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

August 29, 2019

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

SUBJECT: LASALLE COUNTY STATION, 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. MF4456 AND MF4457; EPID NO. L-2014-JLD-0050)

Dear Mr. Hanson:

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 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 30, 2014 (ADAMS Accession No. ML14184A016), Exelon Generation Company, LLC (the licensee) submitted its Phase 1 OIP for LaSalle County Station, Units 1 and 2 (LaSalle) 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 LaSalle, including the combined Phase 1 and Phase 2 OIP in its letter dated December 16, 2015 (ADAMS Accession No. ML15352A109). 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 Boiling Water Reactor 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 31, 2015 (Phase 1) (ADAMS Accession No. ML15084A180), August 2, 2016 (Phase 2) (ADAMS Accession No. ML16110A368), and December 22, 2017 (ADAMS Accession No. ML17354B306), the NRC issued Interim Staff Evaluations and an audit report, respectively, on the licensee's progress. By letter dated December 14, 2018 (ADAMS Accession No. ML18348B252), the licensee reported that LaSalle is in full compliance with the requirements of Order EA-13-109 and submitted a Final Integrated Plan for LaSalle.

The enclosed safety evaluation provides the results of the NRC staff's review of LaSalle's hardened containment vent design and water management strategy for LaSalle. The intent of the safety evaluation is to inform LaSalle 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,

Nathan Sanfilippo, Chief
Beyond-Design-Basis Engineering Branch
Division of Licensing Projects
Office of Nuclear Reactor Regulation

Docket Nos. 50-373 and 50-374

Enclosure:
Safety Evaluation

cc w/encl: Distribution via Listserv

TABLE OF CONTENTS

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

EXELON GENERATION COMPANY, LLC

LASALLE COUNTY STATION, UNITS 1 AND 2

DOCKET NOS. 50-373 AND 50-374

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 30, 2014 [Reference 2], Exelon Generation Company, LLC (the licensee) submitted a Phase 1 Overall Integrated Plan (OIP) for LaSalle County Station, Units 1 and 2 (LaSalle, LSCS) in response to Order EA-13-109. By letters dated December 17, 2014 [Reference 3], June 30, 2015 [Reference 4], December 16, 2015 (which included the combined Phase 1 and Phase 2 OIP) [Reference 5], June 30, 2016 [Reference 6], December 14, 2016 [Reference 7], June 29, 2017 [Reference 8], December 15, 2017 [Reference 9], and June 22, 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 31, 2015 (Phase 1) [Reference 14], August 2, 2016 (Phase 2) [Reference 15], and December 22, 2017 [Reference 16], the NRC issued Interim Staff Evaluations (ISEs) and an audit report, respectively, on the licensee's progress. By letter dated December 14, 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 [Reference 24], NEI issued NEI 13-02, "Industry Guidance for Compliance with Order EA-13-109," Revision 0, 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

LaSalle is a two-unit site and each unit is a General Electric BWR Model 5 with a Mark II containment. Containment integrity is maintained by controlling containment pressure using the HCVS. The HCVS is initiated using manual action from the main control room (MCR) or remote operating station (ROS) at the appropriate time based on procedural guidance in response to plant conditions from observed or derived symptoms. The HCVS utilizes containment parameters of drywell pressure and wetwell water level from the MCR instrumentation to monitor effectiveness of the venting actions. Vent operation is monitored by HCVS valve position, temperature, and effluent radiation levels. The HCVS motive force is monitored and has the capacity to operate for 24 hours with installed equipment. Replenishment of the motive force will be by use of portable equipment once the installed motive force is exhausted. Venting actions are capable of being maintained for a sustained period of at least 7 days.

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 the HCVS was designed to minimize the reliance on operator actions in response to the hazards identified in NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide" (Reference 28), that are applicable to the plant site. Operator actions to initiate the HCVS vent path can be completed by plant personnel and include the capability for remote-manual initiation from the HCVS control station. A list of the remote manual actions performed by plant personnel to open the HCVS vent path 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 (FIP 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 large portable equipment needs to be moved in the first 24 hours to operate the HCVS. After 24 hours, available personnel will be able to connect supplemental electric power and pneumatic supplies for sustained operation of the HCVS for a minimum of 7 days. The FLEX generators and replacement nitrogen bottles provide this motive force. Likely, 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. These actions are consistent with the type 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 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

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.

In its FIP, the licensee stated that the primary control location for the HCVS is the MCR. The alternate control location is the ROS located at the 731' elevation of the auxiliary building. FLEX actions that may be taken to maintain habitability of the MCR and ROS were developed in response to NRC Order EA-12-049. The environmental evaluation in these areas was performed in response to NRC Order EA-12-049 and is evaluated in the NRC mitigating strategies safety evaluation. Plant procedure LOA-FSG-005, "Area Ventilation," Revision 5, provides guidance for compensatory actions to maintain temperatures such that operators will not be prevented from performing required actions. The FLEX actions include:

1. Restoring MCR ventilation via the FLEX diesel generator (DG). The MCR ventilation loads were included in FLEX DG load calculations.
2. Opening MCR doors to the auxiliary building (if required).
3. Operating portable fans to move auxiliary building air through the MCR (if required).
4. Opening doors in the Division 1 and 2 switchgear rooms to the diesel generator roof and establish air flow into the auxiliary building.
5. Opening doors between the auxiliary building stairways to the Division 1 and 2 switchgear rooms and establish air flow.
6. Opening doors in the Division 1 switchgear rooms to the turbine building to establish air flow.
7. Installing portable fans to assist in air movement through the auxiliary building.

In the FIP, Table 2 contains a thermal evaluation of all the operator actions that may be required to support HCVS operation. The relevant evaluations (EC 392353 and EC 397691 in Design Consideration Summary (DCS) Section 4.1.14) demonstrate that the final design meets the order requirements to minimize the plant operators' exposure to occupational hazards.

The licensee performed calculation L-003969, "U1/U2 Transients Heat-Up Analysis for the Control Room, AEERs, Div 1 and Div 2 Switchgear Rooms following a BDBEE," Revision 0, which predicts the temperature profile in various areas including at the respective ROS following an ELAP. The licensee determined that performing compensatory ventilation actions (opening doors and establishing portable ventilation) in the area of the ROS will maintain temperatures below 120 degrees Fahrenheit (°F). An oxygen monitoring system is installed for each ROS location for U1 and U2 to alert personnel of a low oxygen environment due to a gas release from the ROS argon compressed gas bottles. The oxygen monitors at the ROS are non-safety and non-seismic as they are not required under EA-13-109. The oxygen monitors are installed for personnel safety concern during normal operation when argon header pressure is not continuously monitored. The oxygen monitoring system will alert (via strobe lights and horns) any personnel in the area when the oxygen concentration at the bottle area in the ROS is below 19.5 percent.

As noted above, 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. The NRC staff also audited the engineering evaluations in DCS Section 4.1.14. The NRC staff noted that in some areas the temperature may be a little higher, however the stay time is limited, and work performed is not strenuous. The NRC staff reviewed the information provided and concurs that the licensee has developed a plan that, if implemented appropriately, should maintain or restore equipment and personnel habitability conditions following a BDBEE such that operators will not be prevented from performing required tasks due to temperature.

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.

The licensee's calculation L-004115, "HCVS Phase 1 Dose Assessment," documents the dose assessment for designated areas inside the reactor building (outside of containment) and outside the reactor building caused by the sustained operation of the HCVS under the beyond-design-basis severe accident condition of an ELAP. Calculation L-004115 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 as determined in the licensee's dose calculation should not exceed 10 Roentgen equivalent man (rem)[2]. The calculated 7-day dose due to HCVS operation is a conservative maximum integrated radiation dose over a 7-day period with ELAP and fuel failure starting at reactor shutdown. For the sources considered and the methodology used in the calculation, the timing of HCVS vent operation or cycling of the vent will not create higher doses at personnel habitability and equipment locations (i.e., maximum doses determined in the calculation bound operational considerations for HCVS vent operation).

[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/radialion/health-effects/rad-exposure-cancer.html

The licensee determined the expected dose rates in all locations requiring access following a beyond-design-basis ELAP. The licensee's evaluation indicates that for the areas requiring access in the early stages of the ELAP 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 (ERO) emergency worker dose guidelines.

The licensee evaluated the maximum dose rates and 7-day integrated whole-body gamma dose equivalents for the MCR and the ROS. In its FIP, the licensee states that the ROS location and the travel path to the ROS have been evaluated for habitability and accessibility during a severe accident. The licensee further states that during an accident, the distance and shielding combined with the short duration of actions required at the ROS show it to be an acceptable location for alternate control. The evaluation (as documented in L-004115) 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) should 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, EPA-400/R-16/001, "Protective Action Guides and Planning Guidance for Radiological Incidents," provides 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 staff 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 audited the licensee's calculation 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 during the sustained operating period, the NRC staff agrees 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 and that under the postulated scenarios of Order EA-13-109, the MCR is adequately protected from excessive radiation dose and no further evaluation of its use is required (HCVS-FAQ-06). The licensee also stated that alternate control of the HCVS is accomplished from the ROS. The ROS location is in an area evaluated to be accessible before and during a severe accident. The Units 1 and 2 ROSs are located at the respective 731' elevation of the auxiliary building. The licensee also provided, in Table 1 of the FIP, a list of the controls and indications that are or may be required to operate the HCVS during a severe accident, 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 evaluation in Section 1.1.4 of the FIP and examined the information provided in Table 1. 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 LaSalle document EC 392353, "U2 Hardened Containment Vent System (HCVS) – Fukushima Order EA-13-109," Revision 5, and calculation L-004115, "HCVS Phase I Dose Assessment," Revision 3. The NRC staff noted that the Regulatory Guide (RG) 1.97 instruments for drywell pressure and wetwell level (not including the reactor building indicators) did not have qualification information listed in Table 1, but are considered acceptable, in accordance with the NEI 13-02 guidance, based on the original qualification for severe accident conditions. The NRC staff also notes that the pressure indicators 1(2)PT-CM029 and 1(2)LT-CM030 qualification was considered separately and was not part of the FAQ for RG 1.97 instruments.

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 calculations L-004097, "Hardened Containment Vent Capacity," Revision 3 (Unit 1) and L-004149, "Hardened Containment Vent Capacity," Revision 0 (Unit 2), which provides verification that the HCVS has the capacity of the equivalent of 1 percent power flow at the lesser of the primary containment design pressure or the primary containment pressure limit (PCPL). These analyses were performed using Reactor Excursion and Leak Analysis Program version 5 (RELAP5) models created for the HCVS piping and fittings.

The design pressure and PCPL are based on the pressure in the drywell, so hydrostatic head must be considered when determining the pressure above the suppression pool water level where the HCVS system is attached to the wetwell. The steady state venting capacity of the HCVS was determined at a wetwell vapor space pressure of 38 psig, which corresponds to PCPL in the drywell reduced by the hydrostatic head of water above the downcomers connecting the drywell and wetwell with the maximum amount of water in the suppression pool (including RCS inventory and thermal expansion). Note that the wetwell will not be filled completely with water due to HCVS Phase 2 severe accident water management (SAWM) strategy. However, for conservatism, the lower value of 38 pounds per square inch gauge (psig) is used. A higher wetwell air space pressure will result in higher flow rates through the vent line.

For Unit 1, at a venting pressure of 38.4 psig, the HCVS can vent 151,351 pounds mass per hour (lbm/hr) of steam. At 1 percent reactor thermal power, the required vent capacity for Unit 1 is 150,700 lbm/hr. For Unit 2, at a wetwell pressure of 38.1 psig, the HCVS can vent 152,464 lbm/hr of steam. At 1 percent reactor thermal power, the required vent capacity for Unit 2 is 150,650 lbm/hr. Therefore, both units' vent designs can accommodate a saturated steam flow rate equivalent to one percent licensed rated power.

The NRC staff reviewed the information provided and audited the evaluations. The NRC staff noted that the evaluation conservatively used a rated thermal power of 4,068 megawatts thermal (MWt). Units 1 and 2 are currently licensed at 3,546 MWt.

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.

The NRC staff evaluated the HCVS vent path and the location of the discharge. The wetwell vent exits the primary containment through the primary containment vacuum breaker line. The vent lines for both units are 12" diameter pipes connected to the existing 24" wetwell to primary containment vacuum breaker line accessible from elevation 740' in reactor building. The 12" vent pipes penetrate the reactor building at elevation 755'-5" and enter a 12"x14" reducer (44' - 11" above the plant grade of 710'-6"). Section 4.1.5.2 of NEI 13-02, Revision 1 requires that, if the release from HCVS is through a stack different than the plant meteorological stack, the elevation of the stack should be higher than the nearest power block building. At LaSalle, the top of the HCVS pipe is 902'-8.5" and the top of the roof parapet is 894'-4", resulting in a release point 8'-4.5" higher than the reactor building roof parapet.

The NRC staff's review indicates that this satisfies the guidance for height from HCVS-FAQ-04, "Missile Evaluation for HCVS Components 30-Feet Above Grade."

Part of the HCVS-FA0-04 guidance is designed to ensure that vented fluids are not drawn immediately back into any emergency ventilation intakes. Such ventilation intakes should be below a level of the pipe by 1 foot for every 5 horizontal feet. The MCR emergency intake in the ELAP event is at elevation 842' elevation, which is approximately 60 feet below the HCVS pipe outlet. This intake is approximately 130 horizontal feet from the Units 1 and 2 vent pipes, which would require the intake to be approximately 26'below the vent pipe. Therefore, the vent pipe is appropriately placed relative to this air intake.

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 (UHS) for plants that are enveloped by the assumptions in the white paper.

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

1. The two HCVS vent lines exit the reactor building at elevation 755'-5" (approximately 45' above the plant grade). Therefore, none of the HCVS vent pipe outside the reactor building is less than 30' above grade.

2. The exposed piping greater than 30'above grade has the following characteristics:
    a. The total vent pipe exposed area is about 275 square feet for Unit 1 and 252 square feet for Unit 2, less than the 300 square foot limit.
    b. The pipe is made of schedule STD carbon steel and is not plastic and the pipe components have no small tubing susceptible to missiles.
    c. There are no obvious sources of missiles located in the proximity of the exposed HCVS components.

3. The licensee maintains a large cutoff saw as part of the FLEX equipment. This saw is capable of cutting the vent pipe should it become damaged such that it restricts flow to an unacceptable level.

4. LaSalle screens out for hurricanes as a credible threat.

The licensee evaluated that the HCVS pipe is adequately protected from all external events and meets all the requirements of this white paper. The licensee determined that no further protection is required.

The licensee's evaluation also determined that the HCVS pipe is adequately protected from the tornado missile assumptions identified in HCVS-WP-04. The NRC staff reviewed the information provided and audited calculation L-004092, Revision 2 and evaluation EC-392353, Revision 5, Section 4.1.38 and the associated drawings. The NRC staff agrees that supplementary protection is not required for the HCVS piping and components.

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 described the HCVS for Units 1 and 2 at LSCS as being fully independent of each other. Therefore, the status at each unit is independent of the status of the other unit. The two vent lines are supported by a common tower, but there is no cross tie between them hydraulically. The HCVS system piping and the Hydrogen Recombiner system piping are independent. The HCVS dedicated discharge flow path has no interconnection with any other systems, except for the primary containment vacuum breaker piping that is utilized for wetwell vent supply. The connection from 1(2)HG05A-6 to the vacuum breaker line is upstream of the HCVS discharge piping connection. Therefore 1(2)HG05A-6 communicates with the suppression chamber via primary containment vacuum breaker piping regardless of HCVS installation. On Unit 1, Hydrogen Recombiner line 1HG05A-6 is isolated from the primary containment vacuum breaker piping via two primary containment isolation valves (1HG005A and 1HG006A). Likewise, on Unit 2, Hydrogen Recombiner line 2HG05A-6 is isolated from the primary containment vacuum breaker piping via two primary containment isolation valves (2HG005A and 2HG006A). These valves are leak-rate tested as part of the station's 10 CFR [Title 10 of the *Code of Federal Regulations*] Part 50, Appendix J, "Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors," Program [Reference 32]. 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 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 main control room 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 HCVS is initiated via manual action from the ROS combined with manual control from either the MCR or ROS. The NRC staff noted that there are separate ROS's for each unit located in the respective auxiliary buildings at the 731' elevation, and that each ROS is readily accessible from the MCR. Table 1 of the FIP contains a list of the HCVS instrumentation and controls components including their location and qualification information. 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 to meet the requirement for an alternate means of operation, the each unit has a separate ROS is located in the auxiliary building on elevation 731'. Each ROS is readily accessible from MCR. Each ROS contains manually-operated valves that supply pneumatics to the HCVS flow path valve actuators so that these valves may be opened without power to the valve actuator solenoids and regardless of any containment isolation signals. This provides a diverse method of valve operation and improves system reliability.

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 required controls and instruments that are required for severe accident response and demonstrates that all these controls and instruments will be functional during a loss of ac power and severe accident. Table 2 of the FIP contains a summary of thermal and radiological evaluations of all the operator actions that may be required to support HCVS operation during a loss of ac power and severe accident. The licensee's evaluations 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. Attachment 6 of the FIP contains a site layout showing the location of these HCVS actions. The NRC staff audited the pertinent plant drawings and evaluation documents. The NRC staff's audit 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.

Pneumatic Sources Analysis

For the first 24 hours following the ELAP event, the pneumatic motive force for the actuation of the two primary containment isolation valves (PCIVs) will be supplied by two nitrogen gas bottles. The nitrogen gas bottles are stored in the ROS located in the auxiliary building. These bottles have been sized such that they can provide motive force for at least eight vent cycles of the PCIVs.

The licensee determined the required pneumatic supply storage volume and supply pressure set point required to operate the PCIVs actuation for 24 hours following a loss of normal pneumatic supplies during an ELAP in calculation L-004117, "HCVS Nitrogen Pressure Regulator Set Point and Bottle Capacity," Revision 1, and calculation L-004184, "HCVS Nitrogen Pressure Regulator Set Point and Bottle Capacity," Revision 1. The minimum required pressure for total HCVS operation is calculated at around 2,000 psig. The licensee's calculation determined that two nitrogen bottles, each filled at the maximum capacity of 2,640 psig, will provide sufficient capacity for eight cycles of the PCIVs for 24 hours following an ELAP. This pressure includes an allowance for leakage. The NRC staff audited the calculations and confirmed that there should be sufficient pneumatic supply available to provide motive force to operate the HCVS system 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, LaSalle would rely on a new dedicated battery and battery charger with sufficient capacity to supply both unit's HCVS loads. The 125-volt (V) dc HCVS battery, battery charger, distribution panel, and transfer switch are located in the Unit 2 auxiliary building on elevation 731'. The HCVS battery and battery charger are installed where they are protected from applicable hazards.

The HCVS battery has a nominal capacity of 344 ampere hours (Ah). The HCVS battery has a minimum capacity capable of providing power for 24 hours without recharging. During the audit period, the licensee provided the NRC staff with an 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 L-004114, "125 VDC Battery Sizing Calculation for Hardened Containment Vent System for 24 Hour Duty Cycle," Revision 0, which verified the capability of the HCVS battery to supply power to the required loads during the first phase of the LaSalle venting strategy for an ELAP. The HCVS battery was sized in accordance with Institute of Electrical and Electronics Engineers (IEEE) Standard 485-2010, "IEEE Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications," which is endorsed by RG 1.212, "Sizing of Large Lead-Acid Storage Batteries," published in 2015. The licensee's calculation identified the required loads and their associated ratings (watts (W), current, and minimum system operating voltage). The licensee's battery sizing calculation also showed that the maximum load for both units (Units 1 and 2) is 8.8 amperes of continuous loading for a 24-hour duty period. The battery selected by the licensee has a capacity to support 9.5 amperes of continuous loading for 24-hour duty period without degrading or utilizing any design margin. Therefore, the LaSalle HCVS battery should have sufficient capacity to supply power for at least 24 hours.

The licensee's strategy includes repowering the HCVS battery charger within 24 hours after initiation of an ELAP. The licensee's strategy relies on one portable 500-kilowatt (kW) 480 Volt alternating current (Vac) FLEX DG per unit. Only one of the FLEX DGs is required for the HCVS electrical strategy. The 480 Vac FLEX DG would provide power to the HCVS load in addition of loads addressed under Order EA-12-049.

The NRC staff also audited licensee engineering changes EC 396062, "FLEX Primary Strategy – Electrical (U1)," Revision 4, and EC 396069, "FLEX Primary Strategy – Electrical (U2)," Revision 3. Based on the NRC staff's audit of EC 396062 and EC 396069, the FLEX DGs are rated for 752 amperes. The margin available for Units 1 and 2 future loads is 337 amperes and 418 amperes, respectively. In its FIP, the licensee stated that the HCVS battery charger input breaker is rated at 15 amperes. Therefore, based on NRC staff's audit, it appears that sufficient margin exists on either FLEX DG to power HCVS loads.

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 500 kW FLEX DG were addressed under Order EA-12-049. Licensee procedure LOA-FSG-002, "FLEX Electrical Strategy," Revision 8, provides guidance for connecting the HCVS battery charger to the 480 Vac FLEX DG. Based on the evaluation above, the NRC staff concludes that the licensee's HCVS design allows for reliable operation with dedicated and permanently installed equipment, 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.

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

The containment isolation valves must be opened to permit vent flow. The PCIVs are air-to-open, spring-to-close, fail-closed air-operated valves (AOVs). The physical features that prevent inadvertent actuation are the key-lock switches in the MCR (for the pneumatic supply solenoid-operated valves (SOVs)) and locked-closed pneumatic supply manual isolation valves at the ROS. These design features prevent inadvertent actuation of HCVS. The NRC staff's audit 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 that support HCVS operation: HCVS temperature; HCVS radiation; wetwell vent radiation; HCVS valve position; 125 V dc battery voltage; N_2 supply pressure; argon pressure; drywell pressure; and wetwell level. The NRC staff notes that drywell pressure and wetwell level are declared LaSalle post-accident monitoring (PAM) variables as described in RG 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 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 Section 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.

The NRC staff reviewed the following channels documented in Table 1 of the FIP that support monitoring of HCVS effluent: HCVS valve position; HCVS vent pipe temperature; and HCVS radiation. The NRC staff found that effluent radiation monitor provides sufficient range to adequately indicate effluent discharge radiation levels.

In Section III.B.1.2.9 of its FIP, the licensee stated that the radiation monitor detector is fully qualified for the expected environment at the vent pipe during accident conditions, and the process and control module is qualified for the environment in the ROS. The NRC staff reviewed the qualification summary information provided in Table 1 of the FIP and found that it appeared to meet the guidance. The NRC staff also confirmed the summary information through audit reviews of LaSalle documents EC 392353, "U2 Hardened Containment Vent System (HCVS) – Fukushima Order EA-13-109," Revision 5, and calculation L-004115, "HCVS Phase I Dose Assessment," Revision 3.

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 SAWA pump and FLEX DG will be staged outside so they will not be adversely impacted by a loss of ventilation.

As discussed above in Section 3.1.1.2, the licensee performed calculation L-003969, under Order EA-12-049, which predicts the temperature profile at the respective ROS following an ELAP. The licensee determined that performing compensatory ventilation actions (opening doors and establishing portable ventilation) in the area of the ROS will maintain temperatures in the area of the ROS below 120°F.

The HCVS battery, battery charger, and supporting equipment are permanently installed on the Unit 2 side of the auxiliary building on the elevation 731'. The calculation L-003969, also predicted the temperature profile in this area following an ELAP. The calculation determined that the temperature would remain less than 120°F. The licensee plans to open doors and establish portable ventilation after the FLEX DG is placed in service. Licensee procedure LOA-FSG-005, "Area Ventilation," Revision 5, directs operators to open doors and establish portable ventilation in the auxiliary building.

Based on the above, the NRC staff concurs with the licensee's calculations that show the Unit 2 auxiliary building 731' elevation will remain below the maximum temperature limit (120°F) of the HCVS batteries, as specified by the battery manufacturer. Furthermore, based on temperature 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 RG 1.155), the NRC staff believes that other electrical equipment located at the respective 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 should not be adversely impacted by the loss of ventilation as a result of an ELAP event.

Radiological

The licensee's calculation L-004115, "HCVS Phase I Dose Assessment," documents the dose assessment for both personnel habitability and equipment locations associated with event response to a postulated ELAP condition. The NRC staff audited calculation L-004115 and notes that the licensee used conservative assumptions to bound the peak dose rates for the analyzed areas. For the sources considered and the methodology used in the dose calculation, the timing of HCVS vent operation or cycling of the vent will not create higher doses at personnel habitability and equipment locations (i.e., maximum doses determined in the calculation bound operational considerations for HCVS vent operation). The NRC staff's audit confirmed that the anticipated severe accident radiological conditions will not preclude 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 the installation of an active purge system (Option 3), which ensures the flammability limit of gases passing through the system is not reached.

In its FIP, the licensee stated that to prevent a detonable mixture from developing in the HCVS pipe, a purge gas (argon) supply system has been provided to displace potentially flammable/denotable mixtures of gases that may be present in the vent after system actuation. After initial line-up to open locked supply isolation valves 1(2)PC516 and 1(2)PC520 at the ROS and opening all individual argon bottle stop valves, the system can be operated from the MCR by keylock switch to energize the solenoid valve 1(2)PC525A. Per the guidance in procedures L-004137 and L-004185, a 2-second purge time is required to burst the rupture disc. For purging the combustibles after a vent cycle, a 56-second purge time has been calculated for Unit 1 and a 55-second purge time for Unit 2.

The NRC staff audited the proposed design to purge the HCVS vent as the means to address the potential for combustible gas deflagration/detonation. The NRC staff confirmed that the licensee's design appears to be consistent with Option 3 of white paper HCVS-WP-03 and that the use of the argon purge system 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 3.1.2.3, the HCVS for Units 1 and 2 are fully independent of each other. Therefore, the status at each unit is independent of the status of the other unit. The two vent lines are supported by a common tower, but hydraulically there is no cross tie between them. Combustible gases cannot migrate between units. The HCVS has been designed with two PCIVs in series that are located outside of the primary containment, as close to the suppression pool air space attached piping as practical. The vent pipe adjacent to the PCIVs has been designed with branch connections to facilitate periodic Appendix J leak rate testing of the PCIVs, ensuring leakage of flammable gases remains low. The NRC staff reviewed the information provided and audited the engineering change package and confirmed that the design appears to be consistent with the guidance and meets the design requirements to minimize the potential of hydrogen 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 LaSalle FIP, Table 3-3 includes testing and inspection requirements for the 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 it implemented operation, testing, and inspection requirements for the HCVS and SAWA that follows the existing plant procedures and process to ensure reliable operation of the systems. The existing plant maintenance program is applied to the HCVS and SAWA valves, instead of the maintenance frequency that has been listed in NEI 13-02, Section 6.2.4. The maintenance program uses PCM (Performance Centered Maintenance) templates, which are used to develop preventive LSCS implemented operation, testing, and inspection requirements for the HCVS and SAWA that follows the existing plant procedures and process to ensure reliable operation of the systems. The existing plant maintenance program is applied to the HCVS and SAWA valves instead of the maintenance frequency that has been listed in NEI 13-02, Section 6.2.4. The maintenance program uses PCM templates, which are used to develop preventive maintenance tasks to maintain the plant's 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 drywell-to-wetwell containment vacuum breaker line is original installation and is consistent with the design basis of the plant. The new reducing tee provided for the HCVS pipe is also designed and installed consistent with the design basis of the plant. The new HCVS piping and components, including the PCIVs, are designed to 60 psig (PCPL) and 350°F. The HCVS components downstream of the reducing tee and including the two PCIVs are designed to the bounding design-basis pressure, temperature, radiation, and seismic loads.

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

The NRC staff audited design consideration summary EC397691, "U1 Hardened Containment Vent System (HCVS) – Fukushima Order EA-13-109," Revision 2, and EC392353, "U2 Hardened Containment Vent System (HCVS) – Fukushima Order EA-13-109," Revision 5. The design consideration summaries provide a review of the calculations. The summaries also indicate the new PCIVs are classified as safety-related, American Society of Mechanical Engineers Boiler and Pressure Vessel Code Section III, Class 2. Downstream of the PCIVs, the piping classification changes to Seismically Supported and Augmented Quality.

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.

The HCVS components downstream of the outboard containment isolation valve, including piping and supports, electrical power supply, valve actuator pneumatic supply, and instrumentation (local and remote) components have been designed and analyzed to conform to the requirements consistent with the applicable design codes for the plant and to ensure functionality following a design basis earthquake. This includes environmental qualification consistent with expected conditions at the equipment location. The NRC staff reviewed the seismic requirements and design as part of Section 3.2.1, "Component Qualifications," above and concurs the design appears consistent with the guidance in Section 5 of NEI 13-02.

Table 1 of the FIP contains a list of components and instruments required to operate HCVS, their qualification and evaluation against the expected conditions. All instruments are fully qualified for the expected seismic conditions so that they will remain functional following a seismic event. 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. The NRC staff also confirmed the instrumentation and control component qualifications through audit reviews of LaSalle documents EC397691, "U1 Hardened Containment Vent System (HCVS) – Fukushima Order EA-13-109," Revision 2, EC 392353, "U2 Hardened Containment Vent System (HCVS) – Fukushima Order EA-13-109," Revision 5, and calculation L-004115, "HCVS Phase I Dose Assessment," Revision 3.

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 in Section 2.2, Order EA-13-109 provides two options to comply with the Phase 2 order requirements. LaSalle 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 one of two FLEX portable diesel driven pumps (PDDP) to provide SAWA flow into the reactor pressure vessel (RPV). Flow control for SAWA will be performed at the SAWA RPV supply portable flow meter (SAWA cart) 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. In its FIP, the licensee states 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 ERO exposure guidelines.

4.1.1 Staff Evaluation

4.1.1.1 Flow Path

The SAWA injection flow path starts with the PDDP taking suction from the Lake Screen House intake outside the protected area. A lay-flat hose is connected from the discharge of the PDDP to the underground piping located inside the protected area. The underground piping is then routed to the reactor building/diesel generator vestibule penetration. The SAWA flow path continues from the underground piping to a hose which is connected to the SAWA cart. The SAWA cart contains a wye connection, flow meter, and requisite lengths of straight pipe for accurate flow measurement. A hose is installed from the SAWA cart to the 'B' fuel pool emergency make-up (FC-EMU) system piping in the diesel generator corridor. A second hose is installed between FC-EMU piping and residual heat removal (RHR) system piping in the reactor building. The valves inside the reactor building will be configured so that water can be injected into the RPV through the 'B' RHR low pressure coolant injection (LPCI) system piping. This LPCI connection ties into the RPV for SAWA injection. The hoses and pump used for SAWA flow are stored in the FLEX building, which is protected from all external 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 two redundant PDDPs, in which one pump will be used for FLEX and SAWA strategies. The two PDDPs are trailer-mounted and include a diesel-driven hydraulic unit, a hydraulically-driven submersible pump, a crane to deploy the pump, instrumentation, and hydraulic hose reels. The PDDP will inject SAWA flow into the RPV within 8 hours of the ELAP event and provides 500 gallons per minute (gpm) of SAWA flow for the first 4 hours of operation. The SAWA flow will be reduced to 100 gpm for the remaining duration of the 7-day sustained operation. The PDDPs pumps are stored in the FLEX building, where they are protected from all applicable external hazards. In its FIP, the licensee described the hydraulic analysis performed to demonstrate the capability of each of the two PDDPs to provide the required SAWA flow. The NRC staff audited calculation L-003961, "FLEX Pump Sizing Hydraulic Calculation," Revision 0, which determined that the required SAWA flow rate of 500 gpm was within the capacity of at least one FLEX pump.

The NRC staff audited the flow rates and pressures evaluated in the hydraulic analyses and confirmed that the equipment can provide the needed 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 the portable FLEX pumps 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 LaSalle from the BWR 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 LSCS 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 industry-developed validation guidance to demonstrate that 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 LaSalle will be approximately 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 performed calculation LS-MISC-034, "MAAP Analysis to Support HCVS Design," Revision 0, to demonstrate that SAWA flow could be reduced to 100 gpm after 4 hours of initial SAWA flow rate and that suppression pool level remains below the suppression pool vent pipe for greater than 7 days of sustained operation allowing significant time for restoration of alternate containment pressure control and heat removal. At some point, if the wetwell 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. The licensee 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 value of 45 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.

The NRC staff audited the information referenced above. Guidance document NEI 13-02 uses an initial SAWA flow of 500 gpm reduced after 4 hours to 100 gpm. The NRC staff noted that the licensee used the same flow rates as the reference plant in the EPRI Technical Report 3002003301, "Technical Basis for Severe-Accident Mitigating Strategies." This is consistent with NEI 13-02, Section 4.1.1.2.

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 licensee's strategy to preclude the necessity for installing a hardened drywell vent at LaSalle 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 (SAWM). Water from the SAWA (FLEX) pump will be routed through the LPCI piping to the RHR system. This RHR connection allows the water to flow into the RPV. Throttling valves and flow meters will be used to control water flow to maintain wetwell availability. Procedures have been issued to implement this strategy, including site specific implementation of the generic BWROG EPG/SAG Revision 3 with Emergency Procedures Committee Generic Issue 1314. The BWROG generic assessment, BWROG-TP-15-008 [Reference 34], provides the principles of SAWA to ensure protection of containment. This strategy has been shown via Modular Accident Analysis Program (MAAP) analysis to protect containment without requiring a drywell vent for at least 7 days, 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 its FIP, the licensee stated that the suppression chamber freeboard volume is at least 1.23 million gallons. Generic assessment BWROG-TP-15-011 [Reference 35] provides the principles of SAWM to preserve the suppression pool vent for a minimum of 7 days. After containment parameters are stabilized with SAWA flow, SAWA flow will be reduced to a point where containment pressure will remain low while suppression pool water level is stable or very slowly rising. For LaSalle, 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 reference plant used in the generic analyses has a torus freeboard volume of 525,000 gallons.

As shown in calculation LS-MISC-034, the suppression pool water level reaches approximately 38.5 feet above the bottom of the wetwell (approximately elevation 712') over the course of the 7-day event, resulting in 12 feet of freeboard level to the inlet of the HCVS vent pipe at 724 feet. A diagram of the available freeboard is shown on Attachment 1 of the FIP.

The NRC staff audited the information provided including the calculation and the Technical Paper. Generic assessments in BWROG-TP-011 demonstrate that starting water addition at a high rate of flow and throttling after approximately 4 hours will not increase the suppression pool level to that which could block the suppression chamber HCVS. The NRC staff concurs that the flow of water added to the suppression pool can be controlled such that the suppression pool remains operational.

4.2.1.2 Strategy Time Line

As noted in Section 4.1.1.3, "SAWA Analysis of Flow Rates and Timing," calculation LS-MISC-034 demonstrates that throttling SAWA flow after containment parameters have stabilized, in conjunction with venting containment through the suppression pool vent will result in a stable or slowly rising suppression pool water level. Calculation LS-MISC-034 demonstrates that for the scenario analyzed, suppression pool level will remain below the suppression pool vent pipe for greater than the 7 days of sustained operation allowing significant time for restoration of alternate containment pressure control and heat removal. 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.

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 one of two PDDPs to provide SAWA flow. Operators will refuel the PDDP and DGs in accordance with Order EA-12-049 procedures using diesel fuel from the installed emergency diesel generator (EDG) fuel oil storage tanks. Operating Abnormal procedure LOA-FSG-009, "FLEX Equipment Fueling," Revision 1, directs operators to refuel the portable FLEX pumps from the onsite EDG fuel oil storage tanks. The licensee indicates that the LaSalle site will maintain sufficient diesel fuel for sustained operation for more than 7 days before off-site diesel fuel is required. In its FIP, the licensee states that refueling will be accomplished in areas that are shielded and protected from the radiological conditions during a severe accident scenario.

4.3.1.2 DG Loading Calculation for SAWA/SAWM Equipment

In its FIP, the licensee lists drywell pressure, wetwell level, and the portable SAWA flow meter, as instruments required for SAWA and SAWM implementation. The wetwell level and drywell pressure are used 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 an electromagnetic flow meter that has an internal battery with a 10-year life.

The NRC staff audited licensee dc sizing calculations L-003447, "LaSalle Units 1 and 2, 125VDC System Analysis," Revision 0, under Order EA-12-049, which verified the capability of the Class 1E station batteries to supply power to the required loads (e.g. wetwell level and drywell pressure) during the first phase of the LaSalle FLEX mitigation strategy plan for an ELAP event. The NRC staff also audited licensee engineering changes EC 396062 and EC 396069, which verified that the 500 kW is adequate to support the HCVS electrical loads. The NRC staff confirmed that the Class 1E station batteries and 500 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 of its FIP the licensee stated, in part, that the instrumentation credited for SAWA/SAWM are wetwell level, drywell pressure and SAWA flow meter. The NRC staff found that wetwell level and drywell pressure are existing RG 1.97 instruments that were designed and qualified for severe accident conditions. The SAWA flow instrument range is 3.3 to 1100 gpm, which appears to be consistent with the licensee's strategy. The NRC staff reviewed 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 qualified for post-accident use and that the LaSalle strategy may also make use of containment temperature, if available. The licensee also stated that these instruments are referenced in SAMGs for control of SAWA flow to maintain the wetwell vent in service while maintaining containment protection and are powered when the FLEX generator is deployed.

In Section IV.C.10.2 of its FIP, the licensee stated that the SAWA flow meter is a portable digital-based electromagnetic flow meter installed on the SAWA cart and self-powered by internal batteries.

The NRC staff reviewed the FIP, including Table I and Section IV.C.10.2 and found the licensees response appears to be consistent with the guidance. The NRC staff notes that NEI 13-02 Revision 1 Section C.8.3 clarifies that drywell temperature is not required, but may provide further information for the operations staff to evaluate plant conditions under severe accident and provide confirmation to adjust SAWA flow rates.

4.4.1.3 Qualification of SAWA/SAWM Instruments

In Section IV.C.10.3 of its FIP, the licensee stated that the drywell pressure and wetwell level instruments are pressure and differential pressure detectors that are safety-related and qualified for post-accident use. These instruments are qualified per RG 1.97, Revision 2, which is the LaSalle-committed version per Updated Final Safety Analysis Report (UFSAR) Section 7.5 as post-accident instruments and are therefore qualified for Order EA-13-109 events. The NRC staff verified the RG 1.97 variables in the LaSalle UFSAR and found that they appear to be qualified in accordance with NEI 13-02, Appendix C, Section C.8.1.

In its FIP, the licensee stated that the SAWA flow meter is rated for continuous use under the expected ambient conditions and so will be available for the entire period of sustained operation and the flowmeter battery is rated for 10 years of continuous operation. The licensee stated in Table 1 of the FIP that anticipated environment at this location is 140°F and 2.45E2 R TID at peak dose rate for the operating period. The NRC staff confirmed in Table 1 of the FIP that the qualification temperature is 140°F and the qualified radiation is assumed as 1E3 R as typical for commercial grade electronics. The NRC staff determined 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 performed a detailed radiological analysis documented as L-004151, "HCVS FLEX Activities and Phase II Dose Assessment for Units 1 and 2." This calculation analyzed the dose at different locations and times where operator actions will take place during FLEX/SAWA/SAWM activities. The analyzed locations include the MCR, ROS, travel paths for hose routing, and FLEX/SAWA pump locations.

In its FIP, the licensee stated that the FLEX pumps are stored in the FLEX building located outside the protected area near the Lake Screen House. In its FIP, the licensee further states that the evaluation of the peak dose rates at the FLEX pump (as documented in calculation L-004151) and the associated integrated dose evaluations have determined that personnel can perform necessary FLEX pump operations without exceeding the ERO dose guidelines.

The SAWA flow path inside the reactor building consists of steel piping that will be unaffected by the radiation dose. The licensee analyzed the radiological conditions along the SAWA flow path to ensure that hoses will only be run in locations that are shielded from significant radiation dose or that have been evaluated for the integrated dose effects over the period of sustained operation. The NRC staff audited the information and agrees 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 LSCS SAWA strategy relies on three instruments: wetwell level; containment pressure; and SAWA flow. Containment pressure and wetwell level are declared PAM variables as described in RG 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.

In its FIP, the licensee states that the SAWA flow meter is rated for continuous use under the expected ambient conditions and so will be available for the entire period of sustained operation. Based on this information, the NRC staff agrees 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

Operation in SAWA/SAWM modes does not change the environmental evaluation for personnel habitability reviewed earlier in Section 3.1.1.2, "Personnel Habitability – Environmental." Procedure LOA-FSG-003 directs actions that must be done early in the severe accident event where there is a loss of all ac power and a loss of all high-pressure injection to the core. In this event, core damage is not expected for at least 1 hour so that there will be no excessive radiation levels or heat related concerns in the reactor building when the above actions are implemented.

After the SAWA flow path is aligned inside the reactor building, the operators can control SAWA/SAWM, as well as observe the necessary instruments from outside the reactor building. The SAWA pump and flow monitoring equipment can all be operated from outside the reactor building. The FLEX response ensures that the FLEX pump, FLEX generators, and other equipment can all be run for a sustained period by refueling. Refueling during a severe accident was evaluated in EC 618667. The monitoring instrumentation includes SAWA flow at the SAWA cart, wetwell level, and containment pressure in the MCR.

Table 2 of the FIP provides a list of SAWA/SAWM operator actions as well as an evaluation of each for suitability during a severe accident. Attachment 6 of the FIP shows the approximate locations of the actions. The NRC staff audited the information referenced and concurs that the temperature should not prevent operators from performing necessary actions to implement the SAWA/SAWM strategy.

The licensee performed calculation L-004151, "HCVS FLEX Activities and Phase II Dose Assessment for Unit 1 and 2," which documents the dose assessment for designated areas inside the reactor building (outside of containment) and outside the reactor building caused by FLEX activities and the sustained operation of the HCVS under the beyond-design-basis severe accident condition of an ELAP. This assessment used conservative assumptions to determine the expected dose rates 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 agrees, based on the audit of the licensee's detailed evaluation, that 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.

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 audited 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 the 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 systems 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 31, 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 December 22, 2017 [Reference 16]. By letter dated December 14, 2018 [Reference 17], the licensee reported that full compliance with the requirements of Order EA-13-109 was achieved and submitted its FIP.

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 LaSalle to NRC, "LaSalle, 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 30, 2014 (ADAMS Accession No. ML14184A016)

3. Letter from LaSalle 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 17, 2014 (ADAMS Accession No. ML14351A450)

4. Letter from LaSalle 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 30, 2015 (ADAMS Accession No. ML15181A226)

5. Letter from LaSalle to NRC, "LaSalle, 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 16, 2015 (ADAMS Accession No. ML15352A109)

6. Letter from LaSalle 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 30, 2016 (ADAMS Accession No. ML16182A394)

7. Letter from LaSalle 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. ML16349A439)

8. Letter from LaSalle 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 29, 2017 (ADAMS Accession No. ML17180A391)

9. Letter from LaSalle 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 15, 2017 (ADAMS Accession No. ML18239A032)

10. Letter from LaSalle 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 22, 2018 (ADAMS Accession No. ML18173A072)

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 LaSalle, "LaSalle County Station, 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 31, 2015 (ADAMS Accession No. ML15084A180)

15. Letter from NRC to LaSalle, "LaSalle County Station, 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. ML16110A368)

16. Letter from NRC to LaSalle, "LaSalle County Station, 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 December 22, 2017 (ADAMS Accession No. ML17354B306)

17. Letter from LaSalle to NRC, "LaSalle County Station, 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 December 14, 2018 (ADAMS Accession No. ML18348B252)

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)

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

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

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

26. NEI 13-02, "Industry Guidance for Compliance with Order EA-13-109," Revision 1, April 23, 2015 (ADAMS Accession No. ML15113B318)

27. Interim Staff Guidance JLD-ISG-2015-01, "Compliance with Phase 2 of Order EA-13-109, Severe Accident Reliable Hardened Containment Vents," April 29, 2015 (ADAMS Accession No. ML15104A118)

28. NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," Revision 0, August 21, 2012 (ADAMS Accession No. ML12221A205)

29. NEI Industry White Paper – HCVS-WP-02, "Sequences for HCVS Design and Method for Determining Radiological Dose from HCVS Piping," Revision 0, October 30, 2014 (ADAMS Accession No. ML14358A038)

30. Letter from NEI to NRC, "Hardened Containment Venting System (HCVS) Phase 1 and 2 Overall Integrated Plan Template," Revision 1, dated September 28, 2015, and Frequently Asked Questions (FAQs) 10, 11, 12, and 13 (ADAMS Accession No. ML15273A141)

31. NEI Industry White Paper – HCVS-WP-04, "Missile Evaluation for HCVS Components 30 Feet Above Grade," Revision 0, August 17, 2015 (ADAMS Accession No. ML15244A923)

32. Appendix J to 10 Code of Federal Regulations Part 50, "Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors"

33. NEI Industry White Paper – HCVS-WP-03, "Hydrogen/Carbon Monoxide Control Measures," Revision 1, October 2014 (ADAMS Accession No. ML14295A442)

34. BWROG-TP-15-008, "BWROG Fukushima Response Committee, Severe Accident Water Addition Timing," September 2015

35. BWROG-TP-15-011, "BWROG Fukushima Response Committee, Severe Accident Water Management Supporting Evaluations," October 2015

36. NRC Letter to LaSalle, "LaSalle County Station, Units 1 and 2 – Safety Evaluation Regarding Implementation of Mitigating Strategies And Reliable Spent Fuel Pool Instrumentation Related To Orders EA-12-049 And EA-12-051," August 21, 2018 (ADAMS Accession No. ML18219B835)

Principal Contributors: Rajender Auluck
Bruce Heida
Brian Lee
Kerby Scales
Garry Armstrong
Steve Wyman
John Parillo

Date: August 29, 2019

SUBJECT: LASALLE COUNTY STATION, 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. MF4456 AND MF4457; EPID NO. L-2014-JLD-0050) DATE: August 29, 2019

DISTRIBUTION:
PUBLIC
PBEB R/F
RidsNrrDorlLpl3 Resource
RidsNrrPMLaSalle Resource
RidsNrrLaSLent Resource
RidsRgn3MailCenter Resource
NSanflippo, NRR
RAuluck, NRR
BLee, NRR
RidsACRS_MailCTR Resource
BTitus, NRR

ADAMS Accession No. ML19218A365

OFFICE	NRR/DLP/PBEB/PM	NRR/DLP/PBMB/LA	NRR/DLP/PBEB/BC
NAME	RAuluck	SLent	NSanfilippo
DATE	8//27/19	8/17/19	8//29/19

OFFICIAL RECORD COPY