



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

April 1, 2015

Mr. Bryan C. Hanson  
President and Chief Nuclear Officer  
Exelon Generation Company, LLC  
4300 Winfield Rd.  
Warrenville, IL 60555

SUBJECT: QUAD CITIES NUCLEAR POWER STATION, UNITS 1 AND 2 - INTERIM  
STAFF EVALUATION RELATING TO OVERALL INTEGRATED PLAN IN  
RESPONSE TO PHASE ONE OF ORDER EA-13-109 (SEVERE ACCIDENT  
CAPABLE HARDENED VENTS) (TAC NOS. MF4460 AND MF4461)

Dear Mr. Hanson:

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. ML14184A017), Exelon Generation Company, LLC. (Exelon) submitted its Overall Integrated Plan (OIP) for Quad Cities Nuclear Power Station, Units 1 and 2 (Quad Cities) in response to Order EA-13-109. By letter dated December 17, 2014 (ADAMS Accession No. ML14351A433), Exelon submitted its first six-month status report for Quad Cities in response to Order EA-13-109. Any changes to the compliance method described in the OIP will be reviewed as part of the ongoing audit process.

Exelon's OIP for Quad Cities appears consistent with the guidance found in Nuclear Energy Institute (NEI) 13-02, Revision 0, 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. This evaluation only addressed consistency with the guidance. Any plant modifications will need to be conducted in accordance with plant engineering change processes and consistent with the licensing basis.

B. Hanson

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If you have any questions, please contact Charles Norton, Project Manager, at 301-415-7818 or at [Charles.Norton@nrc.gov](mailto:Charles.Norton@nrc.gov).

Sincerely,

A handwritten signature in black ink that reads "Mandy K Halter". The signature is written in a cursive style with a large, looped initial "M".

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

Docket Nos. 50-254 and 50-265

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  
EXELON GENERATION COMPANY, LLC  
QUAD CITIES NUCLEAR POWER STATION, UNITS 1 AND 2  
DOCKET NOS. 50-254 AND 50-265

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 (WW) during severe accident 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.<sup>1</sup>

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

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<sup>1</sup> 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 ISE at a later date.

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 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], Exelon Generation Company, LLC (Exelon, the licensee) provided the OIP for Quad Cities Nuclear Power Station, Units 1 and 2 (Quad Cities) for compliance with Phase 1 of Order EA-13-109. By letter dated December 17, 2014, Exelon submitted its first six-month update to the OIP (ADAMS Accession No. ML14351A433). The OIP, as updated, 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 of 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, "Recommendations for Enhancing Reactor Safety in the 21<sup>st</sup> Century – The Near-Term Task Force Review of Insights From the Fukushima Dai-Ichi Accident," 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) for SECY-11-0124, "Staff Requirements - SECY-11-0124 - Recommended Actions to be Taken Without Delay From The Near-Term Task Force Report," dated September 9, 2011 [Reference 4], and SRM-SECY-11-0137, "Staff Requirements - 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 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. SRM-SECY-11-0124 and SRM-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, "Issuance of Order to Modify Licenses with Regard to Reliable Hardened Containment Vents" [Reference 9], which required 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 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

Quad Cities is a two unit General Electric BWR site. Both units have Mark I primary containment systems. To implement phase 1 of Order EA-13-109 on each unit, Exelon intends to tee a dedicated HCVS line off the containment ventilation exhaust header downstream of the inboard drywell and wetwell primary containment isolation valves (PCIVs) and upstream of the common outboard PCIV. The HCVS line will have an outboard PCIV and a secondary containment isolation valve and be routed to a discharge point above the reactor building roof. The HCVS on each unit will be completely independent from the HCVS on the other unit. The OIP describes plant modifications, strategies and guidance under development for HCVS implementation.

#### 3.1 GENERAL INTEGRATED PLAN ELEMENTS AND ASSUMPTIONS

##### 3.1.1 Evaluation of Extreme External Hazards

Extreme external hazards for Quad Cities were evaluated in the Quad Cities OIP in response to Order EA 12-049 (Mitigation Strategies) [Reference 15]. In the Quad Cities ISE relating to Mitigation Strategies [Reference 16], NRC staff documented an analysis of Exelon's extreme external hazards evaluation. The following extreme external hazards screened in: Seismic, External Flooding, Extreme Cold, High Wind, and Extreme High Temperature. No extreme external hazards screened out. Based on Exelon not excluding any external hazard from consideration, the NRC staff determined that Exelon appears to have identified the appropriate external hazards for consideration in the design of HCVS.

##### 3.1.2 Assumptions

On page 5 of the OIP, Exelon adopted a set of generic assumptions associated with Order EA-13-109 Phase 1 actions.

The NRC staff reviewed the Quad Cities plant-specific HCVS related assumptions stated below:

- |               |  |
|---------------|--|
| Quad Cities 1 | EA-12-049 (FLEX) actions to restore power are sufficient to ensure continuous operation of non-dedicated containment instrumentation.  |
| Quad Cities 2 | Although Quad Cities screens in for the Combined Maximum River Flood, HCVS will not be required due to the Station's response to this event. The Station will have advance warning of the River Flood, and will be in cold shutdown via normal procedures, with the two Reactor Vessels disassembled and flooded up to the refueling cavity and combined with the Spent Fuel Pool, prior to water going above plant grade. Therefore, since Primary Containment will no longer be intact during this event, the HCVS will not be required. |

The NRC staff determined that the plant specific assumptions for Quad Cities do not appear to deviate from the guidance found in NEI 13-02, endorsed, in part, by JLD-ISG-2013-02 as an acceptable method to implement the requirements of Order EA-13-109. Concerning assumption Quad Cities 1, in the OIP the licensee identified an open item to confirm actions to restore power are sufficient to ensure continuous operation of non-dedicated containment instrumentation. In its first OIP six-month status report for Quad Cities, the licensee reported that calculation QDC-8300-E-2100 confirms the actions are sufficient to ensure continuous operation of non-dedicated containment equipment. Calculation QDC-8300-E-2100 has not been made available at this time; therefore the NRC staff has not completed its review.

Open Item: Make available for NRC staff audit the calculation (QDC-8300-E-2100) that confirms that Order EA-12-049 actions to restore power are sufficient to ensure continuous operation of non-dedicated containment instrumentation.

### 3.1.3 Compliance Timeline and Deviations

Page 4 of the OIP states the following:

Compliance will be attained for Quad Cities with no known deviations to the guidelines in JLD-ISG-2013-02 and NEI 13-02 for each phase as follows:

- Unit 1 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 1<sup>st</sup> Qtr 2017.
- Unit 2 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 2<sup>nd</sup> Qtr 2018.
- Unit 2 Phase 2 (drywell): by the startup from the first refueling outage that begins after June 30, 2017, or June 30, 2019, whichever comes first. Currently scheduled for 2<sup>nd</sup> Qtr 2018.
- Unit 1 Phase 2: (drywell): by the startup from the first refueling outage that begins after June 30, 2017, or June 30, 2019, whichever comes first. Currently scheduled for 1<sup>st</sup> Qtr 2019.

If deviations are identified at a later date, then the deviations will be communicated in a future 6 month update following identification.

The Quad Cities implementation schedule for Phase 1 and Phase 2 of Order EA-13-109 appears to comply with the requirements of the order without deviation. Regarding other deviations, neither Exelon nor the NRC staff have identified any at this time. Therefore, the NRC staff concludes that it appears Quad Cities will attain compliance with no known deviations from the guidance found in NEI 13-02, endorsed, in part, by JLD-ISG-2013-02 as an acceptable method for implementing Order EA-13-109.

Summary, Section 3.1:

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 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 integrated plan states the following:

The containment vent exhaust at each Quad Cities unit consists of a WW primary containment isolation valve (PCIV), a Drywell (DW) PCIV, and common downstream PCIVs. The HCVS flow path will utilize portions of this system. The HCVS will connect upstream of the existing downstream PCIVs. Consequently, the HCVS flow path will share the upstream PCIVs with the containment vent system, but it will have a downstream PCIV dedicated to the HCVS flow path. The new HCVS flow path will have a dedicated secondary containment isolation valve (SCIV), which will also supply HCVS flow control. Each unit will have piping that is totally separate from the other unit and with no interconnected systems downstream of the new downstream PCIV. The piping from each unit is routed separately and discharges above the Reactor Building roof.

Each unit will have dedicated motive power (Pressurized N<sub>2</sub>/air) for HCVS valves and dedicated DC power for HCVS components that are not shared with any other function and do not rely on FLEX, with the clarification that existing containment instrumentation (pressure and WW level) are not considered HCVS components and power will be maintained through the actions for EA-12-049.

The operation of the HCVS will be designed to minimize the reliance on operator actions in response to hazards listed in Part 1. Immediate operator actions will be completed by plant personnel and will include the capability for remote-manual initiation from the HCVS control station. A list of the remote manual



actions performed by plant personnel to open the HCVS vent path can be found in the following table (2-1 [in 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].

The NRC staff reviewed the Remote Manual Actions (Table 2-1 of the OIP) and concluded that these actions appear to minimize the reliance on operator actions. The actions appear consistent with the types of actions described in 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 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 all ac power, long-term loss of batteries, long-term loss of normal pneumatic supply, and solenoid operated valve failure. In the OIP, the licensee identified an open item to determine how HCVS dc power and/or motive power will be disabled during normal operation to provide assurances against inadvertent operation, but to also minimize actions to enable HCVS operation during an ELAP. In the first six-month status report dated December 17, 2014 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML14351A433), the licensee stated that the HCVS control panel will be provided with a key lock switch to activate the system.

The NRC 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 Quad Cities FLEX OIP [Reference 17], SECY-12-0157 [Reference 10], and the State-of-the-Art Reactor Consequence Analyses (SOARCA) [Reference 18].

The NRC staff reviewed the licensee discussion of time constraints on page 8 of the OIP and confirmed that the time constraints identified appear to be appropriately derived from the time lines developed in Attachment 2 of the OIP, 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. 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 final sizing evaluation for HCVS batteries/battery charger including incorporation into FLEX diesel generator (DG) loading calculation and documentation of the HCVS nitrogen pneumatic system design including sizing and location are not available at this time; therefore the NRC staff has not completed its review.

The NRC staff reviewed the discussion of radiological and temperature constraints on page 9 of the OIP and determined that Exelon considers radiological and temperature conditions at the locations identified to date where manual actions are necessary to operate HCVS. Specific evaluations of temperature and radiological conditions to ensure that operating personnel can safely access and operate controls and equipment outside the main control room (MCR) are not available at this time [licensee identified]; therefore, the NRC staff has not completed its review. The licensee identified an open item to confirm that the remote operating station (ROS) will be in an accessible area following a severe accident.

- 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.

### 3.2.2 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 WW path is designed for venting steam/energy at a nominal capacity of 1% of 2957 MWt [megawatt thermal] thermal power at a pressure of 56 psig. This pressure is the lower of the containment design pressure and the PCPL [Primary Containment Pressure Limit] value.

The nominal diameter of the upstream HCVS piping, which is part of the containment penetration boundary, is 18 inches, which provides adequate capacity to meet or exceed the Order criteria. The new downstream piping, which is dedicated to the HCVS venting function, is estimated to be between 12 to 14 inches in diameter[.]

The Quad Cities OIP describes a HCVS design that will be able to vent one percent of rated core thermal power. The licensee identified an open item to confirm the diameter of the new common HCVS piping. 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 are not available at this time; therefore, the NRC staff has not completed its review.

- Open Item: Make available for NRC staff review documentation that confirms the final design diameter of the HCVS piping.

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 12 of the OIP states the following:

The 1% value at Quad Cities 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 will be confirmed.

The Quad Cities OIP assumes that until decay heat is less than or equal to one percent, the suppression pool must absorb the decay heat generated and prevent containment pressure from increasing above the containment design pressure until HCVS is able to restore and maintain primary containment pressure below the primary containment design pressure. The licensee identified an open item to confirm suppression pool heat capacity. 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 are not available at this time; therefore, the NRC 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, Sections 1.1.4 and 1.2.2 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.
- 1.2.2 The HCVS shall discharge the effluent to a release point above main plant structures.

Page 12 of the OIP states the following:

The WW HCVS path at Quad Cities will use the existing upstream primary containment isolation Valve (PCIV) that is common with the WW exhaust to the Standby Gas Treatment System (SGTS) and the normal containment ventilation system. The HCVS WW ventilation path will add a line starting upstream of the existing downstream PCIV. It will include a new, dedicated downstream PCIV and Secondary Containment Isolation Valve (SCIV). The new line will route horizontally through the Reactor Building wall, and then rise vertically on the outside of the Reactor Building to a point above the top of the Reactor Building. There are no interconnected systems downstream of the second, dedicated PCIV and there is no sharing of any flow path between the two units.

The HCVS discharge path will be routed to a point above any adjacent structure. This discharge point is just above that unit's Reactor Building, and will follow the guidance of FAQ [frequently asked question] - HCVS-04 (Reference 16 [of the OIP]) such that the release point will vent away from contingency ventilation system intake and exhaust openings, main control room location, location of HCVS portable equipment, access routes required following a ELAP and BDBEE, and emergency response facilities to the extent reasonably possible: however, these must be considered in conjunction with other design criteria (e.g., flow capacity) and pipe routing limitations.

The detailed design will address 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 pipe.

The Quad Cities OIP describes the routing and discharge point of the HCVS that, pending resolution of open items, appear 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. Design details not available at this time include: the HCVS seismic final design criteria, the HCVS stack tornado missile final design criteria [licensee identified], 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 NRC 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 13 of the OIP states the following:

All electrical power required for operation of HCVS components will be from a dedicated HCVS DC battery source with permanently installed capacity for the first 24 hours and design provisions for recharging to maintain sustained operation.

Motive (pneumatic) power to the HCVS valves is provided by a dedicated bank of N<sub>2</sub>/air gas bottles with permanently installed capacity for the first 24 hours and design provisions for replacing bottles and/or connecting a portable compressor to maintain sustained operation. The initial stored motive air/gas will allow for a minimum of 12 vent cycles for the HCVS valves for the first 24-hours. The 12 vent cycles is defined as initially opening all valves in the WW flow path, and then shutting and reopening one of the valves in the flow paths 11 times.

1. The HCVS flow path valves are air-operated valves (AOV) with air-to-open and spring-to-shut. Opening the valves from the HCVS control panel located in the MCR requires energizing a DC powered solenoid operated valve (SOV) and providing motive air/gas.

2. An assessment of temperature and radiological conditions will be performed to ensure that operating personnel can safely access and operate controls at the ROS based on time constraints listed in Attachment 2 [of the OIP].
3. All permanently installed HCVS equipment, including any connections required to supplement the HCVS operation during an ELAP (i.e., DC power and motive force [pressurized N<sub>2</sub>/air]) will be located in areas reasonably protected from defined hazards listed in Part 1 of this report [the OIP]).
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 handwheel, reachrod or similar means that requires close proximity to the valve (reference FAQ HCVS-03). The preferred method is opening from the MCR through the control switch that energizes the AOVs SOV. The back-up method is from the ROS by repositioning valves on the pneumatic line; this allows opening and closing of a valve from the ROS without reliance on any electrical power or control circuit. Accessibility to the ROS will be verified during the detailed design phase. ...
5. 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 the OIP].
6. Access to the locations described above will not require temporary ladders or scaffolding.

The Quad Cities OIP contains system feature descriptions of power and pneumatic supply sources that, pending resolution of open items, appear to make the HCVS system reliable 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. Design details not available at this time include: 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 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 [licensee identified]; therefore, the NRC 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, 1.1.4, 1.2.4, and 1.2.5 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.
- 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 13 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 in addition, opening valve(s) from the ROS in case of a DC circuit failure. The tentative location for the ROS is the Turbine Building Main Floor along the Turbine/Reactor Building wall. The MCR location is protected from adverse natural phenomena and the normal control point for Plant Emergency Response actions. The ROS location will be evaluated to ensure acceptable temperature and dose consequences.

The Quad Cities OIP describes HCVS control locations that, pending resolution of open items, 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. Design details not available at this time include: documentation demonstrating 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 temperature and radiological conditions to ensure that

operating personnel can safely access and operate controls and support equipment [licensee identified]; therefore, the NRC 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 14 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). Quad Cities will determine the approach or combination of approaches the plant will take to address the combustible gas



mixture. Quad Cities intends to follow the guidance in HCVS-WP-03, Hydrogen/CO Control Measures.

Design details for hydrogen control not available at this time include 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 NRC 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 14 of the OIP states the following:

The HCVS uses dedicated PCIVs for containment isolation and a dedicated flow path that has neither any interconnected-systems nor sharing with the opposite unit's HCVS. These containment isolation valves are AOVs that are air-to-open and spring-to-shut.

The Quad Cities OIP describes a HCVS design with no interconnected systems and no sharing with the opposite unit. These features to minimize unintended cross flow of vented fluids appear 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.

### 3.2.2.8 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 14 of the OIP states the following:

EOP/ERG [emergency operating procedure/emergency response guideline] operating procedures provide clear guidance that the HCVS will not 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 an equipment malfunction or operator error such that any credited containment accident pressure (CAP) that would provide net positive suction head [NPSH] 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. Note that Quad Cities does credit CAP for its DBLOCA. However, preventing inadvertent operation is addressed.

The features that prevent inadvertent actuation are two PCIVs in series. These valves are fail-shut AOVs. They are air to open, spring to shut AOVs that require energizing a SOV to allow the motive air to open the valve. Emergency operation of each PCIV will require dedicated operation of a key-locked switch. In addition, the DC power to the SOVs will normally be disabled to prevent inadvertent operation.

The Quad Cities OIP provides a description of methods to prevent inadvertent HCVS initiation that includes: key lock switches, valves in series that are air-to-open spring-to-close 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 14 of the OIP states the following:

The HCVS components and components that interface with the HCVS are routed in seismically qualified structures.

HCVS components that are part of the containment pressure boundary will be 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. HCVS components downstream of the containment pressure boundary (i.e., downstream of the downstream PCIV) will not be safety-related.

The HCVS components (SOVs and instrumentation) will be powered from a normally de-energized, dedicated power supply. HCVS electrical or control components that interface 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 installation of the remaining equipment will be considered Augmented Quality. Newly installed piping and valves will be seismically qualified to handle the forces associated with the Safe Shutdown Earthquake (SSE) 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).

HCVS instrumentation performance (e.g., accuracy and precision) need not exceed that of similar plant installed equipment. Additionally, radiation monitoring instrumentation accuracy and range will be sufficient to confirm flow of radionuclides through the HCVS. The HCVS instruments, including valve position indication, process instrumentation, radiation monitoring, and support system monitoring, will be qualified by using one or more of the three methods described in the ISG, which includes:

1. Purchase of instruments and supporting components with known operating principles from manufacturers with commercial quality assurance programs (e.g., ISO9001) where the procurement specifications include the applicable seismic requirements, design requirements, and applicable testing.
2. Demonstration of seismic reliability via methods that predict performance described in IEEE [Institute of Electrical and Electronic Engineers] 344-2004
3. Demonstration that instrumentation is substantially similar to the design of instrumentation previously qualified.

<b>Instrument</b>	<b>Qualification Method*</b>
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 Quad Cities OIP describes component qualification methods that, pending resolution of open items, 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. An evaluation for seismic qualifications of HCVS components [licensee identified] and 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 are not available at this time; therefore, the NRC 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.

### 3.2.2.10 Monitoring of HCVS

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

- 1.1.1 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.
- 1.2.8 The HCVS shall include means to monitor the status of the vent system (e.g., valve position indication) from 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 15 of the OIP states the following:

The Quad Cities WW HCVS will be capable of being remote-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. (Generic Assumption 109-12) 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 and indications 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 ROS location, habitability, staffing sufficiency, and communication capability with Vent-use decision makers.

The WW HCVS will include means to monitor the status of the vent system in the MCR and to monitor DC power and  $N_2$ /air pressure at the ROS. The proposed design for the HCVS includes control switches in the MCR with valve position indication. The HCVS controls will meet the environmental and seismic requirements of the Order for the plant severe accident with an ELAP. The ability to open/close these valves multiple times during the event's first 24 hours will be provided by dedicated motive air and DC power. Beyond the first 24 hours, the ability to maintain these valves open or closed will be maintained by sustaining the motive air and DC power.

The WW HCVS will include indications for vent pipe pressure, temperature, valve position, and effluent radiation levels in the MCR. Other important information on the status of supporting systems (i.e., DC power source status and pneumatic supply pressure) will also be included in the design and located to support HCVS operation.

Other instrumentation that supports HCVS function is provided in the MCR. This includes existing DW vent pressure and containment level indication. This instrumentation is not required to validate HCVS function and is therefore not powered from the dedicated HCVS batteries. However, these instruments are expected to be available since the FLEX DG supplies the station battery charger for these instruments and will be installed prior to depletion of the station batteries.

The Quad Cities OIP provides a description of HCVS monitoring that, pending resolution of open items, 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. Design details not available at this time include: documentation demonstrating adequate communication between remote HCVS operation locations and HCVS operational decision makers, descriptions of all instrumentation and controls (existing and

planned) including qualification methods, 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, and an evaluation of temperature and radiological conditions to ensure that operating personnel can safely access and operate controls and support equipment; therefore, the NRC 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 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 16 of the OIP states the following:

Unless otherwise required to be safety-related, Augmented Quality requirements will be applied to the components installed in response to this Order.

Non-safety related piping, electrical power supply, valve actuator pneumatic supply, and instrumentation (local and remote) components, would be designed/analyzed to conform to the requirements consistent with the applicable design codes (e.g., Non-safety, Seismic Category 1, B31.1) for the plant and to ensure functionality following a design basis earthquake.

Additional modifications required to meet the Order will provide reliability at the postulated vent pipe conditions (temperature, pressure, and radiation levels). The instrumentation/power supplies/cables/connections (components) will be qualified for temperature, pressure, radiation level, total integrated radiation dose appropriate for that location (e.g., near the effluent vent pipe or at the HCVS ROS location).

Conduit design and/or cable trays will be installed to Seismic Class 1 criteria.

Both existing and new barriers will be used to provide a level of protection from externally generated missiles below 30 feet above ground level when equipment is located outside of seismically qualified structures.

If the instruments are purchased as commercial-grade equipment, they will be qualified to operate under severe accident environment as required by NRC Order EA-13-109 and the guidance of NEI 13-02. These qualifications will be bounding conditions for Quad Cities.

For the HCVS 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:

- demonstration of seismic motion will be consistent with that of existing design basis loads at the installed location;
- 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;
- 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 in the OIP) or a substantially similar industrial standard;
- 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
- seismic qualification using seismic motion consistent with that of existing design basis loading at the installation location.

The Quad Cities 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 18 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 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 [the OIP] as a non-automatic power operation of a component that 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 (MCR). 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 and dedicated power and motive air/gas capability will be available to support operation and monitoring of the HCVS for the first 24 hours.

System control:

- i. Active: The PCIV and the SCIV will be operated in accordance with EOPs/SOPs [standard operating procedures] to control containment pressure. The HCVS will be designed for 12 vent 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.
- ii. Passive: Inadvertent actuation protection is provided by:



A key locked switch for the dedicated downstream PCIV located in the Main Control Room and controlled by procedures

AND

Disabling the HCVS DC power to the SOV and disabling the motive power (pressurized N<sub>2</sub>/air) for the dedicated PCIV except when required by procedures to initiate containment venting

The Quad Cities OIP describes a first 24 hour BDBEE coping strategy that, pending resolution of open items, 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. 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 are not available at this time; therefore, the NRC 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 19 of the OIP states the following:

Before the end of the 24 hours initial phase, 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 to minimize manpower resources.

FLEX is credited solely to sustain power for a BDBEE ELAP to containment instruments used to monitor the containment (e.g., pressure and WW level). The response to NRC Order EA-12-049 will demonstrate the capability for FLEX efforts to maintain the power source.

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

The Quad Cities OIP describes a greater than 24 hour BDBEE coping strategy that, pending resolution of open items, 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. 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 are not available at this time; 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 21 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-1 2-049 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) and will include remote-manual actions. The ROS provides back-up capability to open HCVS valve(s) in case of a valve circuit or SOV failure. 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[of the OIP]).

Permanently installed power and motive air/gas capability will be available to support operation and monitoring of the HCVS for 24 hours. Specifics are the same as for Part 2 [of the OIP] BDBEE Venting.

System control:

- i. Active: Same as for Part 2 BDBEE Venting.

ii. Passive: Same as for Part 2 BDBEE Venting

The Quad Cities OIP describes a first 24 hour severe accident coping strategy that, pending resolution of open items, 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, the final nitrogen pneumatic system design including sizing and location, and an evaluation of temperature and radiological conditions to ensure that operating personnel can safely access and operate controls and support equipment (licensee identified); therefore, the NRC 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, Sections 1.2.4 and 1.2.8 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.

1.2.8 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.

Page 21 of the OIP states the following:

Specifics are the same as for Part 2 BDBEE Venting.

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

The Quad Cities OIP describes greater than 24 hour severe accident coping strategy that pending resolution of open items, 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 temperature 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.

### 3.2.5 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 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:

All containment venting functions will be performed from the MCR or ROS.

Venting to prevent containment overpressurization will be maintained by permanently installed equipment. The HCVS dedicated DC power source and dedicated motive force is adequate for the first 24 hours, but it can be replenished to support sustained operation.

Existing safety related station batteries will provide sufficient electrical power for MCR containment instrumentation for greater than 8 hours. Before station batteries are depleted, the response detailed in Order EA-12-049 will be credited to maintain DC bus voltage.

The Quad Cities OIP describes BDBEE supporting equipment functions that pending resolution of open items, 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 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 are not available at this time; therefore, the NRC 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 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 same support functions that are used in the BDBEE scenario would be used for severe accident venting. The ROS (the location of the HCVS DC power source and motive force) location will be evaluated to confirm accessibility under severe accident conditions.

The Quad Cities OIP describes support equipment functions for severe accident venting that, pending resolution of open items, 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. Design 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 temperature and radiological conditions to ensure that operating personnel can safely access and operate controls and support equipment (licensee identified); therefore, the NRC 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 25 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.

Before the end of the initial 24-hour period, replenishment of the HCVS dedicated DC power and motive power (pressurized gas) will occur at the ROS. The selection of the ROS location will take into account the SA [severe accident] temperature and radiation condition to ensure access to the ROS is maintained. The design will allow replenishment with minimal actions.

The Quad Cities OIP describes venting portable equipment deployment functions that pending resolution of open items, 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. Design 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 temperature and radiological conditions to ensure that operating personnel can safely access and operate controls and support equipment; therefore, the NRC 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 DRY WELL 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 PROGRAMMATIC 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 28 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 procedures will be developed and implemented following the plant's process for initiation 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

Quad Cities relies on CAP for ECCS pump NPSH. The procedures will state that the use of the HCVS vent path would impact NPSH.

Quad Cities will establish provisions for out-of-service requirements of the HCVS and compensatory measures.

The following provisions will be documented in the Quad Cities HCVS Program Document. A procedure will document the following provisions, the development of which is tracked in the Corrective Action Process. ...

The provisions for out-of-service requirements for HCVS 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 be 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 unavailability for similar causes.
- Initiate action to implement appropriate compensatory actions.

The Quad Cities OIP describes programmatic controls that, pending resolution of open items, 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 identified an open item to provide the procedures for HCVS operation.

Open Item: Make available for NRC staff audit the procedures for HCVS operation.

#### 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 28 of the OIP states the following:

Personnel expected to perform direct execution of the HCVS 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, personnel on-site will be available to supplement trained personnel.

The Quad Cities 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 29 of the OIP states the following:

Quad Cities 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, Quad Cities will integrate these requirements with compliance to any rulemaking resulting from the NTF Recommendations 8 and 9.

The Quad Cities OIP describes an approach to drills that appears 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 30 of the OIP states the following:

Quad Cities 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.

Quad Cities 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 Quad Cities 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.

Summary, Section 3.4:

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 NRC 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 the calculation (QDC-8300-E-2100) that confirms that Order EA-12-49 actions to restore power are sufficient to ensure continuous operation of non-dedicated containment instrumentation.	Section 3.1.2
2.	Make available for NRC staff audit the final sizing evaluation for HCVS batteries/battery charger including incorporation into FLEX DG loading calculation.	Section 3.2.1 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 Section 3.2.6
3.	Make available for NRC staff audit documentation of the HCVS nitrogen pneumatic system design including sizing and location.	Section 3.2.1 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 Section 3.2.6
4.	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
5.	Make available for NRC staff review documentation that confirms the final design diameter of the HCVS piping.	Section 3.2.2.1
6.	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 3.2.1 Section 3.2.2.2

7.	Make available for NRC staff audit the seismic and tornado missile final design criteria for the HCVS stack.	Section 3.2.2.3
8.	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
9.	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 Section 3.2.2.10
10.	Provide a description of the final design of the HCVS to address hydrogen detonation and deflagration.	Section 3.2.2.6
11.	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
12.	Make available for NRC staff audit documentation of a seismic qualification evaluation of HCVS components.	Section 3.2.2.9
13.	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
14.	Make available for NRC staff audit the procedures for HCVS operation.	Section 3.4.1

## 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, "Issuance of Order to Modify Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions," June 6, 2013 (ADAMS Accession No. ML13143A321).
2. Letter from Exelon to NRC, "Phase 1 Overall Integrated Plan for Quad Cities Nuclear Power Station in Response to June 6, 2013 Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109)," dated June 30, 2014 (ADAMS Accession No. ML14184A017).
3. SECY-11-0093, "Recommendations For Enhancing Reactor Safety in The 21<sup>st</sup> Century – The Near-Term Task Force Review of Insights From The Fukushima Dai-Ichi Accident," July 12, 2011 (ADAMS Accession No. ML111861807).
4. SRM-SECY-11-0124, "Staff Requirements - SECY-11-0124 - Recommended Actions to be Taken Without Delay From The Near-Term Task Force Report," September 9, 2011 (ADAMS Accession No. ML112911571).
5. SRM-SECY-11-0137, "Staff Requirements - SECY-11-0137 - Prioritization of Recommended Actions to be Taken in Response to Fukushima Lessons Learned," October 3, 2011 (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, "Issuance of Order to Modify Licenses with Regard to Reliable Hardened Containment Vents," March 12, 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. Interim Staff Guidance JLD-ISG-2013-02, "Compliance with Order EA-13-109, Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions," November 14, 2013 (ADAMS Accession No. ML13304B836).
14. NRC Letter dated May 27, 2014, "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 EA-12-049, "Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," March 12, 2012 (ADAMS Accession No. ML12054A735).
16. NRC Letter dated November 22, 2013, "Quad Cities Nuclear Power Station, Units 1 and 2 - Interim Staff Evaluation Relating to Overall Integrated Plan in Response to Order EA-12-049 (Mitigation Strategies) TAC Nos. MF1048 and MF1049" (ADAMS Accession No. ML13220A351).
17. Letter from Exelon to NRC, regarding Quad Cities, Units 1 and 2 - Overall Integrated Plan for in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049), dated February 28, 2013 (ADAMS Accession No. ML13060A420).
18. NUREG-1935, "State-of-the-Art Reactor Consequence Analyses (SOARCA) Final Report" (ADAMS Accession No. ML12332A0583).

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Date: April 1, 2015

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Sincerely,

*/RA/*

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Docket Nos. 50-254 and 50-265

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