**Nebraska Public Power District**

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NLS2014057
June 30, 2014

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

Subject: Nebraska Public Power District's Phase 1 Overall Integrated Plan in Response to June 6, 2013, Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109)
Cooper Nuclear Station, Docket No 50-298, DPR-46

References:

1. NRC Generic Letter 89-16, Installation of a Hardened Wetwell Vent, dated September 1, 1989
2. NRC Order Number EA-12-050, Order Modifying Licenses with Regard to Reliable Hardened Containment Vents (Effective Immediately), dated March 12, 2012
3. NRC Order Number EA-13-109, Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions, dated June 6, 2013
4. NRC Interim Staff Guidance JLD-ISG-2013-02, Compliance with Order EA-13-109, Severe Accident Reliable Hardened Containment Vents, dated November 14, 2013
5. NRC Acknowledgement of NEI 13-02 Hardened Containment Venting System (HCVS) Phase 1 Overall Integrated Plan Template, dated May 14, 2014
6. NEI 13-02, Industry Guidance for Compliance with Order EA-13-109, Revision 0, Dated November 2013

Dear Sir or Madam:

On June 6, 2013, the Nuclear Regulatory Commission (NRC) issued an Order (Reference 3) to Nebraska Public Power District (NPPD). Reference 3 was immediately effective and directs NPPD to require Cooper Nuclear Station (CNS), a boiling water reactor with a Mark I containment, to take certain actions to ensure that it has a hardened containment vent system (HCVS) to remove decay heat from the containment, and maintain control of containment pressure within acceptable limits following events that result in the loss of active containment heat removal capability while maintaining the capability to operate under severe accident (SA) conditions resulting from an Extended Loss of AC Power (ELAP). Specific requirements are outlined in Attachment 2 of Reference 3.

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Reference 3 requires submission of an Overall Integrated Plan (OIP) by June 30, 2014, for Phase 1 of the Order. The interim staff guidance (Reference 4) was issued November 14, 2013, and provides direction regarding the content of this OIP. The purpose of this letter is to provide the OIP for Phase 1 of the Order pursuant to Section IV, Condition D.1, of Reference 3. This letter confirms NPPD has received Reference 4 and has a Phase 1 OIP for CNS which complies with the guidance for the purpose of ensuring the functionality of a HCVS to remove decay heat from the containment, and maintain control of containment pressure within acceptable limits following events that result in the loss of active containment heat removal capability while maintaining the capability to operate under SA conditions resulting from an ELAP as described in Attachment 2 of Reference 3.

Reference 6, Section 7.0, contains the specific reporting requirements for the OIP. The information in the attachment provides NPPD's Phase 1 OIP for CNS pursuant to Section 7.0 of Reference 6 by use of the Phase 1 OIP Template per Reference 5.

For the purposes of compliance with Phase 1 of Order EA-13-109, Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions, NPPD plans to install a severe accident capable wetwell vent at CNS.

Compliance with the requirements of Reference 3 will supersede any and all actions or commitments associated with References 1 and 2. Any actions or commitments made relative to Reference 1 or 2 are rescinded and not binding by submittal of the Reference 3 Phase 1 OIP via this letter.

This letter contains no new regulatory commitments.

Should you have any questions concerning the content of this letter, please contact David Van Der Kamp, Licensing Manager, at (402) 825-2904.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on: 06/30/14

Sincerely,

Oscar A. Limpias
Vice President - Nuclear and
Chief Nuclear Officer

/bk

Attachment: Cooper Nuclear Station's Overall Integrated Plan in Response to June 6, 2013, Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents (Order Number EA-13-109)

cc: Regional Administrator, w/attachment
USNRC - Region IV

Director, w/attachment
USNRC - Office of Nuclear Reactor Regulation

Cooper Project Manager, w/attachment
USNRC - NRR Project Directorate IV-1

Senior Resident Inspector, w/attachment
USNRC - CNS

NPG Distribution, w/o attachment

CNS Records, w/attachment

**Attachment to**
**NLS2014057**

**Cooper Nuclear Station's Overall Integrated Plan**
**in Response to June 6, 2013, Commission Order Modifying Licenses**
**with Regard to Reliable Hardened Containment Vents**
**(Order Number EA-13-109)**

# Cooper Nuclear Station
# Hardened Containment Venting System (HCVS)
# Overall Integrated Plan

## Table of Contents:

## Introduction

In 1989, the NRC issued Generic Letter 89-16, "Installation of a Hardened Wetwell Vent," to all licensees of BWRs with Mark I containments to encourage licensees to voluntarily install a hardened wetwell vent. In response, licensees installed a hardened vent pipe from the wetwell to some point outside the secondary containment envelope (usually outside the reactor building). Some licensees also installed a hardened vent branch line from the drywell.

On March 19, 2013, the NRC Commissioners directed the staff, per SRM for SECY-12-0157, to require licensees with Mark I and Mark II containments to "upgrade or replace the reliable hardened vents required by Order EA-12-050 with a containment venting system designed and installed to remain functional during severe accident conditions." In response, the NRC issued Order EA-13-109, "Issuance of Order to Modify Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions," June 6, 2013. The Order (EA-13-109) requires that licensees of BWR facilities with Mark I and Mark II containment designs ensure that these facilities have a reliable hardened vent to remove decay heat from the containment, and maintain control of containment pressure within acceptable limits following events that result in the loss of active containment heat removal capability while maintaining the capability to operate under SA conditions resulting from an ELAP.

The Order requirements are applied in a phased approach where:

- "Phase 1 involves upgrading the venting capabilities from the containment wetwell to provide reliable, severe accident capable hardened vents to assist in preventing core damage and, if necessary, to provide venting capability during severe accident conditions." (Completed "no later than startup from the second refueling outage that begins after June 30, 2014, or June 30, 2018, whichever comes first.")

- "Phase 2 involves providing additional protections for severe accident conditions through installation of a reliable, severe accident capable drywell vent system or the development of a reliable containment venting strategy that makes it unlikely that a licensee would need to vent from the containment drywell during severe accident conditions." (Completed "no later than startup from the first refueling outage that begins after June 30, 2017, or June 30, 2019, whichever comes first.")

The NRC provided an acceptable approach for complying with Order EA-13-109 through ISG (JLD-ISG-2013-02) issued in November 2013. The ISG endorses the compliance approach presented in NEI 13-02, Revision 0, "Compliance with Order EA-13-109, Severe Accident Reliable Hardened Containment Vents," with clarifications. Except in those cases in which a licensee proposes an acceptable alternative method for complying with Order EA-13-109, the NRC staff will use the methods described in this ISG (NEI 13-02) to evaluate licensee compliance as presented in submittals required in Order EA-13-109.

The Order also requires submittal of an OIP which will provide a description of how the requirements of the Order will be achieved. This document provides the OIP for complying with Order EA-13-109 using the methods described in NEI 13-02 and endorsed by NRC JLD-ISG-2013-02. Six month progress reports will be provided consistent with the requirements of Order EA-13-109.

The Plant venting actions for the EA-13-109 severe accident capable venting scenario can be summarized by the following:

- The HCVS will be initiated via manual action from the MCR or ROS at the appropriate time based on procedural guidance in response to plant conditions from observed or derived symptoms.

- The vent will utilize Containment Parameters of Pressure, Level, and Temperature from the MCR instrumentation to monitor effectiveness of the venting actions.

- The vent operation will be monitored by HCVS valve position, temperature, pressure, and effluent radiation levels.

- The HCVS motive force will be monitored and have the capacity to operate for 24 hours with installed equipment. Replenishment of the motive force will be by use of portable equipment once the installed motive force is exhausted.

- Venting actions will be capable of being maintained for a sustained period of up to 7 days or a shorter time if justified.

# Part 1: General Integrated Plan Elements and Assumptions

**Extent to which the guidance, JLD-ISG-2013-02 and NEI 13-02, are being followed. Identify any deviations.**
*Include a description of any alternatives to the guidance. A technical justification and basis for the alternative needs to be provided. This will likely require a pre-meeting with the NRC to review the alternative.*

**Ref: JLD-ISG-2013-02**

Compliance will be attained for CNS with no known deviations to the guidelines in JLD-ISG-2013-02 and NEI 13-02 for each phase as follows:

- Phase 1 (wetwell): By the startup from the second refueling outage that begins after June 30, 2014, or June 30, 2018, whichever comes first. Currently scheduled for 4th Quarter (November) of 2016.
- Phase 2: No later than startup from the first refueling outage that begins after June 30, 2017, or June 30, 2019, whichever comes first. Currently scheduled for 4th Quarter (November) of 2018.

If deviations are identified at a later date, then the deviations will be communicated in a future 6 month update following identification.

**State Applicable Extreme External Hazard from NEI 12-06, Section 4.0-9.0**
*List resultant determination of screened in hazards from the EA-12-049 Compliance.*

**Ref: NEI 13-02 Section 5.2.3 and D.1.2**

The following extreme external hazards screen-in for CNS:

- Seismic, Extreme Cold, Snow, Ice, High Wind, Extreme High Temperature

The following extreme external hazards screen out for CNS:

- External Flooding

**Key Site assumptions to implement NEI 13-02 HCVS Actions.**
*Provide key assumptions associated with implementation of HCVS Phase 1 Actions.*

**Ref: NEI 13-02 Section 1**

Mark I/II Generic HCVS Related Assumptions:

Applicable EA-12-049 assumptions:

049-1. Assumed initial plant conditions are as identified in NEI 12-06, Section 3.2.1.2, items 1 and 2 (Reference 10).
049-2. Assumed initial conditions are as identified in NEI 12-06, Section 3.2.1.3, items 1, 2, 4, 5, 6 and 8 (Reference 10).
049-3. Assumed reactor transient boundary conditions are as identified in NEI 12-06, Section 3.2.1.4, items 1, 2, 3 and 4 (Reference 10).
049-4. No additional events or failures are assumed to occur immediately prior to or during the event, including security events except for failure of RCIC or HPCI (Reference 10, NEI 12-

## Part 1: General Integrated Plan Elements and Assumptions

06, Section 3.2.1.3, item 9).

049-5. At Time=0 the event is initiated and all rods insert and no other event beyond a common site ELAP is occurring at any or all of the units (Reference 10, NEI 12-06, Section 3.2.1.3, item 9 and 3.2.1.4, item 1-4).

049-6. At 1 hour an ELAP is declared and actions begin as defined in EA-12-049 compliance.

049-7. DC power and distribution can be credited for the duration determined per the EA-12-049 (FLEX) methodology for battery usage, (greater than 8 hours with a calculation limiting value of 9 hours) (Reference 10, NEI 12-06, Section 3.2.1.3, item 8).

049-8. Deployment resources are assumed to begin arriving at hour 6 and fully staffed by 24 hours.

049-9. All activities associated with plant specific EA-12-049 FLEX strategies that are not specific to implementation of the HCVS, including such items as debris removal, communication, notifications, SFP level and makeup, security response, opening doors for cooling, and initiating conditions for the event, can be credited as previously evaluated for FLEX.

Applicable EA-13-109 generic assumptions:

109-1. Site response activities associated with EA-13-109 actions are considered to have no access limitations associated with radiological impacts while RPV level is above 2/3 core height (core damage is not expected).

109-2. Portable equipment can supplement the installed equipment after 24 hours provided the portable equipment credited meets the criteria applicable to the HCVS. An example is use of FLEX portable air supply equipment that is credited to recharge air lines for HCVS components after 24 hours. The FLEX portable air supply used must be demonstrated to meet the "SA Capable" criteria that are defined in NEI 13-02, Section 4.2.4.2 and Appendix D, Section D.1.3.

109-3. SFP level is maintained with either on-site or off-site resources such that the SFP does not contribute to the analyzed source term (Reference 20, HCVS-FAQ-07).

109-4. Existing containment components design and testing values are governed by existing plant containment criteria (e.g., Appendix J) and are not subject to the testing criteria from NEI 13-02 (References 18 (HCVS-FAQ-05) and 11 (NEI 13-02), Section 6.2.2).

109-5. Classical design basis evaluations and assumptions are not required when assessing the operation of the HCVS. The reason this is not required is that the order postulates an unsuccessful mitigation of an event such that an ELAP progresses to a severe accident with ex-vessel core debris which classical design basis evaluations are intended to prevent (Reference 11 (NEI 13-02), Section 2.3.1).

109-6. HCVS manual actions that require minimal operator steps and can be performed in the postulated thermal and radiological environment at the location of the step(s) (e.g., load stripping, control switch manipulation, valving-in nitrogen bottles) are acceptable to obtain HCVS venting dedicated functionality (Reference 14 (HCVS-FAQ-01)).

109-7. HCVS dedicated equipment is defined as vent process elements that are required for the HCVS to function in an ELAP event that progresses to core melt ex-vessel (Reference 15 (HCVS-FAQ-02) and 23 (White Paper HCVS-WP-01)).

109-8. Use of MAAP, Version 4 or higher, provides adequate assurance of the plant conditions

## Part 1: General Integrated Plan Elements and Assumptions

(e.g., RPV water level, temperatures, etc.) assumed for Order EA-13-109 BDBEE and SA HCVS operation (Reference 31 (FLEX MAAP Endorsement ML13190A201)). Additional analysis using RELAP5/MOD 3, GOTHIC, PCFLUD, LOCADOSE and SHIELD are acceptable methods for evaluating environmental conditions in areas of the plant provided the specific version utilized is documented in the analysis.

109-9. Utilization of NRC published accident evaluations (e.g., SOARCA, SECY-12-0157, and NUREG 1465) as related to Order EA-13-109 conditions are acceptable as references (Reference 11 (NEI 13-02), Section 8).

109-10. Permanent modifications installed per EA-12-049 are assumed implemented and may be credited for use in EA-13-109 Order response.

109-11. This OIP is based on EOP changes consistent with EPG/SAGs Revision 3 as incorporated per the sites EOP/SAMG procedure change process.

109-12. Under the postulated scenarios of order EA-13-109, the MCR is adequately protected from excessive radiation dose per GDC 19 in 10CFR50 Appendix A, and no further evaluation of its use as the preferred HCVS control location is required (Reference 14 (HCVS-FAQ-01)). In addition, adequate protective clothing and respiratory protection is available if required to address contamination issues.

Plant Specific HCVS Related Assumptions/Characteristics:

CNS-1 The plant layout of buildings and structures are depicted in the following Figure 1-1 (Cooper Nuclear Station Layout). Furthermore, the figure depicts the path of the vent piping, which exits the Reactor Building on the south wall and travels underground to the ERP. Note that CNS includes only one unit. The MCR is located in the Control Building at elevation 932'-6" (ground level of the Control Building is 903'-6"), which is to the north of the Reactor Building (ground level is 903').

CNS-2 The ERP (or main stack) at CNS will be the release point of the HCVS flow.

CNS-3 The rupture disk will be manually breached within 8 hours of event initiation.

# Part 1: General Integrated Plan Elements and Assumptions

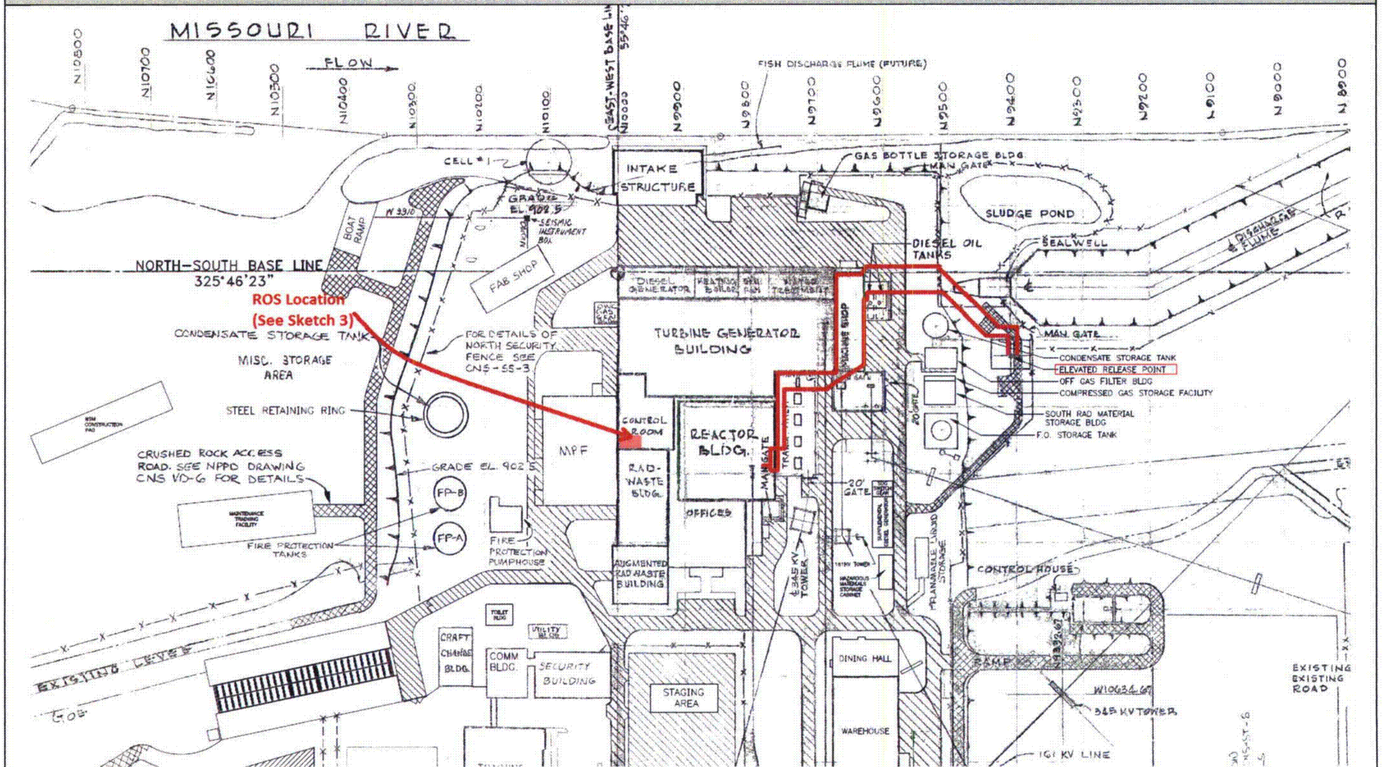


Figure 1-1, Cooper Nuclear Station Layout

# Part 2: Boundary Conditions for Wetwell Vent

**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. Immediate operator actions will be completed by plant personnel and will include the capability for remote-manual initiation 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. An HCVS 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 Actions | Primary Location / Component | Notes |
|---|---|---|---|
| Isolate torus purge | 1. Ensure $N_2$ purge to torus valve AO-239 is closed. | MCR Vertical Board H | This valve is Normally Closed, Fails-Closed. |
| | 2. Ensure torus inlet purge shutoff valve AO-235 is closed. | MCR Vertical Board H | This valve is Normally Closed, Fails-Closed. |
| Isolate the Standby Gas Treatment System | 3. Ensure SGT Unit bypass valves SGT-AO-255 and SGT-AO-256 are closed. SGT exhaust check-valves SGT-CV-14CV and SGT-CV-15CV will close against back pressure and protect SGT from overpressure. | | Bypass valves SGT-AO-255 and SGT-AO-256 are normally locked-closed, and they have no active safety function. |

## Part 2: Boundary Conditions for Wetwell Vent

| | | | |
|---|---|---|---|
| Prepare Hardened Pipe Venting | 4. Breach the rupture disk by manually opening an argon cylinder valve and an additional valve (one of which will be normally locked closed). | Manual hand wheels for valves at the argon bottle and at the piping at the argon bottle station. | **Not required during SA event. Only required if performing early venting for FLEX.** |
| | 5. Close argon cylinder valves. | Manual hand wheels for valves at the argon bottle and at the piping at the argon bottle station. | **Not required during SA event. Only required if performing early venting for FLEX.** |
| | 6. Place PC-MO-233 ISOLATION OVERRIDE to OVERRIDE. | MCR Key PA2235 Panel P2 | |
| | 7. Place PC-AO-237 ISOLATION OVERRIDE to OVERRIDE. | MCR Key PA2235 Panel P2 | |
| | 8. Open torus inlet outboard isolation valve PC-AO-237AV. | MCR Vertical Board H | This valve is normally closed, and fails-closed on loss of air or electricity.<br>Controlled from ROS panel, as well. |
| | 9. Open torus inlet inboard isolation valve PC-MO-233MV. | MCR Vertical Board H | This valve is normally closed.<br>Controlled from ROS panel, as well. |
| | 10. Open torus HPV valve PC-AO-32. | MCR Key PA2235 Panel P2 | PC-AO-32 is the venting valve.<br>This valve is normally closed, and fails-closed on loss of air and electricity.<br>Controlled from ROS panel, as well. |
| Post-24 hours actions | 11. Connect FLEX DG (480 VAC) to emergency connection of the UPS system. | ROS / UPS | Prior to depletion of the HCVS dedicated power supply (the UPS battery), actions will be required to connect back-up sources at a time greater than 24 hours. |
| | 12. Switch UPS power from 125 VDC battery to bypass source. | ROS / UPS | Prior to depletion of the HCVS dedicated power supply (the |

## Part 2: Boundary Conditions for Wetwell Vent

| | | | |
|---|---|---|---|
| | | | UPS battery), actions will be required to connect back-up sources at a time greater than 24 hours. |
| | 13. Connect nitrogen bottles to pre-installed connections. | ROS / Control Building | Prior to depletion of the pneumatic sources, actions will be required to connect back-up sources at a time greater than 24 hours. |
| | 14. Replenish pneumatics with replaceable nitrogen bottles to pre-installed connections. | ROS / Control Building<br>N2 bottles will be located in an area accessible to operators (by ROS). | Prior to depletion of the pneumatic sources, actions will be required to connect back-up sources at a time greater than 24 hours. |

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 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.

<u>Discussion of time constraints identified in Attachment 2 for the 3 timeline cases identified above</u>

- 8 Hours: Initiate use of 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 a dedicated HCVS DC powered UPS (the UPS system mentioned below) with motive force supplied to HCVS valves from installed accumulators and portable nitrogen storage bottles. Critical HCVS controls and instruments associated with containment will be powered by the UPS system (a three-phase 480 VAC inverter powered from a 125 VDC battery) and operated from the MCR or an ROS. HCVS battery capacity will be available to extend to 24 hours. In addition, when available, Phase 2 FLEX DG can provide power before battery life is exhausted. Thus, initiation of the HCVS from the MCR or the ROS within 8 hours is acceptable because the actions can be performed any time after declaration of an ELAP until the venting is needed at 8 hours for BDBEE venting. This action can also be performed for SA

## Part 2: Boundary Conditions for Wetwell Vent

HCVS operation which occur at a time further removed from an ELAP declaration as shown in Attachment 2.

- Dedicated HCVS battery capacity will be available from a UPS system (Sketch 1 in Attachment 3) to provide power for at least 24 hours until the FLEX DG is ready to be put in service. Therefore providing power to the UPS is under no time constraint until at least 24 hours. The UPS has a three-phase 480 VAC inverter powered from a 125 VDC battery to meet the 460 VAC required power directly, and the other 120 VAC loads via a step-down transformer.

- 24 hours: A fused disconnect switch is shown on the AC side of the UPS battery charger. This connection point is provided to accept input from a FLEX DG after the initial 24 hour period. Transformers may be necessary to accommodate the voltages of the different devices. The battery will be sized to provide power to all the necessary loads for at least 24 hours and consider inverter inefficiency and end of battery life and non-conservative ambient temperatures.

- 24 hours: The accumulators of PC-237AOV-AV and PC-AOV-AO32 will be recharged using portable nitrogen bottles connected near the potential location for the ROS on the north side of the Control Building. Although the connection of portable nitrogen bottles can be performed at any time prior to 24 hours to ensure adequate capacity is maintained, the accumulators of PC-237AOV-AV and PC-AOV-32AO will be sized to provide enough pneumatic supplies until the portable nitrogen bottles are connected and ready for recharge during the SA (Cases 2 and 3 of Figure 2 of Attachment 2). Hence, this time constraint is not limiting.

Discussion of radiological and temperature constraints identified in Attachment 2

- Actions to initiate HCVS operation are taken from the MCR or from the ROS. As per assumption 109-12, the MCR is adequately protected from excessive radiation dose per GDC 19 in 10CFR50 Appendix A. Non-radiological habitability for the MCR is being addressed as part of the FLEX response (Reference 28). The location selected for the ROS will take into account radiological and environmental conditions resulting from a SA and will be designed appropriately.

OPEN ITEM 1: Determine location of HCVS ROS.

OPEN ITEM 2: Evaluate accessibility of the ROS for radiological and environmental conditions. Address dose and temperature items for the ROS (non-MCR) location. FAQ-HCVS-01 (Reference 14) will be used as guidance.

Two options currently exist for the location of the ROS: the first option would locate the ROS in a large storage area at the end of a hallway in the Control Building at the 903'-6" elevation (shown in Figure 1-1, above), near the battery charging rooms. This location is relatively close to the MCR (and close to an area where FLEX equipment could be stored). This large storage room could also be the

## Part 2: Boundary Conditions for Wetwell Vent

location of the UPS. The second option is the Control Building Corridor at the 903' elevation, which is near an entrance to the north side of the Reactor Building.

- At < 8 Hours, the rupture disk will be manually breached using an argon tank station in the Reactor Building. The argon tank will be newly installed for manual breach of the rupture disk. The rupture disk has a setpoint of 15 psig (equal to the SGT system piping design pressure). Manual breaching of the rupture disk will not be needed for SA cases (i.e., Cases 2 and 3 of Figure 2 of Attachment 2), since the venting pressure will exceed 15 psig. To support anticipatory venting for FLEX success (Case 1, "green line" of Figure 2), manual breaching of the rupture disk may be required. This action will not be an environmental constraint because it would occur before venting started and would only be needed for anticipatory venting (i.e., not needed for SA cases).

- At 24 hours, based on battery depletion, power supply will be swapped from the dedicated HCVS batteries to the FLEX DG to ensure power to the inverters. Access to the transfer switch will be in the Control Building.

OPEN ITEM 3: Determine the location of the dedicated HCVS battery transfer switch.

- At > 24 hours, installed nitrogen bottles will be valved-in to supplement the air accumulator supply for PC-AOV-237AV and PC-AOV-AO32 as stated for the related time constraint item. Nitrogen bottles will be located in an area that is accessible to operators, preferably near the ROS. The storage location of these portable nitrogen bottles is still under consideration. Option 1 would be the far end of the Control Building corridor at the 903'-6" level in close proximity to the ROS. FLEX Storage Building #1 would be Option 2. Bottles could be stored on an anchored rolling cart, which would be unlocked when needed and pulled to the connecting station. The connection station could be on the north side on the Control Building near the potential location of the ROS. Option 3 considers pre-staging the nitrogen bottles on the north side of the Control Building in a rugged structure protected from all applicable screened-in hazards and located such that operator exposure to radiation and occupational hazards will be minimized, to meet the requirements identified in NEI-12-06, Section 11, for screened in hazards. Options 1, 2, and 3 could be combined.

OPEN ITEM 4: Determine the location of backup nitrogen bottles and evaluate the effects of radiological and temperature constraints on their deployment.

- At > 24 Hours, actions to connect the UPS battery to a power supply will occur on the north side of the CNS Control Building and within the Control Building itself. The Control Building is located on the north side of the Reactor Building. The locations for installation (and control) of the DG are therefore shielded from HCVS piping by the Reactor Building and is greater than 100' away from the piping and the stack. Although there is no radiological and temperature constraints associated with the connection of the UPS batteries to its backup power supply, there

## Part 2: Boundary Conditions for Wetwell Vent

may be radiological and temperature constraints related to the deployment of the backup supply itself, such as the deployment of the FLEX DG dedicated to recharge the UPS battery.

OPEN ITEM 5: Evaluate location of the portable DG for accessibility under SA HCVS use.

**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.*

***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)***

## Part 2: Boundary Conditions for Wetwell Vent

*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.*

*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 (References 6 (ISG-JLD-2012-01) and 33 (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.*

## Part 2: Boundary Conditions for Wetwell Vent

**Vent Size and Basis**

The HCVS wetwell path is designed for venting steam/energy at a nominal capacity of 1% or greater of 2,419 MWt (which corresponds to the CLTP) at pressure of 56 psig. This pressure is the lower of the containment design pressure (56 psig) and the PCPL value (62.7 psig). The size of the wetwell portion of the HCVS goes from 20" to 24" until it combines with the common HCVS piping sized at 10", which provides adequate capacity to meet or exceed the Order criteria.
There are no plans for increases on licensed power.

**Vent Capacity**

There are no exceptions to the 1% decay heat removal capacity. The 1% value at CNS 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 absorption capability will be confirmed.

OPEN ITEM 6: Confirm suppression pool heat capacity.

**Vent Path and Discharge**

The existing HCVS vent path at CNS consists of a wetwell vent. The HCVS line exits the wetwell from Penetration X-205. This 20" piping penetration is located at the top of the torus, midway between ring girders in a vent pipe bay. The piping enlarges to a 24" pipe at a tee right beyond the penetration. This pipe contains two butterfly PCIVs, PC-MOV-233MV and PC-AOV-237AV. Further downstream, the 24" pipe changes to a 24" piping/thin-walled piping. The existing 10" Torus Hard Pipe Vent is attached to this 24" thin walled piping using two bellows. Approximately 23' into the 10" line is another butterfly valve, PC-AOV-AO32, and a rupture disk downstream that provides isolation of the SGT system. Before exiting the Reactor Building, the 10"-diameter pipe splits in two 10"-diameter pipes. One line meets with the SGT discharge line. Both 10"-diameter pipes travel underground for more than 700' to the base of the ERP (Reference 32). The HCVS effluents exit out of the main stack.

The HCVS discharge path uses the ERP (or plant stack), which is approximately 325' above ground level and is higher than adjacent plant structures.

**Power and Pneumatic Supply Sources**

All electrical power required for operation of HCVS components will be routed through the UPS system. The currently preferred configuration consists of a three phase 480 VAC inverter powered from a 125 VDC battery. The inverter output can then supply the 460 VAC motor operated valve motor directly and the 120 VAC loads via a step down transformer (see Sketch 1 of Attachment 3). The battery of choice is a sealed cell (or voltage regulated lead acid) due to its minimal hydrogen

## Part 2: Boundary Conditions for Wetwell Vent

generation. The HCVS has no tie to the station batteries 125 DCA, 125 DCB, 250 VDCA, or 250 VDCB. The UPS will be sized to provide enough power for at least 24 hours and until an emergency power source can be connected to it through the fused disconnect switch on the AC side of the UPS. The UPS will provide power to not only the HCVS components (e.g., valves, actuators), but also the HCVS instrumentation and indication in the MCR and ROS. After 24 hours, the fused disconnect switch will be capable of accepting input from whatever portable power source is available. Transformers may be necessary to accommodate the voltage of different devices, such as the 4160 VAC RRC FLEX portable DG. If a 480 VAC HCVS dedicated DG or the 480 VAC SAMG DG is used, no transformer should be necessary. The battery charger and inverter can be bypassed and directly feed the HCVS loads if the normal AC power source via MCC-A or F is not available.

Pneumatic power is normally provided by the non-interruptible air system with backup nitrogen provided from installed nitrogen supply tanks. Following an ELAP event, the station air system is lost, and normal backup from installed nitrogen supply tanks is isolated. Therefore, for the first 24 hours, pneumatic force will be supplied from existing and possibly newly installed air accumulator tanks. These tanks will supply the required motive force to those HCVS valves needed to maintain flow through the HCVS effluent piping.

1. The HCVS flow path valves are a 24" MOV, AC power to open and close, followed by a 24" AOV, air-to-open and spring-to-shut. The vent control valve is a 10" AOV with air-to-open and spring-to-shut. Opening the air-operated valves requires energizing an AC powered SOV and providing motive air/gas, while opening the MOV requires AC power. The detailed design will provide a permanently installed power source and motive air/gas supply adequate for the first 24 hours. Beyond the first 24 hours, FLEX generators will be used to maintain battery power to the HCVS components. The initial stored motive air/gas will allow for a minimum of 8 valve operating cycles for the HCVS valves for the first 24 hours.

2. 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.

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

4. All valves required to open the flow path or valves that require manual operation to be closed to prevent diversion or cross-flow into other systems/units will be designed for remote manual operation following a 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 16, FAQ HCVS-03). The remote manual operation of the valves will be performed from the MCR or the ROS. Accessibility of the ROS during the event will be evaluated for radiological and environmental conditions, and strategies such as the use of ice vests or shielding will be implemented if deemed necessary. Any supplemental connections will be

## Part 2: Boundary Conditions for Wetwell Vent

pre-engineered to minimize man-power resources and address environmental concerns. Required portable equipment will be reasonably protected from screened in hazards listed in Part 1 of this OIP. A list of portable equipment can be found in Attachment 1.

5. Access to the locations described above will not require temporary ladders or scaffolding.

6. Following the initial 24 hour period, additional motive force will be supplied from nitrogen bottles that will be staged at a gas cylinder rack located (near the ROS in the Control Building or outside) such that radiological impacts are not an issue. Additional bottles can be brought in as needed.

**Location of Control Panels**

The HCVS design allows initiating and then operating and monitoring the HCVS from the MCR and the ROS. The MCR location is protected from adverse natural phenomena and is the normal control point for Plant Emergency Response actions.

The final location of the ROS is still under evaluation.

OPEN ITEM 1: Determine location of HCVS ROS.

OPEN ITEM 2: Evaluate accessibility of the ROS for radiological and environmental conditions. Address dose and temperature items for the non-MCR location. FAQ HCVS-01 (Reference 14) will be used as guidance.

**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).

OPEN ITEM 7: Determine which approach or combination of approaches CNS 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**

The HCVS uses the Containment Purge System containment isolation valves for containment isolation. The inboard valve (PC-MOV-233MV) is an AC motor driven MOV and the outboard valve (PC-AOV-237AV) is an AOV with an AC powered SOV, and can be operated from switches in the

## Part 2: Boundary Conditions for Wetwell Vent

MCR. An AC motor must be energized to open the MOV. An AC SOV must be energized to allow the motive air to open the AOV. Although these valves are shared between the Containment Purge System and the HCVS, key-locked override switches are provided to each valve to allow Operators to override the containment isolation signal. Specifically:

- The Containment Purge System control circuit will be used during all "design basis" operating modes including all design basis transients and accidents.
- Suppression Chamber In/Outboard Isolation Valves PC-MOV-1304MV and PC-MOV-1303MV are normally closed and meet the requirements of 10CFR50 Appendix J, Type C Testing.
- Suppression Chamber Vacuum Relief Outboard Isolation Valves PC-13CV and PC-14CV are normally closed check-valves that automatically open on a differential pressure of 0.5 psid across the valve to ensure that the external design pressure of the torus will not be exceeded. The valve in its normally closed position provides outboard primary containment isolation. The valves meet the requirements of 10CFR50 Appendix J, Type C Testing. PC-AOV-243AV and PC-AOV-244AV, which are the Inboard Isolation Valves for Suppression Chamber Vacuum Relief, meet the requirements of 10CFR50 Appendix J, Type C Testing.
- Vacuum breaker PC-CV-30CV is installed on the HCVS pipe upstream of PC-AOV-AO32 to prevent collapse of the 24" Purge and Vent Line after venting operation. The detailed design phase will review the vacuum breaker to determine if it can meet the required leakage criteria. If necessary, the valve will be replaced with a leak-tight valve or upgraded. Testing and maintenance will be performed to ensure that the valve remains leak-tight.
- PC-AOV-235AV and PC-AOV-239AV: the detailed design phase will review the valves to determine if they can meet the required leakage criteria. If necessary, these valves will be replaced with leak-tight valves or upgraded. Testing and maintenance will be performed to ensure that the valves remain leak-tight.
- Cross flow potential exists between the HCVS and the SGT system. Resolution involves evaluation of SGT isolation valve leakage for both inlet and outlet valves, as both interface with the HCVS. Backflow to the SGT is currently prevented by the automatic actuation of the SGT Fan Exhaust check valves SGT-CV-14CV, and SGT-CV-15CV in addition of two locked-closed, fail-closed SGT Unit bypass valves (SGT-AOV-255AV, -256AV). The detailed design phase will review the valves to determine if these valves can meet the required leakage criteria. If necessary, these valves will be replaced with leak-tight valves or upgraded. Testing and maintenance will be performed to ensure that the valves remain leak-tight.
- An additional cross-flow avenue exists within the ERP. However, the natural draft intrinsically created by the design of the stack precludes backflows to the other lines connected to the ERP. In addition, the interface connections to the ERP tower are either protected by check valves or are

## Part 2: Boundary Conditions for Wetwell Vent

directed through piping systems which contain components (pipe, valves, elbows, etc.) that contribute to system resistance. This resistance is higher than the flowpath out the top of the ERP tower, therefore, creating a non-credible backflow situation to the other lines connecting to the ERP.

- CNS is a single unit. As such, interconnection through the common plant stack is not applicable.

**Prevention of Inadvertent Actuation**

EOPs/EPGs 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 CAP that would provide NPSH to the ECCS pumps will be available (inclusive of a DBLOCA). However, the ECCS pumps will not have normal power available because of the starting boundary conditions of an ELAP. CNS credits CAP to maintain sufficient NPSH for ECCS pumps. Therefore, it is essential to prevent inadvertent actuation of the HCVS to ensure that the CAP can be maintained.

At CNS, the features that prevent inadvertent actuation are two containment isolation valves in-series powered from different divisions, key-lock switches, and a rupture disk. With respect to the containment isolation valves, the inboard valve (PC-MOV-233MV) is an AC motor driven MOV fed from a Division I AC power source, and the outboard valve (PC-AOV-237AV) is an AOV with an AC powered SOV fed from a Division II AC power source. Hence, the containment isolation valves meet the requirements for redundant and diverse power sources. Furthermore, these valves can be operated from key-locked switches in the MCR. Although these valves are shared between the Containment Purge System and the HCVS, key-locked override switches are provided for each valve to allow Operators to override the containment isolation signal. Specifically:

- The Containment Purge System control circuit will be used during all "design basis" operating modes including all design basis transients and accidents. The containment isolation signal will cause the valves to shut.

- The HCVS control circuit will have a key-locked switch for each of the two in-series valves to address inadvertent operation. Turning the switch to "open" will energize the control circuit opening the valve. Both valves will use AC power for opening for the HCVS function. Also, 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.

Procedures also provide clear guidance to not circumvent containment integrity by simultaneously opening torus and drywell vent valves during any design basis transient or 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.

## Part 2: Boundary Conditions for Wetwell Vent

**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. During the detailed phase of the design, if the nitrogen bottles cannot be located in seismically qualified structures, the structure either 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. HCVS components that directly interface with the pressure boundary will be considered safety-related, as the existing system is safety-related. 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 controls 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 containment isolation and/or a 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 SME back to their isolation boundaries. Electrical and controls 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 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:

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.

## Part 2: Boundary Conditions for Wetwell Vent

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

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

OPEN ITEM 8: Identify qualification method used for HCVS instruments.

**Monitoring of HCVS**

The CNS wetwell HCVS will be capable of being manually operated during sustained operations from a control panel located in the MCR and will meet the requirements of Order element 1.2.4. The MCR is a readily accessible location with no further evaluation required. MCR dose associated with HCVS operation conforms to GDC 19/AST. Additionally, to meet the intent for a secondary control location of Section 1.2.5 of the Order, a readily accessible ROS will also be incorporated into the HCVS design as described in NEI 13-02, Section 4.2.2.1.2.1. The controls and indications at the ROS location will be accessible and functional under a range of plant conditions, including SA conditions with due consideration to source term and dose impact on operator exposure, ELAP, and inadequate containment cooling. An evaluation will be performed to determine accessibility to the location, habitability, staffing sufficiency, and communication capability with vent-use decision makers.

OPEN ITEM 9: Evaluate HCVS monitoring location for accessibility, habitability, staffing sufficiency, and communication capability with vent-use decision makers.

The wetwell HCVS will include means to monitor the status of the vent system in both the MCR and the ROS. Included in the current design of the THV are control switches in the MCR with valve position indication (Reference 34). The existing THV controls currently meet the environmental and seismic requirements of the Order for the plant SA and will be upgraded to address ELAP. The ability

## Part 2: Boundary Conditions for Wetwell Vent

to open/close these valves multiple times during the event's first 24 hours will be provided by air accumulator tanks and a UPS system providing a backup battery power source. Beyond the first 24 hours, the ability to maintain these valves open or closed will be provided with replaceable nitrogen bottles and FLEX generators.

The wetwell HCVS will include indications for vent pipe pressure (already available in the MCR), temperature (to be installed), and effluent radiation levels (already available in the MCR) at both the MCR and ROS. Other important information on the status of supporting systems, such as power source status (to be installed) and pneumatic supply pressure (already available for PC-AOV-AO32, in the MCR), will also be included in the design and located to support HCVS operation. The wetwell HCVS includes existing containment pressure and wetwell level indication in the MCR to monitor vent operation. This monitoring instrumentation provides the indication from the MCR as per Requirement 1.2.4 and will be designed for sustained operation during an ELAP event.

**Component reliable and rugged performance**

The HCVS downstream of the second containment isolation valve, including piping and supports, electrical power 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, Cat 1, SS and 300# ASME or B31.1, NEMA 4, etc.) for the plant and to ensure functionality following a design basis earthquake.

A THV system was originally installed to satisfy the requirements of Generic Letter 89-16. The modifications associated with the THV were performed under the provisions of 10CFR50.59 and thus the CNS THV was designed, analyzed, and implemented consistent with the design basis of the plant. The current design will be evaluated to confirm that the existing system, coupled with current and planned modifications to upgrade the THV to a HCVS, will meet the requirements of Order EA-13-109 and remain functional following a SA.

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

Conduit design will be installed to Seismic Class 1 criteria. Both existing and new barriers will be used to provide a level of protection from missiles when equipment is located outside of seismically qualified structures. Augmented quality requirements, 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 SA environment as required by NRC Order EA-13-109 and the guidance of NEI 13-02. The equipment will be qualified seismically (IEEE 344), environmentally (IEEE 323), and EMC (per RG

## Part 2: Boundary Conditions for Wetwell Vent

1.180). These qualifications will be bounding conditions for CNS.

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 SA event conditions in the area of instrument component use 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 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 344-2004, *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. Immediate operator actions can be completed by Operators from either the MCR or the HCVS ROS and will include remote-manual initiation, as well as an action to breach the rupture disk from a local gas cylinder station for anticipatory venting. 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 MCR and will be able to be operated from an installed ROS as part of the response to this Order. Both locations minimize plant operators' exposure to adverse temperature and radiological conditions and are protected from hazards assumed in Part 1 of this report.

This scenario credits anticipatory venting at t=8 hours and anticipates cycling of the control valve PC-AOV-AO32. Therefore, PCIVs PC-MOV-233MV and PC-AOV-237AV are expected to be opened only once and left open during the first 24 hours of mitigation. Valve PC-AOV-237AV currently has two accumulators which provide sufficient back up air to operate the valve once. Valve PC-AOV-AO32 can be cycled to control anticipatory venting. The accumulator that supports operation of PC-AOV-AO32 is currently sized for five valve cycles, and will likely require a larger accumulator sized for eight cycles (or an additional accumulator could complement the existing one). As per industry white paper HCVS-WP-02. "Hardened Containment Vent System Cyclic Operations Approach" (Reference 24), a generic number of eight wetwell cycles or 12 drywell cycles within the first 24 hours was deemed reasonable. The detailed design of CNS HCVS will determine the number of required valve cycles for the first 24 hours and the size of the initial stored motive air/gas that is required to support the number of valve cycles.

OPEN ITEM 10: Determine the number of required valve cycles during the first 24 hours. Size the electrical and pneumatic supplies accordingly.

Permanently installed power and motive air/gas capability will be available to support operation and monitoring of the HCVS for 24 hours.

| Part 2 Boundary Conditions for WW Vent: **BDBEE Venting** |
|---|
| |
| System control:<br><br>i. Active: Control valves and/or PCIVs are operated in accordance with EOPs/SOPs to control containment pressure. Controlled venting will be permitted in the revised EPGs and associated implementing EOPs. Anticipatory venting will be permitted, and the vent line will be kept open (or cycled) until 24 hours in the event. A key-lock switch permissive circuit without any automatic controls will allow the containment isolation valves to be opened regardless of existing containment isolation signals.<br><br>ii. Passive: Inadvertent actuation protection is provided by the current circuitry associated with the containment isolation valves used to operate the HCVS. The containment isolation valves can be opened with key-lock switches in the MCR, as directed by applicable procedures. In addition, the HCVS venting line has a rupture disk downstream of the venting valve (PC-AOV-AO32). This rupture disk isolates the SGT system and has a burst pressure setpoint of 15 psig. Breach of the rupture disk will occur outside of the MCR and will require manual operation of two valves, one of which will be normally locked-closed. |
| **Greater Than 24 Hour Coping Detail**<br>*Provide a general description of the venting actions for greater than 24 hours using portable and installed equipment including station modifications that are proposed.*<br><br>**Ref: EA-13-109 Section 1.2.4, 1.2.8 / NEI 13-02 Section 4.2.2** |
| 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 for HCVS initiation and operation. Connections will be pre-engineered quick disconnects to minimize manpower resources.<br><br>After 24 hours the HCVS will be powered by a FLEX DG.<br><br>Pneumatic supplies, in the form of portable nitrogen bottles, will be available for connection to recharge the accumulators and provide motive gas to the HCVS.<br><br>These actions provide long term support for HCVS operation for the period beyond 24 hours to 7 days (sustained operation time period) because on-site and off-site personnel and resources will have access to the unit to provide needed action and supplies. |
| **Details:** |
| **Provide a brief description of Procedures / Guidelines:**<br>*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, including use of the existing HCVS. Other site procedures for venting containment using the HCVS include: EOP 5.8.18, Primary Containment Venting for PCPL, PSP, or Primary Containment Flooding (Reference 39); EOP 5.8.21, PC Venting and Hydrogen Control (Less than Combustible Limits) (Reference 35); EOP 5.8.22, PC Venting and Hydrogen Control (Greater than |

| Part 2 Boundary Conditions for WW Vent: **BDBEE Venting** |
|---|
| |
| Combustible Limits) (Reference 36); Emergency Procedure 5.3ALT-STRATEGY, Alternate Core Cooling Mitigating Strategies (Reference 37). |
| **Identify modifications**:<br>*List modifications and describe how they support the HCVS Actions.* |
| EA-12-049 Modifications<br>• Upgrade power supply and indicators for torus level.<br>• New connections to the pre-staged FLEX 480 VAC DG may be required.<br>EA-13-109 Modifications<br>• A modification will be required to install nitrogen bottles to provide pneumatic supply after 24 hours.<br>• A modification will be required to route pneumatic supply piping from the nitrogen bottle connection to the accumulators.<br>• A modification will be required to install a larger accumulator for the venting valve (PC-AOV-AO32) to accommodate 8 venting cycles.<br>• A modification will be required to install a dedicated battery, charger, and an UPS system to maintain power for the HCVS for 24 hours following the ELAP event.<br>• A modification will be required to install a connection at the MCC for PC-MOV-233MV and a connection to the SOVs actuating PC-AOV-237AV and PC-AOV-AO32 to the UPS.<br>• A modification will be required to route cables from the UPS to the equipment it supplies.<br>• A modification will be required to install an ROS.<br>• A modification may be required to ensure accessibility and habitability of the ROS during a BDBEE without core damage.<br>• A modification will be required to install an argon tank to manually breach the rupture disk.<br>• A modification will be required to install a HCVS Rad Monitor and power supply, if the existing rad monitor is not sufficient to meet Order requirements.<br>• A modification will be required for installation of required HCVS instrumentation and controls in the MCR and ROS, such as indication of power availability and effluent temperature.<br>• Modifications may be needed to add connection points and valves to the HCVS to facilitate Appendix J type testing of the boundary valves.<br>• Modifications may be needed to replace boundary valves with boundary valves capable of being qualified to 10CFR50 Appendix J.<br>• Additional modifications may be required to system isolation valves, rupture disk/assembly, and existing HCVS piping. |
| **Key Venting Parameters:**<br>*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)* |

Part 2 Boundary Conditions for WW Vent: **BDBEE Venting**

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

| Key Parameter | Component Identifier | Indication Location |
|---|---|---|
| HCVS Effluent temperature | TBD | MCR / ROS |
| HCVS Pneumatic supply pressure | IA-PS-3 | MCR (Annunciator P-2/C-2 point 4992) / ROS (add to ROS) |
| HCVS valve position indication | Limit switch | MCR / ROS (add to ROS) |
| HCVS system pressure indication | Pressure switch PC-PS-20 | MCR (Annunciator P-2/B-2 point 4991) / ROS (add to ROS) |
| HCVS electrical power supply availability (voltmeter) | TBD | MCR/ROS |
| HCVS process radiation monitor | RMA-RE-27 | MCR (Panel 9-11 and Annunciator P-2/A-2 on Panel P2) / ROS (add to ROS) |
| Rupture disk air space pressure | Pressure switch PC-PS-20 | MCR / ROS (add to ROS) |

Initiation and operation of the HCVS system will rely on several existing MCR key parameters and indicators which are qualified or evaluated to the existing plant design (Reference 11, NEI 13-02, Section 4.2.2.1.9):

| Key Parameter | Component Identifier | Indication Location |
|---|---|---|
| Drywell pressure | Transmitter PC-PT-512A (-5 to 70 psig) recorded on PC-LRPR-1A CH6 | MCR Panel 9-3 |
| | Transmitter PC-PT-512B (-5 to 70 psig) recorded on PC-LRPR-1B CH6 | MCR Panel 9-4 |
| | Transmitter PC-PT-4A1 (0 to 250psig) recorded on PC-LRPR-1A CH3 | MCR Panel 9-3 |
| | Transmitter PC-PT-4B2 (0 to 250psig) recorded on PC-LRPR-1B CH3 | MCR Panel 9-4 |
| Torus pressure | Transmitter PC-PT-30A (-5 to 70 psig) recorded on PC-LRPR-1A CH5 | MCR Panel 9-3 |
| | Transmitter PC-PT-30B (-5 to 70 psig) recorded on PC-LRPR-1A CH5 | MCR Panel 9-4 |
| Torus water temperature | Elements PC-TE-1A through 1H (0 to 250F) recorded on PC-TR-24, -25 | MCR Annunciator window J-1/A-1, J-1/A-2 |
| | Elements PC-TE-2A through 2H (0 to 250F), recorded on PC-TR-24, -25 | MCR Annunciator window J-1/A-1, J-1/A-2 |
| Torus level | Transmitter PC-LT-10 (-4 to 6ft) indicated | MCR Panel 9-3 (and |

Part 2 Boundary Conditions for WW Vent: **BDBEE Venting**

| | | |
|---|---|---|
| | on PC-LI-10 (and PC-LI-110) | ASRL) |
| | Transmitter PC-LT-11 (-4 to 6ft) recorded on PC-LR-11 | MCR Panel 9-3 |
| | Transmitter PC-LT-12 +/- 10in recorded on PC-LI-12 | MCR Panel 9-3 |
| | Transmitter PC-LT-13 (+/- 10in) recorded on PC-LI-13 | MCR Panel 9-3 |
| Reactor pressure | RFC-PI-90A, B and C (0 to 1200 psig) | MCR |
| HCVS Process Radiation Monitor | RMA-RE-27 recorded on RMA-RA-27 | MCR Panel 9-11 and Annunciator P-2/A-2 on Panel P2 |
| HCVS system pressure indication | Pressure switch PC-PS-20 | MCR (Annunciator P-2/B-2 point 4991) |
| HCVS pneumatic supply pressure | IA-PS-3 | MCR (Annunciator P-2/C-2 point 4992) |
| HCVS valve position indication | Limit switch (for PC-MOV-233MV) | Indicating lights in MCR (Vertical Panel 9-3) Vertical Board H |
| HCVS valve position indication | Limit switch (for PC-AOV-237AV) | Indicating lights in MCR (Vertical Panel H) |
| HCVS valve position indication | Limit switch (for PC-AOV-AO32) | Indicating lights in MCR (Panel P2) |

HCVS indications for HCVS valve position indication, HCVS pneumatic supply pressure, HCVS effluent temperature, and HCVS system pressure 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 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 MCR or at the HCVS ROS and will include remote-manual actions. Venting will occur without the need for manually breaching the rupture disk, since conditions in the wetwell would be sufficient to burst the rupture disk without assistance from operators. The operator actions required to open a vent path were previously listed in BDBEE Venting, Part 2 section (Table 2-1).

As stated in the section on BDBEE Venting, the HCVS will be designed to allow initiation, control, and monitoring of venting from the MCR and will be capable of operation from an ROS to be installed as part of the response to this Order. Both locations minimize plant operators' exposure to adverse temperature and radiological conditions and are protected from hazards assumed in Part 1 of this document. Travel pathways will be reviewed for dose and temperature, and alternate routes may need to be considered to minimize operator exposure to harsh environmental conditions.

Permanently installed power 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: Same as for BDBEE Venting, Part 2.

ii. Passive: Same as for BDBEE Venting, Part 2, except that the rupture disk has a burst pressure setpoint of 15 psig, which provides isolation of the SGT system. In a SA scenario, the pressure from the wetwell will be able to burst the rupture disk unassisted, as it will be above the pressure expected during the worst case design basis event.

**Greater Than 24 Hour Coping Detail**

*Provide a general description of the venting actions for greater than 24 hours using portable and installed*

| Part 2 Boundary Conditions for WW Vent: **Severe Accident Venting** |
|---|
| *equipment including station modifications that are proposed.*<br><br>**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:<br>• A connection point will be provided on the AC side of the battery charger in the UPS to accept input from whatever portable source is available to relieve the battery after the initial 24 hours period.<br>• The location and refueling actions for the FLEX DG and replacement nitrogen bottles will be evaluated for SA environmental conditions resulting from the proposed damaged Reactor Core and resultant HCVS vent pathway.<br><br>OPEN ITEM 11: Evaluate the impact of SA environmental conditions for post-24 hour actions supporting the implementation of power and pneumatic supplies.<br><br>These actions provide long term support for HCVS operation for the period beyond 24 hours to 7 days (sustained operation time period) because on-site and off-site personnel and resources will have access to the unit to provide needed action and supplies. |
| **Details:** |
| **Provide a brief description of Procedures / Guidelines:**<br>*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, except for the need to manually breach the rupture disk. Existing guidance in the SAMGs directs the plant staff to consider changing radiological conditions in a severe accident. |
| **Identify modifications**:<br>*List modifications and describe how they support the HCVS Actions.* |
| The same as for BDBEE Venting, Part 2, except:<br>• A modification will be required to install additional post-24 hours nitrogen bottles on-site.<br>• A modification may be required to ensure accessibility and habitability of the ROS during SA conditions.<br>• A modification will be required to ensure the flammability limits of gases passing through the system are not reached or to ensure the system can withstand dynamic loading resulting from hydrogen deflagration and detonation. |
| **Key Venting Parameters:**<br>*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. |
| **Notes:** |

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, except for breaching of the rupture disk for anticipatory venting. Venting will require support from the HCVS installed UPS batteries, UPS battery charger, and pneumatic supply. This installed equipment will provide a minimum of 24 hour operation. Connection points will be provided.

All DC and AC power to support HCVS venting will be provided by a dedicated UPS system with a dedicated UPS battery to support 24 hours of operation. Existing safety-related station batteries will provide sufficient electrical power for RCIC operation. Before station batteries are depleted, portable FLEX DGs, as detailed in the response to Order EA-12-049, will be credited to charge the station batteries and maintain DC bus voltage. Existing and newly installed accumulator tanks with back-up portable N2 bottles will provide sufficient motive force for all HCVS valve operation and will provide for multiple operations of the PC-AOV-AO32 vent valve.

Installed pneumatic supplies (accumulators) for PC-AOV-237AV and PC-AOV-AO32 will be sized to support venting for 24 hours in a BDBEE without core damage. With respect to the BDBEE without core damage strategy, the accumulators do not need to be modified; however to support 24 hours of venting during a SA, a larger accumulator of PC-AOV-AO32 may be required. This larger accumulator would either complement or replace the current accumulator sized for five cycles.

The UPS to be installed will provide at least 24 hours of power supplies and support venting for 24 hours in a BDBEE with or without core damage. The proposed location for the UPS is the far end of the Control Building corridor at the 903'-6" level (near the ROS). This location is proposed based on the seismic class of the Control Building and being protected from the design basis flood. The relative absence of other safety-related equipment in that area is also a positive feature. Additionally, this location is in relatively close proximity to both the MCR and anticipated connection points for FLEX power sources. During the final design evaluation for NFPA 805 Fire PRA compatibility of this new design must be evaluated as well as the effects of an additional combustible and heat source to the area. Floor loading is also an issue that would require an engineered foundation to support the weight of the new equipment. As described in the section "Power and Pneumatic Supply Sources," the currently preferred configuration consists of a 125 VDC Battery, Battery Charger, and a three-phase 480 VAC inverter. The inverter output can then supply the 460 VAC motor operated valve motor directly and the 120 VAC loads via a step down transformer (see Sketch 1 of Attachment 3).

After 24 hours, pneumatic supply would be provided by portable nitrogen bottles. Three options are considered for the proposed location. Option 1 would be the far end of the Control Building corridor at

| Part 2 Boundary Conditions for WW Vent: **HCVS Support Equipment Functions** |
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| |
| the 903'-6" level in close proximity to the ROS. Option 2 would involve storing the bottles on an anchored rolling cart, which would be unlocked when needed and pulled to the connecting station, in the FLEX Storage Building #1. Option 3 considers pre-staging the nitrogen bottles on the north side of the Control Building in a rugged structure protected from all applicable screened-in hazards and located such that operator exposure to radiation and occupational hazards will be minimized, to meet the requirements identified in NEI 12-06, Section 11 for screened in hazards. Options 1, 2 and 3 could be combined.<br><br>Power supplies after 24 hours will be provided to the UPS by the FLEX DG. |
| **Severe Accident Venting**<br>*Provide a general description of the Severe Accident Venting actions support functions. Identify methods and strategy(ies) utilized to achieve venting results.*<br><br>**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.<br><br>Similar to the BDBEE scenario, the UPS will provide power for the first 24 hours. After 24 hours however, the power to the UPS battery chargers will be switched to the FLEX DG.<br><br>Nitrogen bottles that will be located outside of the reactor building and in the immediate area of the ROS will be available to tie-in supplemental pneumatic sources. |
| **Details:** |
| **Provide a brief description of Procedures / Guidelines:**<br>*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 DG, argon bottles needed to burst the rupture disk, and the nitrogen bottles needed to supplement the air supply to the AOVs after 24 hours. The argon and nitrogen bottles will be permanently staged/stored in the plant for use post-event. The DGs and additional nitrogen bottles once deployed post-event will remain in position for the duration of the event. The staging and deployment of this equipment will be incorporated into new or existing procedures as part of the BDBEE/SA response.<br><br>The staging and deployment locations of the FLEX DG is still an open ISE Confirmatory Item as per Item 3.1.1.4.A in Attachment 1 of Reference 38. |
| **Identify modifications**:<br>*List modifications and describe how they support the HCVS Actions.* |
| FLEX modifications applicable to HCVS operation: installation of an emergency connection point for a FLEX DG to repower the battery charger of the UPS.<br><br>HCVS modification: add piping and connection points at a suitable location in the Control Building (near the ROS) or outside to connect portable N2 bottles for motive force to HCVS components after 24 hours. Install the UPS system consisting of a 125 VDC Battery, Battery Charger, and a three-phase 480 VAC inverter. HCVS connections required for portable equipment will be protected from all applicable |

| Part 2 Boundary Conditions for WW Vent: **HCVS Support Equipment Functions** |
|---|
| 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:**<br>*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)* |
| New equipment:<br>• Local control features of the FLEX DG electrical load and fuel supply (part of EA-12-049 compliance).<br>• Pressure gauge on supplemental Nitrogen bottles.<br>• Indication of UPS electrical power supply availability. |
| **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.

Venting actions using portable equipment include the following:

- Replenishment of pneumatic supplies: The current strategy would consist in connecting portable nitrogen supplies to pre-installed connections in order to recharge the accumulators of PC-AOV-237AV and PC-AOV-AO32. The location of the nitrogen bottles is an Open Item. Option 1 would be the far end of the Control Building corridor at the 903'-6" level in close proximity to the ROS. Option 2 would involve storing the bottles on an anchored rolling cart, which would be unlocked when needed and pulled to the connecting station, in the FLEX Storage Building #1. Option 3 considers pre-staging the nitrogen bottles on the north side of the Control Building in a rugged structure protected from all applicable screened-in hazards and located such that operator exposure to radiation and occupational hazards will be minimized, to meet the requirements identified in NEI 12-06, Section 11 for screened in hazards. Options 1, 2 and 3 could be combined. Off-site supplies would relieve the on-site supplies after about 72 hours in the event. The connections would occur near the ROS location on the north side of the Control Building far from the HCVS piping and on the opposite side of the plant stack. Therefore, deployment operations would not be affected by the operation of the vent.

- Repowering the UPS system: After the first 24 hours of power provided by the UPS system, the FLEX DG will be connected to the UPS pre-installed connection to provide power to the UPS system. This connection would occur on the north side of the Control Building, far from the HCVS piping (on the opposite side of the plant site) that exits the Reactor Building on the south side and continues underground out for release to the ERP.

**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.

All deployment actions are not impacted by the vent piping since the piping is underground for the routing outside the building, and CNS is utilizing the ERP (main plant stack) for discharge. Specifically, the HCVS discharge pipe exits the Reactor Building on the south wall and continues underground to the ERP on the south side of the plant site. The ROS and equipment connections will be in and around the Control Building north of the Reactor Building. Therefore, the procedures/guidelines

| Part 2 Boundary Conditions for WW Vent: **HCVS Venting Portable Equipment Deployment** | | |
|---|---|---|
| for HCVS actions are the same as for the support equipment section.<br><br>Implementation procedures are being developed to address all HCVS operating strategies, including deployment of portable equipment. Direction to enter the procedure for HCVS operation will be given in the EOPs, the ELAP procedure, and the SAMGs (refer to Part 4 for general information on procedures). | | |
| **HCVS Actions** | **Modifications** | **Protection of connections** |
| *Identify Actions including how the equipment will be deployed to the point of use* | *Identify modifications* | *Identify how the connection is protected* |
| Per compliance with Order EA-12-049 (FLEX) | N/A | Per compliance with Order EA-12-049 (FLEX) |
| **Notes:** Additional nitrogen bottles can be brought in after 72 hours for the valve motive force. | | |

## Part 3: Boundary Conditions for Drywell Vent

**Provide a sequence of events and identify any time constraint required for success including the basis for the time 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, a walk-through of deployment).*

*Describe in detail in this section the technical basis for the time constraint identified on the sequence of events timeline Attachment 2B*

*See attached sequence of events timeline (Attachment 2B).*

**Ref: EA-13-109 Section X.X.X / NEI 13-02 Section X.X.x**

This section (Part 3) will be completed with the Phase 2 OIP submittal by December 31, 2015.

### 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 X.X.X / NEI 13-02 Section X.X.x**

### 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 X.X.X / NEI 13-02 Section X.X.x**

### 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 X.X.X / NEI 13-02 Section X.X.x**

### Details:

**Provide a brief description of Procedures / Guidelines:**

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

**Identify modifications***:*

*List modifications and describe how they support the HCVS Actions.*

| |
|---|
| **Part 3: Boundary Conditions for Drywell Vent** |
| |
| |
| **Key Venting Parameters:**<br>*List instrumentation credited for the venting HCVS Actions.* |
| |
| **Notes:** |

# Part 4: Programmatic Controls, Training, Drills and Maintenance

**Identify how the programmatic controls will be met.**
*Provide a description of the programmatic controls equipment protection, storage and deployment and equipment quality addressing the impact of temperature and environment.*

**Ref: EA-13-109 Section 3.1, 3.2 / NEI 13-02 Section 6.1.2, 6.1.3, 6.2**

Program Controls:

The HCVS venting actions will include:

- Site procedures and programs are being developed in accordance with NEI 13-02 to address use and storage of portable equipment relative to the Severe Accident defined in NRC Order EA-13-109 and the hazards applicable to the site per Part 1 of this OIP.
- Routes for transporting portable equipment from storage location(s) to deployment areas will be developed as the response details are identified and finalized. The identified paths and deployment areas will be accessible during all modes of operation and during SAs.

Procedures:

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

The HCVS procedures will be developed and implemented following CNS' 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, including the storage location of portable equipment,
- location of the HCVS ROS panel,
- training on operating the portable equipment, and
- testing of portable equipment.

The procedures should state that "use of the vent may impact NPSH."

Licensees will establish provisions for out-of-service requirements of the HCVS and compensatory measures. The following provisions will be documented in a controlled document:

The provisions for out-of-service requirements for HCVS functionality are applicable in Modes 1, 2 and 3.

- If for up to 90 consecutive days, the primary or alternate means of HCVS operation are non-functional, no compensatory actions are necessary.

## Part 4: Programmatic Controls, Training, Drills and Maintenance

- If for up to 30 days, the primary and alternate means of HCVS operation are non-functional, no compensatory actions are necessary.

- If the out of service times exceed 30 or 90 days as described above, the following actions will be performed:
  - The condition will be entered into the corrective action system.
  - The HCVS functionality will be restored in a manner consistent with plant procedures.
  - A cause assessment will be performed to prevent future loss of function for similar causes.
  - Initiate action to implement appropriate compensatory actions.

OPEN ITEM 12: Determine the control document for HCVS out-of-service time criteria.

**Describe training plan**
*List training plans for affected organizations or describe the plan for training development.*

**Ref: EA-13-109 Section 3.2 / NEI 13-02 Section 6.1.3**

Personnel expected to perform direct execution of the HCVS will receive necessary training in the use of plant procedures for system operations when normal and backup power is available and during ELAP conditions. The training will be refreshed on a periodic basis and as any changes occur to the HCVS. Training content and frequency will be established using the Systematic Approach to Training process.

In addition (per Reference 10 (NEI 12-06)), all personnel on-site will be available to supplement trained personnel.

**Identify how the drills and exercise parameters will be met.**
*Alignment with NEI 13-06 and 14-01as codified in NTTF Recommendation 8 and 9 rulemaking.*

The Licensee should demonstrate use of the HCVS system in drills, tabletops, or exercises as follows:

- Hardened containment vent operation on normal power sources (no ELAP).
- During FLEX demonstrations (as required by EA-12-049): Hardened containment vent operation on backup power and from primary or alternate location during conditions of ELAP/loss of UHS with no core damage. System use is for containment heat removal AND containment pressure control.
- HCVS operation on backup power and from primary or alternate location during conditions of ELAP/loss of UHS with core damage. System use is for containment heat removal AND containment pressure control with potential for combustible gases (demonstration may be in conjunction with SAG change).

**Ref: EA-13-109 Section 3.1 / NEI 13-02 Section 6.1.3**

## Part 4: Programmatic Controls, Training, Drills and Maintenance

The site will utilize the guidance provided in NEI 13-06 and NEI 14-01 for guidance related to drills, tabletops, or exercises for HCVS operation. In addition, the site will integrate these requirements with compliance to any rulemaking resulting from the NTTF Recommendations 8 and 9.

**Describe maintenance plan:**

- The HCVS maintenance program should ensure that the HCVS equipment reliability is being achieved in a manner similar to that required for FLEX equipment. Standard industry templates (e.g., EPRI) and associated bases may be developed to define specific maintenance and testing.
  - Periodic testing and frequency should be determined based on equipment type, expected use and manufacturer's recommendations (further details are provided in Section 6 of this document).
  - Testing should be done to verify design requirements and/or basis. The basis should be documented and deviations from vendor recommendations and applicable standards should be justified.
  - Preventive maintenance should be determined based on equipment type and expected use. The basis should be documented and deviations from vendor recommendations and applicable standards should be justified.
  - Existing work control processes may be used to control maintenance and testing.

- HCVS permanent installed equipment should be maintained in a manner that is consistent with assuring that it performs its function when required.
  - HCVS permanently installed equipment should be subject to maintenance and testing guidance provided to verify proper function.

- HCVS non-installed equipment should be stored and maintained in a manner that is consistent with assuring that it does not degrade over long periods of storage and that it is accessible for periodic maintenance and testing.

**Ref: EA-13-109 Section 1.2.13 / NEI 13-02 Section 5.4, 6.2**

The site will utilize the standard EPRI industry PM process (Similar to the Preventive Maintenance Basis Database) for establishing the maintenance calibration and testing actions for HCVS components. The control program will include maintenance guidance, testing procedures and frequencies established based on type of equipment and considerations made within the EPRI guidelines.

CNS will implement the following operation, testing, and inspection requirements for the HCVS to ensure reliable operation of the system.

**Table 4-1: Testing and Inspection Requirements**

| Description | Frequency |
|---|---|
| Cycle the HCVS valves and the interfacing system valves not used to maintain | Once per operating cycle |

## Part 4: Programmatic Controls, Training, Drills and Maintenance

| | |
|---|---|
| containment integrity during operations. | |
| Perform visual inspections and a walk down 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;<br>(2) Once every three operating cycles thereafter; and<br>(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 |

Notes:

# Part 5: Milestone Schedule

**Provide a milestone schedule. This schedule should include:**

- **Modifications timeline**
- **Procedure guidance development complete**
  - **HCVS Actions**
  - **Maintenance**
- **Storage plan (reasonable protection)**
- **Staffing analysis completion**
- **Long term use equipment acquisition timeline**
- **Training completion for the HCVS Actions**

*The dates specifically required by the order are obligated or committed dates. Other dates are planned dates subject to change. Updates will be provided in the periodic (six month) status reports.*

**Ref: EA-13-109 Section D.1, D.3 / NEI 13-02 Section 7.2.1**

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.

| Milestone | Target Completion Date | Activity Status | Comments *{Include date changes in this column}* |
|---|---|---|---|
| Hold preliminary/conceptual design meeting | June 2014 | Complete | |
| Submit Overall Integrated Implementation Plan | June 2014 | Complete | |
| Submit 6 Month Status Report | Dec. 2014 | | |
| Submit 6 Month Status Report | June 2015 | | |
| Design Engineering On-site/Complete | Sept. 2015 | | |
| Submit 6 Month Status Report | Dec. 2015 | | Simultaneous with Phase 2 OIP |
| Submit 6 Month Status Report | June 2016 | | |
| Operations Procedure Changes Developed | Aug. 2016 | | |
| Site Specific Maintenance Procedure Developed | Aug. 2016 | | |
| Training Complete | Sept. 2016 | | |
| Implementation Outage | Oct. 2016 | | |
| Procedure Changes Active | Nov. 2016 | | |
| Walk Through Demonstration/Functional Test | Nov. 2016 | | |
| Submit Completion Report | Nov. 2016 | | |

## Attachment 1: HCVS Portable Equipment

| *List portable equipment* | *BDBEE Venting* | *Severe Accident Venting* | *Performance Criteria* | *Maintenance / PM requirements* |
|---|---|---|---|---|
| Argon Cylinders | X | | | Check periodically for pressure, replace or replenish as needed. |
| Nitrogen Cylinders | X | X | X | Check periodically for pressure, replace or replenish as needed. |
| FLEX DG | X | X | TBD | Per Response to EA-12-049. |
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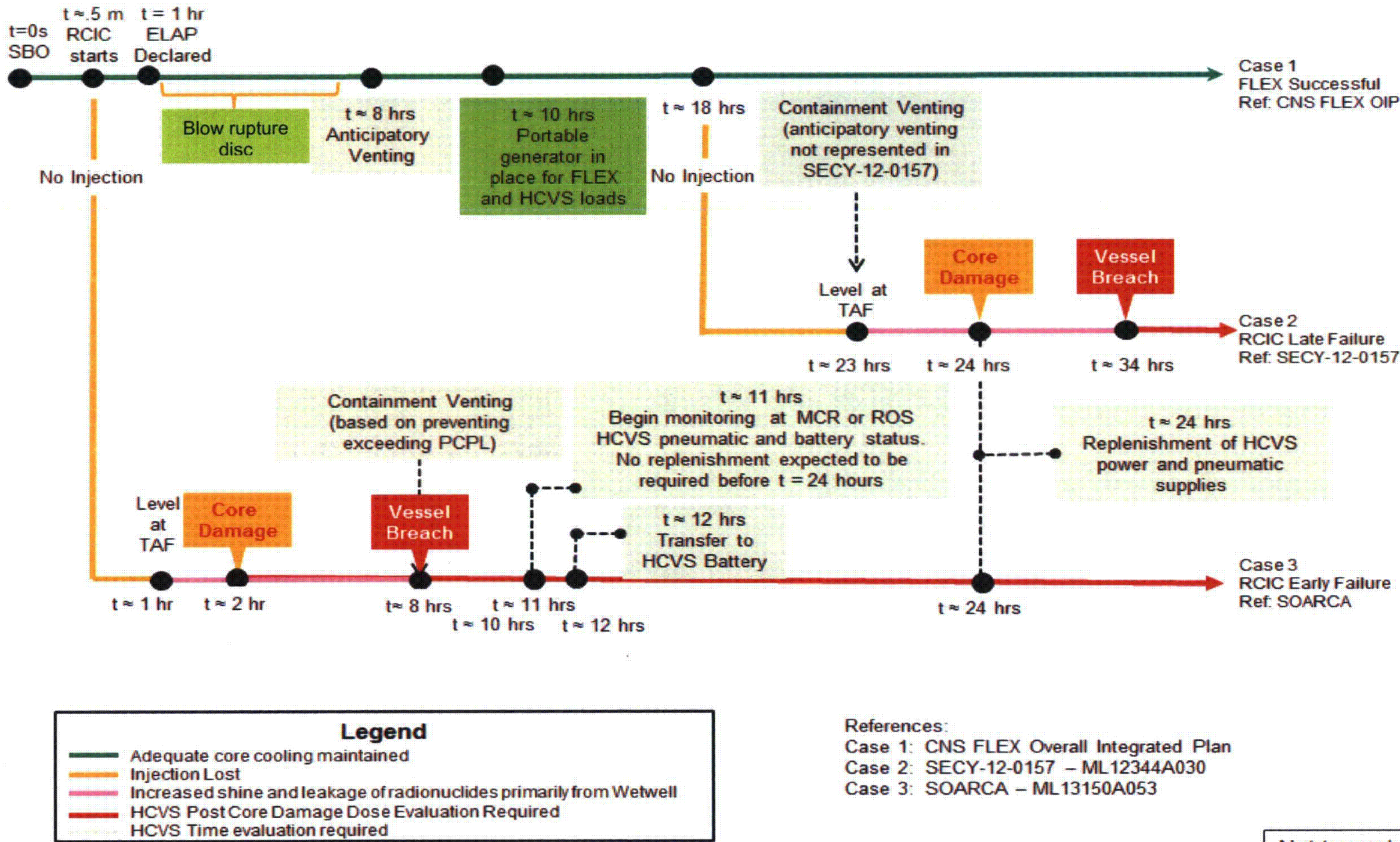
# Attachment 2: Sequence of Events Timeline

Figure 2: Wetwell HCVS Timeline



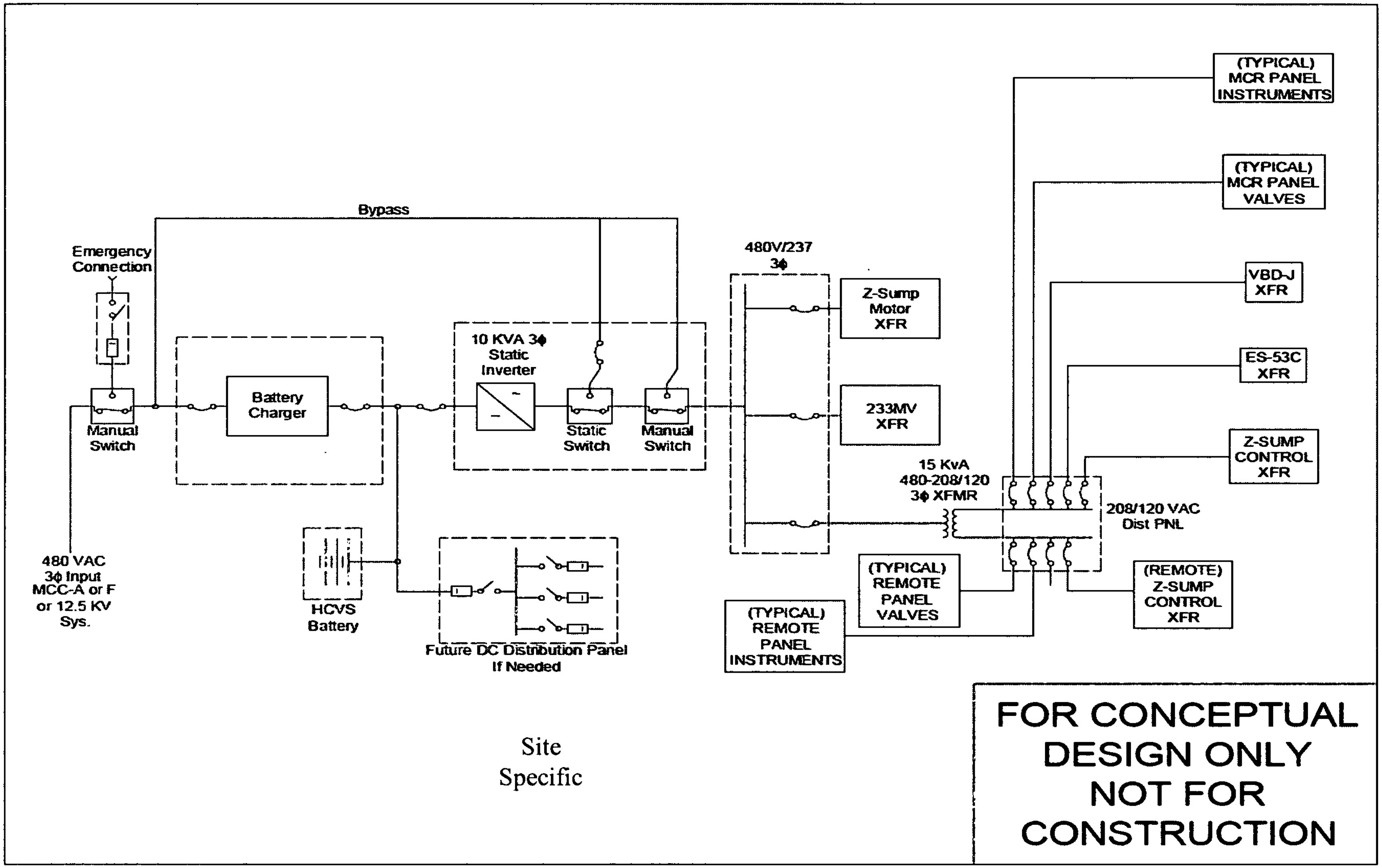

References:
Case 1: CNS FLEX Overall Integrated Plan
Case 2: SECY-12-0157 – ML12344A030
Case 3: SOARCA – ML13150A053

Not to scale

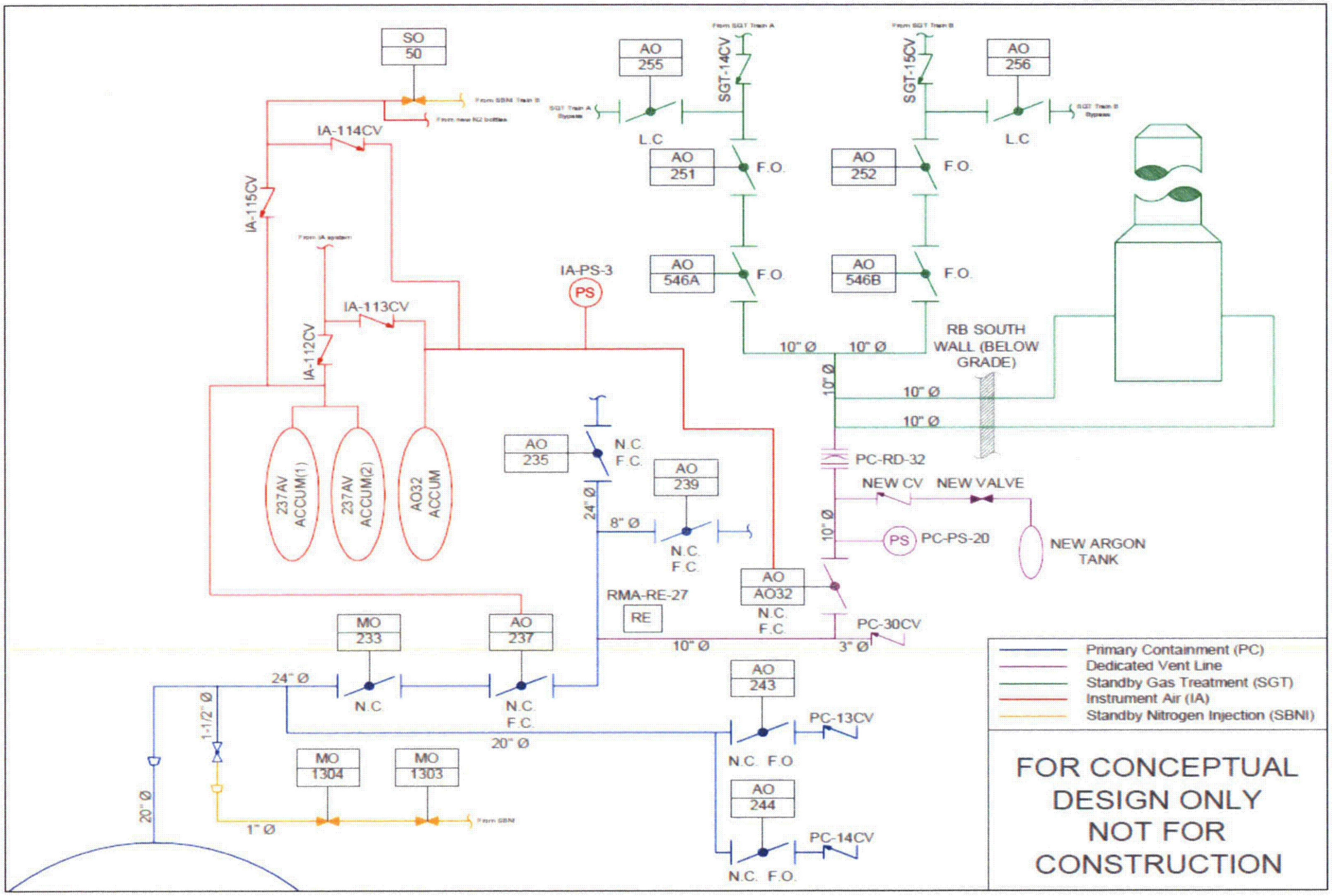
# Attachment 3: Conceptual Sketches

**Sketch 1: Electrical Layout of System *(preliminary)***
**Sketch 2: P&ID Layout of HCVS *(preliminary)***
- **Piping routing for vent path**

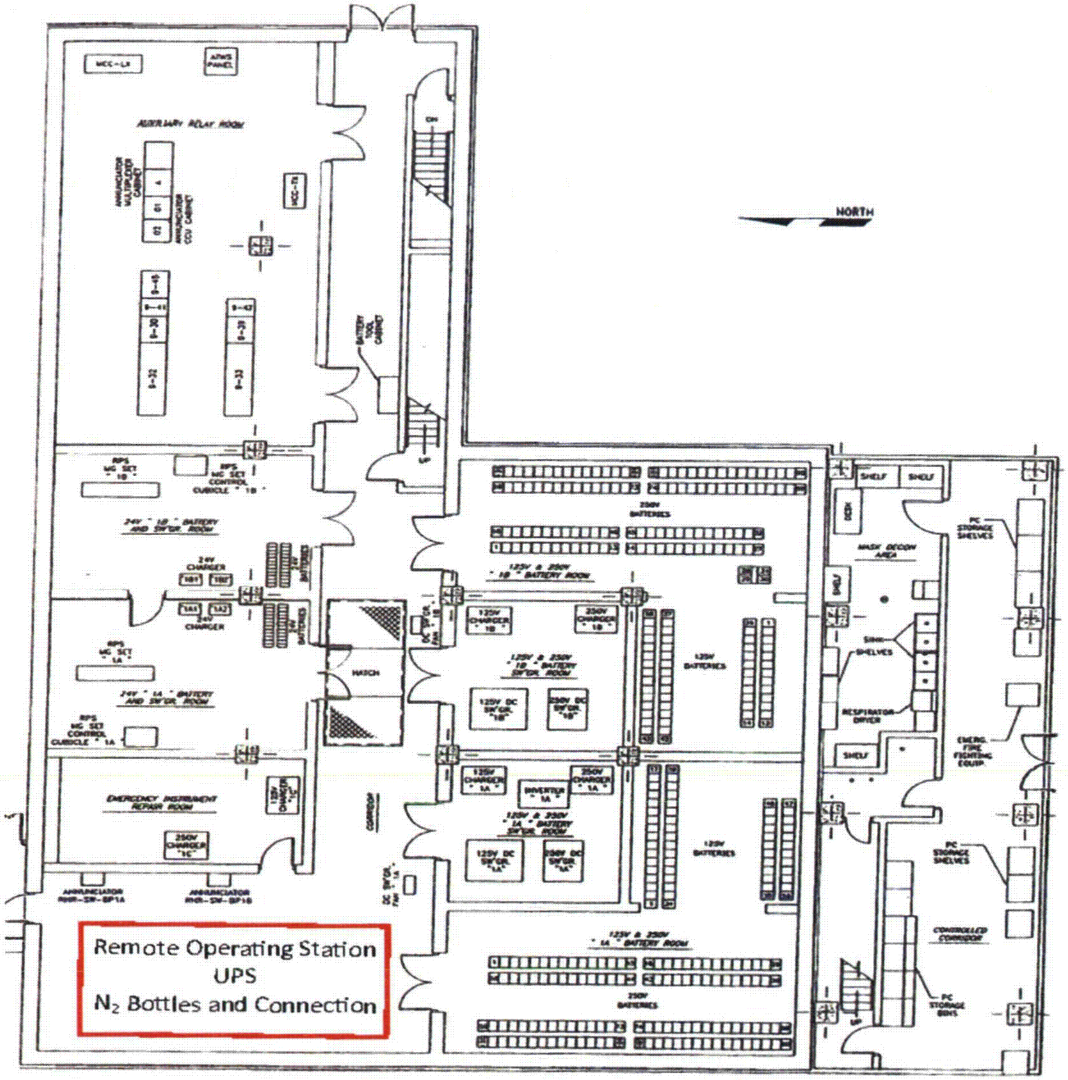
**Sketch 3: Remote Operating Station (ROS) Location *(preliminary)***




**Sketch 1: Electrical Layout of System (preliminary)**




**Sketch 2: P&ID Layout of HCVS (preliminary)**




**Sketch 3: Remote Operating Station (ROS) Location (preliminary)**

# Attachment 4: Failure Evaluation Table

Table 4A: Wetwell HCVS Failure Evaluation Table

| Functional Failure Mode | Failure Cause | Alternate Action | Failure with Alternate Action Impact on Containment Venting? |
|---|---|---|---|
| Failure of Vent to Open on Demand | Valves fail to open/close due to loss of normal AC power | No action needed, as power from dedicated UPS system provides 24 hour supply. Or, station service battery via inverter for minimum nine hours. | No |
| Failure of Vent to Open on Demand | Valves fail to open/close due to loss of alternate AC power (long term) or depletion of dedicated power supply | UPS system can supply power for 24 hours. After that, UPS system can be supplied power directly (bypassing battery charger) from FLEX provided generators. | No |
| Failure of Vent to Open on Demand | Valves fail to open/close due to complete loss of batteries (long term) | Recharge station service batteries with FLEX provided generators, considering severe accident conditions. Or, power UPS system directly (bypassing battery charger) with FLEX provided generators, and/or recharge UPS system battery. | No |
| Failure of Vent to Open on Demand | Valves fail to open/close due to loss of normal pneumatic air supply | No action needed, air can be supplied by accumulator tanks, which is sufficient for at least eight cycles of AO32 valve over first 24 hours. | No |
| Failure of Vent to Open on Demand | Valves fail to open/close due to loss of alternate pneumatic | Tie-in nitrogen cylinders to air system supporting HCVS valves, replace bottles as needed. | No |

| | | | |
|---|---|---|---|
| | air supply (long term) | | |
| Failure of Vent to Open on Demand | Valves fail to open/close due to SOV failure | Heroic action needed | Yes |

# Attachment 5: References


1. Generic Letter 89-16, Installation of a Hardened Wetwell Vent, dated September 1, 1989
2. Order EA-12-049, Mitigation Strategies for Beyond-Design-Basis External Events, dated March 12, 2012
3. Order EA-12-050, Reliable Hardened Containment Vents, dated March 12, 2012
4. Order EA-12-051, Reliable SFP Level Instrumentation, dated March 12, 2012
5. Order EA-13-109, Severe Accident Reliable Hardened Containment Vents, dated June 6, 2013
6. JLD-ISG-2012-01, Compliance with Order EA-12-049, Mitigation Strategies for Beyond-Design-Basis External Events, dated August 29, 2012
7. JLD-ISG-2012-02, Compliance with Order EA-12-050, Reliable Hardened Containment Vents, dated August 29, 2012
8. JLD-ISG-2013-02, Compliance with Order EA-13-109, Severe Accident Reliable Hardened Containment Vents, dated November 14, 2013
9. 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
10. NEI 12-06, Diverse and Flexible Coping Strategies (FLEX) Implementation Guide, Revision 1, dated August 2012
11. NEI 13-02, Industry Guidance for Compliance with Order EA–13–109, Revision 0, Dated November 2013
12. NEI 13-06, Enhancements to Emergency Response Capabilities for Beyond Design Basis Accidents and Events, Revision 0, dated March 2014
13. NEI 14-01, Emergency Response Procedures and Guidelines for Extreme Events and Severe Accidents, Revision 0, dated March 2014
14. NEI FAQ HCVS-01, HCVS Primary Controls and Alternate Controls and Monitoring Locations
15. NEI FAQ HCVS-02, HCVS Dedicated Equipment
16. NEI FAQ HCVS-03, HCVS Alternate Control Operating Mechanisms
17. Deleted
18. NEI FAQ HCVS-05, HCVS Control and 'Boundary Valves'
19. NEI FAQ HCVS-06, FLEX Assumptions/HCVS Generic Assumptions
20. NEI FAQ HCVS-07, Consideration of Release from Spent Fuel Pool Anomalies
21. NEI FAQ HCVS-08, HCVS Instrument Qualifications
22. NEI FAQ HCVS-09, Use of Toolbox Actions for Personnel

23. NEI White Paper HCVS-WP-01, HCVS Dedicated Power and Motive Force
24. NEI White Paper HCVS-WP-02, HCVS Cyclic Operations Approach
25. NEI White Paper HCVS-WP-03, Hydrogen/CO Control Measures
26. NEI White Paper HCVS-WP-04, FLEX/HCVS Interactions
27. IEEE Standard 344-2004, IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power *Generating Stations*,
28. Cooper Nuclear Station EA-12-049 (FLEX) Overall Integrated Implementation Plan, Rev 0, February 2013
29. Cooper Nuclear Station EA-12-050 (HCVS) Overall Integrated Implementation Plan, Rev 0, February 2013
30. Cooper Nuclear Station EA-12-051 (SFP LI) Overall Integrated Implementation Plan, Rev 0, February 2013
31. EPRI Technical Report, Use of Modular Accident Analysis Program (MAAP) in Support of Post-Fukushima Applications, June 2013
32. NEDC 92-092, Review of Nutech Calculation of THPV Flow Rate and Vent Pipe Size, Nutech Calc. No. XNP033.0201
33. ISG-JLD-2012-03, Compliance with Order EA-12-051, Reliable Spent Fuel Pool Instrumentation, May 31, 2012
34. CNS DC-91-041, Torus Hard Pipe Vent, August 5, 1993
35. CNS Emergency Operating Procedure 5.8.21, PC Venting and Hydrogen Control (Less than Combustible Limits), Revision 18
36. CNS Emergency Operating Procedure 5.8.22, PC Venting and Hydrogen Control (Greater than Combustible Limits), Revision 15
37. CNS Emergency Procedure 5.3ALT-STRATEGY, Alternate Core Cooling Mitigating Strategies, Revision 36
38. Nebraska Public Power District's Second Six-Month Status Report in Response to March 12, 2012, Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond Design Basis External Events (Order Number EA-12-049), February 26, 2014
39. CNS Emergency Operating Procedure 5.8.18, Primary Containment Venting for PCPL, PSP, or Primary Containment Flooding, Revision 16
40. Cooper Nuclear Station Updated Safety Analysis Report (USAR)
41. Cooper Nuclear Station Design Change Document Chapter 9 and Chapter 7
42. Cooper Nuclear Station Drawing 3617, sh. 1, Control Room Vertical Board H Arrangement
43. Cooper Nuclear Station Drawing 3621 sh. 2, Control Room Vertical Board P2 Arrangement

# Attachment 6: Changes/Updates to this Overall Integrated Implementation Plan

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

# Attachment 7: List of Overall Integrated Plan Open Items

| Open Item | Action | Comment |
|---|---|---|
| 1 | Determine location of HCVS ROS. | |
| 2 | Evaluate accessibility of the ROS for radiological and environmental conditions. Address dose and temperature items for the ROS (non-MCR) location. FAQ-HCVS-01 (Reference 14) will be used as guidance. | |
| 3 | Determine the location of the dedicated HCVS battery transfer switch. | |
| 4 | Determine the location of backup nitrogen bottles and evaluate the effects of radiological and temperature constraints on their deployment. | |
| 5 | Evaluate the location of the portable DG for accessibility under SA HCVS use. | |
| 6 | Confirm suppression pool heat capacity. | |
| 7 | Determine which approach or combination of approaches CNS will take to address the control of flammable gases, clearly demarcating the segments of vent system to which an approach applies. | |
| 8 | Identify qualification method used for HCVS instruments. | |
| 9 | Evaluate HCVS monitoring location for accessibility, habitability, staffing sufficiency, and communication capability with vent-use decision makers. | |
| 10 | Determine the number of required valve cycles during the first 24 hours. Size the electrical and pneumatic supplies accordingly. | |
| 11 | Evaluate the impact of SA environmental conditions for post-24 hour actions supporting the implementation of power and pneumatic supplies. | |
| 12 | Determine the control document for HCVS out-of-service time criteria. | |

# Attachment 8: List of Acronyms

| | |
|---|---|
| AC | Alternating Current |
| AOV | Air-Operated Valve |
| ASME | American Society of Mechanical Engineers |
| AST | Alternate Source Term |
| BDBEE | Beyond-Design-Basis External Event |
| BWR | Boiling Water Reactor |
| CAP | Containment Accident Pressure |
| CLTP | Current Licensed Thermal Power |
| CNS | Cooper Nuclear Station |
| DBLOCA | Design-Basis Loss Of Coolant Accident |
| DC | Direct Current |
| DG | Diesel Generator |
| DW | Drywell |
| ECCS | Emergency Core Cooling System |
| ELAP | Extended Loss of AC Power |
| EMC | Electromagnetic Compatibility |
| EOP | Emergency Operating Procedures |
| EPG | Emergency Procedure Guidelines |
| EPRI | Electric Power Research Institute |
| ERP | Elevated Release Point |
| EQ | Environmental Qualification |
| GDC | General Design Criterion |
| HCVS | Hardened Containment Venting System |
| HPCI | High Pressure Coolant Injection |
| HPV | Hard Pipe Vent |
| IEEE | Institute of Electrical and Electronics Engineers |
| ISE | Interim Staff Evaluation |
| ISG | Interim Staff Guidance |

| | |
|---|---|
| LTSBO | Long-Term Station Blackout |
| MCC | Motor Control Center |
| MCR | Main Control Room |
| MOV | Motor-Operated Valve |
| NEI | Nuclear Energy Institute |
| NEMA | National Electrical Manufacturers Association |
| NFPA | National Fire Protection Association |
| NPSH | Net Positive Suction Head |
| NRC | Nuclear Regulatory Commission |
| NTTF | Near-Term Task Force |
| PRA | Probability Risk Assessment |
| OIP | Overall Integrated Plan |
| PCIV | Primary Containment Isolation Valve |
| PCPL | Primary Containment Pressure Limit |
| PSP | Pressure Suppression Pressure |
| RCIC | Reactor Core Isolation Cooling |
| RG | Regulatory Guide |
| ROS | Remote Operating Station |
| RPV | Reactor Pressure Vessel |
| RRC | Regional Response Center |
| SA | Severe Accident |
| SAG | Severe Accident Guidelines |
| SAMG | Severe Accident Management Guidelines |
| SBO | Station Blackout |
| SGT(S) | Standby Gas Treatment (System) |
| SME | Seismic Margin Earthquake |
| SFP | Spent Fuel Pool |
| SRM | Staff Requirement Memorandum |
| SOP | Standard Operating Procedures |
| SOV | Solenoid-Operated Valve |
| TBD | To Be Determined |

| | |
|---|---|
| THV | Torus Hardened Vent |
| UHS | Ultimate Heat Sink |
| UPS | Uninterruptible Power System |
| VAC | Volts Alternating Current |
| VDC | Volts Direct Current |
| WW | Wetwell |