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May 22, 2019

Serial: RA-19-0176

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

Subject: Brunswick Steam Electric Plant (BSEP), Unit Nos. 1 and 2
Renewed Facility Operating License Nos. DPR-71 and DPR-62
NRC Docket No. 50-325 and 50-324
Completion of Required Action for NRC Order EA-13-109, Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions

References:

1. Nuclear Regulatory Commission (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, Agencywide Documents Access and Management System (ADAMS) Accession Number 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, ADAMS Accession Number ML13304B836.
3. 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 30, 2015, ADAMS Accession Number ML15104A118.
4. 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 2015, ADAMS Accession Number ML15113B318.
5. Duke Energy Letter, BSEP, Unit Nos. 1 and 2, *Duke Energy's Response to June 6, 2013, Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109)*, dated June 17, 2013, ADAMS Accession Number ML13191A567.
6. Duke Energy Letter, BSEP, Unit Nos. 1 and 2, *Phase 1 Overall Integrated Plan in Response to June 6, 2013, Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109)*, dated June 26, 2014, ADAMS Accession Number ML14191A687.
7. Duke Energy Letter, BSEP, Unit Nos. 1 and 2, *First Six-Month Status Report in Response to June 6, 2013, Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109)*, dated December 17, 2014, ADAMS Accession Number ML14364A029.

8. Duke Energy Letter, BSEP, Unit Nos. 1 and 2, *Second Six-Month Status Report in Response to June 6, 2013, Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109)*, dated June 25, 2015, ADAMS Accession Number ML15196A035.
9. Duke Energy Letter, BSEP, Unit Nos. 1 and 2, *Phase 1 and Phase 2 Overall Integrated Plan in Response to June 6, 2013, Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109)*, dated December 11, 2015, ADAMS Accession Number ML16020A064.
10. Duke Energy Letter, BSEP, Unit Nos. 1 and 2, *Fourth Six-Month Status Report in Response to June 6, 2013, Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109)*, dated June 28, 2016, ADAMS Accession Number ML16190A111.
11. Duke Energy Letter, BSEP, Unit Nos. 1 and 2, *Fifth Six-Month Status Report in Response to June 6, 2013, Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109)*, dated December 15, 2016, ADAMS Accession Number ML16365A007.
12. Duke Energy Letter, BSEP, Unit Nos. 1 and 2, *Sixth Six-Month Status Report in Response to June 6, 2013, Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109)*, dated June 19, 2017, ADAMS Accession Number ML17171A383.
13. Duke Energy Letter, BSEP, Unit Nos. 1 and 2, *Seventh Six-Month Status Report in Response to June 6, 2013, Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109)*, dated December 20, 2017, ADAMS Accession Number ML17354A248.
14. NRC Letter, *Brunswick Steam Electric Plant, Units 1 and 2 -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. MF4467 and MF4468)*, dated March 10, 2015, ADAMS Accession Number ML15049A266.
15. NRC Letter, *Brunswick Steam Electric Plant, Units 1 and 2 - Interim Staff Evaluation Relating to Overall Integrated Plan in Response to Phase 2 of Order EA-13-109 (Severe Accident Capable Hardened Vents) (CAC Nos. MF4467 and MF4468)*, dated August 17, 2016, ADAMS Accession Number ML16223A725.
16. NRC Letter, *Brunswick Steam Electric Plant, Units 1 and 2 - Report for the Audit of Licensee Responses to Interim Staff Evaluations Open Items Related to NRC Order EA-13-109 to Modify Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (CAC Nos. MF4467 and MF4468; EPID L-2014-JLD-0041),* dated March 22, 2018, ADAMS Accession Number ML18068A627.
17. Duke Energy Letter, *Brunswick Steam Electric Plant, Unit 1, Completion of Required Action for NRC Order EA-13-109, Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions,* dated May 29, 2018, ADAMS Accession Number ML18149A523.

18. Duke Energy Letter, BSEP, Unit Nos. 1 and 2, *Eighth Six-Month Status Report in Response to June 6, 2013, Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109)*, dated June 26, 2018, ADAMS Accession Number ML18177A458.
19. Duke Energy Letter, BSEP, Unit Nos. 1 and 2, *Ninth Six-Month Status Report in Response to June 6, 2013, Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109)*, dated December 19, 2018, ADAMS Accession Number ML18354A907.

Ladies and Gentlemen:

On June 6, 2013, the Nuclear Regulatory Commission (NRC) issued 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* (i.e., Reference 1) to Brunswick Steam Electric Plant (BSEP), Unit Nos. 1 and 2. Reference 1 was immediately effective and directed all boiling water reactors (BWRs) with Mark I and Mark II containments to take certain actions to ensure that these facilities have a hardened containment venting system (HCVS) to support strategies for controlling containment pressure and preventing core damage following an event that causes a loss of heat removal systems, such as an Extended Loss of AC Power (ELAP), while ensuring the venting functions are also available during severe accident (SA) conditions. BSEP, Unit Nos. 1 and 2, have Mark I containments. Specific requirements are outlined in Attachment 2 of Reference 1.

Reference 1 required submission of an Overall Integrated Plan (OIP) by June 30, 2014, for Phase 1 of the Order, and by December 31, 2015, for Phase 2 of the Order. The interim staff guidance (i.e., References 2 and 3) provided direction regarding the content of the OIP for Phase 1 and Phase 2. Reference 4 endorsed industry guidance document NEI 13-02, Revision 1 with clarifications and exceptions identified in Reference 3. Reference 5 provided the Duke Energy initial status report. Reference 6 provided the BSEP, Units 1 and 2, Phase 1 OIP.

References 7, 8, 9, 10, 11, 12, 13, 18, and 19 provided the first, second, third, fourth, fifth, sixth, seventh, eighth, and ninth six-month status reports pursuant to Section IV, Condition D.3 of Reference 1 for BSEP, Units 1 and 2, respectively. Reference 9 and the six-month status reports thereafter, included both the six-month status report for Phase 1 of the Order pursuant to Section IV, Condition D.3, of Reference 1, and Phase 2 of the Order pursuant to Section IV, Condition D.2 of Reference 1, for BSEP, Units 1 and 2, in a combined Phase 1 and Phase 2 OIP.

References 14 and 15 provide the NRC Interim Staff Evaluations relating to the Phase 1 OIP and Phase 2 OIP, respectively. Reference 16 provides the NRC Report for the Audit of Licensee Responses to Interim Staff Evaluations Open Items Related to NRC Order EA-13-109.

Reference 17 provided the notification required by Item IV.D.4 of Order EA-13-109 that full compliance (i.e., Phase 1 and Phase 2) with the requirements described in Attachment 2 of the Order has been achieved for BSEP, Unit No. 1.

The purpose of this letter along with Enclosure 1 is to provide the notification required by Item IV.D.4 of Order EA-13-109 that full compliance (i.e., Phase 1 and Phase 2) with the requirements described in Attachment 2 of the Order has been achieved for BSEP, Unit No. 2. BSEP, Unit Nos. 1 and 2, are now both in full compliance (i.e., Phase 1 and Phase 2) with the requirements described in Attachment 2 of the Order EA-13-109.

Enclosure 2 contains the BSEP, Unit Nos. 1 and 2, HCVS Final Integrated Plan (FIP) which provides strategies for the establishment of hardened venting capabilities to manage containment over-pressurization for both NRC Order EA-12-049 Mitigation Strategies for Beyond-Design-Basis External Events (FLEX) and a non-mitigated (Severe Accident) Extended Loss of all AC Power (ELAP). The BSEP, Unit Nos. 1 and 2, HCVS FIP is based on NEI 13-02 (i.e., Reference 4).

This letter contains no new regulatory commitments.

If you have any questions regarding this submittal, please contact Mr. Jerry Pierce, Manager - Nuclear Support Services, at (910) 832-7931.

I declare under penalty of perjury that the foregoing is true and correct. Executed on May 22, 2019.

Sincerely,

William R. Gideon

Enclosures:

Enclosure 1 – Brunswick Steam Electric Plant (BSEP), Unit No. 2, Completion of Required Action for NRC Order EA-13-109, Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions

Enclosure 2 – Brunswick Steam Electric Plant (BSEP), Unit Nos. 1 and 2, HCVS Final Integrated Plan (FIP) cc (with enclosures):

U.S. Nuclear Regulatory Commission, Region II
ATTN: Ms. Catherine Haney, Regional Administrator
245 Peachtree Center Ave, NE, Suite 1200
Atlanta, GA 30303-1257

U.S. Nuclear Regulatory Commission
ATTN: Mr. Dennis Galvin (Mail Stop OWFN 8B1A)
11555 Rockville Pike
Rockville, MD 20852-2738

U.S. Nuclear Regulatory Commission
ATTN: Mr. Peter Bamford (Mail Stop OWFN 12D20)
11555 Rockville Pike
Rockville, MD 20852-2738

U.S. Nuclear Regulatory Commission
ATTN: Mr. Gale Smith, NRC Senior Resident Inspector
8470 River Road
Southport, NC 28461-8869

Chair - North Carolina Utilities Commission **(Electronic Copy Only)**
P.O. Box 29510
Raleigh, NC 27626-0510

Brunswick Steam Electric Plant (BSEP), Unit No. 2, Completion of Required Action for NRC Order EA-13-109, Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions

1. Introduction

Note: References are provided in Section 6 of this enclosure.

On June 6, 2013, the Nuclear Regulatory Commission (NRC) issued 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 (i.e., Reference 1) to Brunswick Steam Electric Plant (BSEP), Unit Nos. 1 and 2. Reference 1 was immediately effective and directed all boiling water reactors (BWRs) with Mark I and Mark II containments to take certain actions to ensure that these facilities have a hardened containment venting system (HCVS) to support strategies for controlling containment pressure and preventing core damage following an event that causes a loss of heat removal systems, such as an Extended Loss of AC Power (ELAP), while ensuring the venting functions are also available during severe accident (SA) conditions. BSEP, Unit Nos. 1 and 2, have Mark I containments. Specific requirements are outlined in Attachment 2 of Reference 1.

Reference 1 required submission of an Overall Integrated Plan (OIP) by June 30, 2014, for Phase 1 of the Order, and by December 31, 2015, for Phase 2 of the Order. The interim staff guidance (i.e., References 2 and 3) provided direction regarding the content of the OIP for Phase 1 and Phase 2. Reference 4 endorsed industry guidance document NEI 13-02, Revision 1 with clarifications and exceptions identified in Reference 3. Reference 5 provided the Duke Energy initial status report. Reference 6 provided the BSEP, Units 1 and 2, Phase 1 OIP. Reference 9 provided the BSEP, Units 1 and 2, Phase 2 OIP.

References 7, 8, 9, 10, 11, 12, 13, 18, and 19 provided the first, second, third, fourth, fifth, sixth, seventh, eighth, and ninth six-month status reports pursuant to Section IV, Condition D.3 of Reference 1 for BSEP, Units 1 and 2, respectively. Reference 9 and the six-month status reports thereafter, included the six-month status report for Phase 1 of the Order pursuant to Section IV, Condition D.3, of Reference 1, and Phase 2 of the Order pursuant to Section IV, Condition D.2 of Reference 1, for BSEP, Units 1 and 2, in a combined Phase 1 and Phase 2 OIP.

References 14 and 15 provided the NRC Interim Staff Evaluation relating to the OIP in response to Phase 1, and Phase 2, respectively. Reference 16 provided the NRC Report for the Audit of Licensee Responses to Interim Staff Evaluations Open Items Related to NRC Order EA-13-109*.*

Reference 17 provided the notification required by Item IV.D.4 of Order EA-13-109 that full compliance (i.e., Phase 1 and Phase 2) with the requirements described in Attachment 2 of the Order has been achieved for BSEP, Unit No. 1.

The information provided herein, as well as the implementation of the OIP (i.e., Phase 1 in Reference 6 and Phase 2 in Reference 9), documents full compliance for the BSEP, Unit No. 2 in response to NRC Order EA-13-109 (i.e., Reference 1).

2. Milestone Accomplishments

- The BSEP Unit No. 2, Phase 1 Overall Integrated Plan Milestones are complete.
  The BSEP Unit No. 2, Phase 2 Overall Integrated Plan Milestones are complete.

Brunswick Steam Electric Plant (BSEP), Unit No. 2, Completion of Required Action for NRC Order EA-13-109, Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions

Phase 1 Milestone Schedule	Target Completion Date	Activity Status	Comments and Date Changes
Hold preliminary/conceptual design meeting.	Jun. 2014	Complete	Date not revised.
Submit Overall Integrated Plan. (i.e., Reference 6)	Jun. 2014	Complete	Date not revised.
Submit (first) 6 Month Status Report. (i.e., Reference 7)	Dec. 2014	Complete	Date not revised.
Submit (second) 6 Month Status Report. (i.e., Reference 8)	Jun. 2015	Complete	Date not revised.
Submit (third) 6-Month Status Report. (i.e., Reference 9)	Dec. 2015	Complete	Simultaneous with Phase 2 OIP.
Submit (fourth) 6-Month Status Report. (i.e., Reference 10)	Jun. 2016	Complete	Date not revised.
Operations Procedure Changes Developed.	Dec. 2016	Complete	Date not revised.
Site Specific Maintenance Procedure Developed.	Dec. 2016	Complete	Date not revised.
Submit (fifth) 6-Month Status Report. (i.e., Reference 11)	Dec. 2016	Complete	Date not revised.
Training Complete.	Feb. 2017	Complete	Date not revised.
Procedure Changes Active.	Mar. 2017	Complete	Date not revised.
U2 Design Engineering On-site/Complete.	Jun. 2016	Complete	Date not revised.
Submit (sixth) 6-Month Status Report. (i.e., Reference 12)	Jun. 2017	Complete	Date not revised.
Submit (seventh) 6-Month Status Report. (i.e., Reference 13)	Dec. 2017	Complete	Date not revised.
U2 Implementation Outage.	Mar. 2017	Complete	Date not revised.
U2 Walk Through Demonstration/Functional Test.	Mar. 2017	Complete	Date not revised.
Submit Completion Report. (Unit 1)	May 2018	Complete	Date not revised.

Phase 2 Milestone Schedule	Target Completion Date	Activity Status	Comments and Date Changes
Hold preliminary/conceptual design meeting.	Oct. 2015	Complete	Date not revised.
Submit Overall Integrated Implementation Plan. (i.e., Reference 9)	Dec. 2015	Complete	Third 6-month update included Phase 2 OIP
Submit (fourth) 6-Month Status Report. (i.e., Reference 10)	Jun. 2016	Complete	Date not revised.
Submit (fifth) 6-Month Status Report. (i.e., Reference 11)	Dec. 2016	Complete	Date not revised.
Submit (sixth) 6-Month Status Report. (i.e., Reference 12)	Jun. 2017	Complete	Date not revised.
Submit (seventh) 6-Month Status Report. (i.e., Reference 13)	Dec. 2017	Complete	Date not revised.
Submit (eighth) 6-Month Status Report. (i.e., Reference 18)	Jun. 2018	Complete	Date not revised.
Submit (ninth) 6-Month Status Report. (i.e., Reference 19)	Dec. 2018	Complete	Date not revised.
U2 Design Engineering On-site/Complete.	Mar. 2018	Complete	Date not revised.
Operations Procedure Changes Developed.	Mar. 2018	Complete	Date not revised.
Site Specific Maintenance Procedure Developed.	Mar. 2018	Complete	Date not revised.
Training Complete.	Feb. 2018	Complete	Date not revised.
U2 Implementation Outage.	Mar. 2019	Complete	Date not revised.
Procedure Changes Active. (Unit 2)	Mar. 2019	Complete	Date not revised.
U2 Walk Through Demonstration/Functional Test.	Mar. 2019	Complete	Date not revised.
Submit Completion Report. (Unit 2)	Jul. 2019	Complete	Date not revised.

Brunswick Steam Electric Plant (BSEP), Unit No. 2, Completion of Required Action for NRC Order EA-13-109, Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions

3. Milestone Schedule Status

The BSEP Unit No. 2, Phase 1 and Phase 2 Overall Integrated Plan Milestones are complete.

4. Changes to Compliance Method

No changes to the Phase 1 or Phase 2 Overall Integrated Plan (i.e., Reference 9) compliance method have been made.

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

There were no changes to the need for relief/relaxation. BSEP is in compliance with the order implementation date.

6. Open Items from Phase 1 Overall Integrated Plan and Phase 1 Interim Staff Evaluation

Phase 1 Open Items were identified in the Phase 1 OIP (i.e., Reference 6) and in the NRC Phase 1 Interim Staff Evaluation (ISE) (i.e., Reference 14). The following tables (Table 6a provides the Phase 1 OIP Open Items, and Table 6b provides the Phase 1 ISE Open Items) provide completion references and a summary of the closure action for Open Items not previously completed.

Table 6a - Overall Integrated Plan Open Items (Phase 1)		
#	Open Item	Status
1	Evaluate, design, and implement missile protection as required for the HCVS piping external to the reactor building.	Complete
	Information provided in the December 2016 Six-Month Status Report by letter dated December 15, 2016 (i.e., ADAMS Accession No. ML16365A007) (i.e., Reference 11).	
2	Finalize location of the Remote Operating Station (ROS).	Complete
	Information provided in the December 2016 Six-Month Status Report by letter dated December 15, 2016 (i.e., ADAMS Accession No. ML16365A007) (i.e., Reference 11).	
3	Finalize and design means to address flammable gases in the HCVS.	Complete
	Information provided in the December 2016 Six-Month Status Report by letter dated December 15, 2016 (i.e., ADAMS Accession No. ML16365A007) (i.e., Reference 11).	
4	Evaluate location of FLEX DG for accessibility under Severe Accident conditions.	Complete
	Information provided in the December 2016 Six-Month Status Report by letter dated December 15, 2016 (i.e., ADAMS Accession No. ML16365A007) (i.e., Reference 11).	

Brunswick Steam Electric Plant (BSEP), Unit No. 2, Completion of Required Action for NRC Order EA-13-109, Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions

Table 6a - Overall Integrated Plan Open Items (Phase 1)		
#	Open Item	Status
5	Develop procedures for BDBEE and severe accident vent operation (i.e., load shedding, power supply transfer, and vent valve operation from the Main Control Room and ROS), vent support functions for sustained operation and portable equipment deployment (FLEX DG supply to the 24/48 VDC battery system, and makeup to the nitrogen backup system).	Complete
	Information provided in the December 2017 Six-Month Status Report by letter dated December 20, 2017 (i.e., ADAMS Accession No. ML17354A248) (i.e., Reference 13).	
6	Confirm suppression pool heat capacity. Initial results from GE report 0000-0165-0656-R0 for BSEP indicate the suppression pool reaches the heat capacity temperature limit (HCTL) in 2.11 hours.	Complete
	Information provided in the December 2016 Six-Month Status Report by letter dated December 15, 2016 (i.e., ADAMS Accession No. ML16365A007) (i.e., Reference 11).	
7	Finalize location of supplemental N2 bottle connection.	Deleted
	Information provided in the December 2016 Six-Month Status Report by letter dated December 15, 2016 (i.e., ADAMS Accession No. ML16365A007) (i.e., Reference 11).	
8	Establish programs and processes for control of HCVS equipment functionality, out-of-service time, and testing.	Complete
	Information provided in the June 2017 Six-Month Status Report by letter dated June 19, 2017 (i.e., ADAMS Accession No. ML17171A383)(i.e., Reference 12).	
9	Confirm Wetwell vent capacity is sufficient at the containment design pressure (62 psig). Existing calculation 0D12-0009 calculates a wetwell vent capacity at the primary containment pressure limit (PCPL, 70 psig).	Complete
	Information provided in the December 2016 Six-Month Status Report by letter dated December 15, 2016 (i.e., ADAMS Accession No. ML16365A007) (i.e., Reference 13).	

Table 6b – Interim Staff Evaluation Open Items (Phase 1)		
#	Open Item	Status
1	Make available for NRC staff audit the site-specific controlling document for HCVS out of service and compensatory measures.	Complete
	Information provided in the June 2017 Six-Month Status Report by letter dated June 19, 2017 (i.e., ADAMS Accession No. ML17171A383) (i.e., Reference 12). Closed per NRC Audit Report of ISE Open Item Responses by letter dated March 22, 2018 (i.e., ADAMS Accession No. ML18068A627) (i.e., Reference 16)	
2	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 (i.e., 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	Complete

Brunswick Steam Electric Plant (BSEP), Unit No. 2, Completion of Required Action for NRC Order EA-13-109, Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions

Table 6b – Interim Staff Evaluation Open Items (Phase 1)		
#	Open Item	Status
	power containment pressure is restored and then maintained below the primary containment design pressure and the primary containment pressure limit.	
	Information provided in the December 2016 Six-Month Status Report by letter dated December 15, 2016 (i.e., ADAMS Accession No. ML16365A007) (i.e., Reference 11). Closed per NRC Audit Report of ISE Open Item Responses by letter dated March 22, 2018 (i.e., ADAMS Accession No. ML18068A627) (i.e., Reference 16)	
3	Make available for NRC staff audit confirmation of the time it takes the suppression pool to reach the heat capacity temperature limit during ELAP with RCIC in operation.	Complete
	Information provided in the December 2016 Six-Month Status Report by letter dated December 15, 2016 (i.e., ADAMS Accession No. ML16365A007) (i.e., Reference 11). Closed per NRC Audit Report of ISE Open Item Responses by letter dated March 22, 2018 (i.e., ADAMS Accession No. ML18068A627) (i.e., Reference 16)	
4	Make available for NRC staff audit a description of the final ROS location.	Complete
	Information provided in the December 2016 Six-Month Status Report by letter dated December 15, 2016 (i.e., ADAMS Accession No. ML16365A007) (i.e., Reference 11). Closed per NRC Audit Report of ISE Open Item Responses by letter dated March 22, 2018 (i.e., ADAMS Accession No. ML18068A627) (i.e., Reference 16)	
5	Make available for NRC staff audit documentation that demonstrates adequate communication between the remote HCVS operation locations and the HCVS decision makers during ELAP and severe accident conditions.	Complete
	Information provided in the December 2016 Six-Month Status Report by letter dated December 15, 2016 (i.e., ADAMS Accession No. ML16365A007) (i.e., Reference 11). Closed per NRC Audit Report of ISE Open Item Responses by letter dated March 22, 2018 (i.e., ADAMS Accession No. ML18068A627) (i.e., Reference 16)	
6	Provide a description of the final design of the HCVS to address hydrogen detonation and deflagration.	Complete
	Information provided in the December 2016 Six-Month Status Report by letter dated December 15, 2016 (i.e., ADAMS Accession No. ML16365A007) (i.e., Reference 11). Closed per NRC Audit Report of ISE Open Item Responses by letter dated March 22, 2018 (i.e., ADAMS Accession No. ML18068A627) (i.e., Reference 16)	
7	Make available for NRC staff audit seismic and tornado missile final design criteria for the HCVS stack.	Complete
	Information provided in the December 2016 Six-Month Status Report by letter dated December 15, 2016 (i.e., ADAMS Accession No. ML16365A007) (i.e., Reference 11). Closed per NRC Audit Report of ISE Open Item Responses by letter dated March 22, 2018 (i.e., ADAMS Accession No. ML18068A627) (i.e., Reference 16)	
8	Make available for NRC staff audit documentation of the HCVS nitrogen pneumatic system	Complete

Brunswick Steam Electric Plant (BSEP), Unit No. 2, Completion of Required Action for NRC Order EA-13-109, Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions

Table 6b – Interim Staff Evaluation Open Items (Phase 1)		
#	Open Item	Status
	design including sizing and location.	
	Information provided in the December 2016 Six-Month Status Report by letter dated December 15, 2016 (i.e., ADAMS Accession No. ML16365A007) (i.e., Reference 11). Closed per NRC Audit Report of ISE Open Item Responses by letter dated March 22, 2018 (i.e., ADAMS Accession No. ML18068A627) (i.e., Reference 16)	
9	Make available for NRC staff audit documentation of HCVS incorporation into the FLEX diesel generator loading calculation.	Complete
	Information provided in the December 2016 Six-Month Status Report by letter dated December 15, 2016 (i.e., ADAMS Accession No. ML16365A007) (i.e., Reference 11). Closed per NRC Audit Report of ISE Open Item Responses by letter dated March 22, 2018 (i.e., ADAMS Accession No. ML18068A627) (i.e., Reference 16)	
10	Make available for NRC staff audit an evaluation of temperature and radiological conditions to ensure that operating personnel can safely access and operate control and support equipment.	Complete
	Information provided in the December 2016 Six-Month Status Report by letter dated December 15, 2016 (i.e., ADAMS Accession No. ML16365A007) (i.e., Reference 11). BSEP radiation dose calculation EC 412141 "Integrated Dose Calculation for Hardened Vent Remote Operating Station (ROS) - Fukushima" shows the integrated radiation dose due to HCVS operation will not inhibit operator actions to initiate and operate the HCVS during an ELAP with severe accident conditions.	
11	Make available for NRC staff audit descriptions of all instrumentation and controls (i.e., existing and planned) necessary to implement this order including qualification methods.	Complete
	Information provided in the December 2016 Six-Month Status Report by letter dated December 15, 2016 (i.e., ADAMS Accession No. ML16365A007) (i.e., Reference 11). Closed per NRC Audit Report of ISE Open Item Responses by letter dated March 22, 2018 (i.e., ADAMS Accession No. ML18068A627) (i.e., Reference 16)	
12	Clarify whether the seismic reliability demonstration of instruments, including valve position indication, vent pipe temperature instrumentation, radiation monitoring, and support system monitoring will (*be*) via methods that predict performance described in IEEE-344-2004 or provide justification for using a different revision of the standard.	Complete
	Information provided in the December 2016 Six-Month Status Report by letter dated December 15, 2016 (i.e., ADAMS Accession No. ML16365A007) (i.e., Reference 11). Closed per NRC Audit Report of ISE Open Item Responses by letter dated March 22, 2018 (i.e., ADAMS Accession No. ML18068A627) (i.e., Reference 16)	
13	Make available for NRC staff audit a justification for not monitoring HCVS system pressure as described in NEI 13-02.	Complete
	Information provided in the December 2016 Six-Month Status Report by letter dated December 15, 2016 (i.e., ADAMS Accession No. ML16365A007) (i.e., Reference 11).	

Brunswick Steam Electric Plant (BSEP), Unit No. 2, Completion of Required Action for NRC Order EA-13-109, Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions

Table 6b – Interim Staff Evaluation Open Items (Phase 1)		
#	Open Item	Status
	Closed per NRC Audit Report of ISE Open Item Responses by letter dated March 22, 2018 (i.e., ADAMS Accession No. ML18068A627) (i.e., Reference 16)	
14	Make available for NRC staff audit the descriptions of local conditions (i.e., temperature, radiation and humidity) anticipated during ELAP and severe accident for the components (e.g., valves, instrumentation, sensors, transmitters, indicators, electronics, control devices, etc.) required for HCVS venting including confirmation that the components are capable of performing their functions during ELAP and severe accident conditions.	Complete **(FIP)**
	Information provided in the December 2016 Six-Month Status Report by letter dated December 15, 2016 (i.e., ADAMS Accession No. ML16365A007) (i.e., Reference 11). See Enclosure 2, HCVS Final Integrated Plan. See Table 1, List of HCVS Component, Control and Instrumentation Qualifications.	
15	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.	Complete
	Information provided in the December 2016 Six-Month Status Report by letter dated December 15, 2016 (i.e., ADAMS Accession No. ML16365A007) (i.e., Reference 11). Closed per NRC Audit Report of ISE Open Item Responses by letter dated March 22, 2018 (i.e., ADAMS Accession No. ML18068A627) (i.e., Reference 16)	
16	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.	Complete
	Information provided in the December 2016 Six-Month Status Report by letter dated December 15, 2016 (i.e., ADAMS Accession No. ML16365A007) (i.e., Reference 11). Closed per NRC Audit Report of ISE Open Item Responses by letter dated March 22, 2018 (i.e., ADAMS Accession No. ML18068A627) (i.e., Reference 16)	

7. Interim Staff Evaluation (ISE) Impacts (Phase 1 only)

Not applicable to this submittal.

8. Open Items from Phase 2 Overall Integrated Plan and Phase 2 Interim Staff Evaluation

There were no open items reported in the Phase 2 OIP (i.e., Reference 9). The Phase 2 NRC Interim Staff Evaluation (ISE) Open Items (i.e., Reference 15) are addressed and documented in Order EA-13-109 six-month status reports. Table 8 provides completion references for each ISE Phase 2 Open Item and a summary of the closure action for Open Items not previously completed.

Brunswick Steam Electric Plant (BSEP), Unit No. 2, Completion of Required Action for NRC Order EA-13-109, Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions

Table 8 – Interim Staff Evaluation Phase 2 Open Items		
#	Open Item	Status
	Indicates a change since last 6-month update	
1	Licensee to confirm through analysis, the temperature and radiological conditions to ensure that operating personnel can safely access and operate controls and support equipment.	Complete
	Information provided in the June 2017 Six-Month Status Report by letter dated June 19, 2017 (i.e., ADAMS Accession No. ML17171A383) (i.e., Reference 12). See Phase 1 Open Item #10 response.	
2	Licensee to provide the site-specific MAAP evaluation that establishes the initial SAWA flow rate.	Complete
	Information provided in the June 2017 Six-Month Status Report by letter dated June 19, 2017 (i.e., ADAMS Accession No. ML17171A383) (i.e., Reference 12). Closed per NRC Audit Report of ISE Open Item Responses by letter dated March 22, 2018 (i.e., ADAMS Accession No. ML18068A627) (i.e., Reference 16)	
3	Licensee to demonstrate how instrumentation and equipment being used for SAWA and supporting equipment is capable to perform for the sustained operating period under the expected temperature and radiological conditions.	Complete **(FIP)**
	Information provided in the June 2017 Six-Month Status Report by letter dated June 19, 2017 (i.e., ADAMS Accession No. ML17171A383) (i.e., Reference 12). See Enclosure 2, HCVS Final Integrated Plan. See Table 1, List of HCVS Component, Control and Instrumentation Qualifications.	
4	Licensee to demonstrate that containment failure as a result of overpressure can be prevented without a drywell vent during severe accident conditions.	Complete
	Information provided in the June 2017 Six-Month Status Report by letter dated June 19, 2017 (i.e., ADAMS Accession No. ML17171A383) (i.e., Reference 12). Closed per NRC Audit Report of ISE Open Item Responses by letter dated March 22, 2018 (i.e., ADAMS Accession No. ML18068A627) (i.e., Reference 16)	
5	Licensee to demonstrate that there is adequate communication between the MCR and the operator at the FLEX pump during severe accident conditions.	Complete
	Information provided in the June 2017 Six-Month Status Report by letter dated June 19, 2017 (i.e., ADAMS Accession No. ML17171A383) (i.e., Reference 12). Closed per NRC Audit Report of ISE Open Item Responses by letter dated March 22, 2018 (i.e., ADAMS Accession No. ML18068A627) (i.e., Reference 16)	
6	Licensee to demonstrate the SAWM flow instrumentation qualification for the expected environmental conditions.	Complete **(FIP)**

Brunswick Steam Electric Plant (BSEP), Unit No. 2, Completion of Required Action for NRC Order EA-13-109, Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions

Table 8 – Interim Staff Evaluation Phase 2 Open Items		
#	Open Item	Status
Indicates a change since last 6-month update		
	Information provided in the June 2017 Six-Month Status Report by letter dated June 19, 2017 (i.e., ADAMS Accession No. ML17171A383) (i.e., Reference 12). See Enclosure 2, HCVS Final Integrated Plan. See Table 1, List of HCVS Component, Control and Instrumentation Qualifications.	

9. Order EA-13-109 Compliance Elements Summary

The elements identified below for BSEP Unit No. 2 as well as the HCVS Phase 1 and Phase 2 OIP (i.e., References 6 and 9), the 6-Month Status Reports (i.e., References 7, 8, 9, 10, 11, 12, 13, 18, and 19) demonstrate compliance with Order EA-13-109.

HCVS Phase 1 and Phase 2 Functional Requirements and Design Features – Complete

The BSEP Unit No. 2, Phase 1 HCVS provides a vent path from the wetwell to remove decay heat, vent the containment atmosphere, and control containment pressure within acceptable limits. The Phase 1 HCVS will function for those accident conditions for which containment venting is relied upon to reduce the probability of containment failure, including accident sequences that result in the loss of active containment heat removal capability during an extended loss of alternating current power.

The BSEP Unit No. 2, Phase 2 HCVS provides a reliable containment venting strategy that makes it unlikely that the plant would need to vent from the containment drywell before alternative reliable containment heat removal and pressure control is reestablished. The BSEP Unit No. 2, Phase 2 HCVS strategies implement Severe Accident Water Addition (SAWA) with Severe Accident Water Management (SAWM) as an alternative venting strategy. This strategy consists of the use of the Phase 1 wetwell vent and SAWA hardware to implement a water management strategy that will preserve the wetwell vent path until alternate reliable containment heat removal can be established.

The BSEP Unit No. 2, Phase 1 and Phase 2 HCVS strategies are in compliance with Order EA-13-109. The modifications required to support the HCVS strategies for BSEP Unit No. 2 have been fully implemented in accordance with the station processes.

HCVS Phase 1 and Phase 2 Quality Standards – Complete

The design and operational considerations of the Phase 1 and Phase 2 HCVS installed at BSEP Unit No. 2 comply with the requirements specified in the Order and described in NEI 13-02, Revision 1, Industry Guidance for Compliance with Order EA-13-109. The Phase 1 and Phase 2 HCVS has been installed in accordance with the station design control process.

The Phase 1 and Phase 2 HCVS components including piping, piping supports, containment isolation valves, containment isolation valve actuators and containment isolation valve position indication have been designed consistent with the design basis of the plant. All other Phase 1 and Phase 2 HCVS components including electrical power supply, valve actuator pneumatic supply and instrumentation have been designed for reliable and rugged performance that is capable of ensuring Phase 1 and Phase 2 HCVS functionality following a seismic event.

HCVS Phase 1 and Phase 2 Programmable Features – Complete

Storage of portable equipment for BSEP Unit No. 2 and Phase 2 HCVS use provides adequate protection from applicable site hazards and identified paths and deployment areas will be accessible during all modes of operation and during severe accidents, as recommended in NEI-13-02, Revision 1, Section 6.1.2.

Training in the use of the Phase 1 and Phase 2 HCVS for BSEP Unit No. 2 has been completed in accordance with an accepted training process as recommended in NEI 13-02, Revision 1, Section 6.1.3.

Operating procedures for BSEP Unit No. 2 have been developed and integrated with existing procedures to ensure safe operation of the Phase 1 and Phase 2 HCVS. Operating procedures have been verified and are available for use in accordance with the site procedure control program. Maintenance procedures that are needed in the short-term have been developed. Procedures that will be needed in the future are scheduled to be developed in accordance with station processes and will be issued prior to their first scheduled use.

Site processes have been established to ensure the Phase 1 and Phase 2 HCVS is tested and maintained as recommended in NEI 13-02, Revision 1, Sections 6.1.2 and 6.2.

BSEP Unit No. 2 has completed validation in accordance with industry developed guidance to assure required tasks, manual actions and decisions for HCVS strategies are feasible and may be executed within the constraints identified in the HCVS Phase 1 and 2 OIP for Order EA-13-109 (i.e., References 6 and 9).

BSEP Unit No. 2 has completed evaluations to confirm accessibility, habitability, staffing sufficiency, and communication capability in accordance with NEI 13-02, Revision 1, Sections 4.2.2 and 4.2.3 (i.e., Reference 4).

10. References

1. Nuclear Regulatory Commission (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, Agencywide Documents Access and Management System (ADAMS) Accession Number 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, ADAMS Accession Number ML13304B836.
3. 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 30, 2015, ADAMS Accession Number ML15104A118.
4. 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 2015, ADAMS Accession Number ML15113B318.
5. Duke Energy Letter, BSEP, Unit Nos. 1 and 2, *Duke Energy's Response to June 6, 2013, Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109)*, dated June 17, 2013, ADAMS Accession Number ML13191A567.
6. Duke Energy Letter, BSEP, Unit Nos. 1 and 2, *Phase 1 Overall Integrated Plan in Response to June 6, 2013, Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109)*, dated June 26, 2014, ADAMS Accession Number ML14191A687.
7. Duke Energy Letter, BSEP, Unit Nos. 1 and 2, *First Six-Month Status Report in Response to June 6, 2013, Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109)*, dated December 17, 2014, ADAMS Accession Number ML14364A029.
8. Duke Energy Letter, BSEP, Unit Nos. 1 and 2, *Second Six-Month Status Report in Response to June 6, 2013, Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109)*, dated June 25, 2015, ADAMS Accession Number ML15196A035.
9. Duke Energy Letter, BSEP, Unit Nos. 1 and 2, *Phase 1 and Phase 2 Overall Integrated Plan in Response to June 6, 2013, Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109)*, dated December 11, 2015, ADAMS Accession Number ML16020A064.
10. Duke Energy Letter, BSEP, Unit Nos. 1 and 2, *Fourth Six-Month Status Report in Response to June 6, 2013, Commission Order Modifying Licenses with Regard to Reliable Hardened*

Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109), dated June 28, 2016, ADAMS Accession Number ML16190A111.

11. Duke Energy Letter, BSEP, Unit Nos. 1 and 2, *Fifth Six-Month Status Report in Response to June 6, 2013, Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109)*, dated December 15, 2016, ADAMS Accession Number ML16365A007.
12. Duke Energy Letter, BSEP, Unit Nos. 1 and 2, *Sixth Six-Month Status Report in Response to June 6, 2013, Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109)*, dated June 19, 2017, ADAMS Accession Number ML17171A383.
13. Duke Energy Letter, BSEP, Unit Nos. 1 and 2, *Seventh Six-Month Status Report in Response to June 6, 2013, Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109)*, dated December 20, 2017, ADAMS Accession Number ML17354A248.
14. NRC Letter, *Brunswick Steam Electric Plant, Units 1 and 2 – 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. MF4467 and MF4468)*, dated March 10, 2015, ADAMS Accession Number ML15049A266.
15. NRC Letter, *Brunswick Steam Electric Plant, Units 1 and 2 - Interim Staff Evaluation Relating to Overall Integrated Plan in Response to Phase 2 of Order EA-13-109 (Severe Accident Capable Hardened Vents) (CAC Nos. MF4467 and MF4468)*, dated August 17, 2016, ADAMS Accession Number ML16223A725.
16. NRC Letter, *Brunswick Steam Electric Plant, Units 1 and 2 – Report for the Audit of Licensee Responses to Interim Staff Evaluations Open Items Related to NRC Order EA-13-109 to Modify Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (CAC Nos. MF4467 and MF4468; EPID L-2014-JLD-0041),* dated March 22, 2018, ADAMS Accession Number ML18068A627.
17. Duke Energy Letter, *Brunswick Steam Electric Plant, Unit 1, Completion of Required Action for NRC Order EA-13-109, Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions,* dated May 29, 2018, ADAMS Accession Number ML18149A523.
18. Duke Energy Letter, BSEP, Unit Nos. 1 and 2, *Eighth Six-Month Status Report in Response to June 6, 2013, Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109)*, dated June 26, 2018, ADAMS Accession Number ML18177A458.
19. Duke Energy Letter, BSEP, Unit Nos. 1 and 2, *Ninth Six-Month Status Report in Response to June 6, 2013, Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109)*, dated December 19, 2018, ADAMS Accession Number ML18354A907.

Brunswick Steam Electric Plant (BSEP), Unit Nos. 1 and 2,
HCVS Final Integrated Plan (FIP)

Section I: Introduction

In 1989, the Nuclear Regulatory Commission (NRC) issued Generic Letter 89-16, Installation of a Hardened Wetwell Vent, (Reference 1) to all licensees of BWRs with Mark I containments to encourage licensees to voluntarily install a hardened wetwell vent. In response, licensees installed a hardened vent pipe from the wetwell to some point outside the secondary containment envelope (usually outside the reactor building). Some licensees also installed a hardened vent branch line from the drywell.

On March 19, 2013, the NRC Commissioners directed the staff per Staff Requirements Memorandum (SRM) for SECY -12-0157, Consideration of Additional Requirements for Containment Venting Systems for Boiling Water Reactors with Mark I and Mark II Containments (References 2 and 3) to require licensees with Mark I and Mark II containments to "upgrade or replace the reliable hardened vents required by Order EA-12-050, Order to Modify Licenses with Regard to Reliable Hardened Containment Vents (Reference 4) with a containment venting system designed and installed to remain functional during severe accident conditions." In response, the NRC issued Order EA-13-109, Issuance of Order to Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accidents, June 6, 2013 (Reference 5). 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 to 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).

Brunswick Steam Electric Plant (BSEP) is required by NRC Order EA-13-109 to have a reliable, severe accident capable hardened containment venting system (HCVS). Order EA-13-109 allows implementation of the HCVS Order in two phases.

- Phase 1 upgraded the venting capabilities from the containment wetwell to provide reliable, severe accident capable hardened vent to assist in preventing core damage and, if necessary, to provide venting capability during severe accident conditions. BSEP achieved Phase 1 compliance March 2018.

- Phase 2 provided additional protections for severe accident conditions through the development of a reliable containment venting strategy that makes it unlikely that BSEP would need to vent from the containment drywell during severe accident conditions. BSEP achieved Phase 2 compliance March 2019.

NEI developed guidance for complying with NRC Order EA-13-109 in 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 0 (Reference 6) with significant interaction with the NRC and Licensees. NEI issued Revision 1 to NEI 13-02 in April 2015 (Reference 7) which contained guidance for compliance with both Phase 1 and Phase 2 of the order. NEI 13-02, Revision 1 also includes HCVS- Frequently Asked Questions (FAQs) 01 through 09 and reference to white papers (HCVS-WP-01 through 03 (References 8 through 10)). The NRC endorsed NEI 13-02 Revision 0 as an acceptable approach for complying with Order EA-13-109 through 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, issued in November 2013 (Reference 12) and JLD-ISG-2015-01, Compliance with Order EA-13-109, Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation under Severe Accident Conditions issued in April 2015 (Reference 13) for NEI 13-02 Revision 1 with some clarifications and exceptions. NEI 13-02 Revision 1 provides an acceptable method of compliance for both Phases of Order EA-13-109.

In addition to the endorsed guidance in NEI 13-02, the NRC staff endorsed several other documents that provide guidance for specific areas. HCVS-FAQs 10 through 13 (References 14 through 17) were endorsed by the NRC after NEI 13-02 Revision 1 on October 8, 2015. NRC staff also endorsed four White Papers, HCVS-WP-01 through 04 (References 8 through 11), which cover broader or more complex topics than the FAQs.

As required by the order, BSEP submitted a phase 1 Overall Integrated Plan (OIP) in June of 2014 (Reference 18) and subsequently submitted a combined Phase 1 and 2 OIP in December 2015 (Reference 19). These OIPs followed the guidance of NEI 13-02 Revision 0 and 1 respectively, Compliance with Order EA-13-109, Severe Accident Reliable Hardened Containment Vents. The NRC staff used the methods described in the ISGs to evaluate licensee compliance as presented in the Order EA-13-109 OIPs. While the Phase 1 and combined Phase 1 and 2 OIPs where written to different revisions of NEI 13-02, BSEP conforms to NEI 13-02 Revision 1 for both Phases of Order EA-13-109.

The NRC performed a review of each OIP submittal and provided BSEP with Interim Staff Evaluations (ISEs) (References 20 and 21) assessing the site's compliance methods. In the ISEs the NRC identified open items which the site needed to address before that phase of compliance was reached. Six month progress reports (References 22 through 28, 37, 38) were provided consistent with the requirements of Order EA-13-109. These status reports were used to close many of the ISE open items. In addition, the site participated in NRC ISE Open Item audit calls where the information provided in the six month updates and on the E-Portal were used by the NRC staff to determine whether the ISE Open Item appeared to be addressed.

By submittal of this Final Integrated Plan BSEP has addressed all the elements of NRC Order EA-13-109 utilizing the endorsed guidance in NEI 13-02, Revision 1 and the related HCVS-FAQs and HCVS-WPs documents. In addition, the site has addressed the NRC Phase 1 and Phase 2 ISE Open Items as documented in previous six month updates, or within the Phase 1 and 2 Compliance Letter for the first compliance Unit 1 (Reference 29) and this letter for Unit 2.

Section II provides a list of acronyms. Section III contains the BSEP Final Integrated Plan details for Phase 1 of the Order. Section IV contains the Final Integrated Plan details for Phase 2 of the Order. Section V details the programmatic elements of compliance.

Section I.A: Summary of Compliance

Section I.A.1: Summary of Phase 1 Compliance

The plant venting actions for the EA-13-109, Phase 1, severe accident capable venting scenario can be summarized by the following:

- The HCVS is 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 utilizes containment parameters of pressure and level from the MCR instrumentation to monitor effectiveness of the venting actions.
- The vent operation is monitored by HCVS valve position, temperature and effluent radiation levels.
- The HCVS motive force is monitored and has the capacity to operate for 24 hours with installed equipment. Replenishment of the motive force will be by use of portable equipment once the installed motive force is exhausted.
- Venting actions are capable of being maintained for a sustained period of at least 7 days.

The operation of the HCVS is designed to minimize the reliance on operator actions in response to external hazards. The applicable external hazards for BSEP are seismic, external flooding, high winds, extreme high temperature, and extreme cold – ice only. Initial operator actions are completed by plant personnel and include the capability for remote-manual initiation from the HCVS control station. Attachment 2 contains a one-line diagram of the HCVS vent flowpath.

Section I.A.2: Summary of Phase 2 Compliance

The Phase 2 actions can be summarized as follows:

- Utilization of Severe Accident Water Addition (SAWA) to initially inject water into the Reactor Pressure Vessel (RPV).
- Utilization of Severe Accident Water Management (SAWM) to control injection and Suppression Pool level to ensure the HCVS Phase 1 wetwell vent will remain functional for the removal of heat from the containment.
- Heat can be removed from the containment for at least seven (7) days using the HCVS or until alternate means of heat removal are established that make it unlikely the drywell vent will be required for containment pressure control.
- The SAWA and SAWM actions can be manually activated and controlled from areas that are accessible during severe accident conditions.

- Parameters measured are Drywell pressure, Suppression Pool level, SAWA flowrate and the HCVS Phase 1 vent path parameters.

The locations of the SAWA equipment and controls, as well as ingress and egress paths have been evaluated for the expected severe accident conditions (temperature, humidity, radiation) for the Sustained Operating period. Equipment has been evaluated to remain operational throughout the Sustained Operating period. Personnel radiological exposure, temperature and humidity conditions for operation of SAWA equipment will not exceed the limits for ERO dose or plant safety guidelines for temperature and humidity.

The SAWA flow path is the same as the FLEX primary injection flow path with the modification that the hose run inside the RB was replaced with stainless steel piping. The flow path is from the unit's Condensate Storage Tank (CST) through the FLEX pump including a SAWA flow indicator. The SAWA flow passes through the FLEX pump discharge hose, to a core bore at the Reactor Building (RB) outer wall where it is connected using quick connection hardware. Inside the RB the SAWA flow path is from the core bore, through a normally closed valve, through a stainless steel hard pipe, then through another isolation valve into the Reactor Water Cleanup system return line. This line connects to the RCIC injection line, which connects to the main Feedwater line and into the Reactor Pressure Vessel. Cross flow into other portions of the RWCU system is isolated by check valves and, in the case of a seismic event, closing one manual valve. DW pressure and Suppression Pool level are monitored and flow rate is adjusted by use of the FLEX pump control valve at the CST. Communication is established between the MCR and the FLEX pump location. Attachment 4 contains a one-line diagram of the SAWA flowpath.

The SAWA electrical loads are included in the FLEX DG loading calculation done for EA-12-049 compliance. The FLEX DGs are located east of the RB and are a significant distance and on the opposite side of the RB from the discharge of the HCVS on the west side of the RBs. See Attachment 6 for applicable locations. Refueling of the FLEX DG is accomplished from the EDG fuel oil tanks as described in the EA-12-049 FIP.

Evaluations for projected SA 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.

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

Section II: List of Acronyms

AC	Alternating Current
AOV	Air Operated Valve
BDBEE	Beyond Design Basis External Event
BSEP	Brunswick Steam Electric Plant
BWROG	Boiling Water Reactor Owners' Group
CAC	Containment Atmospheric Control System
CAP	Containment Accident Pressure
CST	Condensate Storage Tank
DC	Direct Current
ECCS	Emergency Core Cooling Systems
ELAP	Extended Loss of AC Power
EOP	Emergency Operating Procedure
EPG/SAG	Emergency Procedure and Severe Accident Guidelines
EPRI	Electric Power Research Institute
ERO	Emergency Response Organization
FAQ	Frequently Asked Question
FIP	Final Integrated Plan
FLEX	Diverse & Flexible Coping Strategy
FSB	FLEX Storage Building
GPM	Gallons per minute
HCVS	Hardened Containment Vent System
ISE	Interim Staff Evaluation
ISG	Interim Staff Guidance
JLD	Japan Lessons Learned Project Directorate
MAAP	Modular Accident Analysis Program
MCR	Main Control Room
N2	Nitrogen
NEI	Nuclear Energy Institute
NPSH	Net Positive Suction Head
NRC	Nuclear Regulatory Commission
OIP	Overall Integrated Plan

PCPL	Primary Containment Pressure Limit
RCIC	Reactor Core Isolation Cooling System
RM	Radiation Monitor
ROS	Remote Operating Station
RPV	Reactor Pressure Vessel
RWCU	Reactor Water Cleanup
SA	Severe Accident
SAMG	Severe Accident Management Guidelines
SAWA	Severe Accident Water Addition
SAWM	Severe Accident Water Management
SBGT	Standby Gas Treatment System
SFP	Spent Fuel Pool
SRV	Safety-Relief Valve
UFSAR	Updated Final Safety Analysis Report
VAC	Voltage AC
VDC	Voltage DC
WW	Wetwell

Section III: Phase 1 Final Integrated Plan Details

Section III.A: HCVS Phase 1 Compliance Overview

BSEP modified the existing hardened wetwell vent path installed in response to NRC Generic Letter 89-16 to comply with NRC Order EA-13-109.

Section III.A.1: Generic Letter 89-16 Vent System

BSEP installed a hardened wetwell vent in response to NRC Generic Letter 89-16, under Plant Modifications PM-91-001 for Unit 1 and PM-92-073 for Unit 2. The description of the vent system below is common to both units. The hardened wetwell vent system allows venting of the wetwell by utilizing the wetwell purge exhaust line thru Penetration X220 and normally closed inboard purge exhaust valve CAC-V7.

Between valve CAC-V7 and the outboard purge exhaust valve CAC-V8, 8-inch vent line (75-8-152) and wetwell vent isolation valve CAC-V216 was installed (Ref. PI2 & PI8). Downstream of isolation valve CAC-V216, line (75-12-154A), a Non-Safety Related, seismic line exits the Reactor Building on the West side at elevation 5 ft. into the “rattlespace“ between the Reactor Building and the Turbine Building and, supported from the Reactor Building wall, runs along the exterior of the building. The vent line re-enters the Reactor Building at the refueling floor level, El. 117’-4”, then rises along the West side where it exits the Reactor Building roof at El. 179’-5”. The vent line is equipped with a rupture disk (CAC-RD-001) with a burst pressure of 55 psig, just downstream of the isolation valve CAC-V216 to preclude inadvertent opening of the vent line in the event of a design basis event and another rupture disk (CAC-RD-002) with a burst pressure of 5 psig at its end to preclude entry of debris and precipitation. The 55 psig burst pressure for rupture disk CAC-RD-001 was selected as being above the maximum Loss of Coolant Accident containment pressure of 49 psig, yet below the containment design pressure of 62 psig. The existing wetwell vent system and components are designed for 70 psig at 316 ºF, corresponding to saturated steam conditions at the Primary Containment Pressure Limit (PCPL) of 70 psig. The vent line is equipped with a radiation monitor adjacent to the line for alerting the operators of a release through the vent line. The current radiation monitor (CAC-RM-80) is equipped with low range and high range detectors, to provide a range of 10^{-4} to 10^{5} µC/cc of Xe-133. Wetwell vent valves CAC-V7 and CAC-V216 are equipped with keylock isolation signal override switches to allow bypass of the containment isolation signal to allow venting during a loss of containment heat removal event. CAC-V216 is additionally operated by a key-lock switch as another measure to prevent inadvertent operation.

Section III.A.2: EA-13-109 Hardened Containment Vent System (HCVS)

The EA-13-109 compliant HCVS system utilizes the GL-89-16 wetwell vent system. The vent system is initiated, operated and monitored from the MCR using the switches described above. A ROS has been installed in a readily accessible location and provides a means to manually operate the wetwell vent. The controls available at the ROS are accessible and functional under a range of plant conditions, including severe accident conditions. The ROS location is in the RB 50’ elevation, just inside the door to the Radwaste Building roof. Table 2 contains the evaluation of the acceptability of the ROS location with respect to severe accident conditions.

The final HCVS utilization does not contain any new electrical circuitry for bypassing isolation signals. The ROS opens the valves directly with compressed nitrogen so that no electrical signal overrides are needed.

The Main Control Room is the primary operating station for the HCVS. During an ELAP, electric power to operate the vent valves will be provided by batteries with a capacity to supply required loads for at least the first 24 hours. Before the batteries are depleted, the FLEX generator will supplement and recharge batteries to support operation of the vent valves. The ROS is designated as the alternate control location and method. Since the ROS does not require any electrical power to operate, the valve solenoids do not need any additional backup electrical power. Attachment 2 shows the HCVS vent flow path.

At the MCR location, the operators can operate the HCVS isolation valves if electrical power has been restored, monitor HCVS vent valve position, drywell pressure, torus level, and backup nitrogen pressure. Also in the MCR area are the HCVS RM, vent pipe temperature, backup battery voltage, and backup vent valve position test jacks. The ROS consists of manual valves that directly port nitrogen to the actuators of the HCVS isolation valves. There is no instrumentation provided at the ROS. Table 1 contains a complete list of instruments available to the operators for operating and monitoring the HCVS.

The hardened vent radiation monitor uses 24 VDC input power. The instruments to be powered for the 24-hour period are already powered by 24 VDC circuits. The following are the final electrical design highlights:

1. The valves' limit switches can be read with a handheld meter at MCR panel XU-53. Test jacks are provided on the front door so that the operators will not have to locate terminal points in the MCR panel, or even open the MCR panel door. Determining valve position this way is only necessary if both FLEX generators fail to restore power to the valves' circuits and the operators desire to verify valve positions directly. They may not need to verify the valve position if drywell pressure remains low indicating venting is occurring.

2. The RM is powered from the unit's Division 2 24/48 VDC battery (only one leg is used, resulting in a 24 VDC circuit) and is located in XU-54 where the Generic Letter 89-16 RM was mounted.

3. The 24 VDC battery voltage is indicated on XU-54.

4. The backup power to the required instruments can be transferred at MCR panel XU- 54 (Unit 2) or XU-76 (Unit 1). The instruments receiving backup power are:

    a. RNA-PT-5268 which indicates the status of the backup nitrogen system that supplies the valve actuators.

    b. CAC-LT-2601 which indicates the level in the torus so that operators can ensure the water level stays below the level of the vent pipe

    c. CAC-PT-1230 which indicates drywell pressure so that operators can ensure that the vent is operating to maintain containment pressure low.

5. A test jack is provided on XU-54 for pipe temperature. It can be read using a hand held meter. This is redundant indication that venting is occurring and is a backup to the drywell pressure and valve position indications.

Attachments 3 and 3A contain one-line diagrams of the HCVS electrical distribution system.

The wetwell vent up to, and including, the second containment isolation barrier is designed consistent with the design basis of the plant. These items include piping, piping supports, containment isolation valves, containment isolation valve actuators and containment isolation valve position indication components. The hardened vent piping, between the wetwell and the Reactor Building roof, including boundary isolation valve CAC-V8 is designed to 70 psig at 316ºF.

NEI 13-02 suggests a 350°F value for HCVS design temperature based on the highest Primary Containment Pressure Limit (PCPL) among the Mark I and II plants. Since 316°F corresponds to the saturation temperature for the BSEP PCPL of 70 psig, it will be retained as the pipe design temperature. Per NEI 13-02, it is acceptable to assume saturation conditions in containment (2.4.3.1), therefore these design parameters are acceptable.

To prevent leakage of vented effluent to other parts of the Reactor Building or other systems (SBGT), boundary valves CAC-V8 and CAC-V172 must be closed before wetwell venting. Valves CAC-V8 and CAC-V172 are the only boundary between the HCVS and the interfacing SBGT system. These valves are normally closed, fail closed, and are not required to change state in order to perform their safety related containment isolation function; therefore, they can be assumed to be closed when required. Valve CAC-V8 and CAC-V172 are part of the IST program and are leak tested in accordance with 10CFR50, Appendix J. This is acceptable for prevention of inadvertent cross-flow of vented fluids per HCVS-FAQ-05.

HCVS features to prevent inadvertent actuation include a key lock switch at the primary control station and locked closed valves at the ROS which is an acceptable method of preventing inadvertent actuation per NEI 13-02.

As required by EA-13-109, Section 1.2.11, the wetwell vent is designed to prevent air/oxygen backflow into the discharge piping to ensure the flammability limits of hydrogen, and other non-condensable gases, are not reached. BSEP design includes a check valve near the end of the vent pipe. Guidance for this design is contained in HCVS-WP-03. The relevant design calculations conclude that the check valve will preclude a flammable mixture from occurring in the vent pipe.

The HCVS radiation monitor with an Ion chamber detector is qualified for the ELAP and external event conditions. In addition to the RM, a temperature element is installed on the vent line to allow the operators to monitor operation of the HCVS. Electrical and controls components are seismically qualified and include the ability to handle harsh environmental conditions (although they are not considered part of the site Environmental Qualification (EQ) program).

Section III.B: HCVS Phase 1 Evaluation Against Requirements:

The functional requirements of Phase 1 of NRC Order EA-13-109 are outlined below along with an evaluation of the BSEP response to maintain compliance with the Order and guidance from JLD-ISG-2015-01. Due to the difference between NEI 13-02, Revision 0 and Revision 1, only Revision 1 will be evaluated. Per JLD-ISG-2015-01, this is acceptable as Revision 1 provides acceptable guidance for compliance with Phase 1 and Phase 2 of the Order.

1 HCVS Functional Requirements

1.1 The design of the HCVS shall consider the following performance objectives:

1.1.1 The HCVS shall be designed to minimize the reliance on operator actions.

Evaluation:

The operation of the HCVS was designed to minimize the reliance on operator actions in response to hazards identified in NEI 12-06, Diverse and Flexible Coping Strategies (FLEX) Implementation Guide (Reference 31), which are applicable to the plant site. Operator actions to initiate the HCVS vent path can be completed by plant personnel and 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 is in the following table:

Table 3-1: HCVS Operator Actions

1. Transfer HCVS electrical loads to 24 VDC Distribution	Key-locked transfer switches located on XU-54 (Unit 2) or XU- 76 (Unit 1).	Only performed if FLEX generators do not re-power these loads and only after the station batteries can no longer supply these loads.
2. Open Inboard Wetwell Purge Exhaust Valve 1/2-CAC-V7.	Control switch located in the MCR or via manual valve located at the ROS.	ROS is the alternate control location.
3. Open Hardened Wetwell Vent Valve 1/2-CAC- V216.	Key-locked control switch located in the MCR or via manual valve located at the ROS.	ROS is the alternate control location.
4. Run hose to FLEX pneumatic makeup connection from FLEX air compressor staging location.	FLEX pneumatic makeup connections are located outside the RB in the vicinity of the HCVS vent pipe.	Action performed prior to venting start.
5. Replenish pneumatics with FLEX air compressor.	FLEX air compressor will be located in an area that is accessible to operators during a severe accident.	Action required to supplement the N2 backup system after a minimum of 24 hours.
6. Re-power the 24/48VDC battery chargers for sustained operations (post-24 hours).	FLEX diesels are located in an area that meets the requirements of EA-12-049 and is accessible to operators during a severe accident.	Action required to provide power to HCVS equipment after a minimum of 24 hours.

Permanently installed electrical power and pneumatic supplies are available to support operation and monitoring of the HCVS for a minimum of 24 hours. No portable equipment larger than a hose need be moved in the first 24 hours (Action 4 in Table 3-1 above).

After 24 hours, available personnel will be able to connect supplemental electric power and pneumatic supplies for sustained operation of the HCVS for a minimum of 7 days. The FLEX generators and air compressors provide this motive force. In all likelihood, these actions will be completed in less than 24 hours. However, the HCVS can be operated or at least 24 hours without any supplementation.

The above set of actions conform to the guidance in NEI 13-02 Revision 1 Section 4.2.6 for minimizing reliance on Operator actions and are acceptable for compliance with Order element A.1.1.1. These were identified in the OIP and subsequent NRC ISE.

Table 3-2: Failure Evaluation

Functional Failure Mode	Failure Cause	Alternate Action	Failure with Alternate Action Impact on Containment Venting?
Fail to Vent (Open) on Demand	Valves fail to open/close due to loss of normal AC power	Transfer power to alternate from FLEX generator	No
Fail to Vent (Open) on Demand	Valves fail to open/close due to loss of alternate AC power	Open valves from ROS	No
Fail to Vent (Open) on Demand	Valves fail to open/close due to loss of normal pneumatic air supply	Open valves using Backup nitrogen system - no operator action required	No
Fail to Vent (Open) on Demand	Valves fail to open/close due to loss of alternate pneumatic air supply (long term)	Align FLEX air compressor to Backup nitrogen system	No

1.1.2 The HCVS shall be designed to minimize plant operators' exposure to occupational hazards, such as extreme heat stress, while operating the HCVS system.

Evaluation:

Primary control of the HCVS is accomplished from the MCR. Alternate control of the HCVS is accomplished from the ROS at the 50' elevation (second floor) of the Reactor Building. FLEX actions that will maintain the MCR and ROS habitable were implemented in response to NRC Order EA-12-049 (Reference 31). These include:

1. Restoring MCR ventilation via the FLEX DG. MCR ventilation was included as a load in the FLEX generator sizing calculations and is acceptable.

2. Opening MCR doors to the outside (if required).

3. Operating portable generators and fans to move outside air through the MCR (if required).

4. Opening doors and a roof hatch in the RB to establish natural circulation air flow in the RB.

Table 2 contains a thermal evaluation of all the operator actions that may be required to support HCVS operation. The relevant ventilation calculation(s) (References 30 and 31) demonstrate that the final design meets the order requirements to minimize the plant operators' exposure to occupational hazards.

1.1.3	The HCVS shall also be designed to account for radiological consequences that would impede personnel actions needed for event response.

Evaluation:

Primary control of the HCVS is accomplished from the MCR. Under the postulated scenarios of order EA-13-109 the control room is adequately protected from excessive radiation dose and no further evaluation of its use is required. (Ref. HCVS-FAQ-06)

Alternate control of the HCVS is accomplished from the ROS. The ROS was evaluated for radiation effects due to a severe accident and determined to be acceptable. The ROS is located in a low dose area during normal operation. During an accident, the core material will be further from the ROS than during normal operation. In addition, there will be additional shielding from the two additional concrete floors after the core has re-located to the pedestal area. The additional distance and shielding combined with the short duration of actions required at the ROS show the ROS to be an acceptable location for alternate control.

Table 2 contains a radiological evaluation of the operator actions that may be required to support HCVS operation in a severe accident. There are no abnormal radiological conditions present for HCVS operation without core damage. The evaluation of radiological hazards demonstrates that the final design meets the order requirements to minimize the plant operators' exposure to radiological hazards.

The HCVS vent is routed away from the MCR such that building structures provide shielding, thus per HCVS-FAQ-01 the MCR is the preferred control location.

1.1.4	The HCVS controls and indications shall be accessible and functional under a range of plant conditions, including severe accident conditions, extended loss of AC power, and inadequate containment cooling.

Evaluation:

Primary control of the HCVS is accomplished from the MCR. Under the postulated scenarios of order EA-13-109 the control room is adequately protected from excessive radiation dose and no further evaluation of its use is required (HCVS-FAQ-06).

Alternate control of the HCVS is accomplished from the ROS. The ROS is in an area evaluated to be accessible before and during a severe accident.

For ELAP with injection, the HCVS wetwell vent will be opened to protect the containment from overpressure. The operator actions and timing of those actions to perform this function under ELAP conditions were evaluated as part of BSEP response to NRC Order EA-12-049 as stated in Reference 36.

Table 1 contains an evaluation of the controls and indications that are or may be required to operate the HCVS during a severe accident. The evaluation demonstrates that the controls and indications are accessible and functional during a severe accident with a loss of AC power and inadequate containment cooling.

Table 2 contains a thermal and radiological evaluation of all the operator actions at the MCR or alternate location that may be required to support HCVS operation during a severe accident. The ventilation calculations (References 30 and 31) demonstrate that the final design meets the order requirements to minimize the plant operators' exposure to occupational and radiological hazards.

1.2 The HCVS shall include the following design features: 1.2.1 The HCVS shall have the capacity to vent the steam/energy equivalent of 1 percent of licensed /rated thermal power (unless a lower value is justified by analysis), and be able to maintain containment pressure below the primary containment design pressure.

Evaluation:

Calculation 0FLEX-0035 contains the verification of 1% power flow capacity at design pressure (62 psig). This calculation models all the piping elbows, valves and other components using industry standard flow coefficients to determine an equivalent length of piping. Since the piping consists of 8" and 12" sections, both are modeled. The model is input to ARROW code which is an industry standard program for modeling compressible flow in piping. The code also looks for flow choking effects. The minimum flow at design pressure to pass 1% RTP is 84,500 lbm/hr. 0FLEX-0035 verifies that the piping can pass greater than 1% flow. Additional assumptions and modeling details are contained in 0FLEX-0035.

The decay heat absorbing capacity of the suppression pool and the selection of venting pressure were made such that the HCVS will have sufficient capacity to maintain containment pressure at or below the lower of the containment design pressure (62 psig) or the PCPL (70 psig). This calculation of containment response is contained in MAAP calculation BNP-MECH-FLEX-0002 that was submitted in Reference 26 and which shows that containment is maintained below the design pressure once the vent is opened, even if it is not opened until PCPL.

1.2.2 The HCVS shall discharge the effluent to a release point above main plant structures.

Evaluation

The wetwell vent exits the Primary Containment through the wetwell purge exhaust piping and associated inboard wetwell purge exhaust valve. Between the inboard and outboard wetwell purge exhaust valves, the wetwell vent isolation valve is installed. Downstream of the wetwell vent isolation valve, the vent piping exits the Reactor Building through the west wall and into the space between the Reactor Building and Turbine Building. The vent traverses up the exterior of the building and re-enters the Reactor Building through the metal siding on the refuel floor, then rises along the west side where it exits the Reactor Building through the roof. All effluents are exhausted above each unit's Reactor Building. This discharge point was extended approximately three feet above each unit's Reactor Building parapet wall 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. Part of the HCVS-FAQ-04 guidance is designed to ensure that vented fluids are not drawn immediately back into any emergency ventilation intakes. Such ventilation intakes should be below a level of the pipe by 1 foot for every 5 horizontal feet. The MCR emergency intake in the ELAP event is at the 49 ft. elevation which is approximately 130 feet below the HVCS pipe outlet. This intake is approximately 200 feet from the Unit 2 vent pipe (further than Unit 1), which would require the intake to be approximately 40 feet below the vent pipe. Therefore, the vent pipe is appropriately placed relative to this air intake.

The vent pipe extends approximately 3 ft. above the parapet wall of the RB roof. This satisfies the guidance for height from HCVS-FAQ-04.

An evaluation of the vent pipe to confirm that it is robust to all hazards including tornado missiles was performed for EA-12-049 compliance. This evaluation concludes that the HCVS pipe is protected from all hazards and was reviewed by NRC staff for EA-12-049 compliance as noted in Reference 36.

BSEP also evaluated the vent pipe robustness with respect to wind-borne missiles against the requirements contained in HCVS-WP-04. This evaluation demonstrated that the pipe was robust with respect to external missiles per HCVS-WP-04 in that:

1. For the portions of exposed piping below 30 feet above grade, the pipe is located in a narrow access space between two concrete walls where it is highly unlikely that a missile could penetrate to a depth required to damage the vent pipe.

2. The exposed piping greater than 30 feet above grade has the following characteristics:

    a. The total vent pipe exposed area is 200 square feet which is less than the 300 square feet.

    b. The pipe is made of schedule 40 stainless steel and the pipe components have no small tubing susceptible to missiles.

c. There are no obvious sources of missiles located in the proximity of the exposed HCVS components.

3. BSEP maintains severe weather preparedness procedures that would require the plant be shut down prior to the arrival of sustained hurricane force winds on site.

Based on the above description of the vent pipe design, the BSEP HCVS vent pipe design meets the order requirement to be robust with respect to all external hazards including wind-borne missiles.

1.2.3	The HCVS shall include design features to minimize unintended cross flow of vented fluids within a unit and between units on the site.

Evaluation

The HCVS for Units 1 & 2 are fully independent of each other. Therefore, the status of each unit is independent of the status of the other unit.

The wetwell vent for each unit utilizes CAC system valves CAC-V7 and CAC-V216 for containment isolation. CAC system containment isolation valves CAC-V8 and CAC-V172 are the only functional boundary valves between the HCVS and the downstream SBGT system. These valves have a safety related function to maintain the containment pressure boundary during a design basis accident and are tested as required by 10CFR50, Appendix J. The 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 from the MCR location. Although these valves are shared between the CAC and the HCVS, separate control circuits are provided to each valve. Specifically, the CAC control circuit will be used during all “design basis” operating modes including all design basis transients and accidents. The downstream CAC isolation valves serve the function of isolating the HCVS flow path from the SBGT. These valves are tested, and will continue to be tested, for leakage under 10CFR50 Appendix J as part of the containment boundary in accordance with HCVS-FAQ-05.

Based on the above description, the BSEP design meets the requirements to minimize unintended cross-flow of vented fluids within a unit and between units on site.

1.2.4	The HCVS shall be designed to be manually operated during sustained operations from a control panel located in the MCR or a remote but readily accessible location.

Evaluation

The existing wetwell vent will allow initiating and then operating and monitoring from a control panel located in the MCR.

1.2.5	The HCVS shall be capable of manual operation (e.g., reach-rod with hand wheel or manual operation of pneumatic supply valves from a shielded location), which is accessible to plant operators during sustained operations.

Evaluation

To meet the requirement for an alternate means of operation, a readily accessible alternate location, called the ROS was added. The ROS contains manually operated valves that supply pneumatics to the HCVS flow path valve actuators so that these valves may be opened without power to the valve actuator solenoids and regardless of any containment isolation signals that may be actuated. This provides a diverse method of valve operation improving system reliability.

The location for the ROS is in the southeast corner of the RB 50'-0" for Unit 1, and the northeast corner of the RB 50'-0" elevation for Unit 2. The ROS is located within the RB in an area shielded from the HCVS vent pipe by intervening structures, with a direct path to the MCR. Refer to the sketch provided in Attachment 6 for the HCVS site layout. The controls available at the ROS location are 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), inadequate containment cooling, and loss of reactor building ventilation. Table 1 contains an evaluation of all the required controls and instruments that are required for severe accident response and demonstrates that all these controls and instruments will be functional during a loss of AC power and severe accident. Table 2 contains a thermal and radiological evaluation of all the operator actions that may be required to support HCVS operation during a loss of AC power and severe accident and demonstrates that these actions will be possible without undue hazard to the operators.

1.2.6	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.

Evaluation

HCVS-WP-01 contains clarification on the definition of "dedicated and permanently installed" with respect to the order. In summary, it is acceptable to use plant equipment that is used for other functions, but it is not acceptable to credit portable equipment that must be moved and connected for the first 24 hour period of the ELAP.

The FLEX generators will start and load, thus there will be no need to use other power sources for HCVS wetwell venting components during the first 24 hours. However, this order element does not allow crediting the FLEX generators for HCVS wetwell venting components until after 24 hours. Therefore, backup electrical power required for operation of HCVS components in the first 24 hours will come from an existing Division 2 24/48 VDC battery. These batteries are permanently installed in the Control Building ground floor where they are protected from screened in hazards, and have sufficient capacity to provide this power without recharging. Calculation BNP-E-6.125 demonstrated that the 24/48VDC battery capacity is sufficient to supply HCVS wetwell venting components for 24 hours. At 24 hours, FLEX generators can be credited to repower the station instrument buses and/or the battery charger to recharge the 24/48VDC batteries, gas control during recharging and room temperature control is per the response to order EA-12-049. Calculation 31116-CALC-E-001 included the 24/48VDC battery chargers in the FLEX DG loading calculation, so there is no additional load on the FLEX DG and they are capable of carrying HCVS wetwell venting components electrical loads. 24/48VDC battery voltage status will be indicated on panel XU-54 so that operators will be able to monitor the status of the 24/48VDC batteries. Attachments 3 and 3a contain one-line diagrams of the HCVS electrical distribution system.

Pneumatic power for the HCVS valve actuators is normally provided by the non-interruptible instrument air system (for the Reactor Building) and the pneumatic nitrogen system (for the Drywell) with backup nitrogen provided from the nitrogen backup system. Following an ELAP event, and the loss of non-interruptible instrument air and pneumatic nitrogen, the nitrogen backup system automatically provides operating pneumatics to the SRV accumulators and hardened wetwell vent valves. Therefore, for the first 24 hours post-ELAP initiation, pneumatic force will be supplied from the existing nitrogen backup system bottle racks located on the EL. 50’-0” of the Reactor Building. Calculation 0RNA-0001 demonstrated that these installed bottles have the capacity to supply the required motive force to those HCVS valves needed to maintain flow through the HCVS effluent piping for 24 hours without replenishment. Backup nitrogen pressure indication will be provided with HCVS power for use if its normal supply is not restored by the FLEX generators.

1.2.7	The HCVS shall include a means to prevent inadvertent actuation.

Evaluation

Emergency operating procedures provide clear guidance that the HCVS is not to be used to defeat containment integrity during any design basis transients and accidents. In addition, the HCVS was designed to provide features to prevent inadvertent actuation due to equipment malfunction or operator error. Also, these protections are designed 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). However, the ECCS pumps will not have normal power available because of the ELAP.

The containment isolation valves must be open to permit vent flow. The physical features that prevent inadvertent actuation are the key lock switch for CAC-V216 at the primary control station and locked closed valves at the ROS. These design features meet the requirement to prevent inadvertent actuation of HCVS.

1.2.8	The HCVS shall include a means to monitor the status of the vent system (e.g., valve position indication) from the control panel required by 1.2.4. The monitoring system shall be designed for sustained operation during an extended loss of AC power.

Evaluation

The HCVS includes indications for HCVS valve position, vent pipe temperature and effluent radiation levels in the MCR, as well as information on the status of supporting systems which are 24 VDC battery voltage and division 2 backup nitrogen pressure.

This monitoring instrumentation provides the indication from the MCR per Requirement 1.2.4. In the event that the FLEX DGs do not energize the emergency buses, the wetwell HCVS and required containment instrumentation will be supplied by the Division 2 24/48VDC batteries and designed for sustained operation during an ELAP event using the FLEX equipment.

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

The HCVS instruments, including valve position indication, vent pipe temperature, radiation monitoring, and support system monitoring, are seismically qualified as indicated on Table 1 and they include the ability to handle harsh environmental conditions (although they may not be considered part of the site Environmental Qualification (EQ) program).

1.2.9	The HCVS shall include a means to monitor the effluent discharge for radioactivity that may be released from operation of the HCVS. The monitoring system shall provide indication from the control panel required by 1.2.4 and shall be designed for sustained operation during an extended loss of AC power.

Evaluation

The HCVS radiation monitoring system consists of an ion chamber detector coupled to a process and control module. The process and control module is mounted in MCR panel XU-54 in the CB 49' elevation. The RM detector is fully qualified for the expected environment at the vent pipe during accident conditions, and the process and control module is qualified for the mild environment in the CB 49'. Both components are qualified for the seismic requirements. Table 1 includes a description and qualification information on the radiation monitor.

1.2.10	The HCVS shall be designed to withstand and remain functional during severe accident conditions, including containment pressure, temperature, and radiation while venting steam, hydrogen, and other non-condensable gases and aerosols. The design is not required to exceed the current capability of the limiting containment components.

Evaluation

The wetwell vent up to, and including, the second containment isolation valve is designed consistent with the design basis of the plant. These items include piping, piping supports, containment isolation valves, containment isolation valve actuators and containment isolation valve position indication components.

The existing hardened vent piping, between the wetwell and the Reactor Building roof, including valve CAC-V8 is designed to 70 psig at 316 ºF. Wetwell vent piping and components installed downstream of the containment isolation boundary are designed for beyond design basis conditions.

HCVS piping and components have been analyzed and shown to perform under severe accident conditions using the guidance provided in HCVS-FAQ-08 and HCVS-WP-02. Table 1 contains the list of components and their evaluation for severe accident conditions.

Refer to EA-13-109, requirement 1.2.11 for a discussion on designing for combustible gas.

1.2.11	The HCVS shall be designed and operated to ensure the flammability limits of gases passing through the system are not reached; otherwise, the system shall be designed to withstand dynamic loading resulting from hydrogen deflagration and detonation.

Evaluation

In order to prevent a detonable mixture from developing in the pipe, a check valve is installed near the top of the pipe in accordance with HCVS-WP-03. This valve will open on venting, but will close to prevent air from migrating back into the pipe after a period of venting. The check valve is installed and tested to ensure that it limits back-leakage to preclude a detonable mixture from occurring in the case venting is stopped prior to the establishment of alternate reliable containment heat removal. The use of a check valve meets the requirement to ensure the flammability limits of gases passing through the vent pipe will not be reached.

1.2.12	The HCVS shall be designed to minimize the potential for hydrogen gas migration and ingress into the reactor building or other buildings.

Evaluation

The response under Order element 1.2.3 explains how the potential for hydrogen migration into other systems, the reactor building or other buildings is minimized.

1.2.13	The HCVS shall include features and provisions for the operation, testing, inspection and maintenance adequate to ensure that reliable function and capability are maintained.

Evaluation

As endorsed in the ISG, sections 5.4 and 6.2 of NEI 13-02 provide acceptable method(s) for satisfying the requirements for operation, testing, inspection, and maintenance of the HCVS.

Primary and secondary containment required leakage testing is covered under existing design basis testing programs. The HCVS outboard the containment boundary shall be tested to ensure that vent flow is released to the outside with minimal leakage, if any, through the interfacing boundaries with other systems or units.

BSEP has implemented the Table 3-3 testing and inspection requirements for the HCVS to ensure reliable operation of the system. These requirements are from NEI 13-02, Table 6.1. The implementing modification packages contain these requirements as well as additional testing requirements for post-modification testing.

Table 3-3: Testing and Inspection Requirements	
Cycle the HCVS valves and the interfacing system valves not used to maintain containment integrity during operations. [Note 1]	Once per every operating cycle. [Note 2]
Cycle the HCVS check valves not used to maintain containment integrity during unit operations. [Note 3]	Once per every other operating cycle. [Note 4]
Perform visual inspections and a walk down of HCVS components	Once per operating cycle
Functionally test the HCVS radiation monitors.	Once per operating cycle
Leak test the HCVS.	(1) Prior to first declaring the system functional; (2) Once every three operating cycles thereafter; and (3) After restoration of any breach of system boundary within the buildings
Validate the HCVS operating procedures by conducting an open/close test of the HCVS control logic from its control panel (primary and alternate) and ensuring that all interfacing system boundary valves move to their proper (intended) positions. [Note 5]	Once per every other operating cycle

Notes:
1 - Not required for HCVS 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.

2 HCVS Quality Standards:

2.1 The HCVS vent path up to and including the second containment isolation barrier shall be designed consistent with the design basis of the plant. Items in this path include piping, piping supports, containment isolation valves, containment isolation valve actuators, and containment isolation valve position indication components.

Evaluation:

The HCVS upstream of and including the second containment isolation valve (CAC-V216) and penetrations are not being modified for order compliance so that they continue to be designed consistent with the design basis of primary containment including pressure, temperature, radiation, and seismic loads.

2.2	All other HCVS components shall be designed for reliable and rugged performance that is capable of ensuring HCVS functionality following a seismic event. These items include electrical power supply, valve actuator pneumatic supply, and instrumentation (local and remote) components.

Evaluation:

The HCVS components downstream of the outboard containment isolation valve and components that interface with the HCVS are routed in seismically qualified structures or supported from seismically qualified structure(s).

The HCVS downstream of the outboard containment isolation valve, including piping and supports, electrical power supply, valve actuator pneumatic supply, and instrumentation (local and remote) components, have been designed and analyzed to conform to the requirements consistent with the applicable design codes for the plant and to ensure functionality following a design basis earthquake. This includes environmental qualification consistent with expected conditions at the equipment location.

Table 1 contains a list of components, controls and instruments required to operate HCVS, their qualification and evaluation against the expected conditions. All instruments are fully qualified for the expected seismic conditions so that they will remain functional following a seismic event.

Section IV: HCVS Phase 2 Final Integrated Plan

Section IV.A: The requirements of EA-13-109, Attachment 2, Section B for Phase 2

Licensees with BWRs with Mark 1 and Mark II containments shall either:

- Design and install a HCVS, using a vent path from the containment drywell, that meets the requirements in section B.1 below, or
- Develop and implement a reliable containment venting strategy that makes it unlikely that a licensee would need to vent from the containment drywell before alternate reliable containment heat removal and pressure control is reestablished and meets the requirements in Section B.2 below.

1 HCVS Drywell Vent Functional Requirements

1.1	The drywell venting system shall be designed to vent the containment atmosphere (including steam, hydrogen, non-condensable gases, aerosols, and fission products), and control containment pressure within acceptable limits during severe accident conditions.
1.2	The same functional requirements (reflecting accident conditions in the drywell), quality requirements, and programmatic requirements defined in Section A of this Attachment for the wetwell venting system shall also apply to the drywell venting system.

2 Containment Venting Strategy Requirements

Licensees choosing to develop and implement a reliable containment venting strategy that does not require a reliable, severe accident capable drywell venting system shall meet the following requirements:

2.1	The strategy making it unlikely that a licensee would need to vent from the containment drywell during severe accident conditions shall be part of the overall accident management plan for Mark I and Mark II containments.
2.2	The licensee shall provide supporting documentation demonstrating that containment failure as a result of overpressure can be prevented without a drywell vent during severe accident conditions.
2.3	Implementation of the strategy shall include licensees preparing the necessary procedures, defining and fulfilling functional requirements for installed or portable equipment (e.g., pumps and valves), and installing needed instrumentation.

Because the order contains just three requirements for the containment venting strategy, the compliance elements are in NEI 13-02, Revision 1. NEI 13-02, Revision 1, endorsed by NRC in JLD-ISG-2015-01, provides the guidance for the containment venting strategy (B.2) of the order. NEI 13-02, Revision 1, provides SAWA in conjunction with Severe Accident Water Management (SAWM), which is designed to maintain the wetwell vent in service until alternate reliable containment heat removal and pressure control are established, as the means for compliance with part B of the order.

BSEP has implemented the Containment Venting Strategy (B.2), as the compliance method for Phase 2 of the Order and conforms to the guidance in NEI 13-02 Revision 1 for this compliance method.

Section IV.B: HCVS Existing System

There previously was neither a hardened drywell vent nor a strategy at BSEP that complied with Phase 2 of the order.

Section IV.C: HCVS Phase 2 SAWA System and SAWM Strategy

The HCVS Phase 2 SAWA system and SAWM strategy utilize the FLEX mitigation equipment and strategies to the extent practical. This approach is reasonable because the external hazards and the event initiator (ELAP) are the same for both FLEX mitigation strategies and HCVS. For SAWA, it is assumed that the initial FLEX response actions are unsuccessful in providing core cooling such that core damage contributes to significant radiological impacts that may impede the deployment, connection and use of FLEX equipment. These radiological impacts, including dose from containment and HCVS vent line shine were evaluated and modifications made as necessary to mitigate the radiological impacts such that the actions needed to implement SAWA and SAWM are feasible in the timeframes necessary to protect the containment from overpressure related failure. To the extent practical, the SAWA equipment, connection points, deployment locations and access routes are the same as the FLEX primary strategies so that a Unit that initially implements FLEX actions that later degrades to severe accident conditions can readily transition between FLEX and SAWA strategies. This approach further enhances the feasibility of SAWA under a variety of event sequences including timing.

BSEP has implemented the containment venting strategy utilizing SAWA and SAWM. The SAWA system consists of a FLEX (SAWA) pump injecting into the Reactor Pressure Vessel (RPV) and SAWM consists of flow control at the FLEX (SAWA) pump along with instrumentation and procedures to ensure that the wetwell vent is not submerged (SAWM). Procedures have been issued to implement this strategy including revision 3 to the Severe Accident Management Guidelines (SAMG). This strategy has been shown via Modular Accident Analysis Program (MAAP) analysis to protect containment without requiring a drywell vent for at least seven days which is the guidance from NEI 13-02 for the period of sustained operation.

Section IV.C.1: Detailed SAWA Flow Path Description

The SAWA flow path is the same as the FLEX primary injection path except that the hose run inside the RB was replaced with stainless steel pipe. The SAWA system, shown on Attachment 4, consists of a FLEX pump injecting into the Reactor Pressure Vessel (RPV) and SAWM consists of flow control at the FLEX pump along with wetwell level indication to ensure that the wetwell vent is not submerged (SAWM). The SAWA injection path, starts at the Condensate Storage Tank (CST), goes to the FLEX pump via suction hoses, goes through the FLEX pump to a flexible discharge hose, then to a core bore at the Reactor Building (RB). The hoses and pumps are stored in the FLEX Storage Building (FSB) which is protected from all hazards. From the core bore inside the RB, the FLEX path runs via stainless steel pipe to a connection at the Reactor Water Cleanup (RWCU) system. This RWCU connection ties to the Reactor Core Isolation Cooling (RCIC) system, then to the Reactor Feedwater System, then to the Reactor Pressure Vessel (RPV). BWROG generic assessment, BWROG-TP-15-008, provides the principles of Severe Accident Water Addition to ensure protection of containment. This SAWA injection path is qualified for the all the screened in hazards (Section III) in addition to severe accident conditions.

Section IV.C.2: Severe Accident Assessment of Flow Path

The actions inside the RB where there could be a high radiation field due to a severe accident will be to open valves at the core bore and the RWCU connection just above the containment hatch and accessed from the 20’ level of the RB via a fixed ladder, and potentially (only for a seismic event) close one valve on the 80’ level. The action to open (and possibly close) valves inside the RB can be performed before the dose is unacceptable, under the worst-case scenario within the first hour, after the loss of RPV injection. This time was validated as part of the Time Sensitive Action validation for EA-13-109. Procedure 0EOP-FSG-16 directs accomplishment of actions that must be done early in the severe accident event where there is a loss of All AC power and a loss of all high-pressure injection to the core. In this event, core damage is not expected for at least one hour so that there will be no excessive radiation levels or heat related concerns in the RB when the valves are operated. The other SAWA actions all take place outside the RB (or inside the RB at a safe location) at the MCR, CST, RB outer wall, FSB, and the deployment pathways. Since these locations are outside the RB, they are shielded from the severe accident radiation by the thick concrete walls of the RB. The SAWA pump deployment time is bounded by the FLEX pump deployment time of 4 hours and 5 minutes as validated for EA-12-049 response. Once SAWA is initiated, the operators will monitor the response of containment from the MCR to determine that venting and SAWA are operating satisfactorily, maintaining containment pressure low to avoid containment failure. A stable or slowly rising trend in wetwell level with SAWA at the minimum flow rate indicates water on the drywell floor up to the vent pipe or downcomer openings. After some period of time, as decay heat levels decrease, the operators will be able to reduce SAWA flow to keep the core debris cool while avoiding overfilling the torus to the point where the wetwell vent is submerged.

Section IV.C.3: Severe Accident Assessment of Safety-Relief Valves

BSEP has methods available to extend the operational capability of manual pressure control using SRVs as provided in the plant specific order EA-12-049 submittal. Assessment of manual SRV pressure control capability for use of SAWA during the Order defined accident is unnecessary because RPV depressurization is directed by the EPGs in all cases prior to entry into the SAGs.

Section IV.C.4: Available Freeboard Use

The freeboard between -2.5’ and 6’ elevation in the wetwell provides approximately 536,700 gallons of water volume before the level instrument would be off scale high. BWROG generic assessment BWROG-TP-15-011, provides the principles of Severe Accident Water Management to preserve the wetwell vent for a minimum of seven days. After containment parameters are stabilized with SAWA flow, SAWA flow will be reduced to a point where containment pressure will remain low while wetwell level is stable or very slowly rising. As shown in calculation BNP-MECH-FLEX-0005, the wetwell level will not reach the wetwell vent for at least seven days. A diagram of the available freeboard is shown on Attachment 1.

Section IV.C.5: Upper range of wetwell level indication

The upper range of wetwell level indication provided for SAWA/SAWM is +6 feet elevation. This defines the upper limit of wetwell volume that will preserve the wetwell vent function as shown in Attachment 1.

Section IV.C.6: Wetwell vent service time

BSEP calculations BNP-MECH-FLEX-0005 and BWROG-TP-15-011, demonstrate that throttling SAWA flow after containment parameters have stabilized, in conjunction with venting containment through the wetwell vent will result in a stable or slowly rising wetwell level. The references demonstrate that, for the scenario analyzed, wetwell level will remain below the wetwell vent pipe for greater than the seven days of sustained operation allowing significant time for restoration of alternate containment pressure control and heat removal.

Section IV.C.7: Strategy time line

The overall accident management plan for BSEP is developed from the BWR Owner’s Group Emergency Procedure Guidelines and Severe Accident Guidelines (EPG/SAG). As such, the

SAWA/SAWM implementing procedures are integrated into the BSEP SAMGs. In particular, EPG/SAG Revision 3, when implemented with Emergency Procedures Committee Generic Issue 1314, allows throttling of SAWA in order to protect containment while maintaining the wetwell vent in service. The SAMG flow charts direct use of the hardened vent as well as SAWA/SAWM when the appropriate plant conditions have been reached.

Using the NEI letter from Nicholas X. Pappas, Senior Project Manager of NEI to Industry Administrative Points of Contact, Validation Document for FLEX Strategies, dated July 18, 2014, BSEP has validated that the SAWA pump can be deployed and commence injection in less than 7 hours. The studies referenced in NEI 13-02 demonstrated that establishing flow within 8 hours will protect containment. The initial SAWA flow rate will be at least 300 gpm. After a period of time, estimated to be about 4 hours, in which the maximum flow rate is maintained, the SAWA flow will be reduced. The reduction in flow rate and the timing of the reduction will be based on stabilization of the containment parameters of drywell pressure and wetwell level.

BNP-MECH-FLEX-005 demonstrated that, SAWA flow could be reduced to 100 gpm after four hours of initial SAWA flow rate and containment would be protected. At some point wetwell level will begin to rise indicating that the SAWA flow is greater than the steaming rate due to containment heat load such that flow can be reduced. While this is expected to be 4-6 hours, no time is specified in the procedures because the SAMGs are symptom based guidelines.

Section IV.C.8: SAWA Flow Control

BSEP will accomplish SAWA flow control by the use of throttle valves on the SAWA pumps. The operators at the SAWA pump will be in communication with the MCR via radios or runners and the exact time to throttle flow is not critical since there is a large margin between normal wetwell level and the level at which the wetwell vent will be submerged. The communications capabilities that will be used for communication between the MCR and the SAWA flow control location are the same as that evaluated and found acceptable for FLEX strategies. The communications capabilities have been tested to ensure functionality at the SAWA flow control and monitoring locations. This information was provided in Reference 27 for Phase 2 open item 5 closure.

Section IV.C.9: SAWA/SAWM Element Assessment

Section IV.C.9.1: SAWA Pump

BSEP uses three portable diesel-driven fire pumps for FLEX and SAWA. Two pumps capable of 3000 gpm and one pump capable of 1500 gpm are available for use at the pressures required for RPV injection during an ELAP. Each of these pumps has been shown to be capable of supplying the required flow rate to the RPV and the SFP for FLEX and for SAWA scenarios. The pumps are stored in the FSB where they are protected from all screened-in hazards and are rugged, over the road, trailer-mounted units, and therefore will be available to function after a seismic event.

Section IV.C.9.2: SAWA analysis of flow rates and timing

BNP-MECH-FLEX-0005 assumes a SAWA flow of 300 gpm starting 8 hours after the loss of injection and demonstrates that containment is protected at this initial flow rate by comparing it to the results using 500 gpm. The results are virtually indistinguishable with respect to containment pressure therefore demonstrating that this flow rate prevents containment failure by over pressurization as required by the order.

Section IV.C.9.3: SAWA Pump Hydraulic Analysis

Calculation 0FLEX-0035 analyzed the FLEX pumps and the lineup for RPV injection that would be used for SAWA. This calculation showed that the pumps have adequate capacity to meet the SAWA flow rate required to protect containment.

Section IV.C.9.4: SAWA Method of backflow prevention

The BSEP SAWA flow path goes through a series of check valves in the RWCU and Feedwater systems. The Feedwater backflow prevention valves are also Primary Containment Isolation Valves (PCIVs) whose integrity of check function (open and closed) is demonstrated by other plant testing requirements such that additional testing per NEI 13-02 Revision 1 Section 6.2 is not required for these valves per NEI 13-02 Revision 1 Table 6-1 Note 3. Thus backflow is prevented by check valves in the SAWA flow path inside the RB.

Section IV.C.9.5: SAWA Water Source

The initial source of water for SAWA is the CST which can provide approximately 52 hours of water injection without makeup based on the FLEX analysis. Before this initial supply of water is depleted, the N+1 FLEX pump or the NSRC-supplied pump will be deployed to re-fill the CST from the discharge canal. This long-term strategy of water supply was qualified for order EA-12-049 response and is available during a severe accident. Therefore there will be sufficient water for injection to protect containment during the period of sustained operation.

Section IV.C.9.6: SAWA/SAWM Motive Force

Section IV.C.9.6.1: SAWA Pump Power Source

The SAWA pumps are stored in the FSB where they are protected from all screened-in hazards. The SAWA pumps are commercial fire pumps rated for long-term outdoor use in emergency scenarios. The pumps are diesel-driven by an engine mounted on the skid with the pump. The pumps will be refueled by the FLEX refueling equipment that has been qualified for long-term refueling operations per EA-12-049. The action to refuel the SAWA pumps was evaluated under severe accident conditions in Table 2, and demonstrated to be acceptable. Since the pumps are stored in a protected structure, are qualified for the environment in which they will be used, and will be refueled by a qualified refueling strategy, they will perform their function to maintain SAWA flow needed to protect primary containment per EA-13-109.

Section IV.C.9.6.2: DG loading calculation for SAWA/SAWM equipment

Table 1 shows the electrical power source for the SAWA/SAWM instruments. For the instruments powered by the 24/48VDC battery, calculation BNP-E-6.125 demonstrates that they can provide power until the FLEX generator restores power to the battery charger.

The FLEX load on the FLEX DG per EA-12-049 was evaluated in calculation 31116-CALC-E-001. This calculation demonstrated 367 kW of margin to full load. The additional loads on the FLEX DGs for SAWA and SAWM consist of the torus level instrument and the drywell pressure instrument which are powered from the division 2 24/48VDC battery via its battery charger. These instrument loops draw a maximum of 20 milliamps so that the load they add to the 500 KW FLEX DG is insignificant. The FLEX generator was qualified to carry the rest of the FLEX loads as part of Order EA-12-049 compliance.

Section IV.C.10: SAWA/SAWM Instrumentation

Section IV.C.10.1: SAWA/SAWM instruments

Table 1 contains a listing of the instruments needed for SAWA and SAWM implementation, and the expected environmental parameters for each instrument, its qualifications, and its power supply for sustained operation.

Section IV.C.10.2: Describe SAWA instruments and guidance

The drywell pressure and wetwell level instruments, used to monitor the condition of containment, are pressure and differential pressure detectors that are safety-related and qualified for post-accident use. These instruments are referenced in Severe Accident Guidelines for control of SAWA flow to maintain the wetwell vent in service while maintaining containment protection. These instruments are powered by batteries for at least 24 hours and will be re-powered by FLEX generator systems for the sustained operating period. These instruments are on buses included in the FLEX generator loading calculations for EA-12-049. Note that other indications of these parameters may be available depending on the exact scenario.

The SAWA flow meter is a paddle-wheel flow meter mounted in piping on the pump's skid, is powered by the pump's electrical system and provides indication of flow rate for the operator at the pump.

No containment temperature instrumentation is required for compliance with HCVS Phase 2. However, most FLEX electrical strategies repower other containment instruments that include drywell temperature, which may provide information for the operations staff to evaluate plant conditions under a severe accident and to provide confirmation for adjusting SAWA flow rates. SAMG strategies will evaluate and use drywell temperature indication if available consistent with the symptom based approach. NEI 13-02 Revision 1 Section C.8.3 discusses installed drywell temperature indication.

Section IV.C.10.3: Qualification of SAWA/SAWM instruments

The drywell pressure and wetwell level instruments are pressure and differential pressure detectors that are safety-related and qualified for post-accident use. The expected integrated dose to the instruments during the period of sustained operation is less than their qualification dose, and they are located in areas that will experience temperatures and humidity less than their qualified values. Table 1 demonstrates that these instruments are qualified for the expected conditions during a loss of AC power and severe accident. These instruments are qualified per RG-1.97 Revision 2 (Reference 32) which is the BSEP committed version per

UFSAR Section 1, Table 1-6 as post-accident instruments and are therefore qualified for EA-13-109 events.

The SAWA flow meter is rated for continuous use under the expected ambient conditions and so will be available for the entire period of sustained operation. Furthermore, since the pump is deployed outside the RB, and on the opposite of the RB from the vent pipe, there is no concern for any effects of radiation exposure to the flow instrument.

Section IV.C.10.4: Instrument Power Supply through Sustained Operation

BSEP FLEX strategies will restore the containment instruments, containment pressure and wetwell level, necessary to successfully implement SAWA. The strategy will be to use the FLEX generator to re-power battery chargers before the batteries supplying the instruments are depleted. Since the FLEX generators are refueled per FLEX strategies for a sustained period of operation, the instruments will be powered for the sustained operating period.

Section IV.C.11: SAWA/SAWM Severe Accident Considerations

Section IV.C.11.1: Severe Accident Effect on SAWA Pump and Flowpath

Since the SAWA pump is stored in the FSB and will be operated from outside the RB, on the opposite side of the RB from the vent pipe, there will be no issues with radiation dose rates at the SAWA pump control location and there will be no significant dose to the SAWA pump.

Inside the RB the SAWA flow path consists of stainless steel pipe which will remain unaffected by the radiation or elevated temperatures inside the RB. Therefore, the SAWA flow path will not be affected by radiation or temperature effects due to a severe accident.

Section IV.C.11.2: Severe Accident Effect on SAWA/SAWM instruments

The SAWA/SAWM instruments are described in section IV.C.9.3, that section provides severe accident effects

Section IV.C.11.3: Severe Accident Effect on personnel actions

Section IV.C.2 describes the RB actions within the first 7 hours. The actions including access routes outside the Reactor Building that will be performed after the first use of the vent during severe accident conditions (assumed to be 7 hours per HCVS-FAQ-12) are located such that they are either shielded from direct exposure to the vent line or are a significant distance from the vent line so that expected dose is maintained below the ERO exposure guidelines.

As part of the response to Order EA-12-049, BSEP performed GOTHIC calculations of the temperature response of the Reactor and Control Buildings during the ELAP event. Since, in the severe accident, the core materials are contained inside the primary containment, the temperature response of the RB and CB is driven by the loss of ventilation and ambient conditions and therefore will not change. Thus, the FLEX GOTHIC calculations are acceptable for severe accident use.

Table 2 provides a list of SAWA/SAWM operator actions as well as an evaluation of each for suitability during a severe accident. Attachment 6 shows the approximate locations of the actions.

After the SAWA pipe is aligned inside the RB, the operators can control SAWA/SAWM as well as observe the necessary instruments from outside the RB. The thick concrete RB walls (below 117’ level) as well as the distance to the core materials mean that there is no radiological concern with any actions outside the RB. Therefore, all SAWA controls and indications are accessible during severe accident conditions.

The SAWA monitoring is from the MCR or from outside the RB at ground level. The SAWA pump operation is from outside the RB at ground level. The BSEP FLEX response ensures that the SAWA pump, FLEX air compressors, FLEX generators and other equipment can all be run for a sustained period by refueling. All the refueling locations are located in shielded or protected areas so that there is no radiation hazard from core material during a severe accident. The monitoring instrumentation includes SAWA flow at the pump, and wetwell level and containment pressure in the MCR.

Section V: HCVS Programmatic Requirements

Section V.A: HCVS Procedure Requirements

Licensees shall develop, implement, and maintain procedures necessary for the safe operation of the HCVS. Procedures shall be established for system operations when normal and backup power is available, and during an extended loss of AC power.

Evaluation:

Procedures have been established for system operations when normal and backup power is available, and during ELAP conditions. The implementing design change documents contain instructions for modifying the HCVS specific procedures.

The HCVS and SAWA procedures have been developed and implemented following BSEP’s process for initiating and/or revising procedures and contain the following details:

- appropriate conditions and criteria for use of the system
- when and how to place the system 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 portable equipment
- since BSEP relies on Containment Accident Pressure (CAP) to achieve net positive suction head (NPSH) for the Emergency Core Cooling System (ECCS) pumps, the procedures need to include precautions that use of the vent may impact NPSH (CAP) available to the ECCS pumps.

BSEP has implemented the BWROG Emergency Procedures Committee Issue 1314 that implements the Severe Accident Water Management (SAWM) strategy in the Severe Accident Management Guidelines (SAMGs). The following general cautions, priorities and methods have been 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 were 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.

<u>Cautions</u>

- “Adding water to hot core debris may result in rapid steam generation challenging primary containment limits.”
- “Raising torus level above +6 ft. (elevation of torus vent) will result in loss of the torus vent path.”

<u>Priorities</u> – 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).
    - First priority is to “Maximize RPV injection.” Guidance is that injection rate should be “>= 300 gpm”
    - Core debris cooling is directed by maintaining up to 100 gpm injection and maintaining torus water level <+6 ft. (elevation of the vent).
- Primary containment pressure is controlled below PCPL (Primary Containment Pressure Limit) by any means including wetwell venting.
- Using the above flow control and pressure control priorities, water addition is managed to preserve the Mark I suppression chamber vent path, thereby retaining the benefits of suppression pool scrubbing and minimizing the likelihood of radioactivity and hydrogen release into the secondary containment (SAWM)

Methods – SAMGs identify systems and capabilities to add water to the RPV or drywell, with the following guidance:

- Inject into the RPV if possible whether or not the RPV had been breached using any of the following sources depending on availability:
  - Condensate and Feedwater
  - Control Rod Drive
  - Reactor Core Isolation Cooling
  - High Pressure Coolant Injection
  - Core Spray
  - Low Pressure Coolant Injection
  - Standby Liquid Control
  - Heater Drain Pumps
  - Residual Heat Removal
  - FLEX (SAWA) pump
- Steps direct "Use external sources only when required" in order to aid in maintaining availability of the torus vent.
- Steps direct the use of external sources only "If torus level can be maintained below +6 feet elevation."

Section V.B: HCVS Out of Service Requirements

Provisions for out-of-service requirements of the HCVS and compensatory measures have been added to 0PLP-01.4 so that it is with the FLEX out-of-service program.

Programmatic controls have been implemented to document and control the following:

NOTE: Out of service times and required actions noted below are for HCVS and SAWA functions. Equipment that also supports a FLEX function that is found to be non-functional must also be addressed using the out of service times and actions in accordance with the FLEX program.

The provisions for out-of-service requirements for HCVS and SAWA functionality are applicable in Modes 1, 2, and 3 per NEI 13-02, 6.3.

- 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 or SAWA are non-functional, no compensatory actions are necessary.

- If the out of service times projected to exceed 30 or 90 days as described above, the following actions will be performed through the corrective action system:
  - The cause(s) of the non-functionality,
  - The actions to be taken and the schedule for restoring the system to functional status and to 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.

The HCVS system is functional when piping, valves, instrumentation and controls including motive force necessary to support system operation are available. Since the system is designed to allow a primary control and monitoring or alternate valve control by Order criteria 1.2.4 or 1.2.5, allowing for a longer out of service time with either of the functional capabilities maintained is justified. A shorter length of time when both primary control and monitoring and alternate valve control are unavailable is needed to restore system functionality in a timely manner while at the same time allowing for component repair or replacement in a time frame consistent with most high priority maintenance scheduling and repair programs, not to exceed 30 days unless compensatory actions are established per NEI 13-02 Section 6.3.1.3.3.

SAWA is functional when piping, valves, motive force, instrumentation and controls necessary to support system operation are functional.

The system functionality basis is for coping with beyond design basis events and therefore plant shutdown to address non-functional conditions is not warranted. However, such conditions should be addressed by the corrective action program and compensatory actions to address the non-functional condition should be established. These compensatory actions may include alternative containment venting strategies or other strategies needed to reduce the likelihood of loss of fission product cladding integrity during design basis and beyond design basis events even though the severe accident capability of the vent system is degraded or non-functional. Compensatory actions may include actions to reduce the likelihood of needing the vent but may not provide redundant vent capability.

Applicability for allowed out of service time for HCVS and SAWA for system functional requirements is limited to startup, power operation and hot shutdown conditions when primary containment is required to be operable and containment integrity may be challenged by decay heat generation.

Section V.C: HCVS Training Requirements

Licensee shall train appropriate personnel in the use of the HCVS. The training curricula shall include system operations when normal and backup power is available, and during an extended loss of AC power.

Evaluation:

Personnel expected to perform direct execution of the HCVS have received 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. The personnel trained and the frequency of training was determined using a systematic analysis of the tasks to be performed using the Systems Approach to Training (SAT) process.

In addition, per NEI 12-06, any non-trained personnel on-site will be available to supplement trained personnel.

Section V.D: Demonstration with other Post Fukushima Measures

BSEP will demonstrate use of the HCVS and SAWA systems in drills, tabletops or exercises as follows:

1. Hardened containment vent operation on normal power sources (no ELAP)

2. During FLEX demonstrations (as required by EA-12-049: Hardened containment vent operation on backup power and from primary or alternate locations during conditions of ELAP/loss of UHS with no core damage.) System use is for containment heat removal AND containment pressure control.

3. HCVS operation on backup power and from primary or alternate location during conditions of ELAP/loss of UHS with core damage. System use is for containment heat removal AND containment pressure control with potential for combustible gases.

Evaluation

NOTE: Items 1 and 2 above are not applicable to SAWA.

The use of the HCVS and SAWA capabilities will be demonstrated during drills, tabletops or exercises consistent with NEI 13-06 and on a frequency consistent with 10 CFR 50.155(e)(4). BSEP will perform the first drill demonstrating at least one of the above capabilities by March 2022 which is within four years of the first unit compliance with Phase 2 of Order EA-13-109. Subsequent drills, tabletops or exercises will be performed to demonstrate the capabilities of different elements of Items 1, 2 and/or 3 above that is applicable to BSEP in subsequent eight-year intervals.

Section VI: References

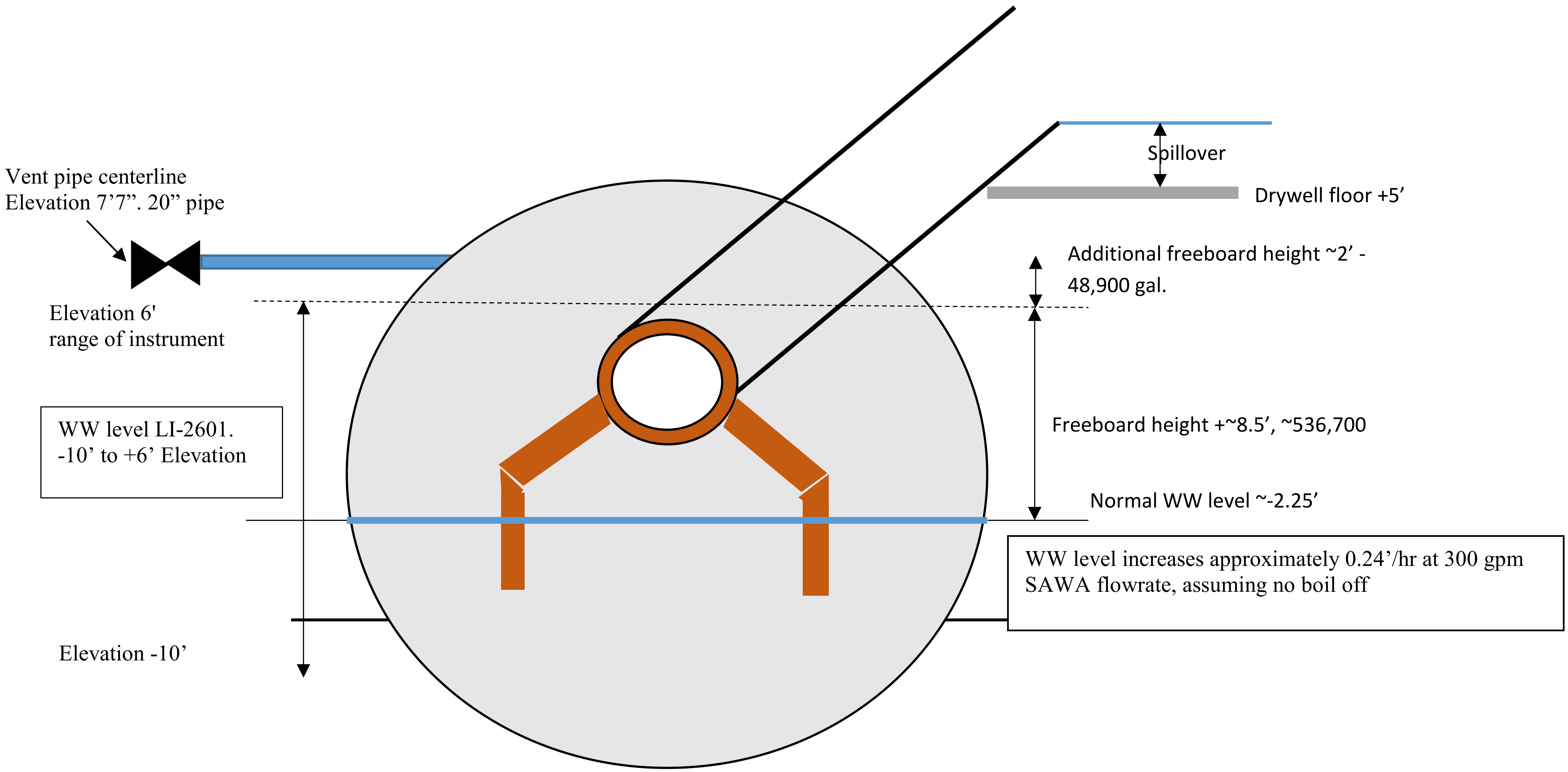
Number	Rev	Title	Location[1]
1. GL-89-16	0	Installation of a Hardened Wetwell Vent (Generic Letter 89-16), dated September 1, 1989.	ML031140220
2. SECY-12-0157	0	Consideration of Additional Requirements for Containment Venting Systems for Boiling Water Reactors with Mark I and Mark II Containments	ML12345A030
3. SRM-SECY-12-0157	0	Staff Requirements – SECY-12-0157 – Consideration of Additional Requirements for Containment Venting Systems for Boiling Water Reactors with Mark I and Mark II Containments	ML13078A017
4. EA-12-050	0	Order to Modify Licenses with Regard to Reliable Hardened Containment Vents	ML12054A694
5. EA-13-109	0	Order to Modify Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions	ML13143A321
6. NEI 13-02	0	Industry Guidance for Compliance with Order EA-13-109, BWR Mark I & II Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions	ML13316A853
7. NEI 13-02[2]	1	Industry Guidance for Compliance with Order EA-13-109, BWR Mark I & II Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions	ML15113B318
8. HCVS-WP-01	0	Hardened Containment Vent System Dedicated and Permanently Installed Motive Force, Revision 0, April 14, 2014	ML14120A295 ML14126A374
9. HCVS-WP-02	0	Sequences for HCVS Design and Method for Determining Radiological Dose from HCVS Piping, Revision 0, October 23, 2014	ML14358A038 ML14358A040
10. HCVS-WP-03	1	Hydrogen/Carbon Monoxide Control Measures Revision 1, October 2014	ML14302A066 ML15040A038
11. HCVS-WP-04	0	Missile Evaluation for HCVS Components 30 Feet Above Grade	ML15244A923 ML15240A072
12. JLD-ISG-2013-02	0	Compliance with Order EA-13-109, Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation under Severe Accident Conditions	ML13304B836
13. JLD-ISG-2015-01	0	Compliance with Order EA-13-109, Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation under Severe Accident Conditions	ML15104A118
14. HCVS-FAQ-10	1	Severe Accident Multiple Unit Response	ML15273A141 ML15271A148

[1] Where two ADAMS accession numbers are listed, the first is the reference document and the second is the NRC endorsement of that document.
[2] NEI 13-02 Revision 1 Appendix J contains HCVS-FAQ-01 through HCVS-FAQ-09.

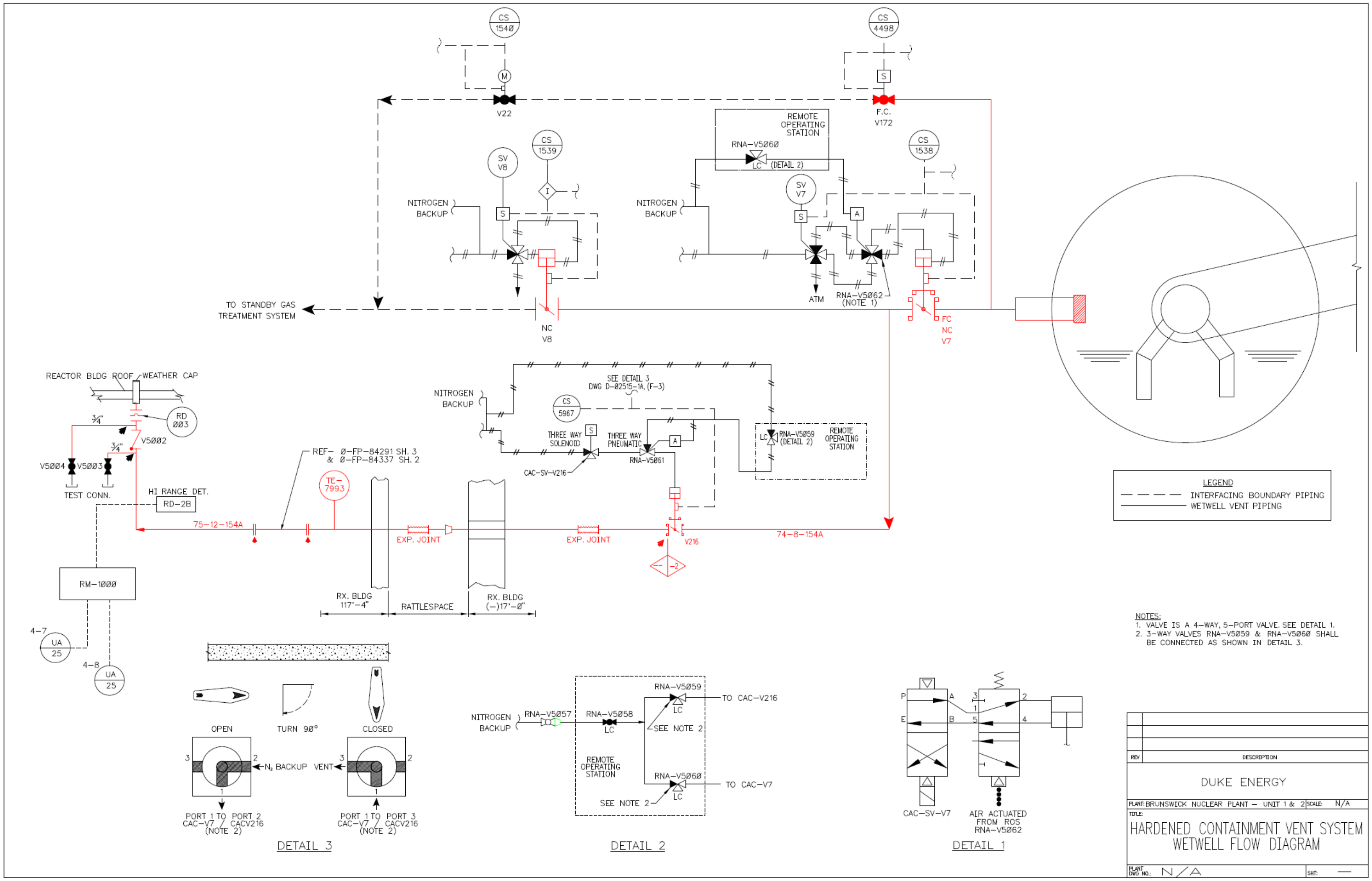
15. HCVS-FAQ-11	0	Plant Response During a Severe Accident	ML15273A141 ML15271A148
16. HCVS-FAQ-12	0	Radiological Evaluations on Plant Actions Prior to HCVS Initial Use	ML15273A141 ML15271A148
17. HCVS-FAQ-13	0	Severe Accident Venting Actions Validation	ML15273A141 ML15271A148
18. Phase 1 OIP	0	HCVS Phase 1 Overall Integrated Plan (OIP)	ML14191A687
19. Combined OIP	0	Combined HCVS Phase 1 and 2 Overall Integrated Plan (OIP)	ML16020A064
20. Phase 1 ISE	0	HCVS Phase 1 Interim Staff Evaluation (ISE)	ML15049A266
21. Phase 2 ISE	0	HCVS Phase 2 Interim Staff Evaluation (ISE)	ML16223A725
22. 1st Update	0	First Six Month Update	ML14364A029
23. 2nd Update	0	Second Six Month Update	ML15196A035
24. 3rd Update	0	Third Six Month Update	ML16020A064
25. 4th Update	0	Fourth Six Month Update	ML16190A111
26. 5th Update	0	Fifth Six Month Update	ML16365A007
27. 6th Update	0	Sixth Six Month Update	ML17171A383
28. 7th Update	0	Seventh Six Month Update	ML18177A458
29. Compliance Letter	0	HCVS Phase 1 and Phase 2 compliance letter	ML17354A248
30. RB FLEX Heat-up Calc.	0	BNP-MECH-FLEX-0001	N/A
31. CB FLEX Room Heat-up Calc.	0	BNP-MECH-FLEX-0003	N/A
32. NEI 12-06	0	Diverse and Flexible Coping Strategies (FLEX) Implementation Guide	ML12221A205
33. EA-12-049	0	Issuance of Order to Modify Licenses With Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events, dated March 12, 2012.	ML12054A735
34. RG 1.97	3	Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Conditions During and Following an Accident	ML003740282
35. TR-1026539	0	EPRI Investigation of Strategies for Mitigating Radiological Releases in Severe Accidents BWR, Mark I and Mark II Studies, October 2012	N/A
36. Safety Evaluation Report EA-12-049 and EA-12-051		Brunswick Steam Electric Plant, Units 1 and 2 - Safety Evaluation Regarding Implementation of Mitigating Strategies and Reliable Spent Fuel Pool Instrumentation Related to Orders EA-12-049 and EA-12-051), December 14, 2016.	ML16335A031
37. 8th Update	0	Eighth Six Month Update	ML18177A458
38. 9th Update	0	Ninth Six Month Update	ML18354A907

Brunswick Steam Electric Plant (BSEP), Unit Nos. 1 and 2,
HCVS Final Integrated Plan (FIP)

Attachment 1: Phase 2 Freeboard diagram

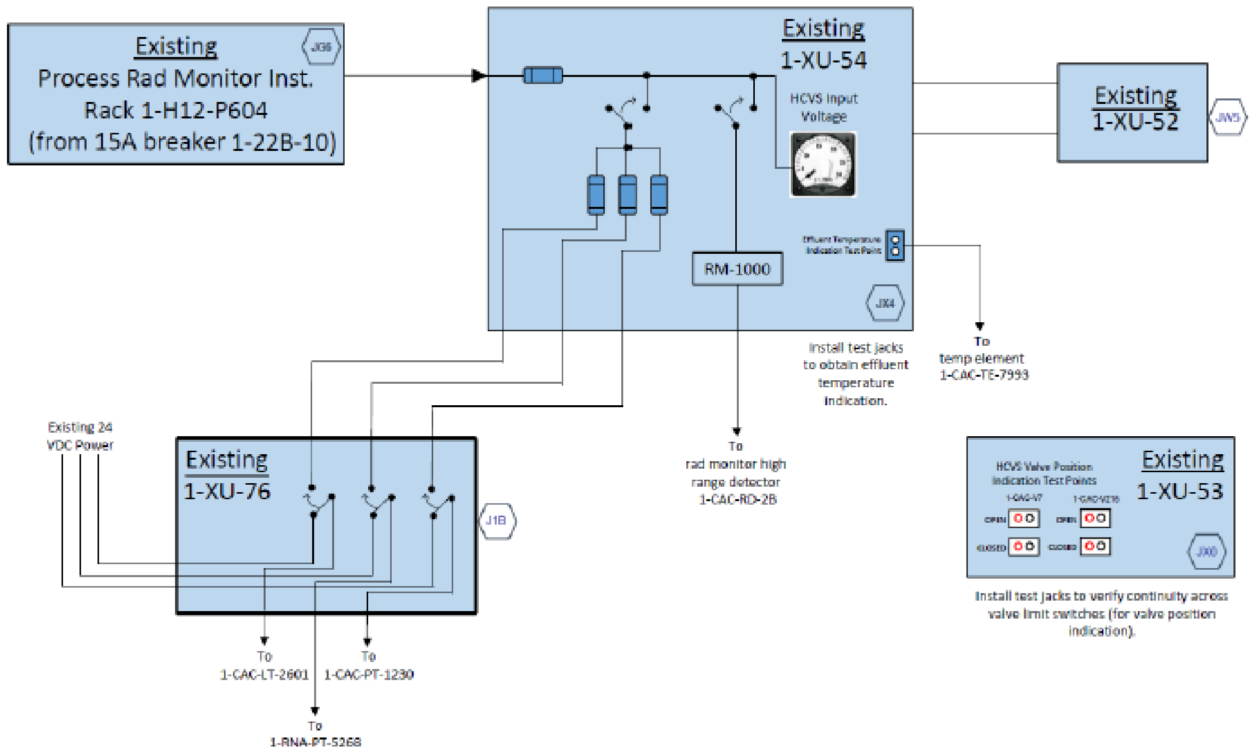


Attachment 2: One Line Diagram of HCVS Vent Path

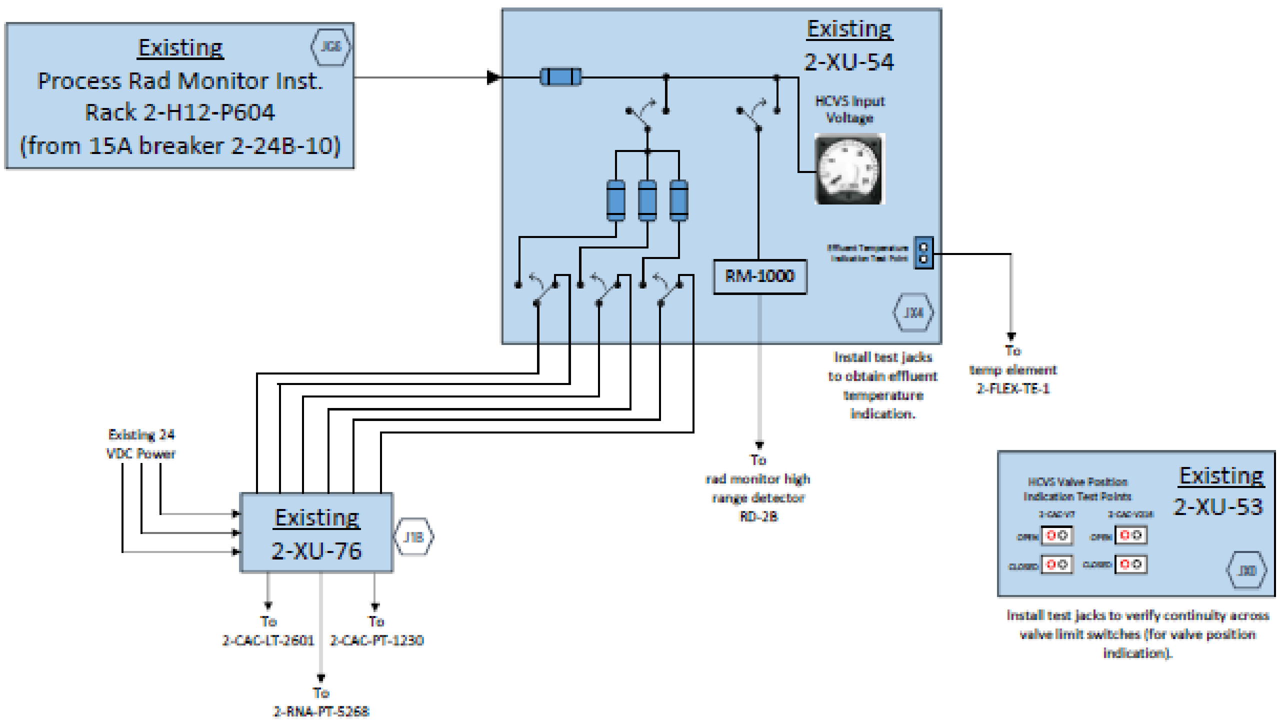


Brunswick Steam Electric Plant (BSEP), Unit Nos. 1 and 2,
HCVS Final Integrated Plan (FIP)

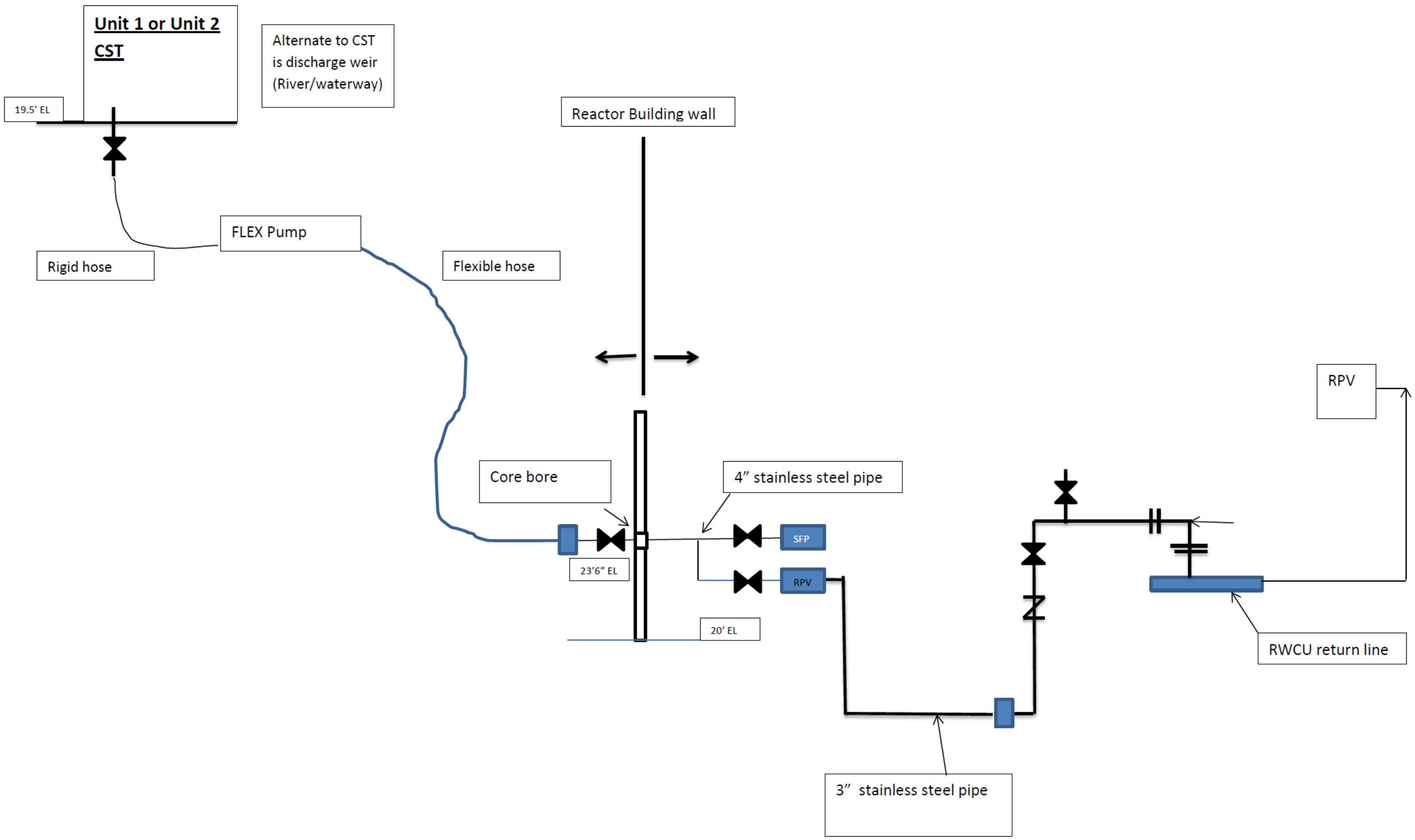
Attachment 3: One Line Diagram of HCVS Electrical Power Supply - Unit 1



Attachment 3a: One Line Diagram of HCVS Electrical Power Supply - Unit 2



Attachment 4: One Line Diagram of SAWA Flow Path



Attachment 5: One Line Diagram of SAWA Electrical Power Supply

N/A for BSEP

Brunswick Steam Electric Plant (BSEP), Unit Nos. 1 and 2,
HCVS Final Integrated Plan (FIP)

Attachment 6: Plant Layout Showing Operator Action Locations

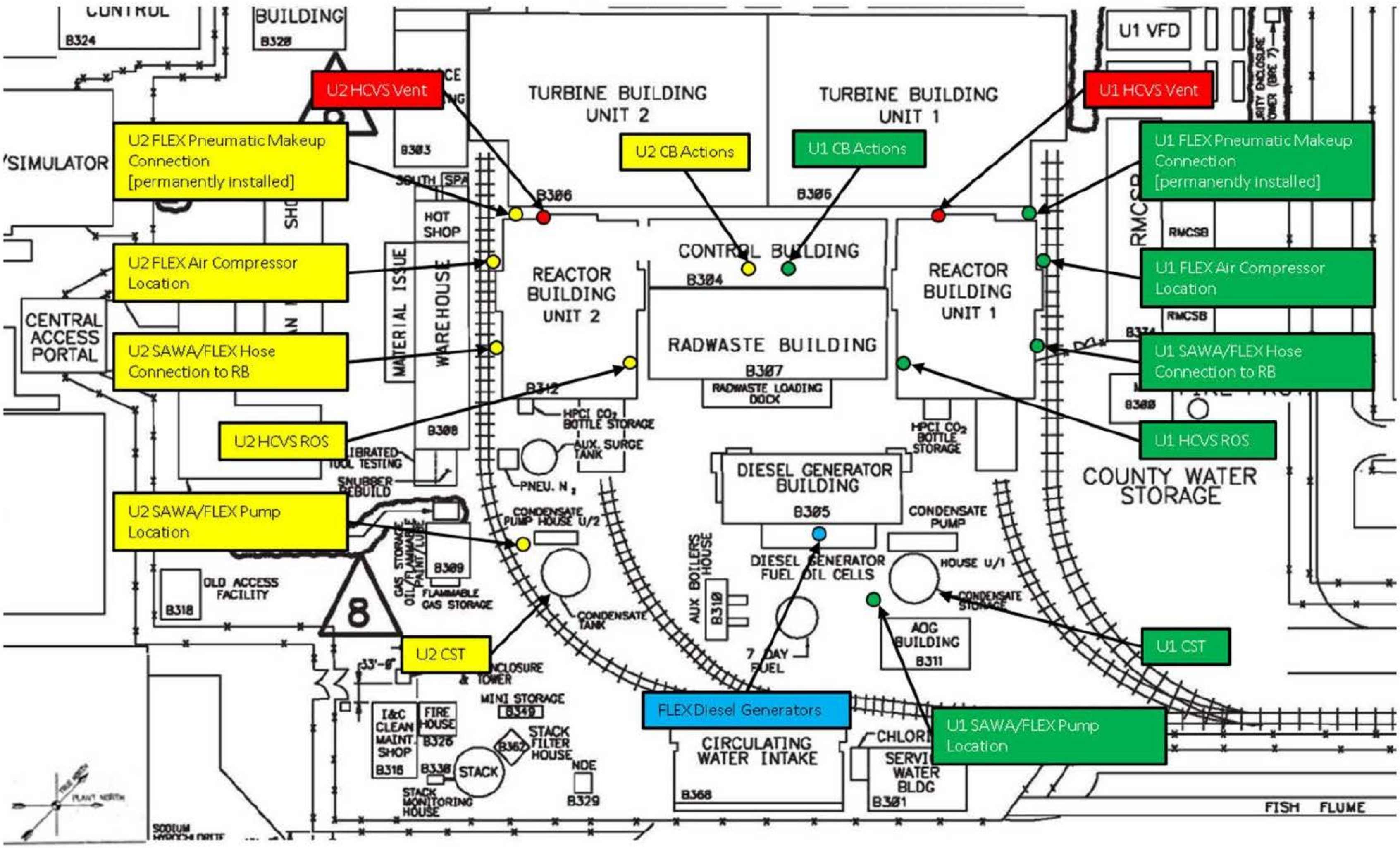


Table 1: List of HCVS Component, Control and Instrument Qualifications

Component Name	Equipment ID	Range	Location	Local Event Temp	Local Event Humidity	Local Radiation Level	Qualification[3]	Qualification Temp	Qualification Humidity	Qualification Radiation	Power Supply
Wetwell Vent Instruments and Components											
HCVS effluent temperature sensor (read with handheld meter in the MCR)	1(2)-CAC-TE-7993	0-700°F	117' RB Floor, on 12" pipe	173°F	100%	TID = 9.13E+05 Rad	IEEE 344-1975	0-700°F	No electronics, not susceptible	3.00E+08	None required
HCVS effluent temperature sensor panel jack (read with a handheld meter)	1(2)-CAC-TE-7993	N/A	MCR	122°F	70%	**CB	N/A - insensitive	N/A - insensitive	N/A - insensitive	N/A - insensitive	Batteries in the handheld meter
24/48VDC battery voltage meter	1(2)-XU-54-VM	0-30 VDC	MCR	122°F	70%	**CB	IEEE-323-2003, IEEE 344-2004	140°F (60°C)	95%	N/A	24/48 VDC Battery
Limit Switch test jacks (limit switches are qualified as PCIV components per existing design basis)	N/A	N/A	MCR	122°F	70%	**CB	IEEE-323-1974, IEEE 344-1975	Insensitive in the mild environment of the CB	No electronics, not susceptible	N/A	None required
Power transfer switches	1(2)-CAC-CS-7984 1(2)-CAC-CS-7985 1(2)-CAC-CS-7987 1(2)-CAC-CS-7988 1(2)-RNA-CS-7986	N/A	MCR	122°F	70%	**CB	IEEE-323-1974, IEEE 344-1975	150°F	95%	N/A	N/A
24/48VDC battery	2-24B-2-24VDC-BAT 1-22B-2-24VDC-BAT	N/A	CB 23' Battery Room B	120°F	91%	**CB	IEEE-323-1974, IEEE 344-1975	125°F	91%	N/A	Self for 24 hours, then FLEX generator powers charger

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[3] See UFSAR Appendix 7B Section B.2 for qualification code of record IEEE-323-1974 and IEEE-344-1975. Where later code years are referenced, this was reconciled in the design process.

Table 1: List of HCVS Component, Control and Instrument Qualifications

Component Name	Equipment ID	Range	Location	Local Event Temp	Local Event Humidity	Local Radiation Level	Qualification[4]	Qualification Temp	Qualification Humidity	Qualification Radiation	Power Supply
Wetwell Vent Instruments and Components											
Wetwell Vent line rad. Detector	1(2)-CAC-RD-2B	1E-03 to 1E+06 Rad/hr	117' RB Floor	173°F	100%	TID =9.13E+05 Rad/Hr	IEEE-323-1974, IEEE 344-1975	350°F	100%	2.00E+08 Rad/Hr	24/48 VDC battery bus
Wetwell vent radiation monitor/ processor	1(2)-CAC-RM-1000	1E-03 TO 1E+06 Rad/hr	MCR	122°F	70%	** CB	IEEE-323-1974, IEEE 344-1975	131°F	95%	N/A	24/48 VDC battery bus
*Pneumatic valves	1(2)-CAC-V5061 1(2)-CAC-V5062	N/A	RB -17 CS SW Room	132°F	100%	TID = 2.54E+06 Rad/Hr for 20" pipe	IEEE-344-1975	356°F	No electronics, not susceptible	1.50E+08 Rad/Hr	Nitrogen backup bottles for 24 hours, then FLEX air compressor
*ROS valves	1(2)-CAC-V5058 1(2)-CAC-V5059 1(2)-CAC-V5060	N/A	U-1 RB 50' SE U-2 RB 50' NE	121°F	100%	Low dose area	ROS location is a mild environment (low dose area and remains at a mild temperature). Valves are seismically robust per AD-EG-ALL-1125 and are therefore qualified for seismic response.	150°F	No electronics, not susceptible	N/A	Manual
Div. II N2 Backup supply pressure meter and module	1(2)-RNA-PI-5268	0-150 psig	MCR	122°F	70%	**CB	IEEE 323-1974, IEEE 344-1975	RG 1.97	RG 1.97	RG 1.97	24/48 VDC battery bus
Div. II N2 Backup supply pressure sensor and transmitter	1(2)-RNA-PT-5268	0-150 psig	50' RB West	122°F/ 119°F	100%	RG 1.97	IEEE 323-1974 & 1983, IEEE 344-1975	148.8°F	100%	RG 1.97	24/48 VDC battery bus

[4] See UFSAR Appendix 7B Section B.2 for qualification code of record IEEE-323-1974 and IEEE-344-1975. Where later code years are referenced, this was reconciled in the design process.

Table 1: List of HCVS Component, Control and Instrument Qualifications

Component Name	Equipment ID	Range	Location	Local Accident Temp	Local Accident Humidity	Local Radiation Level	Qualification[5]	Qualification Temp	Qualification Humidity	Qualification Radiation	Power Supply
SAWA/SAWM Instruments											
***Drywell pressure sensor / transmitter	1(2)-CAC-PT-1230	0-60 psig	80' RB West	117°F	100%	Use 1' TID of 9.13E5, but is outside the 6' thick PC concrete, so should be much lower	IEEE 323-1974, IEEE 344-1975	148.8°F	100%	8.36E+06 Rad/Hr	24/48 VDC battery bus
***Drywell pressure meter module and meter	1(2)-CAC-PI-1230	N/A	MCR	122°F	70%	**CB	IEEE 323-1974, IEEE 344-1975	122°F	***same as CAC-LI-2601 and RNA-PT-5268	N/A (MCR)	24/48 VDC battery bus
Wetwell level sensor/ transmitter	1(2)-CAC-LT-2601	-10 to +6 feet	-17' RB CS SW Room	132°F	100%	RG 1.97	IEEE 323-1974, IEEE 344-1975	RG 1.97	RG 1.97	RG 1.97	24/48 VDC battery bus
Wetwell level meter and module	1(2)-CAC-LI-2601	N/A	MCR	122°F	70%	**CB	IEEE 323-1974, IEEE 344-1975	RG 1.97	RG 1.97	RG 1.97	24/48 VDC battery bus
SAWA flow instrument and readout	N/A	0-500 gpm	Outside, mounted on the FLEX pump	-40 to 158°F	N/A	Outside, radiation not a concern	Commercial instrument qualified to over the road use, therefore qualified per NEI 12-06	120°F	100%	N/A	FLEX Pump alternator

* Denotes non-required item, added for site-specific design.
** Denotes Control Building where local radiation levels are not applicable. Building has no significant radiation sources.
*** 1(2)-CAC-PT-1230 loop is not on the RG 1.97 list. However, it uses the same safety-related type and model pressure sensor/transmitter instrument, and the same indicator in the MCR as CAC-LT-2601 and RNA-PT-5268 loops. The components have the same seismic, radiation, and thermal qualifications as the two RG 1.97 instruments. As are the other two instruments, it is supplied alternate power from the 24/48VDC battery bus as required in an ELAP. Therefore CAC-PT-1230 will be available for use during an ELAP with a severe accident.

[5] See UFSAR Appendix 7B Section B.2 for qualification code of record IEEE-323-1974 and IEEE-344-1975. Where later code years are referenced, this was reconciled in the design process.

Table 2: Operator Actions Evaluation

Operator Action		Evaluation Time[6]	Validation Time	Location	Thermal conditions	Radiological Conditions	Evaluation
1	SAWA manual valve alignment in RB - 3 valves	0-1 hour	26 minutes includes EOP time to direct the action	RB ground floor 20' elevation	Done in the first hour, so no concerns.	Done in the first hour, so no concerns.	Acceptable
2	Open RB roof hatch for ventilation	0-1 hour	19 minutes includes EOP time to direct the action	RB refueling floor	Done in the first hour, so no concerns.	Done in the first hour, so no concerns.	Acceptable
3	Pneumatic hose connection	≤7 hours	2 hours once directed	Between RB and TB in the seismic isolation space between the buildings. Near the vent pipe on Unit 2.	Outside, so ambient conditions	Action will be complete prior to venting start so no radiological concern.	Acceptable
4	HCVS Valves switch actuation and instrument monitoring	≤7 hours (approximate venting start)	2 minutes once directed	MCR	<120°F Per GOTHIC[7] calculations performed for FLEX actions	MCR is removed from the vent pipes and RP actions will provide protection from any airborne activity	Acceptable MCR is a preferred location based on HCVS-FAQ-1.
5	Switch actuation for instrument backup power	≤7 hours (approximate venting start)	5 minutes and 30 seconds once directed	MCR	<120°F Per GOTHIC calculations performed for FLEX actions	MCR is removed from the vent pipes and RP actions will provide protection from any airborne activity	Acceptable MCR is a preferred location based on HCVS-FAQ-1.

[6] Evaluation Time is from NEI 13-02 to support radiological evaluations.
[7] Calculation BNP-MECH-FLEX-0003, BNP CB FLEX Room Heat-up Analysis

Table 2: Operator Actions Evaluation

Operator Action		Evaluation Time[6]	Validation Time	Location	Thermal conditions	Radiological Conditions	Evaluation
6	Backup HCVS valve operation (if primary method fails)	≤7 hours (approximate venting start)	11 minutes and 5 seconds once directed	RB 50' elevation at Remote Operating Station	121°F maximum Based on GOTHIC[8] evaluation. Short time action of approximately 5 minutes is acceptable.	Far from the Primary containment, shielded by intervening structures and concrete, no radiological concern.	Acceptable
7	SAWA pump staging and hose connection	≤7 hours	3 hours and 27 minutes, then 38 minutes for SAWA pump operation	East of RB near CST and RB	Outside, so ambient conditions	Opposite side of the RBs from the vent pipes, well shielded by structure and distance	Acceptable
8	SAWA pump operation and refueling	>7 hours maximum injection start time is 8 hours	Operation - see item #7. Refueling - 2 hours and 47 minutes.	East of RB near CST and RB	Outside, so ambient conditions	Opposite side of the RBs from the vent pipes, well shielded by structure and distance	Acceptable
9	FLEX Generator connection and alignment	>24 hours	N/A - >24 hours	DG building	No heat sources in either structure during this event, so no thermal concern.	Concrete structure on the opposite side of the RB from the vent pipes, so no radiological concern	Acceptable
10	FLEX Generator operation and refueling	>24 hours	N/A - >24 hours	FLEX DG enclosure	Outside, vented enclosure, so near ambient conditions	Opposite side of the RBs from the vent pipes, well shielded by structure and distance, no radiological concern.	Acceptable
11	Start, operate and refuel FLEX air compressor	>24 hours	N/A - >24 hours	Outside RB, east of the seismic isolation space	Outside, so ambient conditions.	Shielded from containment and vent pipe by RB concrete walls, so no radiological concern.	Acceptable No thermal or radiological concerns.

[8] Calculation BNP-MECH-FLEX-0001 documents the Reactor Building Heatup Analysis