant and the location of the external release from the HCVS could impact the event response from on-site operators and off-site help arriving at the plant. An adequate strategy to minimize radiological consequences that could impede personnel actions should include the following:

1. Licensees shall provide permanent radiation shielding where necessary to facilitate personnel access to valves and allow manual operation of the valves locally. Licensee may use alternatives such as providing features to facilitate manual operation of valves from remote locations, as discussed further in this guidance under Requirement 1.2.2, or relocate the vent valves to areas that are significantly less challenging to operator access/actions.

2. In accordance with Requirement 1.2.8, the HCVS shall be designed for pressures that are consistent with the higher of the primary containment design pressure and the primary containment pressure limit (PCPL), as well as including dynamic loading resulting from system actuation. In addition, the system shall be leak-tight. As such, ventilation duct work (i.e., sheet metal) shall not be utilized in the design of the HCVS. Licensees should perform appropriate testing, such as hydrostatic or pneumatic testing, to establish the leak-tightness of the HCVS.

3. The HCVS release to outside atmosphere shall be at an elevation higher than adjacent plant structures. Release through existing plant stacks is considered acceptable, provided the guidance under Requirement 1.2.6 is satisfied. If the release from HCVS is through a vent stack different than the plant stack, the elevation of the stack should be higher than the nearest building or structure.

Response (ref. ISG Item 1.1.3):

The HCVS design will make the existing THV PCIV's more reliable, such that manual operation in the Torus Room will not be required. The HCVS design will provide reliable remote operation from a dedicated control panel. Applicable radiological conditions will be considered in locating the dedicated control panel, either in the MCR or in a nearby remote but readily accessible location. The HCVS design will coordinate with the BDBEE modifications and strategies, such that the HCVS will be capable of operating for a minimum duration of 24 hours with no credited operator actions other than system initiation, or will credit only those actions that are in accordance with the NRC Order EA-12-049 and NEI Guidance 12-06.

PB has installed wetwell THV's in response to GL 89-16. Drywell vents were not required by GL 89-16. The existing THV has a rupture disc that precludes secondary containment bypass leakage. The rupture disc has a burst pressure of 30 psig, which is above the maximum calculated pressure that could result from leakage through the PCIV. The HCVS design will evaluate the use of a PCV in place of the existing rupture disc; and whether the PCV can satisfy the leakage prevention function of the rupture disc. The existing THV has radiation monitoring. The HCVS design will maintain radiation monitoring and will consider offsite radiation release in a BDBEE early venting strategy, including a release that could impact event response from on-site operators and off-site help arriving at the plant.

The HCVS design strategy to minimize radiological consequences that could impede personnel actions will include the following:

1. The HCVS design will provide the initiation, operation, and monitoring of the HCVS from a dedicated control panel. This location of the HCVS panel will be chosen considering sustained operation at that remote panel and minimizing plant operators' exposure to radiological hazards. The new HCVS control panel will preclude operator actions in the Torus Room, therefore valve relocation or additional permanent shielding will not be required.
2. As discussed in Section 1.2.8, the THV was designed using the PCPL value of 60 psig, which is higher than the containment design pressure (56 psig). The installed THV's are sized to exhaust sufficient saturated steam to prevent the containment pressure from exceeding the PCPL. The current rupture disc is rated at 30 psig, which is significantly lower than either of the PCPL or the containment design pressure. The HCVS design will consider existing torus-related calculations including those for dynamic loading and will revise affected calculations or create new calculations to support HCVS modifications and operational procedure changes. The THV uses only piping components and excludes the use of HVAC ducting. The PCIV's are local leak rate tested in accordance with 10 CFR 50 Appendix J.
3. The HCVS design will consider radiological consequences resulting from the event that could negatively impact event response. Currently, each PB THV can provide a direct path from the torus vapor space to an atmospheric release point at elevation 300'-0", above the Reactor Building roof elevation of 291'-3". The roof elevation is higher than any of the adjacent buildings. The units' THV's are separate and independent, and do not allow inter-unit cross flow. Each unit's THV tees off from each unit's Torus Purge Exhaust Line, which connects to the common-unit SGTS. Inter-unit leakage is prevented by automatic isolation of the Torus Purge Exhaust Line outboard PCIV's. This design provides isolation, preventing cross-flow into unintended areas via the SGTS.

Section 3: Operational characteristics and a description of how each of the Order's technical requirements is being met.

Order EA-12-050 1.2.1 Requirement:

The HCVS shall have the capacity to vent the steam/energy equivalent of 1 percent of licensed/rated thermal power (unless a lower value is justified by analyses), and be able to maintain containment pressure below the primary containment design pressure.

ISG 1.2.1 Criteria:

Beyond design basis external events such as a prolonged SBO could result in the loss of active containment heat removal capability. The primary design objective of the HCVS is to provide sufficient venting capacity to prevent a long-term overpressure failure of the containment by keeping the containment pressure below the primary containment design pressure and the PCPL. The PCPL may be dictated by other factors, such as the maximum containment pressure at which the safety relief valves (SRVs) and the HCVS valves can be opened and closed.

The NRC staff has determined that, for a vent sized under conditions of constant heat input at a rate equal to 1 percent of rated thermal power and containment pressure equal to the lower of the primary containment design pressure and the PCPL, the exhaust-flow through the vent would be sufficient to prevent the containment pressure from increasing. This determination is based on studies that have shown that the torus suppression capacity is typically sufficient to absorb the decay heat generated during at least the first three hours following the shutdown of the reactor with suppression pool as the source of injection, that decay heat is typically less than 1 percent of rated thermal power three hours following shutdown of the reactor, and that decay heat continues to decrease to well under 1 percent, thereafter. Licensees shall have an auditable engineering basis for the decay heat absorbing capacity of their suppression pools, selection of venting pressure such that the HCVS will have sufficient venting capacity under such conditions to maintain containment pressure at or below the primary containment design pressure and the PCPL. If required, venting capacity shall be increased to an appropriate level commensurate with the licensee's venting strategy. Licensees may also use a venting capacity sized under conditions of constant heat input at a rate lower than 1 percent of thermal power if it can be justified by analysis that primary containment design pressure and the PCPL would not be exceeded. In cases where plants were granted, have applied, or plan to apply for power uprates, the licensees shall use 1 percent thermal power corresponding to the uprated thermal power. The basis for the venting capacity shall give appropriate consideration of where venting is being performed from (i.e., wetwell or drywell) and the difference in pressure between the drywell and the suppression chamber. Vent sizing for multi-unit sites must take into consideration simultaneous venting from all the units, and ensure that venting on one unit does not negatively impact the ability to vent on the other units.

Response (ref. ISG Item 1.2.1):

The bases for the decay heat absorbing capacity and containment pressure at or below the design pressure are documented in controlled calculations.

The existing THV is sized to exhaust sufficient steam to prevent the containment pressure from exceeding the PCPL with a constant heat input equal to 1% of the rated thermal power (3514 MWt). Per review of the THV flow calculation, there appears to be sufficient margin to keep the containment pressure from exceeding the design pressure, with a constant heat input equal to 1% of the EPU thermal power (3951MWt). This will be validated during the HCVS design, which will revise existing pressure vs. flow curve to include HCVS changes for the PCV (if applicable), as well as for EPU conditions.

Order EA-12-050 1.2.2 Requirement:

The HCVS shall be accessible to plant operators and be capable of remote operation and control, or manual operation, during sustained operations.

ISG 1.2.2 Criteria:

The preferred location for remote operation and control of the HCVS is from the main control room. However, alternate locations to the control room are also acceptable, provided the licensees take into consideration the following:

1. *Sustained operations mean the ability to open/close the valves multiple times during the event. Licensees shall determine the number of open/close cycles necessary during the first 24 hours of operation and provide supporting basis consistent with the plant-specific containment venting strategy.*
2. *An assessment of temperature and radiological conditions that operating personnel may encounter both in transit and locally at the controls. Licensee may use alternatives such as providing features to facilitate manual operation of valves from remote locations or relocating/reorienting the valves.*
3. *All permanently installed HCVS equipment, including any connections required to supplement the HCVS operation during a prolonged SBO (electric power, N2/air) shall be located above the maximum design basis external flood level or protected from the design basis external flood.*
4. *During a prolonged SBO, manual operation/action may become necessary to operate the HCVS. As demonstrated during the Fukushima event, the valves lost motive force including electric power and pneumatic air supply to the valve operators, and control power to solenoid valves. If direct access and local operation of the valves is not feasible due to temperature or radiological hazards, licensees should include design features to facilitate remote manual operation of the HCVS valves by means such as reach rods, chain links, hand wheels, and portable equipment to provide motive force (e.g., air/N2 bottles, diesel powered compressors, and dc batteries). The connections between the valves and portable equipment should be designed for quick deployment. If a portable motive force (e.g., air or N2 bottles, dc power supplies) is used in the design strategy, licensees shall provide reasonable protection of that equipment consistent with the staff's guidance delineated in JLD-ISG-2012-01 for Order EA-12-049.*
5. *The design shall preclude the need for operators to move temporary ladders or operate from atop scaffolding to access the HCVS valves or remote operating locations.*

<u>Response (ref. ISG Item 1.2.2):</u>

Currently, the controls and indication for the THV PCIV's are in the MCR. Any new BDBEE-related controls and indication will be at a new control panel in the MCR or in a remote but readily accessible location. The HCVS design will provide system initiation, control, and monitoring at the new control panel. All operator actions will take place at the control panel, precluding operator proximity to flow path components such as valves.

1. The HCVS design will evaluate replacing the existing rupture disc with a PCV that will automatically modulate to maintain torus pressure and temperature. The HCVS design will evaluate the motive air requirements for opening the PCIV's and modulating the PCV during the first 24 hours. If PCV is not used, then the design will evaluate the expected number of cycles by the PCIV(s) in the first 24 hours to maintain torus pressure. The PCIV's are normally closed valves that require deliberate energizing of a DC SV that supplies pneumatic pressure to open. The HCVS will validate the backup SGIG System has adequate capacity to cycle the PCV and/or the PCIV's, or will provide a stand-alone pneumatic system.
2. The HCVS design will account for the temperature and radiological conditions that operating personnel would be expected to encounter both in transit and locally at the HCVS panel, under extended SBO conditions.
3. The HCVS design will coordinate with the BDBEE modifications to address connections for temporary FLEX equipment. All permanently installed equipment and connections will be protected against the PB design basis flood. The majority of equipment will be installed above the PB external flood elevation, which is elevation 132'. Any equipment not installed above this elevation will be protected by PB credited external flood features.

The HCVS design will validate SGIG is sufficient to provide 24 or more hours of pneumatic supply, or will provide a stand-alone backup pneumatic system. The SGIG tank is located in a Seismic Class I structure.

4. The HCVS design will make the PCIV's more reliable for remote power operation, precluding the need for operators to have direct access and local operation to these components. It is expected that remote manual operation of valves via reach rods, chain links, hand wheels, and portable equipment will not be required. The HCVS design will provide SVs capable of opening the PCIV. Any needed portable equipment, including DC power, pneumatic supply, and the connections to these support systems required for sustained operation will be located in accessible areas protected from severe natural phenomena and which minimize exposure to occupational hazards. Any supplemental connections will be pre-engineered to minimize man-power resources.
5. Access to BDBEE connections or storage locations is not expected to require temporary ladders or scaffolds. Tools required for sustained operation, such as portable headlamps and connection specific tooling will be pre-staged in the NEI 12-06 storage locations.

Order EA-12-050 1.2.3 Requirement:

The HCVS shall include a means to prevent inadvertent actuation.

ISG 1.2.3 Criteria:

The design of the HCVS shall incorporate features, such as control panel key-locked switches, locking systems, rupture discs, or administrative controls to prevent the inadvertent use of the vent valves. The system shall be designed to preclude inadvertent actuation of the HCVS due to any single active failure. The design should consider general guidelines such as single point vulnerability and spurious operations of any plant installed equipment associated with HCVS.

The objective of the HCVS is to provide sufficient venting of containment and prevent long-term overpressure failure of containment following the loss of active containment heat removal capability or prolonged SBO. However, inadvertent actuation of HCVS due to a design error, equipment malfunction, or operator error during a design basis loss-of-coolant accident (DBLOCA) could have an undesirable effect on the containment accident pressure (CAP) to provide adequate net positive suction head to the emergency core cooling system (ECCS) pumps. Therefore, prevention of inadvertent actuation, while important for all plants, is essential for plants relying on CAP. The licensee submittals on HCVS shall specifically include details on how this issue will be addressed on their individual plants for all situations when CAP credit is required.

Response (ref. ISG Item 1.2.3):

The HCVS design will maintain existing THV PCIV features that provide defense in depth against inadvertent actuation. The HCVS design will include similar features on any newly installed equipment.

- Inboard and outboard PCIV's on the THV line provide double isolation, and have unique controls such that valves are opened individually
- The THV outboard PCIV is normally-closed, fail-closed and administratively controlled. The valve has a key-lock switch to prevent inadvertent opening. Fuses have been pulled from

the circuit and are administratively controlled. There needs to be two separate actions – installing fuses and opening the key-lock switch - in order to open the THV outboard PCIV. The new HCVS control circuit will have the same features to assure the PCIV's cannot be opened inadvertently and adversely impact CAP during a design basis event.

- The THV inboard PCIV is normally-closed, fail-closed. The existing control circuit for the inboard PCIV will remain unchanged. The new HCVS control circuit will have a key-lock switch to prevent inadvertent opening. Fuses will be pulled from the circuit and will be administratively controlled. There will need to be two separate actions – installing fuses and opening the key-lock switch - in order to open the inboard PCIV using the HCVS control circuit.

PB Emergency Core Cooling System (ECCS) Pumps' suction from the suppression pool relies on some amount of containment pressure to provide for adequate NPSH at elevated suppression pool temperatures.

Order EA-12-050 1.2.4 Requirement:

The HCVS shall include a means to monitor the status of the vent system (e.g., valve position indication) from the control room or other location(s). The monitoring system shall be designed for sustained operation during a prolonged SBO.

ISG 1.2.4 Criteria:

Plant operators must be able to readily monitor the status of the HCVS at all times, including being able to understand whether or not containment pressure/energy is being vented through the HCVS, and whether or not containment integrity has been restored following venting operations. Licensees shall provide a means to allow plant operators to readily determine, or have knowledge of, the following system parameters:

(1) HCVS vent valves' position (open or closed),

(2) system pressure, and

(3) effluent temperature.

Other important information includes the status of supporting systems, such as availability of electrical power and pneumatic supply pressure. Monitoring by means of permanently installed gauges that are at, or nearby, the HCVS control panel is acceptable. The staff will consider alternative approaches for system status instrumentation; however, licensees must provide sufficient information and justification for alternative approaches.

The means to monitor system status shall support sustained operations during a prolonged SBO, and be designed to operate under potentially harsh environmental conditions that would be expected following a loss of containment heat removal capability and SBO. Power supplies to all instruments, controls, and indications shall be from the same power sources supporting the HCVS operation. "Sustained operations" may include the use of portable equipment to provide an alternate source of power to components used to monitor HCVS status. Licensees shall demonstrate instrument reliability via an appropriate combination of design, analyses, operating experience, and/or testing of channel components for the following sets of parameters:

- *radiological conditions that the instruments may encounter under normal plant conditions, and during and after a prolonged SBO event.*
- *temperatures and pressure conditions as described under requirement 1.2.8, including dynamic loading from system operation.*
- *humidity based on instrument location and effluent conditions in the HCVS.*

Response (ref. ISG Item 1.2.4):

Currently, the controls and indication for the THV PCIV's are in the MCR. Any new HCVS controls and indication will be at a new control panel in the MCR or in a remote but readily accessible location.

The HCVS design will provide control panel indication for valve position, vent effluent pressure and temperature, and indication for support systems including electrical power and pneumatic supply pressure. The HCVS design will ensure the power supplies and all instruments meet the applicable design requirements.

The approximate range for the temperature indication will be 50°F to 600°F. The approximate range for the pressure indication will be 0 psig to 120 psig. The upper limits were selected to be approximately twice the required HCVS design temperature and pressure. The ranges will be finalized when the detailed design and equipment specifications are prepared.

The detailed design will address the radiological, temperature, pressure, flow induced vibration (if applicable) and internal piping dynamic forces, humidity/condensation and seismic qualification requirements. Assumed radiological conditions are those expected after a prolonged SBO (without fuel failure), which will bound normal plant conditions.

Order EA-12-050 1.2.5 Requirement:

The HCVS shall include a means to monitor the effluent discharge for radioactivity that may be released from operation of the HCVS. The monitoring system shall provide indication in the control room or other location(s), and shall be designed for sustained operation during a prolonged SBO.

ISG 1.2.5 Criteria:

Licensees shall provide an independent means to monitor overall radioactivity that may be released from the HCVS discharge. The radiation monitor does not need to meet the requirements of NUREG 0737 for monitored releases, nor does it need to be able monitor releases quantitatively to ensure compliance with Title 10 of the Code of Federal Regulations (10 CFR) Part 100 or 10 CFR Section 50.67. A wide-range monitoring system to monitor the overall activity in the release providing indication that effluent from the containment environment that is passing by the monitor is acceptable. The use of other existing radiation monitoring capability in lieu of an independent HCVS radiation monitor is not acceptable because plant operators need accurate information about releases coming from the containment via the HCVS in order to make informed decisions on operation of the reliable hardened venting system.

The monitoring system shall provide indication in the control room or a remote location (i.e., HCVS control panel) for the first 24 hours of an extended SBO with electric power provided by permanent DC battery sources, and supplemented by portable power sources for sustained operations. Monitoring radiation levels is required only during the events that necessitate operation of the HCVS. The reliability of the effluent monitoring system under the applicable environmental conditions shall be demonstrated by methods described under Requirement 1.2.4.

Response (ref. ISG Item 1.2.5):

The existing THV radiation path monitoring is a dedicated system. It is monitored at the MCR Process Radiation Monitor Panel, 2(3)0C010. The range of the THV instrument is CPM equivalent 10^{-2} to 10^{2} uCi/cc Xenon-133. The HCVS design will evaluate if this existing instrumentation meets the applicable HCVS design criteria, if additional effluent radiation monitoring is required, and if the existing panel location is acceptable. The existing THV radiation monitoring is powered by a DC supply. The HCVS design will evaluate the existing power supply.

Order EA-12-050 1.2.6 Requirement:

The HCVS shall include design features to minimize unintended cross flow of vented fluids within a unit and between units on the site.

ISG 1.2.6 Criteria:

At Fukushima, an explosion occurred in Unit 4, which was in a maintenance outage at the time of the event. Although the facts have not been fully established, a likely cause of the explosion in Unit 4 is that hydrogen leaked from Unit 3 to Unit 4 through a common venting system. System cross-connections present a potential for steam, hydrogen, and airborne radioactivity leakage to other areas of the plant and to adjacent units at multi-unit sites if the units are equipped with common vent piping. In this context, a design that is free of physical and control interfaces with other systems eliminates the potential for any cross-flow and is one way to satisfy this requirement. Regardless, system design shall provide design features to prevent the cross flow of vented fluids and migration to other areas within the plant or to adjacent units at multi-unit sites.

The current design of the hardened vent at several plants in the U.S. includes cross connections with the standby gas treatment system, which contains sheet metal ducts and filter and fan housings that are not as leak tight as hard pipes. In addition, dual unit plant sites are often equipped with a common plant stack. Examples of acceptable means for prevention of cross flow is by valves, leak-tight dampers, and check valves, which shall be designed to automatically close upon the initiation of the HCVS and shall remain closed for as long as the HCVS is in operation. Licensee's shall evaluate the environmental conditions (e.g. pressure, temperature) at the damper locations during venting operations to ensure that the dampers will remain functional and sufficiently leak-tight, and if necessary, replace the dampers with other suitable equipment such as valves. If power is required for the interfacing valves to move to isolation position, it shall be from the same power sources as the vent valves. Leak tightness of any such barriers shall be periodically verified by testing as described under Requirement 1.2.7.

Response (ref. ISG Item 1.2.6):

The THV's for both units are fully independent of each other, with separate discharge points. The discharge points are approximately at the reactor buildings' (north-south) centerlines. The distance between the reactor buildings' centerlines is 289'-6". This distance prevents effluent from one of the units from entering the THV of the other unit.

The THV tees off of the Torus Purge Exhaust Line to the common-unit SGTS. This SGTS flow path is automatically isolated by the Torus Purge Exhaust Line outboard PCIV, which is a normally-closed, fail-closed valve. The AC-powered SV on the SGTS outboard PCIV is de-energized during a SBO event. The outboard PCIV is only permitted to be opened 90 hours per year during power operations. This restriction provides further confidence that the valve will be closed at the time the HCVS is required.

Order EA-12-050 1.2.7 Requirement:

The HCVS shall include features and provision for the operation, testing, inspection and maintenance adequate to ensure that reliable function and capability are maintained.

ISG 1.2.7 Criteria:

The HCVS piping run shall be designed to eliminate the potential for condensation accumulation, as subsequent water hammer could complicate system operation during intermittent venting or to withstand the potential for water hammer without compromising the functionality of the system. Licensees shall provide a means (e.g., drain valves, pressure and temperature gauge connections) to periodically test system components, including exercising (opening and closing) the vent valve(s). In situations where total elimination of condensation is not feasible, HCVS shall be designed to accommodate condensation, including applicable water hammer loads.

The HCVS outboard of the containment boundary shall be tested to ensure that vent flow is released to the outside with minimal leakage, if any, through the interfacing boundaries with other systems or units. Licensees have the option of individually leak testing interfacing valves or testing the overall leakage of the HCVS volume by conventional leak rate testing methods. The test volume shall envelope the HCVS between the outer primary containment isolation barrier and the vent exiting the plant buildings, including the volume up to the interfacing valves. The test pressure shall be based on the HCVS design pressure. Permissible leakage rates for the interfacing valves shall be within the requirements of American Society of Mechanical Engineers Operation and Maintenance of Nuclear Power Plants Code (ASME OM) – 2009, Subsection ISTC – 3630 (e) (2), or later edition of the ASME OM Code. When testing the HCVS volume, allowed leakage shall not exceed the sum of the interfacing valve leakages as determined from the ASME OM Code. The NRC staff will consider a higher leakage acceptance values if licensees provide acceptable justification. When reviewing such requests, the NRC staff will consider the impact of the leakage on the habitability of the rooms and areas within the building and operability of equipment in these areas during the event response and subsequent recovery periods. Licensees shall implement the following operation, testing and inspection requirements for the HCVS to ensure reliable operation of the system.

Testing and Inspection Requirements

Description	*Frequency*
Cycle the HCVS valves and the interfacing system valves not used to maintain containment integrity during operations.	*Once per year*
Perform visual inspections and a walkdown of HCVS components	*Once per operating cycle*
Test and calibrate the HCVS radiation monitors.	*Once per operating cycle*
Leak test the HCVS.	*(1) Prior to first declaring the system functional;* *(2) Once every five years thereafter; and* *(3) After restoration of any breach of system boundary within the buildings*
Validate the HCVS operating procedures by conducting an open/close test of the HCVS control logic from its control panel and ensuring that all interfacing system valves move to their proper (intended) positions.	*Once per every other operating cycle*

Response (ref. ISG Item 1.2.7):

The HCVS design will address features and provisions for the operation, testing, inspection, and maintenance to ensure reliability is maintained. The THV's are designed with drain lines to eliminate the potential for condensation accumulation. A 1" drain line, located on the drip leg downstream of the rupture disc, connects to the Clean Radwaste System. Every 184 days, the line is drained in accordance station procedures. These THV features will be maintained in the HCVS design.

The THV's have various connections to periodically pressure test the PCIV's. The THV PCIV's have Local Leak Rate Tests (LLRTs) according to the governing 10 CFR 50 Appendix J

Program frequency. The THV PCIV's position indication is verified every 24 months. If a PCV is installed, it will be cycled once per year, in accordance with a recurring task. The HCVS design will address testing of the HCVS control logic. A recurring task will be created to document the walkdown of the HCVS once per operating cycle.

The existing THV radiation monitor, RY-8(9)0291 is tested and calibrated once per operating cycle (every two years) in accordance with the station preventative maintenance process. This testing and calibration frequency will be maintained.

The THV piping was examined and leak tested per ASME Section XI for the portion inside the Torus Room that connected to existing piping. The remaining portion inside the Torus Room was examined and leak tested in accordance with ASME Section III. The piping outside the Torus Room did not require testing since this is an open vent per ANSI B31.1, but was examined per ANSI B31.1. Any piping changes resulting from HCVS modifications will be examined and tested in accordance with these same governing codes.

The HCVS control logic will be open/close tested to ensure that all interfacing system valves properly move to their intended positions and indicating lights function properly. This test will be performed once per every other operating cycle, from the new control panel, using HCVS procedures.

Order EA-12-050 1.2.8 Requirement:

The HCVS shall be designed for pressures that are consistent with maximum containment design pressures, as well as, dynamic loading resulting from system actuation.

ISG 1.2.8 Criteria:

The vent system shall be designed for the higher of the primary containment design pressure or PCPL, and a saturation temperature corresponding to the HCVS design pressure. However, if the venting location is from the drywell, an additional margin of 50 °F shall be added to the design temperature because of the potential for superheated conditions in the drywell. The piping, valves, and the valve actuators shall be designed to withstand the dynamic loading resulting from the actuation of the system, including piping reaction loads from valve opening, concurrent hydrodynamic loads from SRV discharges to the suppression pool, and potential for water hammer from accumulation of steam condensation during multiple venting cycles.

Response (ref. ISG Item 1.2.8):

There are no expected changes to THV piping, unless the rupture disc is replaced with a PCV. The THV piping is safety-related and complies with ASME Section III Class 2 for the portion inside the Torus Room (reactor building secondary containment) up to and including the Torus Room penetration anchor. The piping outside the Torus Room is non-safety related, and complies with ANSI B31.1. All piping is Seismic Class I. The existing THV piping has a design rating of 150 psig at 350° F. The normal service conditions are listed as 60 psig at 308° F. The THV uses only piping components and excludes the use of HVAC ducting.

The piping, valves, and valve actuators are designed to withstand the dynamic loading resulting from the actuation of the HCVS, including piping reaction loads from valve opening. Concurrent hydrodynamic loads from SRV discharges to the suppression pool are accounted for by upstream anchor points for the torus attached piping. The HCVS design will consider existing torus-related calculations including those for dynamic loading and will revise affected calculations or create new calculations to support HCVS modifications and operational procedure changes. The HCVS design will account for EPU thermal power of 3951MW.

The THV's are designed with drain lines to eliminate the potential for condensation accumulation. This minimizes the potential for water hammer. Drainage is provided as discussed in section 1.2.7.

Order EA-12-050 1.2.9 Requirement:

The HCVS shall discharge the effluent to a release point above main plant structures.

ISG 1.2.9 Criteria:

The HCVS release to outside atmosphere shall be at an elevation higher than adjacent plant structures. Release through existing plant stacks is considered acceptable, provided the guidance under Requirement 1.2.6 is satisfied. If the release from HCVS is through a stack different than the plant stack, the elevation of the stack should be higher than the nearest building or structure. The release point should be situated away from ventilation system intake and exhaust openings, and emergency response facilities. The release stack or structure exposed to outside shall be designed or protected to withstand missiles that could be generated by the external events causing the prolonged SBO (e.g., tornadoes, high winds).

Response (ref. ISG Item 1.2.9):

The THV's discharge to an atmospheric release point at elevation 300'-0", above the Reactor Building roof elevation of 291'-3". This THV is a dedicated vent line and not associated with the plant stack. Because the reactor building is this tallest building in the PB protected area, this discharge point is higher than any nearby building or structure.

The nearest building ventilation intake openings are the Reactor Building HVAC intakes, which are located approximately 90 feet below and on the opposite side of the reactor building from the THV exhaust point. Therefore the release point is situated away from ventilation system openings, as well as the emergency response facilities.

The THV is designed in accordance with seismic and tornado wind loadings. However, THV is not designed for tornado missiles, which was not required under GL 89-16. Per NEI 12-06 Section 4.1, all severe natural phenomena that may result in a prolonged SBO must be identified. This includes evaluation if the tornado (including tornado missiles) can cause the failure of the normal, on-site emergency AC power sources, the safety-related AC distribution system, or the heat sinks required to support on-site emergency AC sources. As a minimum, all external HCVS components will be designed for tornado winds. If it is determined that tornado missiles have the potential for a prolonged SBO, any external HCVS would also have to be tornado missile protected. This will be determined early in the detailed design effort.

Section 4: Applicable Quality Requirements (Order EA-12-050 requirements 2.1 and 2.2)

Order EA-12-050 2.1 Requirement:

The HCVS system design shall not preclude the containment isolation valves, including the vent valve from performing their intended containment isolation function consistent with the design basis for the plant. These items include piping, piping supports, containment isolation valves, containment isolation valve actuators and containment isolation valve position indication components.

ISG 2.1 Criteria:

The HCVS vent path up to and including the second containment isolation barrier shall be designed consistent with the design basis of the plant. These items include piping, piping supports, containment isolation valves, containment isolation valve actuators and containment isolation valve position indication components. The HCVS design, out to and including the second containment isolation barrier, shall meet safety-related requirements consistent with the design basis of the plant. The staff notes that in response to GL 89-16, in many cases, the HCVS vent line connections were made to existing systems. In some cases, the connection was made in between two existing containment isolation valves and in others to the vacuum breaker line. The HCVS system design shall not preclude the containment isolation valves, including the vent valve from performing their intended containment isolation function consistent with the design basis for the plant. The design shall include all necessary overrides of containment isolation signals and other interface system signals to enable the vent valves to open upon initiation of the HCVS from its control panel

Response (ref. ISG Item 2.1):

The existing THV, through the inboard PCIV, shares a common path with the Torus Purge Exhaust Line to SGTS. From the SGTS tee, the THV has a dedicated flow path. The THV piping and supports are designed in accordance with existing design basis. Associated actuators, position indication, and power supplies are also designed consistent with the requirements to meet the design basis for containment isolation.

In order to maintain containment isolation when required by the plant design basis, both PCIV's in the flow path are normally closed, fail-closed AOV's. The existing control circuit for the inboard PCIV will not be changed and will still receive the Group III isolation signal. The HCVS design will add an independent control circuit that ensures the HCVS function. Opening the HCVS PCIV's will be controlled procedurally and the design will guard against inadvertent operation to ensure that the HCVS flow path remains isolated anytime the design basis requires containment integrity. An automatic containment isolation signal will not be provided to the redundant HCVS PCIV control circuits, which will be de-energized during reactor operation.

The HCVS design will not preclude any existing PCIV's from performing their intended containment isolation function when required by the plants design basis. However, the new control circuit for the HCVS will allow operation of the PCIV's from its dedicated control panel when required, even following a containment isolation signal.

Order EA-12-050 2.2 Requirement:

All other HCVS components shall be designed for reliable and rugged performance that is capable of ensuring HCVS functionality following a seismic event. These items include electrical power supply, valve actuator pneumatic supply, and instrumentation (local and remote) components.

ISG 2.2 Criteria:

All components of the HCVS beyond the second containment isolation barrier shall be designed to ensure HCVS functionality following the plant's design basis seismic event. These components include, in addition to the hardened vent pipe, electric power supply, pneumatic supply and instrumentation. The design of power and pneumatic supply lines between the HCVS valves and remote locations (if portable sources were to be employed) shall also be designed to ensure HCVS functionality. Licensees shall ensure that the HCVS will not impact other safety-related structures and components and that the HCVS will not be impacted by non-seismic components. The staff prefers that the HCVS components, including the piping run, be located in seismically qualified structures. However, short runs of HCVS piping in non-seismic structures are acceptable if the licensee provides adequate justification on the seismic ruggedness of these structures. The hardened vent shall be designed to conform to the requirements consistent with the applicable design codes for the plant, such as the American Society of Mechanical Engineers Boiler and Pressure Vessel Code and the applicable Specifications, Codes and Standards of the American Institute of Steel Construction.

To ensure the functionality of instruments following a seismic event, the NRC staff considers any of the following as acceptable methods:

- *Use of instruments and supporting components with known operating principles that are supplied by manufacturers with commercial quality assurance programs, such as ISO9001. The procurement specifications shall include the seismic requirements and/or instrument design requirements, and specify the need for commercial design standards and testing under seismic loadings consistent with design basis values at the instrument locations.*
- *Demonstration of the seismic reliability of the instrumentation through methods that predict performance by analysis, qualification testing under simulated seismic conditions, a combination of testing and analysis, or the use of experience data. Guidance for these is based on sections 7, 8, 9, and 10 of IEEE Standard 344-2004, "IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations," or a substantially similar industrial standard could be used.*
- *Demonstration that the instrumentation is substantially similar in design to instrumentation that has been previously tested to seismic loading levels in accordance with the plant design basis at the location where the instrument is to be installed (g-levels and frequency ranges). Such testing and analysis should be similar to that performed for the plant licensing basis.*

Response (ref. ISG Item 2.2):

The HCVS design will ensure components downstream of the outboard PCIV, and components that interface with the HCVS are seismically qualified.

The HCVS downstream of the outboard PCIV, including piping and supports, electrical power supply, valve actuator pneumatic supply, and instrumentation (local and remote) components, will be designed/analyzed to ensure functionality following a design basis earthquake and to conform to the applicable plant requirements/design codes except as the HCVS ISG allows or directs other criteria.

The ISG definition for "seismically rugged design" allows the use of commercial grade components and materials beyond the second containment isolation barrier including exclusion from compliance with Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants".

Per ISG Item 2.2 direction, the HCVS instruments, including valve position indication, process instrumentation, radiation monitoring, and support system monitoring, will be qualified using one of the three methods described in the ISG, which includes:

1. Purchase of instruments and supporting components with known operating principles from manufacturers with commercial quality assurance programs (e.g., ISO9001) where the procurement specifications include the applicable seismic requirements, design requirements, and applicable testing

2. Demonstration of seismic reliability via methods that predict performance described in IEEE 344-2004
3. Demonstration that instrumentation is substantially similar to the design of instrumentation previously qualified.

Instrument	**Qualification Method***
HCVS Process Temperature	ISO9001 / IEEE 344-2004 / Demonstration
HCVS Process Pressure	ISO9001 / IEEE 344-2004 / Demonstration
HCVS Process Radiation Monitor	ISO9001 / IEEE 344-2004 / Demonstration
HCVS Process Valve Position	ISO9001 / IEEE 344-2004 / Demonstration
HCVS Pneumatic Supply Pressure	ISO9001 / IEEE 344-2004 / Demonstration
HCVS Electrical Power Supply Availability	ISO9001 / IEEE 344-2004 / Demonstration

* The specific qualification method used for each required HCVS instrument will be reported in future 6 month status reports.

Section 5: Procedures and Training (Order EA-12-050 requirements 3.1 and 3.2)

Order EA-12-050 3.1 Requirement:

Licensees shall develop, implement, and maintain procedures necessary for the safe operation of the HCVS. Procedures shall be established for system operations when normal and backup power is available, and during SBO conditions.

ISG 3.1 Criteria:

Procedures shall be developed describing when and how to place the HCVS in operation, the location of system components, instrumentation available, normal and backup power supplies, directions for sustained operation, including the storage location of portable equipment, training on operating the portable equipment, and testing of equipment. The procedures shall identify appropriate conditions and criteria for use of the HCVS. The procedures shall clearly state the nexus between CAP and ECCS pumps during a DBLOCA and how an inadvertent opening of the vent valve could have an adverse impact on this nexus. The HCVS procedures shall be developed and implemented in the same manner as other plant procedures necessary to support the execution of the Emergency Operating Procedures (EOPs).

Licensees shall establish provisions for out-of-service requirements of the HCVS and compensatory measures. These provisions shall be documented in the Technical Requirements Manual (TRM) or similar document. The allowed unavailability time for the HCVS shall not exceed 30 days during modes 1, 2, and 3. If the unavailability time exceeds 30 days, the TRM shall direct licensees to perform a cause assessment and take the necessary actions to restore HCVS availability in a timely manner, consistent with plant procedures and prevent future unavailability for similar causes.

Response (ref. ISG Item 3.1):

Procedures will be established for system operations when normal and backup power is available, and during prolonged SBO conditions.

The HCVS procedures will be developed and implemented following the plants process for initiating or revising procedures and contain the following details:

- appropriate conditions and criteria for use of the HCVS
- when and how to place the HCVS in operation,
- the location of system components,
- instrumentation available,
- normal and backup power supplies,
- directions for sustained operation (reference NEI 12-06), including the storage location of portable equipment,
- training on operating the portable equipment, and
- testing of portable equipment

Licensees will establish provisions for out-of-service requirements of the HCVS and compensatory measures. The following provisions will be documented in the Technical Requirements Manual (TRM) document:

- The allowed unavailability time for the HCVS shall not exceed 30 days during modes 1, 2, and 3.
- If the unavailability time exceeds 30 days
  - The condition will be entered into the corrective action system,
  - The HCVS availability will be restored in a manner consistent with plant procedures,
  - A cause assessment will be performed to prevent future unavailability for similar causes.

Order EA-12-050 3.2 Requirement:

Licensee shall train appropriate personnel in the use of the HCVS. The training curricula shall include system operations when normal and backup power is available, and during SBO conditions.

ISG 3.2 Criteria:

All personnel expected to operate the HCVS shall receive training in the use of plant procedures developed for system operations when normal and backup power is available, and during SBO conditions consistent with the plants systematic approach to training. The training shall be refreshed on a periodic basis and as any changes occur to the HCVS.

Response (ref. ISG Item 3.2):

Training materials will be developed for the staff involved in operating the HCVS in all of modes of HCVS operation. For accredited training programs, the Systematic Approach to Training (SAT) will be used to determine training needs. Assignments to personnel responsible for implementing the SAT process at The Peach Bottom Atomic Power Station will include direction to ensure compliance with training requirements of NRC Order EA-12-50 Requirement 3.2 and ISG Criteria 3.2.

Section 6: Implementation Schedule Milestones

The following milestone schedule is provided. The dates are planning dates subject to change as design and implementation details are developed. Any changes to the following target dates will be reflected in the subsequent 6 month status reports.

Original Target Date	Activity	Status
Oct. 2012	Conceptual design meeting	Complete
Oct. 2012	Submit 60 Day Status Report	Complete
Feb. 2013	Submit Overall Integrated Implementation Plan	Completed with this submittal
Aug 2013	Submit 6 Month Status Report	
Feb. 2014	Submit 6 Month Status Report	
Aug. 2014	Submit 6 Month Status Report	
Sept. 2014	U3 Design Change Package Issued	
Sept. 2014	U3 Design Major Material On-site	
Feb. 2015	Submit 6 Month Status Report	
March 2015	Procedure Changes Training Material Complete	
Aug. 2015	Submit 6 Month Status Report	
P3R20 outage Fall 2015	U3 Design Change Implemented	
P3R20 outage Fall 2015	Procedure Changes Active	
P3R20 outage Fall 2015	U3 Demonstration/ Functional Test prior to rod withdrawal; Full compliance.	
Sept. 2015	U2 Design Change Package Issued	
Sept. 2015	U2 Design Major Material On-site	
Feb. 2016	Submit 6 Month Status Report	
Aug. 2016	Submit 6 Month Status Report	
P2R21 outage Fall 2016	U2 Design Change Implemented	
P2R21 outage Fall 2016	U2 Demonstration/Functional Test prior to rod withdrawal; Full compliance.	
Nov. 2016	Submit Completion Report	

Section 7: Changes/Updates to this Overall Integrated Implementation Plan

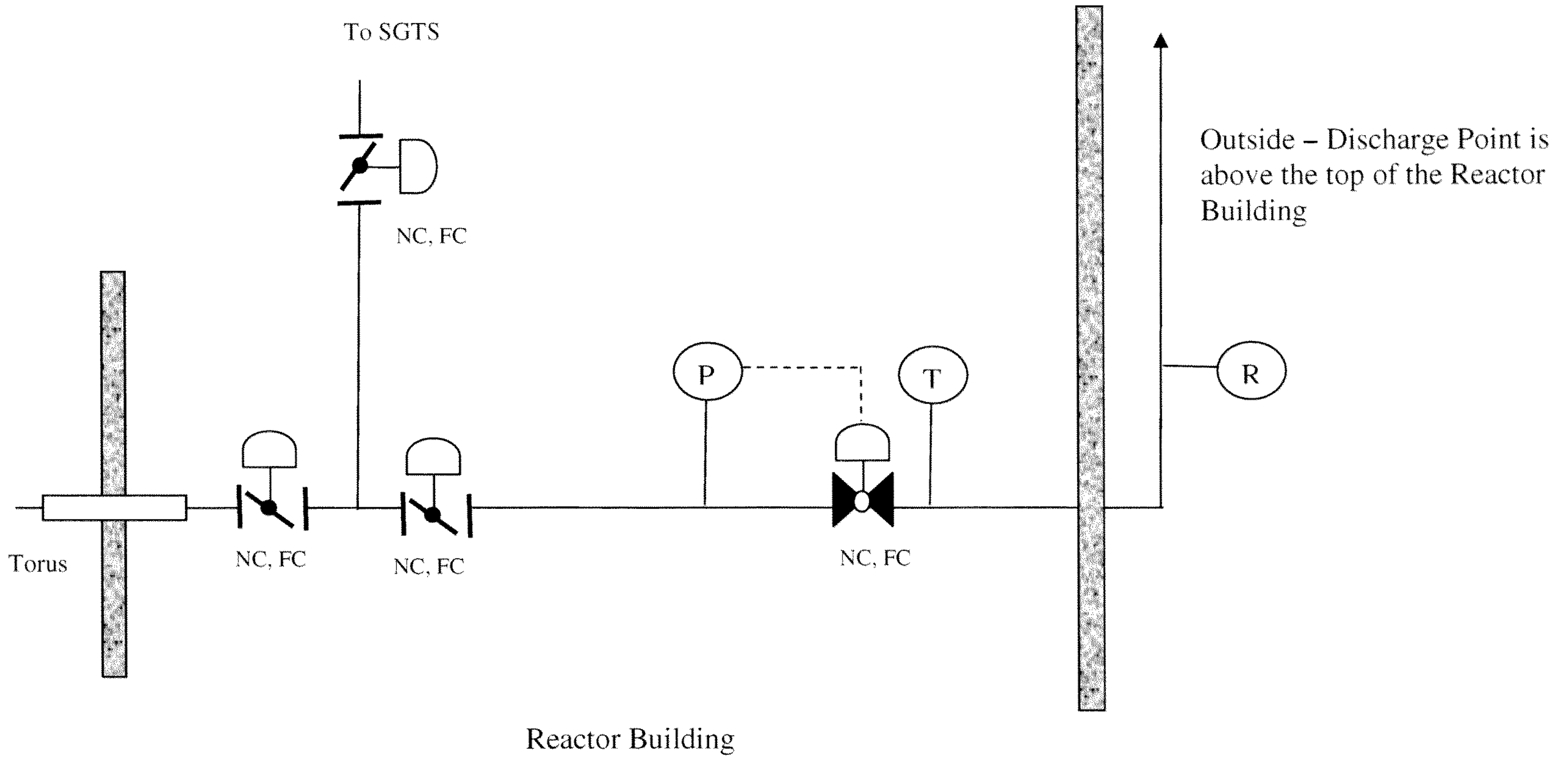
Significant changes and added design details to this plan will be communicated to the NRC in the 6 month Status Reports.

Section 8: Figures/Diagrams

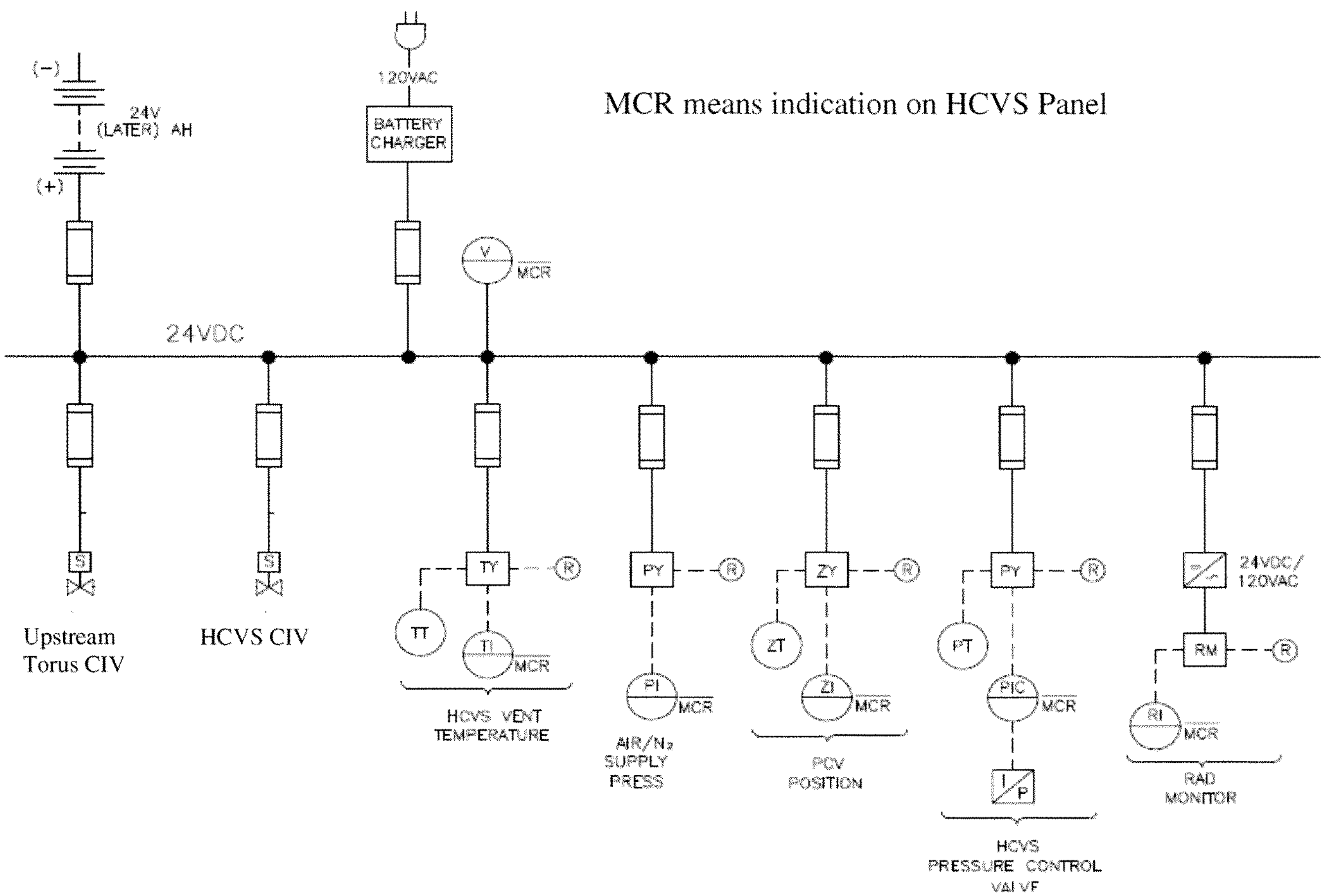
ISG IV.C. 1. Reporting Requirements:

A piping and instrumentation diagram or a similar diagram that shows system components and interfaces with plant systems and structures is acceptable.

Conceptual one-line diagram for the HCVS Piping (typical for each Unit)



Conceptual one-line diagram for Dedicated DC power for the HCVS (typical for each Unit)



Section 9: Table – HCVS Failure Modes

The following table summarizes the Integrated Plan response to specific HCVS valve circuit, valve power and valve motive air ISG requirements for reliability and sustainability.

Evaluated THV Failure Modes	Potential Cause	Alternate Action Provided to Address the Failure Mode	Containment Venting Fails?
PCIV fails to vent (Open) on demand or fails shut after opening	Valve fails to open due to a solenoid valve (SV) failure.	Redundant SVs are provided on each of the HCVS PCIVs. Energizing either SV can open the PCIV.	No
	Valve fails to open due to a loss of power to the SV.	One of the SVs will be powered from the dedicated DC power supply in an accessible location sized for 24 hours with provisions for sustaining the charge after 24 hours. The accessible location would allow corrective actions (e.g., battery change-out) if required. The other SV is powered from an existing DC source which will be maintained energized by FLEX.	No
	Valve fails to open due to loss of pneumatic air supply.	Normal Instrument Air to the PCIVs is backed-up by the safety-grade SGIG system. The HCVS detailed design will validate that the SGIG system has 24-hour supply capability, or the design will include a stand-alone, seismic, pneumatic supply with 24-hour capability. If required, the HCVS detailed design will include portable pneumatic equipment to sustain operation after 24 hours, and pre-engineered connections for the portable equipment to minimize manpower efforts.	No
PCIVs fail to stop venting (Close) on demand	Not postulated since there are no credible failure modes that would prevent at least one of two redundant containment isolation valves that fail-close on loss of air or loss of power from being able to isolate the flow path.	N/A	No

Evaluated THV Failure Modes	Potential Cause	Alternate Action Provided to Address the Failure Mode	Containment Venting Fails?
Spurious opening of flow path	Not credible as key locked switch on each PCIV and other actions require at least three discrete steps to open the flow path.	N/A	No
PCIV closure due to automatic signal	Containment isolation signal.	The upstream PCIV has an automatic isolation signal, but there is the ability to defeat the containment isolation signal to allow re-opening. In addition, the second SV will have a separate circuit that does not have any automatic isolation signal.	No
PCV* fails to vent (Open) on demand or fails shut after opening	PCV fails to open on loss of motive air.	Motive air/gas would be the same as provided to the THV PCIVs following a BDBEE. Refer to PCIV loss of motive air discussion.	No
	PCV fails to open on failure of control circuit component or power .	It is recognized that the detailed design will also have to provide an alternate means to open the PCV in case the control circuit fails (including loss of DC power to the circuit). Under consideration are (a) a hydraulic system with hand-pump, located at an accessible location, to over-ride the spring-to-shut function and (b) providing a back-up means to deliver motive air to the air-operator which would fully open the valve.	No

*The PCV is being considered as an option to replace the rupture disc.