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

April 3, 2019

Ms. Cheryl A. Gayheart
Regulatory Affairs Director
Southern Nuclear Operating Co., Inc.
3535 Colonnade Parkway
Birmingham, AL 35243

SUBJECT: EDWIN I. HATCH NUCLEAR PLANT, UNITS 1 AND 2 - SAFETY EVALUATION REGARDING IMPLEMENTATION OF HARDENED CONTAINMENT VENTS CAPABLE OF OPERATION UNDER SEVERE ACCIDENT CONDITIONS RELATED TO ORDER EA-13-109 (CAC NOS. MF4479 AND MF4480; EPID NO. L-2014-JLD-0042)

Dear Ms. Gayheart:

On June 6, 2013 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML13143A334), 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," to all Boiling Water Reactor (BWR) licensees with Mark I and Mark II primary containments. The order requirements are provided in Attachment 2 to the order and are divided into two parts to allow for a phased approach to implementation. The order required each licensee to submit an Overall Integrated Plan (OIP) for review that describes how compliance with the requirements for both phases of Order EA-13-109 would be achieved.

By letter dated June 27, 2014 (ADAMS Accession No. ML14178B464), Southern Nuclear Operating Company, Inc. (SNC, the licensee) submitted its Phase 1 OIP for Edwin I. Hatch Nuclear Plant, Units 1 and 2 (Hatch) in response to Order EA-13-109. At 6-month intervals following the submittal of the Phase 1 OIP, the licensee submitted status reports on its progress in complying with Order EA-13-109 at Hatch, including the combined Phase 1 and Phase 2 OIP in its letter dated December 23, 2015 (ADAMS Accession No. ML15357A212). These status reports were required by the order, and are listed in the enclosed safety evaluation. By letters dated May 27, 2014 (ADAMS Accession No. ML14126A545), and August 10, 2017 (ADAMS Accession No. ML17220A328), the NRC notified all BWR Mark I and Mark II licensees that the staff will be conducting audits of their implementation of Order EA-13-109 in accordance with NRC Office of Nuclear Reactor Regulation (NRR) Office Instruction LIC-111, "Regulatory Audits" (ADAMS Accession No. ML082900195). By letters dated March 25, 2015 (Phase 1) (ADAMS Accession No. ML14335A137), August 2, 2016 (Phase 2) (ADAMS Accession No. ML16099A260), and September 19, 2017 (ADAMS Accession No. ML17254A042), the NRC issued Interim Staff Evaluations and an audit report, respectively, on the licensee's progress. By letter dated November 12, 2018 (ADAMS Accession No. ML18316A022), the licensee reported that Hatch is in full compliance with the requirements of Order EA-13-109, and submitted a Final Integrated Plan for Hatch.

The enclosed safety evaluation provides the results of the NRC staff's review of Hatch's hardened containment vent design and water management strategy for Hatch.

The intent of the safety evaluation is to inform Hatch on whether or not its integrated plans, if implemented as described, appear to adequately address the requirements of Order EA-13-109. The staff will evaluate implementation of the plans through inspection, using Temporary Instruction 2515-193, "Inspection of the Implementation of EA-13-109: Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions" (ADAMS Accession No. ML17249A105). This inspection will be conducted in accordance with the NRC's inspection schedule for the plant.

If you have any questions, please contact Dr. Rajender Auluck, Senior Project Manager, Beyond-Design-Basis Engineering Branch, at 301-415-1025, or by e-mail at Rajender.Auluck@nrc.gov.

Sincerely,

Brett Titus

Brett Titus, Acting Chief
Beyond-Design-Basis Engineering Branch
Division of Licensing Projects
Office of Nuclear Reactor Regulation

Docket Nos. 50-321 and 50-366

Enclosure:
Safety Evaluation

cc w/encl: Distribution via Listserv

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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO ORDER EA-13-109

SOUTHERN NUCLEAR OPERATING COMPANY, INC.

EDWIN I. HATCH NUCLEAR PLANT, UNITS 1 AND 2

DOCKET NOS. 50-321 AND 50-366

1.0 INTRODUCTION

The earthquake and tsunami at the Fukushima Dai-ichi nuclear power plant in March 2011 highlighted the possibility that extreme natural phenomena could challenge the prevention, mitigation and emergency preparedness defense-in-depth layers already in place in nuclear power plants in the United States. At Fukushima, limitations in time and unpredictable conditions associated with the accident significantly challenged attempts by the responders to preclude core damage and containment failure. During the events at Fukushima, the challenges faced by the operators were beyond any faced previously at a commercial nuclear reactor and beyond the anticipated design basis of the plants. The U.S. Nuclear Regulatory Commission (NRC) determined that additional requirements needed to be imposed at U.S. commercial power reactors to mitigate such beyond-design-basis external events (BDBEEs) during applicable severe accident conditions.

On June 6, 2013 [Reference 1], the NRC issued Order EA-13-109, "Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation under Severe Accident Conditions". This order requires licensees to implement its requirements in two phases. In Phase 1, licensees of boiling-water reactors (BWRs) with Mark I and Mark II containments shall design and install a venting system that provides venting capability from the wetwell during severe accident 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.

By letter dated June 27, 2014 [Reference 2], Southern Nuclear Operating Company, Inc. (SNC, the licensee) submitted its Phase 1 Overall Integrated Plan (OIP) for Edwin I. Hatch Nuclear Plant, Units 1 and 2 (Hatch, HNP) in response to Order EA-13-109. By letters dated December 30, 2014 [Reference 3], June 26, 2015 [Reference 4], December 23, 2015 (which included the combined Phase 1 and Phase 2 OIP) [Reference 5], June 13, 2016 [Reference 6], December 14, 2016 [Reference 7], June 12, 2017 [Reference 8], December 5, 2017 [Reference 9], and June 27, 2018 [Reference 10], the licensee submitted 6-month updates to its OIP. By letters dated May 27, 2014 [Reference 11], and August 10, 2017 [Reference 12], the NRC notified all BWR Mark I and Mark II licensees that the staff will be conducting audits of their implementation of Order EA-13-109 in accordance with NRC Office of Nuclear Reactor Regulation (NRR) Office Instruction LIC-111, "Regulatory Audits" [Reference 13]. By letters dated March 25, 2015 (Phase 1) [Reference 14], August 2, 2016 (Phase 2) [Reference 15], and September 19, 2017 [Reference 16], the NRC issued Interim Staff Evaluations (ISEs) and an audit report, respectively, on the licensee's progress. By letter dated November 12, 2018 [Reference 17], the licensee reported that full compliance with the requirements of Order EA-13-109 was achieved and submitted its Final Integrated Plan (FIP).

2.0 REGULATORY EVALUATION

Following the events at the Fukushima Dai-ichi nuclear power plant on March 11, 2011, the NRC established a senior-level agency task force referred to as the Near-Term Task Force (NTTF). The NTTF was tasked with conducting a systematic and methodical review of the NRC regulations and processes and determining if the agency should make improvements to these programs in light of the events at Fukushima Dai-ichi. As a result of this review, the NTTF developed a set of recommendations, documented in SECY-11-0093, "Near-Term Report and Recommendations for Agency Actions Following the Events in Japan," dated July 12, 2011 [Reference 18]. Following interactions with stakeholders, these recommendations were enhanced by the NRC staff and presented to the Commission.

On February 17, 2012 [Reference 19], 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", to the Commission. This paper included a proposal to order licensees to implement the installation of a reliable hardened containment venting system (HCVS) for Mark I and Mark II containments. As directed by the Commission in staff requirements memorandum (SRM)-SECY-12-0025 [Reference 20], the NRC staff issued Order EA-12-050, "Order Modifying Licenses with Regard to Reliable Hardened Containment Vents" [Reference 21], 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 22]. In the SRM for SECY-12-0157 [Reference 23], 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, as directed by the Commission in SRM-SECY-12-0157, on June 6, 2013, the NRC staff issued Order EA-13-109.

Order EA-13-109 requires that BWRs with Mark I and Mark II containments have a reliable, severe-accident capable HCVS. Attachment 2 of the order provides specific requirements for implementation of the order. The order shall be implemented in two phases.

2.1 Order EA-13-109, Phase 1

For Phase 1, licensees of BWRs with Mark I and Mark II containments are required to 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.

The NRC staff held several public meetings to provide additional clarifications on the order's requirements and comments on the proposed draft guidance prepared by the Nuclear Energy Institute (NEI) working group. On November 12, 2013, NEI issued NEI 13-02, "Industry Guidance for Compliance with Order EA-13-109," Revision 0 [Reference 24], to provide guidance to assist nuclear power reactor licensees with the identification of measures needed to comply with the requirements of Phase 1 of Order EA-13-109. The NRC staff reviewed NEI 13-02, Revision 0, and on November 14, 2013 [Reference 25], 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'", 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 on November 25, 2013, published a notice of its availability in the *Federal Register* (78 FR 70356).

2.2 Order EA-13-109, Phase 2

For Phase 2, licensees of BWRs with Mark I and Mark II containments are required to design and install a venting system that provides venting capability from the drywell under severe accident conditions, or, alternatively, to 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.

The NRC staff, following a similar process, held several meetings with the public and stakeholders to review and provide comments on the proposed drafts prepared by the NEI working group to comply with the Phase 2 requirements of the order. On April 23, 2015 [Reference 26], NEI issued NEI 13-02, "Industry Guidance for Compliance with Order EA-13-109," Revision 1 to provide guidance to assist nuclear power reactor licensees with the identification of measures needed to comply with the requirements of Phase 2 of Order EA-13-109. The NRC staff reviewed NEI 13-02, Revision 1, and on April 29, 2015 [Reference 27], the NRC staff issued JLD-ISG-2015-01, "Compliance with Phase 2 of Order EA-13-109, 'Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Performing under Severe Accident Conditions'", endorsing, in part, NEI 13-02, Revision 1, as an acceptable means of meeting the requirements of Phase 2 of Order EA-13-109, and on April 7, 2015, published a notice of its availability in the *Federal Register* (80 FR 26303).

3.0 TECHNICAL EVALUATION OF ORDER EA-13-109, PHASE 1

Hatch is a two unit General Electric BWR site with Mark I primary containment systems. To implement Phase 1 requirements of Order EA-13-109, the licensee uses the existing containment vent piping from the suppression pool/torus air space, which exits the reactor building through an underground pipe. This pipe travels approximately 500 feet from both units and combines in a mixing chamber at the base of the main stack.

All effluents exit out the main stack. The HCVS is initiated via manual action from either the main control room (MCR) or the remote operating station (ROS) at the appropriate time based on procedural guidance in response to plant conditions from observed or derived symptoms. The ROS provides backup manual operation of the HCVS valves and pneumatics system as required by the order. The containment parameters of pressure and level from the MCR instrumentation are used to monitor effectiveness of the venting actions. The vent operation is monitored using HCVS valve position, HCVS vent line temperature, HCVS vent line pressure, and effluent radiation levels. The HCVS motive force has the capacity to operate for 24 hours with installed equipment. Replenishment of the motive force will be by use of portable equipment once the installed motive force is exhausted. Venting actions will be capable of being maintained for a sustained period of up to 7 days.

3.1 HCVS Functional Requirements

3.1.1 Performance Objectives

Order EA-13-109 requires that the design and operation of the HCVS shall satisfy specific performance objectives including minimizing the reliance on operator actions and plant operators' exposure to occupational hazards such as extreme heat stress and radiological conditions, and accessibility and functionality of HCVS controls and indications under a broad range of plant conditions. Below is the staff's assessment of how the licensee's HCVS meets the performance objectives required by Order EA-13-109.

3.1.1.1 Operator Actions

Order EA-13-109, Attachment 2, Section 1.1.1 requires that the HCVS be designed to minimize the reliance on operator actions. Relevant guidance is found in NEI 13-02, Section 4.2.6 and HCVS-FAQ [Frequently Asked Questions]-01.

In its FIP, the licensee stated that operation of the HCVS was designed to minimize the reliance on operator actions in response to hazards identified in NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," Revision 0 [Reference 28], which are applicable to the plant site. Operator actions to initiate venting through the HCVS vent path can be completed by plant personnel, and the system includes the capability for remote-manual initiation from the HCVS remote operating station. A list of the remote-manual actions performed by plant personnel to open the HCVS vent path are listed in Table 3-1, "HCVS Operator Actions," of the FIP. An HCVS extended loss of alternating current (ac) power (ELAP) Failure Evaluation Table (Table 3-2), which shows alternate actions that can be performed, is also provided in the FIP.

The licensee also stated that permanently-installed electrical power and pneumatic supplies are available to support operation and monitoring of the HCVS for a minimum of 24 hours. No portable equipment needs to be moved in the first 24 hours. After 24 hours, available personnel will be able to connect supplemental electric power and pneumatic supplies for sustained operation of the HCVS for a minimum of 7 days. The FLEX generators provide electrical power. Pneumatic power is maintained by replacing gas bottles. In all likelihood, these actions will be completed in less than 24 hours. However, the HCVS can be operated for at least 24 hours without any supplementation.

The NRC staff reviewed the HCVS Operator Actions Table, compared it with the information contained in NEI 13-02 and determined that these actions should minimize the reliance on operator actions. The actions are consistent with the types of actions described in NEI 13-02, Revision 1, as endorsed, in part, by JLD-ISG-2013-02 and JLD-ISG-2015-01, as an acceptable means for implementing applicable requirements of Order EA-13-109. The NRC staff also reviewed the HCVS Failure Evaluation Table and determined that the actions described adequately address all the failure modes listed in NEI 13-02, Revision 1, which include: loss of normal alternating current (ac) power; long-term loss of batteries; loss of normal pneumatic supply; loss of alternate pneumatic supply; and solenoid operated valve failure.

Based on the evaluation above, the NRC staff concludes that the licensee's HCVS design should minimize the reliance on operator actions, and, if implemented appropriately, appears to be consistent with NEI 13-02 guidance, as endorsed by JLD-ISG-2013-02 and JLD-ISG-2015-01, and should adequately address the requirements of the order.

3.1.1.2 Personnel Habitability – Environmental (Non-Radiological)

Order EA-13-109, Attachment 2, Section 1.1.2 requires that the HCVS be designed to minimize plant operators' exposure to occupational hazards, such as extreme heat stress, while operating the HCVS. Relevant guidance is found in: NEI 13-02, Sections 4.2.5 and 6.1.1; NEI 13-02, Appendix I; and HCVS-FAQ-01 and -09.

In its FIP, the licensee stated that primary control of the HCVS is accomplished from the MCR. Alternate control of the HCVS is accomplished from the ROS at the 147' elevation of the control building, one floor below the MCR. FLEX actions that may be taken to maintain the habitability of the MCR and ROS were developed in response to NRC Order EA-12-049. These actions include:

1. Opening MCR doors to the outside (if required).
2. Restoring MCR ventilation via the FLEX diesel generator. The MCR ventilation was included as a load in the FLEX generator sizing calculations and is acceptable.
3. Providing cooling water to MCR ventilation near the MCR.

In the FIP, Table 2 contains a thermal evaluation of all the operator actions that may be required to support HCVS operation. The relevant ventilation calculations (the same ones used for the Order EA-12-049 response) demonstrate that the final design meets the order requirements to minimize the plant operators' exposure to occupational hazards.

The NRC staff audited the temperature response for the MCR under Order EA-12-049 compliance and documented in the NRC staff's safety evaluation [Reference 36] that the licensee has developed a plan that, if implemented appropriately, should maintain or restore equipment and personnel habitability conditions in the MCR following a BDBEE.

Although, the licensee did not perform a specific habitability calculation for the ROS, a qualitative evaluation was provided during the audit. HNP calculation BH2-M-0557 establishes an environmental qualification temperature for the 147' elevation of the control building as 122 degrees Fahrenheit (°F). The ROS is located at the 147' elevation of the control building in an annex/access room (Room C-210). Thus, the temperature in Room C-210 for the EA-13-109 event can conservatively be assumed to be no higher than 122°F. The actions at the ROS are not continuous monitoring, and they follow the acceptable toolbox approach guidance in HCVS-FAQ-09 for which Hatch utilizes existing procedures and practices. The NRC staff audited the information and calculation provided, and determined that, with the compensatory actions, operators in the ROS should not be adversely impacted by the loss of ventilation as a result of an ELAP event.

Based on the evaluation above, the NRC staff concludes that the licensee's HCVS design, with respect to personnel habitability during severe accident conditions, if implemented appropriately, appears to be consistent with NEI 13-02 guidance, as endorsed by JLD-ISG-2013-02 and JLD-ISG-2015-01, and should adequately address the requirements of the order.

3.1.1.3 Personnel Habitability – Radiological

Order EA-13-109, Attachment 2, Section 1.1.3 requires that the HCVS be designed to account for radiological conditions that would impede personnel actions needed for event response. Relevant guidance is found in: NEI 13-02, Sections 4.2.5 and 6.1.1; NEI 13-02, Appendices D, F, G and I; HCVS-FAQ-01, -07, -09 and -12; and HCVS-WP [White Paper]-02.

In its FIP, the licensee assessed the radiological conditions for designated areas outside of containment caused by the sustained operation of the HCVS under severe accident conditions. The assessment was performed using NRC-endorsed HCVS-WP-02 [Reference 29] and HCVS-FAQ-12 [Reference 30] methodologies. Consistent with the definition of sustained operations in NEI 13-02, Revision 1, the integrated whole-body gamma dose equivalent[1] due to HCVS operation over a 7-day period was assessed by the licensee and the expected dose will not exceed the emergency response organization (ERO) emergency worker guidelines (dose will be maintained below 10 Roentgen equivalent man (rem)[2]).

The licensee assessed the expected severe accident conditions of the order, in all locations requiring personnel access. The licensee's evaluation indicates that, for the areas requiring access in the early stages of the event, the expected dose rates would not be a limiting consideration. For those areas where expected dose rates would be elevated at later stages of the accident, the licensee has determined that the expected stay times would ensure that operations could be accomplished without exceeding the emergency response organization emergency worker dose guidelines.

The licensee assessed the maximum dose rates and 7-day integrated whole-body gamma dose equivalents for the MCR and the ROS. The assessment demonstrates that the integrated whole-body gamma dose equivalent to personnel occupying defined habitability locations (resulting from HCVS operation under beyond-design-basis severe accident conditions) will not exceed 10 rem.

The NRC staff notes that there are no explicit regulatory dose acceptance criteria for personnel performing emergency response actions during a beyond-design-basis severe accident. The Environmental Protection Agency (EPA) Protective Action Guides (PAG) Manual: Protective Action Guides and Planning Guidance for Radiological Incidents, EPA-400/R-16/001, provides

[1] For the purposes of calculating the personnel whole-body gamma dose equivalent (rem), it is assumed that the radiation units of Roentgen (R), radiation absorbed dose (rad), and Roentgen equivalent man (rem) are equivalent. The conversion from exposure in R to absorbed dose on in rad is 0.874 in air and < 1 in soft tissue. For photons, 1 rad is equal to 1 rem. Therefore, it is conservative to report radiation exposure in units of R and to assume that 1 R = 1 rad = 1 rem.

[2] Although radiation may cause cancer at high doses and high dose rates, public health data do not absolutely establish the occurrence of cancer following exposure to low doses and dose rates — below about 10,000 mrem (100 mSv). https://www.nrc.gov/about-nrc/radiation/health-effects/rad-exposure-cancer.html

emergency worker dose guidelines. Table 3.1 of EPA-400/R-16/001 specifies a guideline of 10 rem for the protection of critical infrastructure necessary for public welfare such as a power plant and a value of 25 rem for lifesaving or for the protection of large populations. The NRC further notes that during an emergency response, areas requiring access will be actively monitored by health physics personnel to ensure that personnel doses are maintained as low as reasonably achievable.

The NRC staff reviewed the licensee's assessment of the expected radiological conditions to ensure that operating personnel can safely access and operate controls and support equipment. Based on the expected integrated whole-body dose equivalent in the MCR and ROS and the expected integrated whole body dose equivalent for expected actions during the sustained operating period, the NRC staff finds with reasonable assurance that the mission doses associated with actions taken to protect the public under beyond-design-basis severe accident conditions will not subject plant personnel to an undue risk from radiation exposure.

Based on the evaluation above, the NRC staff concludes that the licensee's HCVS design, with respect to personnel habitability during severe accident conditions, if implemented appropriately, appears to be consistent with NEI 13-02 guidance, as endorsed by JLD-ISG-2013-02 and JLD-ISG-2015-01, and should adequately address the requirements of the order.

3.1.1.4 HCVS Controls and Indications

Order EA-13-109, Attachment 2, Section 1.1.4 requires that the HCVS controls and indications be accessible and functional under a range of plant conditions, including severe accident conditions, ELAP, and inadequate containment cooling. Relevant guidance is found in: NEI 13-02, Sections 4.1.3, 4.2.2, 4.2.3, 4.2.4, 4.2.5, and 6.1.1; NEI 13-02, Appendices F, G and I; and HCVS-FAQs-01 and -02.

Accessibility of the controls and indications for the environmental and radiological conditions are addressed in Sections 3.1.1.2 and 3.1.1.3 of this safety evaluation, respectively.

In its FIP, the licensee stated that primary control of the HCVS is accomplished from the MCR. Under the postulated scenarios of Order EA-13-109, the control room is adequately protected from excessive radiation dose and no further evaluation of its use is required (HCVS-FAQ-06). Alternate control of the HCVS is accomplished from the ROS at the 147' elevation of the control building. The ROS at the 147' elevation of the control building is in an area evaluated to be accessible before and during a severe accident.

Under ELAP conditions, the HCVS wetwell vent will be opened to protect the containment from overpressure. The operator actions to perform this function under ELAP conditions (and timing of those actions) were evaluated as part of HNP's Order EA-12-049 compliance and documented in the NRC safety evaluation [Reference 36]. The licensee also provided, in Table 1 of the FIP, a list of the controls and indications including the locations, anticipated environmental conditions, and the environmental conditions (temperature and radiation) to which each component is qualified.

The NRC staff reviewed the FIP including the response in Section III.B.1.1.4 of the FIP and examined the information provided in Table 1, including an update to FIP Table 1 provided in a January 28, 2019, email (ADAMS Accession No. ML19045A491). The NRC staff determined that the controls and indications appear to be consistent with the NEI 13-02 guidance. The NRC staff also confirmed the environmental qualification information in Table 1 of the FIP, as well as the seismic qualification of the controls and indications equipment through audit reviews of SNC documents SNC598056, "SAM-HNP U2 HCVS Wetwell," Revision 1, and S-77683, "Qualification Summary Report, HCVS Radiation Monitoring System," Revision 1. The NRC staff noted that the Regulatory Guide (R.G.) 1.97 instruments for drywell pressure and torus level did not have qualification information listed in Table 1, but are considered acceptable for severe accident conditions, in accordance with the NEI 13-02 guidance, based on their design basis qualifications.

Based on the evaluation above, the NRC staff concludes that the licensee's HCVS design, with respect to accessibility and functionality of the HCVS controls and indications during severe accident conditions, if implemented appropriately, appears to be consistent with NEI 13-02 guidance, as endorsed by JLD-ISG-2013-02 and JLD-ISG-2015-01, and should adequately address the requirements of the order.

3.1.2 Design Features

Order EA-13-109 requires that the HCVS shall include specific design features, including specifications of the vent characteristics, vent path and discharge, control panel, power and pneumatic supply sources, inadvertent actuation prevention, HCVS monitoring, equipment operability, and hydrogen control. Below is the staff's assessment of how the licensee's HCVS meets the performance objectives required by Order EA-13-109.

3.1.2.1 Vent Characteristics

Order EA-13-109, Attachment 2, Section 1.2.1 requires that the HCVS has the capacity to vent the steam/energy equivalent of one 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. Relevant guidance is found in NEI 13-02, Section 4.1.1.

The licensee performed an analysis of the decay heat absorbing capacity of the suppression pool and the selection of the venting pressure, which demonstrated that the HCVS will have sufficient capacity to maintain containment pressure at or below the containment design pressure (56 per square inch gauge (psig)), which is lower than the primary containment pressure limit (PCPL) (62 psig). It also shows that containment is maintained below the design pressure once the vent is opened, even if it is not opened until containment pressure reaches the PCPL.

The licensee stated that the generic, GE Hitachi evaluation in NEDC-33771P, "GEH Evaluation of FLEX Implementation Guidelines," Revision 1, determined that a 12-inch vent provided adequate venting for a representative BWR 4 with a Mark I containment plant similar to Hatch. The actual size of the HNP wetwell portion of the HCVS is ≥ 18 inches in diameter which provides adequate capacity to meet or exceed the order criteria. The stack mixing chamber and the main stack pipe is ≥ 18 inches also, thus based on the NEDC assessment of a 12-inch vent, the HNP vent (≥ 18 inches) is adequate. The NRC staff audited the information provided and confirmed that the HCVS vent design should support the capacity to vent one percent of rated thermal power during ELAP and severe accident conditions.

Section 8.4 of the licensee's Final Safety Analysis Report (FSAR) states that the coping time duration for a station blackout (SBO) event at Hatch is 4 hours. The licensee's FIP states that the suppression pool is capable of accepting exhausted steam from the reactor core isolation cooling system and safety relief valves (SRVs) without any suppression pool cooling for the duration of the SBO event. Furthermore, the FIP states that, with no suppression pool cooling during these 4 hours, the resulting peak pool temperature is 194°F and is within the acceptable temperature limit for containment.

Based on the evaluation above, the NRC staff concludes that the licensee's HCVS design characteristics, if implemented appropriately, appear to be consistent with NEI 13-02 guidance, as endorsed by JLD-ISG-2013-02 and JLD-ISG-2015-01, and should adequately address the requirements of the order.

3.1.2.2 Vent Path and Discharge

Order EA-13-109, Attachment 2, Section 1.2.2 requires that the HCVS discharge the effluent to a release point above main plant structures. Relevant guidance is found in: NEI 13-02, Section 4.1.5; NEI 13-02, Appendix H; and HCVS-FAQ-04.

In its FIP, the licensee stated that the Order EA-13-109 compliant HCVS utilizes the Generic Letter (GL) 89-16 wetwell vent system. The GL 89-16 vent path at HNP consists of an 18-inch diameter wetwell and 18-inch diameter drywell vent on each unit. The drywell vent exits the primary containment into the reactor building and proceeds down to the torus bay, where it merges with the wetwell piping into a common header. The vent path for both the wetwell and drywell exits the reactor building through an underground pipe. This pipe travels approximately 500 feet from both units and combines in a mixing chamber at the base of the concrete main stack. All effluents exit out the main stack. This is consistent with the guidance provided in HCVS-FAQ-04.

Guidance document NEI 13-02, Section 5.1.1.6 provides guidance that missile impacts are to be considered for portions of the HCVS. The NRC-endorsed NEI white paper, HCVS-WP-04, "Tornado Missile Evaluation for HCVS Components 30 Feet Above Grade," Revision 0 [Reference 31], provides a risk-informed approach to evaluate the threat posed to exposed portions of the HCVS by wind-borne missiles. The white paper concludes that the HCVS is unlikely to be damaged in a manner that prevents containment venting by wind-generated missiles coincident with an ELAP or loss of normal access to the ultimate heat sink for plants that are enveloped by the assumptions in the white paper.

Since the Hatch HCVS piping is underground and has no exposed piping, HCVS-WP-04 is not applicable. Based on the above description of the vent pipe design, the Hatch HCVS vent pipe design meets the endorsed guidance to be robust with respect to all applicable external hazards including wind-borne missiles.

Based on the evaluation above, the NRC staff concludes that the licensee's location and design of the HCVS vent path and discharge, if implemented appropriately, appears to be consistent with NEI 13-02 guidance, as endorsed by JLD-ISG-2013-02 and JLD-ISG-2015-01, and should adequately address the requirements of the order.

3.1.2.3 Unintended Cross Flow of Vented Fluids

Order EA-13-109, Attachment 2, Section 1.2.3 requires that the HCVS include design features to minimize unintended cross flow of vented fluids within a unit and between units on the site. Relevant guidance is found in: NEI 13-02, Sections 4.1.2, 4.1.4, and 4.1.6; and HCVS-FAQ-05.

In its FIP, the licensee stated that a cross flow potential exists between the HCVS and the standby gas treatment system (SBGT). The valves which isolate these systems are tested, and will continue to be tested, for leakage under 10 CFR Part 50 Appendix J ,"Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors", Program [Reference 32]. These system isolation valves are normally open and fail open on loss of control air pressure. These valves are provided with manually actuated backup nitrogen to maintain these valves closed. As shown in Table 3-1 of the FIP, the actuation of this nitrogen is a primary action for operators and can be performed from the MCR or the ROS as appropriate.

An additional cross-flow avenue exists between the HCVS of the two units and other connected systems at the mixing chamber in the shared main stack. The interfacing valves in the main stack mixing chamber are connected to long runs of piping that will be evacuated of any combustible gases before combustible gas levels are approached. However, for defense in depth and per the testing criteria in HCVS-FAQ-04, the interfacing valves were leak tested as described in HCVS-FAQ-05, "HCVS Control and Boundary Valves." The NRC staff audited the information provided and agrees that the use of primary containment isolation valves appears to be acceptable for prevention of inadvertent cross-flow of vented fluids and consistent with the guidance provided in NEI 13-02, HCVS-FAQ-05.

Based on the evaluation above, the NRC staff concludes that the licensee's HCVS design limits the potential for unintended cross flow of vented fluids and, if implemented appropriately, appears to be consistent with NEI 13-02 guidance, as endorsed by JLD-ISG-2013-02 and JLD-ISG-2015-01, and should adequately address the requirements of the order.

3.1.2.4 Control Panels

Order EA-13-109, Attachment 2, Section 1.2.4 requires that the HCVS be designed to be manually operated during sustained operations from a control panel located in the MCR or a remote but readily accessible location. Relevant guidance is found in NEI 13-02, Sections 4.2.2, 4.2.4, 4.2.5, 5.1, and 6.1; NEI 13-02, Appendices A and H; and HCVS-FAQs-01 and -08.

In its FIP, the licensee stated that the existing HCVS allows for initiation and then operation and monitoring from a control panel located in the MCR and alternate control of the HCVS is accomplished from the ROS. The ROS is located on the 147' elevation of the control building, which is one floor below the elevation of the MCR and one floor above ground level. The NRC staff reviewed Section III.B.1.2.4 and confirmed these statements by comparing the instrumentation and controls component locations provided in Table 1 of the FIP.

Based on the evaluation above, the NRC staff concludes that the licensee's location and design of the HCVS control panels, if implemented appropriately, appears to be consistent with NEI 13-02 guidance, as endorsed by JLD-ISG-2013-02 and JLD-ISG-2015-01, and should adequately address the requirements of the order.

3.1.2.5 Manual Operation

Order EA-13-109, Attachment 2, Section 1.2.5 requires that the HCVS, in addition to meeting the requirements of Section 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. Relevant guidance is found in NEI 13-02, Section 4.2.3 and in HCVS-FAQs-01, -03, -08, and -09.

In its FIP, the licensee stated that it meets the requirement for manual operation by having an alternate means of operation, a readily accessible remote operation station. Initial operator actions can be completed by operators from the HCVS control stations (MCR and/or ROS) and include remote-manual initiation. The operator actions required to open a vent path are as described in Table 3-1 of the FIP. Remote manual is defined in the NEI 13-02 guidance as a non-automatic power operation of a component and does not require the operator to be at or in close proximity to the component. No other operator actions are required to initiate and this provides a diverse method of valve operation that improves system reliability.

The ROS is located on the 147' elevation of the control building in an area shielded from the HCVS vent pipe by intervening structures, with a direct path to the MCR. Attachment 6 of the FIP provides a sketch for the HCVS site layout. The controls available at the ROS location are accessible and functional under a range of plant conditions, including severe accident conditions (with due consideration to source term and dose impact on operator exposure), ELAP, inadequate containment cooling, and loss of reactor building ventilation. Table 1 of the FIP contains an evaluation of all the controls and instruments that are required for severe accident response and demonstrates their functionality during a loss of AC power and severe accident. Table 2 of the FIP contains a summary of thermal and radiological evaluations of all operator actions that may be required to support HCVS operation during a loss of ac power and severe accident. The licensee's calculations conclude that these actions will be possible without undue hazard to the operators. These evaluations demonstrate that the design meets the requirement to be manually operated from a remote but readily accessible location during sustained operation.

As part of the audit process the NRC staff requested additional detail. The NRC staff expressed concern that a single failure of the batteries could render the HCVS unavailable. The licensee indicated that they have alternate batteries they can connect to the HCVS valve solenoid valves. Each battery bank will provide sufficient power for at least 12 hours of operation. In addition, they have the ability to connect a portable generator to one of three available inverters. Only one inverter is required to restore direct current (dc) power. The NRC staff audited the information provided and confirmed that the actions appear to be consistent with the guidance.

Based on the evaluation above, the NRC staff concludes that the licensee's HCVS design allows for manual operation, and, if implemented appropriately, appears to be consistent with NEI 13-02 guidance, as endorsed by JLD-ISG-2013-02 and JLD-ISG-2015-01, and should adequately address the requirements of the order.

3.1.2.6 Power and Pneumatic Supply Sources

Order EA-13-109, Attachment 2, Section 1.2.6 requires that the HCVS 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 ELAP. Relevant guidance is found in: NEI 13-02, Sections 2.5, 4.2.2, 4.2.4, 4.2.6, and 6.1; NEI 13-02, Appendix A; HCVS-FAQ-02; and HCVS-WPs-01 and -02.

<u>Pneumatic Sources Analysis</u>

For the first 24 hours following the ELAP event, the motive force for the eight HCVS air operated valves (AOVs) will be supplied by pre-installed air accumulator tanks. After the initial 24 hours, backup nitrogen supply bottles located near the ROS will be manually valved-in to supply the motive force for the HCVS valves. The nitrogen bottles are initially located in the control building. These bottles have been sized such that they can provide motive force for at least eight venting cycles, which includes opening each of the drywell and suppression chamber isolation valves (2T48-F318, 2T48-F319, 2T48-F320, and 2T48-F326), opening the HCVS valve (2T48-F082), and closing the SBGT isolation valves (2T48-F081, 2T46-F002A, and 2T46-F002B).

The licensee also determined the required pneumatic supply storage volume and supply pressure set point required to operate the HCVS AOVs for 24 hours following a loss of normal pneumatic supplies during an ELAP in calculation SMNH-13-019, "Sizing of Nitrogen Bottles for Reliable Hardened Containment Venting System," Revision 1. The required pressure for AOVs actuation is calculated at above 90 psig. The licensee's calculation determined that two nitrogen bottles combined at the maximum capacity of 2,640 psig will provide sufficient capacity for eight cycles of the HCVS valves for 24 hours following an ELAP. This pressure includes an allowance for leakage. The NRC staff audited the calculation and confirmed that there should be sufficient pneumatic supply available to provide motive force to operate the HCVS AOVs for 24 hours following a loss of normal pneumatic supplies during an ELAP.

Power Source Analysis

In its FIP, the licensee stated that during the first 24 hours of an ELAP event, Hatch would rely on existing station service batteries for at least the first 12 hours following an ELAP event. Power supplied to HCVS components is from the station batteries for the first 12 hours, and then it is switched from the station batteries to the HCVS dedicated batteries for an additional 12 hours. Each unit has new dedicated HCVS batteries and chargers (Division 1 and 2) to provide power to HCVS components. The 250 volt (V) dc HCVS batteries and battery chargers are located on elevation 112' in the control building in the Unit 2 reactor protection system (RPS) battery rooms. The HCVS battery and battery charger are installed where they are protected from applicable hazards. C&D Technologies manufactured the HCVS battery.

The HCVS battery is model AT-17P with a nominal capacity of 920 ampere hours (Ah). The HCVS battery has a minimum capacity capable of providing power for 14 hours without recharging. During the audit process, the licensee provided the NRC staff the evaluation for the HCVS battery/battery charger sizing requirements including incorporation into the FLEX diesel generator (DG) loading calculation.

The NRC staff audited licensee calculation SENH-16-003, "Battery Sizing, Voltage Drop, Cable Sizing, and Short Circuit Evaluation for 250V Dedicated Battery System (Unit 2)," Version 2, which verified the capability of the HCVS battery to supply power to the required loads during the first phase of the Hatch venting strategy for an ELAP. The HCVS battery was sized in accordance with IEEE Standard 485-2010, "IEEE Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications," which is endorsed by R.G. 1.212, "Sizing of Large Lead-Acid Storage Batteries," published in 2015. The licensee's calculation verified the load profile, cables and protective equipment, and the minimum system operating voltage. The NRC staff also audited licensee calculation SENH-13-005, "Load Data for Sizing the Inverters for FLEX and HCVS," Version 1, which verified the capability of the 250 Vdc/120 Vac FLEX inverters to supply FLEX and HCVS electrical loads powered from the 120 Vac FLEX instrument cabinets. Based on the NRC staff's audit, it appears that that the dedicated HCVS batteries should have sufficient capacity to supply power at least an additional 14 hours.

The licensee's strategy includes repowering the Class 1E station service battery charger within 24 hours after initiation of an ELAP. The licensee's strategy relies on one 545 kilowatt (kW), 600 Volt alternating current (Vac) FLEX DG per unit. The 600 Vac FLEX DG provides power to the HCVS load in addition to loads addressed under Order EA-12-049.

The NRC staff audited licensee calculation A-47402, "FLEX Portable System Phase 2 600V FLEX Diesel Generator Sizing Calculation," Revision 1, which incorporated the HCVS load on the FLEX DG. The required loads for the Phase 2 FLEX DGs total approximately 387 kW for both units' Division I load and 383 kW for both units' Division II loads. Based on the NRC staff's audit of calculation A-47402, it appears that the FLEX DGs should have sufficient capacity and capability to supply the necessary loads during an ELAP event.

Electrical Connection Points

The licensee's strategy to supply power to HCVS components requires using a combination of permanently installed and portable components. Staging and connecting the 545 kW FLEX DG to repower the Class 1E station service battery charger to recharge the Class 1E station service batteries was addressed under Order EA-12-049. Licensee procedures NMP-OS-019-262, "Hatch Unit 1 SIG-2, 600V Alternate Power," Version 5, and NMP-OS-019-282, "Hatch Unit 2 SIG-2, 600V Alternate Power," Version 5, provide direction for deploying, staging, and connecting 600 Vac FLEX DGs to energize the electrical buses to supply required loads within the required timeframes.

3.1.2.7 Prevention of Inadvertent Actuation

Order EA-13-109, Attachment 2, Section 1.2.7 requires that the HCVS include means to prevent inadvertent actuation. Relevant guidance is found in NEI 13-02, Section 4.2.1.

In its FIP, the licensee stated that emergency operating procedures provide clear guidance that the HCVS is not to be used to defeat containment integrity during any design basis transients and accidents. In addition, the HCVS was designed to provide features to prevent inadvertent actuation due to equipment malfunction or operator error. Also, these protections are designed such that any credited containment accident pressure (CAP) that would provide net positive suction head to the ECCS pumps will be available (inclusive of a design basis loss-of-coolant accident). However, the ECCS pumps will not have normal power available because of the ELAP.

The containment isolation valves must be open to permit vent flow. Inadvertent actuation protection is provided by the current containment isolation circuitry associated with the primary containment isolation valves (PCIVs) used to operate the HCVS. The physical features that prevent inadvertent actuation are the key lock switches at the primary control station and a rupture disc located downstream of the HCVS control valve. This rupture disc has a burst set pressure above the header pressure expected (at the disc) during a design basis event. Intentional breaching of the rupture disc will occur outside of the MCR and will require manual operation. These design features meet the requirement to prevent inadvertent actuation of HCVS. The NRC staff's audit of the HCVS confirmed that the licensee's design is consistent with the guidance and appears to preclude inadvertent actuation.

Based on the evaluation above, the NRC staff concludes that the licensee's HCVS design, with respect to prevention of inadvertent actuation, if implemented appropriately, appears to be consistent with NEI 13-02 guidance, as endorsed by JLD-ISG-2013-02 and JLD-ISG-2015-01, and should adequately address the requirements of the order.

3.1.2.8 Monitoring of HCVS

Order EA-13-109, Attachment 2, Section 1.2.8 requires that the HCVS include means to monitor the status of the vent system (e.g. valve position indication) from the control panel required by Section 1.2.4. In addition, Order EA-13-109 requires that the monitoring system be designed for sustained operation during an ELAP. Relevant guidance is found in: NEI 13-02, Section 4.2.2; and HCVS-FAQs-01, -08, and -09.

The NRC staff reviewed the following channels documented in Table 1 of the FIP which support HCVS operation: HCVS effluent temperature, HCVS effluent radiation, HCVS valve position, HCVS control panel (ACR), HCVS components (ROS includes dc voltage, pneumatic and purge pressure), drywell pressure, and torus level. The staff notes that drywell pressure, torus level are declared HNP post-accident monitoring (PAM) variables as described in R.G. 1.97. The existing qualification of these channels is considered acceptable for compliance with Order EA-13-109 in accordance with the guidance in NEI 13-02, Appendix C, Section C.8.1. The NRC staff also reviewed FIP Section III.B.1.2.8 and determined that the HCVS instrumentation appears to be adequate to support HCVS venting operations and is capable of performing its intended function during ELAP and severe accident conditions.

Based on the evaluation above, the NRC staff concludes that the licensee's HCVS design allows for the monitoring of key HCVS instrumentation, and, if implemented appropriately, appears to be consistent with NEI 13-02 guidance, as endorsed by JLD-ISG-2013-02 and JLD-ISG-2015-01, and should adequately address the requirements of the order.

3.1.2.9 Monitoring of Effluent Discharge

Order EA-13-109, Attachment 2, Section 1.2.9 requires that the HCVS include means to monitor the effluent discharge for radioactivity that may be released from operation of the HCVS. In addition, Order EA-13-109 requires that the monitoring system provide indication from the control panel required by 1.2.4 and be designed for sustained operation during an ELAP. Relevant guidance is found in: NEI 13-02, Section 4.2.4; and HCVS-FAQs-08 and -09.

In Section III.B.1.2.9 of its FIP, the licensee described the ion chamber detector installed in the torus bay, the process and control module in the MCR, and electronics and line filter installed in enclosure 1/2T48-P801 in the control building, adjacent to the ROS (control building elevation 147'). The licensee stated the detector is qualified for the anticipated environment at the vent pipe during accident conditions. The licensee further stated that the process and control module is qualified for the expected conditions at the MCR. The NRC staff reviewed the following channels documented in Table 1 of the FIP, which support monitoring of HCVS effluent: HCVS effluent temperature and HCVS effluent radiation. The NRC staff confirmed that the effluent radiation monitor provides sufficient range to adequately indicate effluent discharge radiation levels.

Based on the evaluation above, the NRC staff concludes that the licensee's HCVS design allows for the monitoring of effluent discharge, and, if implemented appropriately, appears to be consistent with NEI 13-02 guidance, as endorsed by JLD-ISG-2013-02 and JLD-ISG-2015-01, and should adequately address the requirements of the order.

3.1.2.10 Equipment Operability (Environmental/Radiological)

Order EA-13-109, Attachment 2, Section 1.2.10 requires that the HCVS 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. Relevant guidance is found in: NEI 13-02, Sections 2.3, 2.4, 4.1.1, 5.1 and 5.2; NEI 13-02 Appendix I; and HCVS-WP-02.

Environmental

The FLEX diesel-driven Severe Accident Water Addition (SAWA) pump and FLEX DG will be staged outside so they will not be adversely impacted by a loss of ventilation.

The HCVS batteries and battery chargers are installed in the Unit 2 RPS battery rooms (2A and 2B) in the control building on the 112' elevation. The NRC staff audited licensee calculation DOEJ-HDSNC598056-M002, "Control Building RPS Battery Room HVAC Justification," Version 1, which predicts the temperature profile in the RPS battery room. The licensee determined that the maximum temperature in the RPS battery rooms will be 100°F.

The licensee sized the HCVS batteries considering a minimum operating temperature of 65°F. This is below the minimum ambient temperature of the area under ELAP conditions where the HCVS batteries are located as specified in calculation DOEJ-HDSNC598056-M002. The manufacturer's maximum temperature design limit for the HCVS batteries when either charging or discharging is 140°F and 160°F, respectively. Therefore, the HCVS batteries appear to be adequate to perform their design function under event temperatures. The manufacturer's operating temperature of the HCVS battery charger is 0°C to +50°C (32°F to 122°F). Therefore, the battery charger also appears to be adequate to perform its design function under event temperatures.

The HCVS inverters are installed in the switchgear rooms in the control building on the 130' elevation. Licensee calculation SMNH-13-005, "Hatch Switchgear Room on Control Building Elevation 130 Heatup Evaluation During an Extended Loss of all AC Power (ELAP)," Version 2, predicted the temperature profile in the switchgear rooms following an ELAP. The licensee determined that opening doors and operating fans is adequate to maintain switchgear room temperatures below 122°F to support continued operation of the equipment for the licensee's mitigating strategies. Licensee procedures NMP-OS-019-270, "Hatch Unit 1 SIG-10, Ventilation," Version 1, and NMP-OS-019-290, "Hatch Unit 2 SIG-10, Ventilation," Version 1, provide guidance for opening doors and establishing portable ventilation in the switchgear rooms.

Based on the above, the NRC staff concurs with the licensee's calculations that show the RPS battery rooms will remain within the maximum temperature limit of 160°F and 122°F for the HCVS batteries and HCVS battery chargers, respectively. Furthermore, based on temperatures remaining below 120°F (the temperature limit for electronic equipment to be able to survive indefinitely, identified in NUMARC-87-00, "Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout at Light Water Reactors," Revision 1, as endorsed by NRC R.G. 1.155), the other electrical equipment located in the switchgear rooms and at the ROS should not be adversely impacted by the loss of ventilation as a result of an ELAP event with the HCVS in operation. Therefore, the NRC staff concurs that the HCVS equipment located in the RPS battery room, switchgear rooms, and at the ROS should not be adversely impacted by the loss of ventilation as a result of an ELAP event.

Radiological

In its FIP, the licensee assessed the radiological conditions for both personnel habitability and equipment locations associated with event response to a postulated ELAP condition. The NRC staff's audit of the licensee's assessment confirmed that the anticipated severe accident radiological conditions appear to not impact the operation of necessary equipment or result in an undue risk to personnel from radiation exposure.

Based on the evaluation above, the NRC staff concludes that the licensee's HCVS design, with respect to equipment operability during severe accident conditions, if implemented appropriately, appears to be consistent with NEI 13-02 guidance, as endorsed by JLD-ISG-2013-02 and JLD-ISG-2015-01, and should adequately address the requirements of the order.

3.1.2.11 Hydrogen Combustible Control

Order EA-13-109, Attachment 2, Section 1.2.11 requires that the HCVS 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. Relevant guidance is found in: NEI 13-02, Sections 4.1.7, 4.1.7.1, and 4.1.7.2; NEI 13-02, Appendix H; and HCVS-WP-03.

In NEI 13-02, Section 4.1.7 provides guidance for the protection from flammable gas ignition for the HCVS system. The NEI issued a white paper, HCVS-WP-03, "Hydrogen /Carbon Monoxide Control Measures," Revision 1, endorsed by the NRC [Reference 33], which provides methods to address control of flammable gases. One of the acceptable methods described in the white paper is to design the HCVS to withstand the reasonable expected hydrogen deflagration and/or detonation present in the system while venting under severe accident conditions using both technical and operational experience lessons learned (Option 1).

In its FIP, the licensee stated that to prevent air/oxygen backflow into the discharge piping to ensure the flammability limits of hydrogen, and other non-condensable gases, are not reached, a strategy of powering up the mixing chamber fan in the base of the meteorological stack is used. Evaluation DOEJ-HDSNC598056-M003 describes the HCVS control of flammable gases. Hatch utilizes the main stack HVAC duct instrument test ports for introduction of argon into the main stack mixing chamber. Argon is heavier than air and will fall from the instrument test port into the base of the mixing chamber. Sufficient volume of argon will be introduced to fill the mixing chamber and "spill over" into connected system pipes. Additional defense against oxygen infiltration into the HCVS or connected systems, if the venting has ceased, is accomplished by introducing argon into the vent path a second time within the first few minutes of closing the vent path.

In addition, procedurally closing the main stack interconnecting valves and purging the main stack mixing chamber is utilized as defense in depth. Hatch will utilize a portable DG deployed to the stack to repower the stack mixing chamber fans and power operators on some of the interconnecting valves. The NRC staff confirmed that the licensee's design appears to be consistent with Option 1 of white paper HCVS-WP-03 and that the use of the mixing chamber fan in conjunction with the HCVS venting strategy should meet the requirement to prevent a detonable mixture from developing in the pipe.

Based on the evaluation above, the NRC staff concludes that the licensee's HCVS design ensures that the flammability limits of gases passing through the system are not reached, and, if implemented appropriately, appears to be consistent with NEI 13-02 guidance, as endorsed by JLD-ISG-2013-02 and JLD-ISG-2015-01, and should adequately address the requirements of the order.

3.1.2.12 Hydrogen Migration and Ingress

Order EA-13-109, Attachment 2, Section 1.2.12 requires that the HCVS be designed to minimize the potential for hydrogen gas migration and ingress into the Reactor Building or other buildings. Relevant guidance is found in NEI 13-02, Section 4.1.6; NEI 13-02, Appendix H; HCVS-FAQ-05; and HCVS-WP-03.

As discussed in Section 3.2.1.3, the SBGT is the primary interfacing mechanical system on the HCVS flow path that could lead to the potential for hydrogen gas migration and ingress into the reactor building or other buildings. The valves which isolate these systems are tested, and will continue to be tested, for leakage under 10 CFR Part 50, Appendix J. These system isolation valves are normally open and fail open on loss of control air pressure. These valves are provided with manually actuated backup nitrogen to maintain these valves closed.

An additional cross-flow avenue exists between the HCVS of the two units and other connected systems at the mixing chamber in the shared main stack. The interfacing valves in the main stack mixing chamber are connected to long runs of piping that will be evacuated of any combustible gases before combustible gas levels are approached. However, for defense in depth and per the testing criteria, the interfacing valves were leak tested as described in HCVS-FAQ-05. The NRC staff's audit of the information provided confirmed that the design appears to be consistent with the guidance and that the proposed design will minimize the potential of combustible gas migration into other buildings.

Based on the evaluation above, the NRC staff concludes that the licensee's HCVS design minimizes the potential for hydrogen gas migration and ingress, and, if implemented appropriately, appears to be consistent with NEI 13-02 guidance, as endorsed by JLD-ISG-2013-02 and JLD-ISG-2015-01, and should adequately address the requirements of the order.

3.1.2.13 HCVS Operation/Testing/Inspection/Maintenance

Order EA-13-109, Attachment 2, Section 1.2.13 requires that the HCVS include features and provisions for the operation, testing, inspection and maintenance adequate to ensure that reliable function and capability are maintained. Relevant guidance is found in NEI 13-02, Sections 5.4 and 6.2; and HCVS-FAQs-05 and -06.

In the Hatch FIP, Table 3-3 includes testing and inspection requirements for HCVS components. The NRC staff reviewed Table 3-3 and found that it is consistent with Section 6.2.4 of NEI 13-02, Revision 1. Implementation of these testing and inspection requirements for the HCVS will ensure reliable operation of the systems.

In its FIP, the licensee stated that the maintenance program was developed using the guidance provided in NEI 13-02, Sections 5.4 and 6.2, and it utilizes the standard Electric Power Research Institute (EPRI) industry preventive maintenance process for the maintenance calibration and testing for the HCVS components. The NRC staff reviewed the information provided and confirmed that the licensee has implemented adequate programs for operation, testing, inspection, and maintenance of the HCVS.

Based on the evaluation above, the NRC staff concludes that the licensee's HCVS design allows for operation, testing, inspection, and maintenance, and, if implemented appropriately, appears to be consistent with NEI 13-02 guidance, as endorsed by JLD-ISG-2013-02 and JLD-ISG-2015-01, and should adequately address the requirements of the order.

3.2 HCVS QUALITY STANDARDS

3.2.1 Component Qualifications

Order EA-13-109, Attachment 2, Section 2.1 requires that the HCVS vent path up to and including the second containment isolation barrier 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. Relevant guidance is found in NEI 13-02, Section 5.3.

In its FIP, the licensee stated that the HCVS upstream of and including the second containment isolation valve (1/2T48-F326) and penetrations are not being modified for order compliance to ensure that they continue to be designed consistent with the design basis of primary containment including pressure, temperature, radiation, and seismic loads.

The wetwell vent up to, and including, the second containment isolation barrier, is designed consistent with the design basis of the plant. These items include piping, piping supports, containment isolation valves, containment isolation valve actuators and containment isolation valve position indication components. The licensee stated that the original design for the GL 89-16 vent line was 343°F, and that engineering judgement was used for qualification to 350°F based on downstream cooling of hardened vent piping, between the wetwell and main stack mixing chamber. The licensee further clarified that the review of ASTM/ASME material properties confirmed that no reduction in material strength is expected with this small increase in temperature for the purpose of component qualification.

The new equipment procured to comply with Order EA-13-109, was purchased through new specifications for the ROS, batteries, and battery charger. Those specifications contained the required parameters for the equipment to operate under normal operational conditions, design basis accidents, and BDBEE requirements. The radiation monitor is an "off the shelf" monitor without its own specification. It was procured with a datasheet specific to HNP for radiation and temperature requirements.

Each engineered item procured with a specification required the vendor to provide test reports that verified that the test specimens were in compliance with the specification requirements. The radiation monitor also has multiple test reports which document compliance with required operating conditions/parameters.

Other commodities such as conduit, wiring, transfer switches, piping, etc. were procured consistent with the design requirements of the systems and locations where they were being installed. For example, items installed in the control building - non-harsh environment were procured according to temperature considerations consistent with current SBO temperatures and radiation. These other items like pipe, cable, valves, transmitters were procured augmented quality as necessary to meet the BDBEE requirements for the location where they were installed. The majority of installed equipment is located outside the reactor building, and therefore does not require additional qualification beyond normal operating/accident conditions of the plant.

Based on the evaluation above, the NRC staff concludes that the licensee's HCVS design, with respect to component qualifications, if implemented appropriately, appears to be consistent with NEI 13-02 guidance, as endorsed by JLD-ISG-2013-02 and JLD-ISG-2015-01, and should adequately address the requirements of the order.

3.2.2 Component Reliability and Rugged Performance

Order EA-13-109, Attachment 2, Section 2.2 requires that all other HCVS components be designed for reliable and rugged performance, 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. Relevant guidance is found in NEI 13-02, Sections 5.2 and 5.3.

In its FIP, the licensee stated that the HCVS components downstream of the outboard containment isolation valve and components that interface with the HCVS are routed in seismically qualified structures or supported from seismically qualified structures. In addition, these components, including piping and supports, electrical power supply, valve actuator pneumatic supply, and instrumentation (local and remote), have been designed and analyzed to conform to the requirements consistent with the applicable design codes for the plant and to ensure functionality following a design basis earthquake. This includes environmental qualification consistent with expected conditions at the equipment location. Table 1 of the FIP contains a list of components and instruments required to operate the HCVS, their qualification limits, and summary of the expected environmental conditions. The NRC staff reviewed this table and confirmed that the components required for HCVS venting are designed to remain functional following a design basis earthquake.

As part of the NRC staff's audit, the licensee verified that the existing primary containment isolation valves credited are capable of opening under the maximum expected differential pressure during BDB and severe accident wetwell venting. The licensee informed the NRC staff that the expected differential is within the scope of containment design for compliance with GL 89-16 since containment pressure is managed below the design pressure. Additionally, Hatch is utilizing existing PCIVs which were designed and procured to meet the containment design pressures. The NRC staff audited the licensee's documentation and confirmed that the PCIVs should open under the maximum expected differential pressure during BDB and severe accident wetwell venting.

Based on the evaluation above, the NRC staff concludes that the licensee's HCVS design, with respect to component reliability and rugged performance, if implemented appropriately, appears to be consistent with NEI 13-02 guidance, as endorsed by JLD-ISG-2013-02 and JLD-ISG-2015-01, and should adequately address the requirements of the order.

3.3 Conclusions for Order EA-13-109, Phase 1

Based on its review, the NRC staff concludes that the licensee has developed guidance and a HCVS design that, if implemented appropriately, appears to be consistent with NEI 13-02 guidance, as endorsed by JLD-ISG-2013-02 and JLD-ISG-2015-01, and should adequately address the requirements of the order.

4.0 TECHNICAL EVALUATION OF ORDER EA-13-109, PHASE 2

As stated above in Section 2.2, Order EA-13-109 provides two options to comply with the Phase 2 order requirements. Hatch has elected the option to develop and implement a reliable containment venting strategy that makes it unlikely the licensee would need to vent from the containment drywell before alternate reliable containment heat removal and pressure control is reestablished.

For this method of compliance, the order requires licensees to meet the following:

- The strategy making it unlikely that a licensee would need to vent from the containment drywell during severe accident conditions shall be part of the overall accident management plan for Mark I and Mark II containments;

- The licensee shall provide supporting documentation demonstrating that containment failure as a result of overpressure can be prevented without a drywell vent during severe accident conditions; and

- Implementation of the strategy shall include licensees preparing the necessary procedures, defining and fulfilling functional requirements for installed or portable equipment (e.g. pumps and valves), and installing the needed instrumentation.

Relevant guidance is found in NEI 13-02, Sections 4, 5 and 6; and Appendices C, D, and I.

4.1 Severe Accident Water Addition (SAWA)

The licensee plans to use the FLEX (SAWA) pump to provide SAWA flow into the RPV. Flow control for SAWA will be performed at the SAWA pump along with instrumentation and procedures to ensure that the wetwell vent is not submerged. Once SAWA flow is initiated, operators will have to monitor and maintain SAWA flow and ensure refueling of the diesel-driven equipment as necessary. The licensee also states in the FIP that the operator locations for deployment and operation of the SAWA equipment that are external to the reactor building are either shielded from direct exposure to the vent line or are a significant distance from the vent line so that dose will be maintained below emergency response organization exposure guidelines.

4.1.1 Staff Evaluation

4.1.1.1 Flow Path

The SAWA injection flow path starts at the Altamaha River and goes through the FLEX (SAWA) pump through suction hoses to the FLEX header on the residual heat removal service water (RHRSW) system at the intake structure. The SAWA flow path continues through the RHRSW system in the intake structure and into the reactor building, where it is connected to the RHR system through permanently installed piping. The SAWA flow path is completed by the RHR piping being connected to the RPV through the RHR A low pressure coolant injection (LPCI) lineup. Drywell pressure and wetwell level will be monitored and the flow rate will be adjusted by use of the SAWA pump control valve at the valve manifold that also contains the SAWA flow indication. The hoses and pumps used for SAWA flow are stored in the FLEX storage building (FSB), which is protected from all hazards. This SAWA injection path is also protected from all external hazards in addition to severe accident conditions.

4.1.1.2 SAWA Pump

In its FIP, the licensee states that the strategy is to use a portable diesel-driven pump to provide SAWA flow. The SAWA pumps are capable of 3000 gallons per minute (gpm) for injection. The SAWA pumps will be transported on trailer-mounted units and are stored in the FSB, where they are protected from all applicable external hazards. The initial SAWA flow will be injected into the RPV within 8 hours of the loss of injection. In its FIP, the licensee described the hydraulic analysis performed to demonstrate the capability of one of the two available portable FLEX pumps to provide the required 500 gpm of SAWA flow to the unit and spent fuel pool (SFP) makeup flow simultaneously. The NRC staff audited calculation A-47400, "Pump Sizing Evaluation for Hatch Units 1 and 2 Core Cooling Phase 2," Revision 2, which determined that the required SAWA flow rate of 500 gpm was within the capacity of the portable FLEX pumps.

The NRC staff audited the flow rates and pressures evaluated in the hydraulic analyses and confirmed that the equipment is capable of providing the required SAWA flow. Based on the NRC staff's audit of the FLEX pumping capabilities, as described in the above hydraulic analysis and the FIP, it appears that the licensee has demonstrated that its portable FLEX pump should perform as intended to support SAWA flow.

4.1.1.3 SAWA Analysis of Flow Rates and Timing

The licensee developed the overall accident management plan for Hatch from the Boiling-Water Reactor Owners Group Owners Group (BWROG) emergency procedure guidelines and severe accident guidelines (EPG/SAG) and NEI 13-02, Appendix I. The SAWA/SAWM [Severe Accident Water Management] implementing procedures are integrated into the HNP severe accident management guidelines (SAMGs). In particular, EPG/SAG, Revision 3, when implemented with Emergency Procedures Committee Generic Issue 1314, allows throttling of SAWA valves in order to protect containment while maintaining the wetwell vent in service. The SAMG flow charts direct the use of the hardened vent, as well as SAWA/SAWM when the appropriate plant conditions have been reached.

The licensee used the validation guidance in Appendix E to NEI 12-06, Revision 1, to demonstrate the FLEX/SAWA portable pump can be deployed and commence injection in less than 8 hours. The studies referenced in NEI 13-02, Revision 1, demonstrate that establishing flow within 8 hours will protect containment. Guidance document NEI 13-02, Appendix I, establishes an initial water addition rate of 500 gpm based on Electric Power Research Institute (EPRI) Technical Report 3002003301, "Technical Basis for Severe-Accident Mitigating Strategies." The initial SAWA flow rate at Hatch will be at least 500 gpm. After roughly 4 hours, during which the maximum flow rate is maintained, the SAWA flow will be reduced. The reduction in flow rate and the timing of the reduction will be based on stabilization of the containment parameters of drywell pressure and wetwell level.

The licensee used the referenced plant analysis included in NEI 13-02, Revision 1, and information from EPRI Technical Report 3002003301, "Technical Basis for Severe Accident Mitigating Strategies", to demonstrate that SAWA flow could be reduced to 100 gpm after 4 hours of initial SAWA flow rate and containment would remain protected. At some point, if torus level begins to rise, indicating that the SAWA flow is greater than the steaming rate due to containment heat load, SAWA flow can be further reduced as directed by the SAMGs.

In its FIP, the licensee stated that the wetwell vent was designed and installed to meet NEI 13-02, Revision 1, guidance and is sized to prevent containment overpressure under severe accident conditions. Hatch will follow the guidance (flow rate and timing) for SAWA/SAWM described in BWROG-TP-15-008, "Severe Accident Water Addition Timing," [Reference 34] and BWROG-TP-15-011 "Severe Accident Water Management" [Reference 35]. The wetwell vent will be opened prior to exceeding the design pressure value of 56 psig. The licensee also referenced analysis included in BWROG-TP-15-008, which demonstrates adding water to the reactor vessel within 8-hours of the onset of the event will limit the peak containment drywell temperature, significantly reducing the possibility of containment failure due to temperature. Drywell pressure can be controlled by venting the containment from the suppression chamber.

4.1.2 Conclusions

Based on this evaluation, the NRC staff concludes that the licensee has developed SAWA guidance that should ensure protection of the containment during severe accident conditions following an ELAP event, and, if implemented appropriately, appears to be consistent with NEI 13-02 guidance, as endorsed by JLD-ISG-2013-02 and JLD-ISG-2015-01, and should adequately address the requirements of the order.

4.2 Severe Accident Water Management (SAWM)

The strategy for Hatch, to preclude the necessity for installing a hardened drywell vent, is to implement the containment venting strategy utilizing SAWA and SAWM. This strategy consists of the use of the Phase 1 wetwell vent and SAWA hardware to implement a water management strategy that will preserve the wetwell vent path until alternate reliable containment heat removal can be established. The SAWA system consists of a FLEX (SAWA) pump injecting into the RPV. The overall strategy consists of flow control at the FLEX (SAWA) pump along with instrumentation and procedures to ensure that the wetwell vent is not submerged. Water from the FLEX (SAWA) pump will be routed through a flexible discharge to the RHR system. Hatch will accomplish SAWA flow control by using four separate discharge lines with throttle valves and digital flow meters on the SAWA pump skid. Torus water level indication will be available in the MCR. Procedures have been issued to implement this strategy, including Revision 3 to the BWROG Generic SAMGs. Via Modular Accident Analysis Program analyses described in BWROG-TP-008, Revision 0, and BWROG-TP-011, Revision 0, this strategy has been shown to protect containment without requiring a drywell vent for at least seven days, which is consistent with the guidance from NEI 13-02 for the period of sustained operation.

4.2.1 Staff Evaluation

4.2.1.1 Available Freeboard Use

As stated in the FIP, the freeboard between the 102' and 114.5' elevations in the wetwell provides approximately 805,160 gallons of water volume before level instruments would be off scale high. Generic assessment BWROG-TP-15-011 [Reference 35], provides the principles of SAWM to preserve the wetwell vent for a minimum of 7 days. After containment parameters are stabilized using SAWA, SAWA flow will be reduced to a point where containment pressure will remain relatively low while wetwell level is stable or rising very slowly. For Hatch, the SAWA/SAWM design flow rates (500 gpm at 8 hours followed by 100 gpm from 12 hours to 168 hours) and above available freeboard volume (described above) are bounded by the values utilized in the BWROG-TP-15-011 reference plant analysis that demonstrates the success of the SAWA/SAWM strategy. The NRC staff audited the information provided and concurs that the flow of water added to the suppression pool can be controlled such that the wetwell vent remains operational.

4.2.1.2 Strategy Time Line

As noted in Section 4.1.1.3, “SAWA Analysis of Flow Rates and Timing,” the SAWA flow is based on the NEI 13-02 generic analysis flow rate of 500 gpm to start at about 8 hours and will be reduced to 100 gpm after 4 hours. The NRC staff concurs that the SAWM approach should provide operators sufficient time to reduce the water flow rate and to maintain wetwell venting capability. The strategy is based on BWROG generic assessments in BWROG-TP-15-008 and BWROG-TP-15-011.

As noted above, BWROG-TP-15-008 demonstrates adding water to the reactor vessel within 8-hours of the onset of the event will limit the peak containment drywell temperature significantly, reducing the possibility of containment failure due to temperature. Drywell pressure can be controlled by venting the containment from the suppression chamber. Technical paper BWROG-TP-011 demonstrates that, for a reference plant, starting water addition at a higher rate of flow and throttling after approximately 4-hours will not increase the suppression pool level to a point that could block the suppression chamber HCVS.

4.2.2 Conclusions

Based on this evaluation, the NRC staff concludes that the licensee has developed SAWM guidance that should make it unlikely that the licensee would need to vent from the containment drywell during severe accident conditions following an ELAP event, and, if implemented appropriately, appears to be consistent with NEI 13-02 guidance, as endorsed by JLD-ISG-2013-02 and JLD-ISG-2015-01, and should adequately address the requirements of the order.

4.3 SAWA/SAWM Motive Force

4.3.1 Staff Evaluation

4.3.1.1 SAWA Pump Power Source

As described in Section 4.1, the licensee plans to use portable diesel-driven pumps to provide SAWA flow. Operators will refuel the pump and DGs in accordance with Order EA-12-049 procedures using fuel oil from the installed emergency diesel generator (EDG) fuel oil storage tanks. Procedure NMP-OS-019-257, "Hatch Unit C SIG-7, Diesel Fuel Oil Transfer," Revision 1, directs operators to refuel the portable FLEX equipment from the onsite EDG fuel oil storage tanks. The licensee states in its FIP that refueling will be accomplished in areas that are shielded and protected from the radiological conditions during a severe accident scenario. The fuel tank on the SAWA pumps are sized such that the pumps can run for approximately 8 hours prior to needing to be refueled.

4.3.1.2 DG Loading Calculation for SAWA/SAWM Equipment

In its FIP, the licensee lists drywell pressure, wetwell level, and the SAWA flow meter as instruments required for SAWA and SAWM implementation. The drywell pressure and wetwell level instruments are used to monitor the conditions of containment for HCVS venting operation. These instruments are powered by the Class 1E station batteries until the FLEX DG is deployed and available. The SAWA flow meter is powered by the pump's electrical system.
The NRC staff audited licensee calculations SENH-13-001, “Station Service Battery 1A SBO Extended Coping Time Study,” Version 1, SENH-13-002, “Station Service Battery 1B SBO Extended Coping Time Study,” Version 1, SENH-13-003, “Station Service Battery 2A SBO

Extended Coping Time Study," Version 1, and SENH-13-004, "Station Service Battery 2B SBO Extended Coping Time Study," Version 1, under compliance for NRC Order EA-12-049, which verified the capability of the Class 1E station batteries to supply power to the required loads (e.g. drywell pressure and wetwell level) during the first phase of the Hatch FLEX mitigation strategy plan for an ELAP event. The NRC staff audited licensee calculation, SENH-16-003, which verified the capability of the existing Class 1E batteries (supplemented with the HCVS Division 1 and 2 batteries) to extend the battery capacity to 24 hours of operation for HCVS functions. The NRC staff also audited licensee calculation A-47402, which verified that the 545 kW FLEX DG is adequate to support the addition of the HCVS electrical loads. The NRC staff confirmed that the Class 1E batteries, HCVS dedicated batteries, and 545 kW FLEX DGs should have sufficient capacity and capability to supply the necessary SAWA/SAWM loads during an ELAP event.

4.3.2 Conclusions

Based on this evaluation, the NRC staff concludes that the licensee has established the necessary motive force capable to implement the water management strategy during severe accident conditions following an ELAP event, and, if implemented appropriately, appears to be consistent with NEI 13-02 guidance, as endorsed by JLD-ISG-2013-02 and JLD-ISG-2015-01, and should adequately address the requirements of the order.

4.4 SAWA/SAWM Instrumentation

4.4.1 Staff Evaluation

4.4.1.1 SAWA/SAWM Instruments

In Section IV.C.10.2 of its FIP the licensee stated, that the instrumentation needed to implement the SAWA/SAWM strategy are drywell pressure, wetwell level, and SAWA flow metering. The drywell pressure and wetwell level instruments are existing R.G. 1.97 instruments that were designed and qualified for severe accident conditions. The flow instrument range is 0 to 500 gpm which appears to be consistent with the licensee's strategy. The NRC staff reviewed Section IV.C.10, Section IV.C.10.1, Section IV.C.10.2, and Table 1 of the FIP and found that the instruments appear to be consistent with the NEI 13-02 guidance.

4.4.1.2 SAWA Instruments and Guidance

In Section IV.C.10.2 of its FIP, the licensee stated that the drywell pressure and wetwell level instruments, used to monitor the condition of containment, are pressure and differential pressure detectors that are safety-related and qualified for post-accident use. The licensee also stated, that these instruments are used to maintain the wetwell vent in service while maintaining containment pressure and that these instruments are powered by batteries for at least 24 hours and will be re-powered when the FLEX generator is deployed.

4.4.1.3 Qualification of SAWA/SAWM Instruments

In Section IV.C.10.3 of the FIP, the licensee stated drywell pressure and wetwell level instruments are pressure and differential pressure detectors, are safety-related, and are qualified for post-accident use. The NRC staff found the drywell pressure and wetwell level instruments are declared HNP post-accident monitoring (PAM) variables as described in R.G. 1.97, and the existing qualification of these channels is considered acceptable for compliance with Order EA-13-109 in accordance with the guidance in NEI 13-02, Appendix C, Section C.8.1. The NRC staff verified the R.G. 1.97 variables in the HNP FSAR.

In Section IV.C.10.2 and Section IV.C.10.3 of its FIP, the licensee stated, in part, the SAWA flow meter is attached to the SAWA pump skid and will be deployed outside the reactor building, a significant distance from the vent pipe; therefore, radiation is not a concern. The licensee stated in Table 1 of its FIP that anticipated temperature at this location is 104°F and the flow meter is qualified to operate up to 120°F. The NRC staff reviewed table 1 and confirmed that the SAWA flow meter appears to be qualified for the anticipated environment.

4.4.2 Conclusions

Based on this evaluation, the NRC staff concludes that the licensee has in place, the appropriate instrumentation capable to implement the water management strategy during severe accident conditions following an ELAP event, and, if implemented appropriately, appears to be consistent with NEI 13-02 guidance, as endorsed by JLD-ISG-2013-02 and JLD-ISG-2015-01, and should adequately address the requirements of the order.

4.5 SAWA/SAWM Severe Accident Considerations

4.5.1 Staff Evaluation

4.5.1.1 Severe Accident Effect on SAWA Pump and Flowpath

To address SAWA/SAWM severe accident dose considerations, the licensee assessed the expected radiological conditions at different locations and times where operator actions will take place during FLEX/SAWA/SAWM activities. The analyzed locations include the MCR, ROS, and travel paths for hose routing.

In its FIP, the licensee states that manual actions required for SAWA inside the reactor building, where there could be a high radiation field due to a severe accident, will be performed before the dose reaches unacceptable levels. The licensee further states that other SAWA actions all take place at locations that are shielded from the severe accident radiation by the thick concrete walls of the reactor building. The SAWA pump is stored in the FSB and will be operated outside the reactor building significantly away from the vent path. The NRC staff audited the information provided and agrees that there will be no significant issues with radiation dose rates at the SAWA pump control location and there will be no significant dose to the SAWA pump.

In its FIP, the licensee states that the SAWA flow path inside the reactor building consists of stainless steel piping that will be unaffected by the radiation dose. Therefore, the NRC staff concurs that the SAWA flow path will not be adversely affected by radiation effects due to the severe accident conditions.

4.5.1.2 Severe Accident Effect on SAWA/SAWM Instruments

The HNP's SAWA strategy relies on three instruments: wetwell level, drywell pressure, and SAWA flow. In its FIP, the licensee states that the drywell pressure and wetwell level instruments are safety-related and qualified for post-accident use and therefore are qualified for Order EA-13-109 events, in accordance with the guidance in NEI 13-02, Appendix C, Section C.8.1.

As stated in Section 4.5.1.1, the SAWA pump will be operated outside the reactor building in a location that is significantly away from the vent path. This location ensures that there will be no adverse effects from radiation exposure to the flow instruments mounted on the SAWA pump. The licensee has chosen low dose areas for the FLEX/SAWA manifold flow meters to ensure that their operation will not be adversely affected by radiation exposure. Based on this information, the NRC staff concurs that the SAWA/SAWM instruments should not be adversely affected by radiation effects due to severe accident conditions.

4.5.1.3 Severe Accident Effect on Personnel Actions

In its FIP, the licensee stated that after the SAWA injection path is aligned inside the reactor building via MCR controls, the operators can control SAWA/SAWM, as well as observe the necessary instruments from outside the reactor building. The thick concrete reactor building walls (below 147' level), as well as the distance to the core materials provide sufficient shielding to ensure there is no radiological concern with any actions outside the reactor building. Therefore, all SAWA controls and indications are accessible during severe accident conditions.

The licensee further stated that the SAWA pump and monitoring equipment can all be operated from outside the reactor building at ground level; therefore, there are no unusual thermal concerns for the operator. Plant monitoring to support SAWA and SAWM is in the MCR or ROS. The HNP FLEX response ensures that the FLEX (SAWA) pump, FLEX generators, and other equipment can all be run for a sustained period by refueling. All of the refueling locations are in shielded or protected areas so that there is no radiation hazard during a severe accident. Environmental conditions in the MCR and the ROS were discussed previously in Section 3.1.1.2, Personnel Habitability - Environmental. Based on the information provided, the NRC staff agrees that, if implemented correctly, the environmental conditions should not prevent operators from implementing the SAWA or SAWM strategies.

The licensee performed an assessment of the radiological conditions for designated areas outside of containment caused by the sustained operation of the HCVS under the beyond-design-basis severe accident condition of an ELAP. This assessment used conservative assumptions to evaluate the expected radiological conditions in all areas that may require access during a beyond design basis ELAP. As stated in Section 3.1.1.3 Personnel Habitability – Radiological, the NRC staff concludes, based on a review of the licensee's assessment as documented in its FIP, that if implemented correctly, mission doses associated with actions taken to protect the public under beyond-design-basis severe accident conditions should not subject plant personnel to an undue risk from radiation exposure.

4.5.2 Conclusions

Based on this evaluation, the NRC staff concludes that the licensee has considered the severe accident effects on the water management strategy and that the operation of components and instrumentation should not be adversely affected, and the performance of personnel actions should not be impeded, during severe accident conditions following an ELAP event. The NRC staff further concludes that the water management strategy, if implemented appropriately, appears to be consistent with NEI 13-02 guidance, as endorsed by JLD-ISG-2013-02 and JLD-ISG-2015-01, and should adequately address the requirements of the order.

4.6 Conclusions for Order EA-13-109, Phase 2

Based on its review, the NRC staff concludes that the licensee has developed guidance and a water management strategy that, if implemented appropriately, appears to be consistent with NEI 13-02 guidance, as endorsed by JLD-ISG-2013-02 and JLD-ISG-2015-01, and should adequately address the requirements of the order.

5.0 HCVS/SAWA/SAWM PROGRAMMATIC CONTROLS

5.1 Procedures

Order EA-13-109, Attachment 2, Section 3.1 requires that the licensee develop, implement, and maintain procedures necessary for the safe operation of the HCVS. Furthermore, Order EA-13-109 requires that procedures be established for system operations when normal and backup power is available, and during an ELAP. Relevant guidance is found in NEI 13-02, Sections 6.1.2 and 6.1.2.1.

In its FIP, the licensee states that a site-specific program and procedures were developed following the guidance provided in NEI 13-02, Sections 6.1.2, 6.1.3, and 6.2. They address the use and storage of portable equipment including routes for transportation from the storage locations to deployment areas. In addition, the procedures have been established for system operations when normal and backup power is available, and during ELAP conditions. The FIP also states that provisions have been established for out-of-service requirements of the HCVS and the compensatory measures. In the FIP, Section V.B provides specific time frames for out-of-service requirements for HCVS functionality.

The FIP also provides a list of key areas where either new procedures were developed or existing procedures were revised. The NRC staff reviewed the overall procedures and programs developed, including the list of key components included, and noted that they appear to be consistent with the guidance found in NEI 13-02, Revision 1. The NRC staff determined that procedures developed appear 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.

Based on the evaluation above, the NRC staff concludes that the licensee's procedures for HCVS/SAWA/SAWM operation, if implemented appropriately, appear to be consistent with NEI 13-02 guidance, as endorsed by JLD-ISG-2013-02 and JLD-ISG-2015-01, and should adequately address the requirements of the order.

5.2 Training

Order EA-13-109, Attachment 2, Section 3.2 requires that the licensee train appropriate personnel in the use of the HCVS. Furthermore, Order EA-13-109 requires that the training include system operations when normal and backup power is available, and during an ELAP. Relevant guidance is found in NEI 13-02, Section 6.1.3.

In its FIP, the licensee stated that all personnel expected to perform direct execution of the HCVS/SAWA/SAWM actions will receive necessary training. The training plan has been developed per the guidance provided in NEI 13-02, Section 6.1.3, and will be refreshed on a periodic basis as changes occur to the HCVS actions, systems, or strategies. In addition, training content and frequency follows the systematic approach to training process. The NRC staff reviewed the information provided in the FIP and confirmed that the training plan is consistent with the established systems approach to training process.

Based on the evaluation above, the NRC staff concludes that the licensee's plan to train personnel in the operation, maintenance, testing, and inspection of the HCVS design and water management strategy, if implemented appropriately, appears to be consistent with NEI 13-02 guidance, as endorsed by JLD-ISG-2013-02 and JLD-ISG-2015-01, and should adequately address the requirements of the order.

6.0 CONCLUSION

In June 2014, the NRC staff started audits of the licensee's progress in complying with Order EA-13-109. The staff issued an ISE for implementation of Phase 1 requirements on March 25 1, 2015 [Reference 14], an ISE for implementation of Phase 2 requirements on August 2, 2016 [Reference 15], and an audit report on the licensee's responses to the ISE open items on September 19, 2017 [Reference 16]. The licensee reached its final compliance date on November 12, 2018, and has declared in letter dated November 12, 2018 [Reference 17], that Edwin I. Hatch Nuclear Plant, Units 1 and 2, is in compliance with the order.

Based on the evaluations above, the NRC staff concludes that the licensee has developed guidance that includes the safe operation of the HCVS design and a water management strategy that, if implemented appropriately, should adequately address the requirements of Order EA-13-109.

7.0 REFERENCES

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

2. Letter from Hatch to NRC, "Hatch, Units 1 & 2 – Phase 1 Overall Integrated Plan in Response to June 6, 2013, Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions Phase 1 (Order Number EA-13-109)," dated June 27, 2014 (ADAMS Accession No. ML14178B464)

3. Letter from Hatch to NRC, "First Six-Month Status Report For Phase 1 Overall Integrated Plan in Response to June 6, 2013 Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109)," dated December 30, 2014 (ADAMS Accession No. ML15049A513)

4. Letter from Hatch to NRC, "Second Six-Month Status Report For Phase 1 Overall Integrated Plan in Response to June 6, 2013 Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109)," dated June 26, 2015 (ADAMS Accession No. ML15177A353)

5. Letter from Hatch to NRC, "Hatch, Units 1 & 2 – Phase 1 (Updated) and Phase 2 Overall Integrated Plan in Response to June 6, 2013 Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order EA-13-109)," dated December 23, 2015 (ADAMS Accession No. ML15357A212)

6. Letter from Hatch to NRC, "Fourth Six-Month Status Report For Phases 1 and 2 Overall Integrated Plan in Response to June 6, 2013 Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109)," dated June 13, 2016 (ADAMS Accession No. ML16165A184)

7. Letter from Hatch to NRC, "Fifth Six-Month Status Report For Phases 1 and 2 Overall Integrated Plan in Response to June 6, 2013 Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109)," dated December 14, 2016 (ADAMS Accession No. ML16349A160)

8. Letter from Hatch to NRC, "Sixth Six-Month Status Report For Phases 1 and 2 Overall Integrated Plan in Response to June 6, 2013 Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109)," dated June 12, 2017 (ADAMS Accession No. ML17163A224)

9. Letter from Hatch to NRC, "Seventh Six-Month Status Report For Phases 1 and 2 Overall Integrated Plan in Response to June 6, 2013 Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation

Under Severe Accident Conditions (Order Number EA-13-109)," dated December 5, 2017 (ADAMS Accession No. ML17339A347)

10. Letter from Hatch to NRC, "Eighth Six-Month Status Report For Phases 1 and 2 Overall Integrated Plan in Response to June 6, 2013 Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109)," dated June 27, 2018 (ADAMS Accession No. ML18178A403)

11. 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, dated May 27, 2014 (ADAMS Accession No. ML14126A545)

12. Nuclear Regulatory Commission Audits of Licensee Responses to Phase 2 of Order EA-13-109 to Modify Licenses With Regard To Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions, dated August 10, 2017 (ADAMS Accession No. ML17220A328)

13. Nuclear Regulatory Commission Office of Nuclear Reactor Regulation Office Instruction LIC-111, "Regulatory Audits" (ADAMS Accession No. ML082900195)

14. Letter from NRC to Hatch, "Hatch Nuclear Plant, Units 1 and 2 – Interim Staff Evaluation Relating to Overall Integrated Plan in Response to Phase 1 of Order EA-13-109 (Severe Accident Capable Hardened Vents)," dated March 25, 2015 (ADAMS Accession No. ML14335A137)

15. Letter from NRC to Hatch, "Hatch Nuclear Plant, Units 1 and 2 – Interim Staff Evaluation Relating to Overall Integrated Plan in Response to Phase 2 of Order EA-13-109 (Severe Accident Capable Hardened Vents)," dated August 2, 2016 (ADAMS Accession No. ML16099A260)

16. Letter from NRC to Hatch, "Hatch Nuclear Plant, Units 1 and 2 – Report for The Audit of Licensee Responses to Interim Staff Evaluations Open Items Related to NRC Order EA-13-109 to Modify Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions," dated September 19, 2017 (ADAMS Accession No. ML17254A042)

17. Letter from Hatch to NRC, "Hatch Nuclear Plant, Units 1 and 2, Report of Full Compliance with Phase 1 and Phase 2 of 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 November 12, 2018 (ADAMS Accession No. ML18316A022)

18. SECY-11-0093, "Near-Term Report and Recommendations for Agency Actions Following the Events in Japan," dated July 12, 2011 (ADAMS Accession No. ML111861807)

19. 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)

20. 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)

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

22. 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)

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

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SUBJECT: EDWIN I. HATCH NUCLEAR PLANT, UNITS 1 AND 2 - SAFETY EVALUATION REGARDING IMPLEMENTATION OF HARDENED CONTAINMENT VENTS CAPABLE OF OPERATION UNDER SEVERE ACCIDENT CONDITIONS RELATED TO ORDER EA-13-109 (CAC NOS. MF4479 AND MF4480; EPID NO. L-2014-JLD-0042) DATED April 3, 2019

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