Commented [LB1]: General comments to be addressed throughout the document:

1) Better author notes/statements
2) Better closure statements
3) Verify language is in appropriate tense

Section I: Introduction

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

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

Plant XXX 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 HCVS in two phases.

- Phase 1 involved upgrading 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. Phase 1 was required to be completed no later than startup from the second refueling outage that began after June 30, 2014, or June 30, 2018, whichever came first. For Plant XXX this criteria corresponds to:
  - Unit 1, Phase 1 was 4th Quarter of 2017 (due by 2018 refueling outage).
  - Unit 2, Phase 1 was 1st Quarter of 2017 (due by 2017 refueling outage).
- Phase 2 involved providing additional protections for severe accident conditions through installation of a reliable, severe accident capable drywell vent system or the development of a reliable containment venting strategy that makes it unlikely that a licensee would need to vent from the containment drywell during severe accident conditions. Phase 2 was required to be completed no later than startup from the first refueling outage that began after June 30, 2017, or June 30, 2019, whichever came first. For Plant XXX this criteria corresponds to:
  - Unit 1, Phase 2 is currently scheduled for 4th Quarter of 2017 (due by 2018 refueling outage).
  - Unit 2, Phase 2 is currently scheduled for 4th Quarter of 2018 (due by 2019 refueling

NEI developed guidance for complying with NRC Order EA-13-109 in NEI 13-02 with significant interaction with the NRC and Licensees. NEI issued Revision 1 to NEI 13-02 in April 2015 which contained guidance for compliance with both Phase 1 and Phase 2 of the order. NEI 13-02, Revision 1 also includes HCVS-FAQs-1-9 and reference to white papers (HCVS-WP-1-3). The NRC documented this as an acceptable approach for complying with Order EA-13-109 through Interim Staff Guidance (JLD-ISG-2013-02 issued in November 2013 and JLD-ISG-2015-01 issued in April 2015) which endorsed the compliance approach presented in NEI 13-02. The ISG did allow exceptions in those cases in which a licensee proposes an acceptable alternative method for complying with Order EA-13-109.

In addition to the endorsed NEI guidance in NEI 13-02, the NRC staff endorsed several other documents that provide guidance for specific areas .~~-~~HCVS-FAQ (frequently asked question) 10-13 were endorsed after NEI 13-02 Revision 1 was released. These FAQs were endorsed by the NRC on XXXXX (Reference MLXXXX).

In addition, the NRC staff endorsed four White Papers, HCVS-WP-01 to 04, that cover broader or more complex topics than the FAQs. These white papers along with their endorsements are available on ADAMS under MLXXXX and MLYYYY.

As required by the order, Plant XXX submitted a phase 1 Overall Integrated Plan (OIP) in June of 2014 (Reference XX) and subsequently submitted a combined Phase 1 and 2 OIP in December 2015 (Reference XX). These OIPs followed the guidance NEI 13-02 Revision 0 and 1, *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.

The NRC performed a review of each OIP submittal and provided the Plant with Interim Staff Evaluations (ISEs) ass~~ec~~essing the site's compliance attributes.~~,~~ In these ISE's the NRC identified open items which the plant needed to address before that phase of compliance was reached. Six month progress reports were provided consistent with the requirements of Order EA-13-109. These status reports were used to close many of the sites 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 ~~to satisfy~~ the NRC staff to determine whether ~~that~~ the ISE Open Item appeared to be~~was~~ addressed.

By submittal of this Final Integrated Plan Plant XXX has addressed all the elements of NRC Order EA-13-109 utilizing the endorsed guidance in NEI 13-02, Rev 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 this FIP.

Section III contains Plant XXX's Final Implementation Plan for Phase 1 of the Order. Section IV contains the Final Implementation Plan for Phase 2 of the Order.

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**:**

Commented [LB2]: edit

Commented [LB3]: Are you leaving a provision for closing OIs as an appendix to the closure letter?

- The HCVS can be initiated via manual action from the Main Control Room (MCR)(some plants have a designated Primary Operating Station (POS) that will be treated as the main operating location for this order) 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, Level and Temperature 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 up to 7 days or a shorter time if justified.

A summary of Plant XXX phase 1 HCVS ~~from the December 2015 OIP Part 2~~:

Commented [LB4]: As built summary of the HCVS design.

The operation of the HCVS is designed to minimize the reliance on operator actions in response to hazards listed in Part 1. Initial operator actions 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 are listed below. The HCVS meets the seismic requirements identified in NEI 13-02 and are powered by DC buses with motive force supplied to HCVS valves from installed accumulators and portable nitrogen storage bottles.

Commented [LB5]: List the hazards.

Table 2-1 HCVS Remote Manual 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.**	
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.**	
4. Run hose to FLEX pneumatic makeup connection from FLEX air compressor staging location.	**FLEX pneumatic makeup connections are located**	**Action performed prior to venting start.**

	outside the RB in the vicinity of the HCVS vent pipe.	
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. AR685573-15.**	**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. AR685573-15.**	**Action required to provide power to HCVS equipment after a minimum of 24 hours.**

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) or Drywell.
- Utilization of Severe Accident Water Management (SAWM) to control injection and Suppression Pool level to ensure the HCVS (Phase 1) wetwell vent (SAWV) will remain functional for the removal of the decay heat from the core from containment.
- The decay heat can be removed from the containment for seven (7) days using the HCVS or until alternate means of decay heat removal are established that make it unlikely the drywell vent will be required for containment pressure control.
- The SAWA and SAWM actions 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 parameters.

A summary of Plant XXX use of SAWA for phase 2 HCVS ~~from the December 2015 OIP section 3..1~~:

Commented [LB6]: As built summary of the HCVS design.

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 exposure and temperature / humidity conditions for operation of SAWA equipment will not exceed the limits for ERO dosage and plant safety guidelines for temperature and humidity.

The flow path will be from the FLEX suction in the Altamaha river through the FLEX pumps with 4 outlets with individual flow indicators. One indicator will be dedicated to the unit in a Severe Accident, and the flow will be monitored that is provided to the RHR service water FLEX header. The monitored water flow rate will pass through the RHRSW piping to the Reactor Building where it will connect with the RHR system by opening MOVs from the MCR that interconnect the systems. The flow will then be directed into the RPV via the LPCI injection valves. Cross flow into other portions of the RHR system will be isolated by ensuring closure of the MOVs from the MCR. DW pressure and Suppression Pool level will be monitored and flow rate will be adjusted by use of the FLEX pump control valve at the Intake Structure. Communication will be established between the MCR and the FLEX pump location.

MOVs will be powered from the FLEX diesel generators connected in the Control Building as described in the EA-12-049 compliance documents. The MOVs will be operated in series (not parallel) to limit the potential for overloading the FLEX DGs. The FLEX DGs are located near the Control Building which is significantly away from the discharge of the HCVS at the Main Meteorological Stack. Refueling of the FLEX DG will be accomplished from the EDG fuel oil tanks as described in the EA-12-049 compliance documents. The Intake structure is a significant distance from the discharge of the HCVS at the Main Meteorological Stack. (see mechanical and electrical sketches in attachments, plant layout sketches in the assumptions section and a list of actions elsewhere in this section)

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. (reference HCVS-WP-02)

Electrical equipment and instrumentation will be powered from the existing station batteries, and from AC distribution systems that are powered from the EA-12-049 generator(s). The battery chargers are also powered from the EA-12-049} generator(s) to maintain the battery capacities during the Sustained Operating period.

Section II: List of Acronyms

Commented [LB7]: Include site-specific variations of acronyms.

AC	Alternating Current
AOV	Air Operated Valve
BDBEE	Beyond Design Basis External Event
BSEP	Brunswick Steam Electric Plant
CAC	Containment Atmospheric Control System
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
FLEX	Diverse & Flexible Coping Strategy
GPM	Gallons per minute
HCVS	Hardened Containment Vent System
ISE	Interim Staff Evaluation
ISG	Interim Staff Guidance

JLD	Japan Lessons Learned Project Directorate
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
RWCU	Reactor Water Cleanup
SBGT	Standby Gas Treatment System
VAC	Voltage AC
VDC	Voltage DC

Section III: Phase 1 Final Implementation Plan

Section III.A: HCVS Phase 1 Compliance Overview

In December 2015, {plant} submitted a revised Overall Integrated Plan for compliance with Phases 1 and 2 of EA-13-019. After the submittal of {plant}'s Overall Integrated Plan (OIP) for Phase 1 compliance with EA-13-109, the NRC staff issued an Interim Staff Evaluation (ISE) {plant ML number} that requested additional information based on the preliminary nature of the OIP. The Phase 1 ISE open items and a response to each are were addressed in XX Sixth Month Update(s) except for ISE Open Items X, Y, and Z. In addition, the Plant and NRC held a ISE Open Item Audit phone call on MM/XX/YY. The Plant response to ISE Open Items X, Y, and Z are contained in Enclosure XX.

The Final Implementation Plan (FIP) for Phase 1 of the order performs the following: {Insert a summary of the Phase 1 solution}

1. Provides a remote operating station (ROS) that will allow the operators to open the vent path without any electrical power and without defeating any interlocks or signals electrically.
2. Provides a check valve near the top of the vent pipe to prevent air from being drawn into the pipe after a period of venting.
3. Extends the top of the pipe to provide better dispersal of the vented fluids.
4. Upgrades the vent's Radiation Monitor to one that is qualified for the expected severe accident conditions.
5. Provides backup power to certain instruments that support venting and monitoring of vent effectiveness.
6. Provides a means to monitor the vent valves' position without power.
7. Provides a means to monitor the vent pipe's temperature without power.

Section III.B.1: Generic Letter 89-16 Vent System: {describe a 89-16 vent below, or for Mk II state not required}

BSEP installed a hardened wetwell vent in response to NRC Generic Letter 89-16 (Ref. R12), under Plant Modifications PM-91-001 for Unit 1 (Ref. M3) and PM-92-073 for Unit 2 (Ref. M4). 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 (Ref. PI1 & PI7). 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 (Ref. E2). 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.B.2: EA-13-109 Hardened Containment Vent System (HCVS): {Describe the final Hardened Wetwell Vent System}

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 will be accessible and functional under a range of plant conditions, including severe accident conditions. The ROS locations and evaluation are included in the response to ISE open item 14 *in AR 685573-19.*

Commented [LB8]: ROS location should be mentioned here. Also, include title of evaluation.

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. ECs 290408 and 294259 provide this ROS and its design.

The Main Control Room is the primary operating station for the HCVS. Even during an ELAP, if the FLEX generators successfully restore FLEX power to the station as expected, there will be power for the vent valves (EC 299559). 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.

Commented [LB9]: Better clarify which controls and indication are available at each location. Refer to I&C table in Appendix.

the hardened vent radiation monitor, RM-1000, uses a 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 cabinet XU-53. Test jacks are provided on the front door so that the operators will not have to locate terminal points in the cabinet, or even open the cabinet 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-1000 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 current RM-23 is mounted.
3. The 24 VDC battery voltage is indicated on XU-54.
4. The backup power to the required instruments can be transferred at cabinet 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.

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 valve CAC-V8 is designed to 70 psig at 316 ºF (Ref. M3 & M4).

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. EC 290408 and 294259 contain this analysis as well as the pipe stress calculations that re-qualify the piping.

To prevent leakage of vented effluent to other parts of the Reactor Building or other systems (Standby Gas Treatment), boundary valves CAC-V8 and CAC-V172 must 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. (Ref. M30). This is acceptable 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.

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. EC 290408 and EC 294259 contain the check valve design and supporting analysis to preclude~~avoid~~ a flammable mixture in the vent pipe. Guidance for this design is contained in HCVS-WP-03.

radiation monitor RM-1000 with an RD-2B detector are qualified for the ELAP and external event conditions. In addition to the RM-1000, 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.C: 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 {PLANT} 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 contains Phase 1 and Phase 2 guidance.

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*. Immediate operator actions 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: {Insert the current table of actions ~~from the OIP~~}

Primary Action	Primary Location / Component	Notes
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.	
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.	
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. AR685573-15.	Action required to supplement the N2 backup system after a minimum of 24 hours.

Commented [LB10]: Include Table #, for reference purposes in the safety evaluation.

Primary Action	Primary Location / Component	Notes
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. AR685573-15.	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.

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 for at least 24 hours without any supplementation.

Commented [LB11]: Include an HCVS ELAP failure evaluation table, which shows alternate actions that can be performed.

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 {main control room}. Alternate control of the HCVS is accomplished from the {ROS}. XXXX in Enclosure XX (usually an open item) contains an evaluation of all the operator actions that may be required to support HCVS.

Commented [LB12]: Include confirmatory statement(s) that you met the order requirements. (e.g. performed evaluation at each location to support personnel habitability per order requirement, as detailed in….)

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

Evaluation:

Primary control of the HCVS is accomplished from the {main control room}. Under the postulated scenarios of order EA-13-109 the control room is adequately protected from excessive radiation dose per GDC 19 in 10CFR50 Appendix A and no further evaluation of its use is required. (Ref. HCVS-FAQ-06)

Commented [LB13]: Clear statement that you met requirement.

Same comment as above.

Confirm that an evaluation has been performed for additional MCR dose shine from vent pipe.

A note stating that if MCR is not the primary control station, that an evaluation should be performed and discussed here.

Provide a description that the requirements are met for the ROS.

{Describe plant's design features that meet this requirement. Items such as geometry, shielding by buildings, additional shielding, distance from the vent pipe, etc. There is likely an Open Item that responds to this element.}

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 main control room. Under the postulated scenarios of order EA-13-109 the control room is adequately protected from excessive radiation dose per GDC 19 in 10CFR50 Appendix A and no further evaluation of its use is required. (HCVS-FAQ-06)

Commented [LB14]: A note stating that if MCR is not the primary control station, that an evaluation should be performed and discussed here.

See previous comment.

Alternate control of the HCVS is accomplished from the {location}. The {location} is in an area evaluated to be accessible before and during a severe accident. {Add information about the plant specifics, this is likely from an Open Item response.}

.

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).

As required by the ISG, an auditable engineering basis was developed during the detailed design, for the decay heat absorbing capacity of the suppression pool and the selection of venting pressure, 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 {BNP-MECH-FLEX-0002} which shows that containment is maintained below the design pressure once the vent is opened, even if it is not opened until PCPL.

Commented [LB15]: Plant-specific (green)

Commented [LB16]: Discuss methods used to size the vent. NRC staff will evaluate the method in the SE. E.g. used RELAP to model compressible flow, assumed discharge of steam only, steaming rate determined using 1% decay heat and hfg, piping resistance factors taken from XX.

Commented [LB17]: This sort of wording isn't needed. Just describe what you did. In this case it was probably a MAAP run to verify that pressure stays below CDP or 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 describe the vent pipe path {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. However, on both units the 89-16 vent pipe terminates approximately 12 inches above the roof. This discharge point will be extended just above each unit's Reactor Building such that the release point will vent away from emergency ventilation system intake and exhaust openings, main control room location, location of HCVS portable equipment, access routes required following an ELAP and BDBEE, and emergency response facilities. HCVS-FAQ-04 provides endorsed guidance for the ventilation exit point and other stack requirements.

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~~is~~ the ~~requirement~~ guidance for height from HCVS-FAQ-04.

In addition to the height and distance-from-emergency-intake requirements, the vent system must be robust with respect to all the external hazards screened in for BSEP IAW NEI 12-06. EC 299559 attachment Z01R0 contains an evaluation of vent pipe for protection from external events – or HCVS-WP-04 provides criteria that demonstrate robustness of the HCVS pipe. {plant} meets all the requirements of this white paper. This evaluation documents that the HCVS pipe is adequately protected from all external events and no further protection is required.

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

For multi-unit sites: The HCVS for Units 1 & 2 are fully independent of each other. Therefore, the status at each unit is independent of the status of the other unit.

Hatch: Unique setup for the plant stack to meet this requirement

Describe potential cross-flow paths and how they are isolated from the vented fluids. 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 IAW HCVS-FAQ-05

1.2.4 The HCVS shall be designed to be manually operated during sustained operations from a control panel located in the main control room 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. The MCR functions as the normal control point for Plant Emergency Response actions and is a readily accessible location with no further evaluation required. Control Room dose associated with HCVS operation conforms to GDC 19/Alternate Source Term (AST). Therefore the Main Control Room remains the primary operating station for the HCVS.

If another location, describe its location and explain how it is readily accessible.

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.

Commented [LB18]: We would put it this way.

Commented [LB19]: Include brief discussion how unit meets the four assumptions the white paper applicability is based on.

Evaluation

To meet the requirement for an alternate means of operation, describe manual operation method: a readily accessible alternate location, called the ROS will be added. The ROS will contain 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. This will provide a diverse method of valve operation improving system reliability.

Describe location and accessibility of this method. 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 will be 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 sketches provided in Attachment 3 of the BSEP OIP (Attachment Z11R2) for the HCVS site layout. The controls available at the ROS location will be accessible and functional under a range of plant conditions, including severe accident conditions with due consideration to source term and dose impact on operator exposure, extended loss of AC power (ELAP), inadequate containment cooling, and loss of reactor building ventilation. Provide pointer to the evaluation that concludes this is true, likely an open item response in Enclosure XXX.

Commented [LB20]: When copying from the OIP, make sure to change to past tense.

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.

Assuming the FLEX DGs start and load as designed, there will be no need to use other power sources for HCVS during the first 24 hours. However, this order element does not allow crediting the FLEX DGs 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, qualified for this application, and have sufficient capacity to provide this power without recharging. At 24 hours, FLEX generators can be credited to repower the station instrument buses and/or the battery charger to recharge the batteries. 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. ECs 290407 and 293339 contain the details and calculations that support this evaluation.

Commented [LB21]: State the battery location and if they're protected from all external hazards.

Is the battery in a new dedicated room? Discuss temperature effects on the battery and hydrogen removal for the battery room?

Commented [LB22]: Are these the pre-staged FLEX DGs? Is this a different (i.e portable) FLEX DG?

Discuss the loads on the FLEX DG? Did they change?

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. 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 DGs.

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 will be designed to provide features to prevent inadvertent actuation due to a design error, equipment malfunction, or operator error such that any credited containment accident pressure (CAP) that would provide net positive suction head to the emergency core cooling system (ECCS) pumps will be available (inclusive of a design basis loss-of-coolant accident). However the ECCS pumps will not have normal power available because of the ELAP.

Commented [LB23]: We'll discuss with the BWROG. To add a better author note.

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.

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 will include 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.

The guidance of NEI 13-02 mentions HCVS pipe pressure as one way to monitor vent status. However, this indication will not be required. This option was included for plants that did not want to provide backup power to the containment pressure instrument which may be safety-related. The addition of a pipe pressure indicator would require breaching the HCVS pipe boundary. The following indications that the HCVS system is operating are available:

a. HCVS valve positions (limit switches on the valve)
b. HCVS radiation monitor reading
c. HCVS pipe temperature
d. Drywell pressure (not specifically required by the order, but provided)

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

The HCVS instruments, including valve position indication, vent pipe temperature instrumentation, radiation monitoring, and support system monitoring, are seismically qualified and include the ability to handle harsh environmental conditions (although they may not be considered part of the site Environmental Qualification (EQ) program). If this was an open item, point to the response here. Enclosure 1, item X contains the response to ISE open item 14 regarding the instruments' qualifications.

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 RD-2B detector coupled to an RM-1000 process and control module. The RM-1000 will be mounted in cabinet 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 RM-1000 is qualified for the mild environment in the CB 49'. Both components are qualified for the seismic requirements. If this was an open item, point to the response here Enclosure 1, item X contains the response to open item X regarding the instruments' qualifications.

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 list interfacing valves 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 evaluated for radiological impact due to HCVS system operation under severe accident conditions using the guidance provided in HCVS-FAQ-08. Point to the document or open item response that contains this evaluation contains the response to ISE open item 14 regarding the evaluation of HCVS components for severe accident conditions.

Refer to EA-13-109, requirement 1.2.11 (next) for a discussion on designing for hydrogen.

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.

Commented [LB24]: Tense?

Commented [LB25]: To what? Please clarify.

Commented [LB26]: This was an open item for every site.

Commented [LB27]: The assumption here is that they have been shown to perform their function under the postulated conditions. Should probably say that.

Evaluation

Check valve response: 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 was installed and will be tested to ensure that it limits backleakage to prevent a detonable mixture from occurring in the case venting is stopped for some reason prior to the establishment of alternate reliable containment heat removal.

Purge response: In order to prevent a detonable mixture from developing in the pipe, a purge system is installed to purge hydrogen from the pipe with argon after a period of venting and to purge oxygen from the pipe prior to resuming venting. This system is describe operation of the system with regard to lineup, manual or automatic, purge gas, etc.

Point to the evaluation that {Enclosure 1, item X contains the response to ISE open item 6 regarding the prevention of reaching an explosive mixture in the vent pipe.

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 only paths for hydrogen migration from the vent pipe into the reactor building describe potential flowpaths and how the potential is minimized are/is through CAC-V8 and CAC-V172 to the duct work of the Standby Gas Treatment System. CAC-V8 and CAC-V172 are tested for leakage as part of the Appendix J test program so that any abnormal leakage through these valves would be detected and corrected. Therefore the HCVS design minimizes the potential for hydrogen gas migration into the reactor building. Since the vent pipe passes through no other buildings, there is no potential for leakage into any other buildings.

Alternate if multiple and/or non-App. J valves: The flow paths for hydrogen migration from the vent pipe into the reactor building include valves XX, XX, XX. These valves are tested for leakage in accordance with NEI 13-02, Table 6-1 so that any abnormal leakage through these valves would detected and corrected. Therefore the HCVS design minimizes the potential for hydrogen gas migration into the reactor building.

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

Testing and Inspection Requirements

Description	Frequency
Cycle the HCVS valves[1] and the interfacing system valves not used to maintain containment integrity during operations.	Once per every[2] operating cycle.
Cycle the HCVS check valves not used to maintain containment integrity during unit operations.[3]	Once per every other[4] operating cycle.
Perform visual inspections and a walk down of 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 valves move to their proper (intended) positions.	Once per every other operating cycle

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.

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:

For existing vents: The HCVS upstream of CAC-V216 including the containment isolation valves and penetrations are not being modified for order compliance so that they

Commented [LB28]: Include Table # for referencing in safety evaluation.

Commented [LB29]: Provide a functional description for the valve. (Ex. Second containment isolation valve.)

continue to be designed consistent with the design basis of primary containment including pressure, temperature, radiation, and seismic loads.

For new vents: The HCVS penetration and containment isolation valves are designed and installed 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.

Enclosure 1, item X contains the response to ISE open item 14 regarding the qualification of HCVS instruments to function during a severe accident contains the detailed information regarding these components' qualifications and the expected conditions for which they are qualified.

Section IV: HCVS Phase 2 Final Implementation Plan

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

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

(1) Design and install a HCVS, using a vent path from the containment drywell, that meets the requirements in section B.1 below, or

(2) 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.

EA-13-109 further states in B.2:

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. <u>Containment Venting Strategy Requirements</u>

   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.

NEI 13-02, Revision 1 provides the guidance for the venting strategy of the order. This was endorsed in JLD-ISG-2015-01. This revision provides no guidance for a severe accident capable drywell vent (Part 3 of NEI 13-02) because, during research into the severe accident scenarios, it was determined that a drywell vent alone is not protective of containment. Therefore, NEI 13-02 provides two options for compliance with part B of the order:

- Severe Accident Water Addition (SAWA) in conjunction with a Severe Accident Capable Drywell Vent or
- SAWA in conjunction with Severe Accident Water Management (SAWM) that is designed to maintain the wetwell vent in service until alternate reliable containment heat removal and pressure control are established.

Because the order contains just three requirements for the containment venting strategy, the primary requirements are in NEI 13-02, Revision 1 and are spread throughout the guidance.

<u>Section IV.B: HCVS Existing System:</u>

There previously was no hardened drywell vent nor strategy at BSEP that complied with Phase 2 of the order.

<u>Section IV.C: HCVS Phase 2 Modified System and Strategy</u>

Brunswick has chosen to implement the containment venting strategy utilizing SAWA and SAWM. The SAWA system consists of a FLEX pump injecting into the Reactor Pressure Vessel (RPV) and SAWM consists of flow control at the FLEX pump along with torus level indication 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 one week which is the requirement of NEI 13-02 for the period of sustained operation.

Describe the SAWA flow path: The FLEX primary 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 flexible discharge hose to a FLEX 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). This FLEX primary injection path is qualified for the FLEX event which includes the same applicable hazards as EA-13-109. The only difference in requirements is that the SAWA flow path must include consideration of a severe accident including the radiation levels associated with such an accident (core melt, RPV breach, etc.) (NEI 13-02, section 6.1).

Commented [LB30]: Reword for clarity.

The only actions inside the RB will be to open valves at the core bore and the RWCU connections just above the containment hatch and accessed from the 23' level of the RB via a fixed ladder, and potentially (if a seismic event) close one valve on the 80' level. The action to open (and possibly close) valves inside the RB can be performed within the first hour after the loss of RPV injection. MAAP analysis shows that core damage is not expected for at least one hour so that there will be no excessive radiation levels 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 three-foot-thick concrete walls of the RB. 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. 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 overfill the torus to the point where the wetwell vent is submerged. This throttling of SAWA flow is termed SAWM.

Commented [LB31]: Is it? By procedure? And is this validated?

Section IV.C.1: Phase 2 Strategy

Describe the water addition strategy, including operator actions and the time to establish the water addition. Discuss hardware requirements necessary to support SAWA including:

1) Water addition point
2) Flow path
3) RPV pressure control
4) Water source(s)

The SAWA system 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). 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 7 days~~one week~~ which is the requirement of NEI 13-02 for the period of sustained operation.

Describe the SAWA flow path: The FLEX primary 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). This SAWA primary injection path is qualified for the all hazards including a severe accident.

Commented [LB32]: Duplicate from page 19.

The only 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 connections just above the containment hatch and accessed from the 23' level of the RB via a fixed ladder, and potentially (if a seismic event) close one valve on the 80' level. The action to open (and possibly close) valves inside the RB can be performed within the first hour after the loss of RPV injection. Core damage is not expected for at least one hour so that there will be no excessive radiation levels 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 three-foot-thick concrete walls of the RB. 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. 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 overfill the torus to the point where the wetwell vent is submerged.

Describe how SRVs will be powered, if they will be: The BSEP FLEX response uses the backup nitrogen system for at least 24 hours to provide pneumatics to SRVs in addition to the wetwell vent valves. After 24 hours, a FLEX air compressor is aligned to provide pneumatics for the period of sustained operation. The FLEX DGs restore and maintain electrical power to the SRV solenoids if the station batteries become depleted. As stated in NEI 13-02, I.1.3.1.1, if the core debris breaches the RPV, RPV pressure will remain at or near containment pressure without the need for SRV actuation.

Section IV.D.1: SAWA Water Addition Source (SE Section 4.1.1.1)

1) Describe plant connection points and installed or portable pump(s) used for the SAWA strategy.
2) Describe the analyses that determined the SAWA flow rate and pressures needed for water addition, including the time to establish this capability.
3) Provide on the e-Portal the hydraulic evaluation for the SAWA pump(s).
4) Describe the method of backflow prevention in the SAWA flow path.

IV.D.1.1: Plant Connection Point

The FLEX pumps are used as the SAWA pumps. The SAWA primary 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 SAWA path runs via a hard pipe 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). This FLEX primary injection path was qualified for the FLEX event which includes the same applicable hazards as EA-13-109.

The SAWA design eliminates the need for extensive operator action in a potential radiation field from the severe accident to initiate the RPV injection. The only actions inside the RB will be to open valves at the core bore and the RWCU connections just above the containment hatch and accessed from the 23’ level of the RB via a fixed ladder, and potentially (if a seismic event) close one valve on the 80’ level. The action to open (and possibly close one) valves inside the RB can be performed within the first hour after the loss of RPV injection.

For long term water supply, the CST will be refilled using FLEX procedures that draw water from the discharge canal using FLEX and/or NSRC pumps and hoses.

The FLEX pump deployment time was validated as 4 hours and 5 minutes which is less than the eight hours required by NEI 13-02 for containment protection. This time included running hoses and setup of the equipment.

Commented [LB33]: Is this time consistent for the FLEX deployment time? Explain any deltas.

IV.D.1.2: Pumps

BSEP uses three portable diesel-driven fire pumps for FLEX and SAWA. Two of the pumps are Hale FP3500DJ-TC and one is a Hale FP1500DI 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 and are rugged, over the road, trailer-mounted units, qualified to perform after a seismic event.

IV.D.1.3: SAWA analysis of flow rates and timing (MAAP or generic)

Generic: PLANT SAWA flow is 500 gpm which is the amount assumed in NEI 13-02 or XXX gpm which is the site-specific RCIC flow rate or XXX which is the site-specific flow rate when the site’s rated thermal power is compared to the reference power level of NEI 13-02.

Site-specific: BNP-MECH-FLEX-0005 assumes a SAWA flow of 300 gpm 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 proving that this flow rate prevents containment failure by overpressurization as required by the order.

IV.D.1.4: 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. This calculation should be provided for review on the ePortal.

IV.D.1.5: Method of backflow prevention

The BSEP SAWA flow path goes through a series of check valves in the RWCU, RCIC and Feedwater systems. Thus backflow is prevented by check valves in the SAWA flow path inside the RB.

Section IV.D.2: SAWA Motive force (SE Section 4.1.1.2)

Describe the motive force (electrical, pneumatic, diesel, etc.) source(s) used for powering components and instrumentation needed to establish a flow path from the water source to the addition point.

1) DG loading calculations (provide on eportal).
2) Provide calculations for any other credited motive force.

IV.D.2.1: Pump source of power

The SAWA pumps are stored in the FSB where they are protected from all applicable external 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. 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 that is protective of primary containment per EA-13-109.

Commented [LB34]: This needs to be confirmed to be OK for dose considerations.

IV.D.2.2: DG loading calculation for SAWA/SAWM equipment

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.

Commented [LB35]: Reference to FLEX DG loading calc.

Section IV.D.3: SAWA Instrumentation (SE Section 4.1.1.3)

1) List the specific instruments credited for SAWA.
2) Describe the instruments and guidance used to support SAWA pump operation and determination of SAWA pump flow.
3) Qualifications of instrumentation (temperature/radiation/seismic).
4) Describe the means to provide power (e.g., skid mounted diesel engine/alternator, batteries or small portable AC generators) to these instruments for the Sustained Operation period.
5) Describe how wetwell level instrumentation will be repowered through the Sustained Operation period.

IV.D.3.1: List instruments

The following instruments are used for SAWA and SAWM.

Instrument	Tag Number	Power Source
Drywell pressure	CAC-PT-1230	FLEX Generator

Wetwell level	CAC-LT-2601	FLEX Generator
SAWA Flow	N/A	FLEX pump electrical system

IV.D.3.2: Describe SAWA instruments and guidance that uses them

The drywell pressure and wetwell level instruments are Rosemount 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. Note that other indications of these parameters may be available depending on the exact scenario, however these instruments will be re-powered by FLEX systems for the sustained operating period.

The SAWA flow meter is a paddle-wheel flow meter mounted in the piping on the pumps skid and powered by the pump's electrical system.

IV.D.3.3: Qualification of SAWA instruments

The drywell pressure and wetwell level instruments are Rosemount pressure and differential pressure detectors that are safety-related and qualified for post-accident use. Non RG-1.97 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 OR for RG-1.97 These instruments are qualified per RG-1.97 as post-accident instruments and are therefore qualified for EA-13-109 events.

Commented [LB36]: List FSAR sections.

The SAWA flow meter is rated for continuous outdoor use under the expected worst-case 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. Or describe how it is shielded if that is the case

IV.D.3.4: Wetwell level instrument power supply through sustained operation

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

Section IV.D.4: SAWA Severe Accident Considerations (SE Section 4.1.1.4)

Discuss if the thermal and radiological impacts on the installed or portable equipment and instrumentation would affect the functionality of these components or operators performing necessary actions for the SAWA strategy. Place the calculation on the ePortal.

IV.D.4.1: Effect on SAWA pump and flowpath

The SAWA valves add actions if necessary inside the RB will be operated within the first hour of the event, before any core damage has occurred, so there will be no dose effects on valve operation. 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.

For pipe runs: 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. Or for hose runs Inside the RB the SAWA flow path consists of piping that will be unaffected by the radiation dose and hoses that will be run only in locations that are shielded from significant radiation dose. These hoses are qualified for the temperatures expected in the areas they will be run. Therefore the SAWA flow path will not be affected by radiation or temperature effects due to a severe accident.

IV.D.4.2: Effect on SAWA/SAWM instruments

The drywell pressure and wetwell level instruments are Rosemount pressure and differential pressure detectors that are safety-related and qualified for post-accident use. Non RG-1.97 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 OR for RG-1.97 These instruments are qualified per RG-1.97 as post-accident instruments and are therefore qualified for EA-13-109 events.

Commented [LB37]: Reference the calc.

IV.D.4.3: Effect on personnel actions

The hard SAWA pipe inside the RB will be aligned within the first hour of the event by opening two valves (and potentially closing one). Core damage does not occur for at least one hour so there are no radiological concerns with this action. After the SAWA pipe is aligned inside the RB, the operators can control SAWA and SAWM as well as observe the necessary instruments from outside the RB. The 3 foot thick concrete RB walls (below 117' level) as well as the distance to the core materials means 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 pump and monitoring equipment can all be operated from the MCR or 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, containment pressure in the MCR, and wetwell level in the MCR.

Section IV.D.5: SAWM Strategy (SE Section 4.2)

Describe the water management strategy, including operator actions and the time to reduce the water addition. Discuss factors in SAWM success including:

1) The means of controlling the SAWA flow rate (e.g., controlling pump speed or use of a throttle valve).
2) Freeboard volume to determine plant capability to maintain wetwell vent availability.

IV.D.5.1: Strategy including actions' 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 Emergency Operating Procedures (EOPs) and 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 torus vent in service. The EOP/SAMG flow charts will direct use of the hardened vent as well as SAWA/SAWM when the appropriate plant conditions have been reached.

BSEP has validated that the SAWA pump can be deployed and commence injection within approximately 4 hours. The studies referenced in NEI 13-02 demonstrated that establishing flow within 8 hours will be protective of containment. The initial SAWA flow rate will be at least 300 gpm. After a period of time in which the maximum flow rate is maintained, the SAWA flow will be reduced. The reduction in flow timing will be based on stabilization of the containment parameters of drywell pressure and wetwell level. At some point wetwell level will begin to rise indicating that the SAWA flow is greater than the steaming rate due to decay heat such that flow can be reduced. This is expected to be 4-6 hours, but no time is specified in the procedures.

IV.D.5.2: Means of controlling SAWA flow

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 amount of margin between normal wetwell level and the level at which the wetwell vent will be submerged.

IV.D.5.3: Freeboard volume to validate wetwell vent availability

The normal wetwell level is approximately -2.5' elevation.. The bottom of the wetwell vent pipe is at elevation 6 feet 9 inches and the suppression pool level instrument span goes up to +6 feet. The freeboard volume between the normal wetwell level and the top of the level instrument span was determined to be approximately 536,700 gallons.

<u>Section IV.D.6:</u> SAWM Thermal Hydraulic Analysis – SAWM for 7 day Sustained Operation Period (SE Section 4.2.1.1)

1) Describe how the available freeboard volume is used for the SAWM strategy.
2) Provide the upper wetwell level indication.
3) Describe the analyses that determined the action times for reducing SAWA flow to achieve a successful SAWM strategy

IV.D.6.1: Available Freeboard Use

The freeboard between -2.5' and 6' provides approximately 536,700 gallons of water volume before the level instrument would be off scale high or water level reaches the bottom of the vent pipe. During the initial SAWA flow injection, most of the water will be flashed to steam as it removes heat from the core materials. This steam will be vented out the vent pipe so that there will be minimal effect on the wetwell level. After containment parameters are stabilized with SAWA flow, the wetwell level will begin to rise. This is an indication that SAWA flow is greater than that required to remove decay heat, so that SAWA flow can be reduced. The 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.

Commented [LB38]: Does this really work procedurally? Would you know if you were under feeding and starving the drywell floor? How do you verify that the water addition is adequate?

IV.D.6.2: Upper wetwell level indication

The upper wetwell level indication provided for SAWA/SAWM is +6 feet elevation.

IV.D.6.3: Wetwell vent service time

BSEP calculation BNP-MECH-FLEX-0005 OR Reference 27 in NEI 13-02, Revision 1, demonstrates 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 calculation demonstrates that 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.

Commented [LB39]: And this is based on analytically-based SAWM flow rates, right?

Section IV.D.7: SAWM Motive Force (SE Section 4.2.1.2)

Describe the motive force (electrical, pneumatic, diesel, etc.) source(s) used to support equipment and instrumentation needed to support SAWM through the Sustained Operation period.

IV.D.7.1: Power for sustained operation

BSEP uses the same pumps and instruments for SAWM as for SAWA. See section 4.1.2.1 for a description of the power supply for sustained operation of the pumps and 4.1.3.4 for a description of the power supply for sustained operation of the instruments.

IV.D.7.2: Equipment qualification for sustained operation

BSEP uses the same pumps and instruments for SAWM as for SAWA. See sections 4.1.3 for the instruments' qualifications and 4.1.2 for the pumps' qualifications.

Section IV.D.8: SAWM Instrumentation (SE Section 4.2.1.3)

1) Provide a listing of instrumentation that will be utilized to implement the SAWM strategy.
2) Qualification of instrumentation (temperature/radiation/seismic).
3) Describe how containment pressure and wetwell level instrumentation will be repowered through the period of Sustained Operation.
4) Provide an evaluation of the installed temperature instrumentation

IV.D.8.1: List of instruments

BSEP uses the same instruments for SAWM as for SAWA. See section 4.1.3 for the list of instruments.

IV.D.8.2: Instrument qualification

BSEP uses the same pumps and instruments for SAWM as for SAWA. See section 4.1.3 for the instruments' qualifications.

IV.D.8.3: Containment pressure and wetwell level instruments' power

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

IV.D.8.4: Evaluation of installed temperature instrumentation

Commented [LB40]: Include author note referencing Guidance NEI 13-02 Section C.8.3.1.

No HCVS temperature instrumentation is required.

Section IV.D.9: SAWM Severe Accident Considerations (SE Section 4.2.1.4)

Discuss if the thermal and radiological impacts on the installed or portable equipment and instrumentation would affect the functionality of these components or operators performing necessary actions for the SAWM strategy. Place the calculation on the ePortal.

IV.D.9.1: Thermal effect on SAWM equipment

BSEP uses the same pumps and instruments for SAWM as for SAWA. See sections 4.1.4 for the thermal effects of a severe accident on the SAWM equipment.

IV.D.9.2: Radiation effect on SAWM equipment

BSEP uses the same pumps and instruments for SAWM as for SAWA. See sections 4.1.4 for the radiation effects of a severe accident on the SAWM equipment.

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 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 HCVS
- when and how to place the HCVS in operation,
- the location of system components,
- instrumentation available,
- normal and backup power supplies,
- directions for sustained operation, including the storage location of portable equipment,
- training on operating the portable equipment, and
- testing of portable equipment.
- If a CAP plant add: 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.

Section V.B: HCVS Out of Service Requirements:

Provisions for out-of-service requirements of the HCVS and compensatory measures have been added to PLP-01.4 so that it is with the FLEX out-of-service program or have been included in new procedure XXXX . Programmatic controls have been implemented to document and control the following:

The provisions for out-of-service requirements for HCVS 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 up for to 30 days, the primary and alternate means of HCVS operation are non-functional, no compensatory actions are necessary.
- If the out of service times exceed 30 or 90 days as described above, the following actions will be performed through the corrective action system determine:
    - The cause of the non-functionality,

Commented [LB41]: Are projected to exceed?

This is interesting because MS would have shorter times. Anything credited for MS should use the most conservative allowed outage time between the two guidance documents.

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

Section V.B: 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 training will utilize the Systems Approach to Training (SAT).

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

Section VI: References

TR-1026539	EPRI Investigation of Strategies for Mitigating Radiological Releases in Severe Accidents BWR, Mark I and Mark II Studies, 2012
NEI 12-06	Diverse and Flexible Coping Strategies (FLEX) Implementation Guide, Revision 0.
EA-12-049	Issuance of Order to Modify Licenses With Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events, dated March 12, 2012.
GL-89-16	Installation of a Hardened Wetwell Vent (Generic Letter 89-16), dated September 1, 1989.
RG 1.97	Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Conditions During and Following an Accident, Revision. 3
EA-13-109	Order to Modify Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions
JLD-ISG-2015-1	Compliance with Order EA-13-109, Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation under Severe Accident Conditions
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
HCVS-WP-01	Hardened Containment Vent System Dedicated and Permanently Installed Motive Force, Revision 0, April 14, 2014

HCVS-WP-02	Sequences for HCVS Design and Method for Determining Radiological Dose from HCVS Piping, Revision 0, October 23, 2014
HCVS-WP-03	Hydrogen/Carbon Monoxide Control Measures Revision 1, October 2014
HCVS-WP-04	Missile Evaluation for HCVS Components 30 Feet Above Grade
HCVS-FAQ-10	Severe Accident Multiple Unit Response
HCVS-FAQ-11	Plant Response During a Severe Accident
HCVS-FAQ-12	Radiological Evaluations on Plant Actions Prior to HCVS Initial Use
HCVS-FAQ-13	Severe Accident Venting Actions Validation

Commented [LB42]: Add Appendix for I&C table (as discussed during the 6/1 public meeting)