ENCLOSURE

To

PNPS Letter 2.13.013

PILGRIM NUCLEAR POWER STATION OVERALL INTEGRATED PLAN FOR RELIABLE HARDENED CONTAINMENT VENTS

Pilgrim Nuclear Power Station's 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)

ANP-3202
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AREVA NP Inc.

Nature of Changes

Item	Section(s) or Page(s)	Description and Justification
1	All	This is a new document

ABSTRACT

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References:

1. Generic Letter 89-16, Installation of a Hardened Wetwell Vent, dated September 1, 1989
2. Order EA-12-049, Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design Basis External Events, dated March 12, 2012
3. Order EA-12-050, Issuance of Order to Modify Licenses with Regard to 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. IEEE Std 344-2004, Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations
8. ANSI/ANS-5.1-1979, Decay Heat Power in Light Water Reactors

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:

The Hardened Containment Vent System (HCVS) is designed for conditions of constant heat input at a rate equal to 1% of rated thermal power at a primary containment design pressure of 56 psig, and the corresponding Primary Containment Pressure Limit (PCPL) value of 60 psig Torus Bottom Pressure, equal to 56 psig Wetwell Pressure plus a Water Level static head of 110 inch (4 psig). This core decay heat thermal condition occurs at 3.00 hours after Reactor shutdown for the ANSI/ANS-5.1 Decay Heat based on Long-Term Full Power at 2038 MWth (based on Rated Power Operation at 2028 MWth per FSAR Table 3.7-1). The equivalent Reactor makeup water rate for this 1% power condition is 126 GPM.

The PNPS Venting Strategy for Extended Loss of AC Power (ELAP) scenarios does not envision venting until approximately 16 hours after Reactor shutdown, at Wetwell Conditions of 281°F F at 35 psig. Thus, the HCVS capacity provides sufficient Containment Heat Removal for a prolonged station blackout event, while maintaining Containment pressure well below the design value. The HCVS is intended for use as one element of a comprehensive core damage prevention strategy as described in the PNPS response to NRC Order EA-12-049 Mitigation Strategies for Beyond-Design-Basis External Events.

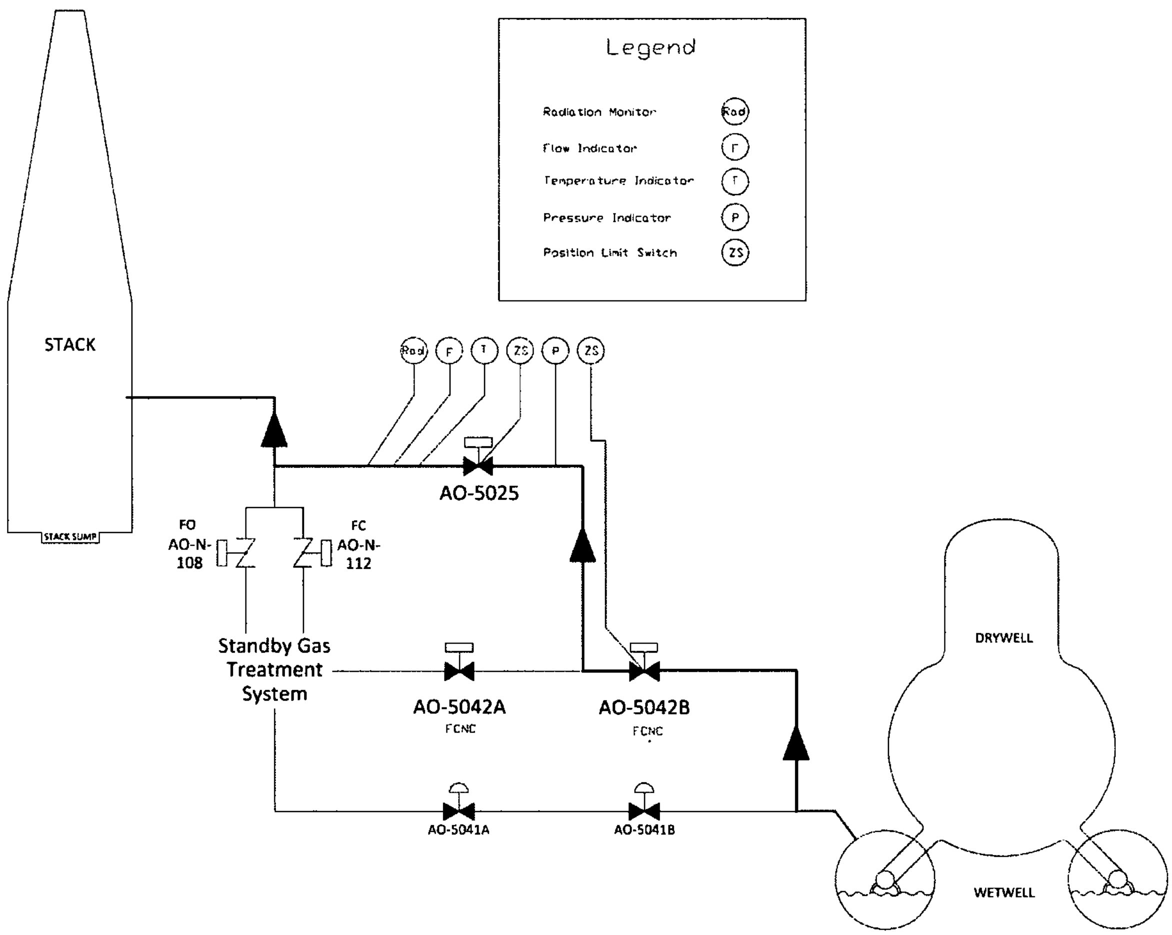
The HCVS flow path is from the Containment Wetwell (Torus) to an elevated release point at the Main Stack as shown in the simplified diagram (Figure 1 below). No ductwork is used in the flow path.

The Main Stack is a 30" OD 0.625" wall thickness pipe with a top elevation of 400 ft msl. The Main Stack is a PNPS Class I structure supported by the Main Stack Base Structure. The Main Stack Base is a reinforced concrete structure which houses the dilution fan, offgas filters, and heaters. The Main Stack is located 700 ft to the West of the centerline of the Station structures.

PNPS FSAR Section 12.2 states that: "The offgas stack is a Class I structure not designed to withstand tornado loadings, as stated in Section 12.2.1.1. The stack is located sufficiently far from other Class I structures to preclude any interaction, assuming the stack were to fall as a result of tornado loads."

PNPS FSAR Section 2.3 states that: "Severe tornado activity in eastern Massachusetts is not common. Thom shows a total number of seven tornadoes during the period of 1953-62 in a 1 degree square which includes the site. These tornadoes did not inflict major damage. The proximity to the ocean and the terrain in the vicinity of the site are unfavorable to severe tornado activity."

Figure 1: Simplified Vent Line Connections to Wetwell and Other Systems



Equipment and components:

The following equipment and components will be provided:

i. HCVS Mechanical Components –

a) Containment isolation piping, valves and controls - The HCVS vent piping and supports up to and including the second containment isolation are designed in accordance with existing design basis. Containment isolation valves (CIV) are provided consistent with the plants containment isolation valve design basis. The CIV (AO-5042B) and the second isolation valve (AO-5025) are air-operated valves (AOV) [Normally closed, fail closed] which are operated by DC powered solenoid valves (SOV). The AOV's can be operated from switches in the Main

Control Room (MCR). In addition a backup HCVS Local Instrument Panel & Pneumatic Control Station will be located in the Reactor Building to allow for manual operation of the AOVs.

b) Other system valves and piping - The HCVS piping and supports downstream of the second containment isolation valve, including valve actuator pneumatic supply components, will be designed / analyzed to conform to the requirements consistent with the applicable design codes for the plant and to ensure functionality following a design basis earthquake.

c) Interface valves will provide positive isolation to the interconnected systems. The HCVS shares part of its flow path with the Standby Gas Treatment System (SGTS).

ii. Instrumentation to monitor the status of the HCVS

a) Instrumentation indications for HCVS Temperature, Pressure, Mass Flow, and Radiation will be available in the MCR and at the Local Control Station in the Reactor Building at a suitably shielded location at the South wall outside of the TIP Room where the Vent valves are located.

b) Effluent gamma radiation sensor will be mounted immediately adjacent to the vent line downstream of the Torus Vent Valve.

c) HCVS vent flow path valve Position Limit Switch Indication, Temperature, Pressure, and Mass Flow instrumentation will monitor the status of the HCVS to aid the operator to ensure verification of proper venting operation. A failure of the Position Limit Switch Indication instrumentation would not prevent opening and closing the valve.

d) Local instrumentation will indicate pressure of nitrogen backup cylinders

e) Pressure indication for Wetwell along with temperature and level indication for the Wetwell will aid the operator to ensure proper venting operation

iii. Support systems –

a) Normal power for the HCVS valve controls, solenoid valves, and instrumentation is provided from the Station 125 VDC Power System.

b) The Station 125 VDC Power System minimum 8-Hour battery capacity and charging strategy will be enhanced as part of the FLEX strategy (NRC order EA-12-049) to provide indefinite operation of the 125 VDC Power System using FLEX portable AC Generators to repower the 125 VDC Battery Chargers before the batteries are depleted.

c) Motive air/gas supply for HCVS operation will be adequate for at least the first 24 hours during operation under prolonged SBO conditions provided from the instrument air or nitrogen from the liquid nitrogen make-up system, and permanently installed nitrogen cylinders as backup.

d) FLEX equipment will have the capability to provide back-up support equipment for reliable HCVS operation. Power is normally supplied from the 125 VDC

Power System battery capacity. The battery charging strategy will be enhanced by using portable generators as part of the FLEX strategy (NRC order EA-12-049). Motive air/gas for HCVS operation is normally supplied from Instrument Air or nitrogen from the Liquid Nitrogen Make-Up System. A self-contained nitrogen cylinder system will be added as a backup pneumatic pressure source for the HCVS AOV Valves. Power for HCVS instrumentation is normally supplied from the 125 VDC Power System battery capacity. The new 24 VDC HCVS instruments (Pressure, Temperature, Mass Flow, and Radiation) will be supplied by the same 125 VDC source, via a 125 VDC to 24 VDC converter. The new instrumentation will also include a 24 VDC backup Battery Panel with the Local Instrument Panel and also provisions to connect 24 VDC external batteries at either the MCR Panel C7 or the Local Panel.

iv. System control:

a) Active: The HCVS AOVs are operated in accordance with EOPs to control Containment pressure and provide Containment Heat Removal. There is no intention to cycle the HCVS Torus Vent Valve once it is opened for purposes of heat removal and the FLEX Strategy will be to minimize Containment pressure from that point until Wetwell venting is no longer required. The pneumatic N2 supply will simply be maintaining a constant 90 psig system pressure to maintain the AOV actuator in the full Open position during the venting phase of the response.

b) Passive: No passive component (e.g. rupture disk) will be installed.

Section 2: Design Objective

Requirement 1.1.1 - Minimize the Reliance on Operator Actions

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):

The operation of the HCVS will be designed to minimize the reliance on operator actions in response to hazards identified in NEI 12-06, Diverse and Flexible Coping Strategies (FLEX) Implementation Guide. Immediate operator actions can be completed by Reactor Operators and include remote-manual initiation from the HCVS control station. The operator actions required to open a vent path are:

Operator Actions Required to Vent the Containment during an SBO	
Preferred Operation from MCR Panel C7	**Optional HCVS Local Instrument Panel & Pneumatic Control Station Operation**
Vent Wetwell (Torus) from MCR if Torus Temperature rises to Design Value of 281°F.	Vent Wetwell (Torus) via local controls if Torus Temperature rises to Design Value of 281°F and MCR or 125 VDC Power is not available.
1. Open 1st Containment Isolation Valve AO-5042B from MCR, confirm Torus Pressure upstream of AO-5025. Displays available on MCR Panel D7.	1. Align manual instrument valves at Local Control Station for manual pneumatic operation of AOVs. Open 1st Containment Isolation Valve AO-5042B pneumatically from Local Control Station, confirm Torus Pressure upstream of AO-5025. Parameter displays available on Local Instrument Panel.
2. Open 2nd Containment Isolation Valve AO-5025 from MCR, monitor Vent Mass Flow obtained and Temperature downstream of AO-5025. Parameter displays available on MCR Panel D7.	2. Open 2nd Containment Isolation Valve AO-5025 pneumatically from Local Control Station, monitor Vent Mass Flow obtained and Temperature downstream of AO-5025. Parameter displays available on Local Instrument Panel.
3. Monitor electrical power status, Containment & HCVS Temperature, Pressure, and Mass Flow conditions, and Vent Radiation level available on MCR Panel D7.	3. Monitor electrical power status, Containment & HCVS Temperature, Pressure, and Mass Flow conditions, and Vent Radiation level available on Local Instrument Panel. If 125 VDC Power is not available, select Local Battery to connect backup 24 VDC Instrument Power from 33 AH Gel-Cell Battery Panel to power the Local and MCR Panel D7 Torus Vent instrumentation.
If needed, provide additional external backup 24 VDC Instrument Power from 100 AH Gel-Cell Batteries in FLEX Storage using External 24 VDC Plug Connectors at either MCR or Local Instrument Panel for indefinite operation of the Torus Vent instrumentation.	If needed, provide additional external backup 24 VDC Instrument Power from 100 AH Gel-Cell Batteries in FLEX Storage using External 24 VDC Plug Connectors at either MCR or Local Instrument Panel for indefinite operation of the Torus Vent instrumentation.

Remote-manual is defined in this report as a non-automatic power operation of a component and does not require the operator to be at or in close proximity to the component. No other operator actions are required to initiate venting under primary procedural protocol.

The HCVS will be designed to allow initiation, control, and monitoring of venting from the MCR or the HCVS Local Instrument Panel & Pneumatic Control Station. This location minimizes plant operators' exposure to adverse temperature and radiological conditions and is protected from hazards assumed in NEI 12-06.

The HCVS Torus Vent instrumentation is powered from the Station 125 VDC Power System, which will be maintained operating indefinitely via the FLEX Strategy in response to NRC EA-12-049, via AC Generators repowering the 125 VDC Battery Chargers before the batteries are depleted. If 125 VDC power is lost for any reason, the Torus Vent instrumentation will have an independent set of 24 VDC Gel-Cell batteries that are maintained fully charged during normal operation and provide a nominal 33 Amp-Hour rated capacity, which provides a 20 hour backup capacity. There will be additional batteries in FLEX storage and the MCR and Local HCVS Instrument Panels will have receptacles for connecting external 24 VDC batteries as-needed for indefinite operation. Local Nitrogen (N_2) Cylinders will be installed to supply N_2 pneumatic pressure to the HCVS for at least the first 24 Hours. There will be additional N_2 Cylinders in FLEX storage that may be swapped-out as-needed for indefinite operation.

After 24 hours, available personnel will be able to connect supplemental motive air/gas to the HCVS. Connections for supplementing electrical power and motive air/gas required for HCVS will be located in accessible areas with reasonable protection per NEI 12-06 that minimize personnel exposure to adverse conditions following a prolonged SBO and venting. Connections will be pre-engineered quick disconnects to minimize manpower resources.

Requirement 1.1.2 - Minimize Plant Operators' Exposure to Occupational Hazards

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 HVCS 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 allows initiating and then operating and monitoring the HCVS from the MCR and the HCVS Local Instrument Panel & Pneumatic Control Station, which minimizes plant operators' exposure to adverse temperature and radiological conditions. The MCR and the HCVS Local Instrument Panel & Pneumatic Control Station are protected from hazards assumed in NEI 12-06.

In order to minimize operator exposure to temperature excursions due to the impact of the prolonged SBO (i.e., loss of normal and emergency building ventilation systems and/or containment temperature changes), Operators will not be required to access the Torus Room,

TIP Room, RHR Quad Rooms, Steam Tunnel, or any other high temperature or potentially high radiation areas.

Connections for supplemental equipment needed for sustained operation will be located in accessible areas protected from severe natural phenomena and minimize exposure to occupational hazards.

Neither temporary ladders nor scaffold are required to access these connections or storage locations.

Requirement 1.1.3 - Minimize Radiological Consequences

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 deigned 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 will be designed for reliable remote-manual operation from the MCR or optionally from a local instrument and control station. Operators will not be required to access the Torus Room, TIP Room, RHR Quad Rooms, Steam Tunnel, or any other high temperature or potentially high radiation areas. The HCVS will be designed for reliable remote-manual operation and monitoring from the MCR. The HCVS is designed to minimize system cross flow, prevent steam flow into unintended areas, provide containment isolation, and provide reliable and rugged performance as discussed below for Order requirements 1.2.6.

Radiation dose rates, accumulated dose, and environmental assessment for the HCVS line-mounted equipment and Local Instrumentation and Control Station are based on a review of the actual Fukushima gamma dose rates reported within the Reactor Building for similar locations after severe accident conditions prevailed at the plants.

It is intended that the implementation of the FLEX Strategy by station personnel is based on preventing core damage, i.e., normal radiation dose rates prevail in and around the site. The FLEX Strategy for instrumentation shall include robust monitoring capabilities to confirm core cooling conditions at all times.

To address potential core damage that does not involve a breach of the Reactor Vessel, the FLEX Strategy shall be capable of providing core cooling flow rates that exceed the EOP Minimum Debris Retention Injection Rate (MDRIR) to the Reactor Vessel at all times, including during continued Torus Venting for Containment Heat Removal, to preclude further core damage and the need to initiate Containment Flooding.

The HCVS Torus Vent piping passes from the Torus Room through the Reactor Building TIP Room on EL 23 ft (Ground Floor). In the TIP Room are the Torus Containment Isolation Valves (AO-5042A & B) and the Torus Vent Valve (AO-5025) and the associated Torus Vent piping that connects to the Standby Gas Treatment System (SGTS) discharge piping above on EL 51 ft. The TIP Room structure provides radiation shielding for the HCVS Local Instrument Panel & Pneumatic Control Station to be located where it is accessible for the optional manual operation of the Torus Vent Valve.

Section 3: Operational characteristics

Requirement 1.2.1 - Capacity to Vent Equivalent of 1%

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 Hardened Containment Vent System (HCVS) is designed for conditions of constant heat input at a rate equal to 1% of rated thermal power at a primary containment design pressure of 56 psig, and the corresponding Primary Containment Pressure Limit (PCPL) value of 60 psig Torus Bottom Pressure, equal to 56 PSIG Wetwell Pressure plus a Water Level static head of 110 inch (4 psig). This core decay heat thermal condition occurs at 3.00 hours after Reactor shutdown for the ANSI/ANS-5.1 Decay Heat based on Long-Term Full Power at 2038 MWth (based on Rated Power Operation at 2028 MWth per FSAR Table 3.7-1). The equivalent Reactor makeup water rate for this 1% power condition is 126 GPM. This design condition represents the HCVS capability at a particular design point, but is not necessarily the conditions under which the vent is expected to be used, as determined by the PNPS FLEX Strategy response to NRC Order EA-12-049 Mitigation Strategies for Beyond-Design-Basis External Events.

The PNPS Venting Strategy for Extended Loss of AC Power (ELAP) scenarios does not envision venting until approximately 16 hours after Reactor shutdown, at Wetwell (Torus) Conditions of 281°F at 35 psig. The HCVS flow capacity provides sufficient Containment Heat Removal for a prolonged station blackout event, while maintaining Containment pressure well below the design value. By 72 Hours after Reactor shutdown, the Torus conditions have dropped to approximately 250°F at 15 psig and is in a stable condition in which the vent capacity exceeds the decay heat input rate and Torus inventory may be steadily reduced and/or controlled as-needed.

The HCVS is intended for use as one element of a comprehensive core damage prevention strategy as described in the response to NRC Order EA-12-049, which is summarized as follows:

Phase 1 employs the Steam-Driven RCIC or HPCI Pump to draw water from the Torus for high pressure vessel injection to maintain a normal to high Reactor Water Level, with the final Reactor depressurization completed at 9 to 10 Hours after shutdown due to the Torus Temperature exceeding 230°F.

Phase 2 includes the low pressure injection of raw seawater (for the most limiting event conditions) at an initial rate of 400 GPM (4x Boil-Off Rate) to stop the steam production, then sub-cool, and flood the Reactor vessel up to the steam lines. This is achieved over approximately 30 minutes, after which the injection rate is controlled at 2x Boil-Off Rate to preclude bulk boiling within the vessel, with the heated liquid discharging via the open SRVs to the Torus. Torus venting is commenced at approximately 16 Hours after shutdown to maintain the Torus temperature at or below 280°F, after which the Torus temperature steadily declines. This Phase 2 mode of sub-cooling the vessel can continue up until at least 72 Hours after shutdown, at which time a net volume of approximately 310,000 gallons of water has been added to the Torus. This is well within the limit of 400,000 gallons that may be added to the original Torus inventory and at 72 Hours the strategy enters the Phase 3 mode.

Phase 3 includes changing modes to a purified water source derived from FLEX Groundwater Wells that have been activated by 72 Hours after shutdown, using a portable FLEX Generator, and produces water at an 80 GPM rate for Reactor & Spent Fuel Pool Makeup. The Groundwater is passed through a FLEX Demineralizer vessel and injected at the boil-off rate to maintain a constant Reactor water level and low pressure boiling at 75 psig. Venting of the Torus is continued at a rate that exceeds the makeup feed rate for the Reactor vessel, resulting in a slow drop in the Torus water inventory. This mode of core and containment cooling is stable and may be continued as-needed, indefinitely, until restoration activities in the plant provide a suitable alternative. There is no need to reject water inventory from the Torus at any time, as the feed and venting rate can be adjusted as-needed for inventory control. There are no time-critical actions needed to restore plant systems in order to maintain core or containment cooling.

Requirement 1.2.2 - HCVS Shall be Accessible to Plant Operators

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.*

Response (ref. ISG Item 1.2.2):

The HCVS design allows initiating and then operating and monitoring the HCVS from the MCR and the HCVS Local Instrument Panel & Pneumatic Control Station. This location is also protected from adverse natural phenomena.

1. The HCVS flow path valves are AOVs with air-to-open and spring-to-close action. Opening the valves requires energizing a 125 VDC powered SOV and providing motive air /gas. The Station 125 VDC Power System will be enhanced as part of the FLEX strategy (NRC order EA-12-049) to provide indefinite operation of the 125 VDC Power System using FLEX portable AC Generators to repower the 125 VDC Battery Chargers before the batteries are depleted. The Local Pneumatic Control Station will include high pressure Nitrogen (N_2) gas cylinders and pressure controls to maintain a pneumatic pressure source for AOV operation during at least the first 24 Hours without any Operator attention. Since there is no intention to cycle the HCVS Torus Vent Valve once it is opened, the N_2 supply will simply be maintaining a constant 90 psig system pressure to maintain the AOV actuator in the full Open position. There will be additional N_2 Cylinders in FLEX storage that may be swapped-out as-needed for indefinite operation.

The SOVs are the only electrical component required for valve functionality that is located inside the area considered not readily accessible following a prolonged SBO. The AOVs do not require torque switches or limit switches. Backup manual operation from the Local Pneumatic Control Station allows for opening the AOVs without DC power by supplying nitrogen directly to the valve actuator via manual valve alignments performed at the Local Station.

2. The HCVS Local Instrument Panel & Pneumatic Control Station is in a readily accessible location outside of the Reactor Building TIP Room in which the HCVS AOVs are located, and provides adequate radiation shielding for all anticipated conditions.
3. All permanently installed HCVS equipment, including any connections required to supplement the HCVS operation during a prolonged SBO (electric power, N2/air) will be located in areas reasonably protected from defined hazards in NEI 12-06.
4. All valves required to open the flow path are designed for remote manual operation following a prolonged SBO, i.e., no valve operation via handwheel, reach–rod or similar means that requires close proximity to the valve. Any supplemental connections will be pre-engineered to minimize man-power resources and any needed portable equipment will be reasonably protected from defined hazards from NEI 12-06.
5. Access to the locations described above will not require temporary ladders or scaffolding.
6. The Local Pneumatic Control Station will be permanently installed to supply motive gas to the HCVS isolation valves to address loss of power to the DC SOVs. The Nitrogen pneumatic supply will be connected in parallel with the existing pneumatic supplies to manually cycle the isolation valves. The manual operation will be performed from the Local Station located in the Reactor Building at the South wall of the TIP Room.

Requirement 1.2.3 - Prevent Inadvertent Actuation

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 containment isolation valves are normally closed AOVs that are air-to-open and spring-to-shut. The DC SOV must be energized to allow the motive air to open the valve. The MCR switch for each of the two in-series valves will have a key-locked switch. Although the same DC and motive air source will be used, separate control circuits including switches will be used for the two redundant valves to address single point vulnerabilities that may cause the flow path to inadvertently open.

The features that prevent inadvertent actuation are administrative controls and key lock switches in the MCR for the two AO isolation valves. Inadvertent action from the HCVS Local Instrument Panel & Pneumatic Control Station is prevented by administrative controls and several manual steps to open the isolation valves.

EOP operating procedures provide clear guidance that the HCVS is not to be used to defeat containment integrity during any design basis transients and accident. In addition, the HCVS will be designed to provide features to prevent inadvertent actuation due to a design error, equipment malfunction, or operator error such that any credited containment accident pressure (CAP) that would provide net positive suction head to the emergency core cooling system (ECCS) pumps will be available (inclusive of a design basis loss-of-coolant accident). PNPS does credit CAP to provide adequate Net Positive Suction Head (NPSH) to the Emergency Core Cooling System (ECCS) Pumps for the Design Basis Loss of Coolant Accident (FSAR Section 14.5.3). There is no conflict between the DBLOCA requirements for CAP and the FLEX Strategy or HCVS operation. The operation of either the RCIC or HPCI System during the initial FLEX response, up until Reactor Depressurization, does not require any use of the HCVS Torus Vent and any existing assumptions regarding CAP during this period remain valid. When the Torus Vent is used in the FLEX Strategy, it is only after the Reactor has been depressurized and the FLEX pumps draw all water from external sources that are not affected by CAP.

Requirement 1.2.4 - Monitor the Status of the Vent System

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):

The HCVS Torus Vent System will have vent temperature, pressure, mass flow, and radiation monitoring. The temperature monitoring will be downstream of the second, outboard (AO-5025) Torus Vent valve. The pressure monitoring will be between the first CIV (AO-5042B) and the second valve, so that Torus pressure can be verified by opening the first isolation valve before the Torus Vent flow path is opened. Both AOVs have open and closed limit switch indication. These HCVS indications will be at the same location as the valve control switches, which is on the MCR Panel C7. The temperature, pressure, mass flow, and radiation indicators and AOV limit switch lights will be provided on MCR Panel C7 and also on the HCVS Local Instrument Panel at the AOV location in the Reactor Building. The AOV limit switches, temperature sensor, pressure, and mass flow sensor will be used to determine with certainty whether or not containment pressure/energy is being vented through the HCVS at the rate and conditions required to meet the FLEX Venting Strategy.

Local pressure gages at the Pneumatic Control Station will monitor the high pressure Nitrogen (N_2) cylinder supplies and gages downstream of the pressure regulators will show the reduced pressure provided to the AOV actuators.

The new instrumentation will normally be supplied by the Station 125 VDC Power System, via a 125 VDC to 24 VDC converter in MCR Panel C7. The new instrumentation will also include a 24 VDC Backup Battery Panel included with the Local Panel and with provisions to connect additional 24 VDC external batteries at either the Local Panel or at the MCR Panel C7.

The measurement ranges proposed for the HCVS Torus Vent instrumentation will be as follows:

Pressure Sensor	= 0 to 250 psig
Temperature Sensor	= 40 to 400°F
Steam Mass Flow Probe	= 5,000 to 80,000 Lbm/Hr Steam
Gamma Radiation Detector	= 0.010 to 10,000 Rad/Hr

These measurement ranges are selected to bound all expected conditions for system operation and will be finalized when the detailed design and equipment specifications are completed.

The HCVS and related controls and instrumentation will be specified and evaluated or tested, as required, with the expectation that the components remain functional under thermal, environmental, and radiation conditions that are consistent with the actual recorded events at the Fukushima Dai-ichi Nuclear Power Plants in March 2011.

Requirement 1.2.5 - Monitor the Effluent Discharge for Radioactivity

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 radiation monitoring system will measure over the wide-range of 0.010 to 10,000 Rad/Hr. The detector will be physically mounted adjacent to the HCVS discharge piping for overall Gamma dose rate monitoring.

The radiation level will be indicated at the MCR and HCVS Local Instrument Panel. The radiation monitor will be powered from the same source as all other powered HCVS components. Refer to the response to 1.2.2 for discussion on sustainability of DC power.

Requirement 1.2.6 - Minimize Unintended Cross Flow of Vented Fluids

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 HCVS shares part of its flow path with the Standby Gas Treatment System (SGTS). The HCVS ties in the SGTS downstream of the filter train AO valves and shares the discharge pipe going to the plant stack. The SGTS will be isolated from the HCVS by closing the AO valves. However, since SGTS isolation valves are AOV's, with air-to-open and spring to shut, the containment isolation signal will automatically isolate the valves upon any abnormal containment pressure. The detailed design phase will review the valves to determine if the inter-system valves can meet the required leakage criteria under the limiting HCVS design conditions. If required, the valve(s) will be modified, replaced or upgraded.

Requirement 1.2.7 - Provision for the Operation, Testing, Inspection and Maintenance

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 Torus Vent is designed to prevent condensation accumulation resulting from steady or intermittent venting by a low point drain system for the discharge piping. The existing drain will be enhanced by the addition of a Drain Trap to release accumulated liquid, which will be transported by gravity drain to a water seal discharging into the Torus Room.

The HCVS Containment Isolation Valves will be tested in accordance with the licensing and design basis for the plant. The HCVS past the outboard Containment Isolation Valve will be tested in conformance with one of the ISG methods. The test pressure shall be based on the HCVS design pressure, 56 psig. Permissible leakage rates for the interfacing valves will 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, the allowed leakage will not exceed the sum of the interfacing valve leakages as determined from the ASME OM Code unless a higher leakage acceptance value is justified to the NRC.

The test types and frequencies will conform to the ISG 1.2.7 Table "Testing and inspection Requirements" with the clarification that "Leak test the HCVS" applies to the HCVS boundary valves.

Requirement 1.2.8 - Design Pressures

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):

The HCVS design temperature is 305°F and design pressure is 56 psig, which as an airspace pressure bounds the Primary Containment Pressure Limit (PCPL) value of 60 psig Torus Bottom Pressure for all Torus Water Levels, and which corresponds to 56 psig Wetwell Pressure plus a Water Level static head of 110 inch (4 psig), and the Drywell & Wetwell Design Pressure is greater than the corresponding pressure based on the PCPL for higher Torus Water Levels, including the 130 inch Normal Water Level.

The HCVS design temperature is the saturation temperature corresponding to the design pressure.

The piping, valves, and valve actuators are designed to withstand the dynamic loading based on seismic inputs and the concurrent hydrodynamic loads from SRV discharges to the Suppression Pool, as applicable to such Torus-attached piping.

Requirement 1.2.9 - Discharge Release Point

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 HCVS discharge path uses the existing plant Main Stack (also referred to as the Offgas Stack).

Section 4: Applicable Quality Requirements

Requirement 2.1- Containment Isolation Function

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 HCVS vent path up to and including the second containment isolation piping and supports are designed in accordance with the existing design basis. The HCVS system design will 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. Associated actuators, position indication, and power supplies are designed consistent with the design basis of the plant as required to maintain their design basis function of maintaining the valves closed. The control circuit will allow operation of the HCVS from its control panel regardless of containment isolation signals.

Requirement 2.2 - Reliable and Rugged Performance

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 components downstream of the second containment isolation valve and components that interface with the HCVS are routed in seismically qualified structures.

The HCVS instruments, including valve position indication, process instrumentation, radiation monitoring, and support system monitoring, will be qualified by 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 Mass Flow	ISO9001 / IEEE 344-2004 / Demonstration
HCVS Process Radiation Monitor	ISO9001 / IEEE 344-2004 / Demonstration
HCVS Pneumatic Supply Pressure	ISO9001 / IEEE 344-2004 / Demonstration
HCVS Electrical Power Supply Availability	ISO9001 / IEEE 344-2004 / Demonstration
Drywell pressure	Existing instruments / pre-qualified
Wetwell pressure	Existing instruments / pre-qualified
Wetwell level	Existing instruments / pre-qualified
Wetwell temperature	Existing instruments / pre-qualified
Reactor Pressure	Existing instruments / pre-qualified
HCVS Valve Position Limit Switches	Existing instruments / pre-qualified

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

Section 5: Procedures and Training

Requirement 3.1- Develop, Implement, and Maintain Procedures

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

The procedures will state the impact on ECCS pumps NPSH (loss of CAP) during a DBLOCA due to an inadvertent opening of the vent.

Licensees will establish provisions for out-of-service requirements of the HCVS and compensatory measures. The following provisions will be tracked and documented in the Operations Daily Surveillance Log and LCO Log or other controlled 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 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.

Requirement 3.2 - Train Appropriate Personnel

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 HVCS 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):

Personnel expected to perform direct execution of the HVCS will receive necessary training in the use of plant procedures for system operations when normal and backup power is available and during prolonged SBO conditions. The training will be refreshed on a periodic basis and as any changes occur to the HCVS. The training will utilize the systematic approach to training.

In addition, per NEI 12-06, all personnel on-site will be available, if needed, to supplement Operations personnel to perform tasks for which they have been trained.

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.

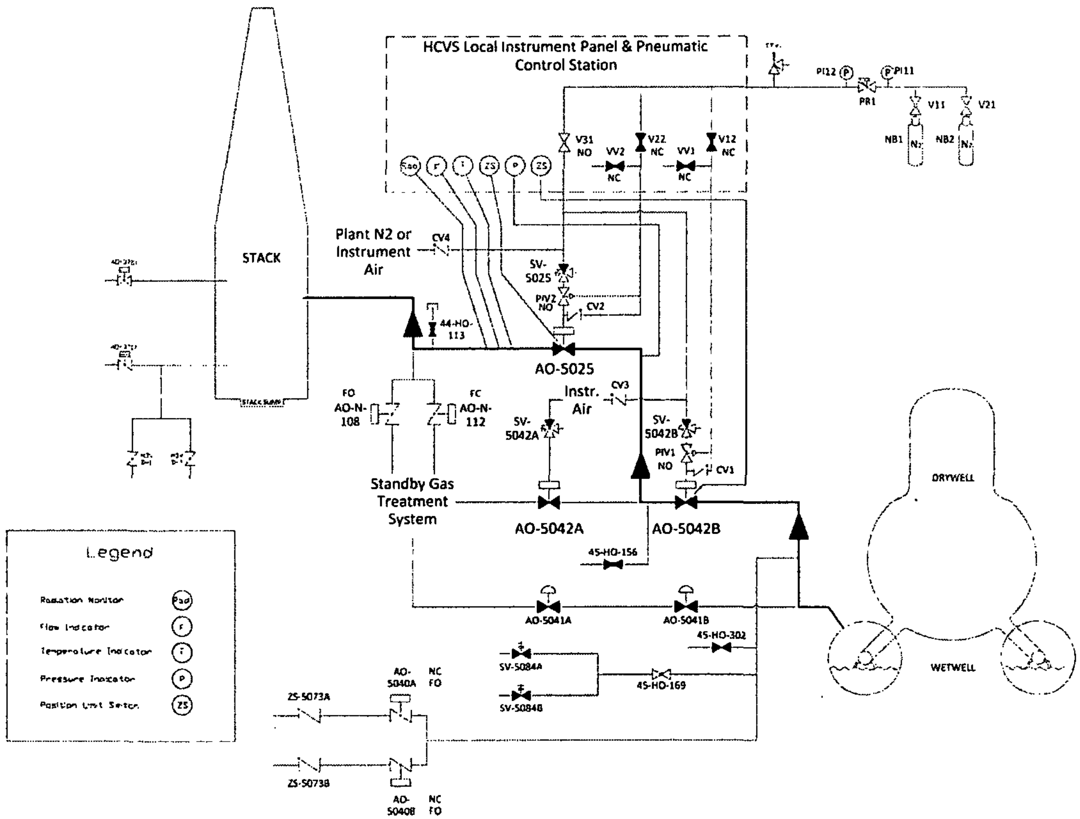
Original Target Date	Activity	Status
Oct. 2012	Hold preliminary/conceptual design meeting	Complete
Oct. 2012	Submit 60 Day Status Report	Complete
Feb. 2013	Submit Overall Integrated Implementation Plan	Complete
Aug. 2013	Submit 6 Month Status Report	
Jan. 2014	Complete Design, Develop Procedures, Issue Final Modification	
Feb. 2014	Submit 6 Month Status Report	
Aug. 2014	Submit 6 Month Status Report	
Feb. 2015	Submit 6 Month Status Report	
May 2015	Complete Implementation of Modifications	
Aug. 2015	Submit Completion Report	

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

Any significant changes to this plan will be communicated to the NRC staff in the 6 Month Status Reports

Section 8: Figures/Diagrams

ISG IV.C. 1. Reporting Requirements:



Note: This simplified schematic drawing shows a conceptual design.
The detailed design may include different features that achieve the same or better functional capabilities and redundancies of equipment.