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

May 4, 2018

Mr. Peter P. Sena, III
President and Chief Nuclear Officer
PSEG Nuclear LLC – N09
Hope Creek Generating Station
P.O. Box 236
Hancocks Bridge, NJ 08038

SUBJECT: HOPE CREEK GENERATING STATION - 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 (CAC NO. MF4458; EPID L-2014-JLD-0040)

Dear Mr. Sena:

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 licensees to submit for review overall integrated plans (OIPs) that describe how compliance with the requirements for both phases of Order EA-13-109 will be achieved.

By letter dated June 25, 2014 (ADAMS Accession No. ML14177A508), PSEG Nuclear LLC (PSEG, the licensee) submitted its Phase 1 OIP for Hope Creek Generating Station (HCGS, Hope Creek). By letters dated December 19, 2014, June 18, 2015, December 28, 2015 (which included the combined Phase 1 and Phase 2 OIP), June 29, 2016, December 22, 2016, June 27, 2017, and December 19, 2017 (ADAMS Accession Nos. ML14353A076, ML15173A026, ML15362A580, ML16181A210, ML16358A254, ML17178A300, and ML17354A772, respectively), the licensee submitted its 6-month updates to the OIP. The NRC staff reviewed the information provided by the licensee and issued interim staff evaluations (ISEs) for Phase 1 and Phase 2 of Order EA-13-109 for Hope Creek by letters dated February 12, 2015 (ADAMS Accession No. ML14332A154), and August 2, 2016 (ADAMS Accession No. ML16103A320), respectively. When developing the ISEs, the staff identified open items where the staff needed additional information to determine whether the licensee's plans would adequately meet the requirements of Order EA-13-109.

The NRC staff is using the audit process described in letters dated May 27, 2014 (ADAMS Accession No. ML14126A545), and August 10, 2017 (ADAMS Accession No. ML17220A328), to gain a better understanding of licensee activities as they come into compliance with the order. As part of the audit process, the staff reviewed the licensee's closeout of the ISE open items.

The NRC staff conducted teleconferences with the licensee on June 15, 2017, and April 19, 2018. The enclosed audit report provides a summary of that aspect of the audit.

If you have any questions, please contact me at (301) 415-1025 or by e-mail at Rajender.Auluck@nrc.gov.

Sincerely,

R Auluck

Rajender Auluck, Senior Project Manager
Beyond-Design-Basis Engineering Branch
Division of Licensing Projects
Office of Nuclear Reactor Regulation

Docket No. 50-354

Enclosure:
Audit report

cc w/encl: Distribution via Listserv

UNITED STATES
NUCLEAR REGULATORY COMMISSION
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AUDIT REPORT BY THE OFFICE OF NUCLEAR REACTOR REGULATION

AUDIT OF LICENSEE RESPONSES TO INTERIM STAFF EVALUATIONS OPEN ITEMS

RELATED TO ORDER EA-13-109 MODIFYING LICENSES

WITH REGARD TO RELIABLE HARDENED CONTAINMENT VENTS CAPABLE OF

OPERATION UNDER SEVERE ACCIDENT CONDITIONS

PSEG NUCLEAR LLC

HOPE CREEK GENERATING STATION

DOCKET NO. 50-354

BACKGROUND

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 Condition," to all Boiling-Water Reactor (BWR) licensees with Mark I and Mark II primary containments. The order requirements are divided into two parts to allow for a phased approach to implementation.

Phase 1 of Order EA-13-109 requires license holders of BWRs with Mark I and Mark II primary containments to design and install a Hardened Containment Vent System (HCVS), using a vent path from the containment wetwell to remove decay heat, vent the containment atmosphere (including steam, hydrogen, carbon monoxide, non-condensable gases, aerosols, and fission products), and control containment pressure within acceptable limits. The HCVS shall be designed for those accident conditions (before and after core damage) for which containment venting is relied upon to reduce the probability of containment failure, including accident sequences that result in the loss of active containment heat removal capability or extended loss of alternating current (ac) power (ELAP). The order required all applicable licensees, by June 30, 2014, to submit to the Commission for review an overall integrated plan (OIP) that describes how compliance with the Phase 1 requirements described in Order EA-13-109 Attachment 2 will be achieved.

Phase 2 of Order EA-13-109 requires license holders of BWRs with Mark I and Mark II primary containments to design and install a system that provides venting capability from the containment 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 order required all applicable licensees, by December 31, 2015, to submit to the Commission for

review an OIP that describes how compliance with the Phase 2 requirements described in Order EA-13-109 Attachment 2 will be achieved.

By letter dated June 25, 2014 (ADAMS Accession No. ML14177A508), PSEG Nuclear LLC (PSEG, the licensee) submitted its Phase 1 OIP for Hope Creek Generating Station (HCGS, Hope Creek). By letters dated December 19, 2014, June 18, 2015, December 28, 2015 (which included the combined Phase 1 and Phase 2 OIP), June 29, 2016, December 22, 2016, June 27, 2017, and December 19, 2017 (ADAMS Accession Nos. ML14353A076, ML15173A026, ML15362A580, ML16181A210, ML16358A254, ML17178A300, and ML17354A772, respectively), the licensee submitted its 6-month updates to the OIP, as required by the order.

The NRC staff reviewed the information provided by the licensee and issued interim staff evaluations (ISEs) for Phase 1 and Phase 2 of Order EA-13-109 for Hope Creek by letters dated February 12, 2015 (ADAMS Accession No. ML14332A154), and August 2, 2016 (ADAMS Accession No. ML16103A320), respectively. When developing the ISEs, the staff identified open items where the staff needed additional information to determine whether the licensee's plans would adequately meet the requirements of Order EA-13-109.

The NRC staff is using the audit process in accordance with the letters dated May 27, 2014 (ADAMS Accession No. ML14126A545), and August 10, 2017 (ADAMS Accession No. ML17220A328), to gain a better understanding of licensee activities as they come into compliance with the order. The staff reviews submitted information, licensee documents (via ePortals), and preliminary Overall Program Documents (OPDs)/OIPs, while identifying areas where additional information is needed. As part of this process, the staff reviewed the licensee closeout of the ISE open items.

AUDIT SUMMARY

As part of the audit, the NRC staff conducted teleconferences with the licensee on June 15, 2017, and April 19, 2018. The purpose of the audit teleconferences were to continue the audit review and provide the NRC staff the opportunity to engage with the licensee regarding the closure of open items from the ISEs. As part of the preparation for these audit calls, the staff reviewed the information and/or references noted in the OIP updates to ensure that closure of ISE open items and the HCVS design are consistent with the guidance provided in Nuclear Energy Institute (NEI) 13-02, Revision 1 and related documents (e.g. white papers (ADAMS Accession Nos. ML14126A374, ML14358A040, ML15040A038 and ML15240A072, respectively) and frequently asked questions (FAQs), (ADAMS Accession No. ML15271A148)) that were developed and reviewed as part of overall guidance development. The NRC staff audit members are listed in Table 1. Table 2 is a list of documents reviewed by the staff. Table 3 provides the status of the ISE open item closeout for Hope Creek. The open items are taken from the Phase 1 and Phase 2 ISEs issued on February 12, 2015, and August 2, 2016, respectively.

FOLLOW UP ACTIVITY

The staff continues to audit the licensee's information as it becomes available. The staff will issue further audit reports for Hope Creek, as appropriate.

Following the licensee's declarations of order compliance, the licensee will provide a final integrated plan (FIP) that describes how the order requirements are met. The NRC staff will

evaluate the FIP, the resulting site-specific OPDs, as appropriate, and other licensee documents, prior to making a safety determination regarding order compliance.

CONCLUSION

This audit report documents the staff's understanding of the licensee's closeout of the ISE open items, based on the documents discussed above. The staff notes that several of these documents are still preliminary, and all documents are subject to change in accordance with the licensee's design process. In summary, the staff has no further questions on how the licensee has addressed the ISE open items, based on the preliminary information. The status of the NRC staff's review of these open items may change if the licensee changes its plans as part of final implementation. Changes in the NRC staff review will be communicated in the ongoing audit process.

Attachments:
1. Table 1 – NRC Staff Audit and Teleconference Participants
2. Table 2 – Audit Documents Reviewed
3. Table 3 – ISE Open Item Status Table

Table 1 - NRC Staff Audit and Teleconference Participants

Title	Team Member	Organization
Team Lead/Sr. Project Manager	Rajender Auluck	NRR/DLP
Project Manager Support/Technical Support – Containment / Ventilation	Brian Lee	NRR/DLP
Technical Support – Containment / Ventilation	Bruce Heida	NRR/DLP
Technical Support – Electrical	Kerby Scales	NRR/DLP
Technical Support – Balance of Plant	Garry Armstrong	NRR/DLP
Technical Support – I&C	Steve Wyman	NRR/DLP
Technical Support – Dose	John Parillo	NRR/DRA

Table 2 – Audit Documents Reviewed

Calculation HC-MISC-005, "MAAP Analysis to Support FLEX Initial Strategy," Revision 7
Calculation GS-0026, "Hardened Containment Vent Capacity," Revision 1
Calculation GS-0027, "Disc Rupture Fluid Transient Analysis in Hardened Containment Vent Piping," Revision 1
Technical Evaluation 80115583 – Missile Evaluation (Hope Creek Conformance to HCVS-WP-04
Calculation H-1-FLX-MDC-4016, "Hope Creek Auxiliary Building Extended Loss of AC Power FLEX Response," Revision 3
Calculation PSEG104-CALC-007, "GOTHIC Modeling of Auxililary Building Extended Loss of AC Power FLEX Response for Hardened Vent," Revision 1
Calculation PSEG104-CAL-004, "Hope Creek Hardened Containment Vent System Dose Evaluation," Revision 0
Calculation PSEG104-CALC-002, "Backup Nitrogen Supply for Hardened Vent," Revision 0
Calculation PSEG104-CALC-005, "Hydrogen Concentration from HCVS into Reactor Building," Revision 0
Calculation E-4.1(Q), "HC Class 1E 125 VDC Station Battery & Charger Sizing," Revision 18C
Calculation E-4.6(Q), "Hope Creek 125 VDC Beyond Design Base Event Battery Sizing Calculation," Revision 1
Calculation E-15.16, "Hope Creek FLEX Electrical System Loading Analysis," Revision 0
Design Change Package (DCP) 80115583, "Hope Creek Hardened Torus Vent Modification," Revision 2
Calculation PSEG104-CALC-001, "Compressed Gas Purge System for Containment Hardened Vent," Revision 3
Calculation 1GSHV-11541, "Air Operated Valve (AOV) Capability Evaluation," Revision 3
Calculation 1GSHV-4964, "Air Operated Valve (AOV) Capability Evaluation," Revision 2
Design Change Package 80113942, "Hardened Containment Vent Electrical," Revision 3
Calculation H-1-FLX-MDC-4022, "FLEX Hydraulic Model," Revision 1
Calculation 2017-04167, "SAWA/SAWM GOTHIC Analyses," Revision 0
Calculation 2017-01221, "Hardened Containment Vent System Phase II Radiation Dose Assessment," Revision 0
BWROG-TP-008, "Severe Accident Water Addition Timing"
BWROG-TP-011, "Severe Accident Water Management Supporting Evaluations"

Hope Creek Generating Station
Vent Order Interim Staff Evaluation Open Items:

Table 3 - ISE Open Item Status Table

ISE Open Item Number Requested Action	Licensee Response – Information provided in 6 month updates and on the ePortal	NRC Staff Close-out notes	Safety Evaluation (SE) status Closed; Pending; Open (need additional information from licensee)
Phase 1 ISE OI 1 Finalize time constraints and their bases. Make available for NRC staff audit the finalized time constraints for remote manual operations and their bases.	Complete. Anticipatory venting time constraints are included in the FLEX strategy timeline which assumes torus venting is initiated approximately four hours following an Extended Loss of AC Power (ELAP) event, based on torus water temperature of 200 degrees F. MAAP [Modular Accident Analysis Program] analyses (HC-MISC-005, Rev. 8 is uploaded to the subfolder for this item in "ISE Item Closure/Phase 1") have been revised to reflect the modified vent design. NRC review of the OIP (Reference 5) timeline for HCVS is documented in Section 3.3.1 of the Phase 2 ISE (Reference 11).	The NRC staff reviewed the information provided in the 6-month updates and on the ePortal. The licensee finalized their time constraints, which includes anticipatory venting (at approx.. 4 hours) into the FLEX strategy timeline. The NRC staff previously reviewed the HCVS timeline as documented in Section 3.3.1 of the Phase 2 ISE. No follow-up questions.	Closed [Staff evaluation to be included in SE Section 3.1.1.1]
Phase 1 ISE OI 2 Make available for NRC staff audit analyses demonstrating that HCVS has the capacity to vent the steam/energy equivalent of one percent of licensed/rated thermal power (unless a lower value is justified), and that the suppression pool and the HCVS together are able to absorb and reject decay heat, such that following a reactor	Complete. Calculation GS-0026, "Hardened Containment Vent Capacity," shows that the HCVS 12-inch vent can accommodate the required steam/energy equivalent of one percent of licensed/rated thermal power flow. GS-0026 uses 3917 MWt reactor power (1.02 x 3840 rated thermal power), vs 3902 MWt per the license amendment request for margin uncertainty recapture, ML17188A260. Calculation GS-0027, "Disc Rupture Fluid Transient Analysis in Hardened Containment Vent Piping," shows that the piping can accommodate	The NRC staff reviewed the information provided in the 6-month updates and on the ePortal. Calculation GS-0026 determined the required flow for the steam equivalent of 1% of 3917 megawatt thermal (MWt (102% of current licensed reactor power of 3840 MWt) at 54.4 per square inch gauge (psig) is 147,108 lb/hr.	Closed [Staff evaluation to be included in SE Section 3.1.2.1]

shutdown from full power containment pressure is restored and then maintained below the primary containment design pressure and the primary containment pressure limit.	the fluid dynamics of the steam/energy equivalent of one percent of licensed/rated thermal power flow. Vendor Technical Document (VTD) 432633, "Suppression Pool Energy Capacity," used 3900 MWt (vs 3902 MWt in the MUR LAR), and evaluated zero to three hours from an ELAP based on Rev 0 of the OIP. VTD 432633 shows that the suppression pool has sufficient capacity to absorb the energy released into the torus for the first three hours following an ELAP event, with approximately 60% margin. MAAP analyses (HC-MISC-005, including cases run using 3902 MWt) support anticipatory venting at four hours based on torus water temperature of 200 degrees F and acceptable containment response thereafter. GS-0026, GS-0027 and VTD 432633 are in the subfolder for this item in "ISE Item Closure/Phase 1" – no changes from the June 2017 upload.	RELAP5 thermal-hydraulic program was used to simulate two-phase flow in piping systems. REFORC was used to determine flow generated forces in piping. Vent capacity with torus pressure at 54.4 psig is 168,000 lb/hr. No follow-up questions.	
Phase 1 ISE OI 3 Provide the seismic and tornado missile final design criteria for the HCVS stack.	Complete. Design Change Package (DCP) 80115583, "Hardened Containment Vent Modification," addresses the seismic design of the HCVS stack and includes a Technical Evaluation of tornado missile protection following NEI white paper HCVS-WP-04 as endorsed by NRC letter to NEI dated September 14, 2015 (ADAMS Accession No. ML 15240A072). DCP 80115583 Rev 2 and Technical Evaluation 80115583-0860 are in the subfolder for this item in "ISE Item Closure/Phase 1" – no changes from the June 2017 upload.	The NRC staff reviewed the information provided in the 6-month updates and on the ePortal. Design Change Package (DCP) 80115583-0860, "Technical Evaluation to Document Hope Creek Conformance to HCVS-WP-04," addresses all 4 assumptions. Procedure "HC.OP-AB.MISC-0001," provides guidance to re-establish vent path in the event the HCVS becomes damaged.	Closed [Staff evaluation to be included in SE Section 3.2.2]

		No follow-up questions.	
Phase 1 ISE OI 4 Make available for NRC staff audit documentation that demonstrates adequate communication between the remote HCVS operation locations and HCVS decision makers during ELAP and severe accident conditions.	Complete. (Replaced reference to the OIP with the response text below, modified to show the final POS [primary operating station] location at the Remote Shutdown Panel): The HCVS POS is at the Remote Shutdown Panel in Room 3576 at elevation 137' in the Auxiliary Building and the ROS in the electrical chase is located at 102 ft elevation of the Control/Diesel Building (also part of the Auxiliary Building). The POS is on the same elevation as the Main Control Room (MCR) and the ROS is two levels below the MCR. They are accessible from the MCR via pathways within the power block. Accessibility under postulated temperature and radiological conditions is addressed via ISE Open Item #5. PSEG has implemented communications enhancements including radio upgrades to support diverse and flexible (FLEX) mitigating strategies for beyond-design-basis external events. These enhancements include the addition of a remote desk set in the MCR which is provided with FLEX-backed uninterruptible power supplies and direct connections to repeaters for reliable radio communication within the power block, including the MCR and the Operations Support Center. Communication between HCVS operators and decision makers would be maintained to support HCVS operation based on the proximity of the POS and ROS to the emergency	The NRC staff reviewed the information provided in the 6-month updates and on the ePortal. The communication methods are the same as accepted in Order EA-12-049. No follow-up questions.	Closed [Staff evaluation to be included in SE Section 3.1.1.1]

	response facilities, and radio communications capability. Additional information regarding communications enhancements is provided in the subfolder for Phase 2 ISE #7. There is no e-portal folder for this Phase 1 item.		
Phase 1 ISE OI 5 Perform dose evaluation for venting actions. Make available for NRC staff audit an evaluation of temperature and radiological conditions to ensure that operating personnel can safely access and operate controls and support equipment.	Complete. The GOTHIC model Vendor Technical Documents (VTDs) 432340 (001) (Auxiliary Building GOTHIC model) and 432611 (001) (Room 5301 and TSC areas GOTHIC model) as well as HCVS Dose Evaluation VTD 432634 (001), show that the temperatures and radiation levels are acceptable for personnel ingress/egress. The referenced VTDs are in the subfolder for this item in "ISE Item Closure/Phase 1." GOTHIC VTDs 432340 and 432611 have been revised for SAWA [Severe Accident Water Addition] and the current revisions are in this subfolder. There have been no changes to dose VTD 432634 since the June 2017 upload, but a new dose VTD 432902 and summary report VTD 432889 were performed for SAWA and are in the subfolder for Phase 2 ISE #3+4. E-Plan Section 12 for Radiological Exposure Control is also included and has not changed since the June 2017 upload.	The NRC staff reviewed the information provided in the 6-month updates and on the ePortal. Main control room (MCR) temperatures have been addressed as part of the FLEX order and were found to acceptable by the NRC staff. Calculation PSEG104-CALC-007, "GOTHIC Modeling of Auxiliary Building Extended Loss of AC Power FLEX Response for Hardened Vent," Revision 1 shows that the remote operating station (ROS) (Room 5301) starts at a little over 100°F (102°F) and remains relatively constant (cools slightly) for 72 hours. Calculation PSEG104-CAL-004, "Hope Creek Hardened Containment Vent System Dose Evaluation," Revision 0 was performed to determine the integrated radiation dose due to HCVS operation. The NRC staff reviewed this calculation and determined that the licensee used conservative assumptions and	Closed [Staff evaluation to be included in SE Sections 3.1.1.2 and 3.1.1.3]

		followed the guidance outlined in NEI 13-02 Rev.1 and HCVS-WP-02 Rev. 0. Based on the expected integrated whole body dose equivalent in the POS and ROS and the expected integrated whole body dose equivalent for expected actions during the sustained operating period, the NRC staff believes that the order requirements are met. Temperature and radiological conditions should not inhibit operator actions needed to initiate and operate the HCVS during an ELAP with severe accident conditions. No follow-up questions.	
Phase 1 ISE OI 6 Make available for NRC staff audit descriptions of all instrumentation and controls (existing and planned) necessary to implement this order including qualification methods.	Complete. Parameters of drywell pressure, torus pressure, torus level, torus water temperature, and reactor pressure on MCR instrumentation allow monitoring effectiveness of torus venting actions. For these parameters, HCGS uses existing instrumentation and MCR displays qualified to Regulatory Guide 1.97 and provided with Class 1E electrical power (Updated Final Safety Analysis Report, Table 7.5-1). HCVS operation is monitored by vent valve position, vent flow, and effluent radiation levels. DCP 80113942, "Hardened Containment Vent Electrical," provided instrumentation and controls at the POS at the Remote Shutdown Panel in Room 3576 at elevation 137' in the Auxiliary Building, and at the ROS in the	The NRC staff reviewed the information provided in the 6-month updates and on the ePortal. The existing plant instuments required for HCVS (i.e. wetwell level instruments and drywell pressure instruments) meet the requirements of Regulatory Guide (RG) 1.97. The licensee provided analyses and/or supporting information of the HCVS instruments and controls (I&C), including a description of each component and the qualification method. The staff's review indicates that the I&C components are consistent	Closed [Staff evaluation to be included in SE Section 3.1.2.8]

	Electrical Chase Area (Room 5301) on EL 102'-0" of the Auxiliary Building. HCVS flow rate is displayed via a recorder in the POS and flow indicator in the ROS. The HCVS instruments are qualified by using one or more of the three methods described in JLD-ISG-2013-02 [Japan Lessons-Learned Directorate-Interim Staff Guidance] (Reference 8). DCP 80113942 Rev. 3 is in the subfolder for this item in "ISE Item Closure/Phase 1." The second paragraph, above, is based on DCP Section 4.1.5 (p. 28/112). Section 4.1.36 (p. 62/112) has additional I&C requirements.	with the guidance in NEI 13-02 and its qualifications meet the order requirements. No follow-up questions.	
Phase 1 ISE OI 7 Make available for NRC staff audit the final sizing evaluation for HCVS batteries/battery charger including incorporation into FLEX DG loading calculation.	Complete. Details are provided in Section 4.3 of Reference 15 (5th six-month update, ML16358A254). The following documents are in the subfolder for this item in "ISE Item Closure/Phase 1": • SAP Order Operation 80115232-0160 (ISE07-Battery(80115232-0160).pdf) is the Item response similar to the one provided in the 5th six-month update • Procedure HC.OP-AB.ZZ-0135 Revision 43, "Station Blackout/ Loss of Offsite Power/Diesel Generator Malfunction." Attachment 8 has the ELAP load shed • Revisions to electrical calculations E-4.1 and E-4.6 resulting from Design Change Package 80113942 (HCVS Electrical)	The NRC staff reviewed the information provided in the 6-month updates and on the ePortal. The licensee stated that all electrical power required for operation of HCVS components is provided by the HCVS 125 volts direct current (VDC) battery and battery charger. The battery sizing calculation E-4.6(Q), "Hope Creek 125 VDC Beyond Design Base Event Battery Sizing Calculation," Revision 1 confirmed that the 125 VDC battery has a minimum capacity capable of providing power for 24 hours without recharging, and therefore is adequate.	Closed [Staff evaluation to be included in SE Section 3.1.2.6]

		The licensee provided DCP 80113942, "Hardened Containment Vent Electrical," Revision 3, which discusses re-powering of the HCVS 125 VDC battery charger using the FLEX DG. No follow-up questions.	
Phase 1 ISE OI 8 Make available for NRC staff audit documentation of the HCVS nitrogen pneumatic system design including sizing and location	Complete. DCP 80113941, "Hardened Containment Vent Mechanical," provided a permanently installed nitrogen supply at the ROS in the Electrical Chase Area (Room 5301) on elevation 1 02'-0" of the Auxiliary Building. The ROS is protected from all external hazards. VTD 432632, "Backup Nitrogen Supply for Hardened Vent," shows that the system possesses enough volume for 8 cycles of the HCVS valves. DCP 80113941 also installed the capability to manually breach the HCVS rupture disk from the ROS using a separate nitrogen source. DCP 80113941, VTD 432632 and drawing M-57-1 sheets 1 and 2 are in the subfolder for this item in "ISE Item Closure/Phase 1": Sheet 2 of the drawing shows details of the nitrogen system.	The NRC staff reviewed the information provided in the 6-month updates and on the ePortal. DCP 80113941 and Vendor Technical Document (VTD) 432632, describes the capability of the nitrogen system of providing eight cycles for the HCVS valves and bursting the rupture disk. The calculation shows that 8 bottles of AirGas 2HP can be used for 8 purge cycles at the minimum of 2,500 psig per cycle (the bottles are rated for 3500 psig). The amount of nitrogen needed for the bursting the rupture disc is 1600 psig. The AirGas 200 bottle is rated for 2265 psig. Therefore, the licensee confirmed that there will be more than enough nitrogen available to fulfill both functions. No follow-up questions.	Closed [Staff evaluation to be included in SE Section 3.1.2.6]
Phase 1 ISE OI 9	Complete. Functionality of HCVS components during ELAP and severe accident conditions is supported by the	The NRC staff reviewed the information provided in the 6-	Closed

Make available for NRC staff audit the descriptions of local conditions (temperature, radiation, and humidity) anticipated during ELAP and severe accident for the components (valves, instrumentation, sensors, transmitters, indicators, electronics, control devices, etc.) required for HCVS venting including confirmation that the components are capable of performing their functions during ELAP and severe accident conditions.	documents referenced in response to ISE #5, combined with DCPs 80113941, 80113942 and 80115583. A detailed response in SAP Order Operation 80115232-0180 "ISE09(80115232-0180).pdf" is in the subfolder for this item in "ISE Item Closure/Phase 1," with references including current revisions of the DCPs. GOTHIC VTDs 432340 and 432611 have been revised for SAWA and the current revisions are in this subfolder. ISE09(80115232-0180).pdf and the other references have not changed since the June 2017 upload.	month updates and on the ePortal. DCPs 80113941 and 80113942 discuss the environmental conditions during an accident at the locations containing instrumentation and controls (I&C) components. The staff's review indicated that the environmental qualification met the order requirements. The primary control location is at the POS at the Remote Shutdown Panel in Room 3576 at elevation 137' in the Auxiliary Building. The ROS is located in the Electrical Chase Area (Room 5301) on elevation 102' of the Auxiliary Building. The staff notes that some instrumentation was pre-existing from the HCGS Hardened Torus Vent (HTV) and the reviewed design documents appear to appropriately address the qualification of the existing/modified and new instrumentation. The main control room was previously evaluated as part of Order EA-12-049. No follow up questions.	[Staff evaluation to be included in SE Section 3.1.1.4]
Phase 1 ISE OI 10 Make available for NRC staff audit an evaluation verifying the existing containment	Complete. The HCVS containment isolation valves (H1GS- HV-11541 and H1GS-HV-4964) are shown to have a disc design differential pressure of 65 psig per VTDs 315211 and 315212, respectively.	The NRC staff reviewed the information provided in the 6-month updates and on the ePortal.	Closed [Staff evaluation to be included in SE Section 3.2.1]

isolation valves, relied upon for the HCVS, will open under the maximum expected differential pressure during BDBEE and severe accident wetwell venting.	The Primary Containment Pressure Limit is 65 psig. The following files are in the subfolder for this item in "ISE Item Closure/Phase 1": • VTDs 315211 and 315212 • HC.OP-EO.ZZ-0206-BASES, Rev. 1, RPV Flooding Emergency Operating Procedure Bases Document, supporting the PCPL value of 65 psig (p. 12/29) • Valve data sheets from Specification H-1-VAR-MGS-0010 (002) for Nuclear Butterfly Valves, Rev. 9 These documents have not changed since the June 2017 upload.	Documentation provided shows the valves were purchased with fail-closed design function. Maximum specified design pressure is 65 psig. During the audit, NRC staff requested information demonstrating the actuators can open the valves under expected differential pressure and that the actuator maintains operability under severe accident conditions for the duration of the coping mission time. Licensee provided evaluations on the primary containment isolation valves. The evaluation determined that the inboard primary isolation valve (PIV) actuator may not have sufficient torque to fully open the valve under maximum anticipated differential pressure. Procedures specify opening the inboard PIV first. As the downstream piping is pressurized equalizing the pressure across the inboard PIV. For subsequent HCVS operation, the inboard PIV will be kept open and the downstream valve cycled as required. No follow-up questions.	
Phase 1 ISE OI 11 Provide a description of the strategies for hydrogen control that minimizes the potential for hydrogen gas migration and	Complete. The release point elevation and plume rise during venting (described in References 12 and 13) will minimize migration and ingress of hydrogen into buildings.	The NRC staff reviewed the information provided in the 6-month updates and on the ePortal.	Closed [Staff evaluation to be included in SE Section 3.1.2.12]

ingress into the reactor building or other buildings.	Vendor Technical Document (VTD) 432628 Volume 2, "Hydrogen Leakage from the CIVs of HCVS into the Enclosed CPCS Duct Return Line," shows that the in-leakage of hydrogen into the vent is minimal in the time between venting operations. When the HCVS valves are closed, the vent piping will be purged with Argon gas using Emergency Operating Procedure HC.OP-EO.ZZ-0318, "Containment Venting" (EOP-0318) if hydrogen is expected. A detailed response in SAP Order Operation 80115232-0200 (ISE11-H2(80115232-0200).pdf) and references are provided in the subfolder for this item in "ISE Item Closure/Phase 1." The only document that has changed since the June 2017 upload is EOP-318, for containment venting. The draft revision to EOP-318 with SAWA changes is included in the subfolder.	The HCVS is connected to the Containment Pre-purge Cleanup System at valve HV4962 (24" diameter) and at valve HV4963 (2" diameter). Evaluation PSEG104-CALC-005, Revision 0 indicates valve 1GS-HV-4962 has a blank flange installed downstream and therefore leakage through the valve is assumed to be 0 standard cubic centiliters per minute (sccm). The valves appear to be primary containment isolation valves and as such should be under an Appendix J leakage testing program. The Appendix J leakage testing program provides assurance hydrogen is not likely to leak into other systems/buildings. The NRC staff's review of the proposed system indicates that the licensee's design appears to meet the requirement for minimizing the potential for hydrogen gas migration and ingress into the Reactor Building or other site buildings. No follow-up questions.	
Phase 1 ISE OI 12 Provide a description of the final design of the HCVS to address hydrogen detonation and deflagration.	Complete. Measures to prevent hydrogen deflagration/detonation have been established by Emergency Operating Procedure HC.OPEO. ZZ-0318, "Containment Venting" (EOP-0318) and the argon purge system installed DCP via 80113941, "Hardened Containment Vent System Mechanical." EOP-0318 has been	The NRC staff reviewed the information provided in the 6-month updates and on the ePortal. The licensee's design is consistent with Option 5 of the	Closed [Staff evaluation to be included in SE Section 3.1.2.11]

	revised in order to require an argon purge of the HCVS prior to opening the containment isolation valves in an accident scenario where hydrogen generation is expected, and to keep the HCVS operating unless containment pressure approaches zero psig. Vendor Technical Document (VTD) 432631 demonstrates that the volume of argon gas used to purge the HCVS is sufficient in order to prevent hydrogen detonation/deflagration by completely filling the HCV downstream of HV-11541. The compressed gas purge system uses argon gas to fill the HCVS piping from valve HV-11541 (V-201) to the release point and prevent oxygen from entering the vent piping after a vent cycle. A detailed response in SAP Order Operation 80115232-0210 (ISE12(80115232-210).pdf) and references are provided in the subfolder for this item in "ISE Item Closure/Phase 1" Draft EOP-318, Containment Venting" with SAWA changes is included in the subfolder. HC.OP-DL.ZZ-0006-F1, HC-Auxiliary Building Log 6, has been revised since the June 2017 upload but the criteria for checking Argon bottle pressures have not changed.	NRC staff endorsed white paper HCVS-WP-03. No follow-up questions.	
Phase 1 ISE OI 13 Finalize χ/Q analysis (OIP #3). Submit a relaxation request as stated in the Order for the deviation from Order EA-13-109 provision 1.2.2, "The HCVS Section 3.2.2.3 shall	Complete (References 12, 13, and 14). There is no e-portal folder for this item. References 12, 13, and 14 are docketed correspondence in ADAMS. DCP 80115583 configured the release point consistent with the relaxation and is included in the folder for Phase 2 ISE #1.	The NRC staff reviewed the information provided in the 6-month updates and on the ePortal. The licensee finalized their χ/Q analysis and submitted a relaxation request from Order EA-	Closed [Staff evaluation to be included in SE Section 3.1.2.2]

discharge the effluent to a release point above the main plant structures," which includes a technical justification for the deviation.		13-109 provision 1.2.2 in letter dated June 21, 2016 (ADAMS Accession No. ML16174A086), as supplemented by letter dated September 7, 2016 (ADAMS Accession No. ML16251A309). The NRC staff reviewed the relaxation request and was accepted in letter dated September 30, 2016 (ADAMS Accession No. ML16256A655). No follow-up questions.	
Phase 2 ISE OI 1 Licensee shall provide the finalized design of HCVS discharge location.	Complete. DCP 80115583, "Hope Creek Hardened Torus Vent Modification," provides the final discharge location design consistent with relaxation of the release point height requirement (NRC Letter to PSEG, "Hope Creek Generating Station- Request for Relaxation of the Release Point Height Requirement of NRC Order EA-13-109, Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation under Severe Accident Conditions (CAC No. MF4458)," dated September 30, 2016). Page 3 of the NRC SER is consistent with the final design of the vent height in DCP 80115583 Revision 2, which is in the subfolder for this item in "ISE Item Closure/Phase 2" DCP 80115583 Affected Document (AD) M05 is also included, and shows the effect of the change on the system piping isometric drawing.	The NRC staff reviewed the information provided in the 6-month updates and on the ePortal. The NRC staff reviewed the relaxation request and was accepted in letter dated September 30, 2016 (ADAMS Accession No. ML16256A655). No follow-up questions.	Closed [Staff evaluation to be included in SE Section 3.1.2.2]
Phase 2 ISE OI 2	Complete. DCP 80118721, "HC Severe Accident Water Addition," provides the	The NRC staff reviewed the information provided in the 6-	Closed

Licensee shall provide the finalized design, which demonstrates the capability to inject the necessary SAWA flow rate and the ability to control that flow under a flooded condition.	SAWA design to inject the required flow rate and to control flow under a flooded condition, as summarized in Section 4. Section 4 has been updated since the previous status report (Reference 16 (ADAMS Accession No. ML17178A300)) to include additional details. Documents supporting the discussion in Section 4 above are in the subfolder for this item in "ISE Item Closure/Phase 2." Section 4 above is annotated with comments to refer to sources of supporting information. DCP 80118721 is under revision and will be provided when available but the response in Section 4 above should not be affected by the changes. Supplements 1 and 2 to the DCP (80118721r0sup01r0 and 80118721r0sup02r1) are the electrical the mechanical sketches, respectively, for the SAWA design.	month updates and on the ePortal. Calculation H-1-FLX-MDC-4022, "FLEX Hydraulic Model," Revision 1, determined that the required SAWA flowrate was within the capacity of the portable FLEX pumps. The NRC staff reviewed the flow rates and pressures evaluated in the hydraulic analyses and confirmed that the equipment is capable of providing the needed flow rate. Based on the NRC staff's review of the FLEX pumping capabilities, as described in the above hydraulic analyses and in the OIP and subsequent 6-month updates, the licensee has demonstrated that its portable FLEX pumps should perform as intended to support SAWA flow.	[Staff evaluation to be included in SE Section 4.1.1.2]
Phase 2 ISE OI 3 Licensee to confirm through analysis the temperature and radiological conditions to ensure that operating personnel can safely access and operate controls and support equipment.	Complete. Vendor Technical Document 432889, "Severe Accident Water Addition Personnel and Equipment Environmental Qualification Report," summarizes the results of temperature and radiological analyses and their impact on personnel access to SAWA equipment. VTD 432889 and its design inputs listed in Section 4 of the VTD are in the subfolder "ISE Item Closure/Phase 2/Ph2_ISE-3+4Temp+Dose."	The NRC staff reviewed the information provided in the 6-month updates and on the ePortal. Calculation 2017-04167, "SAWA/SAWM (Severe Accident Water Management) GOTHIC Analyses," Revision 0 and calculation 2017-01221, "Hardened Containment Vent System Phase II Radiation Dose Assessment," Revision 0, demonstrates that the temperature and radiological	Closed [Staff evaluation to be included in SE Section 4.5.1.3]

		conditions should not inhibit operator actions needed to support SAWA/SAWM during an ELAP with severe accident conditions. No follow-up questions.	
Phase 2 ISE OI 4 Licensee to demonstrate how instrumentation and equipment being used for SAWA and supporting equipment is capable to perform for the sustained operating period under the expected temperature and radiological conditions.	Same response as for Phase 2 ISE # 3.	The NRC staff reviewed the information provided in the 6-month updates and on the ePortal. The drywell pressure and torus level indications are RG 1.97 compliant and are acceptable as qualified. The NRC staff reviewed calculation 2017-01221, "Hardened Containment Vent System Phase II Radiation Dose Assessment," Revision 0 and determined that the licensee used conservative assumptions and followed the guidance outlined in NEI 13-02 Rev.1 and HCVS-WP-02 Rev.0. Based on the expected integrated whole body dose equivalent in the POS and ROS and the expected integrated whole body dose equivalent for expected actions during the sustained operating period, the NRC staff believes that the order requirements are met. No follow-up questions.	Closed [Staff evaluation to be included in SE Sections 4.4.1.3 and 4.5.1.2]
Phase 2 ISE OI 5	Complete. ISE #5 and ISE #6 are addressed in Technical Evaluation 80115232-0380, which shows that the	The NRC staff reviewed the information provided in the 6-	Closed

Licensee to demonstrate that containment failure as a result of overpressure can be prevented without a drywell vent during severe accident conditions.	reference plant analyses are applicable to Hope Creek and that the SAWA/SAWM strategy can prevent containment failure due to overpressure without the use of a drywell vent. TEVL 80115232-0380 and references (except for NEI 13-02 Rev 1) are in the subfolder "ISE Item Closure/Phase 2/Ph2_ISE-5+6_RefPlant_SAWA-SAWM."	month updates and on the ePortal. 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 (see Phase 1 ISE Open Item 2). Hope Creek will follow the guidance (flow rate and timing) for SAWA/SAWM described in BWROG-TP-15-008, "Severe Accident Water Addition Timing", and BWROG-TP-15-011 "Severe Accident Water Management". The wetwell be opened prior to exceeding the PCPL value of 65 psig. BWROG-TP-15-008 demonstrates adding water to the reactor vessel within 8-hours of the onset of the event will limit the peak containment drywell temperature significantly reducing the possibility of containment failure due to temperature. Drywell pressure can be controlled by venting the suppression chamber through the suppression pool. BWROG-TP-011 demonstrates 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.	[Staff evaluation to be included in SE Section 4.2]

		No follow-up questions.	
Phase 2 ISE OI 6 Licensee shall demonstrate how the plant is bounded by the reference plant analysis that shows the SAWM strategy is successful in making it unlikely that a drywell vent is needed.	Same response as for Phase 2 ISE #5.	The NRC staff reviewed the information provided in the 6-month updates and on the ePortal. The reference plant has a Torus freeboard of 525,000 gallons. Hope Creek has a Torus freeboard of 655,000 gallons. Both the reference plant and Hope Creek assume SAWA flow of 500 gallons per minute (gpm) starting at 8 hours. The reference plant reduces SAWA flow to 100 gpm at 12 hours. Hope Creek reduces SAWA flow to 100 gpm at 14 hours. BWROG TP-15-011, evaluation demonstrates that the Mark I (and Mark II) fleet is bounded by the reference plant analyses. This study addressed how suppression pool level control could be achieved in a manner that maintains long-term function of the wetwell vent, and determined if there would be adverse effects by controlling (limiting) flow rate. The study concludes that plants with Mark I containments, with injection into the RPV, can maintain containment cooling and preserve the wetwell vent without a plant specific analysis. The evaluation bounds the parameters at Hope Creek. Hope Creek plans to flow this strategy and is bounded by	Closed [Staff evaluation to be included in SE Section 4.2.1.1]

		the conclusions of the BWROG evaluation. No follow-up questions.	
Phase 2 ISE OI 7 Licensee to demonstrate that there is adequate communication between the MCR and the operator at the FLEX pump during severe accident conditions.	Complete. The SAWA design includes mechanical flow indicator (H1BC-1BCFI-0100) in the Control/Diesel area of the Auxiliary Building at 102 ft. elevation, near the manual flow control valve BC-V643, which is used to control SAWA flowrate. Communication between the operator locally controlling SAWA flow and the MCR is via UHF radio or Plant Page, and is similar to communications capability available during FLEX strategy implementation. Details including FLEX communications enhancements are contained in SAP Order Operation 80115232-0340, which is in the subfolder "ISE Item Closure/Phase 2/Ph2_ISE-7_Communications." The subfolder also includes calculation D7.5 Revision 24, which is mentioned in the response as establishing Room 3197 as a mild environment (pp. 69, 106, and 145/190 for normal, abnormal, and design basis event conditions, respectively). SAWA Design Change Package DCP 80118721 is under revision but the descriptions used in this response should not be affected.	The NRC staff reviewed the information provided in the 6-month updates and on the ePortal. The communication methods are the same as accepted in Order EA-12-049. No follow-up questions.	Closed [Staff evaluation to be included in SE Section 4.1]

SUBJECT: HOPE CREEK GENERATING STATION - 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 (CAC NO. MF4458; EPID L-2014-JLD-0040) DATED May 4, 2018

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