CNL-14-100

Order EA-13-109

June 30, 2014

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

Browns Ferry Nuclear Plant, Units 1, 2, and 3
Renewed Facility Operating License Nos. DPR-33, DPR-52, and DPR-68
NRC Docket Nos. 50-259, 50-260, and 50-296

Subject: **Tennessee Valley Authority'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 (Order Number EA-13-109)**

References:

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

On June 6, 2013, the Nuclear Regulatory Commission (NRC) issued an order (Reference 1) to all licensees of Boiling Water Reactors (BWR) with Mark I and II containments, including the Tennessee Valley Authority (TVA). Reference 1 was immediately effective and directs TVA to take certain actions to ensure that the subject facilities have 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 1.

Reference 1 requires submission of an Overall Integrated Plan (OIP) by June 30, 2014, for Phase 1 of the order. The interim staff guidance (Reference 2) was issued November 14, 2013, which provides direction regarding the content of this OIP. The purpose of this letter is to provide the OIP for Phase 1 pursuant to Section IV, Condition D.1, of Reference 1. This letter confirms TVA has received Reference 2 and has a Phase 1 OIP complying with the guidance contained in Reference 2 for the purpose of ensuring the functionality of an 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 1.

Reference 3, Section 7.0 contains the specific reporting guidance for the OIP. The information in the enclosure provides TVA's Phase 1 OIP pursuant to Section 7.0 of Reference 3 by use of the Phase 1 OIP Template per Reference 4.

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, TVA plans to install a severe accident capable wetwell vent.

Compliance with the requirements of Reference 1 will supersede any and all actions or commitments associated with TVA's responses to References 5 and 6. By submittal of the Reference 1 Phase 1 OIP via this letter, any actions or commitments made relative to Reference 5 or 6 are rescinded and no longer binding.

This letter contains no new regulatory commitments. If you have any questions regarding this report, please contact Kevin E. Casey at (423) 751-8523.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 30th day of June 2014.

Respectfully,

J. W. Shea
Vice President, Nuclear Licensing

Enclosure

Hardened Containment Venting System (HCVS) Phase 1 Overall Integrated Plan for Browns Ferry Nuclear Plant

cc: See Page 3

KEC
Enclosure
cc(Enclosure):

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NRR Director - NRC Headquarters
NRR Project Manager - Browns Ferry Nuclear Plant
NRC Senior Resident Inspector - Browns Ferry Nuclear Plant
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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 Nuclear Regulatory Commission (NRC) Commissioners directed the staff per Staff Requirements Memorandum (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 Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accidents*, 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 severe accident (SA) conditions resulting from an Extended Loss of AC Power (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 Interim Staff Guidance (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 overall integrated plan which will provide a description of how the requirements of the Order will be achieved. This document provides the Overall Integrated Plan (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 Main Control Room (MCR) or Remote Operating Station (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 Browns Ferry Nuclear Plant (BFNP) 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 design and implementation as noted in Part 5 of this OIP.
- Phase 2: The Phase 2 portion of the order is in the early strategy stage and future updates will provide additional information when available.

  The Browns Ferry Nuclear Plant is a three unit site that will have the capacity to have each unit operate at Extended Power Uprate (3952 MWt). The design and implementation of the HCVS system for each unit will have independent operation and be fully compliant with the NRC Order EA-13-109.

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 BFNP:

- Seismic, External Flooding, High Wind, Extreme High Temperature.

  The HCVS equipment will demonstrate functionality to meet the Design Basis Earthquake (DBE).

The following extreme external hazards screen out for BFNP:

- Extreme Cold

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:

<u>Applicable EA-12-049 assumptions:</u>

Part 1: General Integrated Plan Elements and Assumptions

049-1. Assumed initial plant conditions are as identified in NEI 12-06 section 3.2.1.2 items 1 and 2
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
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
049-4. No additional events or failures are assumed to occur immediately prior to or during the event. (Reference NEI 12-06, 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. (NEI 12-06, section 3.2.1.3 item 9 and 3.2.1.4 item 1-4)
049-6. At 1 hour (time critical at a time greater than 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 8 hrs.) (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, RPV water makeup, FLEX supply for drywell spray, FLEX water supply for Torus water level, 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, 4.2.3 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 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 (reference HCVS-FAQ-05 and 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 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

Part 1: General Integrated Plan Elements and Assumptions

HCVS venting dedicated functionality. (reference 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 HCVS-FAQ-02 and White Paper HCVS-WP-01)

109-8. Use of MAAP Version 4 or higher provides adequate assurance of the plant conditions (e.g., RPV water level, temperatures, etc.) assumed for Order EA-13-109 BDBEE and SA HCVS operation. (reference 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 NEI 13-02 section 8)

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

109-11. This Overall Integrated Plan is based on Emergency Operating Procedure 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 Control Room is adequately protected from excessive radiation dose per General Design Criterion (GDC) 19 in 10CFR50 Appendix A and no further evaluation of its use as the preferred HCVS control location is required. (reference 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:

BFNP-1 Each operating unit will have an individual release point to the highest point of the Reactor building

BFNP-2 All load sheds will be accomplished within one hour of event initiation and will occur in an area not impacted by a possible radiological event.

BFNP-3 The implementation of Order EA-13-109 will be staged for each operating unit such that the operating units that have not implemented the order will be able to vent via the existing plant stack.

BFNP-4 BFN will design any exposed HCVS piping that is outside of the Reactor Building to seismic class 1 criteria.

[OPEN ITEM 6] Electrical load shedding will be performed in 1 hour of the event.
[OPEN ITEM 7] The implementation of the HCVS Design Change notice (DCN’s) will be staged so that there is no effect on the operating units.

Part 2: Boundary Conditions for Wet Well 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). A HCVS Extended Loss of AC Power (ELAP) Failure Evaluation table, which shows alternate actions that can be performed, is included in Attachment 4.

Table 2-1 HCVS Remote Manual Actions

Primary Action	Primary Location / Component	Notes
1. Verify that Primary Containment Isolation valves are closed: FCV-64-18, 19, 20, 21. FSV 84-8B & 8C FCV 76-19 & 24	Indicating lights located in the MCR	
2. Disable PCIV keylock switch if required.	Panels in MCR containing PCIV keylock switch	Ref. EOI appendix 13
3. Open Wetwell PCIVs FCV-64-221 & 222.	Hand switches located in the MCR panel	And at the Remote Operating Station (ROS)
4. Verify that power supplies for all valves and instruments can be supplied by dedicated batteries.	Instruments and controls located in the MCR	A 24 hour supply of power will be available to the HCVS system. After 24 hours of operation the portable generators may be aligned to supply power to the HCVS

Part 2: Boundary Conditions for Wet Well Vent

5. Verify that the pneumatic supply to the CIV's required for service is operable with replaceable nitrogen bottles	Nitrogen bottles will be located in an area that is accessible to operators, preferable near the ROS located in the associated diesel generator building.	Prior to depletion of the pneumatic sources actions will be required to connect back-up sources at a time greater than 24 hours.

Other considerations to minimize the impact to operational hazards is that HCVS controls will be located in areas where sustained operation is possible accounting for expected temperatures and radiological conditions in the HCVS vent pipe and attached components without extreme heat stress or radiological over exposure to the operators.

HCVS components may serve multiple functions described in the plant Current License Basis (CLB). For BFNP this is inclusive of:

Piping, valves and penetrations for the Wetwell may be used for Wetwell vent and purge prior to or following refueling outages or for pressure control during normal plant operation.

Containment Isolation valves in the HCVS system may provide a containment isolation function independent of the HCVS function.

Containment Isolation valve position indication for valves in the HCVS may be used for post-accident indications

Instrumentation supporting HCVS and non HCVS functions

Components required for manual operation will be placed in areas that are readily accessible to plant operators, and not require additional actions, such as the installation of ladders or temporary scaffolding, to operate the system. The design strategy will evaluate potential plant conditions and use acquired knowledge of these areas to provide input to system operating procedures, training, the choice of protective clothing, required tools and equipment, and portable lighting. The evaluation will include considerations such as, how temperatures would elevate due to extended loss of AC power conditions and the lighting that would be available following beyond design basis external events. The use of handheld or portable lighting for operations personnel is an acceptable practice.

Part 2: Boundary Conditions for Wet Well Vent

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

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

- 6 Hours, Initiate use of Hardened Containment Vent System (HCVS) per site procedures to maintain containment parameters below design limits and within the limits that allow continued use of RCIC - The reliable operation of HCVS will be met because HCVS meets the seismic requirements identified in NEI 13-02 and will be powered by DC buses with motive force supplied to HCVS valves from installed accumulators and portable nitrogen storage bottles. Critical HCVS controls and instruments associated with containment will be DC powered and operated from the MCR or a Remote Operating Station on each unit. The DC power for HCVS will be available as long as the HCVS is required. HCVS battery capacity will be available to extend past 24 hours. In addition, when available Phase 2 FLEX Portable Generator (PG) can provide power before battery life is exhausted. Thus initiation of the HCVS from the MCR or the Remote Operating Station within 6 hours is acceptable because the actions can be performed any time after declaration of an ELAP until the venting is needed at 6 hours for BDBEE venting. This action can also be performed for SA HCVS operation which occur at a time further removed from an ELAP declaration as shown in Attachment 2.
- After 24 Hours, installed nitrogen bottles will be valved-in to supplement the Nitrogen tanks supply at the Remote Operating Station. The Nitrogen bottles can be replenished one at a time leaving the other tanks supplying the HCVS. This can be performed at any time prior to 24 hours to ensure adequate capacity is maintained so this time constraint is not limiting.
- At 6 to 8 hours portable generators will be connected to the 480V unit battery chargers. At 24 hours, additional temporary generators will be installed and connected to the 480 volt system to power the unit battery chargers using a portable PG to supply power to HCVS critical components/instruments - Time critical after 12 hours. Current battery durations are calculated to last greater than 24 hours. PG will be staged beginning at approximately 5-8 hour time frame (Reference 28, FLEX OIP). Within 2 hours later the PG will be in service. Thus the PGs will be available to be placed in service at any point after 24 hours as required to supply power to HCVS critical components/instruments. A PG will be maintained in on-site FLEX storage buildings. PG will be transferred and staged via haul routes and staging areas evaluated for impact from external hazards. Modifications to will be implemented to facilitate the connections and operational actions required to supply power within 24 hours which is acceptable because the actions can be performed any time after declaration of an ELAP until the repowering is needed at greater than 24 hours.

Part 2: Boundary Conditions for Wet Well Vent

Discussion of radiological and temperature constraints identified in Attachment 2

1. 6 Hours, Initiate use of Hardened Containment Vent System (HCVS) per site procedures to maintain containment parameters below design limits and within the limits that allow continued use of RCIC - The reliable operation of HCVS will be met because HCVS meets the seismic requirements identified in NEI 13-02 and will be powered by DC buses with motive force supplied to HCVS valves from installed accumulators and portable nitrogen storage bottles. Critical HCVS controls and instruments associated with containment will be DC powered and operated from the MCR or a Remote Operating Station on each unit. Unit batteries will provide power for 8 hours. After 6 hours, Phase 2 FLEX Portable Generator (PG) can provide power before battery life is exhausted. Thus initiation of the HCVS from the MCR or the Remote Operating Station within 6 hours is acceptable because the actions can be performed any time after declaration of an ELAP until the venting is needed at 12 hours for BDBEE venting. This action can also be performed for severe accident HCVS operation which occur at a time further removed from an ELAP declaration as shown in Attachment 2.

2. Prior to 8 hours, based on battery depletion, power supply will be swapped from Unit batteries to dedicated HCVS batteries to ensure power to the inverters. Access to the transfer switch will be in the control building.

3. At >24 hours, installed nitrogen bottles will be aligned to supplement the air accumulator supply as stated for the related time constraint item. Nitrogen bottles will be located in an area that is accessible to operators near the Remote Operating Station.

4. At >24 Hours, temporary generators will be installed and connected to power up unit battery chargers using a portable PG to supply power to HCVS critical components/instruments - Time critical after 24 hours. Current battery durations are calculated to last greater than 24 hours (Reference 32). PG will be staged beginning at approximately 5-8 hour time frame (Reference 28). Within Two (2) hours of deployment the PG will be in service. Thus the PGs will be available to be placed in service at any point after 24 hours as required to supply power to HCVS critical components/instruments. The connections, location of the PG and access for refueling will be located in an area that is accessible to operators in the Control Building or in the yard area.

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

Part 2: Boundary Conditions for Wet Well Vent

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)
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.

Part 2: Boundary Conditions for Wet Well Vent

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

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

Use of instruments and supporting components with known operating principles that are supplied by manufacturers with commercial quality assurance programs, such as ISO9001. The procurement specifications shall include the seismic requirements and/or instrument design requirements, and specify the need for commercial design standards and testing under seismic loadings consistent with design basis values at the instrument locations.

Demonstration of the seismic reliability of the instrumentation through methods that predict performance by analysis, qualification testing under simulated seismic conditions, a combination of testing and analysis, or the use of experience data. Guidance for these is based on sections 7, 8, 9, and 10 of IEEE Standard 344-2004, "IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations," or a substantially similar industrial standard could be used.

Demonstration that the instrumentation is substantially similar in design to instrumentation that has been previously tested to seismic loading levels in accordance with the plant design basis at the location where the instrument is to be installed (g-levels and frequency ranges). Such testing and analysis should be similar to that performed for the plant licensing basis.

Vent Size and Basis

The HCVS wetwell path is designed for venting steam/energy at a nominal capacity of 1% or greater of 3952 MWt thermal power at pressure of 56 psig. This pressure is the lower of the containment design pressure (56 psig) and the PCPL value (62 psig). The thermal power is based on a power uprate of 15% above the currently licensed thermal power of 3458 MWt. This pressure is the lower of the containment design pressure and the PCPL value. The size of the wetwell portion of the HCVS of 14 inches in diameter which provides adequate capacity to meet or exceed the Order criteria.

The primary design objective of the HCVS is to provide sufficient venting capacity to prevent a long-term overpressure failure of the containment by keeping the containment pressure below the lower value of either Primary Containment Pressure Limit (PCPL) or containment design pressure, and maintaining Pressure Suppression Capability such that the safety relief valves (SRVs) can be opened and closed as required by plant conditions. Operational functionality of these valves will ensure the capability to depressurize the RPV to permit injection of low head injection systems and to maintain the containment pressure boundary.

The wet well vent will be sized under conditions of constant heat input at a rate equal to 1% of rated thermal power and containment pressure equal to the lesser of the PCPL or containment design pressure, the exhaust-flow through the wetwell vent would be sufficient to prevent the containment pressure from increasing.

Part 2: Boundary Conditions for Wet Well Vent

[OPEN ITEM 8] The wetwell vent will be designed to remove 1% of rated thermal power at EPU conditions.

During a severe accident, temperature of gases in the wetwell and drywell will differ due to insufficient removal of decay heat from fission products resulting in superheat or non-saturated conditions in the drywell. The suppression pool/wetwell of a BWR Mark I/II containment can be considered to be in a saturated condition. The plant-specific PCPL determination provides a temperature range for the suppression pool of 70ºF to 350ºF. Therefore, the design temperature for the wetwell vent portions of the HCVS are recommended to be based on the 350ºF upper bound of the EPG/SAG bases document which is above the saturation temperature corresponding to typical PCPL values.

Anticipatory venting of primary containment may be used in the BFNP HCVS design to preclude elevated containment temperature, hydrogen generation, containment pressure and extend RCIC operation. Early removal of energy from containment during an ELAP via the containment vents is an effective action that can be taken to support the containment and core cooling safety function capabilities described in NEI 12-06 (Reference 10) Table 3-1 for Mark 1 containment designs. Anticipatory venting provides a controlled vent path (for exhausted/scrubbed reactor steam) and maintains operation of an installed (operator-familiar) injection system that provides a reliable strategy for maintaining long term functionality of Containment (and the Core).

Vent Capacity

The 1% capacity value at BFNP 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 has been confirmed. (Reference 31)

Vent Path and Discharge

The HCVS vent path at BFNP will consist of a wetwell vent on each unit. There will be no connection to the existing drywell vent. The proposed HCVS vent path for the wetwell will exit the reactor building 565.0 elevation through an underground pipe. This pipe will be routed approximately 200 feet vertically up the outside of the reactor building. The HCVS path will pass through the BFNP superstructure to the roof of the Reactor Building. The release point will be above any adjacent structure and will be designed to not mix with the other units release plume as the distance from each individual release point will be greater than 150 feet in the horizontal direction.

The HCVS discharge path is in the early design developmental stage and subject to refinement, however current consideration is that the HCVS vent will be routed to a point above any adjacent structure. This discharge point is above that unit's Reactor Building such that the release point will vent away from emergency ventilation system intake and exhaust openings, main control room location, location of HCVS portable equipment, access routes required following a ELAP and BDBEE, and emergency response facilities; however, these must be considered in conjunction with other design criteria (e.g., flow capacity) and pipe routing limitations, to the degree practical. The existing routing of the Wet Well vent will follow the existing path to the Reactor Building wall. The proposed HCVS pipe will exit the Reactor Building wall and be routed through an earthen berm to a

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vertical discharge path on the exterior side of the Reactor building wall. The HCVS piping will then pass through the superstructure that encases the refuel floor to an exit point on the roof. This path will provide an enhanced method to minimize any radiological dose to the operating staff and any exposed piping and supports will be designed for missile protection form excessive winds.

The HCVS shall be designed for those accident conditions (before and after core damage) for which containment venting is relied upon to reduce the probability of containment failure. The BFNP HCVS will be designed to protect the containment against overpressurization in a beyond design basis accident such that the release of radioactive effluent will be maintained as a controlled process.

When anticipatory venting is performed at low containment pressure to maintain core cooling using FLEX strategies, there is no minimum required exhaust stack exit velocity, since without core damage there will be negligible levels of radionuclides and/or combustible gas in the effluent. Therefore, there is no concern with entrainment of the stack effluent into the roof or downstream recirculation zones associated with airflow around the building.

Severe accident venting to maintain containment integrity may have the potential presence of significant quantities of radionuclides and/or combustible gas in the vent discharge that requires additional restrictions to be applied to the design and operation of the vent under severe accident conditions. ASHRAE HVAC design requirements is used as the guidance document, and it states that an effluent release velocity of 8000 fpm will assure that the effluent plume will not be entrained into the roof recirculation zone of a given building. Vent pipe design (e.g., pipe diameter at the exit) and conditions under which the vent is operated (e.g., minimum containment pressure at which the vent is operated; use of flow control devices) should be considered to ensure this is the predominant minimum release velocity under severe accident conditions.

However it must also be realized that venting of the containment volume at the accident pressures is considered to be predominately a high velocity evolution such that for the vast majority of time the effluent will be jetted up beyond the affected building recirculation zone. Effluent will not simply waft across a building roof as if released by a predominantly buoyancy driven exhaust stack but will be jetted upward from the vent due to momentum. Hence, it should be understood that by nature of any venting strategy there may be times when the effluent release velocity may drop below the stated 8000 fpm.

Under severe accident conditions the main purpose of the vent is to protect the containment function and use of the vent should not be limited by an effluent release velocity of 8000 fpm (e.g., venting at low pressure may be required to optimize the timing of a release or to optimize a venting strategy). In such cases, the margin in containment pressure gained by venting is more important than dispersion of the effluent.

Momentum and buoyancy will work to drive the vented effluent upward once it has exited the release point, there is the possibility that any vented hydrogen may deflagrate or possibly detonate if an ignition source is available. Based on the guidance and philosophy of the release point and the structural integrity of the HCVS, there is reasonable assurance that such an event would occur well away from building equipment. However, flammable or heat sensitive equipment should not be located in the general vicinity of the release point.

The design of the HCVS release point relative to the location of the air intakes for the control building will follow a general guidance of a 1:5 ratio. This allows a 1 foot vertical drop for every 5 feet of horizontal travel.

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The detailed design will provide missile protection to a maximum height of 30 feet from ground elevation, from external events as defined by NEI 12-06 for the outside portions of the selected release stack or structure. This is a design consideration using reasonable protection features for the screened in hazards from NEI 12-06, engineering will use design basis missile hazards methods in the calculations. BFNP external missiles are detailed in Design Criteria BFN-50-C-7101 (References 17 and 33).

Power and Pneumatic Supply Sources

All electrical power required for operation of HCVS components will be routed through a 250 VDC system which is normally supplied from two Unit Batteries, one for each electrical division. Battery power will be provided by the existing Unit batteries for up to 8 hours (to be validated by calculation) if proper load shedding is performed within 1 hour following the ELAP event. At any time following the ELAP event, power may be transferred to dedicated batteries that will supply power for 24 hours. At 24 hours, power will transfer back to the Unit batteries, at which time it is expected that FLEX generators will be in service to recharge Unit batteries.

Pneumatic power is normally provided by the non-interruptible air system with backup nitrogen provided from installed nitrogen supply tanks. Following an ELAP event, station control 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 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 and the use of a two way pneumatic spool valve that is automatically opened by a pressure regulator to isolate the normal path bypassing the existing solenoid valve and enable the ROS to provide motive force to the CIV’s.

1. The HCVS flow path valves are air-operated valves (AOV) with air-to-open and spring-to-shut. Opening the valves requires energizing an AC powered solenoid operated valve (SOV) and providing motive air/gas. 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, there will be FLEX portable generators that are able to sustain DC power. The capacity of the FLEX portable generators will have the capability to sustain extended operation and will be sized to supply the required FLEX and HCVS electrical loads. The initial stored motive air/gas will allow for a minimum of approximately 192 valve operating cycles for the HCVS valves for the first 24-hours.

   BFNP will use Anticipatory Venting during the initial phase of the HCVS operation. Use of the HCVS system during Severe Accidents (particularly with a high level of Aerosol formation) may require cycling the vent to create pressure changes to promote plate out of Aerosols. The method used for these pressure cycles may be either full vent closure or vent throttling. The number of cycles of the HCVS system may change during the detailed design process to

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determine the amount of motive air/pneumatics required over the first 24 hours. The HCVS will be designed for sustained operation of 7 days. This will allow two objectives to be met:

First, to allow sufficient time for decay heat to be reduced so that water flooding of the debris would not pose a large risk of containment overpressure due to Zirc water reaction. This would be coupled with steam formation and the loss of Drywell air space caused by large water injections.

Second, to allow time for additional equipment to arrive to support water injection into the Containment to cover the core debris and achieve Minimum Debris Submergence Level.

During Sustained Operation, the containment barrier is initially manually controlled by the plant staff/ERO during containment heat removal operations (either by containment venting or alternative measures) to prevent further fuel damage. This manual containment heat removal allows RPV injection by use of RCIC or external water supplies (reduced containment pressure may be required.) Severe accident venting to remove containment heat may be stopped as soon as possible to fully restore the containment function so that the containment source term barrier is available (i.e., no substantial leakage through containment components.) Thus allowing design barriers to be maintained for potential degrading core conditions. These operations will be considered in providing available pneumatic power.

2. An assessment of temperature and radiological conditions will be performed to ensure that operating personnel can safely access and operate controls at the Remote Operating Station based on time constraints listed in Attachment 2.

   [OPEN ITEM 1] Perform assessment of temperature and radiological conditions.

   The Primary operating location, inclusive of the valve position indication, will be designed for the expected Thermal and Radiological challenges posed by loss of ventilation (possible for the entire “Sustained” Operating period of 7 days), any Thermal challenge posed by operating the HCVS, and any Radiological challenge posed by the HCVS system on the equipment located in the control panel. The Primary operating location will be the Control Room and the dose allowable will comply with General Design Criteria 19 (5 Rem/person for the duration of the event.

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.

   Power that is available following an ELAP to provide the required Containment Indications (See JLD-ISG-2012-01 for Order EA-12-049) will be available for the BFNP HCVS. Indications required for Containment Pressure and Wetwell level are used to operate the HCVS system (determine when to close to prevent negative pressure or air intrusion) and thus either have to be available or the parametric values must be actively communicated to the HCVS control location.

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4. All valves required to open the flow path 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 FAQ HCVS-03). The ROS will be located in the Diesel Generator Building for the respective unit. These structures are not subject to the thermal and radiological conditions in the Reactor Building(s) and no ice vests or shielding is required. Any supplemental connections will be 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.

   The Alternate operation of the HCVS components will meet Order Element 1.2.5. Manual Operation of the CIV's will be the use of a manual valve, to provide pneumatic supply to the CIV, will be located in at the ROS in the diesel generator building for the respective unit. This location is in a mild environment and will not be subject to the temperature and radiological conditions in the reactor building during HCVS operation. There will be no requirement for ice vests or shielding to perform any operation of plant installed equipment at the ROS.

   The HCVS shall be capable of operating with dedicated and permanently installed equipment for at least 24 hours following the loss of normal power or loss of normal pneumatic supplies to air operated components during an extended loss of AC power. The ROS is inclusive of the manual valve and connections for pneumatic supply. The HCVS CIV's and associated components are dedicated equipment that will be used for sustained operation.

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

   The primary and ROS control panels are located in normally occupied spaces or accessible to plant staff for all modes of operation including a severe accident. The panels will consider human factors and be designed so that ladders and scaffolding is not required.

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 diesel generator building) such that radiological impacts are not an issue. Additional bottles can be deployed and installed as needed.

Location of Control Panels

The HCVS design allows initiating and then operating and monitoring the HCVS from the Main Control Room (MCR) and the Remote Operating Station located in the Diesel Generator Building(s). The MCR location is protected from adverse natural phenomena and the normal control point for Plant Emergency Response actions.

The Remote Operating Station located in the Diesel Generator Building(S) has the same accessibility and habitability as the Main Control Room. Evaluations have been performed for the Diesel Generator Buildings and area temperatures are within the NEI 12-06 limit of 110°F. Radiological conditions will also vary with the source term over time and could either drop or rise depending on deposition of source term in the HCVS system and vent system use. However, based on the distance of the Remote Operating Station to the operating HCVS process piping the radiological conditions will

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conform to GDC 19 requirements.

The HCVS will include a means to monitor the effluent discharge for radioactivity that may be released from operation of the HCVS. The monitoring system will provide indication from the control panel and shall be designed for sustained operation during an extended loss of AC power. The HCVS design will provide a means to allow plant operators to readily determine, or have knowledge of HCVS vent valve position, radiation levels with a range for severe accident service, pressure, temperature and the status of supporting systems, such as availability of electrical power and pneumatic supply pressure.

[OPEN ITEM 9] Communication between the MCR and the ROS will be through a harris communication system.

Power to Monitor HCVS Indications that is available following an ELAP will be provided for at least 24 hours of capability with minimal operator actions. The power source will be available without use of portable equipment for at least 24 hours.

The temperature and heat load that exist due to proximity to the undercooled containment in the MCR has been considered for NRC Order EA-12-049 (FLEX) and EA-13-109 (HCVS) and are within guidelines. The opening of doors or placement of portable fans may be required during certain timeframes. This is reasonable since any impact as the result of a severe accident are not expected to have an adverse impact the MCR due to Control Room location in a separate air space and FLEX ventilation methods applied to the MCR. The instrumentation should be capable of operating in the thermal and radiological environment for at least 24 hours without significant operator action.

The ROS located outside the main control room will be determined to be readily accessible locations by performing an evaluation that includes: Accessibility, Habitability, Staffing sufficiency and providing communication capability with vent use decision makers. Radiological conditions will also vary with the source term over time and could either drop or rise depending on deposition of source term in the HCVS system and vent system use. This will have to be accounted for over the time frame during which the HCVS system is being used. The definition of “sustained operation” prescribes this time frame based on when other containment cooling measures are put in place and when HCVS system operation ceases.

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)

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).
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.

The HCVS will be designed to avoid a detonable mixture or be designed to accommodate a detonation while remaining functional. A number of conditions as shown in attachment 2 must align to allow for a detonation to occur. A series of specific conditions must occur in order for a pressure spike high enough to potentially damage the vent pipe to be possible. It should also be realized that the occurrence of such a set of conditions is extremely unlikely due mainly to the process of venting

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which will purge the vent system of available oxygen prior to a combustible mix occurring. After a venting evolution, the vent pipe would contain a large amount of steam (the predominant constituent of the effluent). The steam in the pipe would not collapse quickly. It would condense and slowly draw air down into the vent pipe. Once the steam has condensed, the air travelling down into the pipe would have marginal motive force to facilitate mixing. Although the hydrogen molecules would tend to diffuse into the air, the likelihood of a large homogeneous mixture of sufficient concentration being formed is remote. The more likely scenario, if an ignition occurred in an area where conditions were favorable, would be that the flame front would travel a short distance along the pipe to a point (in both directions) where there was no longer a combustible mix that could support the flame.

A Deflagration to Detonation Transition DDT is cited in assumption 5 (Reference 25) as a condition which will drive detonation pressure. In a piping configuration such as HCVS, the potential for an actual detonation is more dependent on the DDT phenomenon than on achieving enough of a mix (with a fuel constituent of 18% to 75% for hydrogen) for a prompt detonation. For a DDT to occur, a confined or semi-confined section of pipe must have a gas mixture which will support a deflagration. Once ignited, the flame front accelerates and presses the unburnt gases ahead to the point that the auto-ignition temperature of the gases is reached. Reflection of the pressure wave off of an effective pipe end will also work to enhance the approach to detonation. The point at which the auto-ignition temperature is reached is considered the transition from deflagration to detonation. This creates a detonation wave equal in pressure profile to that of a prompt detonation. The shock wave from this detonation causes the highest pipe stresses in a straight pipe section.

Although a prompt detonation (with an air/hydrogen mix containing at least 18% hydrogen by volume) is within the realm of possibility, the much more likely scenario would be that of a DDT to drive a detonation pressure wave. This is based simply on a reasonable combustible mixture being much more likely to occur with a lower combustible gas concentration than the higher concentration needed for a prompt detonation. Ultimately, any reasonable mixture of air or oxygen with a hydrogen constituent at or greater than 13.5% (by volume) would produce a like end result. That is to say, a mixture containing 13.5% hydrogen will produce the same end result as a mixture containing 50% hydrogen. Once you get beyond 13.5% hydrogen, the end result is the same.

The BFN HCVS system will be designed to allow the vent to operate during all three cases in attachment 2, inclusive of a severe accident that may produce hydrogen. The vent path will be designed so that the path can be open to the release point and provide for the movement of any built-up gases. The piping will minimize low points and the upper segment will be designed with a check valve to eliminate the ability of air to enter the HCVS during periods when the CIV's may close and steam may be condensing in the piping. The design of the HCVS may require that it withstand the dynamic loading resulting from hydrogen deflagration/detonation. For design purposes, the HCVS that is subject to hydrogen presence is not required to consider assumed simultaneous loads that would not be present or occur during the venting of hydrogen.

The HCVS design will address the reduction of Hydrogen Gas flammability in the vent pipe through the use of steam suppression nitrogen inerting or the exclusion of oxygen. An auditable engineering basis should be maintained to show that the piping, supports, valves, fittings, and other items subject to the detonation will maintain the ability to function after repeated detonations .Instruments required for HCVS operation will be located upstream of the check valve and not prone to detonation loading.

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The design concept of using a check valve is to bottle up the steam and hydrogen in the pipe volume between a downstream check valve and the upstream PCIV. There are check valves available currently which have near zero leakage for these applications and would use a swing disc to prevent backflow up near the exit point of a HCVS. Based on the run-up distance required for a deflagration to detonation transition to occur, detonation loading would be ruled out for the downstream piping. With the disc swinging up, gravity would assist the spring closure mechanism to limit leakage to an absolute minimum.

Relative buoyancy of hydrogen would also tend to exacerbate any sustained mixing of the oxygen as it leaked by the check valve. Once venting has ceased, the atmosphere in the contained volume in the HCVS would become relatively stagnant. As such oxygen and nitrogen (air), which may slowly enter the volume due to leakage past the check valve, would not tend to mix so much with the hydrogen layer but would tend to pass though it and settle out low in the pipe run. Due to the close molecular weights of nitrogen and oxygen gas (14 and 16 respectively) they would tend to remain mixed and both remain low in the piping. Hydrogen would tend to rise in such an environment and exist quite close to the check valve.

Consideration will be given to the placement of the check valve at or near the roof level and placing a low pressure rupture disc to prevent foreign material from entering the HCVS piping.

<u>Unintended Cross Flow of Vented Fluids</u>

The HCVS uses the Containment Purge and inerting System containment isolation valves for containment isolation. These containment isolation valves are AOVs and they are air-to-open and spring-to-shut. An SOV must be energized to allow the motive air to open the valve. Although these valves are shared between the Containment Purge System and the HCVS, separate control circuits are provided to each valve for each function. Specifically the Containment Purge and inerting System control circuit will be used during all “design basis” operating modes including all design basis transients and accidents.

Each HCVS containment penetration will have two in-series PCIVs as required by GDC 56. These PCIVs will be as evaluated for the required BDBEE process conditions. The design basis requirements will not be altered by the implementation of the modification to implement NRC Order EA-13-109. The HCVS path upstream of the HCVS PCIVs will be a multipurpose containment penetration that serve purge and inerting flow. The HCVS path downstream of the second PCIV must be analyzed for the condition of 350°F with corresponding PCPL values. The analysis of the non-HCVS system downstream of any boundary valve only has to consider consequences of heat transfer and leakage with the boundary valve closed.

The primary containment connection that are upstream of the HCVS PCIV’s are in accordance with 10 CFR 50, Appendix J, Type C testing. These paths accordingly are protected by redundant and diversely powered isolation valves. In standby conditions the normal state of the Torus Purge and Vent valves (Containment Isolation valves) are closed. Any leakage through these valves to the HCVS line would be determined by the Appendix J testing. During HCVS Operation the secondary containment bypass leakage criteria would not apply.

System cross-connections or shared Unit vent exhaust flowpaths present a potential for steam, hydrogen, and airborne radioactivity leakage to other areas of the plant and to adjacent units at

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multi-unit sites if the units are equipped with common vent piping. The implementation of NRC Order EA-13-109 will provide independence of the discharge path for all three units. The minimum distance between each units release point will be 150 feet. Based on the prevailing wind direction and velocity of the plume, the discharge of the effluent should not have any effect on the adjacent units HCVS.

The HCVS boundary valves are any valve which serves to isolate the HCVS from another system. For BFNP these valves are safety related PCIV's that function as required by 10 CFR 50, Appendix J. Their safety related function is to maintain the containment pressure boundary during a design bases accident. There would be no change to their testing requirement when NRC Order EA-13-109 is implemented.

Prevention of Inadvertent Actuation

EOP/ERG operating procedures provide clear guidance that the HCVS is not to be used to defeat containment integrity during any design basis transients and accident. In addition, the HCVS will be designed to provide features to prevent inadvertent actuation due to a design error, equipment malfunction, or operator error such that any credited containment accident pressure (CAP) that would provide net positive suction head to the emergency core cooling system (ECCS) pumps will be available (inclusive of a design basis loss-of-coolant accident (DBLOCA)). However the ECCS pumps will not have normal power available because of the starting boundary conditions of an ELAP. BFNP will use Containment Accident Pressure (CAP) to provide sufficient NPSH for the RCIC pump during the BDBEE. Analysis will be performed to ensure that the suppression pool water level in conjunction with pressure will provide sufficient margin to operate the RCIC pump for sustained service.

- The features that prevent inadvertent actuation are two PCIV's in series powered from different division and key lock switches. 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.
- BFNP will have circuitry to bypass containment high pressure interlocks that keep the HCVS containment isolation valves closed when high containment pressure exists. IEEE standards require some form of annunciation of features intended to bypass these containment interlocks for the Licensed Based Containment Reliability function. It will be ensured that this is properly designed to avoid conflict with the CLB.

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. For those components, the structure 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

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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 seismic margin earthquake (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 Environmental Qualification (EQ) program).

The HVCS will be required to be capable of functioning during severe accidents in which the containment function is not compromised by the severe accident conditions. The HCVS equipment is designed to provide reasonable assurance of operation in the severe accident environment for which they are intended to function and over the time span for which they are needed. However, the environmental requirements of 10 CFR 50.49 are design basis regulatory requirements and as such are not applicable under severe accident conditions.

Drywell radiological conditions should be consistent with the conditions assumed in the plant's current licensing basis (CLB) for a major accident. Such accidents have generally been assumed to result in substantial meltdown of the core with subsequent release of appreciable quantities of fission products (e.g., Technical Information Document (TID) 14844, Calculation of Distance Factors for Power and Test Reactor Sites (March 1962), or NUREG-1465, Accident Source Terms for Light-Water Nuclear Power Plants consistent with the current design basis of the plant.).

The evaluation of HCVS functionality should consider the potential conditions resulting from accidental events, whether postulated, hypothesized or otherwise identified, which do not exceed the conditions resulting from any credible accident as identified in the plant's CLB.

Routing considerations should consist of both Radiological conditions along the piping path and at the control stations where the new equipment will be placed. Additionally, locations where remote instrumentation will be located would need to be evaluated.

HCVS components including instrumentation should, as minimum, meet the quality design requirements of the plant, ensuring HCVS functionality. The HCVS up to and including the second isolation valve is designed to the same quality requirements of the connected system. HCVS elements that are not noted above should be reliable and rugged to ensure HCVS functionality following a seismic event. Additionally, non-safety equipment installed to meet the requirements of Order EA-13-109 must be implemented so that they do not degrade the existing safety-related systems

The instrumentation that is required for HCVS operation should be capable of operating in the thermal and radiological environment for at least 24 hours without significant operator action. The restriction on permanently installed equipment and operator actions only exists for the 24 hour period to ensure HCVS viability for at least a 24 hour mission time.

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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.

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.

Monitoring of HCVS

The BFNP wetwell HCVS will be capable of being manually operated during sustained operations from a control panel located in the main control room (MCR) and will meet the requirements of Order element 1.2.4. The MCR is a readily accessible location with no further evaluation required. Control Room dose associated with HCVS operation conforms to GDC 19/Alternate Source Term (AST). Additionally, to meet the intent for a secondary control location of section 1.2.5 of the Order, a readily accessible Remote Operating Station (ROS) will also be incorporated into the HCVS design as described in NEI 13-02 section 4.2.2.1.2.1. The controls at the ROS location will be accessible and functional under a range of plant conditions, including severe accident conditions with due consideration to source term and dose impact on operator exposure, extended loss of AC power (ELAP), and inadequate containment cooling. An evaluation will be performed to determine accessibility to the location, 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 the MCR.

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Included in the current design of the reliable hardened vent (RHV) are control switches in the MCR with valve position indication. The existing RHV controls currently meet the environmental and seismic requirements of the Order for the plant severe accident and will be upgraded to address ELAP. The ability to open/close these valves multiple times during the event's first 24 hours will be provided by air accumulator tanks and Unit batteries, supplemented by installed backup battery power sources. 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, temperature, and effluent radiation levels at the MCR . Other important information on the status of supporting systems, such as power source status and pneumatic supply pressure, 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.

Thermal Conditions: Routing considerations in this section consist of both Thermal conditions along the piping and at the control stations where the new equipment will be placed. Additionally, locations where remote instrumentation will be located would need to be evaluated for protection of equipment and limiting personnel dose for those individuals responding to the BDBEE. The general principles to be applied are summarized below:

Map the locations of piping, valves, valve position indications, Rad Monitors or Thermal monitors used to verify flow in the HCVS system, Primary and Alternate Control stations within the plant structure that would be subject to thermal impacts from either loss of station ventilation due to ELAP or thermal impacts from venting the steam and gases from the containment through the HCVS system/components should also be mapped to verify any new equipment/systems would not suffer functional impairment due to thermal or radiological concerns.

- Determine the thermal impacts for the mapped areas.
- Insulate piping as required.
- Provide signage to indicate high dose rates
- Apply appropriate compensatory actions as necessary
- Shield piping to minimize dose rate as required.

The Primary operating location needs to be designed for the expected Thermal and Radiological challenges posed by loss of ventilation (possible for the entire “Sustained” Operating period of 7 days), any Thermal challenge posed by operating the HCVS equipment (including any power supply heating, electrical components in the panel, or proximity of the panel to the HCVS piping), and any Radiological challenge posed by the HCVS system on the equipment located in the control panel. If the Primary operating location is the Control Room, then the dose allowable should comply with General Design Criteria 19 (5 Rem/person for the duration of the event).

Part 2: Boundary Conditions for Wet Well Vent

The Valve Position Indications will be designed for the expected Thermal and Radiological challenges posed by loss of ventilation (possible for the entire “Sustained” Operating period of 7 days), any Thermal challenge posed by operating the HCVS equipment (including any power supply heating, electrical components in the panel, or proximity of the panel to the HCVS piping), and any Radiological challenge posed by the HCVS system on the Valve Position Indication.

Power that is available following an ELAP to power the required Containment Indications (See JLD-ISG-2012-01 for Order EA-12-049) is acceptable. Indications required for Containment Pressure and Wetwell level are used to operate the HCVS system (determine when to close to prevent negative pressure or air intrusion) and thus have to be indicated at the HCVS control location. These indications are not specified in EA-13-109 as Order Elements and thus do not require HCVS dedicated power. Environmental conditions specified per JLD-ISG-2012-01 for Order EA-12-049 are acceptable for these instruments provided they are not routed such that the Thermal/Radiological impacts from HCVS operation would impede their function.

The justification for using alternative approaches shall be determined during the design phase of the HCVS and documented in procedures.

The HCVS Vent Monitoring Indications will be designed for the expected Thermal and Radiological challenges posed by loss of ventilation (possible for the entire “Sustained” Operating period of 7 days), any Thermal challenge posed by operating the HCVS equipment (including any power supply heating, electrical components in the panel, or proximity of the panel to the HCVS piping), and any Radiological challenge posed by the HCVS system on the HCVS Vent Monitoring Indication.

<u>Component reliable and rugged performance</u>

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.

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 severe accident 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

Part 2: Boundary Conditions for Wet Well Vent

(per RG 1.180). These qualifications will be bounding conditions for BFNP.

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

1. demonstration of seismic motion will be consistent with that of existing design basis loads at the installed location;
2. 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;
3. 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;
4. 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
5. seismic qualification using seismic motion consistent with that of existing design basis loading at the installation location.

HCVS components including instrumentation should be designed, as a minimum, to meet the seismic design requirements of the BFNP. Components including instrumentation that are not required to be seismically designed by the design basis of the plant should be designed for reliable and rugged performance that is capable of ensuring HCVS functionality following a seismic event. (reference ISG-JLD-2012-01 and ISG-JLD-2012-03 [References 6 & 8] for seismic details.)

The components including instrumentation external to a seismic category 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.

The BFNP HCVS and its associated components will comply with the structural requirements as defined in the BFN design criteria for FLEX mitigation systems. (Reference 35).

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 a ELAP and BDBEE hazards identified in part 1 of this OIP. Immediate operator actions can be completed by Operators from the HCVS control station(s) and include remote-manual initiation. The operator actions required to open a vent path are as described in table 2-1.

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

The HCVS will be designed to allow initiation, control, and monitoring of venting from the Main Control Room and will be able to be operated from an installed Remote Operating Station. This location minimizes plant operators' exposure to adverse temperature and radiological conditions and is protected from hazards assumed in Part 1 of this report.

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

System control:

i. Active: PCIVs are operated in accordance with EOPs/SOPs to control containment pressure. The HCVS will be designed for approximately 200 open/close cycles under ELAP conditions over the first 24 hours following an ELAP. Controlled venting will be permitted in the revised EPGs and associated implementing EOPs. Controlled venting will be permitted in the revised EPG's to open, close or throttle vent flow. The strategy is to allow venting of the wetwell and control the flow to maintain sufficient NPSH for the RCIC pump. Jumpers will be used to override the containment isolation circuit on the PCIVs needed to vent containment.

[OPEN ITEM 2] Perform an evaluation for HCVS ability to operate from the MCR and has the ability to be supplied adequate amounts of pneumatic pressure for 24 hour actions.

ii. Passive: Inadvertent actuation protection is provided by the current containment isolation circuitry associated with the PCIVs used to operate the HCVS. In addition, the HCVS isolation valve is normally key-locked closed.

Part 2 Boundary Conditions for WW Vent**: BDBEE Venting**
Greater Than 24 Hour Coping Detail *Provide a general description of the venting actions for greater than 24 hours using portable and installed equipment including station modifications that are proposed.* **Ref: EA-13-109 Section 1.2.4, 1.2.8 / NEI 13-02 Section 4.2.2**
After approximately 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. Sufficient nitrogen bottles will be staged to support operations for up to 24 hours following the ELAP event. BFNP will credit FLEX to sustain power for a BDBEE ELAP. [OPEN ITEM 3] Perform an evaluation for FLEX portable generator and nitrogen cylinders use past 24 hour actions. These actions provide long term support for HCVS operation for the period beyond 24 hrs. to 7 days (sustained operation time period) because on-site and off-site personnel and resources will have access to the unit(s) to provide needed action and supplies.
Details:
Provide a brief description of Procedures / Guidelines: *Confirm that procedure/guidance exists or will be developed to support implementation.*
Primary Containment Control Flowchart exists to direct operations in protection and control of containment integrity, including use of the Hardened Containment Vent System. Other site procedures for venting containment using the HCVS include: Technical Support Guidelines; Emergency Containment Venting; Primary Containment Venting for Hydrogen and Oxygen Control. These guidelines will be revised to support the operation of the HCVS. [OPEN ITEM 4] Revise 1/2/3-EOI Appendix 13 to include venting for loss of DC power
Identify modifications*:* *List modifications and describe how they support the HCVS Actions.*
<u>EA-12-049 Modifications</u> 1. DCN 70745: Install a Flexible Equipment Storage Building (FESB). This structure will be a permanent building to house all of the equipment to respond to a BDBEE. Some of the major components housed in this building are the portable generators, Tow vehicles, FLEX pumps, FLEX Portable Generators and debris removing equipment 2. DCN 71329: This change package will provide connections for the FLEX pumps to align water to various systems that support the HCVS. These Mechanical connections will be on safety related sections of the RHRSW and EECW system. The RCIC system will be provided cooling water to the lube oil cooler to extend running time. RHRSW will provide water to the RPV,

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

wetwell and the drywell sprays as required for cooling.

3. DCN 70810 FLEX Nitrogen supply will provide a pneumatic supply to the Main Steam Relief Valves to allow depressurization of the RPV.

4. DCN 71162 (Unit 1), DCN 71335 (Unit 2) & DCN 71336 (Unit 3) FLEX Battery backed instrumentation will provide containment monitoring capability in the Main Control Room.

5. DCN XXX (Number to be assigned) FLEX 480V portable generators will be deployed to provide backup power to the 480V power system via the main unit battery chargers 1A, 2A, 3A and 2B.

6. DCN XXX (Number to be assigned) FLEX Deployment road and pump landing will be used to place equipment into operation that has been stored in the FESB

7. DCN 71741 FLEX 4kv spare portable generators will be stored in the FESB and be placed into service to power equipment as required during phase 2 and 3 of the BDBEE. This power supply will be connected to the Shutdown boards or directly to the emergency diesel generator output.

EA-13-109 Modifications

DCN 71389 (Unit 1), 71390 (Unit 2), 71391 (Unit 3) are design changes that will be used to implement the HCVS for BFN. Each design change will be staged to allow pre-outage implementation

A power supply will be installed to allow the required HCVS components to operate for a period of 24 hours. This power supply will have the capability to use a transfer switch to swap the power supply to the portable generators after 24 hours.

Each HCVS system will have a corresponding Remote Operation Station (ROS) for all three units. This ROS will allow operations personnel to operate the Containment Isolation valves for a sustained period of time.

Each HCVS system will have instrumentation and controls to allow operations to monitor and control the HCVS wetwell effluent. The effluent process pressure, temperature and gross radiation levels will be displayed in the Main Control Room of each operating unit. This instrumentation will be designed for expected process conditions for a severe accident event.

Each HCVS discharge pipe will be routed to the Reactor Building roof. As the HCVS piping passes thru the refuel floor, a check valve will be designed to prevent the introduction of air to the HCVS piping to mitigate the possible detonation or deflagration of the HCVS piping downstream of the CIV’s.

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

Key Venting Parameters:

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

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

Key Parameter	Component Identifier	Indication Location
HCVS Effluent temperature	TBD	MCR
HCVS Pneumatic supply pressure	TBD	MCR/ROS
HCVS valve position indication	TBD	MCR
HCVS system pressure indication	TBD	MCR

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

Key Parameter	Component Identifier	Indication Location
Drywell pressure	TBD	MCR
Torus pressure	TBD	MCR
Torus water temperature	TBD	MCR
Torus level	TBD	MCR
Reactor pressure	TBD	MCR
Drywell radiation	TBD	MCR

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 Main Control Room (MCR) or at the HCVS Remote Operating Station (ROS) and will include remote-manual actions from a local gas cylinder station. The operator actions required to open a vent path were previously listed in the BDBEE Venting Part 2 section of this report (Table 2-1).

Permanently installed 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, with no exceptions.

Greater Than 24 Hour Coping Detail

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

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

Specifics are the same as for BDBEE Venting Part 2 except the location and refueling actions for the FLEX PG and replacement Nitrogen Bottles will be evaluated for SA environmental conditions resulting from the proposed damaged Reactor Core and resultant HCVS vent pathway.

[OPEN ITEM 5]: Perform an Evaluation for FLEX PG use for post 24 hour actions

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

Part 2 Boundary Conditions for WW Vent**: Severe Accident Venting**
Details:
Provide a brief description of Procedures / Guidelines: *Confirm that procedure/guidance exists or will be developed to support implementation.*
The operation of the HCVS will be governed by the same for SA conditions as for BDBEE conditions. Existing guidance in the SAMGs directs the plant staff to consider changing radiological conditions in a severe accident.
Identify modifications*:* *List modifications and describe how they support the HCVS Actions.*
The same as for BDBEE Venting Part 2, Greater than 24 Hour Coping Details
Key Venting Parameters: *List instrumentation credited for the HCVS Actions. Clearly indicate which of those already exist in the plant and what others will be newly installed (to comply with the vent order)*
The same as for BDBEE Venting Part 2, Greater than 24 Hour Coping Details
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. Venting will require support from DC power as well as instrument air systems as detailed in the response to Order EA-12-049. Existing safety related Unit batteries will provide sufficient electrical power for HCVS operation for greater than 8 hours. Before Unit batteries are depleted, FLEX portable generators, as detailed in the response to Order EA-12-049, will be credited to charge the station batteries and maintain DC bus voltage after 8 hours. 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 HCVS CIV's vent valve.
Severe Accident Venting *Provide a general description of the Severe Accident Venting actions support functions. Identify methods and strategy(ies) utilized to achieve venting results.* **Ref: EA-13-109 Section 1.2.8, 1.2.9 / NEI 13-02 Section 2.5, 4.2.2, 4.2.4, 6.1.2**
The same support functions that are used in the BDBEE scenario would be used for severe accident venting. To ensure power for 24 hours, a set of dedicated HCVS batteries will be available to feed HCVS loads via a manual transfer switch. At 24 hours, power will be will be backed up by FLEX generators supplying power to the Unit Battery chargers for a severe accident HCVS capability. Nitrogen bottles that will be located in the Diesel Generator building(s) in the immediate area of the ROS will be available to tie-in supplemental pneumatic sources.
Details:
Provide a brief description of Procedures / Guidelines: *Confirm that procedure/guidance exists or will be developed to support implementation.*
Most of the equipment used in the HCVS is permanently installed. The key portable items are the severe accident capable portable generators and the nitrogen bottles needed to supplement the air supply to the AOVs after 24 hours. These will be staged in position for the duration of the event.
Identify modifications*:* *List modifications and describe how they support the HCVS Actions.*
Flex modifications applicable to HCVS operation: The same for BDBEE venting, Part 2. HCVS modification: add piping and connection points at a suitable location in the control building or outside to connect portable N2 bottles for motive force to HCVS components after 24 hours. HCVS connections required for portable equipment will be protected from all applicable screened-in hazards and located such that operator exposure to radiation and occupational hazards will be minimized.

Part 2 Boundary Conditions for WW Vent**: HCVS Support Equipment Functions**
Structures to provide protection of the HCVS connections will be constructed to meet the requirements identified in NEI-12-06 section 11 for screened in hazards.
Key Support Equipment Parameters: *List instrumentation credited for the support equipment utilized in the venting operation. Clearly indicate which of those already exist in the plant and what others will be newly installed (to comply with the vent order)*
Local control features of the FLEX portable generator electrical load and fuel supply. Pressure gauge on supplemental Nitrogen bottles.
Notes:

Part 2 Boundary Conditions for WW Vent: **HCVS Venting Portable Equipment Deployment**		
Provide a general description of the venting actions using portable equipment including modifications that are proposed to maintain and/or support safety functions. **Ref: EA-13-109 Section 3.1 / NEI 13-02 Section 6.1.2, D.1.3.1**		
Deployment pathways for compliance with Order EA-12-049 are acceptable without further evaluation needed except in areas around the Reactor Building or in the vicinity of the HCVS piping. Deployment in the areas around the Reactor Building or in the vicinity of the HCVS piping will allow access, operation and replenishment of consumables with the consideration that there is potential Reactor Core Damage and HCVS operation.		
Details:		
Provide a brief description of Procedures / Guidelines: *Confirm that procedure/guidance exists or will be developed to support implementation.*		
Operation of the portable equipment is the same as for compliance with Order EA-12-049 thus they are acceptable without further evaluation		
HCVS Actions	**Modifications**	**Protection of connections**
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:		

Part 3: <u>Boundary Conditions for Dry Well Vent</u>

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

The normal response for a BDBEE/Severe Accident is to vent via the wetwell. The duration and severity of the event may render the wetwell inoperable. This would then require primary containment venting via the drywell based on the existing design, licensing basis and procedural compliance for BFNP.

The rest of Part 3 will be completed with the EA Order EA-13-109, 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.

Part 3: Boundary Conditions for Dry Well Vent

Identify modifications:
List modifications and describe how they support the HCVS Actions.

Key Venting Parameters:
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 Severe Accidents.

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 the plants process for initiating or revising procedures and contain the following details:

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

BFNP utilizes CAP for ECCS pump NPSH. The BFNP procedures already provide guidance to state that “Reducing Primary Containment pressure will reduce the available NPSH for pumps taking suction from the suppression pool.”

Licensees will establish provisions for out-of-service requirements of the HCVS and compensatory measures. The following provisions will be documented in the 1/2/3-EOI-2 (Reference 34):

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.
- 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

Part 4: Programmatic Controls, Training, Drills and Maintenance

be performed:

- The condition will 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

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 HVCS 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 (SAT) process.

In addition, (reference 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

The site will utilize the guidance provided in NEI 13-06 and 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.

Part 4: Programmatic Controls, Training, Drills and Maintenance

  - 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.

BFNP 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 containment integrity during operations.	Once per operating cycle
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; (2) Once every three operating cycles thereafter; and (3) After restoration of any breach of system boundary within the buildings
Validate the HCVS operating procedures by conducting an open/close test of the HCVS control logic from its control panel and ensuring that all interfacing system valves move to their proper (intended) positions.	Once per every other operating cycle

Part 4: Programmatic Controls, Training, Drills and Maintenance

Notes:

None

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	Jun 2014	Complete	
Submit Overall Integrated Implementation Plan	Jun 2014	Complete	
Submit 6 Month Status Report	Dec 2014		
Submit 6 Month Status Report	Jun. 2015		
Submit 6 Month Status Report	Dec 2015		Simultaneous with Phase 2 OIP
U1 Design Engineering On-site/Complete	Jan 2016		
Submit 6 Month Status Report	Jun 2016		
Operations Procedure Changes Developed	Jul 2016		
Site Specific Maintenance Procedure Developed	Jul 2016		
Submit 6 Month Status Report	Dec 2016		
Training Complete	Sep 2016		
U1 Implementation Outage	Nov 2016		
Procedure Changes Active	Nov 2016		
U1 Walk Through Demonstration/Functional Test	Nov 2016		
U2 Design Engineering On-site/Complete	Jun 2016		
U2 Implementation Outage	Mar 2017		
U2 Walk Through Demonstration/Functional Test	Apr 2017		
Submit 6 Month Status Report	Jun 2017		
Submit 6 Month Status Report	Dec 2017		
Submit 6 Month Status Report	Jun 2017		

Part 5: Milestone Schedule

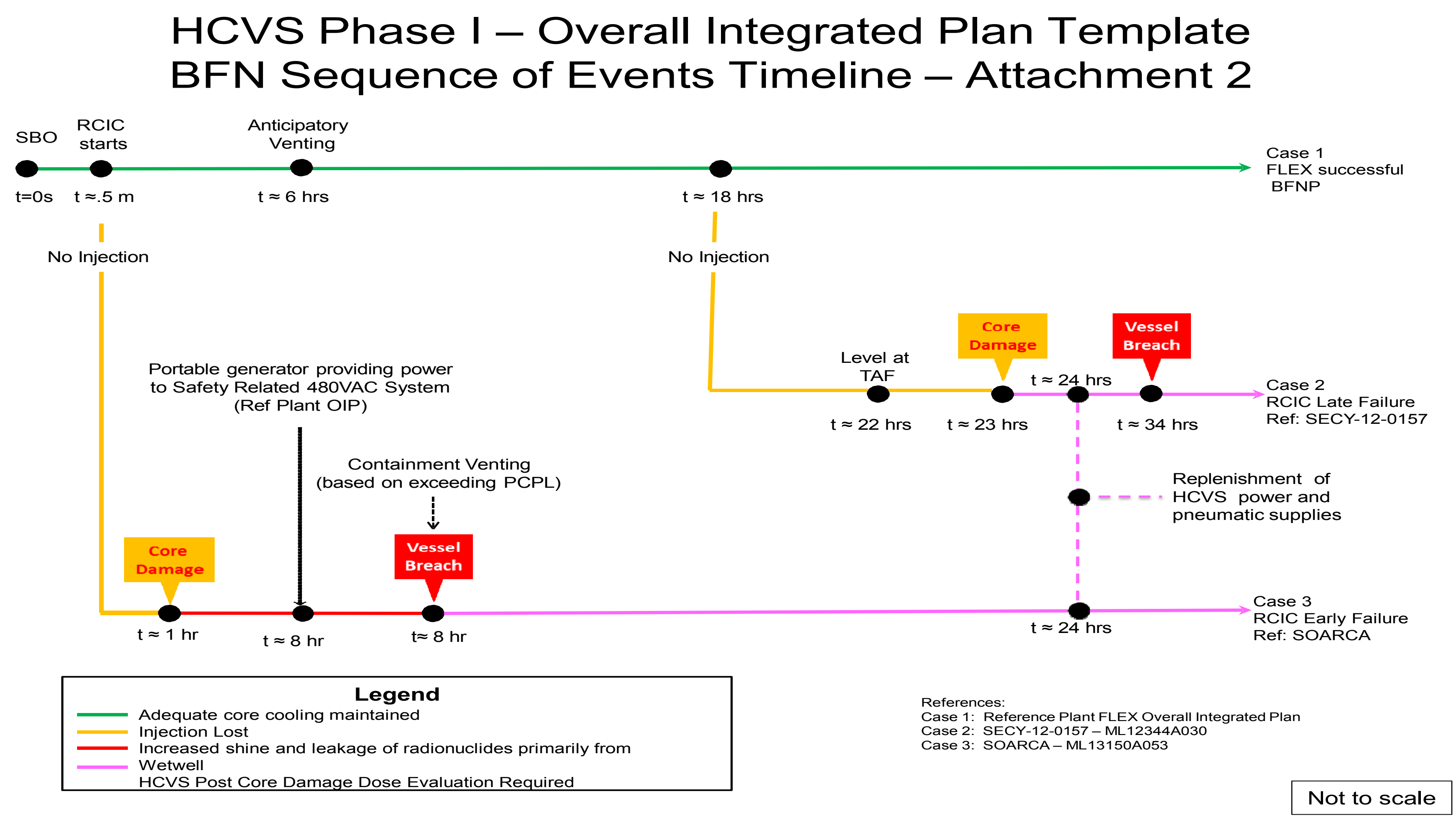
U3 Design Engineering On-site/Complete	Jul 2017		
U3 Implementation Outage	Mar 2018		
U3 Walk Through Demonstration/Functional Test	Apr 2018		
Submit Completion Report	Jun 2018		

Attachment 1: <u>HCVS Portable Equipment</u>

List portable equipment	*BDBEE Venting*	*Severe Accident Venting*	*Performance Criteria*	*Maintenance / PM requirements*
FLEX Portable Generators	X	X	TBD	Per Response to EA-12-049
FLEX Portable Pumps	X	X	TBD	Per Response to EA-12-049
Nitrogen Cylinders	X	X	TBD	Check periodically for pressure, replace or replenish as needed

Attachment 2: Sequence of Events Timeline

Table 2A: Wet Well HCVS Timeline



Attachment 3: Conceptual Sketches

Figure 1 – Flow Diagram

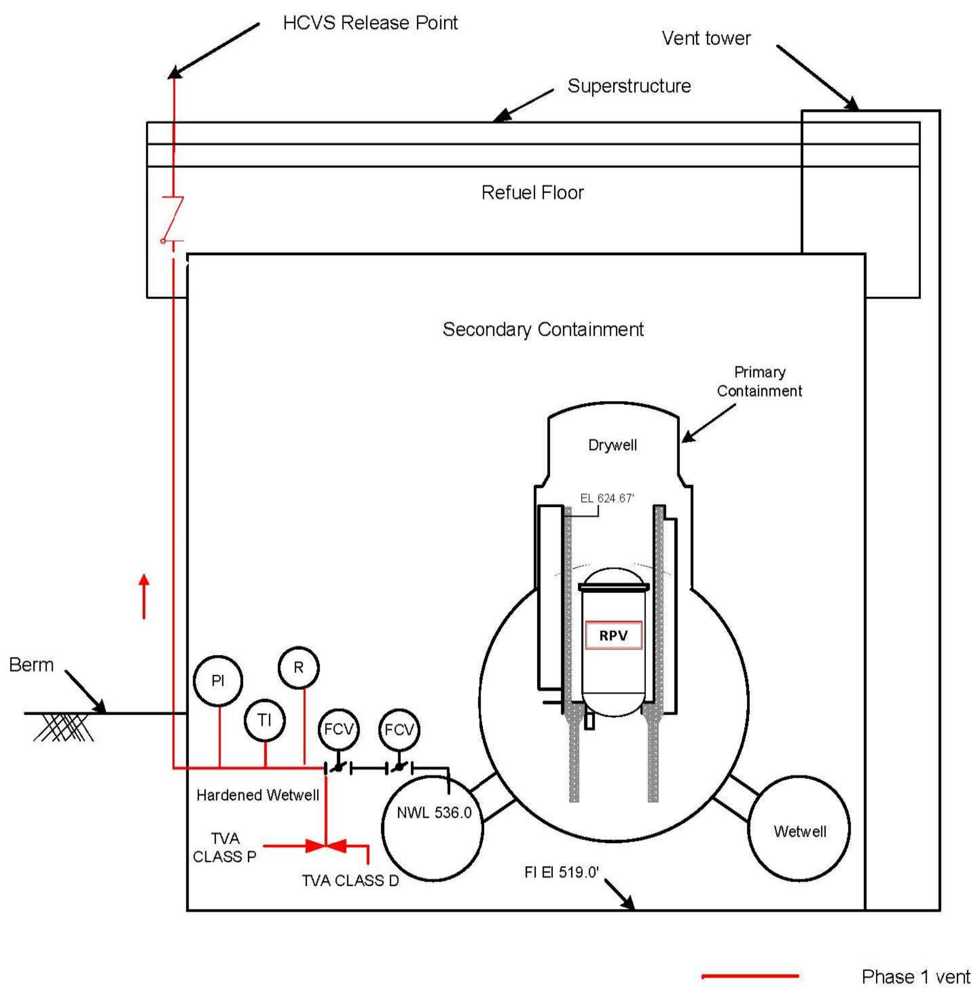


Figure 1

Figure 2 - Typical CIV Actuator Supply

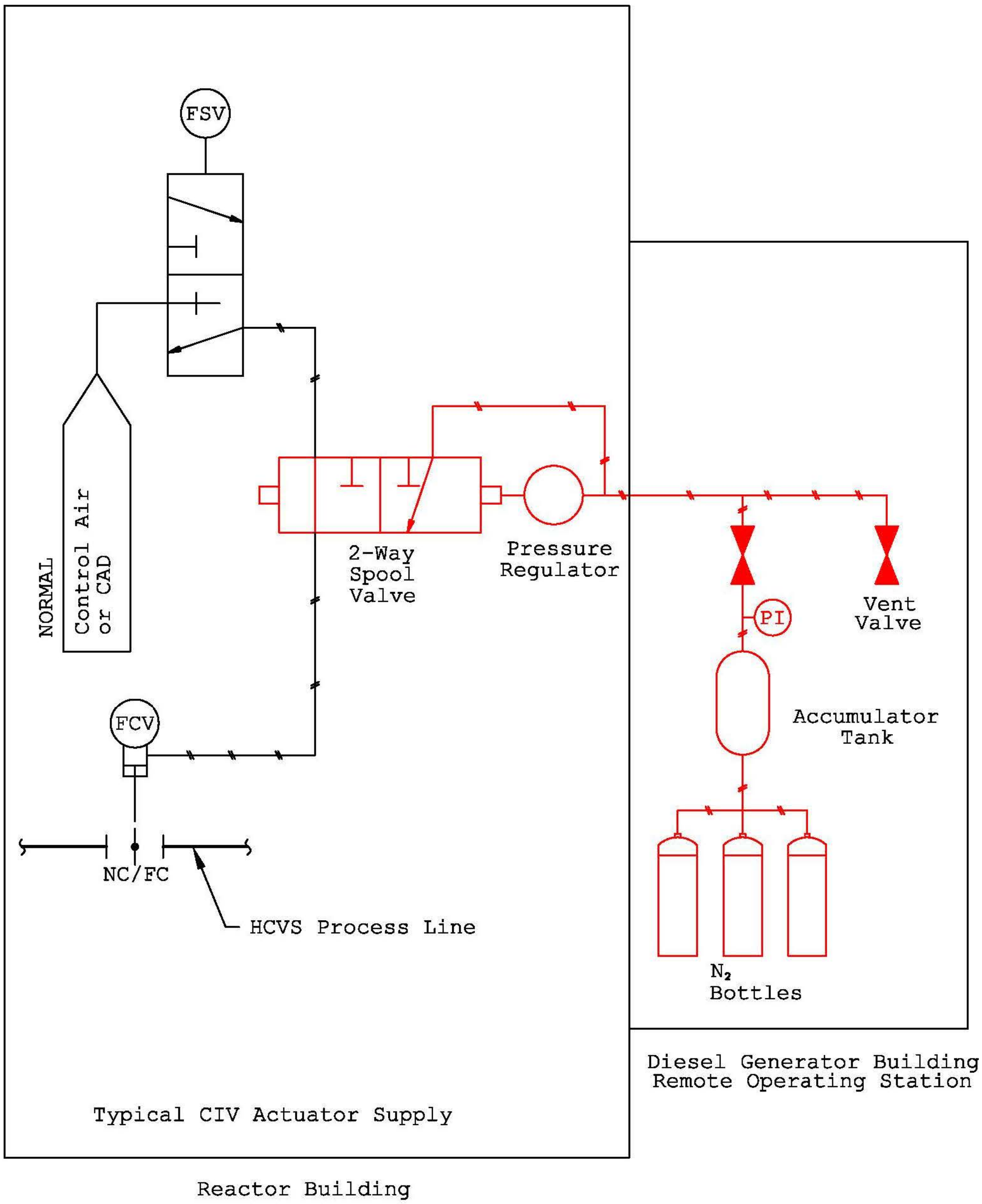


Figure 3 - BFN HCVS Battery Backed Electrical Power Supply (Unit 1 shown – t y p i c a l for Units 2 and 3)

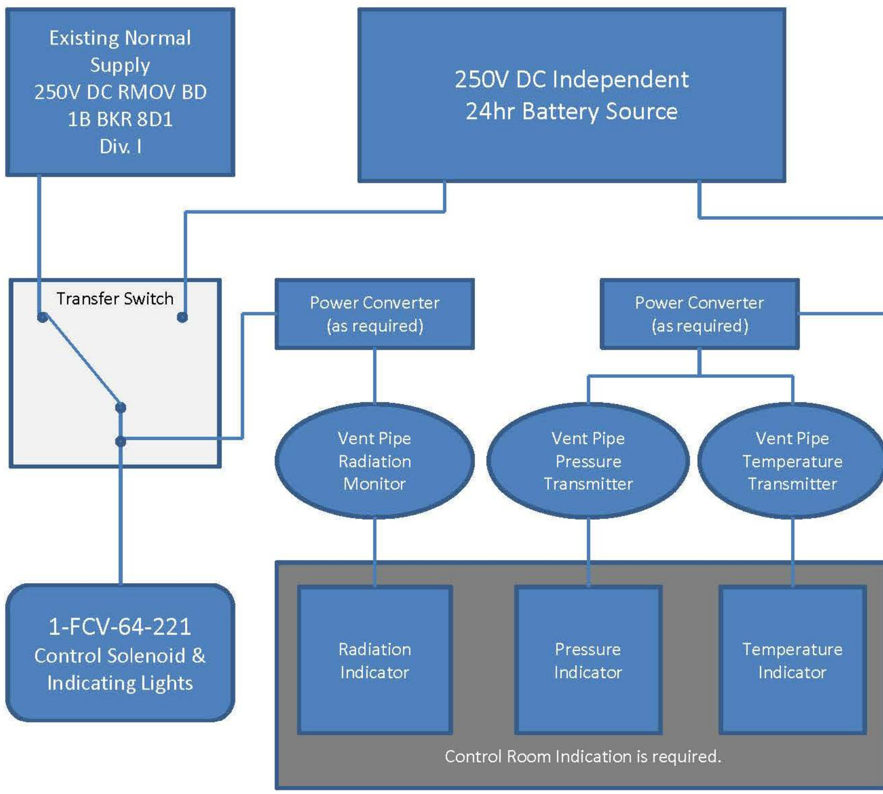


Figure 3

Figure 4 BFNP Roof Plan View

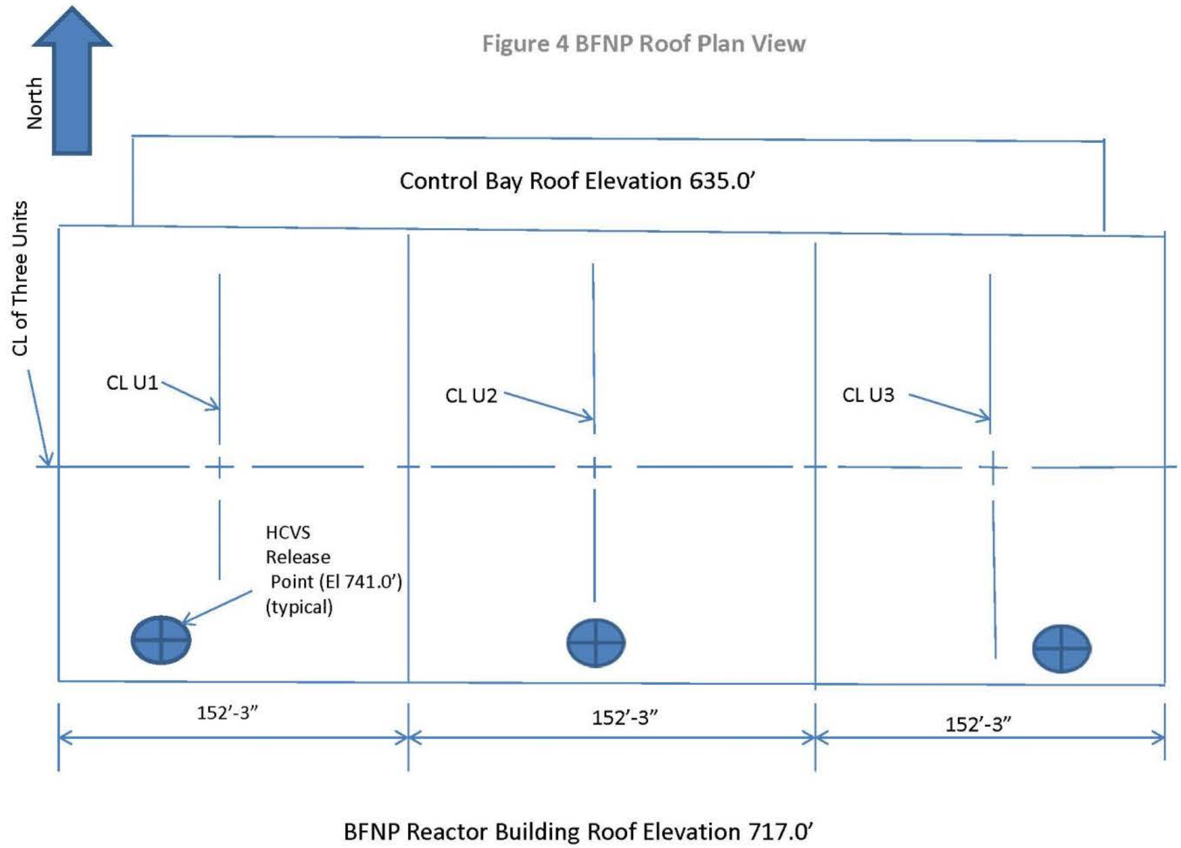


Figure 5 HCVS RELEASE POINT

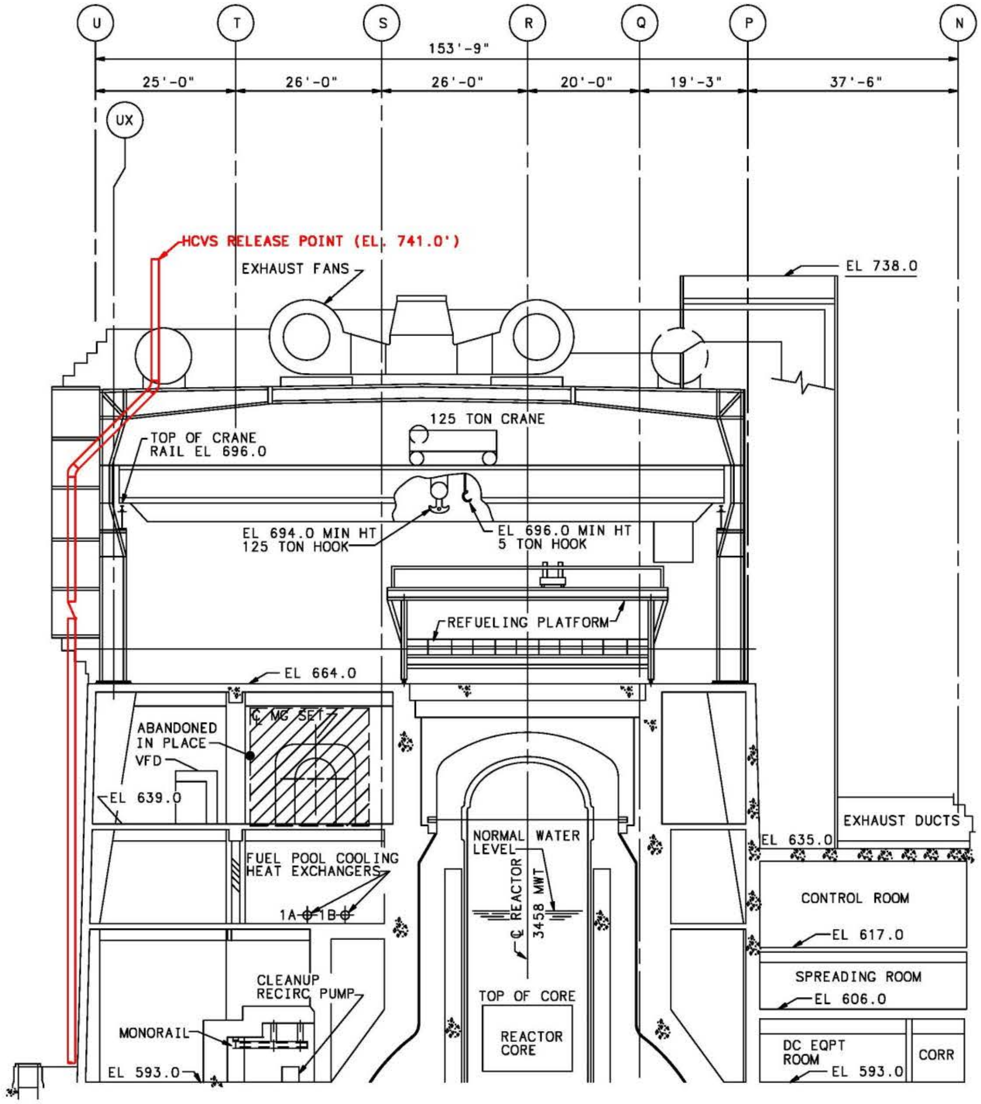


FIGURE 6 HCVS BOUNDARY

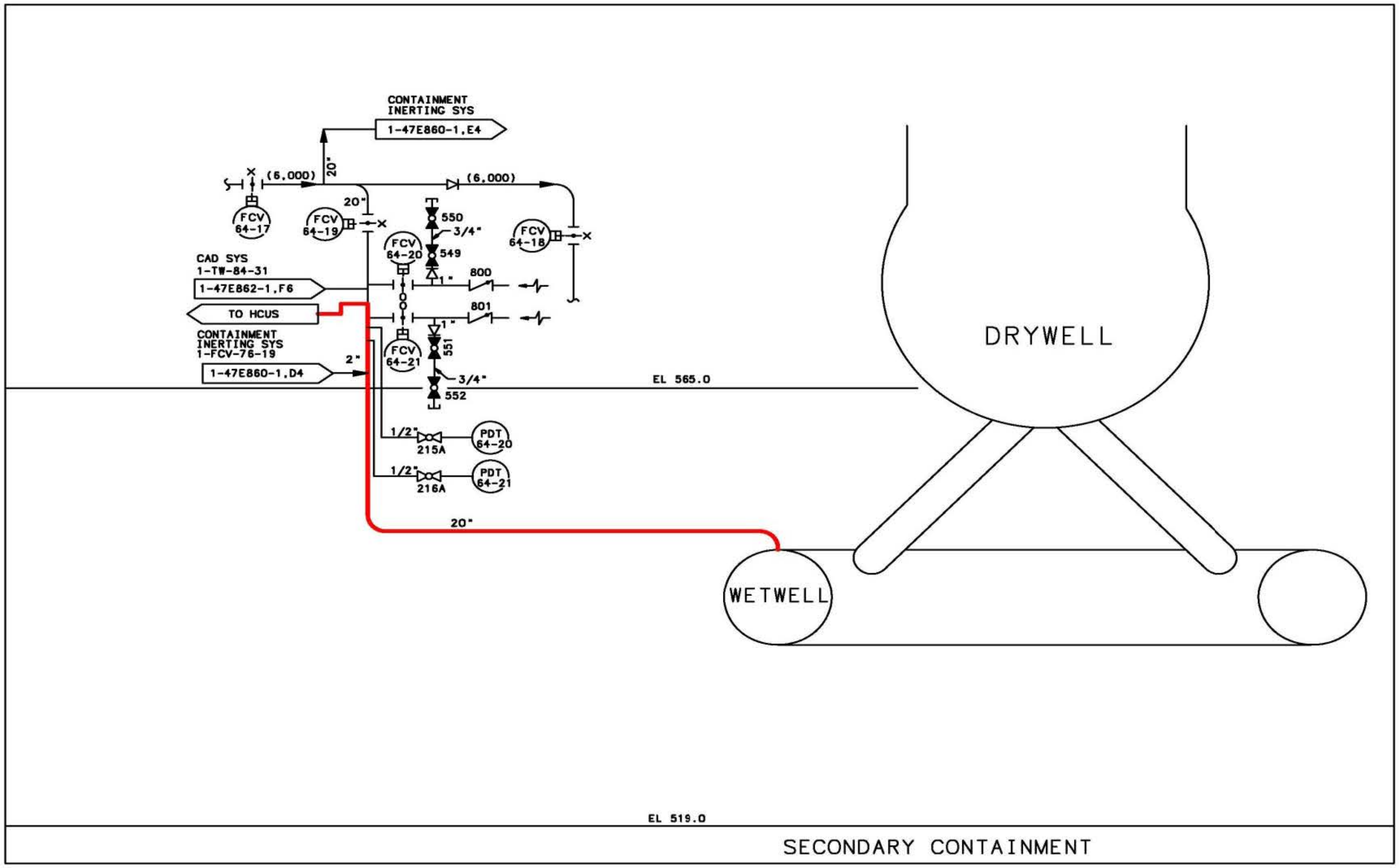
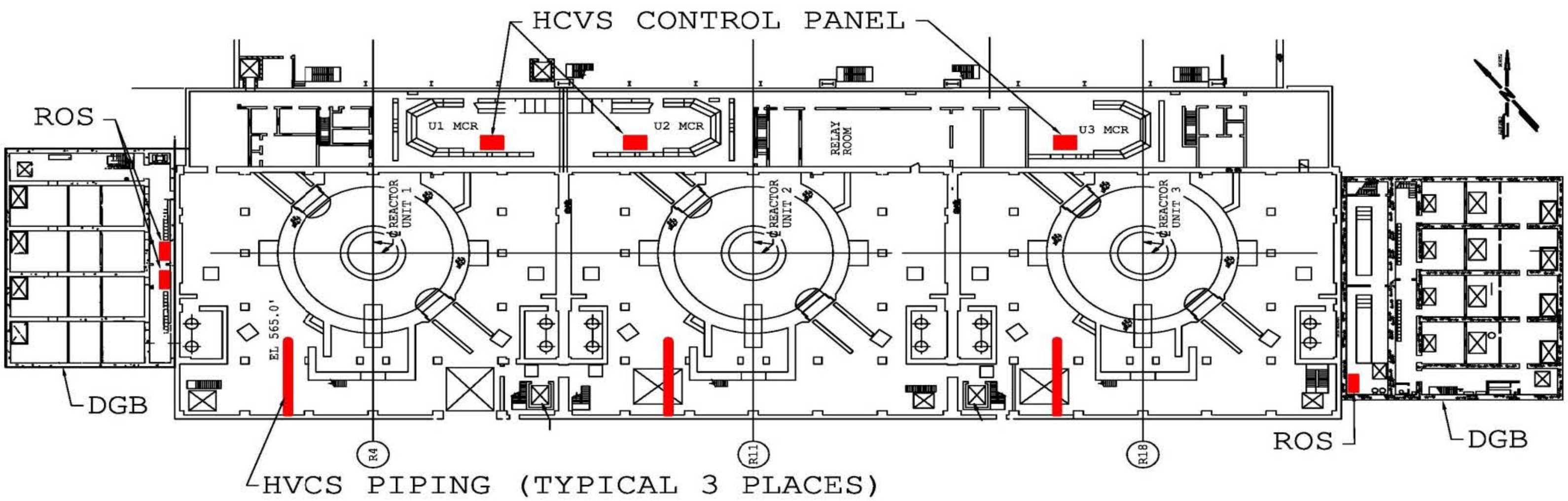


Figure 7 - Monitoring Locations



HCVS PIPING REACTOR BUILDING EL. 565.0'
ROS PANEL DIESEL GENERATOR BUILDING EL. 583.5'
HCUS PANEL CONTROL BAY BUILDING EL. 617.0'

NOTE: LOCATIONS IN BUILDING ARE PRELIMINARY

Attachment 4: Failure Evaluation Table

Table 4A: Wet Well 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, power is already tied into Unit battery for 8 hours maximum	No
Failure of Vent to Open on Demand	Valves fail to open/close due to loss of normal DC power (long term)	Connect dedicated batteries via transfer switch for minimum 24 hours	No
Failure of Vent to Open on Demand	Valves fail to open/close due to complete loss of batteries (long term)	Recharge Unit batteries with FLEX provided generators, considering severe accident conditions	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 12 cycles of F082 valve over first 24 hours.	No
Failure of Vent to Open on Demand	Valves fail to open/close due to loss of alternate pneumatic air supply (long term)	Tie-in nitrogen cylinders to air system supporting HCVS valves, replace bottles as needed.	No
Failure of Vent to Open on Demand	Valves fail to open/close due to SOV failure	Use nitrogen supply from the ROS that is located in the Diesel Generator Building.	No

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. NEI FAQ HCVS-04, HCVS Release Point
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. BFNP EA-12-049 (FLEX) Overall Integrated Implementation Plan, Rev 0, February 2013
29. BFNP EA-12-050 (HCVS) Overall Integrated Implementation Plan, Rev 0, February 2013
30. BFNP EA-12-051 (SFP LI) Overall Integrated Implementation Plan, Rev 0, February 2013
31. BFNP Calculation MDN0999980114 Rev 3 “Station Blackout Evaluation”
32. BFNP Calculation EDQ0009992013000202 Rev 0 “250V DC UNIT BATTERIES 1,2 & 3 EVALUATION”
33. BFNP Design Criteria BFN-50-C-7101 Rev 03 "Protection from wind, tornado wind, tornado depressurization, tornado generated missiles, and external flooding”
34. BFNP Procedure 1/2/3-EOI-2, Primary Containment Control
35. BFNP Design Criteria: BFN-50-7360 “FLEX MITIGATION SYSTEM”
36. TVA Calculation MDQ0003602014000222 “BFN ELAP Transient Temperature Analysis”

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 6 Month Status Reports

None.

Attachment 7: List of Overall Integrated Plan Open Items

Open Item	Action	Comment
1	Perform an assessment of temperature and radiological conditions to ensure that operating personnel can safely access and operate controls at the Remote Operating Station based on time constraints listed in Attachment 2.	
2	Perform an evaluation for HCVS ability to operate from the MCR and has the ability to be supplied adequate amounts pneumatic pressure for 24 hour actions	
3	Perform an evaluation for FLEX portable generators and nitrogen cylinders use past 24 hour actions	
4	Revise 1/2/3-EOI Appendix 13 to include venting for loss of DC power	
5	Perform an Evaluation for FLEX portable generators use for post 24 hour actions	
6	Electrical load shedding will be performed in 1 hour of the event.	
7	The implementation of the HCVS DCN's will be staged so that there is no effect on the operating units	
8	The wetwell vent will be designed to remove 1% of rated thermal power at EPU conditions.	
9	Implement the harris radio system for communication between the MCR and the ROS.	