Tennessee Valley Authority, 1101 Market Street, Chattanooga, Tennessee 37402

CNL-15-254

December 29, 2015

10 CFR 50.4

Attn: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D.C. 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 Browns Ferry Nuclear Plant Third Six-Month Status Report and Phase 1 and Phase 2 Overall Integrated Plan in Response to the June 6, 2013 Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109)**

References:

1. NRC Order Number EA-13-109, "Issuance of Order to Modify Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions," dated June 6, 2013 (ML13143A321)
2. NRC Interim Staff Guidance JLD-ISG-2013-02, "Compliance with Order EA-13-109, Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions," Revision 0, dated November 14, 2013 (ML13304B836)
3. NEI 13-02, "Industry Guidance for Compliance with Order EA-13-109, BWR Mark I & II Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions," Revision 1, dated April 23, 2015 (ML15113B318)
4. Letter from TVA to NRC, "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)," dated June 30, 2014 (ML14181B169)
5. Letter from TVA to NRC, "Tennessee Valley Authority's Browns Ferry Nuclear Plant First Six-Month Status Report in Response to the June 6, 2013 Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109)," dated December 19, 2014 (ML14353A428)

6. Letter from NRC to TVA, "Browns Ferry Nuclear Plant, Units 1, 2, and 3 - Interim Staff Evaluation Relating to Overall Integrated Plan in Response to Phase 1 of Order EA-13-109 (Severe Accident Capable Hardened Vents) (TAC Nos. MF4540, MF4541 and MF4542)," dated February 11, 2015 (ML14356A362)
7. NRC Interim Staff Guidance JLD-ISG-2015-01, "Compliance with Phase 2 of Order EA-13-109, Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation under Severe Accident Conditions," Revision 0, dated April 29, 2015 (ML15104A118)
8. Letter from TVA to NRC, "Tennessee Valley Authority's Browns Ferry Nuclear Plant Second Six-Month Status Report in Response to the June 6, 2013 Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109)" dated June 29, 2015 (ML15181A338)

On June 6, 2013, the Nuclear Regulatory Commission (NRC) issued an Order (Reference 1) to Tennessee Valley Authority (TVA). Reference 1 was immediately effective and directed TVA to install a reliable hardened venting capability for pre-core damage and under severe accident conditions, including those involving a breach of the reactor vessel by molten core debris. Specific requirements are outlined in Attachment 2 of Reference 1.

Reference 1 required submission of a Phase 1 and Phase 2 Overall Integrated Plan (OIP) pursuant to Section IV, Condition D for Browns Ferry Nuclear Plant (BFN), Units 1, 2, and 3. References 2 and 7 endorse industry guidance document Nuclear Energy Institute (NEI) 13-02, Revision 1 (Reference 3) with clarifications and exceptions identified in References 2 and 7. Reference 3 provides direction regarding the content of the Phase 1 and Phase 2 OIPs and includes guidance for combining the OIPs.

Reference 4 provided TVA's Phase 1 OIP. The NRC issued its Interim Staff Evaluation relating to the BFN Phase 1 OIP on February 11, 2015 (Reference 6).

Reference 1 also requires submission of status reports at six-month intervals following submittal of the OIP. Reference 3 provides direction regarding the content of the status reports. TVA submitted the first six-month status report on December 19, 2014 (Reference 5) and the second six-month status report on June 29, 2015 (Reference 8).

The purpose of this letter is to provide the combined Phase 1 and Phase 2 OIP pursuant to Section IV, Condition D and to provide the third six-month status report pursuant to Section IV, Condition D of Reference 1 that delineates progress made in implementing the requirements of Reference 1. Enclosure 1 provides an update of milestone accomplishments since submittal of the Phase 1 OIP (Reference 4) and previous updates (References 5 and 8), including any changes to the compliance method, schedule, or need for relief and the basis, if any. Enclosure 2 provides Revision 2 of the OIP, which is the combined Phase 1 and Phase 2 OIP.

There are no new regulatory commitments resulting from this submittal. If you have any question regarding this submittal, please contact Mike Oliver at (256) 729-7874.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 29th day of December 2015.

Respectfully,

J. W. Shea
Vice President, Nuclear Licensing

Enclosures:

1. Tennessee Valley Authority Browns Ferry Nuclear Plant's Third Six-Month Status Report for the Implementation of Order EA-13-109, "Issuance Of Order to Modify Licenses With Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions"
2. Tennessee Valley Authority Browns Ferry Nuclear Plant's Phase 1 and Phase 2 Overall Integrated Plan for the Implementation of Order EA-13-109, "Issuance Of Order to Modify Licenses With Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions," Revision 2

cc (w/Enclosure):

NRR Director - NRC Headquarters
NRO Director - NRC Headquarters
NRR JLD Director - NRC Headquarters
NRC Regional Administrator - Region II
NRR Project Manager - Browns Ferry Nuclear Plant
NRR JLD Project Manager - Browns Ferry Nuclear Plant
NRC Senior Resident Inspector - Browns Ferry Nuclear Plant

ENCLOSURE 1

Tennessee Valley Authority Browns Ferry Nuclear Plant's Third Six-Month Status Report for the Implementation of Order EA-13-109, "Issuance Of Order to Modify Licenses With Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions"

1 Introduction

Browns Ferry Nuclear Plant (BFN) developed an Overall Integrated Plan (OIP) (Reference 5), documenting the planned installation of a Hardened Containment Vent System (HCVS) that provides a reliable hardened venting capability for pre-core damage and under severe accident conditions, including those involving a breach of the reactor vessel by molten core debris, in response to Reference 1. This enclosure provides an update of milestone accomplishments since submittal of the Phase 1 OIP (Reference 5) and previous six month updates (References 6 and 9), including any changes to the compliance method, schedule, or need for relief/relaxation and the basis, if any. As this is the first submittal of the Phase 2 OIP, details related to Phase 2 compliance are not included.

2 Milestone Accomplishments

No milestone has been completed since submittal of the second six month update (Reference 9) and to December 1, 2015.

3 Milestone Schedule Status

The following provides an update to the Milestone Schedule of the OIP. This section provides the activity status of each item and the expected completion date, noting any change. The dates are planning dates subject to change as design and implementation details are developed.

The milestone target completion dates do not impact the Order implementation date.

Activity Status updates are shown in bold type.

Milestone	Target Completion Date	Activity Status	Revised Target Completion Date
Phase 1 HCVS Milestone Table			
Submit Overall Integrated Plan	Jun 2014	Complete	
Submit 6 Month Updates:			
Update 1	Dec 2014	Complete	
Update 2	Jun 2015	Complete	
Update 3 [Simultaneous with Phase 2 OIP]	Dec 2015	**Complete with this submittal**	
Update 4	Jun 2016	Not Started	
Update 5	Dec 2016	Not Started	
Update 6	Jun 2017	Not Started	
Update 7	Dec 2017	Not Started	
Modifications:			
Hold preliminary/conceptual design meeting	Nov 2014	Complete	
Unit 1 Design Engineering On-site /Complete	~~Jan 2016~~	In Progress	Apr 2016
Unit 1 Implementation Outage	Nov 2016	Not Started	
Unit 1 Walk Through Demonstration /Functional Test	Nov 2016	Not Started	
Unit 2 Design Engineering On-site /Complete	Jun 2016	Not Started	
Unit 2 Walk Through Demonstration /Functional Test	Apr 2017	Not Started	
Unit 2 Implementation Outage	Mar 2017	Not Started	
Unit 3 Design Engineering On-site /Complete	Jul 2017	Not Started	
Unit 3 Walk Through Demonstration /Functional Test	Apr 2018	Not Started	
Unit 3 Implementation Outage	Mar 2018	Not Started	
Procedure Changes Active:		Not Started	
Operations Procedure Changes Developed	Jul 2016	Not Started	
Site Specific Maintenance Procedure Developed	Jul 2016	Not Started	
Procedure Changes Active	Nov 2016	Not Started	
Training:			
Training Complete	Sep 2016	Not Started	
Completion:			
Unit 1 HCVS Implementation	Dec 2016	Not Started	
Unit 2 HCVS Implementation	Apr 2017	Not Started	
Unit 3 HCVS Implementation	Mar 2018	Not Started	
Full Site HCVS Implementation	Mar 2018	Not Started	
Submit Completion Report [60 days after full site compliance] -	Jun 2018	Not Started	

Milestone	Target Completion Date	Activity Status	Revised Target Completion Date
Phase 2 HCVS Milestone Table			
Submit Overall Integrated Plan	Dec 2015	**Complete with this submittal**	
Submit 6 Month Updates:			
Submit 6 Month Status Report	June 2016		
Submit 6 Month Status Report	Dec 2016		
Submit 6 Month Status Report	June 2017		
Submit 6 Month Status Report	Dec 2017		
Submit 6 Month Status Report	June 2018		
Submit 6 Month Status Report	Dec 2018		
Modifications:			
Preliminary/conceptual design meeting	Jan 2017		
U3 Design Engineering On-site /Complete	May 2017		
U1 Design Engineering On-Site /Complete	Dec 2017		
U2 Design Engineering On-site /Complete	May 2018		
U3 Walk Through Demonstration /Functional Test	Mar 2018		
U1 Walk Through Demonstration /Functional Test	Oct 2018		
U2 Walk Through Demonstration /Functional Test	Mar 2019		
Procedure Changes Active:		Not Started	
Operations Procedure Changes Developed	Sept 2017		
Site Specific Maintenance Procedure Developed	Dec 2017		
Procedure Changes Active	Mar 2018		
Training:			
Training Complete	Dec 2017		
Completion:			
U3 Implementation Outage	Mar 2018		
U1 Implementation Outage	Oct 2018		
U2 Implementation Outage	Mar 2019		
Submit Completion Report [60 days after full site compliance] -	May 2019		

4 Changes to Compliance Method

The following is a list of changes made to the information provided in the OIP (Reference 5) and previous six month update (Reference 9). These changes were performed to clarify the OIP and provide more accurate information due to being further along in the design process. These changes meet the NEI 13-02 compliance method. As this is the first submittal of the Phase 2 OIP, details related to Phase 2 compliance are not included.

- Page 1 of 79. Updated Table of Contents to include Phase 2 plan.
- Pages 2 and 3 of 79. Updated to include NRC Interim Staff Guidance JLD-ISG-2015-01 and to state what the Hardened Containment Vent System (HCVS) is comprised of.
- Page 3 of 79. Revised to remove the statement that pressure would be monitored for vent operation as this is not a requirement of NEI 13-02, and it is redundant to HCVS valve position, pipe temperature, and effluent radiation levels.
- Pages 6, 7, and 8 of 79. Updated assumptions made for NRC Confirmatory Orders EA-12-049 and EA-13-109 to include Phase 2 Severe Accident Water Addition (SAWA) and Severe Accident Water Management (SAWM).
- Page 8 of 79. Revised to include response to OIP Open Items 6 and 7.
- Page 9 of 79. Revised to state that "Initial operator actions will be completed by plant personnel and will include the capability for remote-manual initiation from the HCVS control station." This statement previously stated that this was an immediate operator actions. This statement is more accurate with this change.
- Page 11 of 79. Revised to state approximately 6 hours vice 4-8 hours for discussion of time constraints identified in the industry revised Attachment 2A.
- Page 15 of 79. Updated to include response of OIP Open Item 8.
- Pages 16 and 17 of 79. Revised to state missile protection used and to reference NEI HCVS-FAQ-04 and NEI White Paper HCVS-WP-04.
- Page 17 of 79, Item 1. Revised to state number of Wetwell Vent Cycles evaluated for the first 24 hours is greater than or equal to 8. This number was obtained from NEI White Paper HCVS-WP-02, which states "A generic number of 8 Wetwell vent cycles within the first 24 hours is reasonable."
- Page 19 of 79. Under Location of Control Panels, revised to include response of OIP Open Item 9.
- Page 23 of 79, Item 3. Revised to remove HCVS Process Pressure as this is not a requirement of NEI 13-02, and it is redundant to HCVS valve position, pipe temperature, and effluent radiation levels.
- Page 25 of 79. Under Component Reliable and Rugged Performance, revised to remove last 3 paragraphs due to being redundant to description previously documented.
- Page 25 of 79. Revised to state "Initial operator actions" vice "Immediate operator actions" to give a more accurate statement.
- Pages 26 and 29 of 79. Under System control (i), revised to state "the HCVS will be designed for greater than or equal to 8 open/close cycles under ELAP conditions over the first 24 hours following an ELAP." This number was obtained from HCVS-WP-02, which states "A generic number of 8 Wetwell vent cycles within the first 24 hours is reasonable."
- Page 26 of 79. Revised to include response of OIP Open Item 2.
- Page 27 of 79, Item 7. Revised to correct DCN number in previous submittal.

- Page 28 of 79. Under Key Parameter, removed HCVS pressure indication due to it is not a requirement of NEI 13-02, and it is redundant to HCVS valve position, pipe temperature, and effluent radiation levels.
- Page 60 of 79. Added Figures 8, 9, and 10 to Conceptual Sketches.
- Page 76 of 79. Updated Attachment 7 for open items and added OIP Open Items 10 and 11 for Phase 2 of EA-13-109.

Currently, there are no changes to the compliance method that would be considered an alternative to NEI 13-02.

5 Need for Relief/Relaxation and Basis for the Relief/Relaxation

BFN expects to comply with the Order implementation date, and no relief/relaxation is required at this time.

6 Open Items from Overall Integrated Plan and Interim Staff Evaluation

The following tables provide a summary of the open items documented in the Phase 1 and Phase 2 OIP or the Interim Staff Evaluation and the status of each item.

#	Overall Integrated Plan Phase 1 & 2 Open Item	Status
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.	Open
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.	Closed - Evaluation has been completed and documented in Calculation MDQ0000322015000347 R0, HCVS Nitrogen System Sizing Analysis, and DCN 71389.
3	Perform an evaluation for FLEX portable generators and nitrogen cylinders use past 24 hour actions.	Open
4	Revise 1/2/3-EOI Appendix 13 to include venting for loss of DC power.	Open
5	Perform an evaluation for FLEX portable generators use for post 24 hour actions in Severe Accident conditions.	Open
6	Electrical load shedding will be performed in 1 hour of the event.	Closed (Reference 6) - Calculation EDQ0009992013000202 R3, 250V DC Unit Batteries, 1, 2, & 3 Evaluation for the Beyond Design Basis External Event (BDBEE) Extended Loss of AC Power (ELAP), has been issued to determine load shedding impact on the unit batteries.

#	Overall Integrated Plan Phase 1 & 2 Open Item	Status
7	The implementation of the HCVS DCN's will be staged so that there is no effect on the operating units.	Closed (Reference 6) - A conceptual meeting was held in November 2014, and a staging plan was used to separate the existing HWWV from the HCVS.
8	The wetwell vent will be designed to remove 1% of rated thermal power at EPU conditions.	Closed (Reference 6) - The existing wetwell vent (CLTP) and the HCVS (EPU) have been designed for 1 percent of rated thermal power at EPU conditions.
9	Implement the Harris Radio System for communication between the MCR and the ROS.	Closed - A communication system has been implemented that uses hand held radios for communication between the main control room and the remote operating station. (DCN 70852)
10	Perform an evaluation for the locations of the SAWA equipment and controls, as well as ingress and egress paths for the expected Severe Accident conditions (temperature, humidity, radiation) for the Sustained Operating period	Open
11	Perform an hydraulic evaluation to ensure flow adequacy can be met for all 3 units using 1 FLEX pump to support SAWA flow requirement	Open

#	Interim Staff Evaluation Phase 1 Open Item	Status
1	Make available for NRC staff audit an evaluation of temperature and radiological conditions to ensure that operating personnel can safely access and operate controls and support equipment.	In Progress
2	Make available for NRC audit documentation that procedure 1/2/3-EOI Appendix 13 to has been revised to include venting for loss of dc power.	In Progress
3	Make available for NRC staff audit documentation demonstrating that 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.	Closed (Reference 6) - Calculation EDQ0009992013000202 R3, 250V DC Unit Batteries, 1, 2, & 3 Evaluation for the Beyond Design Basis External Event (BDBEE) Extended Loss of AC Power (ELAP), has been issued to determine load shedding impact on the unit batteries.
4	Make available for NRC staff audit documentation that demonstrates that operating units that have not implemented the order will be able to vent through the existing vent system unaffected by the implementation of HCVS on other units.	Closed (Reference 6) - A conceptual meeting was held in November 2014, and a staging plan was used to separate the existing HWWV from the HCVS.
5	Make available for NRC staff audit analyses demonstrating that HCVS has the capacity to vent the steam/energy equivalent of one percent of licensed/rated thermal power (unless a lower value is justified), and that the suppression pool and the HCVS together are able to absorb and reject decay heat, such that following a reactor shutdown from full power containment pressure is restored and then maintained below the primary containment design pressure and the primary containment pressure limit.	Closed (Reference 6) - The existing wetwell vent (CLTP) and the HCVS (EPU) have been designed for 1 percent of rated thermal power at EPU conditions.

#	Interim Staff Evaluation Phase 1 Open Item	Status
6	Make available for NRC staff audit documentation that demonstrates adequate communication between the remote HCVS operation locations and HCVS decision makers during ELAP and severe accident conditions.	Closed - A communication system has been implemented that uses hand held radios for communication between the main control room and the remote operating station. (DCN 70852)
7	Make available for NRC staff audit documentation of an evaluation verifying the existing containment isolation valves, relied upon for the HCVS, will open under the maximum expected differential pressure during BDBEE and severe accident wetwell venting.	In Progress
8	Make available for NRC staff audit documentation of a seismic qualification evaluation of HCVS components.	In Progress
9	Make available for NRC staff audit descriptions of all instrumentation and controls (existing and planned) necessary to implement this order including qualification methods.	In Progress
10	Make available for NRC staff audit the descriptions of local conditions (temperature, radiation and humidity) anticipated during ELAP and severe accident for the components (valves, instrumentation, sensors, transmitters, indicators, electronics, control devices, and etc.) required for HCVS venting including confirmation that the components are capable of performing their functions during ELAP and severe accident conditions.	In Progress
11	Make available for NRC staff audit the final sizing evaluation for HCVS batteries/battery charger including incorporation into FLEX DG loading calculation.	In Progress
12	Make available for NRC staff audit documentation of the HCVS nitrogen pneumatic system design including sizing and location.	In Progress
13	Make available for NRC staff audit the seismic and tornado missile final design criteria for the HCVS stack.	In Progress
14	Provide a description of the final design of the HCVS to address hydrogen detonation and deflagration.	In Progress
15	Provide a description of the strategies for hydrogen control that minimizes the potential for hydrogen gas migration and ingress into the reactor building or other buildings.	In Progress
16	Provide design details that minimize unintended cross flow of vented fluids within a unit and between units on the site.	In Progress

7 Interim Staff Evaluation Impacts

There are no potential impacts to the Interim Staff Evaluation identified at this time.

8 References

The following references support the updates to the Overall Integrated Plan described in this enclosure.

1. NRC Order Number EA-13-109, "Issuance of Order to Modify Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions," dated June 6, 2013 (ML13143A321)
2. NEI 13-02, "Industry Guidance for Compliance with Order EA-13-109, BWR Mark I & II Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions," Revision 1, dated April 23, 2015 (ML15113B318)
3. NRC Interim Staff Guidance JLD-ISG-2013-02, "Compliance with Order EA-13-109, Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions," Revision 0, dated November 14, 2013 (ML13304B836)
4. Letter from NRC to NEI, Endorsement of Industry "Hardened Containment Venting System (HCVS) Phase 1 Overall Integrated Plan Template (EA-13-109) Rev 0," dated May 14, 2014 (ML14128A219)
5. Letter from TVA to NRC, "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)," dated June 30, 2014 (ML14181B169)
6. Letter from TVA to NRC, "Tennessee Valley Authority's Browns Ferry Nuclear Plant First Six-Month Status Report in Response to the June 6, 2013 Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109)," dated December 19, 2014 (ML14353A428)
7. Letter from NRC to TVA, "Browns Ferry Nuclear Plant, Units 1, 2, and 3 - Interim Staff Evaluation Relating To Overall Integrated Plan In Response To Phase 1 of Order EA-13-109 (Severe Accident Capable Hardened Vents) (TAC Nos. MF4540, MF4541 and MF4542)," dated February 11, 2015 (ML14356A362)
8. NRC Interim Staff Guidance JLD-ISG-2015-01, "Compliance with Phase 2 of Order EA-13-109, Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation under Severe Accident Conditions," Revision 0, dated April 29, 2015 (ML15104A118)
9. Letter from TVA to NRC, "Tennessee Valley Authority's Browns Ferry Nuclear Plant Second Six-Month Status Report in Response to the June 6, 2013 Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109)" dated June 29, 2015 (ML15181A338)

ENCLOSURE 2

Tennessee Valley Authority Browns Ferry Nuclear Plant's Phase 1 and Phase 2 Overall Integrated Plan for the Implementation of Order EA-13-109, "Issuance Of Order to Modify Licenses With Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions," Revision 2

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ENCLOSURE 2

Tennessee Valley Authority Browns Ferry Nuclear Plant's Phase 1 and Phase 2 Overall Integrated Plan for the Implementation of Order EA-13-109, "Issuance Of Order to Modify Licenses With Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions," Revision 2

Introduction

In 1989, the NRC issued Generic Letter 89-16, "Installation of a Hardened Wetwell Vent," to all licensees of Boiling Water Reactors (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 Modify Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions*, June 6, 2013. The Order (EA-13-109) requires that licensees of BWR facilities with Mark I and Mark II containment designs ensure that these facilities have a reliable hardened vent to remove decay heat from the containment, and maintain control of containment pressure within acceptable limits following events that result in the loss of active containment heat removal capability while maintaining the capability to operate under 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 Phase 1 of Order EA-13-109 through Interim Staff Guidance (ISG) JLD-ISG-2013-02, which was issued in November 2013, and JLD-ISG-2015-01, which was issued in April 2015. The ISGs endorse the compliance approach presented in NEI 13-02 Revisions 0 and 1, *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 the ISGs to evaluate licensee compliance as presented in submittals required in Order EA-13-109.

The Order also requires submittal of an overall integrated plan (OIP) that will provide a description of how the requirements of the Order will be achieved. This document provides the Tennessee Valley Authority's (TVA's) OIP for the Browns Ferry Nuclear Plant's (BFN's) compliance with Order EA-13-109 using the methods described in NEI 13-02 and endorsed by

NRC ISG JLD-ISG-2013-02 and JLD-ISG-2015-01. Six month progress reports will be provided consistent with the requirements of Order EA-13-109.

The submittals required are:

- OIP for Phase 1 of EA-13-109 was required to be submitted by licensees to the NRC by June 30, 2014. The NRC requires periodic (6-month) updates for the HCVS actions being taken. The first update for Phase 1, was due December 2014, with the second due June 2015.
- OIP for Phase 2 of EA-13-109 is required to be submitted by licensees to the NRC by December 31, 2015. The December 2015 six-month update for Phase 1 will be combined with the Phase 2 OIP submittal by means of a combined Phase 1 and 2 OIP.
- Thereafter, the 6-month updates will be for both the Phase 1 and Phase 2 actions until complete, consistent with the requirements of Order EA-13-109.

The Hardened Containment Vent System (HCVS) is comprised of the following installed and portable equipment and operating guidance:

- Severe Accident Wetwell Vent (SAWV) – Permanently installed vent from the torus of each BFN unit to an elevation approximately 20 feet above the top of the Reactor Building
- Severe Accident Water Addition (SAWA) – A combination of permanently installed and portable equipment to provide a means to add water to the reactor pressure vessel (RPV) following a severe accident and monitor system and plant conditions.

In addition, Severe Accident Water Management (SAWM) strategies and guidance for controlling the water addition to the RPV/containment to support operation of SAWV and SAWA for the sustained operating period will be developed per attachment 2.1.D.

The Plant venting actions for the EA-13-109, Phase 1, 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 and level from the MCR instrumentation to monitor effectiveness of the venting actions.
- Vent operation will be monitored by HCVS valve position, temperature, and effluent radiation levels.
- The HCVS motive force will be monitored and have the capacity to operate for 24 hours with installed equipment. Motive force will be replenished 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.

The Phase 2 actions can be summarized as follows:

- Utilization of SAWA to initially inject water into the RPV or Drywell.
- Utilization of Severe Accident Water Management (SAWM) to control injection and Suppression Pool level to ensure the HCVS (Phase 1) wetwell vent (SAWV) will remain functional for the removal of the decay heat from the core from containment.

- Ensure that the decay heat can be removed from the containment for seven (7) days using the HCVS or describe the alternate method(s) to remove decay heat from the containment from the time the HCVS is no longer functional until alternate means of decay heat removal are established that make it unlikely the drywell vent will be required for containment pressure control.
- The SAWA and SAWM actions will be manually initiated and controlled from areas that are accessible during severe accident conditions.
- Parameters measured should be Drywell pressure, Suppression Pool level, SAWA flowrate and the HCVS parameters listed above.
- Alternatively SAWA and a Severe Accident Capable Drywell Vent (SADV) strategy may be implemented to meet Phase 2 of Order EA-13-109.

ENCLOSURE 2

Tennessee Valley Authority Browns Ferry Nuclear Plant's Phase 1 and Phase 2 Overall Integrated Plan for the Implementation of Order EA-13-109, "Issuance Of Order to Modify Licenses With Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions," Revision 2

Part 1: <u>General Integrated Plan Elements and Assumptions</u>
Extent to which the guidance, JLD-ISG-2013-02, JLD-ISG-2015-01 and NEI 13-02 (Revision 1), 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, JLD-ISG-2015-01**
Compliance will be attained for BFN with no known deviations to the guidelines in JLD-ISG-2013-02, JLD-ISG-2015-01 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 (alternate strategy): by the startup from the first refueling outage that begins after June 30, 2017 or June 30, 2019, whichever comes first. Currently scheduled for Spring 2018 (Unit 3), Fall 2018 (Unit 1) and Spring 2019 (Unit 2) BFN 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 for each unit will have independent operation and be fully compliant with 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 BFN: • Seismic, External Flooding, High Wind, Extreme High Temperature, Extreme Cold. The following extreme external hazards screen out for BFN: • None
Key Site assumptions to implement NEI 13-02 HCVS Phase 1 and 2 Actions.
Provide key assumptions associated with implementation of HCVS Phase 1 Actions. **Ref: NEI 13-02, Revision 1, NEI-12-06 Revision 0**
Mark I/II Generic EA-13-109 Phase 1 and Phase 2 Related Assumptions:

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Applicable EA-12-049 assumptions:

049-1. Assumed initial plant conditions are as identified in NEI 12-06 Section 3.2.1.2 items 1 and 2

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, FLEX supply for drywell spray, FLEX water supply for Suppression Pool water level, communication, notifications, Spent Fuel Pool (SFP) level and makeup, security response, opening doors for cooling, and initiating conditions for the event, can be credited as previously evaluated for FLEX. (refer to assumption 109-02 below for clarity on SAWA)(HCVS-FAQ-11)

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. This assumption does not apply to Phase 2 SAWA/SAWM because SAWA equipment needs to be connected and placed in service within 8 hours from the time of the loss of RPV

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injection. (reference HCVS-FAQ-12)

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 primary 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 HCVS venting dedicated functionality (reference HCVS-FAQ-01). This assumption does not apply to Phase 2 SAWA/SAWM because SAWA equipment needs to be connected and placed in service within 8 hours from the time of the loss of RPV injection and will require more than minimal operator action.

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). This assumption does not apply to Phase 2 SAWA/SAWM because SAWA equipment is not dedicated to HCVS but shared to support FLEX functions.

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. MAAP Version 5 was used to develop EPRI Technical Report 3002003301 to support drywell temperature response to SAWA under severe accident conditions.

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 is 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 OIP is based on Emergency Operating Procedure (EOP) changes consistent

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with Emergency Procedure Guidelines/Severe Accident Guidelines (EPG/SAGs) Revision 3 as incorporated per the site's Emergency Operating Procedures/Severe Accident Mitigation Guidelines (EOP/SAMG) procedure change process. This assumption does not apply to Phase 2 SAWM because SAWM is not part of revision 3. (reference to Attachment 2.1.D for SAWM SAMG Changes approved by the BWROG Emergency Procedures Committee)

109-12. Under the postulated scenarios of Order EA-13-109 the Control Room is adequately protected from excessive radiation dose due to its distance and shielding from the reactor (per General Design Criterion (GDC) 19 in 10 CFR 50 Appendix A) and no further evaluation of its use as the preferred HCVS control location is required. In addition, adequate protective clothing and respiratory protection is available if required to address contamination issues. (reference HCVS-FAQ-01 and HCVS-FAQ-09)

109-13. The suppression pool/wetwell of a BWR Mark I/II containment is considered to be bounded by assuming a saturated environment for the duration of the event response because of the water/steam interactions.

109-14. RPV depressurization is directed by the EPGs in all cases prior to entry into the SAGs (reference NEI 13-02 Rev 1 Section I.1.3)

109-15. The Severe Accident impacts is assumed on one unit only due to the site compliance with NRC Order EA-12-049, However, each BWR MK I and II under the assumptions of NRC Order EA-13-109 ensure the capability to protect containment exists for each unit. (HCVS-FAQ-1) This is further addressed in HCVS-FAQ-10.

Plant Specific HCVS Related Assumptions/Characteristics:

BFN-1 Each operating unit will have an individual release point above the highest point of the Reactor Building.

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

BFN-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.

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

[OIP OPEN ITEM 6] Electrical load shedding will be performed in 1 hour of the event.

Response: This Open item is closed. Calculation EDQ0009992013000202 Rev 1 has been issued to determine load shedding impact on the unit batteries.

[OIP OPEN ITEM 7] The implementation of the HCVS Design Change Notices (DCNs) will be staged so that there is no effect on the operating units.

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Response: This Open item is closed. A conceptual meeting was held in November 2014, and a staging plan was used to separate the existing hardened wetwell vent (HWWV) from the HCVS.

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 2A).

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. Initial 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.

(Note: In this section use of the term HCVS is implied to refer to the Severe Accident Wetwell Vent (SAWV) portion of the HCVS.)

Table 2-1 HCVS Manual Actions

Primary Action	Primary Location / Component	Notes
1. Verify that Primary Containment Isolation Valves (PCIVs) are closed: FCV-64-18, 19, 20, 21 FSV 84-8B & 8C FCV 76-19 & 24	Indicating lights located in the MCR	

Part 2: Boundary Conditions for Wet Well Vent

2. Disable PCIV keylock switch if required.	Panels in MCR containing PCIV keylock switch	Ref. EOI Appendix 13
3. 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. After 24 hours of operation the portable generators may be aligned to supply power to the HCVS
4. Verify that the pneumatic supply to the CIVs required for service is operable and aligned with replaceable nitrogen bottles	Nitrogen bottles will be located in an area that is accessible to operators, preferably 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.
5. Open Wetwell PCIVs FCV-64-221 & 222.	Hand switches located in the MCR panel	And at the (ROS by operation of manual valves.

To minimize the impact to operational hazards the 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 BFN this is inclusive of:

Containment Isolation Valves in the HCVS 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, choice of protective clothing, required tools and equipment, and portable lighting. The evaluation will include considerations such as, how temperatures

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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.

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 Beyond Design Basis External Event (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.

The following is a discussion of time constraints identified in Attachment 2A for the 3 timeline cases identified above

- Approximately 6 Hours, initiate use of HCVS per site procedures to maintain containment parameters below design limits and within the limits that allow continued use of RCIC - The reliable operation of HCVS will be met because HCVS meets the seismic requirements identified in NEI 13-02 and will be powered by DC buses with motive force supplied to HCVS valves from installed nitrogen storage bottles. Critical HCVS controls and instruments associated with containment will be DC powered and operated from the MCR or a ROS on each unit. The DC power for HCVS will be available as long as the HCVS is required. HCVS battery capacity will be available for 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 ROS within 6 hours is acceptable because the actions can be performed any time after declaration of an ELAP until the venting is needed at approximately 6 hours for BDBEE venting. This action can also be performed for SA HCVS operation which occurs at a time further removed from an ELAP declaration as shown in Attachment 2A (approximately 8 hours).
- After 24 Hours, supplemental nitrogen bottles will be moved into position to supplement the Nitrogen supply at the ROS. 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 8 hours PGs will be connected to the 480V unit battery chargers to supply power to HCVS critical components/instruments - Time critical after 12 hours. Current 250V Unit batteries are calculated to last 12 hours. PG will be staged beginning at approximately 8 hour time frame (Reference 28, FLEX OIP). Thus, the PGs will be available to be placed

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in service at any point after 8 hours as required to supply power to HCVS critical components/instruments. A PG will be maintained in an on-site FLEX storage building. PG will be transferred and staged via haul routes and staging areas evaluated for impact from external hazards. Modifications will be implemented as part of BFN response to NRC Order EA-12-049 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.

Discussion of radiological and temperature constraints identified in Attachment 2A

- Approximately 6 Hours, Initiate use of HCVS per site procedures to maintain containment parameters below design limits and within the limits that allow continued use of RCIC - The reliable operation of HCVS will be met because HCVS meets the seismic requirements identified in NEI 13-02 and will be powered by DC buses with motive force supplied to HCVS valves from an installed nitrogen supply. Critical HCVS controls and instruments associated with containment will be DC powered and operated from the MCR or a ROS on each unit. After 8 hours, Phase 2 FLEX PG can provide power through the 250V Unit Battery before battery life is exhausted. Thus, initiation of the HCVS from the MCR or the ROS within 6 hours is acceptable because the actions can be performed any time after declaration of an ELAP until the venting is needed 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.
- Prior to 12 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 diesel buildings.
- At greater than 24 hours, additional nitrogen bottles will be aligned to supplement the nitrogen supply as stated for the related time constraint item.
- At 8 Hours, temporary generators will be installed and connected to power up Unit Battery chargers using a PG to supply power to HCVS critical components/instruments - Time critical after 12 hours. Current battery durations are calculated to last 12 hours (Reference 32). PG will be connected at 8 hours time frame (Reference 28). Thus, the PGs will be available to be placed in service at any point after 8 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

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criteria (e.g. anticipatory venting)?

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

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

<u>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)</u>

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

<u>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)</u>

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.

<u>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)</u>

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.

<u>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)</u>

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.

<u>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)</u>

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?

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

The HCVS shall include means to prevent inadvertent actuation

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

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

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

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

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

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

Components including instrumentation that are not required to be seismically designed by the design basis of the plant should be designed for reliable and rugged performance that is capable of ensuring HCVS functionality following a seismic event. (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.

Part 2: Boundary Conditions for Wet Well Vent

Vent Size and Basis

The HCVS wetwell path is designed for venting steam/energy at a nominal capacity of 1 percent of 3952 MW thermal power at a 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 approximately 15 percent above the currently licensed thermal power of 3458 MWt. The size of the wetwell portion of the HCVS is 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 wetwell vent will be sized to operate under conditions of constant heat input at a rate equal to 1 percent of rated thermal power and containment pressure equal to the lesser of the PCPL or containment design pressure. Therefore, the exhaust-flow through the wetwell vent would be sufficient to prevent the containment pressure from exceeding design limits.

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

Response: This Open item is closed. The existing wetwell vent (CLTP) and the HCVS (EPU) have been designed for 1 percent 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 BFN HCVS design to preclude elevated containment temperature, hydrogen generation, containment pressure and extended 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 core and containment cooling safety function capabilities described in NEI 12-06 (Reference 10) Table 3-1 for Mark I 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).

Part 2: Boundary Conditions for Wet Well Vent

Vent Capacity

The 1 percent capacity value at BFN is acceptable based on analysis demonstrating 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 BFN 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 on the first floor 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 BFN superstructure to the roof of the Reactor Building. The effluent will be discharged at an elevated release point and the velocity and spacing of each unit will provide compliance with the Order EA-13-109 requirements of separation.

The HCVS discharge path will be routed to a point above any adjacent structure. Each discharge point is above the unit's Reactor Building such that the release point will vent away from emergency ventilation system intake and exhaust openings, MCR location, location of HCVS portable equipment, access routes required following an 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 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 existing valve pit to a 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 protected from missile impacts below 30 feet and in accordance with HCVS-WP-04 for exposed vent piping above 30 feet. (reference HCVS-FAQ-04; HCVS-WP-04). Based on a site-specific evaluation the point at which the vent pipe exits the valve pit outside the Reactor Building is greater than 30 feet above surrounding elevations, and is, therefore, considered protected from wind generated missiles.

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 BFN HCVS will be designed to protect the containment against over-pressurization 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

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downstream recirculation zones associated with airflow around the building. Severe accident venting to maintain containment integrity may have the 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 are 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. Venting of the containment volume at 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. 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. 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. The detailed design will provide missile protection from ground level to 30 feet in accordance with NRC Regulatory Guide 1.76 based on a site-specific tornado missile evaluation. Above 30 feet the exposed vent piping will be robustly designed in accordance with HCVS-WP-04. This is a design consideration using reasonable protection features for the screened in hazards from NEI 12-06. (reference HCVS-FAQ-04; HCVS-WP-04) **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 until load shed performed at which time the HCVS loads will be powered from dedicated HCVS Batteries. At 24 hours, power will transfer back to the Unit Batteries, at which time the FLEX generators will be in service and will have recharged the 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 nitrogen bottles.

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These bottles will supply the required motive force to those HCVS valves needed to maintain flow through the HCVS effluent piping. 1. The HCVS flow path valves are air-operated valves (AOV) with air-to-open and spring-to-shut. Opening the valves from the MCR requires energizing a solenoid operated valve (SOV) and providing motive gas. The detailed design will provide a permanently installed power source and motive gas supply adequate for the first 24 hours. Beyond the first 24 hours, there will be FLEX PGs that are able to sustain power. The capacity of the FLEX PGs 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 gas will allow for a minimum of greater than or equal to 8 valve operating cycles for the HCVS valves for the first 24 hours. 2. An assessment of temperature and radiological conditions will be performed to ensure that operating personnel can safely access and operate controls at the ROS based on time constraints listed in Attachment 2A. [OIP OPEN ITEM 1] Perform assessment of temperature and radiological conditions. The primary operating location, inclusive of the valve position indication, is designed for the expected Thermal and Radiological challenges posed by loss of ventilation (possible for the entire "Sustained" Operating period of 7 days), including any thermal challenge posed by operating the HCVS, and any radiological challenge posed by the HCVS on the equipment located at the control panel. The primary operating location will be the MCR 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 and N2) 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 BFN HCVS. Indications required for Drywell Pressure and Suppression Pool level are used to operate the HCVS (determine when to close to prevent negative pressure or air intrusion) and, thus, either must be available or the parametric values must be actively communicated to the HCVS control location. 4. All valves required to open the flow path will be designed for remote manual operation following an ELAP, such that the primary means of valve manipulation does not rely on use of a hand wheel, reach–rod or similar means that requires close proximity to the valve (reference FAQ HCVS-03). The ROS will be located in the Diesel Generator Buildings. These structures are not subject to the thermal and radiological conditions in the Reactor Building(s) and no ice vest 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 to meet Order Element 1.2.5. Manual

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Operation of the PCIVs will be the use of a manual valve, located at the ROS in the diesel generator buildings, to provide pneumatic supply to the PCIV. 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 PCIVs 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 are not required.

Location of Control Panels

The HCVS design allows initiating and then operating the HCVS from the MCR and the ROS located in the Diesel Generator Building(s); however, monitoring is from the MCR only. The MCR location is protected from adverse natural phenomena and is the normal control point for Plant Emergency Response actions.

The ROS located in the Diesel Generator Building(s) has the same accessibility and habitability as the MCR. Evaluations have been performed for the Diesel Generator Buildings to verify area temperatures are acceptable for ROS location. 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 during use. However, based on the distance of the ROS to the operating HCVS process piping the radiological conditions will 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 at the MCR 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, effluent radiation levels with a range for severe accident service, temperature and the status of supporting systems, such as availability of electrical power and pneumatic supply pressure.

[OIP OPEN ITEM 9] Communication between the MCR and the ROS will be with handheld radios.

Response: This Open item has been closed. A communication system has been implemented that uses hand held radios for communication between the MCR and the ROS.

The temperature and heat load that exist in the MCR due to proximity to the undercooled containment have 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. The instrumentation will be capable of operating in the thermal and radiological environment for at least 24 hours without significant operator action.

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The ROSs located outside the main control room have been determined to be readily accessible locations based on evaluations that include: accessibility, habitability, staffing sufficiency and providing communication capability with vent use decision makers.

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 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).

The BFN HCVS will be designed to avoid a detonable mixture while remaining functional. A number of conditions as shown in Attachment 2A 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. The occurrence of such a set of conditions is extremely unlikely due mainly to the process of venting 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, but 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.

The BFN HCVS will be designed to allow the vent to operate during all three cases in Attachment 2A, 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 PCIVs may close and steam may be condensing in the piping. 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.

Relative buoyancy of hydrogen would also tend to alleviate 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.

Instruments required for HCVS operation will be located upstream of the check valve and not prone to detonation loading.

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 that have near zero leakage for these applications and would prevent backflow up near the exit point of the 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 lifting up, gravity would assist the spring closure mechanism to limit leakage to an absolute minimum.

BFN will use a 'blow off cap' to prevent foreign material from entering the HCVS piping.

Unintended Cross Flow of Vented Fluids

The HCVS uses the Containment Purge and Inerting System containment isolation valves as the boundary to other plant systems. 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. These PCIVs are maintained leak tight and tested in accordance with the station's Appendix J Program.

Each HCVS containment penetration will have two, in-series PCIVs as required by GDC 56. These PCIVs will be 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 serves 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 primary containment connections that are upstream of the HCVS PCIVs 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 Suppression Pool Purge and Vent Valves (PCIVs) is 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.

The HCVS boundary valves are any valves which serve to isolate the HCVS from another system. For BFN these valves are safety related PCIVs 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. Downstream of the PCIVs the HCVS in each unit will not interact with any other system and no crossflow potential exists. The implementation of NRC Order EA-13-109 will provide independence of the discharge path for all three units.

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 transient or accident. In addition, the HCVS will be designed to provide features to prevent inadvertent actuation due to a design

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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. BFN will use CAP to provide sufficient NPSH for the RCIC pump during the BDBEE. Analysis has been 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 PCIVs in series powered from different divisions and key lock switches.

<u>Component Qualifications</u>

The HCVS components downstream of the second containment isolation valve will be routed in a seismically qualified structure or exterior to the Reactor Building. HCVS components that directly interface with the primary containment pressure boundary will be considered safety related, as the existing system is safety related. The containment system limits the leakage or release of radioactive materials to the environment to prevent offsite exposures from exceeding the guidelines of 10 CFR 100. 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 that 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.

Containment radiological conditions should be consistent with the conditions assumed in the plant's 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).

Routing considerations will account for radiological conditions along both the piping path and at the control stations where the new equipment will be placed. Additionally, remote

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instrumentation locations will be evaluated.

HCVS components including instrumentation will 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 will 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 designed so it does 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 7 day mission time.

HCVS instrumentation performance (i.e. 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 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 BFN wetwell HCVS will be capable of being manually operated during sustained operations from a control panel located in the MCR and will meet the requirements of Order element 1.2.4. The MCR is a readily accessible location with no further evaluation required.

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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 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. Included in the current design of the reliable hardened vent (RHV) are control switches in the MCR with valve position indication. Following load shed, the installed HCVS Battery and nitrogen supply provides for operation of the system for 24 hours. Beyond the first 24 hours, the ability to maintain these valves open or closed will be provided with replaceable nitrogen bottles and FLEX PGs. The wetwell HCVS will include indications in the MCR for vent pipe temperature, and effluent radiation levels. 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 Drywell pressure and Suppression Pool level indication in the MCR to monitor vent operation. This monitoring instrumentation provides the indication from the MCR as per Requirement 1.2.4 and will be designed for sustained operation during an ELAP event. **Component Reliable and Rugged Performance** The HCVS downstream of the second containment isolation valve, including piping and supports, electrical power supply, valve actuator pneumatic supply, and instrumentation (local and remote) components, will be designed/analyzed to conform to the requirements consistent with the applicable design codes (e.g., Non-safety, Cat 1, SS and 300# ASME or B31.1, NEMA 4, etc.) for the plant and to ensure functionality following a design basis earthquake. 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, and 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. These qualifications will be bounding conditions for BFN. For the instruments required after a potential seismic event, the following methods will be used

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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.

Part 2: <u>Boundary Conditions for WW Vent: BDBEE Venting</u>
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 the ELAP and BDBEE hazards identified in Part 1 of this OIP. Initial 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.

Part 2: Boundary Conditions for Wet Well Vent
Remote-manual is defined in this report as a non-automatic power operation of a component and does not require the operator to be at or in close proximity to the component. No other operator actions are required to initiate venting under the guiding procedural protocol. The HCVS will be designed to allow initiation, control, and monitoring of venting from the MCR and will be able to be operated from an installed ROS. 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 gas capability will be available to support operation and monitoring of the 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 greater than or equal to 8 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. [OIP 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. Response: This Open item is closed. The evaluation has been completed and documented in Calculation MDQ0000322015000347 Rev 0, Nitrogen Sizing, and DCN 71389. 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 valves are normally key-locked closed.
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**
Available personnel will be able to connect supplemental motive gas and electrical power to the HCVS (not required within first 24 hours). Connections for supplementing electrical power and motive 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. Sufficient nitrogen and battery capacity will be installed to support operations for up to 24 hours following the ELAP event. BFN will credit FLEX to sustain power for a BDBEE ELAP for the period after 24 hours. [OIP OPEN ITEM 3] Perform an evaluation for FLEX PG and nitrogen cylinders use past 24 hour actions. These actions provide long term support for HCVS operation for the period beyond 24 hours to 7 days (sustained operation time period) because on-site and off-site personnel and resources

Part 2: Boundary Conditions for Wet Well Vent
will have access to the unit(s) to provide needed actions 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. [OIP 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.*
EA-12-049 Modifications 1. DCN 70745 (Complete): Install a Flex Equipment Storage Building (FESB). This structure is 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 PGs, tow vehicles, FLEX pumps, FLEX PGs and debris removal 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, wetwell and the drywell sprays as required for cooling. 3. DCN 70810 (Unit 2 - Complete), DCN 71387 (Unit 1), and DCN 71386 (Unit 3) FLEX Nitrogen supply will provide a pneumatic supply to the Main Steam Relief Valves to allow depressurization of the RPV. 4. DCN 71335 (Unit 2 - Complete), DCN 71162 (Unit 1), & DCN 71336 (Unit 3) FLEX Battery backed instrumentation will provide containment monitoring capability in the MCR. 5. DCN 71470 (Complete) FLEX 480V PGs are deployed to provide backup power to the 480V power system via the main unit battery chargers 1A, 2A, 3A and 2B. 6. DCN 71454 (Complete) FLEX deployment road and pump landing is used to place equipment into operation that has been stored in the FESB 7. DCN 71405 (Complete) FLEX 4kv spare PGs are 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

Part 2: Boundary Conditions for Wet Well Vent

generator output.

EA-13-109 Modifications

1. 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 of applicable portions of the system.
2. 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 Unit Batteries after 24 hours.
3. Each HCVS will have a corresponding ROS for all three units. This ROS will allow operations personnel to operate the HCVS valves for a sustained period of time.
4. Each HCVS will have instrumentation and controls to allow operations to monitor and control the HCVS wetwell effluent. The effluent process 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.
5. The HCVS shall be supplied with a dedicated nitrogen supply capable of operating the HCVS for the desired number of cycles within the first 24 hours.
6. Each HCVS discharge pipe will be routed to the Reactor Building roof. As the HCVS piping passes thru the refuel floor roof, 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 PCIVs.

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	ROS
HCVS Valve Position Indication	TBD	MCR
HCVS Radiation	TBD	MCR

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

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Key Parameter	**Component Identifier**	**Indication Location**
Drywell Pressure	1,2,3-PI-64-67B	MCR
Suppression Pool Level	1,2,3-LI-64-159A	MCR

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

Notes:

Part 2: Boundary Conditions for Wet Well Vent
Part 2: Boundary Conditions for Wet Well 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 reliance on operator actions for response to an ELAP and severe accident events. It is assumed that a Severe Accident Events occurs based on presumed failure of injection systems or presumed failure of injections systems in a timely manner. Access to the reactor building will be restricted as determined by the RPV water level and core damage conditions. Initial actions will be completed by Operators in the MCR or at the HCVS 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 capability will be available to support operation and monitoring of the HCVS for 24 hours. Specifics are the same as for BDBEE Venting Part 2. System control: i. Active: PCIVs are operated in accordance with EOPs/SOPs to control containment pressure. The HCVS will be designed for greater than 8 open/close cycles under ELAP conditions over the first 24 hours following an ELAP. HCVS venting will be directed per the SAMGs. 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 valves are normally key-locked closed.
Details
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

Part 2: Boundary Conditions for Wet Well Vent
conditions resulting from the postulated damaged Reactor Core and resultant HCVS vent pathway. [OIP OPEN ITEM 5]: Perform an Evaluation for FLEX PG use for post 24 hour actions in Severe Accident conditions. These actions provide long term support for HCVS operation for the period beyond 24 hours to 7 days (sustained operation time period) because on-site and off-site personnel and resources will have access to the unit(s) to provide needed action and supplies.
First 24 Hour Coping Detail
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 processes and procedures 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 Wet Well Vent

Part 2: Boundary Conditions for Wet Well 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 until load shed at approximately 1 hour. Following load shed the installed HCVS Battery will provide DC power for 24 hours. At 24 hours, power will be backed up by FLEX generators supplying power to the Unit Battery chargers. Newly installed nitrogen supply will provide sufficient motive force for all HCVS valve operation and will provide for multiple operations of the HCVS valves.

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 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.

Part 2: Boundary Conditions for Wet Well Vent
Part 2: Boundary Conditions for Wet Well Vent: HCVS Support Equipment Functions
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 PGs and the nitrogen bottles needed to supplement the nitrogen 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 Diesel Generator Building 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. 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 PGs or electrical load and fuel supply. Pressure gauge on supplemental Nitrogen bottles.
Notes:

Part 2: Boundary Conditions for Wet Well Vent		
Part 2: Boundary Conditions for Wet Well 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 EA-13-109, Option B.2</u>

General:

Licensees that use Option B.1 of EA-13-109 (SA Capable DW Vent without SAWA) must develop their own OIP. This template does not provide guidance for that option.

Licensees using Option B.2 of EA-13-109 (SAWA and SAWM or 545°F SADW Vent (SADV) with SAWA) may use this template for their OIP submittal. Both SAWM and SADV require the use of SAWA and may not be done independently. The HCVS actions under Section 2 apply to all of the following:

This section is divided into the following strategies:

3.1: Severe Accident Water Addition (SAWA)

3.1.A: Severe Accident Water Management (SAWM)
3.1.B: Severe Accident DW Vent (545 deg F)

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

SAWA and SAWM or SADV Actions supporting SA conditions 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 walkthrough of deployment). Actions already identified under the HCVS section of this template need not be repeated here.

The time to establish the water addition capability into the RPV or DW should be less than 8 hours from the onset of the loss of all injection sources.

- *Electrical generators satisfying the requirements of EA-12-049 may be credited for powering components and instrumentation needed to establish a flow path.*
- *Time Sensitive Actions (TSAs) for the purpose of SAWA are those actions needed to transport, connect and start portable equipment needed to provide SAWA flow or provide power to SAWA components in the flow path between the connection point and the RPV or drywell. Actions needed to establish power to SAWA instrumentation should also be included as TSAs.*

Ref: NEI 13-02 Section 6.1.1.7.4.1, I.1.4, I.1.5

The operation of the HCVS using SAWA will be designed to minimize the reliance on operator actions in response to hazards listed in Part 1. Initial operator actions performed to open manual valves to align SAWA flow path on the first floor (elevation 565) or lower in the Reactor Building will be completed by plant personnel within the first hour of event initiation. Additional actions will be required to hook up and align the SAWA pump at the SA-A1 staging area. Operator actions will be completed to align the FLEX Portable Diesel to the appropriate 4KV Electrical boards and routed to the appropriate 480V Electrical board to supply power to the Core Spray Loop II injection valves. This will provide the capability for remote-manual initiation

Part 3: Boundary Conditions for EA-13-109, Option B.2

from the MCR using control switches. HCVS operation may occur at the MCR or the ROS in the Diesel Generator buildings.

Timelines (see attachment 2.1.A for SAWA/SAWM) were developed to identify required operator response times and actions. The timelines are an expansion of Attachment 2A and begin either as core damage occurs (SAWA) or after initial SAWA injection is established and as flowrate is adjusted for option B.2 (SAWM). The timelines are appropriate for both in-vessel and ex-vessel core damage conditions.

Part 3.1: Boundary Conditions for SAWA

Table 3.1 – SAWA Manual Actions

Primary Action	Primary Location / Component	Notes
1. Establish HCVS capability in accordance with Part 2 of this guidance.	• MCR or ROS	
2. Open CILRT valve to Condensate Storage and Supply and open 1,2,3-SHV-2-724 on 1st floor. Open 1,2,3-SHV-75-582B on El 593.	• 1st and 2nd floors of Reactor Building	Align CS&S to Core Spray System
3. Connect SAWA pump / motive component to water source	• SA-A1 Staging Area	
4. Connect SAWA pump discharge to injection piping	• Use installed piping	Containment Integrated Leak Rate Test Connection in RHRSW pipe tunnels to Core Spray loop
5. Align Portable Generator to appropriate 4KV Electrical Board and route to appropriate 1B, or 2B, or 3B 480V RMOV Board	• Diesel Generator Building and Electrical Board Rooms	

Part 3: Boundary Conditions for EA-13-109, Option B.2

6. Power up SAWA (Loop II Core Spray Injection 1,2,3-FCV-75-51 and 1,2,3-FCV-75-53) valves with Portable Generator	• Core Spray Injection valves 1,2,3-FCV-75-51 and 1,2,3-FCV-75-53 may be operated from the main control room	Should be done as soon as possible
7. Inject to RPV using SAWA pump (diesel) by opening local manual throttle valve	• SA-A1 Staging Area	• Initial SAWA injection rate is 500 gpm
8. Monitor SAWA indications	• SA-A1 Staging Area	• Using Skid mounted ○ Pump Flow ○ Valve Position
9. Use SAWM to maintain availability of the SAWV	• MCR and SA-A1 Staging Area	• Monitor DW Pressure and Suppression Pool Level in MCR • Control SAWA flow at pump skid at SA-A1 Staging Area

Discussion of timeline SAWA identified items

HCVS operations are discussed under Phase 1 of EA-13-109 (Section 2 of this OIP).

- 7.5 Hours – Establish electrical power and other EA-12-049 actions needed to support the strategies for EA-13-109, Phase 1 and Phase 2. Action being taken within the Reactor Building under EA-12-049 conditions after RPV level lowers to 2/3 core height must be evaluated for radiological conditions assuming permanent containment shielding remains intact. HCVS-FAQ-12) All other actions required are assumed to be inline with the FLEX timeline submitted in accordance with the EA-12-049 requirements.
- Less than 8 Hours – Initiate SAWA flow to the RPV. Having the HCVS in service will assist in minimizing the peak DW pressure during the initial cooling conditions provided by SAWA.

Part 3: <u>Boundary Conditions for EA-13-109, Option B.2</u>
Severe Accident Operation
Determine operating requirements for SAWA, such as may be used in an ELAP scenario to mitigate core damage. **Ref: EA-13-109 Attachment 2, Section B.2.2, B.2.3/NEI 13-02 Section I.1.6, I.1.4.4**
It is anticipated that SAWA will be used in Severe Accident Events based on presumed failure of injection systems or presumed failure of injections systems in a timely manner. This does not preclude the use of the SAWA system to supplement or replace the EA-12-049 injection systems if desired. SAWA will consist of both portable and installed equipment. The motive force equipment needed to support the SAWA strategy shall be available prior to t=8 hours from the loss of injection (assumed at T = 0). The SAWA flow path includes methods to minimize exposure of personnel to radioactive liquids/gases and potentially flammable conditions by inclusion of backflow prevention. The check valve is integral with the pump skid and will close and prevent leakage when the SAWA pump is secured. Core Spray injection line has installed ECCS backflow prevention devices.
Description of SAWA actions for first 24 hours:

T≤ 1 hr:
• No evaluation required for actions inside the reactor building for SAWA. Expected actions are*:*
   o *Opening manual valves on Elevation 565(1st floor) and 593(2nd floor) to align water to Loop II Core Spray Injection valves.*
T=1 – 7 hr *:
• Evaluation of core gap release impact to reactor building access for SAWA actions is required. It is assumed that reactor building access is limited due to the source term at this time unless otherwise noted. Expected actions are:
   o *Perform required electrical lineups in Electrical Board Rooms located in Control Bay to align 4KV Power from EA-12-049 Generator to 1B, 2B, 3B 480 Volt Reactor MOV Boards.*
• Establish electrical power for SAWA systems and indications using EA-12-049.
   o *Step 5 of Table 3.1 above*
• Establish flow to the RPV using SAWA systems. Begin injection at a maximum rate, not to exceed 500 gpm.
   o *Steps 2, 3, 5, 6, and 7 of Table 3.1 above*
*The assumed times of T=1 hour and T=8 hours to establish the bounds of applicability of these evaluation methods should be reduced to T=1 hour to T=7 hours in order to provide

Part 3: Boundary Conditions for EA-13-109, Option B.2

sufficient margin to inform operator action feasibility evaluations and will be further informed by emergency response dose assessment activities during an actual event.

T≤ 8 -12 hr:

- Continue injection for 4 hours after SAWA injection begins at initial SAWA rate (500 gpm).

T≤ 12 hrs:

- Proceed to SAWM actions (Section 3.1.A)
  - *Step 8 of Table 3.1 above*

Greater Than 24 Hour Coping Detail

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

Ref: EA-13-109 Attachment 2, Section B.2.2, B.2.3/NEI 13-02 Section 4.2.2.4.1.3.1, I.1.4,

SAWA Operation is the same for the full period of sustained operation. SAWM flow rates will be directed to preserve the availability of the HCVS wetwell vent (see 3.1.A).

Details:

Details of Design Characteristics/Performance Specifications

SAWA shall be capable of providing a RPV or DW injection rate of 500 gpm within 8 hours of a loss of all RPV injection following an ELAP/Severe Accident. SAWA shall meet the design characteristics of the HCVS with the exception of the dedicated 24 hour power source. Hydrogen mitigation is not applicable to SAWA.

Ref: EA-13-109 Attachment 2, Section B.2.1, B.2.2, B.2.3/NEI 13-02 Section I.1.4

Equipment Locations/Controls/Instrumentation

The locations of the SAWA equipment and controls, as well as ingress and egress paths will be evaluated for the expected Severe Accident conditions (temperature, humidity, radiation) for the Sustained Operating period. Equipment will be evaluated to remain operational throughout the Sustained Operating period. Personnel exposure and temperature / humidity conditions for operation of SAWA equipment will not exceed the limits for ERO dosage and plant safety guidelines for temperature and humidity.

[OIP OPEN ITEM 10] Perform an evaluation for the locations of the SAWA equipment and controls, as well as ingress and egress paths for the expected Severe Accident conditions (temperature, humidity, radiation) for the Sustained Operating period

Part 3: Boundary Conditions for EA-13-109, Option B.2

The flow path will be from the FLEX suction in the Tennessee river through a FLEX pump with 3 outlets with individual flow indicators (one for each Unit). Flow will be monitored that is provided to the Containment Integrated Leak Rate Test (CILRT) connection in each Unit. The water will pass through the CILRT connection to Condensate Storage and Supply line into Loop II of the Core Spray System. Flow will then be directed into the RPV via the Core Spray injection valves. DW pressure and Suppression Pool level will be monitored and flow rate will be adjusted by use of the FLEX pump control valve at the SA-A1 staging area.

[OIP OPEN ITEM 11] Perform an hydraulic evaluation to ensure flow adequacy can be met for all 3 units using 1 FLEX pump to support SAWA flow requirement.

Communication will be established between the MCR and the FLEX pump location.

MOVs will be powered from the FLEX diesel generators connected in the Electrical Board Rooms located in Control Bay as described in the EA-12-049 compliance documents. The PGs are located near the Diesel Building which is away from the discharge of the HCVS. Refueling of the FLEX DG will be accomplished as described in the BFN response to EA-12-049. SA-A1 staging area is a significant distance from the discharge of the HCVS. In the event of an ELAP due to a flood then the PGs will be located and connected in accordance with EA-12-049 Mitigation Strategies for Beyond-Design Basis External Events response, dated August 28, 2015.

Evaluations for projected Severe Accident conditions (radiation / temperature) indicate that personnel can complete the initial and support activities without exceeding the ERO-allowable dose for equipment operation or site safety standards. (reference HCVS-WP-02)

Electrical equipment and instrumentation will be powered from the existing station batteries, and from AC distribution systems that are powered from the PG(s). The battery chargers are also powered from the PG(s) to maintain the battery capacities during the Sustained Operating period.

Parameter	Instrument	Location	Power Source / Notes
DW Pressure	1,2,3-PI-64-67B	MCR	Station batteries via EA-12-049 generator
Suppression Pool Level	1,2,3-LI-64-159A	MCR	Station batteries via EA-12-049 generator
SAWA Flow	Unit 1, 2,and 3 FLEX Pump Flow indicator	FLEX Pump Skid	SAWA pump (skid mounted device)
Loop II Core Spray Injection Valves 1,2,3-FCV-75-51 and 1,2,3-FCV-75-53 position indication	Unit 1, 2, and 3 MCR Panel position indicating lights	MCR and Control Building	1,2,3-FCV-75-51 and 1,2,3-FCV-75-53 powered from 1B,2B,3B 480 Volt Reactor MOV Board via EA-12-049 generator

Part 3: Boundary Conditions for EA-13-109, Option B.2

The instrumentation and equipment being used for SAWA and supporting equipment have been evaluated to perform for the Sustained Operating period under the expected radiological and temperature conditions with the exception of SAWA Flow, which will be evaluated to perform for the Sustained Operating period under the expected radiological and temperature conditions.

Equipment Protection

Any SAWA component and connections external to protected buildings will be protected against the screened-in hazards of EA-12-049 for the station. Portable equipment used for SAWA implementation will meet the protection requirements for storage in accordance with the criteria in NEI 12-06 Revision 0.

Ref: EA-13-109 Attachment 2, Section B.2.2, B.2.3/NEI 13-02 Section 5.1.1, 5.4.6, I.1.6

Provide a brief description of Procedures / Guidelines:

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

Ref: EA-13-109 Attachment 2, Section A.3.1, B.2.3/NEI 13-02 Section 1.3, 6.1.2

The FLEX Support Instructions (FSI) will contain the guidance to perform the following actions:

- *Hook up FLEX pump to SAWA connection*
- *Hook-up and start FLEX DG to repower 4KV Shutdown Boards*
- *Align 4KV Shutdown Board power to appropriate 480 Volt Boards*
- *Manually Align SAWA flow to Core Spray loop II*
- *Start FLEX pump via on-board generator*
- *Open Loop II Core Spray Injection valves to start SAWA flow*
- *Adjust flow rate using skid mounted flow indicator and isolation/throttle valve*

Identify modifications*:*

List modifications and describe how they support the SAWA Actions.

Ref: EA-13-109 Attachment 2, Section B.2.2,/NEI 13-02 Section 4.2.4.4, 7.2.1.8, Appendix I

A modification will be required for EA-13-109 Phase 2 to install pipe to replace FLEX hose connections to reduce actions in the Reactor Building.

Component Qualifications:

State the qualification used for equipment supporting SAWA

Ref: EA-13-109 Attachment 2, Section B.2.2, B.2.3/NEI 13-02 Section I.1.6

Permanently installed plant equipment shall meet the same qualifications as described in Part 2 of this OIP. Temporary/Portable equipment shall be qualified and stored to the same requirements as FLEX equipment as specified in NEI 12-06. SAWA components are not

Part 3: <u>Boundary Conditions for EA-13-109, Option B.2</u>
required to meet NEI 13-02, Table 2-1 design conditions.
Notes:

Part 3: <u>Boundary Conditions for EA-13-109, Option B.2</u>
Part 3.1.A: Boundary Conditions for SAWA/SAWM
Time periods for maintaining SAWM actions such that the WW vent remains available

SAWM Actions supporting SA conditions 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 walkthrough of deployment). Actions already identified under the HCVS section of this template need not be repeated here.
There are three time periods for the maintaining SAWM actions such that the WW vent remains available to remove decay heat from the containment:
• *SAWM can be maintained for greater than 7 days without the need for a drywell vent to maintain pressure below PCPL or containment design pressure, whichever is lower.*
  o *Under this approach, no detail concerning plant modifications or procedures is necessary with respect to how alternate containment heat removal will be provided.*
• *SAWM can be maintained for at least 72 hours, but less than 7 days before containment pressure reaches PCPL or design pressure, whichever is lower.*
  o *Under this approach, a functional description is required of how alternate containment heat removal might be established before containment pressure reaches PCPL or design pressure whichever is lower. Under this approach, physical plant modifications and detailed procedures are not necessary, but written descriptions of possible approaches for achieving alternate containment heat removal and pressure control will be provided.*
• *SAWM can be maintained for less than 72 hours* SAWM strategy can be implemented but for less than 72 hours before containment pressure reaches PCPL or design pressure whichever is lower.
  o *Under this approach, a functional description is required of how alternate containment heat removal might be established before containment pressure reaches PCPL or design pressure whichever is lower. Under this approach, physical plant modifications and detailed procedures are required to be implemented to insure achieving alternate containment heat removal and pressure control will be provided for the sustained operating period.*
Ref: NEI 13-02 Appendix C.7

Part 3: Boundary Conditions for EA-13-109, Option B.2

SAWM can be maintained for greater than7 days without the need for a drywell vent to maintain pressure below PCPL.

Basis for SAWM time frame

SAWM can be maintained greater than 7 days:

BFN is bounded by the evaluations performed in BWROG TP-2015-008 and is representative of the reference plant in NEI 13-02 figures C-2 through C-6.

Instrumentation relied upon for SAWM operations is Drywell pressure and Suppression Pool level. All these are powered by station batteries which are maintained charged by the FLEX (EA-12-049) generator which is placed in-service prior to core breach. The DG will provide power throughout the Sustained Operation period (7 days).

Suppression Pool level is maintained below the height of the HCVS opening throughout the Sustained Operation period, so the HCVS remains in-service. The time to reach the level at which the Wetwell vent must be secured is greater than 7days using SAWM flowrates

Procedures will be developed that control the Suppression Pool level in the indicating range, while ensuring the DW pressure indicates the core is being cooled, whether in-vessel or ex-vessel. Procedures will dictate conditions during which SAWM flow rate should be adjusted (up or down) using Suppression Pool level and Drywell pressure as controlling parameters to remove the decay heat from the containment.

Attachment 2.1.A shows the timeline of events for SAWA/SAWM.

Table 3.1.B – SAWM Manual Actions

Primary Action	Primary Location /Component	Notes
1. Lower SAWA injection rate to control Suppression Pool level and decay heat removal	SA-A1 staging area	• Control to maintain containment and Suppression Pool parameters to ensure SAWV remains operational. • 100 gpm minimum capability is maintained for greater than 7 days
2. Control SAWA flow rate for containment control / decay heat removal	SA-A1 staging area and MCR	• SAWA Flow rates will be monitored using the following instrumentation ○ FLEX Pump Flow ○ Suppression Pool level ○ DW pressure • SAWA flow rates will be controlled using the manual flow control valve

Part 3: <u>Boundary Conditions for EA-13-109, Option B.2</u>

		at the FLEX pump
3. Establish alternate source of decay heat removal	Yard	• Greater than 7days
4. Secure SAWA / SAWM	SA-A1 staging area	• When reliable alternate containment decay heat removal and pressure control is established.

SAWM Time Sensitive Actions

Time Sensitive SAWM Actions:

12 Hours – Initiate actions to maintain the Wetwell vent (HCVS) capability by lowering injection rate, while maintaining the cooling of the core debris (SAWM). Monitor SAWM critical parameters while ensuring the SAWV remains available.

SAWM Severe Accident Operation

Determine operating requirements for SAWM, such as may be used in an ELAP scenario to mitigate core damage.

Ref: EA-13-109 Attachment 2, Section B.2.2, B.2.3/NEI 13-02 Appendix C

It is anticipated that SAWM will only be used in Severe Accident events based on presumed failure of injection systems.

First 24 Hour Coping Detail

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

Given the initial conditions for EA-13-109:

- *BDBEE occurs with ELAP*
- *Failure of all injection systems, including steam-powered injection systems*

Ref: EA-13-109 Section 1.2.6, Attachment 2, Section B.2.2, B.2.3/NEI 13-02 2.5, 4.2.2, Appendix C, Section C.7

SAWA will be established as stated above. SAWM will use the installed instrumentation to monitor and adjust the flow from SAWA to deliver flowrates applicable to the SAWM strategy.

Once the SAWA initial flow rate has been established for 4 hours, the flow will be reduced monitoring Drywell pressure and Suppression Pool level. SAWA flow rate can be lowered to maintain containment parameters and preserve the Wetwell vent path. SAWA will be capable

Part 3: Boundary Conditions for EA-13-109, Option B.2
of injection for the period of Sustained Operation.
Greater Than 24 Hour Coping Detail
Provide a general description of the SAWM 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, Attachment 2, Section B.2.2, B.2.3/NEI 13-02 Section 4.2.2, Appendix C, Section C.7**
SAWM can be maintained greater than 7 days: The SAWM flow strategy will be the same as the first 24 hours until 'alternate reliable containment heat removal and pressure control' is established. SAWM flow strategy uses the SAWA flow path.
Details:
Details of Design Characteristics/Performance Specifications **Ref: EA-13-109 Attachment 2, Section B.2.2, B.2.3/NEI 13-02 Section Appendix C**
SAWM shall be capable of monitoring the containment parameters (Drywell pressure and Suppression Pool level) to provide guidance on when injection rates shall be reduced, until alternate containment decay heat removal/pressure control is established. SAWA will be capable of injection for the period of Sustained Operation.
Equipment Locations/Controls/Instrumentation *Describe location for SAWM monitoring and control.* **Ref: EA-13-109 Attachment 2, Section B.2.2, B.2.3/NEI 13-02 Appendix C, Section C.8, Appendix I**
The SAWM control location is the same as the SAWA control location. Local indication of SAWA flow rate is provided at the pump skid by installed flow instrument qualified to operate under the expected environmental conditions. Injection flowrate is controlled by FLEX manual valve located on the FLEX pump at the SA-A1 staging area. Suppression Pool level and Drywell pressure are read in the control room using indicators powered by the FLEX DG installed under EA-12-049. These indications are used to control SAWA flowrate to the RPV.

Part 3: <u>Boundary Conditions for EA-13-109, Option B.2</u>
Key Parameters: *List instrumentation credited for the SAWM Actions.*
Parameters used for SAWM are: • DW Pressure • Suppression Pool Level • SAWA Flow The DW Pressure and Suppression Pool Level instruments are qualified to RG 1.97 and are the same as listed in Section 2 of this OIP. The SAWA flow instrumentation is qualified for the expected environmental conditions expected when needed which is extreme temperatures.
Notes:

Part 4: <u>Programmatic Controls, Training, Drills and Maintenance</u>

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

<u>Program Controls:</u>

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 analyzed for radiation and temperature to ensure they are accessible during all modes of operation and during severe accidents.

The Hardened Containment Vent System (HCVS) is comprised of the following installed and portable equipment and operating guidance:

- Severe Accident Wetwell Vent (SAWV) – Permanently installed vent from the torus of each BFN unit to an elevation approximately 20 feet above the top of the Reactor Building
- Severe accident Water Addition (SAWA) – A combination of permanently installed and portable equipment to provide a means to add water to the RPV following a severe accident and monitor system and plant conditions.

In addition, Severe Accident Water Management (SAWM) strategies and guidance for controlling the water addition to the RPV/containment to support operation of SAWV and SAWA for the sustained operating period will be developed per attachment 2.1.D.

<u>Procedures:</u>

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

The HCVS procedures will be developed and implemented following the site's process for initiating or revising procedures and will 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.

Part 4: Programmatic Controls, Training, Drills and Maintenance

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

BFN will establish provisions for out-of-service requirements of the HCVS and compensatory measures. The following provisions will be documented in OPDP-8 "Operability Determination Process and Limiting Conditions for Operations Tracking" (Reference 37):

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 be performed:
  - The cause(s) of the non-functionality
  - The actions to be taken and the schedule for restoring the system to functional status and prevent recurrence
  - Initiate action to implement appropriate compensatory actions, and
  - Restore full HCVS functionality at the earliest opportunity not to exceed one full operating cycle.

Describe training plan

List training plans for affected organizations or describe the plan for training development

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

Personnel expected to perform direct execution of the HCVS actions 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 actions, systems or strategies. Training content and frequency will be established using the Systematic Approach to Training (SAT) process.

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

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

Part 4: Programmatic Controls, Training, Drills and Maintenance

The Licensee should demonstrate use of the HCVS 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: Severe Accident Wetwell 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.
- SAWV 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 SAMG change).
- Operation for sustained period with SAWA and SAWM to provide decay heat removal and containment pressure control.

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/SAWA/SAWM 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 SAWV/SAWA equipment reliability is being achieved in a manner similar to that required for FLEX equipment. Standard industry templates (e.g. EPRI) and associated bases may be developed to define specific maintenance and testing.
  - Periodic testing and frequency should be determined based on equipment type, expected use and manufacturer's recommendations (further details are provided in Section 6 of this document).
  - Testing should be done to verify design requirements and/or basis. The basis should be documented and deviations from vendor recommendations and applicable standards should be justified.
  - Preventive maintenance should be determined based on equipment type and expected use. The basis should be documented and deviations from vendor recommendations and applicable standards should be justified.
  - Existing work control processes may be used to control maintenance and testing.
- HCVS permanent installed equipment should be maintained in a manner that is consistent with assuring that it performs its function when required.
  - HCVS permanently installed equipment should be subject to maintenance and testing guidance provided to verify proper function.
- HCVS non-installed equipment should be stored and maintained in a manner that is

Part 4: Programmatic Controls, Training, Drills and Maintenance

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

BFN will utilize the standard EPRI industry preventive maintenance (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.

BFN 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 SAWV and installed SAWA valves[1] and the interfacing system boundary valves not used to maintain containment integrity during Mode 1, 2 and 3. For HCVS valves, this test may be performed concurrently with the control logic test described below.	Once per every[2] operating cycle
Cycle the SAWV and installed SAWA check valves not used to maintain containment integrity during unit operations[3].	Once per every other[4] operating cycle
Perform visual inspections and a walk down of SAWV and installed SAWA components.	Once per operating cycle
Functionally test the SAWV radiation monitors.	Once per operating cycle
Leak test the SAWV (as described in Section 6.2.2 and 6.2.3).	(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 buildings.
Validate the SAWV operating procedures by conducting an open/close test of the HCVS control function from its control location and ensuring that all SAWV vent path and interfacing system boundary valves[5] move to their proper (intended) positions.	Once per every other operating cycle

Part 4: Programmatic Controls, Training, Drills and Maintenance
Notes: 1. Not required for SAWV and SAWA check valves. 2. After two consecutive successful performances, the test frequency may be reduced to a maximum of once per every other operating cycle. 3. Not required if integrity of check function (open and closed) is demonstrated by other plant testing requirements. 4. After two consecutive successful performances, the test frequency may be reduced by one operating cycle to a maximum of once per every fourth operating cycle. 5. Interfacing system boundary valves that are normally closed and fail closed under ELAP conditions (loss of power and/or air) do not require control function testing under this section. Performing existing plant design basis function testing or system operation that reposition the valve(s) to the HCVS required position will meet this requirement without the need for additional testing.

ENCLOSURE 2

Tennessee Valley Authority Browns Ferry Nuclear Plant's Phase 1 and Phase 2 Overall Integrated Plan for the Implementation of Order EA-13-109, "Issuance Of Order to Modify Licenses With Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions," Revision 2

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.

Phase 1 Milestone Schedule:			
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	Complete	
Submit 6 Month Status Report	Jun. 2015	Complete	
Submit 6 Month Status Report	Dec 2015	Complete with this submittal	Simultaneous with Phase 2 OIP
U1 Design Engineering On-site/Complete	Apr 2016	Started	
Submit 6 Month Status Report	Jun 2016		
Operations Procedure Changes Developed	Jul 2016		

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Tennessee Valley Authority Browns Ferry Nuclear Plant's Phase 1 and Phase 2 Overall Integrated Plan for the Implementation of Order EA-13-109, "Issuance Of Order to Modify Licenses With Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions," Revision 2

Part 5: Milestone Schedule

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		
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		

Phase 2 Milestone Schedule:

Milestone	Target Completion Date	Activity Status	Comments *{Include date changes in this column}*
Submit Overall Integrated Implementation Plan	Dec 2015	Complete with this submittal	
Submit 6 Month Status Report	June 2016		

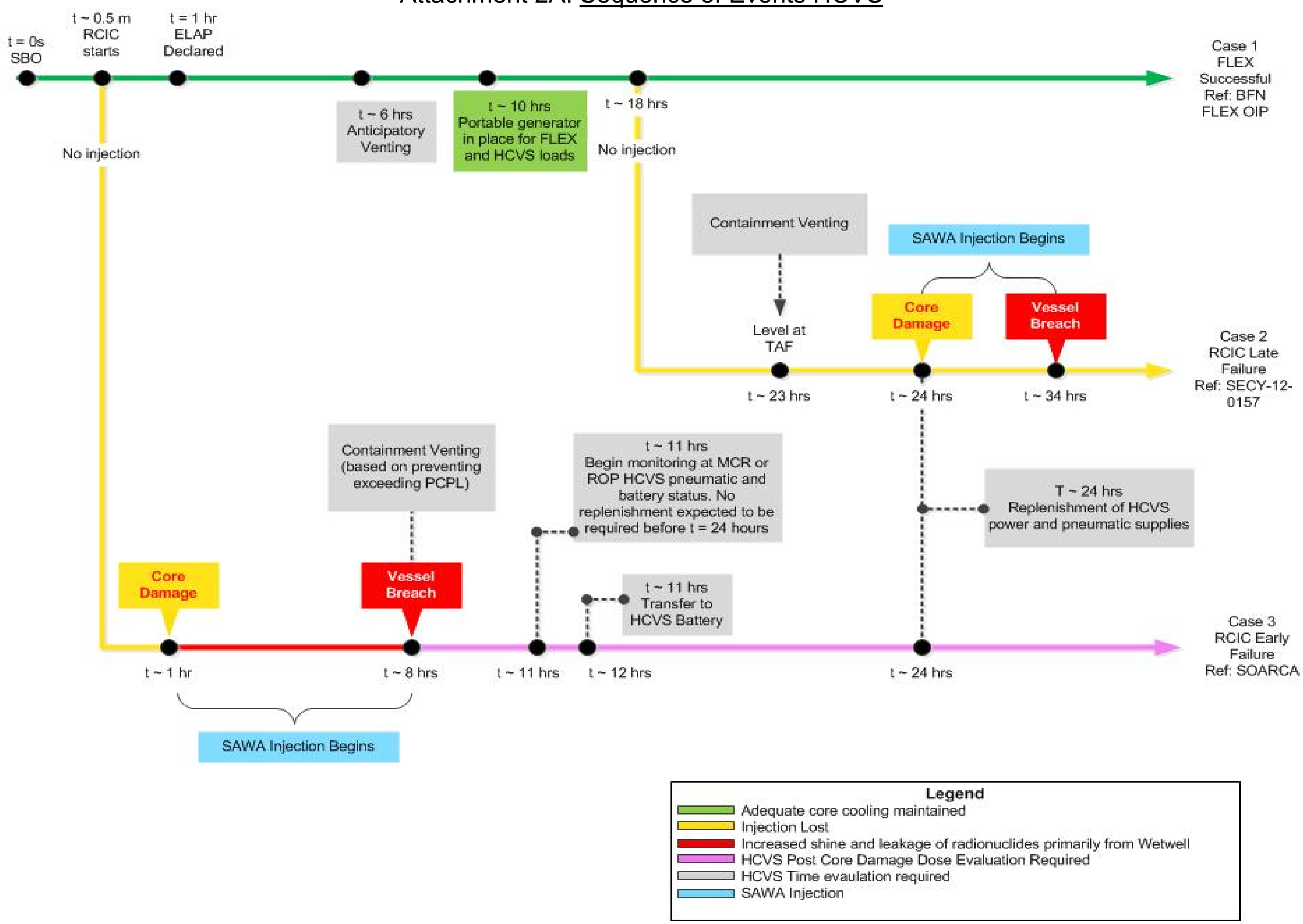
Submit 6 Month Status Report	Dec 2016		
Hold preliminary/conceptual design meeting	Jan 2017		
U3 Design Engineering On-site/Complete	May 2017		
Submit 6 Month Status Report	June 2017		
Operations Procedure Changes Developed	Sep 2017		SAMG Revision
Site Specific Maintenance Procedure Developed	Dec 2017		Expect to be N/A
Training Complete	Dec 2017		
Submit 6 Month Status Report	Dec 2017		
U1 Design Engineering On-site/Complete	Dec 2017		
U3 Implementation Outage	Mar 2018		
Procedure Changes Active	Mar 2018		
U3 Walk Through Demonstration/Functional Test	Mar 2018		
U2 Design Engineering On-site/Complete	May 2018		
Submit 6 Month Status Report	June 2018		
Submit 6 Month Status Report	Dec 2018		
U1 Implementation Outage	Oct 2018		
U1 Walk Through Demonstration/Functional Test	Oct 2018		
U2 Implementation Outage	Mar 2019		
U2 Walk Through Demonstration/Functional Test	Mar 2019		
Submit Completion Report	May 2019		

Notes:

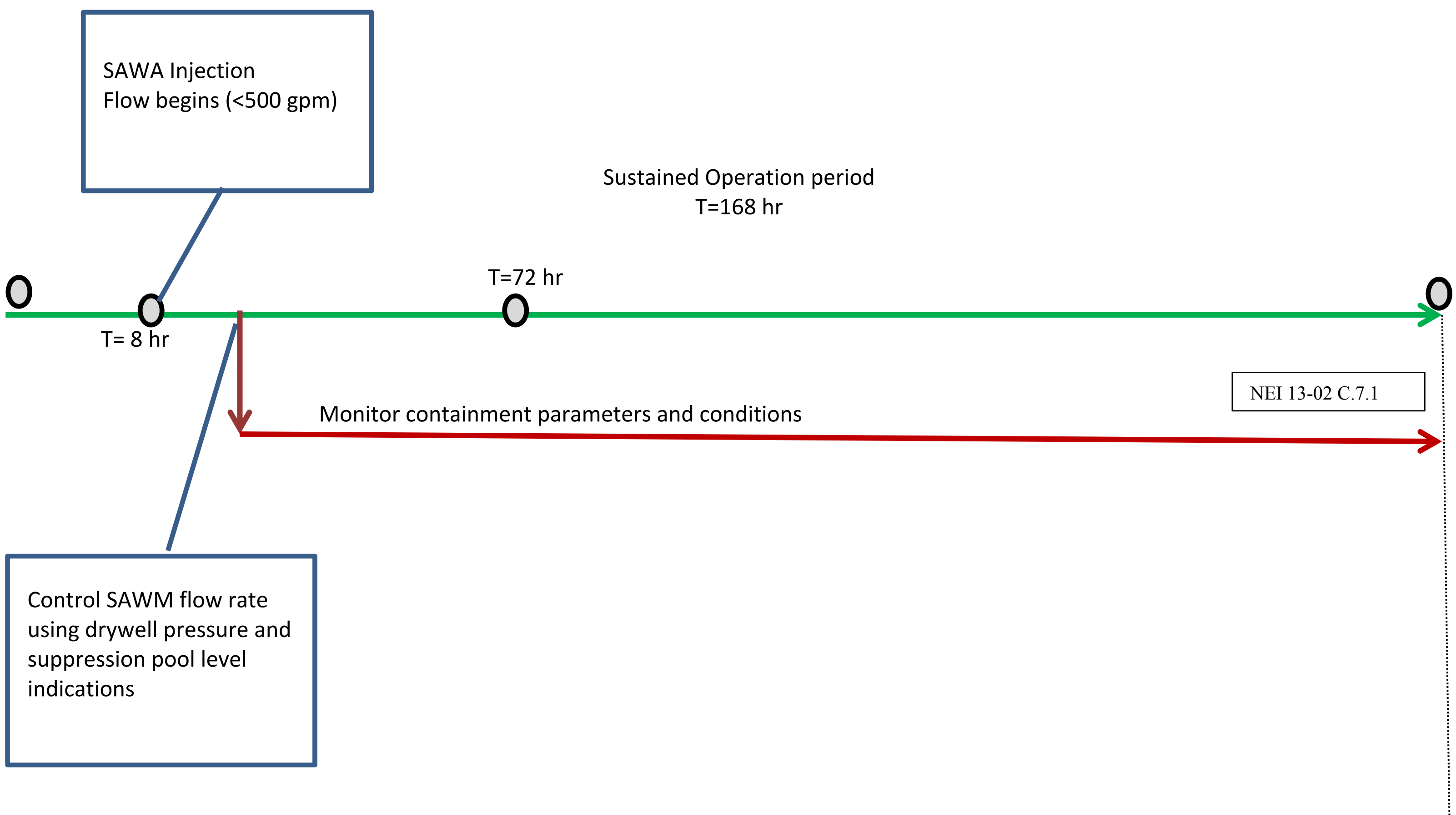
Attachment 1: HCVS/SAWA/SADV Portable Equipment				
List portable equipment	*BDBEE Venting*	*Severe Accident Venting*	*Performance Criteria*	*Maintenance / PM requirements*
FLEX Portable Generators	X	X	TBD	Per Response to EA-12-049
Nitrogen Cylinders	X	X	TBD	Check periodically for pressure, replace or replenish as needed
SAWA Pump (and associated equipment)	**X**	**X**	**TBD**	

Tennessee Valley Authority Browns Ferry Nuclear Plant's Phase 1 and Phase 2 Overall Integrated Plan for the Implementation of Order EA-13-109, "Issuance Of Order to Modify Licenses With Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions," Revision 2

Attachment 2A: Sequence of Events HCVS



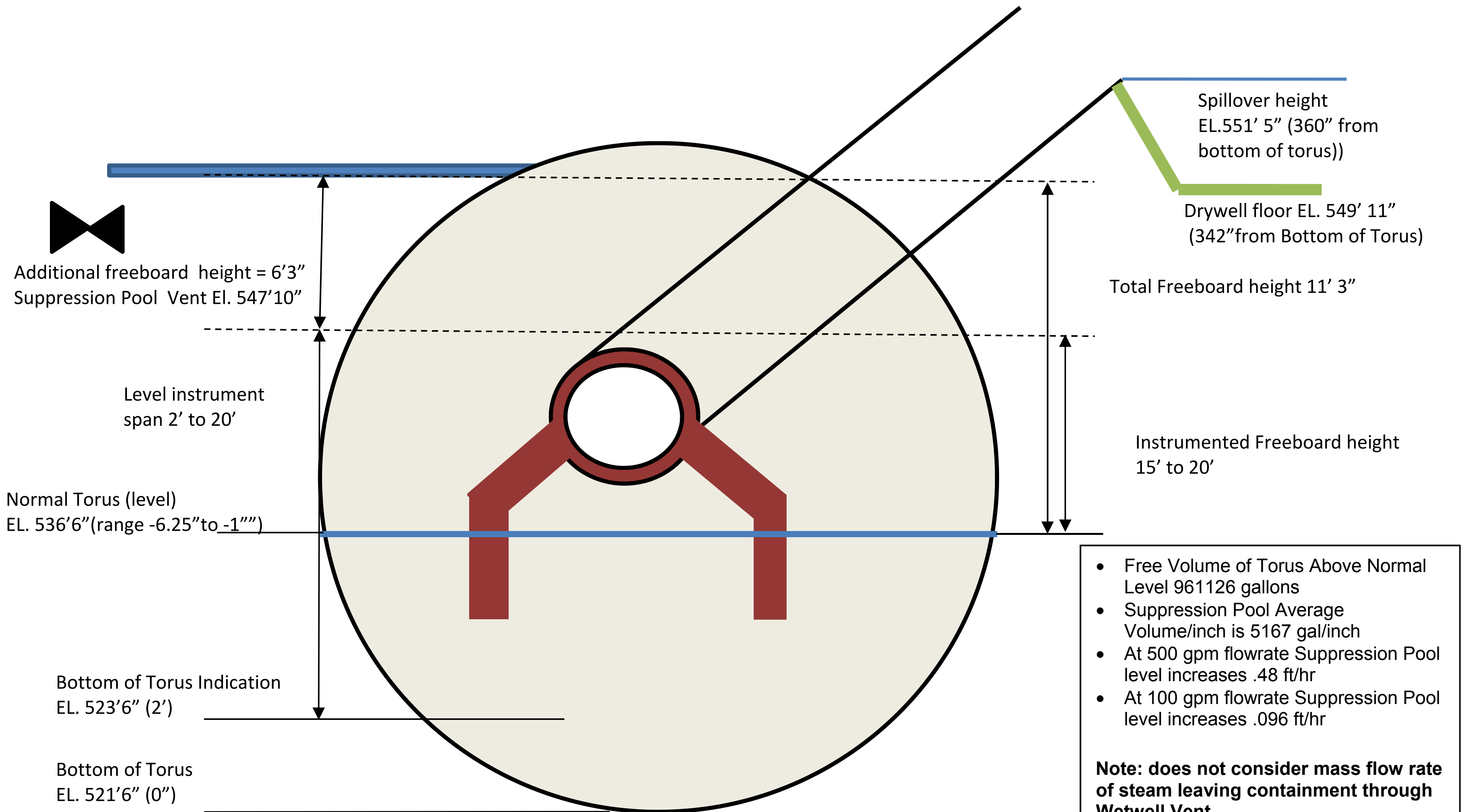
Attachment 2.1.A: Sequence of Events Timeline – SAWA / SAWM



Attachment 2.1.B: Sequence of Events Timeline – SADV

Not used at BFN

Attachment 2.1.C: <u>SAWA / SAWM Plant-Specific Data (Drawing not to Scale)</u>



- Free Volume of Torus Above Normal Level 961126 gallons
- Suppression Pool Average Volume/inch is 5167 gal/inch
- At 500 gpm flowrate Suppression Pool level increases .48 ft/hr
- At 100 gpm flowrate Suppression Pool level increases .096 ft/hr

Note: does not consider mass flow rate of steam leaving containment through Wetwell Vent

Attachment 2.1.D: SAWM SAMG Approved Language

The following general cautions, priorities and methods will be evaluated for plant specific applicability and incorporated as appropriate into the plant specific SAMGs using administrative procedures for EPG/SAG change control process and implementation. SAMGs are symptom based guidelines and therefore address a wide variety of possible plant conditions and capabilities while these changes are intended to accommodate those specific conditions assumed in Order EA-13-109. The changes will be made in a way that maintains the use of SAMGs in a symptom based mode while at the same time addressing those conditions that may exist under extended loss of AC power (ELAP) conditions with significant core damage including ex-vessel core debris.

Actual Approved Language that will be incorporated into site SAMG*

Cautions:

- Addressing the possible plant response associated with adding water to hot core debris and the resulting pressurization of the primary containment by rapid steam generation.
- Addressing the plant impact that raising suppression pool water level above the elevation of the suppression chamber vent opening elevation will flood the suppression chamber vent path.

Priorities:

With significant core damage and RPV breach, SAMGs prioritize the preservation of primary containment integrity while limiting radioactivity releases as follows:

- Core debris in the primary containment is stabilized by water addition (SAWA)
- Primary containment pressure is controlled below the Primary Containment Pressure Limit (Wetwell venting)
- Water addition is managed to preserve the Mark I/II suppression chamber vent paths, thereby retaining the benefits of suppression pool scrubbing and minimizing the likelihood of radioactivity and hydrogen release into the secondary containment (SAWM)

Methods:

Identify systems and capabilities to add water to the RPV or drywell, with the following generic guidance:

- Use controlled injection if possible.
- Inject into the RPV if possible.
- Maintain injection from external sources of water as low as possible to preserve suppression chamber vent capability.

* Actual language may vary by acceptable site procedure standards, but intent and structure should follow this guidance.

Attachment 3: Conceptual Sketches

(Conceptual sketches, as necessary to indicate equipment which is installed or equipment hookups necessary for the HCVS Actions)

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Tennessee Valley Authority Browns Ferry Nuclear Plant's Phase 1 and Phase 2 Overall Integrated Plan for the Implementation of Order EA-13-109, "Issuance Of Order to Modify Licenses With Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions," Revision 2

Figure 1 – Flow Diagram

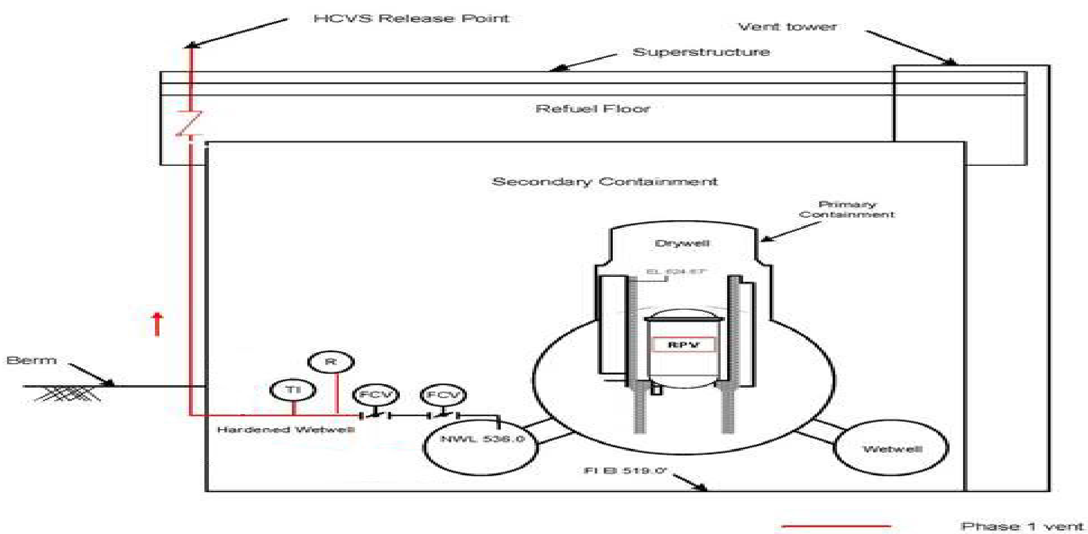


Figure 2 - Mechanical I&C Flow Diagram Control Air System

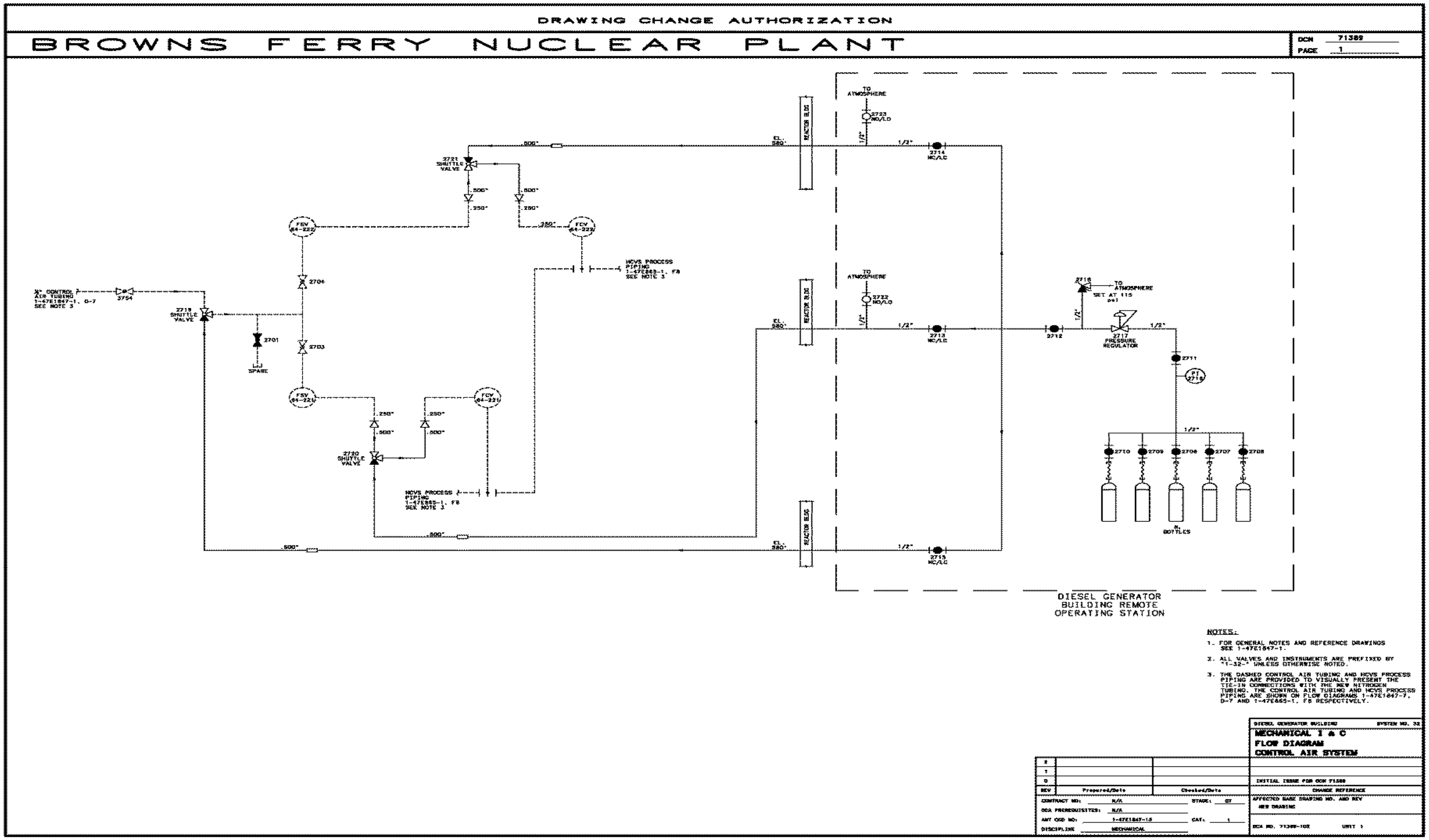


Figure 3 - HCVS Electrical Block Diagram

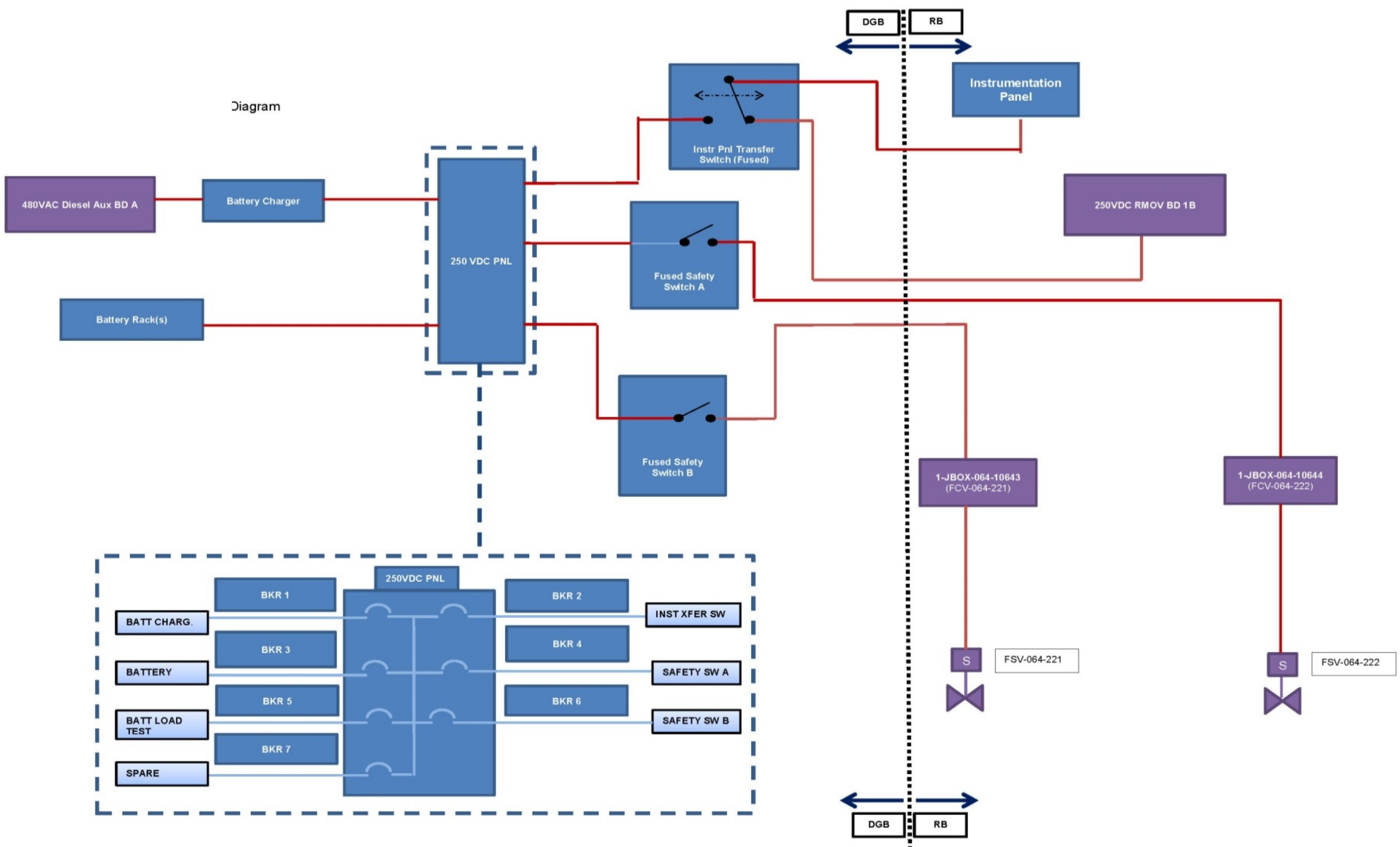


Figure 4 - BFNP Roof Plan View

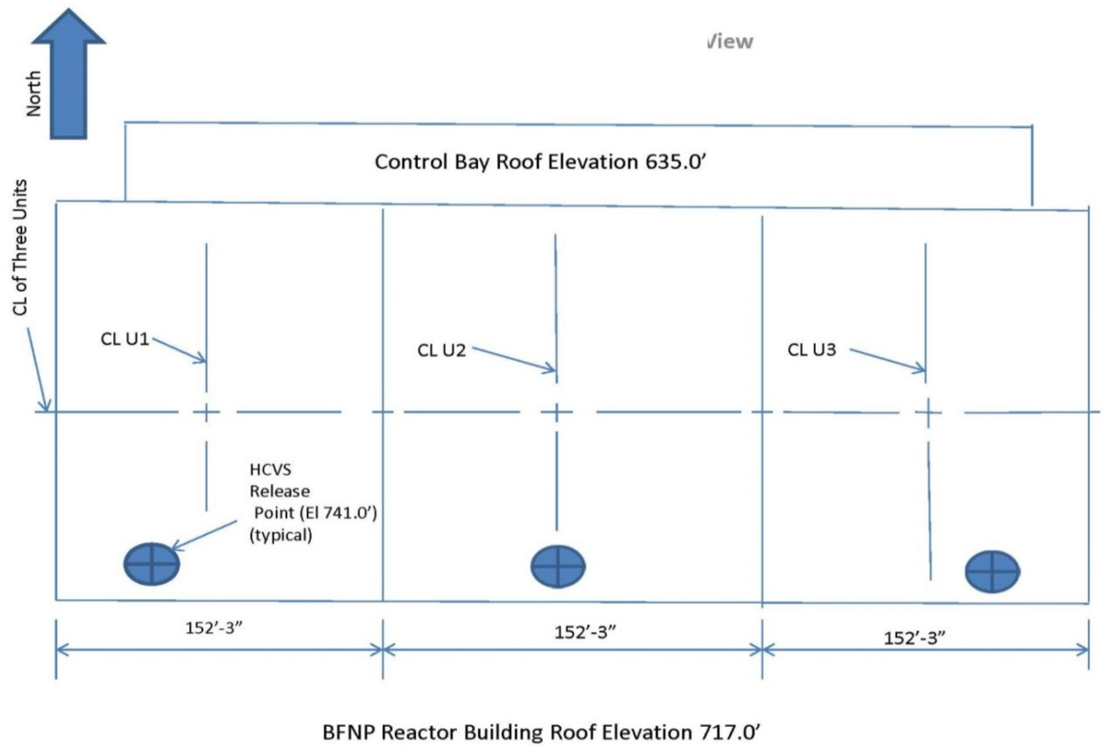


Figure 5 - HCVS Release Point

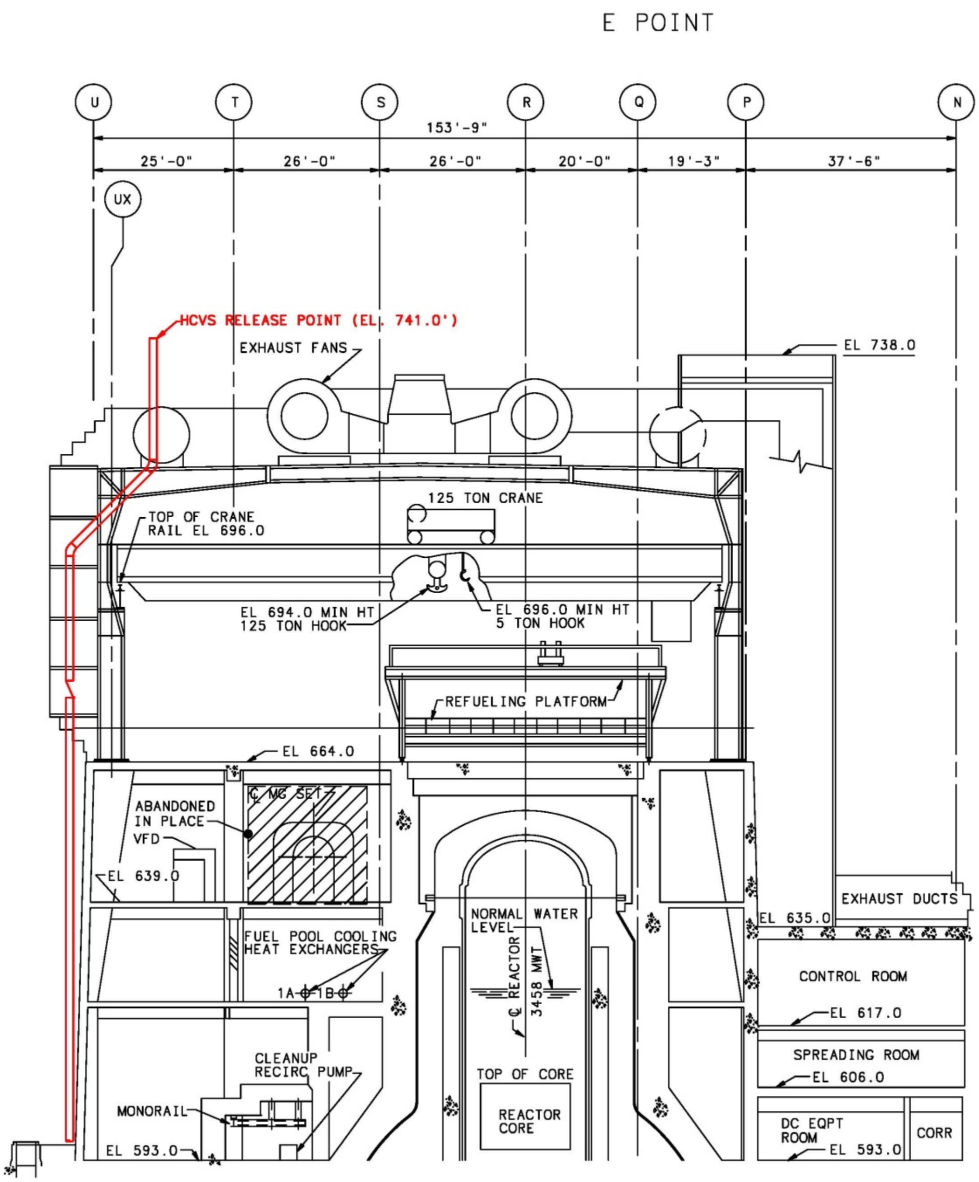


FIGURE 6 HCVS BOUNDARY

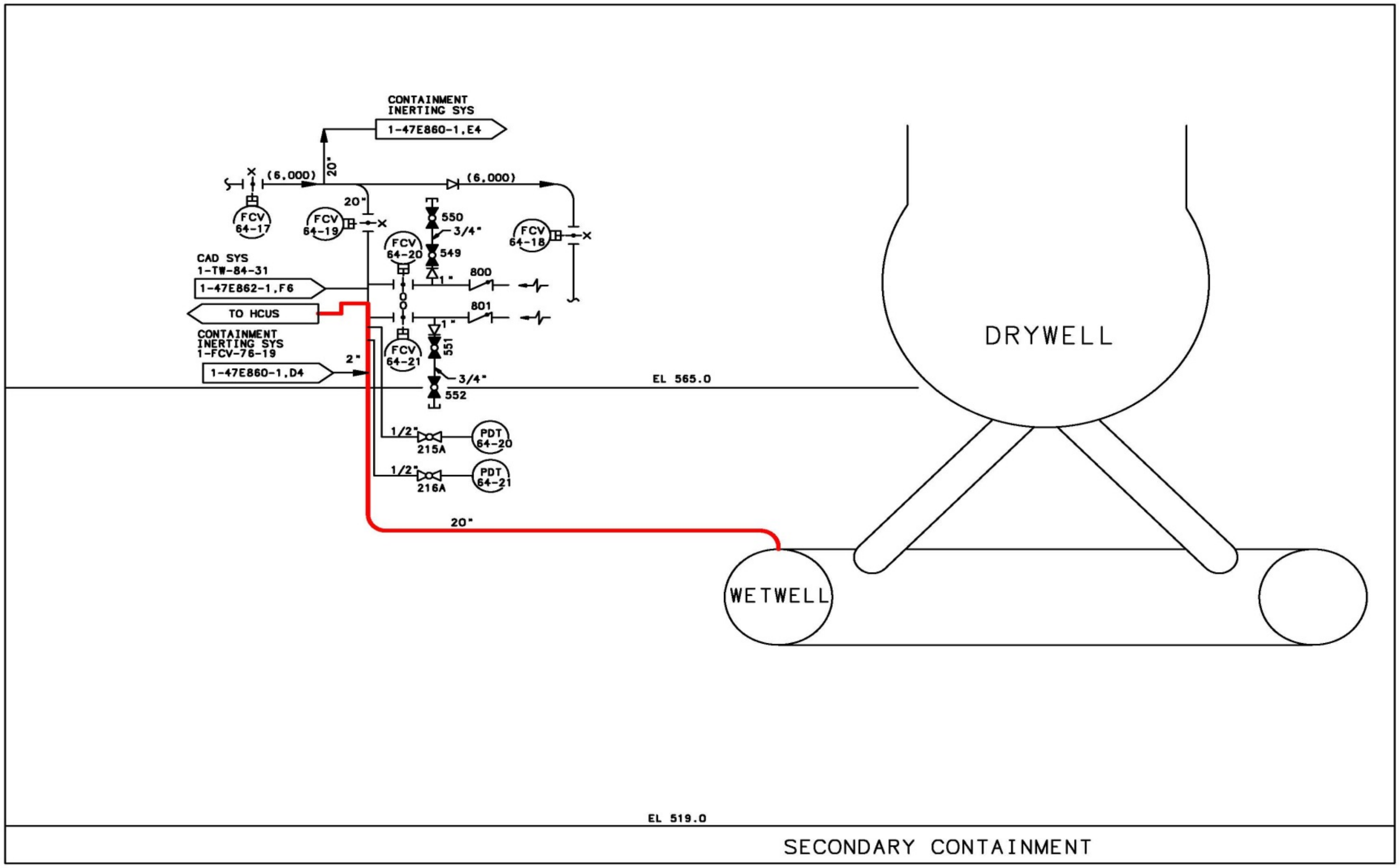


Figure 7 - Monitoring Locations

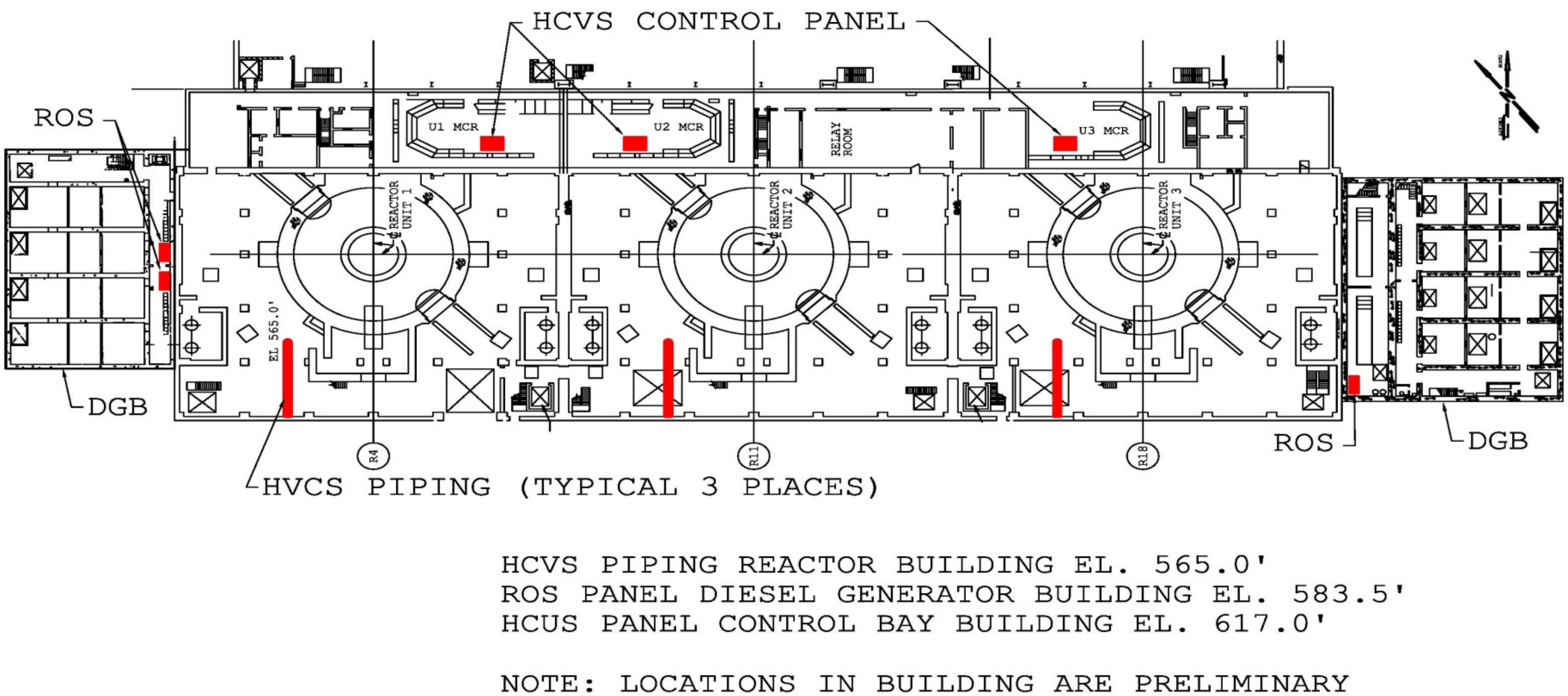
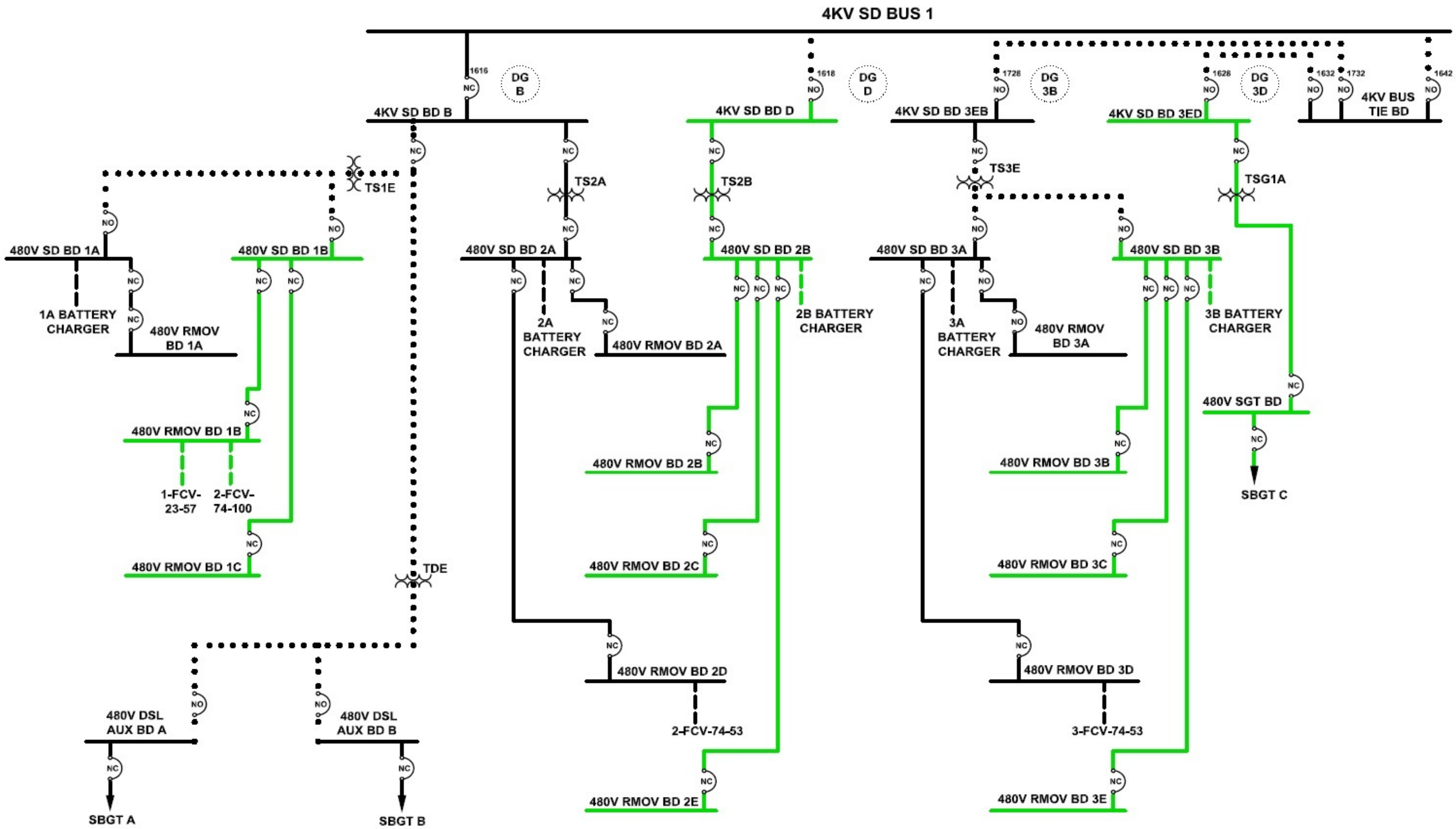
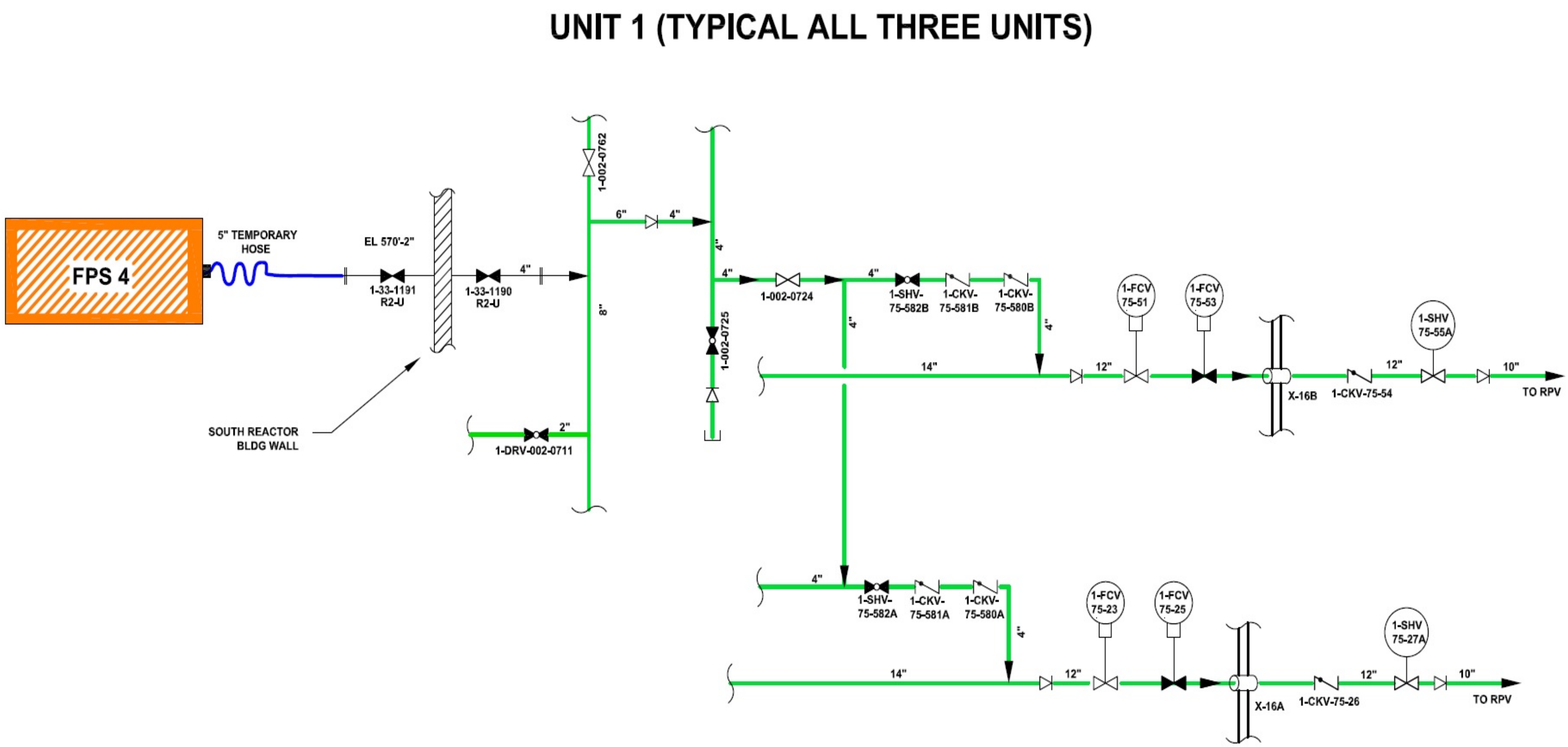


Figure 8 - 4KV Electrical Distribution Diagram



Tennessee Valley Authority Browns Ferry Nuclear Plant's Phase 1 and Phase 2 Overall Integrated Plan for the Implementation of Order EA-13-109, "Issuance Of Order to Modify Licenses With Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions," Revision 2

Figure 9 - SAWA Flowpath



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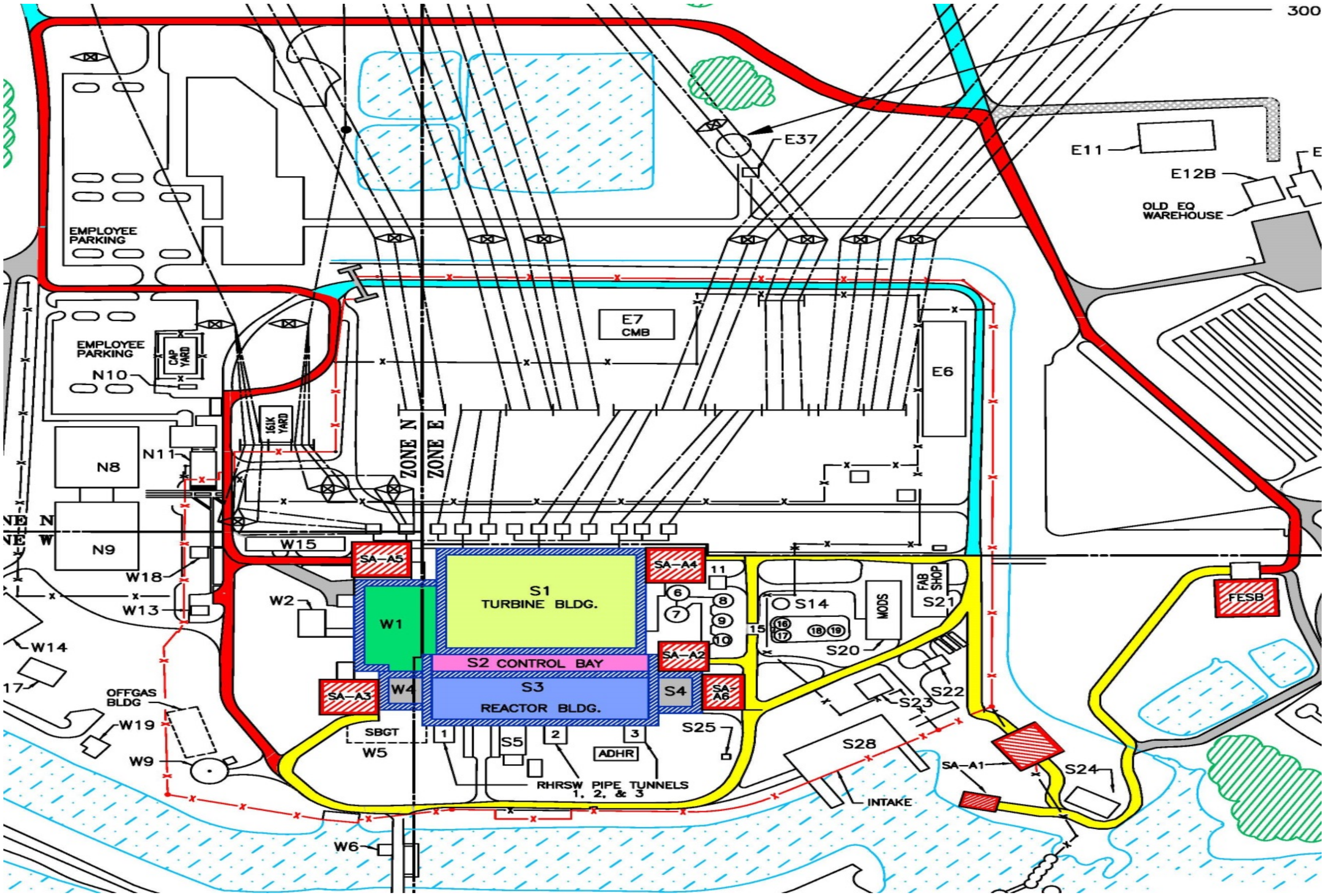
Tennessee Valley Authority Browns Ferry Nuclear Plant's Phase 1 and Phase 2 Overall Integrated Plan for the Implementation of Order EA-13-109, "Issuance Of Order to Modify Licenses With Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions," Revision 2

Figure 10 FLEX Staging



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, N2 can be supplied by nitrogen tanks, which is sufficient for greater than 8 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 N2 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

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Tennessee Valley Authority Browns Ferry Nuclear Plant's Phase 1 and Phase 2 Overall Integrated Plan for the Implementation of Order EA-13-109, "Issuance Of Order to Modify Licenses With Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions," Revision 2

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 Revision 1, dated August 28, 2015
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 0, dated August 2012
11. NEI 13-02, Industry Guidance for Compliance with Order EA–13–109, Revision 1, Dated April 2015
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

Attachment 5: <u>References (continued)</u>

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. BFN EA-12-049 (FLEX) Overall Integrated Implementation Plan, Rev 0, February 2013
29. BFN EA-12-050 (HCVS) Overall Integrated Implementation Plan, Rev 0, February 2013
30. BFN EA-12-051 (SFPLI) Overall Integrated Implementation Plan, Rev 0, February 2013
31. BFN Calculation MDN0999980114 Rev 3 "Station Blackout Evaluation"
32. BFN Calculation EDQ0009992013000202 Rev 0, "250V DC UNIT BATTERIES 1,2 & 3 EVALUATION"
33. BFN Design Criteria BFN-50-C-7101 Rev 03, "Protection from wind, tornado wind, tornado depressurization, tornado generated missiles, and external flooding"
34. BFN Procedure 1/2/3-EOI-2, Primary Containment Control
35. BFN Design Criteria: BFN-50-7360, "FLEX MITIGATION SYSTEM"
36. TVA Calculation MDQ0003602014000222, "BFN ELAP Transient Temperature Analysis"
37. TVA OPDP-8, "Operability Determination Process and Limiting Conditions for Operation Tracking," Revision 18.
38. Browns Ferry Nuclear Plant, Units 1,2, and 3 - Interim Staff Evaluation Relating To Overall Integrated Plan In Response To Phase 1 of Order EA-13-109 (Severe Accident Capable Hardened Vents) (TAC NOS. MF4540, MF4541 and MF4542)
39. Consideration of Additional Requirements for Containment Venting Systems for Boiling Water Reactors with Mark I and Mark II Containments, SECY-12-0157, ML12344A030
40. NUREG/CR-7110, V1, R1, State-of-the-Art Reactor Consequence Analyses (SOARCA) Project: Peach Bottom Integrated Analysis, ML13150A053
41. JLD-ISG-2015-01, Compliance with Phase 2 of Order EA-13-109, Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation under Severe Accident Conditions, dated March 2015
42. NEI HCVS-FAQ-10, Severe Accident Unit Response
43. NEI HCVS-FAQ-11, Plant Response During a Severe Accident
44. NEI HCVS-FAQ-12, Radiological Evaluations on Plant Actions Prior to HCVS Initial Use
45. NEI HCVS-FAQ-13, Severe Accident Venting Actions Validation.

Attachment 6: <u>Changes/Updates to this Overall Integrated Implementation Plan</u>

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

None.

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Tennessee Valley Authority Browns Ferry Nuclear Plant's Phase 1 and Phase 2 Overall Integrated Plan for the Implementation of Order EA-13-109, "Issuance Of Order to Modify Licenses With Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions," Revision 2

Attachment 7: List of Overall Integrated Plan and Interim Staff Evaluation (ISE) Open Items

#	Overall Integrated Plan Phase 1 and 2 Open Item	Status
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.	Open
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.	Closed - Evaluation has been completed and documented in Calculation MDQ0000322015000347 R0, HCVS Nitrogen System Sizing Analysis, and DCN 71389.
3	Perform an evaluation for FLEX portable generators and nitrogen cylinders use past 24 hour actions.	Open
4	Revise 1/2/3-EOI Appendix 13 to include venting for loss of DC power.	Open
5	Perform an evaluation for FLEX portable generators use for post 24 hour actions in Severe Accident conditions.	Open
6	Electrical load shedding will be performed in 1 hour of the event.	Closed - Calculation EDQ0009992013000202 R3, 250V DC Unit Batteries, 1, 2, & 3 Evaluation for the Beyond Design Basis External Event (BDBEE) Extended Loss of AC Power (ELAP), has been issued to determine load shedding impact on the unit batteries.
7	The implementation of the HCVS DCNs will be staged so that there is no effect on the operating units.	Closed - A conceptual meeting was held in November 2014, and a staging plan was used to separate the existing HWWV from the HCVS.

ENCLOSURE 2

Tennessee Valley Authority Browns Ferry Nuclear Plant's Phase 1 and Phase 2 Overall Integrated Plan for the Implementation of Order EA-13-109, "Issuance Of Order to Modify Licenses With Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions," Revision 2

#	Overall Integrated Plan Phase 1 and 2 Open Item	Status
8	The wetwell vent will be designed to remove 1 percent of rated thermal power at EPU conditions.	Closed - The existing wetwell vent (CLTP) and the HCVS (EPU) have been designed for 1 percent of rated thermal power at EPU conditions
9	Implement the Harris Radio System for communication between the MCR and the ROS.	Closed - A communication system has been implemented that uses hand held radios for communication between the MCR and the ROS. DCN 70852
10	Perform an evaluation for the locations of the SAWA equipment and controls, as well as ingress and egress paths for the expected Severe Accident conditions (temperature, humidity, radiation) for the Sustained Operating period	Open
11	Perform an hydraulic evaluation to ensure flow adequacy can be met for all 3 units using 1 FLEX pump to support SAWA flow requirement	Open

ENCLOSURE 2

Tennessee Valley Authority Browns Ferry Nuclear Plant's Phase 1 and Phase 2 Overall Integrated Plan for the Implementation of Order EA-13-109, "Issuance Of Order to Modify Licenses With Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions," Revision 2

#	Interim Staff Evaluation Phase 1 Open Items	Status
1	Make available for NRC staff audit an evaluation of temperature and radiological conditions to ensure that operating personnel can safely access and operate controls and support equipment.	In Progress
2	Make available for NRC audit documentation that procedure 1/2/3-EOI Appendix 13 to has been revised to include venting for loss of dc power.	In Progress
3	Make available for NRC staff audit documentation demonstrating that 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.	Closed - Calculation EDQ0009992013000202 R3, 250V DC Unit Batteries, 1, 2, & 3 Evaluation for the Beyond Design Basis External Event (BDBEE) Extended Loss of AC Power (ELAP), has been issued to determine load shedding impact on the unit batteries.
4	Make available for NRC staff audit documentation that demonstrates that operating units that have not implemented the order will be able to vent through the existing vent system unaffected by the implementation of HCVS on other units.	Closed - A conceptual meeting was held in November 2014, and a staging plan was used to separate the existing HWWV from the HCVS.
5	Make available for NRC staff audit analyses demonstrating that HCVS has the capacity to vent the steam/energy equivalent of one percent of licensed/rated thermal power (unless a lower value is justified), and that the suppression pool and the HCVS together are able to absorb and reject decay heat, such that following a reactor shutdown from full power containment pressure is restored and then maintained below the primary containment design pressure and the primary containment pressure limit.	Closed - The existing wetwell vent (CLTP) and the HCVS (EPU) have been designed for 1 percent of rated thermal power at EPU conditions.

#	Interim Staff Evaluation Phase 1 Open Items	Status
6	Make available for NRC staff audit documentation that demonstrates adequate communication between the remote HCVS operation locations and HCVS decision makers during ELAP and severe accident conditions.	Closed - A communication system has been implemented that uses hand held radios for communication between the MCR and the ROS. DCN 70852
7	Make available for NRC staff audit documentation of an evaluation verifying the existing containment isolation valves, relied upon for the HCVS, will open under the maximum expected differential pressure during BDBEE and severe accident wetwell venting.	In Progress
8	Make available for NRC staff audit documentation of a seismic qualification evaluation of HCVS components.	In Progress
9	Make available for NRC staff audit descriptions of all instrumentation and controls (existing and planned) necessary to implement this order including qualification methods.	In Progress
10	Make available for NRC staff audit the descriptions of local conditions (temperature, radiation and humidity) anticipated during ELAP and severe accident for the components (valves, instrumentation, sensors, transmitters, indicators, electronics, control devices, and etc.) required for HCVS venting including confirmation that the components are capable of performing their functions during ELAP and severe accident conditions.	In Progress
11	Make available for NRC staff audit the final sizing evaluation for HCVS batteries/battery charger including incorporation into FLEX DG loading calculation.	In Progress
12	Make available for NRC staff audit documentation of the HCVS nitrogen pneumatic system design including sizing and location	In Progress

#	Interim Staff Evaluation Phase 1 Open Item	Status
13	Make available for NRC staff audit the seismic and tornado missile final design criteria for the HCVS stack.	In Progress
14	Provide a description of the final design of the HCVS to address hydrogen detonation and deflagration.	In Progress
15	Provide a description of the strategies for hydrogen control that minimizes the potential for hydrogen gas migration and ingress into the reactor building or other buildings.	In Progress
16	Provide design details that minimize unintended cross flow of vented fluids within a unit and between units on the site.	In Progress