UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

February 11, 2015

Mr. Joseph W. Shea
Vice President, Nuclear Licensing
Tennessee Valley Authority
1101 Market Street, LP 3D-C
Chattanooga, TN 37402-2801

SUBJECT: BROWNS FERRY NUCLEAR PLANT, UNITS 1, 2, AND 3 - INTERIM STAFF EVALUATION RELATING TO OVERALL INTEGRATED PLAN IN RESPONSE TO PHASE 1 OF ORDER EA-13-109 (SEVERE ACCIDENT CAPABLE HARDENED VENTS) (TAC NOS. MF4540, MF4541 AND MF4542)

Dear Mr. Shea:

By letter dated June 6, 2013, the U.S. Nuclear Regulatory Commission (NRC) issued Order EA-13-109, "Order to Modify Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions" (Agencywide Documents Access and Management System (ADAMS) Accession No. ML13143A334). By letter dated June 30, 2014 (ADAMS Accession No. ML14181B169), Tennessee Valley Authority (TVA), submitted its Overall Integrated Plan (OIP) for Browns Ferry Nuclear Plant (BFNP) in response to Phase 1 of Order EA-13-109. By letter dated December 19, 2014 (ADAMS Accession No. ML14353A428), TVA submitted its first six-month status report for BFNP in response to Order EA-13-109. Any changes to the compliance method described in the OIP, dated June 30, 2014, will be reviewed as part of the ongoing audit process.

TVA's OIP appears consistent with the guidance found in Nuclear Energy Institute (NEI) 13-02, Revision 0 as endorsed, in part, by the NRC's Japan Lessons-Learned Project Directorate (JLD) Interim Staff Guidance (ISG) JLD-ISG-2013-02, as an acceptable means for implementing the requirements of Phase 1 of Order EA-13-109. This conclusion is based on satisfactory resolution of the open items detailed in the enclosed Interim Staff Evaluation (ISE). This ISE only addresses consistency with the guidance. Any plant modifications will need to be conducted in accordance with the plant engineering change process and be consistent with the plant's licensing basis.

If you have any questions, please contact Charles Norton, Project Manager, at 301-415-7818 or at Charles.Norton@nrc.gov.

Sincerely,

Mandy K Halter

Mandy K. Halter, Acting Chief
Orders Management Branch
Japan Lessons-Learned Division
Office of Nuclear Reactor Regulation

Docket Nos. 50-259, 50-260 and 50-296

Enclosure:
Interim Staff Evaluation

cc w/encl: Distribution via Listserv

UNITED STATES
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INTERIM STAFF EVALUATION

BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO ORDER EA-13-109 PHASE 1, MODIFYING LICENSES

WITH REGARD TO RELIABLE HARDENED

CONTAINMENT VENTS CAPABLE OF OPERATION UNDER

SEVERE ACCIDENT CONDITIONS

TENNESSEE VALLEY AUTHORITY

BROWNS FERRY NUCLEAR PLANT, UNITS 1, 2, AND 3

DOCKET NOS. 50-259, 50-260 AND 50-296

1.0 INTRODUCTION

By letter dated June 6, 2013, the U.S. Nuclear Regulatory Commission (NRC, or Commission) issued Order EA-13-109, "Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation under Severe Accident Conditions" [Reference 1]. The order requires licensees to implement its requirements in two phases. In Phase 1, licensees of boiling-water reactors (BWRs) with Mark I and Mark II containments shall design and install a venting system that provides venting capability from the wetwell during severe accident (SA) conditions. In Phase 2, licensees of BWRs with Mark I and Mark II containments shall design and install a venting system that provides venting capability from the drywell under severe accident conditions, or, alternatively, those licensees shall develop and implement a reliable containment venting strategy that makes it unlikely that a licensee would need to vent from the containment drywell during severe accident conditions.[1]

The purpose of the NRC staff's review, as documented in this interim staff evaluation (ISE) is to provide an interim evaluation of the Overall Integrated Plan (OIP) for Phase 1 of Order EA-13-109. Phase 1 of Order EA-13-109 requires that BWRs with Mark I and Mark II containments design and install a severe accident capable hardened containment vent system (HCVS) that provides venting capability from the wetwell during severe accident conditions, using a vent path from the containment wetwell to remove decay heat, vent the containment atmosphere (including steam, hydrogen, carbon monoxide, non-condensable gases, aerosols, and fission

[1] This ISE only addresses the licensee's plans for implementing Phase 1 of Order EA-13-109. While the licensee's OIP makes reference to Phase 2 issues, those issues are not being considered in this evaluation. Issues related to Phase 2 of Order EA-13-109 will be considered in a separate interim staff evaluation at a later date.

Enclosure

products), and control containment pressure within acceptable limits. The HCVS shall be designed for those accident conditions (before and after core damage) for which containment venting is relied upon to reduce the probability of containment failure, including accident sequences that result in the loss of active containment heat removal capability or extended loss of alternating current (ac) power (ELAP).

By letter dated June 30, 2014 [Reference 2], Tennessee Valley Authority (TVA, the licensee) provided the OIP for Browns Ferry Nuclear Plant (BFNP) Units 1, 2, and 3 for compliance with Phase 1 of Order EA-13-109. The OIP describes the licensee's currently proposed modifications to systems, structures, and components, new and revised guidance, and strategies that it intends to implement in order to comply with the requirements in Order EA-13-109.

2.0 REGULATORY EVALUATION

Following the events at the Fukushima Dai-ichi nuclear power plant on March 11, 2011, the NRC established a senior-level agency task force referred to as the Near-Term Task Force (NTTF). The NTTF was tasked with conducting a systematic and methodical review of the NRC regulations and processes and determining if the agency should make improvements to these programs in light of the events at Fukushima Dai-ichi. As a result of this review, the NTTF developed a set of recommendations, documented in SECY-11-0093, "Near-Term Report and Recommendations for Agency Actions Following the Events in Japan," dated July 12, 2011 [Reference 3]. These recommendations were enhanced by the NRC staff following interactions with stakeholders. Documentation of the NRC staff's efforts is contained in the Commission's Staff Requirements Memorandum (SRM) SECY-11-0124, "Recommended Actions to be Taken without Delay from the Near-Term Task Force Report," dated September 9, 2011 [Reference 4] and SECY-11-0137, "Prioritization of Recommended Actions to be Taken in Response to Fukushima Lessons Learned," dated October 3, 2011 [Reference 5].

As directed by the Commission's Staff Requirements Memorandum (SRM) for SECY-11-0093 [Reference 6], the NRC staff reviewed the NTTF recommendations within the context of the NRC's existing regulatory framework and considered the various regulatory vehicles available to the NRC to implement the recommendations. SECY-11-0124 and SECY-11-0137 established the NRC staff's prioritization of the recommendations based upon the potential safety enhancements.

On February 17, 2012, the NRC staff provided SECY-12-0025, "Proposed Orders and Requests for Information in Response to Lessons Learned from Japan's March 11, 2011, Great Tohoku Earthquake and Tsunami" [Reference 7], to the Commission, including the proposed order to implement the installation of a reliable HCVS for Mark I and Mark II containments. As directed by SRM-SECY-12-0025 [Reference 8], the NRC staff issued Order EA-12-050, "Order Modifying Licenses with Regard to Reliable Hardened Containment Vents" [Reference 9], which requires licensees to install a reliable HCVS for Mark I and Mark II containments.

While developing the requirements for Order EA-12-050, the NRC acknowledged that questions remained about maintaining containment integrity and limiting the release of radioactive materials if the venting systems were used during severe accident conditions. The NRC staff presented options to address these issues for Commission consideration in SECY-12-0157, "Consideration of Additional Requirements for Containment Venting Systems for Boiling Water Reactors with Mark I and Mark II Containments" [Reference 10]. In the SRM for SECY-12-0157 [Reference 11], the Commission directed the staff to issue a modification to Order EA-12-050, requiring 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." The NRC staff held a series of public meetings following issuance of SRM SECY-12-0157 to engage stakeholders on revising the order. Accordingly, by letter dated June 6, 2013, the NRC issued Order EA-13-109, "Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Performing under Severe Accident Conditions."

Order EA-13-109, Attachment 2 requires that BWRs with Mark I and Mark II containments shall have a reliable, severe accident capable HCVS. This requirement shall be implemented in two phases. In Phase 1, licensees of BWRs with Mark I and Mark II containments shall design and install a venting system that provides venting capability from the wetwell during severe accident conditions. Severe accident conditions include the elevated temperatures, pressures, radiation levels, and combustible gas concentrations, such as hydrogen and carbon monoxide, associated with accidents involving extensive core damage, including accidents involving a breach of the reactor vessel by molten core debris. In Phase 2, licensees of BWRs with Mark I and Mark II containments shall design and install a venting system that provides venting capability from the drywell under severe accident conditions, or, alternatively, those licensees shall develop and implement a reliable containment venting strategy that makes it unlikely that a licensee would need to vent from the containment drywell during severe accident conditions.

On November 12, 2013, the Nuclear Energy Institute (NEI) issued NEI 13-02, "Industry Guidance for Compliance with Order EA-13-109," Revision 0 [Reference 12] to provide guidance to assist nuclear power reactor licensees with the identification of measures needed to comply with the requirements of Phase 1 of the HCVS order. On November 14, 2013, the NRC staff issued Japan Lessons-Learned Project Directorate (JLD) interim staff guidance (ISG) JLD-ISG-2013-02, "Compliance with Order EA-13-109, 'Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Performing under Severe Accident Conditions'" [Reference 13], endorsing, in part, NEI 13-02, Revision 0, as an acceptable means of meeting the requirements of Phase 1 of Order EA-13-109, and published a notice of its availability in the *Federal Register* (FR) [78 FR 70356]. Licensees are free to propose alternate methods for complying with the requirements of Phase 1 of Order EA-13-109.

By letter dated May, 27, 2014 [Reference 14], the NRC notified all BWR Mark I and Mark II Licensees that the staff will be conducting audits of the implementation of Order EA-13-109. This letter described the audit process to be used by the staff in its review of the information contained in licensee's submittals in response to Phase 1 of Order EA-13-109.

3.0 TECHNICAL EVALUATION

BFNP consists of three General Electric BWRs with Mark I containment systems. To implement Phase 1 (HCVS) of Order EA-13-109, TVA plans to install a new independent HCVS wetwell vent on each of the BFNP units with no connection to the unit's existing drywell vent. The OIP describes plant modifications, strategies and guidance under development for implementation by the licensee to install HCVSs. As part of its interim review of the submitted OIP, the NRC staff held clarifying discussions with TVA in evaluating the licensee's plans for addressing wetwell venting during beyond-design-basis external events (BDBEEs) and severe accidents.

3.1 GENERAL INTEGRATED PLAN ELEMENTS AND ASSUMPTIONS

3.1.1 Evaluation of Extreme External Hazards

Extreme external hazards for BFNP were evaluated in the BFNP OIP in response to Order EA-12-049 (Mitigation Strategies) [Reference 15]. In the BFNP ISE relating to Mitigating Strategies [Reference 16], NRC staff documented an analysis of TVA's extreme external hazards evaluation. The following extreme external hazards screened in: Seismic, External Flooding, High Wind, and Extreme High Temperature. Extreme Cold screened out. Based on TVA not excluding any external hazard from consideration, the NRC staff determined that TVA appears to have identified the appropriate external hazards for consideration in the design of HVCS.

3.1.2 Assumptions

On page 4 of the BFNP OIP, TVA adopted a set of generic assumptions associated with Order EA-13-109 Phase 1 actions. The staff determined that the set of generic assumptions appear to establish a baseline for HCVS evaluation consistent with the guidance found NEI 13-02, as endorsed, in part, by JLD-ISG-2013-02 as an acceptable method to implement the requirements of Order EA-13-109.

The staff reviewed the BFNP plant-specific HCVS assumptions:

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

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

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

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

The staff determined that the plant specific assumptions do not appear to deviate from the guidance found in NEI 13-02, as endorsed, in part, by JLD-ISG-2013-02 as an acceptable method to implement the requirements of Order EA-13-109. The licensee identified the following open items as a result of the plant specific assumptions.

Open Item: Make available for NRC staff audit documentation demonstrating that all load sheds will be accomplished within one hour of event initiation and will occur in an area not impacted by a possible radiological event.

Open Item: Make available for NRC staff audit documentation that demonstrates that operating units that have not implemented the order will be able to vent through the existing vent system unaffected by the implementation of HCVS on other units.

3.1.3 Compliance Timeline and Deviations

Page 4 of the OIP states the following:

> Compliance will be attained for Browns Ferry Nuclear Plant (BFNP) with no known deviations to the guidelines in JLD-ISG-2013-02 and NEI 13-02 for each phase as follows:
>
> - Phase 1 (wetwell): by the startup from the second refueling outage that begins after June 30, 2014, or June 30, 2018, whichever comes first. Currently scheduled for design and implementation as noted in Part 5 of this OIP.
>
> - Phase 2: The Phase 2 portion of the order is in the early strategy stage and future updates will provide additional information when available.
>
> The Browns Ferry Nuclear Plant is a three unit site that will have the capacity to have each unit operate at Extended Power Uprate [EPU] (3952 MWt [megawatt thermal]). The design and implementation of the HCVS system for each unit will have independent operation and be fully compliant with the NRC Order EA-13-109.
>
> If deviations are identified at a later date, then the deviations will be communicated in a future 6 month update following identification.

BFNP's implementation schedule appears to be in compliance with Order EA-13-109 requirements. TVA reports that BFNP will implement Order EA-13-109 with no known deviations from the guidance found in NEI 13-02, as endorsed, in part, by JLD-ISG-2013-02 as an acceptable method to implement the requirements of Order EA-13-109.

<u>Summary, Section 3.1:</u>

The licensee's described approach to General Integrated Plan Elements and Assumptions if implemented as described in Section 3.1, and assuming acceptable resolution of any open items identified here or as a result of licensee alterations to their proposed plans, appears to be consistent with the guidance found in NEI 13-02, endorsed, in part, by JLD-ISG-2013-02 as an acceptable means for implementing applicable requirements of Order EA-13-109.

3.2 BOUNDARY CONDITIONS FOR WETWELL VENT

3.2.1 Sequence of Events (SOE)

Order EA-13-109, Sections 1.1.1, 1.1.2, and 1.1.3, state that:

> 1.1.1 The HCVS shall be designed to minimize the reliance on operator actions,
>
> 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,
>
> 1.1.3 The HCVS shall also be designed to account for radiological conditions that would impede personnel actions needed for event response.

Page 7 of the OIP states the following:

> The operation of the HCVS will be designed to minimize the reliance on operator actions in response to hazards listed in Part 1 [of the OIP]. Immediate operator actions will be completed by plant personnel and will include the capability for remote-manual initiation from the HCVS control station. A list of the remote manual actions performed by plant personnel to open the HCVS vent path can be found in the following table (2-1 [of the OIP]). A HCVS Extended Loss of AC Power (ELAP) Failure Evaluation table, which shows alternate actions that can be performed, is included in Attachment 4 [of the OIP].
>
> Other considerations to minimize the impact to operational hazards is that HCVS controls will be located in areas where sustained operation is possible accounting for expected temperatures and radiological conditions in the HCVS vent pipe and attached components without extreme heat stress or radiological over exposure to the operators.
>
> HCVS components may serve multiple functions described in the plant Current License Basis (CLB). For BFNP this is inclusive of:
>
> > Piping, valves and penetrations for the Wetwell may be used for Wetwell vent and purge prior to or following refueling outages or for pressure control during normal plant operation.
> >
> > Containment Isolation valves in the HCVS system may provide a containment isolation function independent of the HCVS function.
> >
> > Containment Isolation valve position indication for valves in the HCVS may be used for post-accident indications.
> >
> > Instrumentation supporting HCVS and non HCVS functions.

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

NRC staff reviewed the Remote Manual Actions (Table 2-1 of the OIP) and concluded that these actions appear to consider minimizing the reliance on operator actions. The actions appear consistent with the types of actions described in the guidance found in NEI 13-02, as endorsed, in part, by JLD-ISG-2013-02 as an acceptable means for implementing applicable requirements of Order EA-13-109. NRC staff reviewed the Wetwell HCVS Failure Evaluation Table (Attachment 4 of the OIP) and determined the actions described appear to adequately address all the failure modes listed in the guidance provided by NEI 13-02, which include: loss of normal ac power, long term loss of batteries, loss of normal pneumatic supply, loss of alternate pneumatic supply, and solenoid operated valve failure.

The staff reviewed the three cases contained in the SOE timeline [Attachment 2 of the OIP] and determined that the three cases appropriately bound the conditions for which the HCVS is required. These cases include: successful FLEX implementation with no failure of reactor core isolation cooling (RCIC); late failure of RCIC leading to core damage; and failure of RCIC to inject at the start of the event. The timelines accurately reflect the progression of events as described in the BFNP FLEX OIP [Reference 17], SECY-12-0157 [Reference 10], and State-of-the-Art Reactor Consequence Analyses (SOARCA) [Reference 18].

The NRC staff reviewed the licensee's discussion of time constraints on page 9 of the OIP. The time constraints establish when the HCVS must be initiated and when supplemental compressed gas for motive power and supplemental electrical power (FLEX) must be supplied. The staff confirmed that the time constraints identified appear to be appropriately derived from the time lines developed in Attachment 2 of the OIP, and therefore are consistent with the guidance found in NEI 13-02, as endorsed, in part, by JLD-ISG-2013-02 as an acceptable means for implementing applicable requirements of Order EA-13-109.

The NRC staff reviewed the discussion of radiological and temperature constraints on page 10 of the OIP and determined that TVA addressed radiological and temperature considerations at the locations identified to date where manual actions are necessary to operate HCVS. BFNP has not identified all locations where operator actions need to be performed and therefore has not evaluated temperature and radiological conditions in those areas.

Open Item: Make available for NRC staff audit an evaluation of temperature and radiological conditions to ensure that operating personnel can safely access and operate controls and support equipment.

3.2.2 Vent Characteristics

3.2.2.1 Vent Size and Basis

Order EA-13-109, Section 1.2.1, states that:

> 1.2.1 The HCVS shall have the capacity to vent the steam/energy equivalent of one (1) percent of licensed/rated thermal power (unless a lower value is justified by analyses), and be able to restore and then maintain containment pressure below the primary containment design pressure and the primary containment pressure limit.

Page 12 of the OIP states the following:

> The HCVS wetwell path is designed for venting steam/energy at a nominal capacity of 1% or greater of 3952 MWt thermal power at pressure of 56 psig. This pressure is the lower of the containment design pressure (56 psig) and the PCPL value (62 psig). The thermal power is based on a power uprate of 15% above the currently licensed thermal power [CLTP] of 3458 MWt. This pressure is the lower of the containment design pressure and the PCPL value. The size of the wetwell portion of the HCVS of 14 inches in diameter provides adequate capacity to meet or exceed the Order criteria.
>
> The primary design objective of the HCVS is to provide sufficient venting capacity to prevent a long-term overpressure failure of the containment by keeping the containment pressure below the lower value of either Primary Containment Pressure Limit (PCPL) or containment design pressure, and maintaining Pressure Suppression Capability such that the safety relief valves (SRVs) can be opened and closed as required by plant conditions. Operational functionality of these valves will ensure the capability to depressurize the RPV [reactor pressure vessel] to permit injection of low head injection systems and to maintain the containment pressure boundary.
>
> The wet well vent will be sized under conditions of constant heat input at a rate equal to 1% of rated thermal power and containment pressure equal to the lesser of the PCPL or containment design pressure, the exhaust-flow through the wetwell vent would be sufficient to prevent the containment pressure from increasing.
>
> [OPEN ITEM 8] The wetwell vent will be designed to remove 1% of rated thermal power at EPU conditions.
>
> During a severe accident, temperature of gases in the wetwell and drywell will differ due to insufficient removal of decay heat from fission products resulting in superheat or non-saturated conditions in the drywell. The suppression pool/wetwell of a BWR Mark I/II containment can be considered to be in a saturated condition. The plant-specific PCPL determination provides a temperature range for the suppression pool of 70°F to 350°F. Therefore, the

> design temperature for the wetwell vent portions of the HCVS are recommended to be based on the 350°F upper bound of the EPG/SAG [Emergency Procedure Guideline/Severe Accident Guideline] bases document which is above the saturation temperature corresponding to typical PCPL values.
>
> Anticipatory venting of primary containment may be used in the BFNP HCVS design to preclude elevated containment temperature, hydrogen generation, containment pressure and extend RCIC operation. Early removal of energy from containment during an ELAP via the containment vents is an effective action that can be taken to support the containment and core cooling safety function capabilities described in NEI 12-06 (Reference 10 [of the OIP]) Table 3-1 for Mark 1 containment designs. Anticipatory venting provides a controlled vent path (for exhausted/scrubbed reactor steam) and maintains operation of an installed (operator-familiar) injection system that provides a reliable strategy for maintaining long term functionality of Containment (and the Core).

The BFNP OIP describes installation of a new vent sized to meet or exceed 1 percent or greater CLTP. Specifically, the licensee indicates that the vent is capable of removing the specified level of decay heat corresponding to an uprated (EPU) power level. This uprated power level is approximately 15 percent higher than the CLTP level. While the EPU application for BFNP has not yet been submitted, performing the analysis at the higher power level would be conservative relative to the CLTP for this consideration. Therefore, the licensee's approach appears to be consistent with the guidance found in NEI 13-02, endorsed, in part, by JLD-ISG-2013-02 as an acceptable means for implementing applicable requirements of Order EA-13-109. Specific design details not provided at this time include: an analysis that demonstrates sufficient HCVS capacity to vent the steam/energy equivalent of one percent of licensed/rated thermal power (unless a lower value is justified), and an analysis that demonstrates that the suppression pool and the HCVS together are able to absorb and reject decay heat, such that following a reactor shutdown from full power containment pressure is restored and then maintained below the primary containment design pressure and the primary containment pressure limit; therefore, the staff has not completed its review.

Open Item: Make available for NRC staff audit analyses demonstrating that HCVS has the capacity to vent the steam/energy equivalent of one percent of licensed/rated thermal power (unless a lower value is justified), and that the suppression pool and the HCVS together are able to absorb and reject decay heat, such that following a reactor shutdown from full power containment pressure is restored and then maintained below the primary containment design pressure and the primary containment pressure limit.

3.2.2.2 Vent Capacity

Order EA-13-109, Section 1.2.1, states that:

> 1.2.1 The HCVS shall have the capacity to vent the steam/energy equivalent of one (1) percent of licensed/rated thermal power (unless a lower value is justified by analyses), and be able to restore and then maintain containment pressure below the primary containment design pressure

and the primary containment pressure limit.

Page 13 of the OIP states the following:

> The 1% capacity value at BFNP assumes that the suppression pool pressure suppression capacity is sufficient to absorb the decay heat generated during the first 3 hours. The vent would then be able to prevent containment pressure from increasing above the containment design pressure. As part of the detailed design, the duration of suppression pool decay heat absorption capability has been confirmed.

The OIP acknowledges that until decay heat is less than 1 percent, the suppression pool must absorb the decay heat generated and prevent containment pressure from rising above the containment design pressure until the 1 percent containment vent is able to restore and maintain primary containment pressure below the primary containment design pressure and the primary containment pressure limit. Specific design details not been provided at this time include: an analysis that demonstrates sufficient HCVS capacity to vent the steam/energy equivalent of one percent of licensed/rated thermal power (unless a lower value is justified), and an analysis that demonstrates that the suppression pool and the HCVS together are able to absorb and reject decay heat, such that following a reactor shutdown from full power containment pressure is restored and then maintained below the primary containment design pressure and the primary containment pressure limit; therefore, the staff has not completed its review.

Open Item: Make available for NRC staff audit analyses demonstrating that HCVS has the capacity to vent the steam/energy equivalent of one percent of licensed/rated thermal power (unless a lower value is justified), and that the suppression pool and the HCVS together are able to absorb and reject decay heat, such that following a reactor shutdown from full power containment pressure is restored and then maintained below the primary containment design pressure and the primary containment pressure limit.

3.2.2.3 Vent Path and Discharge

Order EA-13-109, Section 1.1.4, states that:

> 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.

Order EA-13-109, section 1.2.2, states that:

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

Page 13 of the OIP states the following:

> The HCVS vent path at BFNP will consist of a wetwell vent on each unit. There will be no connection to the existing drywell vent. The proposed HCVS vent path for the wetwell will exit the reactor building 565.0 elevation through an underground pipe. This pipe will be routed approximately 200 feet vertically up the outside of the reactor building. The HCVS path will pass through the BFNP superstructure to the roof of the Reactor Building. The release point will be above any adjacent structure and will be designed to not mix with the other units release plume as the distance from each individual release point will be greater than 150 feet in the horizontal direction.
>
> The HCVS discharge path is in the early design developmental stage and subject to refinement; however current consideration is that the HCVS vent will be routed to a point above any adjacent structure. This discharge point is above that unit's Reactor Building such that the release point will vent away from emergency ventilation system intake and exhaust openings, main control room location, location of HCVS portable equipment, access routes required following an ELAP and BDBEE, and emergency response facilities; however, these must be considered in conjunction with other design criteria (e.g., flow capacity) and pipe routing limitations, to the degree practical. The existing routing of the Wet Well vent will follow the existing path to the Reactor Building wall. The proposed HCVS pipe will exit the Reactor Building wall and be routed through an earthen berm to a vertical discharge path on the exterior side of the Reactor building wall. The HCVS piping will then pass through the superstructure that encases the refuel floor to an exit point on the roof. This path will provide an enhanced method to minimize any radiological dose to the operating staff and any exposed piping and supports will be designed for missile protection form excessive winds.
>
> The HCVS shall be designed for those accident conditions (before and after core damage) for which containment venting is relied upon to reduce the probability of containment failure. The BFNP HCVS will be designed to protect the containment against over pressurization in a beyond design basis accident such that the release of radioactive effluent will be maintained as a controlled process.
>
> When anticipatory venting is performed at low containment pressure to maintain core cooling using FLEX strategies, there is no minimum required exhaust stack exit velocity, since without core damage there will be negligible levels of radionuclides and/or combustible gas in the effluent. Therefore, there is no concern with entrainment of the stack effluent into the roof or downstream recirculation zones associated with airflow around the building.
>
> Severe accident venting to maintain containment integrity may have the potential presence of significant quantities of radionuclides and/or combustible gas in the vent discharge that requires additional restrictions to be applied to the design and operation of the vent under severe accident conditions. ASHRAE [American Society of Heating, Refrigeration and Air Conditioning Engineers] HVAC design requirements is used as the guidance document, and it states that an effluent

release velocity of 8000 fpm will assure that the effluent plume will not be entrained into the roof recirculation zone of a given building. Vent pipe design (e.g., pipe diameter at the exit) and conditions under which the vent is operated (e.g., minimum containment pressure at which the vent is operated; use of flow control devices) should be considered to ensure this is the predominant minimum release velocity under severe accident conditions.

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

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

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

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

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

The BFNP OIP describes the routing and discharge point of the HCVS that appear consistent with the guidance found in NEI 13-02, as endorsed, in part, by JLD-ISG-2013-02 as an acceptable means for implementing applicable requirements of Order EA-13-109. Design details not available at this time include: the seismic and tornado missile final design criteria for the HCVS stack, evaluations of the environmental and radiological effects on HCVS controls and indications, and documentation of an evaluation of temperature and radiological conditions to ensure that operating personnel can safely access and operate controls and support equipment; therefore, the staff has not completed its review.

Open Item: Make available for NRC staff audit the seismic and tornado missile final design criteria for the HCVS stack.

Open Item: Make available for NRC staff audit the descriptions of local conditions (temperature, radiation and humidity) anticipated during ELAP and severe accident for the components (valves, instrumentation, sensors, transmitters, indicators, electronics, control devices, and etc.) required for HCVS venting including confirmation that the components are capable of performing their functions during ELAP and severe accident conditions.

Open Item: Make available for NRC staff audit an evaluation of temperature and radiological conditions to ensure that operating personnel can safely access and operate controls and support equipment.

3.2.2.4 Power and Pneumatic Supply Sources

Order EA-13-109, Sections 1.2.5 and 1.2.6, state that:

> 1.2.5 The HCVS shall, in addition to meeting the requirements of 1.2.4, 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.
>
> 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.

Page 15 of the OIP states the following:

> All electrical power required for operation of HCVS components will be routed through a 250 VDC system which is normally supplied from two Unit Batteries, one for each electrical division. Battery power will be provided by the existing Unit batteries for up to 8 hours (to be validated by calculation) if proper load shedding is performed within 1 hour following the ELAP event. At any time following the ELAP event, power may be transferred to dedicated batteries that will supply power for 24 hours. At 24 hours, power will transfer back to the Unit batteries, at which time it is expected that FLEX generators will be in service to recharge Unit batteries.
>
> Pneumatic power is normally provided by the non-interruptible air system with backup nitrogen provided from installed nitrogen supply tanks. Following an ELAP event, station control air system is lost, and normal backup from installed nitrogen supply tanks is isolated. Therefore, for the first 24 hours, pneumatic

force will be supplied from newly installed air accumulator tanks. These tanks will supply the required motive force to those HCVS valves needed to maintain flow through the HCVS effluent piping and the use of a two way pneumatic spool valve that is automatically opened by a pressure regulator to isolate the normal path bypassing the existing solenoid valve and enable the ROS [Remote Operating Station] to provide motive force to the CIV's [containment isolation valves].

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

   BFNP will use Anticipatory Venting during the initial phase of the HCVS operation. Use of the HCVS system during Severe Accidents (particularly with a high level of Aerosol formation) may require cycling the vent to create pressure changes to promote plate out of Aerosols. The method used for these pressure cycles may be either full vent closure or vent throttling. The number of cycles of the HCVS system may change during the detailed design process to determine the amount of motive air/pneumatics required over the first 24 hours. The HCVS will be designed for sustained operation of 7 days. This will allow two objectives to be met:

   > First, to allow sufficient time for decay heat to be reduced so that water flooding of the debris would not pose a large risk of containment overpressure due to Zirc water reaction. This would be coupled with steam formation and the loss of Drywell air space caused by large water injections.
   >
   > Second, to allow time for additional equipment to arrive to support water injection into the Containment to cover the core debris and achieve Minimum Debris Submergence Level.

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

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

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

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

3. All permanently installed HCVS equipment, including any connections required to supplement the HCVS operation during an ELAP (i.e., electric power, N2/air) will be located in areas reasonably protected from defined hazards listed in Part 1 of this report.

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

4. All valves required to open the flow path will be designed for remote manual operation following an ELAP, such that the primary means of valve manipulation does not rely on use of a hand wheel, reach–rod or similar means that requires close proximity to the valve. The ROS will be located in the Diesel Generator Building for the respective unit. These structures are not subject to the thermal and radiological conditions in the Reactor Building(s) and no ice vests or shielding is required. Any supplemental connections will be pre-engineered to minimize man-power resources and address environmental concerns. Required portable equipment will be reasonably protected from screened in hazards listed in Part 1 of this OIP.

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

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

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

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

6. Following the initial 24 hour period, additional motive force will be supplied from nitrogen bottles that will be staged at a gas cylinder rack located (near the ROS in the diesel generator building) such that radiological impacts are not an issue. Additional bottles can be deployed and installed as needed.

The BFNP OIP contains system feature descriptions that appear to make the system reliable consistent with the guidance found in NEI 13-02, as endorsed, in part, by JLD-ISG-2013-02 as an acceptable means for implementing applicable requirements of Order EA-13-109. Specific details not available at this time include: the final nitrogen pneumatic system design including sizing and location, the final sizing for HCVS battery/battery charger including documentation of incorporating HCVS electrical sources into the FLEX diesel generator (DG) loading calculations, and documentation of an evaluation of temperature and radiological conditions to ensure that operating personnel can safely access and operate controls and support equipment; therefore, the staff has not completed its review.

Open Item: Make available for NRC staff audit documentation of the HCVS nitrogen pneumatic system design including sizing and location.

Open Item: Make available for NRC staff audit the final sizing evaluation for HCVS batteries/battery charger including incorporation into FLEX DG loading calculation.

Open Item: Make available for NRC staff audit an evaluation of temperature and radiological conditions to ensure that operating personnel can safely access and operate controls and support equipment.

3.2.2.5 Location of Control Panels

Order EA-13-109, Sections 1.1.1, 1.1.2, 1.1.3, and 1.1.4 state that:

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

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

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

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.

Order EA-13-109, Sections 1.2.4 and 1.2.5 state that:

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.

1.2.5 The HCVS shall, in addition to meeting the requirements of 1.2.4, 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.

Page 17 of the OIP states the following:

> The HCVS design allows initiating and then operating and monitoring the HCVS from the Main Control Room (MCR) and the Remote Operating Station located in the Diesel Generator Building(s). The MCR location is protected from adverse natural phenomena and the normal control point for Plant Emergency Response actions.
>
> The Remote Operating Station located in the Diesel Generator Building(S) has the same accessibility and habitability as the Main Control Room. Evaluations have been performed for the Diesel Generator Buildings and area temperatures are within the NEI 12-06 limit of 110°F. Radiological conditions will also vary with the source term over time and could either drop or rise depending on deposition of source term in the HCVS system and vent system use. However, based on the distance of the Remote Operating Station to the operating HCVS process piping the radiological conditions will conform to GDC 19 requirements.
>
> The HCVS will include a means to monitor the effluent discharge for radioactivity that may be released from operation of the HCVS. The monitoring system will provide indication from the control panel and shall be designed for sustained

operation during an extended loss of AC power. The HCVS design will provide a means to allow plant operators to readily determine, or have knowledge of HCVS vent valve position, radiation levels with a range for severe accident service, pressure, temperature and the status of supporting systems, such as availability of electrical power and pneumatic supply pressure.

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

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

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

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

The BFNP OIP describes HCVS control locations that appear to be consistent with the guidance found in NEI 13-02, endorsed, in part, by JLD-ISG-2013-02 as an acceptable means for implementing applicable requirements of Order EA-13-109. Specific design details not available at this time include: documentation that demonstrates adequate communication between remote HCVS operation locations and HCVS operational decision makers, evaluations of the environmental and radiological effects on HCVS controls and indications, and an evaluation of environmental and radiological conditions to ensure that operating personnel can safely access and operate controls and support equipment; therefore, the staff has not completed its review.

Open Item: Make available for NRC staff audit documentation that demonstrates adequate communication between the remote HCVS operation locations and HCVS decision makers during ELAP and severe accident conditions.

Open Item: Make available for NRC staff audit the descriptions of local conditions (temperature, radiation and humidity) anticipated during ELAP and severe accident for the components (valves, instrumentation, sensors, transmitters, indicators, electronics, control devices, and etc.) required for HCVS venting including confirmation that the components are capable of performing their functions during ELAP and severe accident conditions.

Open Item: Make available for NRC staff audit an evaluation of temperature and radiological conditions to ensure that operating personnel can safely access and operate controls and support equipment.

3.2.2.6 Hydrogen

Order EA-13-109, Sections 1.2.10, 1.2.11, and 1.2.12, state that:

> 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.
>
> 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.
>
> 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.

Page 18 of the OIP states the following:

> As is required by EA-13-109, Section 1.2.11, the HCVS must be designed such that it is able to either provide assurance that oxygen cannot enter and mix with flammable gas in the HCVS (so as to form a combustible gas mixture), or it must be able to accommodate the dynamic loading resulting from a combustible gas detonation. Several configurations are available which will support the former (e.g., purge, mechanical isolation from outside air, etc.) or the latter (design of potentially affected portions of the system to withstand a detonation relative to pipe stress and support structures).
>
> State which approach or combination of approaches the plant will take to address the control of flammable gases, clearly demarcating the segments of vent system to which an approach applies.
>
> The HCVS will be designed to avoid a detonable mixture or be designed to accommodate a detonation while remaining functional. A number of conditions as shown in attachment 2 [of the OIP] must align to allow for a detonation to occur. A series of specific conditions must occur in order for a pressure spike high enough to potentially damage the vent pipe to be possible. It should also be realized that the

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

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

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

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

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

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

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

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

A description of the final design for hydrogen control is not available at this time including a description of the final design of the HCVS to address hydrogen detonation and deflagration (licensee identified) and 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; therefore, the staff has not completed its review.

Open Item: Provide a description of the final design of the HCVS to address hydrogen detonation and deflagration.

Open Item: 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.

3.2.2.7 Unintended Cross Flow of Vented Fluids

Order EA-13-109, Sections 1.2.3 and 1.2.12, state that:

> 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.
>
> 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.

Page 20 of the OIP states the following:

> The HCVS uses the Containment Purge and inerting System containment isolation valves for containment isolation. These containment isolation valves are AOVs and they are air-to-open and spring-to-shut. An SOV must be energized to allow the motive air to open the valve. Although these valves are shared between the Containment Purge System and the HCVS, separate control circuits are provided to each valve for each function. Specifically the Containment Purge and inerting System control circuit will be used during all "design basis" operating modes including all design basis transients and accidents.
>
> Each HCVS containment penetration will have two in-series PCIVs as required by GDC 56. These PCIVs will be as evaluated for the required BDBEE process conditions. The design basis requirements will not be altered by the implementation of the modification to implement NRC Order EA-13-109. The HCVS path upstream of the HCVS PCIVs will be a multipurpose containment penetration that serve purge and inerting flow. The HCVS path downstream of the second PCIV must be analyzed for the condition of 350°F with corresponding PCPL values. The analysis of the non- HCVS system downstream of any boundary valve only has to consider consequences of heat transfer and leakage with the boundary valve closed.
>
> The primary containment connections that are upstream of the HCVS PCIV's are in accordance with 10 CFR 50, Appendix J, Type C testing. These paths accordingly are protected by redundant and diversely powered isolation valves. In standby conditions the normal state of the Torus Purge and Vent valves (Containment Isolation valves) are closed. Any leakage through these valves to the HCVS line would be determined by the Appendix J testing. During HCVS Operation the secondary containment bypass leakage criteria would not apply.
>
> System cross-connections or shared Unit vent exhaust flowpaths present a potential for steam, hydrogen, and airborne radioactivity leakage to other areas of the plant and to adjacent units at multi-unit sites if the units are equipped with common vent piping. The implementation of NRC Order EA-13-109 will provide independence of the discharge path for all three units. The minimum distance between each units release point will be 150 feet. Based on the prevailing wind

direction and velocity of the plume, the discharge of the effluent should not have any effect on the adjacent units HCVS.

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

The BFNP OIP describes a system to be designed as an independent new system on each unit to minimize unintended cross flow. Specific design details and drawings are not available at this time; therefore, the NRC staff has not completed its review.

Open Item: Make available for NRC staff audit design details that minimize unintended cross flow of vented fluids within a unit and between units on the site.

3.2.2.8 Prevention of Inadvertent Actuation

Order EA-13-109, Section 1.2.7, states that:

1.2.7 The HCVS shall include means to prevent inadvertent actuation.

Page 21 of the OIP states the following:

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

- The features that prevent inadvertent actuation are two PCIV's in series powered from different division and key lock switches. Procedures also provide clear guidance to not circumvent containment integrity by simultaneously opening torus and drywell vent valves during any design basis transient or accident. In addition, the HCVS will be designed to provide features to prevent inadvertent actuation due to a design error, equipment malfunction, or operator error.

- BFNP will have circuitry to bypass containment high pressure interlocks that keep the HCVS containment isolation valves closed when high containment pressure exists. IEEE [Institute of Electrical and Electronic Engineers] standards require some form of annunciation of features intended to bypass these containment interlocks for the Licensed Based Containment Reliability function. It will be ensured that this is properly designed to avoid conflict with the [current licensing basis] CLB.

The BFNP OIP provides a description of methods to prevent inadvertent HCVS initiation that includes: key lock switches, valves in series powered from separate power supplies and procedural guidance. This appears to be consistent with the guidance found in NEI 13-02, endorsed, in part, by JLD-ISG-2013-02 as an acceptable means for implementing applicable requirements of Order EA-13-109.

3.2.2.9 Component Qualifications

Order EA-13-109, Section 2.1, states that:

> 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.

Page 21 of the OIP states the following:

> The HCVS components downstream of the second containment isolation valve and components that interface with the HCVS are routed in seismically qualified structures. For those components, the structure will be analyzed for seismic ruggedness to ensure that any potential failure would not adversely impact the function of the HCVS or other safety related structures or components. HCVS components that directly interface with the pressure boundary will be considered safety related, as the existing system is safety related. The containment system limits the leakage or release of radioactive materials to the environment to prevent offsite exposures from exceeding the guidelines of 10CFR100. During normal or design basis operations, this means serving as a pressure boundary to prevent release of radioactive material.
>
> Likewise, any electrical or controls component which interfaces with Class 1E power sources will be considered safety related up to and including appropriate isolation devices such as fuses or breakers, as their failure could adversely impact containment isolation and/or a safety-related power source. The remaining components will be considered Augmented Quality. Newly installed piping and valves will be seismically qualified to handle the forces associated with the seismic margin earthquake (SME) back to their isolation boundaries. Electrical and controls components will be seismically qualified and will include the ability to handle harsh environmental conditions (although they will not be considered part of the site Environmental Qualification (EQ) program).

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

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

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

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

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

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

The HCVS instruments, including valve position indication, process instrumentation, radiation monitoring, and support system monitoring, will be qualified by using one or more of the three methods described in JLD-ISG-2013-02, which includes:

1. Purchase of instruments and supporting components with known operating principles from manufacturers with commercial quality assurance programs (e.g., ISO9001) where the procurement specifications include the applicable seismic requirements, design requirements, and applicable testing.

2. Demonstration of seismic reliability via methods that predict performance described in IEEE 344-2004

3. Demonstration that instrumentation is substantially similar to the design of instrumentation previously qualified.

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

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

The BFNP OIP describes component qualification methods that appear to be consistent with the design-basis of the plant and the guidance found in NEI 13-02, endorsed, in part, by JLD-ISG-2013-02 as an acceptable means for implementing applicable requirements of Order EA-13-109. Specific design details not available at this time include: an evaluation for seismic and environmental qualifications of HCVS components, documentation of an evaluation verifying the existing containment isolation valves, relied upon for the HCVS, will open under ELAP and severe accident conditions; therefore, the staff has not completed its review.

Open Item: Make available for NRC staff audit documentation of a seismic qualification evaluation of HCVS components.

Open Item: Make available for NRC staff audit the descriptions of local conditions (temperature, radiation and humidity) anticipated during ELAP and severe accident for the components (valves, instrumentation, sensors, transmitters, indicators, electronics, control devices, and etc.) required for HCVS venting including confirmation that the components are capable of performing their functions during ELAP and severe accident conditions.

Open Item: 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.

3.2.2.10 Monitoring of HCVS

Order EA-13-109, Sections 1.1.4, 1.2.8, and 1.2.9, state that:

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.

Order EA-13-109, Sections 1.2.8 and 1.2.9 state that:

1.2.8 The HCVS shall include 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.

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.

Page 23 of the OIP states the following:

> The BFNP wetwell HCVS will be capable of being manually operated during sustained operations from a control panel located in the main control room (MCR) and will meet the requirements of Order element 1.2.4. The MCR is a readily accessible location with no further evaluation required. Control Room dose associated with HCVS operation conforms to GDC 19/Alternate Source Term (AST). Additionally, to meet the intent for a secondary control location of section 1.2.5 of the Order, a readily accessible Remote Operating Station (ROS) will also be incorporated into the HCVS design as described in NEI 13-02 section 4.2.2.1.2.1. The controls at the ROS location will be accessible and functional under a range of plant conditions, including severe accident conditions with due consideration to source term and dose impact on operator exposure, extended loss of AC power (ELAP), and inadequate containment cooling. An evaluation will be performed to determine accessibility to the location, habitability, staffing sufficiency, and communication capability with Vent use decision makers.
>
> The wetwell HCVS will include means to monitor the status of the vent system in the MCR.
>
> Included in the current design of the reliable hardened vent (RHV) are control switches in the MCR with valve position indication. The existing RHV controls currently meet the environmental and seismic requirements of the Order for the

plant severe accident and will be upgraded to address ELAP. The ability to open/close these valves multiple times during the event's first 24 hours will be provided by air accumulator tanks and Unit batteries, supplemented by installed backup battery power sources. Beyond the first 24 hours, the ability to maintain these valves open or closed will be provided with replaceable nitrogen bottles and FLEX generators.

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

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

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

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

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

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

Power that is available following an ELAP to power the required Containment Indications (See JLD-ISG-2012-01 for Order EA-12-049) is acceptable. Indications required for Containment

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

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

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

The BFNP OIP provides a description of HCVS monitoring and control that appears to be consistent with the guidance found in NEI 13-02, endorsed, in part, by JLD-ISG-2013-02 as an acceptable means for implementing applicable requirements of Order EA-13-109. Specific details not available at this time include: descriptions of all instrumentation and controls (existing and planned) including qualification methods, evaluations of the environmental and radiological effects on HCVS controls and indications, and an evaluation of environmental and radiological conditions to ensure that operating personnel can safely access and operate controls and support equipment; therefore, the staff has not completed its review.

Open Item: Make available for NRC staff audit descriptions of all instrumentation and controls (existing and planned) necessary to implement this order including qualification methods.

Open Item: Make available for NRC staff audit the descriptions of local conditions (temperature, radiation and humidity) anticipated during ELAP and severe accident for the components (valves, instrumentation, sensors, transmitters, indicators, electronics, control devices, and etc.) required for HCVS venting including confirmation that the components are capable of performing their functions during ELAP and severe accident conditions.

Open Item: Make available for NRC staff audit an evaluation of temperature and radiological conditions to ensure that operating personnel can safely access and operate controls and support equipment.

3.2.2.11 Component Reliable and Rugged Performance

Order EA-13-109, Section 2.2, states that:

> 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.

Page 25 of the OIP states the following:

> The HCVS downstream of the second containment isolation valve, including piping and supports, electrical power supply, valve actuator pneumatic supply, and instrumentation (local and remote) components, will be designed/analyzed to conform to the requirements consistent with the applicable design codes (e.g., Non-safety, Cat 1, SS and 300# ASME or B31.1, NEMA 4, etc.) for the plant and to ensure functionality following a design basis earthquake.
>
> Additional modifications required to meet the Order will be reliably functional at the temperature, pressure, and radiation levels consistent with the vent pipe conditions for sustained operations. The instrumentation/power supplies/cables/connections (components) will be qualified for temperature, pressure, radiation level, total integrated dose radiation for the Effluent Vent Pipe and HCVS ROS Location.
>
> Conduit design will be installed to Seismic Class 1 criteria. Both existing and new barriers will be used to provide a level of protection from missiles when equipment is located outside of seismically qualified structures. Augmented quality requirements, will be applied to the components installed in response to this Order.
>
> If the instruments are purchased as commercial-grade equipment, they will be qualified to operate under severe accident environment as required by NRC Order EA-13-109 and the guidance of NEI 13-02. The equipment will be qualified seismically (IEEE 344), environmentally (IEEE 323), and EMC (per RG 1.180). These qualifications will be bounding conditions for BFNP.
>
> For the instruments required after a potential seismic event, the following methods will be used to verify that the design and installation is reliable / rugged

and thus capable of ensuring HCVS functionality following a seismic event. Applicable instruments are rated by the manufacturer (or otherwise tested) for seismic impact at levels commensurate with those of postulated severe accident event conditions in the area of instrument component use using one or more of the following methods:

1. demonstration of seismic motion will be consistent with that of existing design basis loads at the installed location;
2. substantial history of operational reliability in environments with significant vibration with a design envelope inclusive of the effects of seismic motion imparted to the instruments proposed at the location;
3. adequacy of seismic design and installation is demonstrated based on the guidance in Sections 7, 8, 9, and 10 of IEEE Standard 344-2004, *IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations*, (Reference 27) or a substantially similar industrial standard;
4. demonstration that proposed devices are substantially similar in design to models that have been previously tested for seismic effects in excess of the plant design basis at the location where the instrument is to be installed (g-levels and frequency ranges); or
5. seismic qualification using seismic motion consistent with that of existing design basis loading at the installation location.

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

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

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

The BFNP OIP provides descriptions for component reliable and rugged performance that appear to be consistent with the guidance found in NEI 13-02, endorsed, in part, by JLD-ISG-2013-02 as an acceptable means for implementing applicable requirements of Order EA-13-109.

3.2.3 Beyond Design Basis External Event Venting

3.2.3.1 First 24-Hour Coping

Order EA-13-109, Section 1.2.6, states that:

> 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.

Page 27 of the OIP states the following:

> The operation of the HCVS will be designed to minimize the reliance on operator actions for response to a ELAP and BDBEE hazards identified in Part 1 of this OIP. Immediate operator actions can be completed by Operators from the HCVS control station(s) and include remote-manual initiation. The operator actions required to open a vent path are as described in table 2-1 [of the OIP].
>
> Remote-manual is defined in this report as a non-automatic power operation of a component and does not require the operator to be at or in close proximity to the component. No other operator actions are required to initiate venting under the guiding procedural protocol.
>
> The HCVS will be designed to allow initiation, control, and monitoring of venting from the Main Control Room and will be able to be operated from an installed Remote Operating Station. This location minimizes plant operators' exposure to adverse temperature and radiological conditions and is protected from hazards assumed in Part 1 of this report [the OIP].
>
> Permanently installed power and motive air/gas capability will be available to support operation and monitoring of the HCVS for 24 hours. Permanently installed equipment will supply air and power to HCVS for 24 hours.
>
> System control:
>
> i. Active: PCIVs are operated in accordance with EOPs/SOPs to control containment pressure. The HCVS will be designed for approximately 200 open/close cycles under ELAP conditions over the first 24 hours following an ELAP. Controlled venting will be permitted in the revised EPGs and associated implementing EOPs. Controlled venting will be permitted in the revised EPG's to open, close or throttle vent flow. The strategy is to allow venting of the wetwell and control the flow to maintain sufficient NPSH for the RCIC pump. Jumpers will be used to override the containment isolation circuit on the PCIVs needed to vent containment.

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

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

The BFNP OIP describes a first 24 hour BDBEE coping strategy that appears to be in accordance with the guidance found in NEI 13-02, endorsed, in part, by JLD-ISG-2013-02 as an acceptable means for implementing applicable requirements of Order EA-13-109. Specific details not available at this time include: the final sizing evaluation for HCVS batteries/battery charger including incorporation into FLEX DG loading calculation, and the final nitrogen pneumatic system design including sizing and location; therefore, the staff has not completed its review.

Open Item: Make available for NRC staff audit the final sizing evaluation for HCVS batteries/battery charger including incorporation into FLEX DG loading calculation.

Open Item: Make available for NRC staff audit documentation of the HCVS nitrogen pneumatic system design including sizing and location.

3.2.3.2 Greater Than 24-Hour Coping

Order EA-13-109, Section 1.2.4, states that:

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.

Page 28 of the OIP states the following:

After approximately 24 hours, available personnel will be able to connect supplemental motive air/gas to the HCVS. Connections for supplementing electrical power and motive air/gas required for HCVS will be located in accessible areas with reasonable protection per NEI 12-06 that minimize personnel exposure to adverse conditions for HCVS initiation and operation. Connections will be pre-engineered quick disconnects to minimize manpower resources. Sufficient nitrogen bottles will be staged to support operations for up to 24 hours following the ELAP event. BFNP will credit FLEX to sustain power for a BDBEE ELAP.

[OPEN ITEM 3 (of the OIP)] Perform an evaluation for FLEX portable generator and nitrogen cylinders use past 24 hour actions.

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

The BFNP OIP describes a greater than 24 hour BDBEE coping strategy, that appears to be in accordance with the guidance found in NEI 13-02, endorsed, in part, by JLD-ISG-2013-02 as an acceptable means for implementing applicable requirements of Order EA-13-109. Design details not available at this time include: the final sizing evaluation for HCVS batteries/battery charger including incorporation into FLEX DG loading calculation, and the final nitrogen pneumatic system design including sizing and location; therefore, the staff has not completed its review.

Open Item: Make available for NRC staff audit the final sizing evaluation for HCVS batteries/battery charger including incorporation into FLEX DG loading calculation.

Open Item: Make available for NRC staff audit documentation of the HCVS nitrogen pneumatic system design including sizing and location.

3.2.4 Severe Accident Event Venting

3.2.4.1 First 24 Hour Coping

Order EA-13-109, Section 1.2.6, states that:

> 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.

Page 31 of the OIP states the following:

> The operation of the HCVS will be designed to minimize the reliance on operator actions for response to an ELAP and severe accident events. Severe accident event assumes that specific core cooling actions from the FLEX strategies identified in the response to Order EA-12-049 were not successfully initiated. Access to the reactor building will be restricted as determined by the RPV water level and core damage conditions. Immediate actions will be completed by Operators in the Main Control Room (MCR) or at the HCVS Remote Operating Station (ROS) and will include remote-manual actions from a local gas cylinder station. The operator actions required to open a vent path were previously listed in the BDBEE Venting Part 2 section of this report [the OIP] (Table 2-1).
>
> Permanently installed power and motive air/gas capable will be available to support operation and monitoring of the HCVS for 24 hours. Specifics are the same as for BDBEE Venting Part 2.

System control:

i. Active: Same as for BDBEE Venting Part 2.
ii. Passive: Same as for BDBEE Venting Part 2, with no exceptions.

The BFNP OIP describes greater than 24 hour severe accident coping strategy that appears to be in accordance with the guidance found in NEI 13-02, endorsed, in part, by JLD-ISG-2013-02 as an acceptable means for implementing applicable requirements of Order EA-13-109. Specific details not available at this time include: the final sizing evaluation for HCVS batteries/battery charger including incorporation into FLEX DG loading calculation, the final nitrogen pneumatic system design including sizing and location, and an evaluation of environmental and radiological conditions to ensure that operating personnel can safely access and operate controls and support equipment; therefore, the staff has not completed its review.

Open Item: Make available for NRC staff audit the final sizing evaluation for HCVS batteries/battery charger including incorporation into FLEX DG loading calculation.

Open Item: Make available for NRC staff audit documentation of the HCVS nitrogen pneumatic system design including sizing and location.

Open Item: Make available for NRC staff audit an evaluation of temperature and radiological conditions to ensure that operating personnel can safely access and operate controls and support equipment.

3.2.4.2 Greater Than 24 Hour Coping

Order EA-13-109, Section 1.2.4 and 1.2.8, states that:

> 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.
>
> 1.2.8 The HCVS shall include 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.

As described on page 31 of the OIP:

> Specifics are the same as for BDBEE Venting Part 2 except the location and refueling actions for the FLEX PG and replacement Nitrogen Bottles will be evaluated for SA environmental conditions resulting from the proposed damaged Reactor Core and resultant HCVS vent pathway.
>
> [OPEN ITEM 5]: Perform an evaluation for FLEX PG [portable generators] use for post 24 hour actions.

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

The BFNP OIP describes greater than 24 hour severe accident coping strategy that appears to be in accordance with the guidance found in NEI 13-02, endorsed, in part, by JLD-ISG-2013-02 as an acceptable means for implementing applicable requirements of Order EA-13-109. Specific details not available at this time include: the final sizing evaluation for HCVS batteries/battery charger including incorporation into FLEX DG loading calculation, the final nitrogen pneumatic system design including sizing and location, and an evaluation of environmental and radiological conditions to ensure that operating personnel can safely access and operate controls and support equipment; therefore, the staff has not completed its review.

Open Item: Make available for NRC staff audit the final sizing evaluation for HCVS batteries/battery charger including incorporation into FLEX DG loading calculation.

Open Item: Make available for NRC staff audit documentation of the HCVS nitrogen pneumatic system design including sizing and location.

Open Item: Make available for NRC staff audit an evaluation of temperature and radiological conditions to ensure that operating personnel can safely access and operate controls and support equipment.

3.2.5 Support Equipment Functions

3.2.5.1 BDBEE

Order EA-13-109, Sections 1.2.8 and 1.2.9, state that:

> 1.2.8 The HCVS shall include 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.
>
> 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.

Page 33 of the OIP states the following:

> Containment integrity is initially maintained by permanently installed equipment. All containment venting functions will be performed from the MCR or ROS.

> Venting will require support from DC power as well as instrument air systems as detailed in the response to Order EA-12-049. Existing safety related Unit batteries will provide sufficient electrical power for HCVS operation for greater than 8 hours. Before Unit batteries are depleted, FLEX portable generators, as detailed in the response to Order EA-12-049, will be credited to charge the station batteries and maintain DC bus voltage after 8 hours. Newly installed accumulator tanks with back-up portable N2 bottles will provide sufficient motive force for all HCVS valve operation and will provide for multiple operations of the HCVS CIV's vent valve.

The BFNP OIP describes BDBEE supporting equipment functions that appear to be in accordance with the guidance found in NEI 13-02, endorsed, in part, by JLD-ISG-2013-02 as an acceptable means for implementing applicable requirements of Order EA-13-109. Specific details not available at this time include: the final sizing evaluation for HCVS batteries/battery charger including incorporation into FLEX DG loading calculation, and the final nitrogen pneumatic system design including sizing and location; therefore, the staff has not completed its review.

Open Item: Make available for NRC staff audit the final sizing evaluation for HCVS batteries/battery charger including incorporation into FLEX DG loading calculation.

Open Item: Make available for NRC staff audit documentation of the HCVS nitrogen pneumatic system design including sizing and location.

3.2.5.2 Severe Accident Venting

Order EA-13-109, Sections 1.2.8 and 1.2.9, state that:

> 1.2.8 The HCVS shall include 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.
>
> 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.

Page 33 of the OIP states the following:

> The same support functions that are used in the BDBEE scenario would be used for severe accident venting. To ensure power for 24 hours, a set of dedicated HCVS batteries will be available to feed HCVS loads via a manual transfer switch. At 24 hours, power will be will be backed up by FLEX generators supplying power to the Unit Battery chargers for a severe accident HCVS capability.

> Nitrogen bottles that will be located in the Diesel Generator building(s) in the immediate area of the ROS will be available to tie-in supplemental pneumatic sources.

The BFNP OIP describes support equipment functions for severe accident venting that appear to be in accordance with the guidance found in NEI 13-02, endorsed, in part, by JLD-ISG-2013-02 as an acceptable means for implementing applicable requirements of Order EA-13-109. Specific details not available at this time include: the final sizing evaluation for HCVS batteries/battery charger including incorporation into FLEX DG loading calculation, the final nitrogen pneumatic system design including sizing and location, and an evaluation of environmental and radiological conditions to ensure that operating personnel can safely access and operate controls and support equipment (licensee identified); therefore, the staff has not completed its review.

Open Item: Make available for NRC staff audit the final sizing evaluation for HCVS batteries/battery charger including incorporation into FLEX DG loading calculation.

Open Item: Make available for NRC staff audit documentation of the HCVS nitrogen pneumatic system design including sizing and location.

Open Item: Make available for NRC staff audit an evaluation of temperature and radiological conditions to ensure that operating personnel can safely access and operate controls and support equipment.

3.2.6 Venting Portable Equipment Deployment

Order EA-13-109, Section 3.1, states that:

> 3.1 The licensee 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.

Page 35 of the OIP states the following:

> Deployment pathways for compliance with Order EA-12-049 are acceptable without further evaluation needed except in areas around the Reactor Building or in the vicinity of the HCVS piping. Deployment in the areas around the Reactor Building or in the vicinity of the HCVS piping will allow access, operation and replenishment of consumables with the consideration that there is potential Reactor Core Damage and HCVS operation.

The BFNP OIP describes venting portable equipment deployment functions that appear to be in accordance with the guidance found in NEI 13-02, endorsed, in part, by JLD-ISG-2013-02 as an acceptable means for implementing applicable requirements of Order EA-13-109. Specific details not available at this time include: the final sizing evaluation for HCVS batteries/battery charger including incorporation into FLEX DG loading calculation, the final nitrogen pneumatic system design including sizing and location, and an evaluation of environmental and radiological conditions to ensure that operating personnel can safely access and operate controls and support equipment; therefore, the staff has not completed its review.

Open Item: Make available for NRC staff audit the final sizing evaluation for HCVS batteries/battery charger including incorporation into FLEX DG loading calculation.

Open Item: Make available for NRC staff audit documentation of the HCVS nitrogen pneumatic system design including sizing and location.

Open Item: Provide documentation of an assessment of temperature and radiological conditions to ensure that operating personnel can safely access and operate controls and support equipment.

Summary, Section 3.2:

The licensee's approach to Boundary Conditions for Wetwell Vent, if implemented as described in Section 3.2, and assuming acceptable resolution of any open items identified here or as a result of licensee alterations to their proposed plans, appears to be consistent with the guidance found in NEI 13-02, endorsed, in part, by JLD-ISG-2013-02 as an acceptable means for implementing applicable requirements of Order EA-13-109.

3.3 BOUNDARY CONDITIONS FOR DRYWELL VENT

Summary, Section 3.3:

Dry Well Vent will be evaluated during Phase 2 of Order EA-13-109. The ISG for Phase 2 will be provided by April 30, 2015. Licensees will submit an updated OIP to address Phase 2 of Order EA-13-109 by December 31, 2015.

3.4 PROGRAMMTIC CONTROLS, TRAINING, DRILLS AND MAINTENANCE

3.4.1 Programmatic Controls

Order EA-13-109, Sections 3.1 and 3.2, state that:

> 3.1 The licensee 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.
>
> 3.2 The 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.

Page 38 of the OIP states the following:

Program Controls

The HCVS venting actions will include:

- Site procedures and programs are being developed in accordance with NEI 13-02 to address use and storage of portable equipment relative to the Severe Accident defined in NRC Order EA-13-109 and the hazards applicable to the site per Part 1 of this OIP.

- Routes for transporting portable equipment from storage location(s) to deployment areas will be developed as the response details are identified and finalized. The identified paths and deployment areas will be accessible during all modes of operation and during Severe Accidents.

Procedures:

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

The HCVS procedures will be developed and implemented following the plants process for initiating or revising procedures and contain the following details:

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

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

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

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

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

- If for up to 30 days, the primary and alternate means of HCVS operation are non-functional, no compensatory actions are necessary.
- If the out of service times exceed 30 or 90 days as described above, the following actions will be performed:
  - The condition will entered into the corrective action system,
  - The HCVS functionality will be restored in a manner consistent with plant procedures,
  - A cause assessment will be performed to prevent future loss of function for similar causes.
  - Initiate action to implement appropriate compensatory actions

The BFNP OIP describes programmatic controls that appear to be consistent with the guidance found in NEI 13-02, endorsed, in part, by JLD-ISG-2013-02 as an acceptable means for implementing applicable requirements of Order EA-13-109. NRC staff determined that procedure development appears to be in accordance with existing industry protocols. The provisions for out-of-service requirements appear to reflect consideration of the probability of an ELAP requiring severe accident venting and the consequences of a failure to vent under such conditions. The licensee has identified an open item to revise a plant procedure to include venting for a loss of dc power.

Open Item: Make available for NRC audit documentation that procedure 1/2/3-EOI Appendix 13 to has been revised to include venting for loss of dc power.

3.4.2 Training

Order EA-13-109, Section 3.2, states that:

> 3.2 The 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.

Page 39 of the OIP states the following:

> Personnel expected to perform direct execution of the HVCS will receive necessary training in the use of plant procedures for system operations when normal and backup power is available and during ELAP conditions. The training will be refreshed on a periodic basis and as any changes occur to the HCVS. Training content and frequency will be established using the Systematic Approach to Training (SAT) process.
>
> In addition, (reference NEI 12-06) all personnel on-site will be available to supplement trained personnel [applies only to FLEX].

The BFNP OIP describes HCVS training requirements that appear to be in accordance with the guidance found in NEI 13-02, endorsed, in part, by JLD-ISG-2013-02 as an acceptable means for implementing applicable requirements of Order EA-13-109. The systematic approach to training process has been accepted by the NRC as appropriate for developing training for nuclear plant personnel.

3.4.3 Drills

Order EA-13-109, Section 3.1, states that:

> 3.1 The licensee 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.

Page 39 of OIP states the following:

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

The BFNP OIP describes an approach to drills that appear to be in accordance with NEI 13-06, "Enhancements to Emergency Response Capabilities for Beyond Design Basis Accidents" and Events and NEI 14-01, "Emergency Response Procedures and Guidelines for Extreme Events and Severe Accidents." This approach appears to be in accordance with the guidance found in NEI 13-02, endorsed, in part, by JLD-ISG-2013-02 as an acceptable means for implementing applicable requirements of Order EA-13-109.

3.4.4 Maintenance

Order EA-13-109, Section 1.2.13, states that:

> 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.

Page 40 of the OIP states the following:

> The site will utilize the standard EPRI [Electric Power Research Institute] industry PM process (similar to the Preventive Maintenance Basis Database) for establishing the maintenance calibration and testing actions for HCVS components. The control program will include maintenance guidance, testing procedures and frequencies established based on type of equipment and considerations made within the EPRI guidelines.
>
> BFNP will implement the following operation, testing and inspection requirements for the HCVS to ensure reliable operation of the system.

Table 4-1: Testing and Inspection Requirements

Description	Frequency
Cycle the HCVS valves and the interfacing system valves not used to maintain containment integrity during operations.	Once per operating cycle
Perform visual inspections and a walk down of HCVS components.	Once per operating cycle
Test and calibrate the HCVS radiation monitors.	Once per operating cycle
Leak test the HCVS.	(1) Prior to first declaring the system functional; (2) Once every three operating cycles thereafter; and (3) After restoration of any breach of system boundary within the buildings
Validate the HCVS operating procedures by conducting an open/close test of the HCVS control logic from its control panel and ensuring that all interfacing system valves move to their proper (intended) positions.	Once per every other operating cycle

The BFNP OIP describes an approach to maintenance that appears to be in accordance with the guidance found in NEI 13-02, endorsed, in part, by JLD-ISG-2013-02 as an acceptable means for implementing applicable requirements of Order EA-13-109.

<u>Summary, Section 3.4:</u>

The licensee's approach to Programmatic Controls Training, Drills and Maintenance, if implemented as described in Section 3.4, and assuming acceptable resolution of any open items identified here or as a result of licensee alterations to their proposed plans, appears to be consistent with the guidance found in NEI 13-02, endorsed, in part, by JLD-ISG-2013-02 as an acceptable means for implementing applicable requirements of Order EA-13-109.

4.0 OPEN ITEMS

This section contains a summary of the open items identified to date as part of the technical evaluation. Open items, whether NRC or licensee identified, are topics for which there is insufficient information to fully resolve the issue, for which the NRC staff requires clarification to ensure the issue is on a path to resolution, or for which the actions to resolve the issue are not yet complete. The intent behind designating an issue as an open item is to highlight items that the staff intends to review further. The NRC staff has reviewed the licensee OIP for consistency with NRC policy and technical accuracy. NRC and licensee identified open items have been identified in Section 3.0 and are listed in the table below.

List of Open items

Open Item	Action	Comment
1.	Make available for NRC staff audit an evaluation of temperature and radiological conditions to ensure that operating personnel can safely access and operate controls and support equipment.	Section 3.2.1 Section 3.2.2.3 Section 3.2.2.4 Section 3.2.2.5 Section 3.2.2.10 Section 3.2.4.1 Section 3.2.4.2 Section 3.2.5.2 Section 3.2.6
2.	Make available for NRC audit documentation that procedure 1/2/3-EOI Appendix 13 to has been revised to include venting for loss of dc power.	Section 3.4.1
3.	Make available for NRC staff audit documentation demonstrating that all load sheds will be accomplished within one hour of event initiation and will occur in an area not impacted by a possible radiological event.	Section 3.1.2
4.	Make available for NRC staff audit documentation that demonstrates that operating units that have not implemented the order will be able to vent through the existing vent system unaffected by the implementation of HCVS on other units.	Section 3.1.2
5.	Make available for NRC staff audit analyses demonstrating that HCVS has the capacity to vent the steam/energy equivalent of one percent of licensed/rated thermal power (unless a lower value is justified), and that the suppression pool and the HCVS together are able to absorb and reject decay heat, such that following a reactor shutdown from full power containment pressure is restored and then maintained below the primary containment design pressure and the primary containment pressure limit.	Section 3.2.2.1 Section 3.2.2.2
6.	Make available for NRC staff audit documentation that demonstrates adequate communication between the remote HCVS operation locations and HCVS decision makers during ELAP and severe accident conditions.	Section 3.2.2.5
7.	Make available for NRC staff audit documentation of an evaluation verifying the existing containment isolation valves, relied upon for the HCVS, will open under the maximum expected differential pressure during BDBEE and severe accident wetwell venting.	Section 3.2.2.9
8.	Make available for NRC staff audit documentation of a seismic qualification evaluation of HCVS components.	Section 3.2.2.9
9.	Make available for NRC staff audit descriptions of all instrumentation and controls (existing and planned) necessary to implement this order including qualification methods.	Section 3.2.2.10

10.	Make available for NRC staff audit the descriptions of local conditions (temperature, radiation and humidity) anticipated during ELAP and severe accident for the components (valves, instrumentation, sensors, transmitters, indicators, electronics, control devices, and etc.) required for HCVS venting including confirmation that the components are capable of performing their functions during ELAP and severe accident conditions.	Section 3.2.2.3 Section 3.2.2.5 Section 3.2.2.9 Section 3.2.2.10
11.	Make available for NRC staff audit the final sizing evaluation for HCVS batteries/battery charger including incorporation into FLEX DG loading calculation.	Section 3.2.2.4 Section 3.2.3.1 Section 3.2.3.2 Section 3.2.4.1 Section 3.2.4.2 Section 3.2.5.1 Section 3.2.5.2
12.	Make available for NRC staff audit documentation of the HCVS nitrogen pneumatic system design including sizing and location.	Section 3.2.2.4 Section 3.2.3.1 Section 3.2.3.2 Section 3.2.4.1 Section 3.2.4.2 Section 3.2.5.1 Section 3.2.5.2
13.	Make available for NRC staff audit the seismic and tornado missile final design criteria for the HCVS stack.	Section 3.2.2.3
14.	Provide a description of the final design of the HCVS to address hydrogen detonation and deflagration.	Section 3.2.2.6
15.	Provide a description of the strategies for hydrogen control that minimizes the potential for hydrogen gas migration and ingress into the reactor building or other buildings.	Section 3.2.2.6
16.	Provide design details that minimize unintended cross flow of vented fluids within a unit and between units on the site.	Section 3.2.2.7

5.0 SUMMARY

As required by Order EA-13-109, the licensee has provided an OIP for designing and installing Phase 1 of a severe accident capable HCVS that provides venting capability from the wetwell during severe accident conditions, using a vent path from the containment wetwell to remove decay heat, vent the containment atmosphere (including steam, hydrogen, carbon monoxide, non-condensable gases, aerosols, and fission products), and control containment pressure within acceptable limits. The OIP describes a HCVS wetwell vent designed for those accident conditions (before and after core damage) 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 or ELAP.

The NRC staff finds that the licensee's OIP for Phase 1 of Order EA-13-109 describes: plan elements and assumptions; boundary conditions; provisions for programmatic controls, training, drills and maintenance; and an implementation schedule that appear consistent with the guidance found in NEI 13-02 endorsed, in part, by JLD-ISG-2013-02 as an acceptable means for implementing Phase 1 requirements of Order EA-13-109, subject to acceptable closure of the above open items.

6.0 REFERENCES

1. Order EA-13-109, "Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions," June 6, 2013 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML13143A321).

2. Letter from TVA to NRC, TVA's Overall Integrated Plan for BFNP in Response to June 6, 2013 Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions Phase 1 (Order EA-13-109)," dated June 30, 2014 (ADAMS Accession No. ML14181B169).

3. SECY-11-0093, Near-Term Report and Recommendations for Agency Actions Following the Events in Japan", (ADAMS Accession No. ML111861807).

4. SRM-SECY-11-0124, "Recommended Actions to be taken Without Delay From The Near-Term Task Force Report", (ADAMS Accession No. ML112911571).

5. SRM-SECY-11-0137, "Prioritization of Recommended Actions to be Taken in Response to Fukushima Lessons Learned", (ADAMS Accession No. ML113490055).

6. SRM-SECY-11-0093, "Staff Requirements – SECY-11-0093 – Near-Term Report and Recommendations for Agency Actions following the Events in Japan," August 19, 2011 (ADAMS Accession No. ML112310021).

7. SECY-12-0025, "Proposed Orders and Requests for Information in Response to Lessons Learned from Japan's March 11, 2011, Great Tohoku Earthquake and Tsunami," February 17, 2012 (ADAMS Accession No. ML12039A103).

8. SRM-SECY-12-0025, "Staff Requirements – SECY-12-0025 - Proposed Orders and Requests for Information in Response to Lessons Learned from Japan's March 11, 2011, Great Tohoku Earthquake and Tsunami," March 9, 2012 (ADAMS Accession No. ML120690347).

9. Order EA-12-050, "Order Modifying Licenses with Regard to Reliable Hardened Containment Vents," March 9, 2012 (ADAMS Accession No. ML12054A694).

10. SECY-12-0157, "Consideration of Additional Requirements for Containment Venting Systems for Boiling Water Reactors with Mark I and Mark II Containments," November 26, 2012 (ADAMS Accession No. ML12325A704).

11. SRM-SECY-12-0157, "Staff Requirements - SECY-12-0157, "Consideration Of Additional Requirements For Containment Venting Systems For Boiling Water Reactors With Mark I And Mark II Containments", March 19, 2013 (ADAMS Accession No. ML13078A017).

12. NEI 13-02, "Industry Guidance for Compliance with Order EA-13-109," Revision 0, November 12, 2013 (ADAMS Accession No. ML13316A853).

13. JLD-ISG-2013-02, "Compliance with Order EA-13-109, 'Severe Accident Reliable Hardened Containment Vents,'" November 14, 2013 (ADAMS Accession No. ML13304B836).

14. Nuclear Regulatory Commission Audits Of Licensee Responses To Phase 1 of Order EA-13-109 to Modify Licenses With Regard To Reliable Hardened Containment Vents Capable Of Operation Under Severe Accident Conditions (ADAMS Accession No. ML14126A545).

15. "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events" (ADAMS Accession No. ML12054A736).

16. Browns Ferry Nuclear Plant, Units 1, 2, & 3, Interim Staff Evaluation Relating to Overall Integrated Plan in Response to Order EA-12-049 (Mitigation Strategies) (TAC Nos. MF0902, MF0903, and MF0904 (ADAMS Accession No. ML13225A541).

17. Browns Ferry - Overall Integrated Plan in Response to the March 12, 2012, Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (EA-12-049) (ADAMS Accession No. ML13064A465.

18. NUREG-1935, State-of-the-Art Reactor Consequence Analyses (SOARCA) Report (ADAMS Accession No. ML12332A058).

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Sincerely,

/RA/

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Docket Nos. 50-259, 50-260 and 50-296

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