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Provide a sequence of events and identify any time or environmental constraint required for success including the basis for the constraint.

HCVS Actions that have a time constraint to be successful should be identified with a technical basis and a justification provided that the time can reasonably be met (for example, action to open vent valves).

HCVS Actions that have an environmental constraint (e.g. actions in areas of High Thermal stress or High Dose areas) should be evaluated per guidance.

Describe in detail in this section the technical basis for the constraints identified on the sequence of events timeline attachment.

See attached sequence of events timeline (Attachment 2)

Ref: EA-13-109 Section 1.1.1, 1.1.2, 1.1.3 / NEI 13-02 Section 4.2.5, 4.2.6,6.1.1

The operation of the HCVS will be designed to minimize the reliance on operator actions in response to hazards listed in Part 1. Operator actions will be completed by plant personnel and will include the capability for remote manual initiation of HCVS valves from the HCVS control station. A list of the remote manual actions performed by plant personnel to open the HCVS vent path can be found in the following Table 2-1. A HCVS Extended Loss of AC Power (ELAP) Failure Evaluation table, which shows alternate actions that can be performed, is included in Attachment 4.

Table 2-1 HCVS Remote Manual Actions

Primary Action	Primary Location / Component	Notes
1. Power MCR HCVS Control Panel	Key-locked switch at HCVS Control Panel in Main Control Room (MCR)	Or unlock ROS door if operation is to occur at the ROS.
2. Unlock ROS door (or equivalent) and open normally isolated gas supply to HCVS Valves	Manual valve at remote operating station (simple operator action)	Required to provide gas supply to HCVS valves to initiate system
3. Open Suppression Chamber Primary Containment Isolation Valves (PCIV)	Key-locked switches at HCVS Control Panel in MCR	Alternate PCIV control via manual three-way valves at Remote Operating Station (ROS)

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4. Monitor electrical power status, pneumatic pressure, and HCVS conditions.	HCVS Control Panel in MCR	Can monitor pneumatic pressure and HCVS conditions at ROS.
5. Connect/re-energize HCVS battery charger using portable FLEX Generators	Battery chargers in Control Structure – Elevation 771'. Chargers will be re-energized via FLEX procedure to install 4 kV Generators. Implementation of the FLEX procedure must meet "Severe Accident (SA) Capable" criteria	The HCVS power supply is capable of operating the system for a minimum of 24 hours. (see Open Item #7 in Attachment 7). This FLEX action is expected to occur within 6 hours of the initiating event.
6. Replenish pneumatic supply to HCVS PCIVs	At Remote Operating Station in Control Structure – Elevation 686'-6". Connect backup gas supply to PCIVs	Prior to depletion of the pneumatic supply (no less than 24 hours from initiation of event)

A timeline was developed to identify required operator response times and potential environmental constraints. This timeline is based upon the following three cases:

1. Case 1 is a based upon the action response times developed for FLEX when utilizing anticipatory venting in a BDBEE without core damage.
2. Case 2 is based on a SECY-12-0157 long term station blackout (LTSBO) (or ELAP) with failure of RCIC after a black start where failure occurs because of subjectively assuming over injection.
3. Case 3 is based on NUREG-1935 (SOARCA) results for a prolonged SBO (or ELAP) with the loss of RCIC case without black start.

Discussion of time constraints identified in Attachment 2 for the 3 timeline cases identified above:

- 5 Hours, Initiate use of Hardened Containment Vent System (HCVS) per site procedures to maintain containment parameters below design limits and within the limits that allow continued use of RCIC. The reliable operation of HCVS will be met because HCVS meets the seismic requirements identified in NEI 13-02 and will be powered by DC buses with motive force supplied to HCVS valves from permanently installed gas storage bottles. Critical HCVS controls and instruments associated with containment will be

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powered and operated from the MCR or a Remote Operating Station on each unit. The DC power for HCVS will be available as long as the HCVS is required. The selected electrical supply is capable of supporting HCVS operation for a minimum of 24 hours with no additional operator actions (see Open Item #7 in Attachment 7). The phase 2 FLEX generator is expected to be connected within 6 hours of event initiation, which will re-energize the battery charger long before HCVS battery capacity is depleted. The simple operator actions required to initiate system operation (as identified in Table 2-1, above) can be readily accomplished within 5 hours to support anticipatory venting and can be performed to support severe accident conditions as described in Attachment 2 – Cases 2 and 3. Initiation of the HCVS under severe accident conditions would occur later than under anticipatory venting conditions; therefore, the anticipatory venting timeline is bounding. Thus, initiation of the HCVS from the MCR or the Remote Operating Station within 5 hours is acceptable because the actions can be performed any time after declaration of an ELAP until the venting is needed at 5 hours for BDBEE venting.

- Within 6 hours, portable FLEX generators will be installed and connected to the station 4 kV system. The generators will re-energize the battery chargers used for the HCVS electrical supply. Since the HCVS the battery supply will be capable of operating the HCVS system for a minimum of 24 hours (see Open Item #7 in Attachment 7), this FLEX action will support extended HCVS operation. It will be confirmed that this FLEX action can be performed under both anticipatory venting conditions and severe accident conditions.
- Within 24 hours, the FLEX generators will be connected to re-energize the battery chargers. This can be performed at any time prior to 24 hours to ensure adequate capacity is maintained so this time constraint is not limiting.
- Within 24 hours, supplemental gas supply will be valved-in to supplement the Nitrogen tank supply at the ROS. The Nitrogen bottles can be replenished one at a time leaving the other bottle(s) supplying the HCVS. This can be performed at any time prior to 24 hours to ensure adequate capacity is maintained so this time constraint is not limiting.

<u>Discussion of radiological and temperature constraints identified in Attachment 2</u>

- Actions to initiate HCVS operation are taken from the MCR and from the ROS in the Control Structure. Both locations will have shielding and physical separation from radiological sources. Non-radiological habitability for the MCR is being addressed as part of the FLEX response (Reference: PLA-7138). An assessment of temperature and radiological conditions will be performed to ensure that operating personnel can safely access and operate controls at the ROS, based on time constraints listed in Attachment 2 (see Open Item #5 in Attachment 7).
- Actions to replenish the pneumatic supply will be completed at the ROS. Deployment under severe accident conditions will be confirmed (see Open Item 3, Attachment 7).

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The location for pneumatic supply replenishment will be shielded from the HCVS piping to ensure accessibility.

- Actions to install the portable FLEX generators will occur on the North end of the Diesel Generator E building. The vent piping will be shielded, if required, to ensure portable FLEX generators can be installed under severe accident conditions. The generic radiological approach criteria included in HCVS-WP-02 will be used as input in the required shielding evaluation.

Provide Details on the Vent characteristics

Vent Size and Basis (EA-13-109 Section 1.2.1 / NEI 13-02 Section 4.1.1)

What is the plants licensed power? Discuss any plans for possible increases in licensed power (e.g. MUR, EPU).

What is the nominal diameter of the vent pipe in inches/ Is the basis determined by venting at containment design pressure, Primary Containment Pressure Limit (PCPL), or some other criteria (e.g. anticipatory venting)?

Vent Capacity (EA-13-109 Section 1.2.1 / NEI 13-02 Section 4.1.1)

Indicate any exceptions to the 1% decay heat removal criteria, including reasons for the exception. Provide the heat capacity of the suppression pool in terms of time versus pressurization capacity, assuming suppression pool is the injection source.

Vent Path and Discharge (EA-13-109 Section 1.1.4, 1.2.2 / NEI 13-02 Section 4.1.3, 4.1.5 and Appendix F/G)

Provides a description of Vent path, release path, and impact of vent path on other vent element items.

Power and Pneumatic Supply Sources (EA-13-109 Section 1.2.5 & 1.2.6 / NEI 13-02 Section 4.2.3, 2.5, 4.2.2, 4.2.6, 6.1)

Provide a discussion of electrical power requirements, including a description of dedicated 24-hour power supply from permanently installed sources. Include a similar discussion as above for the valve motive force requirements. Indicate the area in the plant from where the installed/dedicated power and pneumatic supply sources are coming

Indicate the areas where portable equipment will be staged after the 24 hour period, the dose fields in the area, and any shielding that would be necessary in that area. Any shielding that would be provided in those areas.

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Location of Control Panels (EA-13-109 Section 1.1.1, 1.1.2, 1.1.3, 1.1.4, 1.2.4, 1.2.5 / NEI 13-02 Section 4.1.3, 4.2.2, 4.2.3, 4.2.5, 4.2.6, 6.1.1 and Appendix F/G)

Indicate the location of the panels, and the dose fields in the area during severe accidents and any shielding that would be required in the area. This can be a qualitative assessment based on criteria in NEI 13-02.

Hydrogen (EA-13-109 Section 1.2.10, 1.2.11, 1.2.12 / NEI 13-02 Section 2.3,2.4, 4.1.1, 4.1.6, 4.1.7, 5.1, & Appendix H)

State which approach or combination of approaches the plant will take to address the control of flammable gases, clearly demarcating the segments of vent system to which an approach applies

Unintended Cross Flow of Vented Fluids (EA-13-109 Section 1.2.3, 1.2.12 / NEI 13-02 Section 4.1.2, 4.1.4, 4.1.6 and Appendix H)

Provide a description to eliminate/minimize unintended cross flow of vented fluids with emphasis on interfacing ventilation systems (e.g. SGTS). What design features are being included to limit leakage through interfacing valves or Appendix J type testing features?

Prevention of Inadvertent Actuation (EA-13-109 Section 1.2.7/NEI 13-02 Section 4.2.1)

The HCVS shall include means to prevent inadvertent actuation

Component Qualifications (EA-13-109 Section 2.1 / NEI 13-02 Section 5.1, 5.3)

State qualification criteria based on use of a combination of safety related and augmented quality dependent on the location, function and interconnected system requirements.

Monitoring of HCVS (Order Elements 1.1.4, 1.2.8, 1.2.9/NEI 13-02 4.1.3, 4.2.2, 4.2.4, and Appendix F/G)

Provides a description of instruments used to monitor HCVS operation and effluent. Power for an instrument will require the intrinsically safe equipment installed as part of the power sourcing.

Component reliable and rugged performance (EA-13-109 Section 2.2 / NEI 13-02 Section 5.2, 5.3)

HCVS components including instrumentation should be designed, as a minimum, to meet the seismic design requirements of the plant.

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Components including instrumentation that are not required to be seismically designed by the design basis of the plant should be designed for reliable and rugged performance that is capable of ensuring HCVS functionality following a seismic event. (Reference ISG-JLD-2012-01 and ISG-JLD-2012-03 for seismic details.)

The components including instrumentation external to a seismic category 1 (or equivalent building or enclosure should be designed to meet the external hazards that screen-in for the plant as defined in guidance NEI 12-06 as endorsed by JLD-ISG-12-01 for Order EA-12-049.

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.

Vent Size and Basis

The HCVS wetwell path is designed for venting steam/energy at a minimum capacity of 1% of 3952 MW thermal power at pressure of 53 psig (Reference: FSAR, Section 6.2.1.1.3.1 and Plant Technical Specifications, Definitions – Rated Thermal Power). This pressure is the lower of the containment design pressure (53 psig) and the PCPL value (65 psig). The size of the wetwell portion of the HCVS is nominally 12 inches in diameter, which provides adequate capacity to meet or exceed the order criteria.

Vent Capacity

The 1% value at SSES Units 1 and 2 assumes that the suppression pool pressure suppression capacity is sufficient to absorb the decay heat generated during the first 3 hours. The vent would then be able to prevent containment pressure from increasing above the containment design pressure. As part of the detailed design, the duration of suppression pool decay heat

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absorption capability will be confirmed.

{Confirm suppression pool heat capacity (see Open Item # 1 in Attachment 7)}

Vent Path and Discharge

The Susquehanna Unit 1 and 2 HCVS vent path utilizes existing spare penetrations in the wetwell. Two PCIVs will be installed in this line outside of containment, in accordance with NEI 13-02, Section 4.1.2.1.1.1.1, and will be located as close as possible to the penetration. The new PCIVs will be manually operated with air actuators and will be either fully open or fully closed during HCVS operation. The valve operators will have an air to open and spring to close design feature (fail closed valves). The outboard PCIV will also serve as the primary method of establishing flow through the system (open or closed).

The Susquehanna Unit 1 and Unit 2 HCVS discharge paths will be routed separately and will exit through each Reactor Building wall a minimum of 30 feet above ground elevation to a point approximately 3 feet above each units Reactor Building roof parapet, which is above any adjacent structure. It is noted that the cooling towers have a higher elevation but they are not adjacent to the Reactor Building. Missile protection for the HCVS external piping will be provided in accordance with guidelines established in HCVS-FAQ-04 (Reference 17).

This HCVS discharge point is such that the release point will as far as practical away from emergency ventilation system intake and emergency ventilation system exhaust openings, main control room location, ROS, storage location of HCVS portable equipment, access routes required following a ELAP and BDBEE, and emergency response facilities; however, these must be considered in conjunction with other design criteria (e.g., flow capacity) and pipe routing limitations, to the degree practical. The vent pipe routing will satisfy the vent routing guidance provided in HCVS-FAQ-04.

Power and Pneumatic Supply Sources

All electrical supply required for operation of HCVS components will be routed through inverters. PCIV position indication in the control room will be normally energized during normal plant operation. The electrical supply to the other HCVS instruments/solenoid valves will be isolated during normal plant operation.

Battery power will be provided by the existing station 250 VDC system for the first 24 hours following the ELAP event (see Open Item #7 in Attachment 7). FLEX generators (4 kV) will be deployed to reenergize plant system components in accordance with FLEX Mitigation Strategy Integrated Plan (Ref. PLA-7137) within 6 hours of event initiation. This includes re-energizing the battery chargers associated with the 250 VDC supply system, which will support extended HCVS operation.

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Pneumatic power will be provided by a nitrogen gas bottle rack installed at the ROS. The gas bottles will supply the required motive force to those HCVS valves needed to maintain flow through the HCVS effluent piping. The gas supply will be sized to support HCVS operation for a minimum of 24 hours (a minimum of 12 valve cycles of valve operation is assumed, consistent with recommendations in HCVS-WP-02). This design assumption will require future validation in the design phase of this project (see Open Item #4 in Attachment 7). Backup gas bottles will be available at the FLEX storage facility to support extended HCVS operation.

During normal plant operation, the gas supply to the PCIVs will be isolated to eliminate the potential for inadvertent operation of these valves. Following an ELAP event, simple operator actions will be required to unlock the ROS door and open a manual valve at the remote operating station to align the gas supply to the PCIVs.

- The HCVS valves (inboard and outboard PCIVs) are air-operated valves (AOV) with air-to-open and spring-to-close. Opening the valves requires energizing an AC powered solenoid operated valve (SOV), which establishes a flow path for motive gas from the nitrogen bottles to open the HCVS valve. The system design will provide adequate power and motive gas supply to support 24 hours of operation with only simple operator actions required to initiate/operate the system, consistent with the guidance provided in HCVS-WP-01. The system design credits FLEX to sustain DC power for greater than 24 hours. The initial stored motive air/gas will allow for a minimum of 12 valve operating cycles for the HCVS valves for the first 24-hours (Ref. HCVS-FAQ-02).
- All HCVS valves required to open the flow path will be designed for remote manual operation following an ELAP, such that the primary means of valve manipulation does not rely on use of a hand wheel, reach–rod or similar means that requires close proximity to the valve (reference FAQ HCVS-03). If the power supply to the solenoid valves were to fail, or if the solenoid valve were to fail, manual valves will be provided at the remote operating station to bypass the solenoid and allow alignment of the nitrogen gas supply to the HCVS valves, to enable opening of the valves. Consequently, a vent flow path could be established, with no power available to the solenoid valves. In order to prevent inadvertent operation of the system from the remote operating station, a locked fence (or door) will be provided to prevent access to the station during normal plant operation.
- An assessment of temperature and radiological conditions will be performed to ensure that operating personnel can safely access and operate controls at the remote operating station, based on time constraints listed in Attachment 2 (see Open Item #5 in Attachment 7).
- All permanently installed HCVS equipment, including any connections required to supplement the HCVS operation during an ELAP (i.e., electric power, N2/air) will be

Part 2: Boundary Conditions for Wet Well Vent

located in areas reasonably protected from defined hazards listed in Part 1 of this report.

- Access to the locations described above will not require temporary ladders or scaffolding.
- During normal plant operation, position indication will be provided in the control room for the HCVS PCIVs.

Location of Control Panels

The HCVS design allows initiating and then operating and monitoring the HCVS from the Main Control Room (MCR) and Remote Operating Station (ROS) located on Elevation 686'-6" in the Control Structure. The MCR location is protected from adverse natural phenomena and is the normal control point for Plant Emergency Response actions. The ROS is also protected from natural phenomena. ROS accessibility and habitability will be evaluated in accordance with HCVS-FAQ-01 (see Open Item #5 in Attachment 7.)

Hydrogen

As is required by EA-13-109, Section 1.2.11, the HCVS must be designed such that it is able to either provide assurance that oxygen cannot enter and mix with flammable gas in the HCVS (so as to form a combustible gas mixture), or it must be able to accommodate the dynamic loading resulting from a combustible gas detonation. Several configurations are available which will support the former (e.g., purge, mechanical isolation from outside air, etc.) or the latter (design of potentially affected portions of the system to withstand a detonation relative to pipe stress and support structures). Viable options available to meet the requirements of EA-13-109, Section 1.2.11 are provided in HCVS-WP-03. SSES will determine the method to be deployed once NRC review of HCVS-WP-03 is complete (see Open Item #6 in Attachment 7).

Unintended Cross Flow of Vented Fluids

Since the Susquehanna Unit 1 and 2 HCVS design is not shared with any existing containment vent/purge systems and the vent path will be routed separately for each unit, cross flow of vented fluids is not a concern for the Susquehanna HCVS design.

For Normal and Design Basis Accident (DBA) Conditions, the safety related position of the HCVS PCIVs is closed. During normal plant operation or DBA conditions, the motive force (gas pressure/electrical supply) required to open these valves will be isolated, thereby eliminating the possibility for inadvertent opening of these valves. Consequently, these valves are equivalent to manual containment isolation valves in the primary containment isolation system. No divisionalized electrical supplies are required to support operation of the two (2) HCVS PCIVs, since these normally closed, fail closed valves only safety function is to remain closed during normal plant operation and under DBA conditions. This design satisfies the existing Containment Isolation System Requirements as required in NRC Order EA-13-109, Section 2.1.

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For beyond design basis ELAP conditions, the function of these valves is to open or close as required to support HCVS operation under either "anticipatory venting" or "severe accident" conditions. Procedures will be in place to manually align the system through simple operator actions to support HCVS operation under these conditions. In this mode of operation, the system is not required to meet the design requirements of the existing containment isolation system design, since this is a beyond design basis mode of operation, not subject to compliance with GDCs. The system is designed to satisfy NRC Order requirements.

Prevention of Inadvertent Actuation

Emergency operating procedures provide guidance that the HCVS is not to be used to defeat containment integrity during any design basis transients and accidents. The HCVS will be designed to provide features to prevent inadvertent actuation due to a design error, equipment malfunction, or operator error. Susquehanna does not rely on Containment Accident Pressure (CAP) to maintain NPSH for ECCS pumps. In addition, it is noted that initially, the ECCS pumps will not have normal power available because of the starting boundary conditions of an ELAP.

The HCVS PCIVs serve a PCIV function to remain closed under normal operation and DBA conditions. The HCVS PCIVs do not have an active containment isolation system design function. The valves are air to open and spring to close and are normally closed. The features that prevent inadvertent actuation of the HCVS system during normal plant operation and design basis accident conditions include:

- The gas supply to the HCVS PCIVs will be normally isolated to eliminate the potential for inadvertent operation of these valves (removes motive force to valves). Prior to initiation of the HCVS, a simple operator action will be required to open a manual valve at the remote operating station to align the gas supply to the PCIVs.
- The electrical supply to the PCIV solenoid valves will be normally isolated to prevent inadvertent operation of the solenoid valves. A keylock switch will be provided on the HCVS control station to initiate/energize the HCVS control panel in the MCR. A separate keylock switch will also be provided for each PCIV. With the exception of PCIV position indication, the electrical supply to all HCVS components will be normally isolated.
- In order to prevent inadvertent operation of the system from the remote operating station, a locked door (or equivalent) will be provided to prevent access to the station during normal plant operation.

By isolating the electrical supply and gas supply to the HCVS PCIVs during normal plant operation, the PCIVs are effectively equivalent to a manual PCIV (no motive force available to inadvertently open the valves). This satisfies the containment isolation system design requirements with regard to inadvertent operation.

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Component Qualifications

The HCVS components downstream of the second containment isolation valve and components that interface with the HCVS are routed in seismically qualified structures, with the exception of the HCVS piping and check valve outside the Reactor building. These and any other exceptions identified during the final design phase of this project will be analyzed for seismic ruggedness to ensure that any potential failure would not adversely impact the function of the HCVS or other safety related structures or components (i.e. - seismic category II over category I criteria]. HCVS components that directly interface with the containment pressure boundary will be considered safety related, consistent with existing containment isolation system components. The containment system limits the leakage or release of radioactive materials to the environment to prevent offsite exposures from exceeding the guidelines of 10CFR100. During normal or design basis operations, this means serving as a pressure boundary to prevent release of radioactive material.

Likewise, any electrical or control component which interfaces with Class 1E power sources will be considered safety related up to and including appropriate isolation devices such as fuses or breakers, as their failure could adversely impact the safety-related power source. The remaining components will be considered augmented quality. Newly installed piping and valves will be seismically qualified to handle the forces associated with the new seismic hazards developed in response to Near Term Task Force (NTTF) Recommendation 2.1 – Seismic, back to their isolation boundaries. Electrical and control components will be seismically qualified and will include the ability to handle harsh environmental conditions (although they will not be considered part of the site Environmental Qualification (EQ) program).

HCVS instrumentation performance (e.g., accuracy and precision) need not exceed that of similar plant installed equipment. Additionally, radiation monitoring instrumentation accuracy and range will be sufficient to confirm flow of radionuclides through the HCVS.

The HCVS instruments, including valve position indication, process instrumentation, radiation monitoring, and support system monitoring, will be qualified by using one or more of the three methods described in the ISG, which includes:

- 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.
- Demonstration of seismic reliability via methods that predict performance described in IEEE 344-1975.
- Demonstration that instrumentation is substantially similar to the design of instrumentation previously qualified.

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

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

Monitoring of HCVS

The Susquehanna Unit 1 and 2 wetwell HCVS will be capable of being manually operated during sustained operations from a control panel located in the main control room (MCR) and will meet the requirements of Order element 1.2.4. The MCR is a readily accessible location with no further evaluation required. Control Room dose associated with HCVS operation conforms to GDC 19 - Alternative Source Term (AST). Additionally, to meet the intent for a secondary control location of section 1.2.5 of the Order, a readily accessible Remote Operating Station (ROS) will also be incorporated into the HCVS design to facilitate remote manual operation of the HCVS. The controls and indications at the ROS location will be accessible and functional under a range of plant conditions, including severe accident conditions with due consideration to source term and dose impact on operator exposure, extended loss of AC power (ELAP), and inadequate containment cooling. For the proposed ROS, an evaluation will be performed to determine accessibility to the location, habitability, staffing sufficiency, and communication capability with Vent-use decision makers (see Open Item #5 in Attachment 7).

The wetwell HCVS will include means to monitor the status of the vent system in the MCR and the ROS. The ability to open/close these valves multiple times during the event's first 24 hours will be provided by nitrogen bottles at the remote operating stations and will be supplemented by a portable gas supply, as required, to support extended HCVS operation beyond 24 hours.

The wetwell HCVS will include indications for vent pipe temperature and effluent radiation levels at both the MCR and ROS. Other important information on the status of supporting systems, such as pneumatic supply pressure, will also be included in the design and located in the MCR and ROS to support HCVS operation.

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Other instrumentation that supports the HCVS function will be provided nearby in the MCR. This instrumentation is not required to validate HCVS function and is therefore not powered from the dedicated HCVS batteries. However, these instruments are expected to be available since the FLEX DG that supports HCVS operation after 24 hours also supplies the station battery charger for these instruments and will be installed prior to depletion of the station batteries (Reference 1).

Component reliable and rugged performance

The HCVS downstream of the second containment isolation valve, including piping and supports, electrical supply, valve actuator pneumatic supply, and instrumentation (local and remote) components, will be designed/analyzed to conform to the requirements consistent with the applicable design codes (e.g., Non-safety, Seismic Category 1, B31.1, NEMA 4, etc.) for the plant and to ensure functionality following a design basis earthquake.

Additional components required to meet the Order will be reliable temperature and radiation level instrumentation consistent with the vent pipe conditions for sustained operations. The instrumentation/electrical supplies/cables/connections (components) will be qualified for temperature, radiation level and total integrated dose radiation for the HCVS Pipe and at the HCVS ROS location.

Conduit design will be installed to Seismic Class 1 criteria. Existing station barriers will be used to provide a level of protection from missiles, if equipment is located outside of seismically qualified structures. Augmented quality program will be applied to the components installed in response to this Order.

If the instruments are purchased as commercial-grade equipment, they will be qualified to operate under severe accident environment as required by NRC Order EA-13-109 and the guidance of NEI 13-02. The equipment will be demonstrated suitable for the seismic, environmental, and EMI/RFI conditions anticipated for their location. These qualifications will be bounding conditions for Susquehanna Units 1 and 2.

For the instruments required after a potential seismic event, the following methods will be used to verify that the design and installation is reliable, rugged and thus capable of ensuring HCVS functionality following a seismic event. Applicable instruments are rated by the manufacturer (or otherwise tested) for seismic impact at levels commensurate with those of postulated severe accident event conditions in the area of the instrument component using one or more of the following methods:

- demonstration of seismic motion will be consistent with that of existing design basis loads at the installed location;
- substantial history of operational reliability in environments with significant vibration with a design envelope inclusive of the effects of seismic motion imparted to the

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instruments proposed at the location;

- adequacy of seismic design and installation is demonstrated based on the guidance in Sections 7, 8, 9, and 10 of IEEE Standard 344-1975, *IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations*, (Reference 27) or a substantially similar industrial standard;
- demonstration that proposed devices are substantially similar in design to models that have been previously tested for seismic effects in excess of the plant design basis at the location where the instrument is to be installed (g-levels and frequency ranges); or
- seismic qualification using seismic motion consistent with that of existing design basis loading at the installation location.

Part 2 Boundary Conditions for WW Vent: BDBEE Venting

Determine venting capability for BDBEE Venting, such as may be used in an ELAP scenario to mitigate core damage.

Ref: EA-13-109 Section 1.1.4 / NEI 13-02 Section 2.2

First 24 Hour Coping Detail

Provide a general description of the venting actions for first 24 hours using installed equipment including station modifications that are proposed.

Ref: EA-13-109 Section 1.2.6 / NEI 13-02 Section 2.5, 4.2.2

The operation of the HCVS will be designed to minimize the reliance on operator actions for response to an ELAP and BDBEE hazards identified in part 1 of this OIP. Operator actions can be completed by Operators from the HCVS control stations and include remote-manual initiation. The operator actions required to open a vent path are as described in Table 2-1.

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 the guiding procedural protocol.

The HCVS will be designed to allow initiation, control, and monitoring of venting from the Main Control Room (MCR) or the ROS. These locations minimize plant operators' exposure to adverse temperature and radiological conditions and are protected from hazards assumed in Part 1 of this report.

Permanently installed electrical supply and motive air/gas capability will be available to support operation and monitoring of the HCVS for a minimum of 24 hours during an ELAP event (see Open Item #7 in Attachment 7). Permanently installed equipment will supply air and power to HCVS a minimum of 24 hours.

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System control:

i. Active: PCIVs are operated in accordance with procedures to control containment pressure. The HCVS will be designed for 12 open/close cycles under ELAP conditions over the first 24 hours following an ELAP. Controlled venting will be permitted in the revised EPGs and associated implementing EOPs.

ii. Passive: Inadvertent actuation protection is provided by isolating the gas supply to the HCVS PCIVs and the power supply to the PCIV solenoid valves during normal plant operation and design basis accident conditions. The PCIVs are air to open, spring to close valves, which are normally closed. By isolating the power/gas supply to the HCVS PCIVs during normal plant operation, the PCIVs are effectively equivalent to a normally closed manual valve with no motive force available to inadvertently open the valves, thereby effectively preventing inadvertent operation of the HCVS. In addition, keylock switches are used in the MCR to isolate the power supply to the PCIV solenoid valves. A locked door (or equivalent) will be used to prevent access to the ROS during normal plant operation.

Greater Than 24 Hour Coping Detail

Provide a general description of the venting actions for greater than 24 hours using portable and installed equipment including station modifications that are proposed.

Ref: EA-13-109 Section 1.2.4, 1.2.8 / NEI 13-02 Section 4.2.2

Within 24 hours, available personnel will be able to connect supplemental motive gas (e.g. - Nitrogen Bottles) to the HCVS. FLEX procedures will also be initiated to connect 4160 V FLEX generators to Class 1E 4 kV buses and supply the station 480 VAC system within approximately 6 hours following an ELAP. These generators will re-energize the battery chargers used to charge the HCVS batteries. The response to NRC EA-12-049 will demonstrate the capability for FLEX efforts to support this credited HCVS function. 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 for HCVS initiation and operation. Connections for the gas supply will be designed with connections to minimize manpower resources.

These actions provide long term support for HCVS operation for the period beyond 24 hrs. to 7 days (sustained operation time period) because on-site and off-site personnel and resources will have access to the unit(s) to provide needed action and supplies.

Part 2: Boundary Conditions for Wet Well Vent

Details:

Provide a brief description of Procedures / Guidelines:

Confirm that procedure/guidance exists or will be developed to support implementation.

Primary Containment Control Flowchart exists to direct operations in protection and control of containment integrity using the existing containment vent. Primary containment control procedures will be revised to incorporate use of the new HCVS during implementation of Revision 3 of the EOP/SAG's (Reference 31 and 32).

Identify modifications*:*

List modifications and describe how they support the HCVS Actions.

EA-12-049 Modifications

- EC 1719084 - PORTABLE GENERATOR TIE IN TO DIESEL GENERATOR E BLDG. This modification provides the required electrical FLEX connection points for tie–in of portable 4 kV generators under ELAP conditions

EA-13-109 Modifications

Unit 2 (lead Unit)

The proposed modifications required to implement the HCVS Vent order are identified below:

- A Unit 2 Outage modification will be required to tie-in the new HCVS connections to the existing wetwell containment penetration and to connect HCVS power supply to the control room. System testing requirements would also be included in this package.
- A modification will be required to install the vent stack including the platform on the top of the vent for check valve maintenance. This modification breaches the reactor building wall.
- A modification will be required to install new remote operating station including conduit, cabling and tubing to instrument and valve locations.
- A modification will be required to install the HCVS Control Room Panel. This modification will install the equipment in the control room and tie-in the instrumentation and remote operating station.

Part 2: Boundary Conditions for Wet Well Vent

- A modification will be required to install the Unit 2 HCVS Piping. This modification will install the piping from the containment isolation valves to the reactor building wall and connect to the vent stack.

Modifications required to implement the Unit 1 HCVS will be similar.

Key Venting Parameters:

List instrumentation credited for this venting actions. Clearly indicate which of those already exist in the plant and what others will be newly installed (to comply with the vent order)

Initiation, operation and monitoring of the HCVS venting will rely on the following key parameters and indicators:

Key Parameter	Component Identifier	Indication Loca
HCVS Effluent temperature	TBD	MCR/ROS
HCVS Pneumatic supply pressure	TBD	MCR/ROS
HCVS valve position indication	TBD	MCR/ROS
HCVS Radiation Level Recorder	TBD	MCR
HCVS Radiation Level Indication	TBD	ROS

Initiation, operation and monitoring of the HCVS system will also utilize several existing Main Control Room key parameters and indicators which are qualified or evaluated to the existing plant design (Reference NEI 13-02, Section 4.2.2.1.9:

Key Parameter	Component Identifier	Indication Location
Drywell and Suppression Pool pressure	UR15701A / UR15701B UR25701A / UR25701B	MCR
Suppression Pool Water Temperature	TIAH15751 / TIAH15752 TIAH25751 / TIAH25752	MCR

Part 2: Boundary Conditions for Wet Well Vent

Suppression Pool Water level	LI15775A / LI15775B LI25775A / LI25775B	MCR
Reactor Pressure	PI14202A(B) / PI14204A(B) PI24202A(B) / PI24204A(B)	MCR

HCVS indications for HCVS valve position indication, HCVS pneumatic supply pressure and HCVS effluent temperature will be installed in the MCR to comply with EA-13-109.

Notes:

Part 2 Boundary Conditions for WW Vent: Severe Accident Venting

Determine venting capability for Severe Accident Venting, such as may be used in an ELAP scenario to mitigate core damage.

Ref: EA-13-109 Section 1.2.10 / NEI 13-02 Section 2.3

First 24 Hour Coping Detail

Provide a general description of the venting actions for first 24 hours using installed equipment including station modifications that are proposed.

Ref: EA-13-109 Section 1.2.6 / NEI 13-02 Section 2.5, 4.2.2

The operation of the HCVS will be designed to minimize the reliance on operator actions for response to an ELAP and severe accident (SA) events. Severe accident event assumes that specific core cooling actions from the FLEX strategies identified in the response to Order EA-12-049 were not successfully initiated. Access to the reactor building will be restricted as determined by the RPV water level and core damage conditions. Immediate actions will be completed by Operators in the Main Control Room (MCR) or at the HCVS Remote Operating Station (ROS) and will include remote-manual actions. The operator actions required to open a vent path were previously listed in the BDBEE Venting Part 2 section of this report (Table 2-1).

Permanently installed electrical supply and motive air/gas capable will be available to support operation and monitoring of the HCVS for 24 hours. Specifics are the same as for BDBEE Venting Part 2.
System control:

i. Active: PCIVs will be manually operated in accordance with EOPs/SOPs to control containment pressure. For severe accident conditions (e.g. - Case 2 or 3 of Figure 2), vent operation will be in accordance with the EOPs and SAMGs. It is anticipated that containment pressure will be maintained within a specified operating band by opening and closing the outboard PCIV in the HCVS. The HCVS will be designed for 12 open/close cycles under ELAP conditions over the first 24 hours following an ELAP. This assumption will require future validation during the design phase of this project, following finalization of HCVS operating strategy under severe accident conditions (see Open Item #4 in Attachment 7).

ii. Passive: Same as for BDBEE Venting Part 2.

Part 2 Boundary Conditions for WW Vent: Severe Accident Venting

Greater Than 24 Hour Coping Detail

Provide a general description of the venting actions for greater than 24 hours using portable and installed equipment including station modifications that are proposed.

Ref: EA-13-109 Section 1.2.4, 1.2.8 / NEI 13-02 Section 4.2.2

Specifics are the same as for BDBEE Venting Part 2 except the credited actions required to support HCVS system operation beyond 24 hours will be evaluated for SA environmental conditions resulting from the proposed damaged Reactor Core and resultant HCVS vent pathway.

Deployment of the FLEX generators under severe accident conditions will be confirmed (see Open Item #2, Attachment 7).

These actions provide long term support for HCVS operation for the period beyond 24 hrs. to 7 days (sustained operation time period) because on-site and off-site personnel and resources will have access to the unit(s) to provide needed action and supplies.

Details:

Provide a brief description of Procedures / Guidelines:

Confirm that procedure/guidance exists or will be developed to support implementation.

The operation of the HCVS is governed the same for SA conditions as for BDBEE conditions. Existing guidance in the SAMGs directs the plant staff to consider changing radiological conditions in a severe accident.

Identify modifications:

List modifications and describe how they support the HCVS Actions.

The same as for BDBEE Venting Part 2.

Key Venting Parameters:

List instrumentation credited for the HCVS Actions. Clearly indicate which of those already exist in the plant and what others will be newly installed (to comply with the vent order)

The same as for BDBEE Venting Part 2

Part 2 Boundary Conditions for WW Vent: HCVS Support Equipment Functions

Determine venting capability support functions needed

Ref: EA-13-109 Section 1.2.8, 1.2.9 / NEI 13-02 Section 2.5, 4.2.4, 6.1.2

BDBEE Venting

Provide a general description of the BDBEE Venting actions support functions. Identify methods and strategy(ies) utilized to achieve venting results.

Ref: EA-13-109 Section 1.2.9 / NEI 13-02 Section 2.5, 4.2.2, 4.2.4, 6.1.2

Containment integrity is initially maintained by permanently installed equipment. All containment venting functions will be performed from the MCR or ROS.

Venting will require a nitrogen gas supply and DC power. Existing safety related station batteries will provide sufficient electrical supply for HCVS operation for greater than 24 hours. Before station batteries are depleted, portable FLEX generators, as detailed in the response to Order EA-12-049, will be credited to charge the station batteries and maintain DC bus voltage after 24 hours. Permanently installed N_2 bottles will provide sufficient motive force for HCVS valve operation up to 24 hours. Portable gas supply will provide the motive force required for HCVS valve operation beyond 24 hours.

Severe Accident Venting

Provide a general description of the Severe Accident Venting actions support functions. Identify methods and strategy(ies) utilized to achieve venting results.

Ref: EA-13-109 Section 1.2.8, 1.2.9 / NEI 13-02 Section 2.5, 4.2.2, 4.2.4, 6.1.2

The same support functions that are used in the BDBEE scenario would be used for severe accident venting. Actions required to-support HCVS operation beyond 24 hours will be evaluated for SA capability.

Details:

Provide a brief description of Procedures / Guidelines:

Confirm that procedure/guidance exists or will be developed to support implementation.

Most of the equipment used in the HCVS is permanently installed. The key portable items are the FLEX Generators and the additional portable gas supply needed to supplement the gas supply to the PCIVs after 24 hours. This equipment will be stored in a new FLEX Equipment

Part 2 Boundary Conditions for WW Vent: Severe Accident Venting
Storage Building, which will be constructed to meet the requirements identified in NEI-12-06 section 11 for screened in hazards.
Identify modifications: *List modifications and describe how they support the HCVS Actions.*
Flex modifications applicable to HCVS operation: A modification will be implemented to provide the required electrical FLEX connection points for tie–in of portable 4 kV generators under ELAP conditions (Reference: EC 1719084). These generators will provide power to the HCVS battery chargers after 24 hours.   HCVS modification: Add Nitrogen bottle connection points at the Remote Operating Stations to connect portable N_2 bottles for motive force to HCVS components after 24 hours. HCVS connections required for portable N2 bottles will be protected from all applicable screened-in hazards and located such that operator exposure to radiation and occupational hazards will be minimized. Structures to provide protection of the HCVS connections will be constructed to meet the requirements identified in NEI-12-06 section 11 for screened in hazards.
Key Support Equipment Parameters: *List instrumentation credited for the support equipment utilized in the venting operation. Clearly indicate which of those already exist in the plant and what others will be newly installed (to comply with the vent order)*
Local control features of the FLEX DG electrical load and fuel supply.   Pressure gauge on supplemental Nitrogen bottles.
Notes:

Part 2 Boundary Conditions for WW Vent: HCVS Venting Portable Equipment Deployment

Provide a general description of the venting actions using portable equipment including modifications that are proposed to maintain and/or support safety functions.

Ref: EA-13-109 Section 3.1 / NEI 13-02 Section 6.1.2, D.1.3.1

Deployment pathways for compliance with Order EA-12-049 are acceptable without further evaluation needed except in areas around the Reactor Building or in the vicinity of the HCVS piping. Deployment in the areas around the Reactor Building or in the vicinity of the HCVS piping will allow access, operation and replenishment of consumables with the consideration that there is potential Reactor Core Damage and HCVS operation.(see Open Item #2 in Attachment 7)

Details:

Provide a brief description of Procedures / Guidelines:

Confirm that procedure/guidance exists or will be developed to support implementation.

Operation of the portable equipment is the same as for compliance with Order EA-12-049 thus they are acceptable without further evaluation.

HCVS Actions	**Modifications**	**Protection of connections**
Per compliance with Order EA-12-049 (FLEX)	N/A	Per compliance with Order EA-12-049 (FLEX)

Notes: