December 19, 2018

NG-18-0138

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Duane Arnold Energy Center
Docket No. 50-331
Renewed Facility Operating License No. DPR-49

NextEra Energy Duane Arnold, LLC's Completion of Required Action for NRC Order Number EA-13-109, Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions

References:

1. Order EA-13-109, "Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions," dated June 6, 2013 (ML13130A067)
2. NRC Interim Staff Guidance JLD-ISG-2013-02, "Compliance With Order EA-13-109, Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions," Revision 0, dated November 14, 2013 (ML13304B836)
3. NRC Interim Staff Guidance 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 Operation Under Severe Accident Conditions," Revision 0, dated April 29, 2015 (ML15104A118)
4. NEI 13-02, "Industry Guidance for Compliance With Order EA-13-109, BWR Mark I & II Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions," Revision 1, dated April 2015 (ML15113B318)
5. NextEra Energy Duane Arnold, LLC's Response to June 6, 2013 Commission Order Modifying License With Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109), NG-13-0269 dated June 25, 2013 (ML13177A410)

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6. NextEra Energy Duane Arnold LLC's 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, NG-14-0151 dated June 25, 2014 (ML14182A423)
7. NextEra Energy Duane Arnold, LLC's Six-Month Status Report 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), NG-14-0285 dated December 10, 2014 (ML14349A324)
8. NextEra Energy Duane Arnold, LLC's Six-Month Status Report 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), NG-15-0169 dated June 18, 2015 (ML15170A333)
9. NextEra Energy Duane Arnold, LLC's Six-Month Status Report and Phase 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), NG-15-0361 dated December 22, 2015 (ML15358A043)
10. NextEra Energy Duane Arnold, LLC's Six-Month Status Report 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), NG-16-0130 dated June 30, 2016 (ML16187A261)
11. NextEra Energy Duane Arnold, LLC's Six-Month Status Report 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), NG-16-0241 dated December 22, 2016 (ML16362A211)
12. NextEra Energy Duane Arnold, LLC's Six-Month Status Report 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), NG-17-0121 dated June 29, 2017 (ML17180A217)

13. NextEra Energy Duane Arnold, LLC's Six-Month Status Report 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), NG-17-0250 dated December 19, 2017 (ML17353A668)
14. NextEra Energy Duane Arnold, LLC's Six-Month Status Report 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), NG-18-0066 dated June 26, 2018 (ML18177A261)
15. NRC Letter, Duane Arnold Energy Center, Interim Staff Evaluation Relating to Overall Integrated Plan in Response to Phase 1 of Order EA-13-109, dated February 11, 2015 (ML15006A319)
16. NRC Letter, Duane Arnold Energy Center, Staff Evaluation Relating to Overall Integrated Plan in Response to Phase 2 of Order EA-13-109, dated September 13, 2016 (ML16248A001)
17. NRC Letter, Duane Arnold Energy Center, 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 March 5, 2018 (ML18057B298)

On June 6, 2013, the Nuclear Regulatory Commission ("NRC" or "Commission") issued an Order (Reference 1) to NextEra Energy Duane Arnold, LLC. Reference 1 was immediately effective and directed NextEra Energy Duane Arnold, LLC (hereafter NextEra Energy Duane Arnold) to install a reliable hardened venting capability for pre-core damage and under severe accident conditions, including those involving a breach of the reactor vessel by molten core debris. Specific requirements are outlined in Attachment 2 of Reference 1.

Reference 1 required submission of a Phase 1 Overall Integrated Plan (OIP) pursuant to Section IV, Condition D, and status reports at six-month intervals thereafter. The interim staff guidance (i.e., References 2 and 3) provided direction regarding content of the OIP for Phase 1 and Phase 2. Reference 4 endorsed industry guidance document NEI 13-02, Revision 1 with clarifications and exceptions identified in Reference 3. Reference 5 provided the NextEra Energy Duane Arnold response to Order EA-13-109. NextEra Energy Duane Arnold submitted the Phase 1 OIP by letter dated June 25, 2014 (Reference 6).

References 7 through 14 provided the subsequent six-month status reports pursuant to Section IV, Condition D.3 of Reference 1. Reference 9 included the required six-month status update, as well as the consolidated Phase 1 and 2 OIP submittal.

References 15 and 16 provide the NRC Interim Staff Evaluations relating to the Phase 1 OIP and Phase 2 OIP, respectively. Reference 17 provides the NRC report for the Audit of Licensee Responses to Interim Staff Evaluations Open Items Related to NRC Order EA-13-109.

The purpose of this letter is to provide the notification required by Item IV.D.4 of Order EA-13-109 that full compliance (i.e., Phase 1 and Phase 2) with the requirements described in Attachment 2 of the Order has been achieved for the Duane Arnold Energy Center. Enclosure 1 documents closure of items that remained open in Reference 14. Enclosure 2 contains DAEC's Final Integrated Plan for Order EA-13-109.

This letter contains no new regulatory commitments. If you have any questions regarding this submittal, please contact Michael Davis, Licensing Manager at 319-851-7032.

I declare under penalty of perjury that the foregoing is true and correct.
Executed on December 19, 2018.

Dean Curtland

Dean Curtland
Site Director, Duane Arnold Energy Center
NextEra Energy Duane Arnold, LLC

Enclosures

cc: Director, Office of Nuclear Reactor Regulation
USNRC Regional Administrator Region III
USNRC Project Manager, Duane Arnold Energy Center
USNRC Resident Inspector, Duane Arnold Energy Center

Enclosure1 to NG-18-0138

<u>NextEra Energy Duane Arnold, LLC's Final Status Report 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)</u>

15 pages follow

1 Introduction

NextEra Duane Arnold Energy Center, LLC developed an Overall Integrated Plan (Reference 1 in Section 8), documenting the planned installation of a Hardened Containment Vent System (HCVS) that provides reliable hardened venting capability for pre-core damage and under severe accident conditions, including those involving a breach of the reactor vessel by molten core debris, in response to Reference 2.

NextEra Duane Arnold Energy Center, LLC developed an updated and combined Phase 1 and 2 Overall Integrated Plan dated December 22, 2015 (Reference 7), documenting:

1. The planned installation of a HCVS as described above; and
2. An alternative venting strategy that makes it unlikely that a drywell vent is needed to protect the containment from overpressure related failure under severe accident conditions, including those that involve a breach of the reactor vessel by molten core debris, in response to Reference 2.

This enclosure provides an update of final milestone accomplishments since submittal of the combined Phase 1 and 2 Overall Integrated Plan, including any changes to the compliance method, schedule, or need for relief/relaxation and the basis, if any.

2 Milestone Accomplishments

At the time of this update, all activities associated with implementation of Phase 1 and Phase 2 have been completed. Refer to the Milestone Schedules and ISE Items status for details.

The following milestone(s) have been completed since the six-month update submitted on June 26, 2018 (Reference 9).

- Operations Procedure Changes Developed
- Site Specific Maintenance Procedure Developed
- Implementation Outage
- Procedure Changes Active
- Submittal of Completion Report (Complete with this submittal)

3 Final Milestone Schedule Status

The following provides an update to Part 5 of the combined Phase 1 and 2 Overall Integrated Plan.

Phase 1 Milestone Schedule:

Milestone	Target Completion Date	Activity Status	Comments
Issue preliminary/conceptual design report	June 2014	Complete	
Submit Overall Integrated Implementation Plan	June 2014	Complete	
Initial Outage for Phase 1 Planning	Nov. 2014	Complete	
Submit 6 Month Status Report	Dec. 2014	Complete	
Submit 6 Month Status Report	June 2015	Complete	
Submit 6 Month Status Report	Dec. 2015	Complete	
Design Complete Phase 1	Mar. 2016	Complete	
Submit 6 Month Status Report	June 2016	Complete	
Operations Procedure Changes Developed	Oct. 2016	Complete	
Site Specific Maintenance and Testing Procedures Developed	Oct. 2016	Complete	
Training Complete	Oct. 2016	Complete	
Implementation Outage	End of RFO25	Complete	
Procedure Changes Active	End of RFO25	Complete	
Walk Through Demonstration/Functional Test	End of RFO25	Complete	
Submit Completion Report	60 days after RFO25	Not Required	Not required for Phase 1

Phase 2 Milestone Schedule

Milestone	Target Completion Date	Activity Status	Comments {Include date changes in this column}
Submit Overall Integrated Implementation Plan	Dec. 2015	Complete	
Hold preliminary/conceptual design meeting	Feb 2017	Complete	
Submit 6 Month Status Report	June 2016	Complete	
Submit 6 Month Status Report	Dec. 2016	Complete	
Submit 6 Month Status Report	June 2017	Complete	
Submit 6 Month Status Report	Dec. 2017	Complete	
Design Engineering On-site/Complete	Jan. 2018	Complete	
Submit 6 Month Status Report	June 2018	Complete	
Operations Procedure Changes Developed	Oct. 2018	Complete	
Site Specific Maintenance Procedure Developed	Oct. 2018	Complete	
Training Complete	Oct. 2018	Eliminated	Phase 2 training not required per Training Impact Review
Implementation Outage	RFO 26	Complete	
Procedure Changes Active	RFO 26	Complete	
Walk Through Demonstration/Functional Test	RFO 26	Complete	Performed as part of FLEX in 2016
Submit Completion Report	RFO 26	Complete with this submittal	

4 Changes to Compliance Method

There are no changes to the compliance method as documented in the combined Phase 1 and 2 Overall Integrated Plan (Reference 7). However, the following changes were made to the design details which affect descriptions contained in Reference 7.

- The HCVS "Nitrogen Supply Isolation at 1A3 ROS" (V43-0642) will be normally closed and locked to prevent inadvertent vent operation. This valve will have to be manually opened at the Remote Operating Station (ROS) in the 1A3 Essential Switchgear Room to supply nitrogen for CV operation and purging.
- The HCVS nitrogen supply and purge pressure control valves (PCV4360 and PCV4361) will be normally closed to prevent inadvertent over pressurization. The PCVs are located at the ROS and will be manually adjusted to the prescribed setpoints after the main pneumatic supply valve is opened (V43-0642).
- The Uninterruptible Power Supply (UPS) originally had the normal power supply from 1B32. Analysis identified that 1B32 did not have adequate margin to add this load; therefore the normal power supply has been changed to 1B15. A receptacle will be installed at the UPS for direct connection to the portable 480 VAC generator. The power to 1B15 will be lost during an ELAP. The UPS will provide power for 24 hours; the FLEX 480 VAC generator will provide power beyond 24 hrs.

5 Need for Relief/Relaxation and Basis for the Relief/Relaxation

NextEra Duane Arnold Energy Center, LLC has complied with the order implementation date and no relief/relaxation is required.

6 Final Status of Open Items from Combined Phase 1 and 2 Overall Integrated Plan and Interim Staff Evaluations

The following tables provide a summary of the open items documented in the combined Phase 1 and 2 Overall Integrated Plan or the Interim Staff Evaluation (ISE) and the final status of each item.

Combined Phase 1 and 2 OIP Open Item	Status
Phase 1 Open Items	
1. Confirm secondary containment bypass leakage is acceptable without an installed rupture disk or retain an appropriate disk.	Completed. Appropriate rupture disk is included in design of modification.
2. Perform severe accident evaluation for FLEX DG and replacement gas to confirm accessibility for use for post 24 hour actions.	Completed. Actions to connect the FLEX DG and replace nitrogen bottles are performed in the Control Building battery room corridor and 1A3 essential switchgear room. DAEC has completed evaluations of temperature and radiological conditions to ensure that operators can safely access and operate controls and support equipment in these areas.
3. Evaluate tornado/missile effects on HCVS components above the protected area of the Reactor Building.	Complete.
4. Evaluate the system design for H2/CO measures to be taken.	Complete.

Phase 1 Interim Staff Evaluation Open Items	Status
1. Make available for NRC staff audit documentation of licensee confirmation that secondary containment leakage is acceptable without an installed rupture disk or that an appropriate rupture disk, including procedures for rupture during HCVS operation, is included in the HCVS design. (Section 3.1.2, Section 3.2.2.8)	Complete. The DAEC final design of the HCVS utilizes an installed rupture disk. Procedures for rupturing the disk have been developed for use during beyond design bases conditions.
2. Make available for NRC staff audit analyses demonstrating that HCVS has the capacity to vent the steam/energy equivalent of one (1) percent of licensed/rated thermal power (unless a lower value is justified), and that the suppression pool and the HCVS together are able to absorb and reject decay heat, such that following a reactor shutdown from full power containment pressure is restored and then maintained below the primary containment design pressure and the primary containment pressure limit. (Section 3.2.2.1, Section 3.2.2.2)	Complete. DAEC has completed analysis demonstrating the HCVS has the capacity to vent the steam/energy equivalent to one percent of licensed thermal power and that the suppression pool and HCVS together are able to absorb and reject decay heat such that following a reactor shutdown from full power containment pressure will be maintained below the primary containment design pressure limit of 53 PSIG.
3. Make available for NRC staff audit evaluations of tornado missile effects on HCVS components above the protected area of the reactor building. (Section 3.2.2.3)	Complete. DAEC has evaluated the potential effects of tornado missiles on HCVS components above the protected area of the reactor building and confirmed that HCVS function will not be impaired. HCVS components located above the protected area of the reactor building are limited to piping components and supports.

4. Make available for NRC staff audit additional detail on the design features that minimize unintended cross flow of vented fluids within a unit, including a one line diagram containing sufficient detail to confirm the description in the OIP. (Section 3.2.2.7)	Eliminated. The DAEC design has been modified since issuance of the ISE. The HCVS system utilizes a dedicated penetration from the torus to HCVS piping with no connecting systems eliminating the possibility of unintended cross flow.
5. Provide a description of the final design of the HCVS to address hydrogen detonation and deflagration. (Section 3.2.2.6)	Complete. The final DAEC design of the HCVS addresses the potential for hydrogen detonation and deflagration with the use of a nitrogen purge of the HCVS piping that ensures hydrogen and oxygen concentrations within the HCVS system are not susceptible to detonation or deflagration (Option 3 of Appendix H of NEI 13-02). The HCVS system isolation is performed by two primary containment isolation valves (PCIVs) to minimize any potential leakage. Prior to use of the system a partial purge of the system is performed to ensure no hydrogen is directly downstream of the PCIVs at the time of actuation. A full nitrogen purge is performed immediately following each period of venting the torus. Each purge is performed with nitrogen flow at sufficient velocity to limit stratification and ensure turbulent flow to preclude retaining hydrogen in the pipe. The piping is sloped upwards from the outboard PCIV to the atmospheric vent discharge to ensure hydrogen will exit the vent through buoyancy. No trapped high points are provided in the piping.
6. Provide a description of the strategies for hydrogen control that minimizes the potential for hydrogen gas migration and ingress into the reactor building or	Complete. DAEC strategies for hydrogen control are as noted above in response to Open Items 4 and 5. The HCVS system utilizes a dedicated penetration from the torus to HCVS piping with no

other buildings. (Section 3.2.2.6)	connecting systems and the HCVS piping does not pass through other buildings thus eliminating the potential for migration of hydrogen gas from the HCVS into the reactor building or other buildings. Nitrogen purge of the system prior to use and immediately following isolation of the system prevents detonation or deflagration of hydrogen inside the HCVS (Option 3 of NEI 13-02 Appendix H).
7. Make available for NRC staff audit documentation that demonstrates adequate communication between the remote HCVS operation locations and HCVS decision makers during ELAP and severe accident conditions. (Section 3.2.2.5)	Complete. DAEC docketed an assessment of communications capabilities under ELAP conditions in NG-12-0430 "Response to NRC 10 CFR 50.54(f) Request for Information Regarding Near-Term Task Force Recommendation 9.3, Emergency Preparedness" (ADAMS Accession No. ML 12307A120). NRC staff review of this assessment is documented in an NRC Letter dated June 6, 2013 "Duane Arnold Energy Center-Staff Assessment in Response to Recommendation 9.3 of the Near-Term Task Force Related to the Fukushima Dai-Ichi Nuclear Power Plant Accident" (ADAMS Accession No. ML 13142A320). The NRC staff concluded the communications assessment was reasonable to ensure communications were maintained during an ELAP. The HCVS operating locations are the main control room located in the control building and the Remote Operating Station in the 1A3 switchgear room also located in the control building. Severe accident conditions do not have an impact on communications in the control building beyond those defined in the communications assessment for ELAP conditions. HCVS decision makers are located in the control room so communication with the operating location in the control room can be

	made directly with no equipment requirements. Operators at the Remote Operating Station can communicate with HCVS decision makers via a variety of methods including sound powered phones, hand held radios, plant page, or telephone.
8. Make available for NRC staff audit an evaluation of temperature and radiological conditions to ensure that operating personnel can safely access and operate controls and support equipment. (Section 3.2.1, Section 3.2.2.3, Section 3.2.2.4, Section 3.2.2.5, Section 3.2.2.10, Section 3.2.4.1, Section 3.2.4.2, Section 3.2.5.2 and Section 3.2.6)	Complete. DAEC has completed evaluations of temperature and radiological conditions to ensure that operators can safely access and operate controls and support equipment for the HCVS system. HCVS controls and support equipment requiring access by operators are located within the control building to minimize radiological and temperature challenges.
9. Make available for NRC staff audit the final sizing evaluation for HCVS batteries/battery charger including incorporation into FLEX DG loading calculation. (Section 3.2.2.4, Section 3.2.3.1, Section 3.2.3.2, Section 3.2.4.1, Section 3.2.4.2, Section 3.2.5.1 and Section 3.2.5.2)	Complete. DAEC has completed final sizing evaluations for HCVS batteries to ensure the batteries can power HCVS equipment for a minimum of 24 hours. DAEC has completed an evaluation for the battery chargers to confirm they are capable of recharging the HCVS batteries while loaded. A review of the use of FLEX diesel generators to power the HCVS battery chargers has confirmed the load is within the capacity of the FLEX diesel generators. The 480 VAC FLEX diesel generators are equipped with two 50A output breakers and four 125A output breakers. One of the 50A breakers will be connected to the HCVS UPS via a 200 foot length cable. The voltage drop across the cable for the assumed 8A UPS load is 1.03 volt which is well within the +10/-12% allowable input voltage range specified by the UPS vendor, and is acceptable. The UPS batteries are adequate for the first 24

	hours of HCVS service. The addition of the small load of the HCVS UPS to the FLEX 480 VAC generator after 24 hours is acceptable.
10. Make available for NRC staff audit the final sizing evaluation for pneumatic N2 supply. (Section 3.2.2.4, Section 3.2.3.1, Section 3.2.3.2, Section 3.2.4.1, Section 3.2.4.2, Section 3.2.5.1 and Section 3.2.5.2)	Complete. DAEC has completed the final sizing evaluation of pneumatic nitrogen supply that demonstrates adequate capacity is installed for the first 24 hours of an ELAP event. After 24 hours replacement nitrogen bottles can be applied in an accessible location in the control building.
11. Make available for NRC staff audit documentation of an evaluation verifying the existing containment isolation valves, relied upon for the HCVS, will open under the maximum expected differential pressure during BDBEE and severe accident wetwell venting. (Section 3.2.2.9)	Eliminated. As stated in NG-15-0169, Six Month Status Update, due to design changes in vent location and routing, existing containment isolation valves will no longer be used for venting. New vent design will utilize a spare torus penetration with two new primary containment isolation valves and a rupture disk. An evaluation has been done to ensure the two new containment isolation valves will open under the maximum expected differential pressure during BDBEE and severe accident wet well venting.
12. Make available for NRC staff audit descriptions of all instrumentation and controls (existing and planned) necessary to implement this order including qualification methods. (Section 3.2.2.10)	Complete. DAEC has completed evaluations of key instruments and controls necessary to implement NRC Order EA-13-109 including the qualification methods as part of the engineering change package for the HCVS system to ensure the instrumentation and controls are suitable for the application.
13. 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,	Complete. DAEC has completed evaluations of key components necessary for HCVS venting to ensure they are capable of performing their intended function under ELAP and severe accident

instrumentation, sensors, transmitters, indicators, electronics, control devices, and etc.) required for HCVS venting including confirmation that the components are capable of performing their functions during ELAP and severe accident conditions. (Section 3.2.2.3, Section 3.2.2.5, Section 3.2.2.9, Section 3.2.2.10)	conditions including local temperature, radiation and humidity as part of the engineering change package for the HCVS system.
14. Provide a justification for deviating from the instrumentation seismic qualification guidance specified in NEI 13-02, endorsed, in part, by JLD-ISG-2013-02 as an acceptable means for implementing applicable requirements of Order EA-13-109. (Section 3.2.2.9)	Eliminated. As stated in NG-15-0169, Six Month Status Update, the qualification method used for each HCVS instrument will be to the IEEE 344-2004 standard or a substantially similar industrial standard and therefore will not be deviating from NEI 13-02 or JLD-ISG-2013-02.

Phase 2 Interim Staff Evaluation Open Items	**Status**
1. Licensee to evaluate the SAWA equipment and controls, as well as ingress and egress paths for the expected severe accident conditions (temperature, humidity, radiation) for the sustained operating period.	Complete. The SAWA pump and manual controls will either be placed behind the pump house or in the Turbine Building south rail bay. The temperature conditions in these locations will be at or near ambient conditions. Portable heaters are available for extreme cold conditions (SAMP-726). Proposed equipment locations are shielded by concrete walls. An evaluation performed for ingress, egress and equipment location determined acceptable radiological conditions for the sustained operating period.

2. Licensee to demonstrate that SAWA components and connections external to protected buildings have been protected against the screened-in hazards of Order EA-12-049 for the station.	Complete. The connection to the SAWA pipe line is located inside the heater bay which is considered a substantially designed area that is surrounded by reinforced concrete walls and therefore protected from tornadoes. Flood protection for the Turbine Building is provided by means of a flood gate and temporary flood barriers and the station has adequate warning time to implement the barriers. The Turbine Building was designed to seismic category 1 criteria and the piping has also been designed to seismic category 1 criteria. The remainder of the piping is located in the Reactor Building which is protected from the screened in hazards.
3. Licensee to demonstrate that containment failure as a result of overpressure can be prevented without a drywell vent during severe accident conditions.	Complete. An evaluation (EVAL-16-M01) has been performed which demonstrates that the containment vent will be available (uncovered) for the 7 day mission time using severe accident water management and installed suppression pool instrumentation. The freeboard volume available for SAWM has been calculated in accordance with NEI 13-02, Revision 1 (Appendix C). As a result, the hardened containment vent will ensure containment pressure does not exceed the design pressure of the drywell.
4. Licensee to 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.	Complete. An evaluation (EVAL-18-M03) has been performed to calculate the minimum initial SAWA flow rate and the minimum long tern SAWA flow rate.

5. Licensee to demonstrate that there is adequate communication between the MCR and the operator at the FLEX pump during severe accident conditions.	Complete. Communications between the MCR and the operator at the FLEX pump during severe accident conditions are described in Section 3.13 of the FLEX Final Integrated Plan (ML16347A010). 24 two-way radios are kept in the control room with chargers. These radios are capable of transmitting and receiving with or without a repeater to provide communications for plant operations.
6. Licensee to demonstrate the SAWM flow instrumentation qualification for the expected environmental conditions.	Complete. The evaluation of the operating design conditions and selection of the flowmeter has been completed. Considerations of seismic, temperature rating as well as process conditions are evaluated. All other instruments were evaluated as part of the FLEX project.

7 Interim Staff Evaluation Impacts

The June 2015 six-month update (Reference 6) noted the following two potential impacts to the Interim Staff Evaluation.

1) One ISE Open Item will be eliminated because the Hardened Pipe Vent will no longer use existing containment isolation valves. The revised vent pipe routing will instead use an existing spare torus penetration and install two new containment isolation valves and a rupture disk. An evaluation will be done to ensure the two new containment isolation valves will open under the maximum expected differential pressure during BDBEE and severe accident wetwell venting.

2) The Interim Staff Evaluation (ISE) inadvertently listed a vent pipe process pressure indicator which will not be part of the Duane Arnold design.

In addition, as discussed previously in Section 4:

The HCVS "Nitrogen Supply Isolation at 1A3 ROS" (V43-0642) will be normally closed and locked to prevent inadvertent vent operation. This valve will have to be manually opened at the Remote Operating Station (ROS) in the 1A3 Essential Switchgear Room to supply nitrogen for CV operation and purging.

The HCVS nitrogen supply and purge pressure control valves (PCV4360 and PCV4361) will be normally closed to prevent inadvertent over pressurization. The PCVs are located at the ROS and will be manually adjusted to the prescribed setpoints after the main pneumatic supply valve is opened (V43-0642).

The Uninterruptible Power Supply (UPS) originally had the normal power supply from 1B32. Analysis identified that 1B32 did not have adequate margin to add this load; therefore the normal power supply has been changed to 1B15. A receptacle will be installed at the UPS for direct connection to the portable 480 VAC generator. The power to 1B15 will be lost during an ELAP. The UPS will provide power for 24 hours; the FLEX 480 VAC generator will provide power beyond 24 hrs.

8 References

The following references support the updates to the combined Phase 1 and 2 Overall Integrated Plan described in this Enclosure.

1. NextEra Duane Arnold Energy Center, LLC 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 25, 2014.
2. NRC Order Number EA-13-109, "Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions" dated June 6, 2013.
3. NEI 13-02, "Industry Guidance for Compliance with NRC Order EA-13-109, 'To Modify Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions," Revision 1, dated April 2015.
4. NRC Interim Staff Guidance JLD-ISG-2013-02, "Compliance with Order EA-13-109, Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions," Revision 0, dated November 2013 (Accession No. ML13304B836).
5. NRC Endorsement of Industry "Hardened Containment Venting System (HCVS) Phase 1 Overall Integrated Plan Template (EA-13-109) Rev 0" (Accession No. ML14128A219).
6. NextEra Energy Duane Arnold, LLC's Six-Month Status Report 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 18, 2015 (ML15170A333)
7. NextEra Duane Arnold Energy Center, LLC Combined Phase 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 22, 2015.
8. NRC Interim Staff Guidance 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 Operation Under Severe Accident Conditions," Revision 0, dated April 2015 (Accession No. ML15104A118).
9. NextEra Energy Duane Arnold, LLC's Six-Month Status Report in Response to June 6, 2013 Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109), dated June 26, 2018 (ML18177A261).

Enclosure to NG-18-0138

NextEra Energy Duane Arnold, LLC's Final Integrated Plan for Order EA-13-109 for the Duane Arnold Energy Center

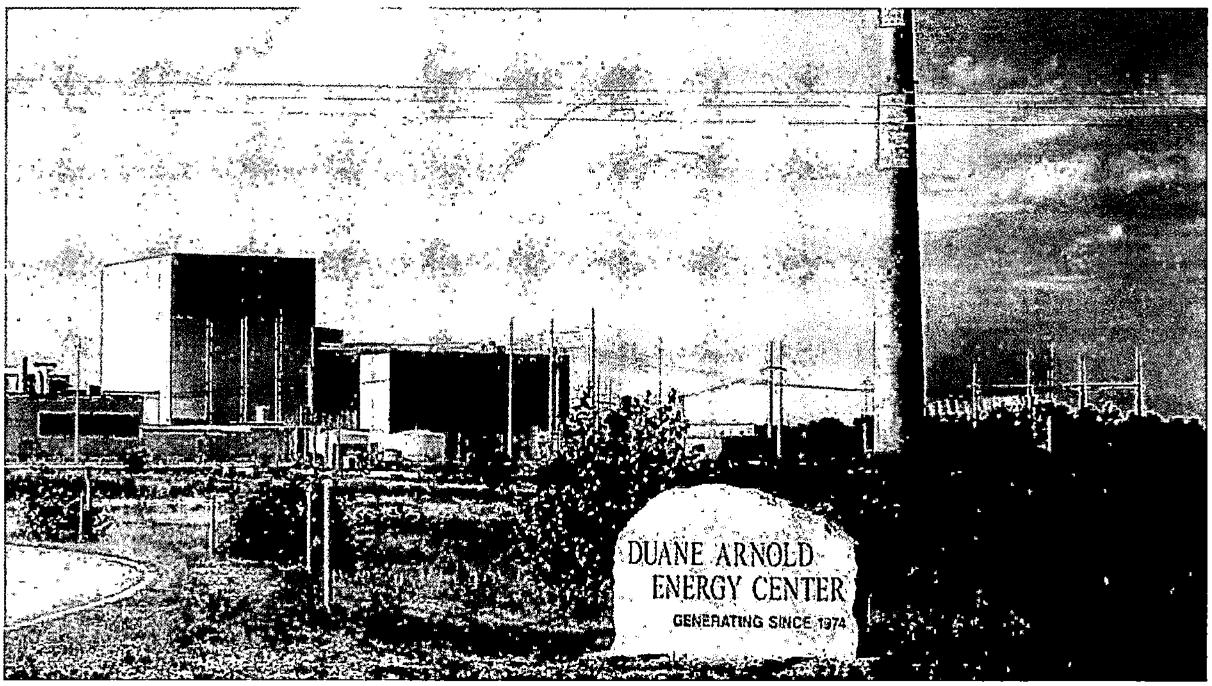
64 pages follow

Final Integrated Plan

HCVS Order EA-13-109

for

Duane Arnold Energy Center (DAEC)



Revision 0

December 14, 2018

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Section I: Introduction

In 1989, the NRC issued Generic Letter 89-16, "Installation of a Hardened Wetwell Vent," (Reference 1) to all licensees of BWRs with Mark I containments to encourage licensees to voluntarily install a hardened wetwell vent. In response, licensees installed a hardened vent pipe from the wetwell to some point outside the secondary containment envelope (usually outside the reactor building). Some licensees also installed a hardened vent branch line from the drywell.

On March 19, 2013, the Nuclear Regulatory Commission (NRC) Commissioners directed the staff per Staff Requirements Memorandum (SRM) for SECY -12-0157, Consideration of Additional Requirements for Containment Venting Systems for Boiling Water Reactors with Mark I and Mark II Containments (References 2 and 3) to require licensees with Mark I and Mark II containments to "upgrade or replace the reliable hardened vents required by Order EA-12-050, Order to Modify Licenses with Regard to Reliable Hardened Containment Vents (Reference 4) with a containment venting system designed and installed to remain functional during severe accident conditions." In response, the NRC issued Order EA-13-109, Issuance of Order to Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accidents, June 6, 2013 (Reference 5). The Order (EA-13-109) requires that licensees of BWR facilities with Mark I and Mark II containment designs ensure that these facilities have a reliable hardened vent to remove decay heat from the containment, and to maintain control of containment pressure within acceptable limits following events that result in the loss of active containment heat removal capability while maintaining the capability to operate under severe accident (SA) conditions resulting from an Extended Loss of AC Power (ELAP).

The Duane Arnold Energy Center (DAEC) is required by NRC Order EA-13-109 to have a reliable, severe accident capable hardened containment venting system (HCVS). Order EA-13-109 allows implementation of the HCVS Order in two phases.

- Phase 1 upgraded the venting capabilities from the containment wetwell to provide reliable, severe accident capable hardened vent to assist in preventing core damage and, if necessary, to provide venting capability during severe accident conditions. DAEC achieved Phase 1 compliance in the last quarter of 2016.

- Phase 2 provided additional protections for severe accident conditions through the development of a reliable containment venting strategy that makes it unlikely that DAEC would need to vent from the containment drywell during severe accident conditions. DAEC achieved Phase 2 compliance in the last quarter of 2018

NEI developed guidance for complying with NRC Order EA-13-109 in NEI 13-02, Industry Guidance for Compliance with Order EA-13-109, BWR Mark I & II Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions, Revision 0 (Reference 6) with significant interaction with the NRC and Licensees. NEI issued Revision 1 to NEI 13-02 in April 2015 (Reference 7) which contained guidance for compliance with both Phase 1 and Phase 2 of the order. NEI 13-02, Revision 1 also includes HCVS- Frequently Asked Questions (FAQs) 01 through 09 and reference to white papers (HCVS-WP-01 through 03 (References 8 through 10)). The NRC endorsed NEI 13-02 Revision 0 as an acceptable approach for complying with Order EA-13-109 through Interim Staff Guidance JLD-ISG-2013-02, Compliance with Order EA-13-109, Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation under Severe Accident Conditions, issued in November 2013 (Reference 12) and JLD-ISG-2015-01, Compliance with Order EA-13-109, Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation under Severe Accident Conditions issued in April 2015 (Reference 13) for NEI 13-02 Revision 1 with some clarifications and exceptions. NEI 13-02 Revision 1 provides an acceptable method of compliance for both Phases of Order EA-13-109.

In addition to the endorsed guidance in NEI 13-02, the NRC staff endorsed several other documents that provide guidance for specific areas. HCVS-FAQs 10 through 13 (References 14 through 17) were endorsed by the NRC after NEI 13-02 Revision 1 on October 8, 2015. NRC staff also endorsed four White Papers, HCVS-WP-01 through 04 (References 8 through 11), which cover broader or more complex topics than the FAQs.

As required by the order, DAEC submitted a phase 1 Overall Integrated Plan (OIP) in June of 2014 (Reference 18) and subsequently submitted a combined Phase 1 and 2 OIP in December 2015 (Reference 19). These OIPs followed the guidance of NEI 13-02 Revision 0 and 1 respectively, Compliance with Order EA-13-109, Severe Accident Reliable Hardened Containment Vents. The NRC staff used the methods described in the ISGs to evaluate licensee compliance as presented in the Order EA-13-109 OIPs. While the Phase 1 and combined Phase 1 and 2 OIPs were written to different revisions of NEI 13-02, DAEC conforms to NEI 13-02 Revision 1 for both Phases of Order EA-13-109.

The NRC performed a review of each OIP submittal and provided DAEC with Interim Staff Evaluations (ISEs) (References 20 and 21) assessing the site's compliance methods. In the ISEs the NRC identified open items which the site needed to address before that phase of compliance was reached. Six-month progress reports (References 22 through 29) were provided consistent with the requirements of Order EA-13-109. These status reports were used to close many of the ISE open items. In addition, the site participated in NRC ISE Open Item audit calls where the information provided in the six-month updates and on the E-Portal were used by the NRC staff to determine whether the ISE Open Item appeared to be addressed.

By submittal of this Final Integrated Plan DAEC has addressed all the elements of NRC Order EA-13-109 utilizing the endorsed guidance in NEI 13-02, Rev 1 and the related HCVS-FAQs and HCVS-WPs documents. In addition, the site has addressed the NRC Phase 1 and Phase 2 ISE Open Items as documented in previous six-month updates.

Section III contains the DAEC Final Integrated Plan details for Phase 1 of the Order. Section IV contains the Final Integrated Plan details for Phase 2 of the Order. Section V details the programmatic elements of compliance.

Section I.A: Summary of Compliance

Section I.A.1: Summary of Phase 1 Compliance

The plant venting actions for the EA-13-109, Phase 1, severe accident capable venting scenario can be summarized by the following:

The HCVS is initiated via 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 vent utilizes containment parameters of pressure and level from the MCR instrumentation to monitor effectiveness of the venting actions.
- The 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.

The operation of the HCVS is designed to minimize the reliance on operator actions in response to external hazards. The screened in external hazards for DAEC are seismic, external flooding, high winds, extreme high temperature, and extreme cold. Initial operator actions are completed by plant personnel and include the capability for remote-manual initiation from the HCVS control station. The primary location of vent operation is the main control room (MCR). Attachment 2 contains a one-line diagram of the HCVS vent flowpath.

Section I.A.2: Summary of Phase 2 Compliance

The Phase 2 actions can be summarized as follows:

- Utilization of Severe Accident Water Addition (SAWA) to initially inject water into the Reactor Pressure Vessel (RPV).
- Utilization of Severe Accident Water Management (SAWM) to control injection and Suppression Pool level to ensure the HCVS Phase 1 wetwell vent will remain functional for the removal of heat from the containment.

- Heat can be removed from the containment for at least seven (7) days using the HCVS or until alternate means of heat removal are established that make it unlikely the drywell vent will be required for containment pressure control.
- The SAWA and SAWM actions can be manually activated and controlled from areas that are accessible during severe accident conditions.
- Parameters measured are Drywell pressure, Suppression Pool level, SAWA flowrate and the HCVS Phase 1 vent path parameters.

The locations of the SAWA equipment and controls, as well as ingress and egress paths have been evaluated for the expected severe accident conditions (temperature, humidity, radiation) for the Sustained Operating period. Equipment has been evaluated to remain operational throughout the Sustained Operating period. Personnel radiological exposure, temperature and humidity conditions for operation of SAWA equipment will not exceed the limits for ERO dose or plant safety guidelines for temperature and humidity.

The SAWA flow path is the same as the FLEX primary injection flow path with the modification that the hose run from the Turbine Building to the Reactor Building was replaced with carbon steel piping. The flow path is from the Hotwell for an external flooding event and from the circulating water pit for SA's other than an external flood. The changes to the flow path have been evaluated in calculation CAL-M13-005, Rev. 1 (Reference 36). Attachment 4 contains a one-line diagram of the SAWA flowpath.

The SAWA electrical loads are included in the FLEX DG loading calculation performed for EA-13-049 compliance. The electrical equipment sizing calculation is contained in CAL-E13-001, Rev. 0 (Reference 34). This calculation includes the uninterruptible power supply for the HCVS loads in addition to the FLEX loads.

Evaluations for projected SA conditions (radiation / temperature) indicate that personnel can complete the initial and support activities without exceeding the ERO-allowable dose for equipment operation or site safety standards.

Electrical equipment and instrumentation is powered from the existing station batteries, and from AC distribution systems that are powered from the FLEX generator. The battery chargers are also powered from the FLEX generator to maintain the battery capacities during the Sustained Operating period.

Section II: List of Acronyms

AC	Alternating Current
AOV	Air Operated Valve
BDB	Beyond Design Basis
BDBEE	Beyond Design Basis External Event
BWROG	Boiling Water Reactor Owners' Group
CAP	Containment Accident Pressure
CST	Condensate Storage Tank
DAEC	Duane Arnold Energy Center
DBA	Design Basis Accident
DC	Direct Current
DG	Diesel Generator
ECCS	Emergency Core Cooling Systems
ELAP	Extended Loss of AC Power
EOP	Emergency Operating Procedure
EPG/SAG	Emergency Procedure and Severe Accident Guidelines EPRI Electric Power Research Institute
ERO	Emergency Response Organization
FAQ	Frequently Asked Question
FIP	Final Integrated Plan
FLEX	Diverse & Flexible Coping Strategy
GPM	Gallons per minute
HCVS	Hardened Containment Vent System
ISE	Interim Staff Evaluation

ISG	Interim Staff Guidance
JLD	Japan Lessons Learned Project Directorate
LOCA	Loss of Coolant Accident
LPCI	Low Pressure Coolant Injection System
MAAP	Modular Accident Analysis Program
MCC	Motor Control Center
MCR	Main Control Room
N_2	Nitrogen
NEI	Nuclear Energy Institute
NPSH	Net Positive Suction Head
NRC	Nuclear Regulatory Commission
OIP	Overall Integrated Plan
PCPL	Primary Containment Pressure Limit
RB	Reactor Building
RM	Radiation Monitor
ROS	Remote Operating Station
RPV	Reactor Pressure Vessel
SA	Severe Accident
SAMG	Severe Accident Management Guidelines
SAWA	Severe Accident Water Addition
SAWM	Severe Accident Water Management
SBGT	Standby Gas Treatment System
SBLC	Standby Liquid Control

SECR	Southeast Corner Room
SFP	Spent Fuel Pool
SRV	Safety-Relief Valve
TB	Turbine Building
UFSAR	Updated Final Safety Analysis Report
UHS	Ultimate Heat Sink
UPS	Uninterruptible Power Supply
VAC	Voltage AC
VDC	Voltage DC
WW	Wetwell

Section III: Phase 1 Final Integrated Plan Details

Section III.A: HCVS Phase 1 Compliance Overview

DAEC decommissioned its existing hardened containment vent path installed in response to Generic Letter 89-16 and installed a new hardened containment wetwell vent path to comply with NRC Order EA-13-109.

Section III.A.1: Generic Letter 89-16 Vent System

The hard pipe vent system installed under this Generic Letter 89-16 was decommissioned and abandoned in place. The decommissioned vent system is discussed below.

DAEC installed a hardened wetwell vent in response to NRC Generic Letter 89-16, under Plant Modification DCP-1524. The hard pipe vent provided an exhaust line from the torus vapor space to the offgas stack for the prevention of primary containment overpressurization. An 8" pipe connected to the torus purge and vent line at a point between the inboard and outboard isolation valves.

A remotely air-operated normally closed primary containment isolation valve was located in the 8" piping in the northeast corner room. A rupture disk was installed downstream of the air-operated valve to prevent opening of a vent path from the primary containment directly to the environment unless the primary containment pressure limit of 53 psig was reached. The rupture disk also served as a zero leakage barrier to prevent any leakage past the containment isolation valves from reaching the environment.

All containment hard vent system piping in the northeast corner room and up to and including the first support in the turbine building were designed, installed, and supported as seismic category 1 piping. Hard vent piping in the turbine building downstream of the first pipe support was not seismically supported.

The 8" piping was routed through the east wall of the northeast corner room into the turbine building where it tied into the steam packing exhauster discharge piping which led to an elevated release point at the offgas stack. The use of the containment hard vent system required manual isolation of existing valves in the condenser bay as well as motor operated valves to prevent backflow through the steam packing exhauster and condenser vacuum pump. These valves were required to be manually closed prior to venting.

Air for the inboard primary containment isolation valve was provided with 100 psig from the instrument and service air system. Air for the operation of CV4357 was provided from the same source by the use of common air lines. A 200 gallon accumulator was installed in the common air supply line to the hardened containment vent valve air-operators and provided a dedicated source of air for the operation of these valves during a station blackout. The accumulator was sized for 3 closed to open cycles of both valves over a four hour period as required for station blackout. A check valve was installed in the air line between the accumulator and the instrument and service air system to prevent loss of air due to back leakage during a station blackout.

The inboard vent valve could have been opened and closed using either AC or DC power. A two position hand-switch provided a "NORMAL" and "OVERRIDE" mode for the inboard valve to select either AC or DC control circuit operation. In the "NORMAL" position the DC logic was deactivated and the existing primary containment isolation system was not altered. In the "OVERRIDE" position the DC solenoid logic was enabled and the AC logic was disabled. The "OVERRIDE" position allowed the valve to be opened using the DC control logic independent of a primary containment isolation signal. Therefore, an annunciator was provided to alert operators of a group III override for CV4300. An amber indicating light was installed above the hand-switch to indicate the abnormal "OVERRIDE" condition.

The outboard vent valve was a sealed closed barrier as defined by NRC Standard Review Plan 6.2.4, paragraph II.6.f. Power was prevented from energizing the air supply solenoid valve by relying on administrative control of the key for the hand-switch in conjunction with removal of the control power fuses. The two positions for the hand switch were "OPEN" and "CLOSED" with the key removable only in the "CLOSED" position. To open the outboard valve, the key for the hand-switch must have been obtained from the operations shift supervisor, control power fuses installed, and the hand-switch placed in the "OPEN" position. The control logic for the outboard valve was not connected to the primary containment isolation system since it was installed as a seal-closed barrier/valve.

<u>Section III.A.2</u>: EA-13-109 Hardened Containment Vent System (HCVS)

The HCVS at the DAEC consists of a new standalone piping system connected to torus air space at spare penetration N-230A.

Overview:

A 10" Sch. 40 pipe is routed from torus air space penetration N230A, through the southwest corner room, up the south RB stairwell, into the refueling floor, and out through the roof to provide an elevated release path. The piping system consists of two 10" butterfly valves (CV4360 and CV4361), a rupture disk (PSE4362), a temperature element (TE4361), a radiation monitor (RM4362), and a purge line to reduce the likelihood of combustion within the piping system.

The primary containment isolation valves, CV4360 and CV4361, are nitrogen-operated valves and are provided with a common nitrogen supply header that is normally isolated from nitrogen supply pressure by locked closed valve V43-0642 located at the remote operating station in the 1A3 switchgear room within the Control Building. The nitrogen header is normally vented to atmospheric pressure through SV4360B. The PCIV's are pneumatically powered by a bank of 11 high pressure nitrogen bottles located in the control rod drive repair room which are also used to perform the purge function of the HCVS. The bottles have been sized to allow for 8 valve cycles and 6 full purges of the piping system per CAL-M15-014 (Reference 41). A spare connection located at the remote operating station is provided to install backup nitrogen bottles when the 11 permanently installed bottles have been exhausted.

All HCVS electrical loads are powered by an uninterruptible power supply (UPS099). The batteries are charged by 1B15 during normal plant operation. Batteries are capable of providing a minimum of 24 hours to operate the instrumentation and electrical loads required for the HCVS per CAL-E15-002 (Reference 42). Portable generators will be connected to a receptacle to allow supply of power to the HCVS UPS after 24 hours prior to battery depletion. This will allow continued operation of the HCVS. The electrical loads for the HCVS are provided below:

- CV4360, CV4361, and SV4362 (purge supply) indicating lights
- Solenoid valves SV4360A (HCVS operator supply), SV4362 (purge supply), and SV4360B (HCVS operator exhaust)
- Radiation monitor RM4362
- 24VDC Power Supply E/S4360 for temperature loop

The wetwell vent up to and including the second containment isolation barrier is designed consistent with the design basis of the plant. These items include piping, pipe supports, containment isolation valves, containment isolation valve actuators, and containment isolation valve position indication components. The piping system was designed to 350°F for a beyond design basis event and 65 psig. The 10" piping downstream of the second containment isolation barrier was also classified as safety related since it penetrates secondary containment. All piping and pipe supports were designed to seismic category 1 criteria. Piping above the fifth floor of the reactor building has been designed to withstand the design basis wind loads. The nitrogen tubing and bottles have also been designed to seismic category 1 criteria. Instrumentation and electrical equipment have either been seismically qualified by test or by similarity to substantially designed and previously seismically tested equipment.

System Operation:

The Main Control Room is the primary operating station for the HCVS. During an ELAP, electric power to operate the vent valves will be provided by batteries with a capacity to supply required loads for at least the first 24 hours. Before the batteries are depleted, the FLEX generator will supplement and recharge batteries to support continued operation of the vent valves. The ROS is designated as the alternate control location and method. Since the ROS does not require any electrical power to operate, the valve solenoids do not need any additional backup electrical power. Attachment 2 shows the

HCVS vent flow path.

The primary location for vent operation is Main Control Room(MCR). The remote operating station (ROS) in the 1A3 switchgear room allows for manual operation of the HCVS and does not require electrical power – all actions can be accomplished by using manual valves and local pressure indications. To operate the system, equipment operators must unlock and open valve V43-0642 (located at the ROS) to supply nitrogen pressure to the system. Operators then adjust the pressure setting for PCV4360 and PCV4361 to allow for valve actuation and purge operation. Following these manual actions, the system is in standby and ready to be operated from either the MCR or the ROS.

From the MCR, operators use key-lock hand-switch HS4362 to supply nitrogen to the rupture disc so it will relieve/burst. Operators then use key-lock hand-switch HS-4360 to open SV4360A, close SV4360B, and open valves CV4360 and CV4361 to vent the wetwell air space. When the valves are no longer required to be open, operators take HS4360 to close. If there is fuel failure, operators will purge the 10" pipe by opening SV4362 via HS4362 after closing and prior to opening valve CV4360 and CV4361. The MCR has instrumentation that provides HCVS valve position, purge solenoid valve position (SV4362), temperature indication (TI4361), and radiation indication (RM4362). Additionally, operators can monitor drywell pressure and torus water level.

From the ROS, to relieve/burst the rupture disk, operators will use the manual bypass around SV4362 to supply nitrogen to the rupture disk. To open CV4360 and CV4361, operators will use the manual bypass around SV4360A. At the ROS, operators have indication of nitrogen supply pressure (PI4364), CV4360/CV4361 nitrogen supply pressure (PI4360), and nitrogen purge supply pressure (PI4362).

The remote operating station is located in the 1A3 switchgear room inside the Control Building. The Control Building is a seismic category 1 structure that is protected from both external flooding and high winds (tornadoes). Temperature and radiological conditions in the 1A3 switchgear room have been evaluated and have been determined to be acceptable for operational occupancy during a SA.

Attachment 3 contains a one-line diagram of the HCVS electrical distribution system for the DAEC.

The HCVS radiation monitor with an ion chamber detector is qualified for the ELAP and external event conditions. In addition to the RM, a temperature element is installed on the vent line to allow the operators to monitor operation of the HCVS. Electrical and controls components are seismically qualified and include the ability to handle harsh environmental conditions (although they are not considered part of the site Environmental Qualification (EQ) program).

<u>Section III.B</u>: HCVS Phase 1 Evaluation Against Requirements:

The functional requirements of Phase 1 of NRC Order EA-13-109 are outlined below along with an evaluation of the DAEC response to maintain compliance with the Order and guidance from JLD-ISG-2015-01. Due to the difference between NEI 13-02, Revision 0 and Revision 1, only Revision 1 will be evaluated. Per JLD-ISG-2015-01, this is acceptable as Revision 1 provides acceptable guidance for compliance with Phase 1 and Phase 2 of the Order.

1. HCVS Functional Requirements

1.1 The design of the HCVS shall consider the following performance objectives:

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

Evaluation:

The operation of the HCVS was designed to minimize the reliance on operator actions in response to hazards identified in NEI 12-06, *Diverse and Flexible Coping Strategies (FLEX) Implementation Guide* (Reference 30), which 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 is in the following table:

Table 3-1: HCVS Operator Actions

Primary Action	Primary Location/ Component	Notes
1. Unlock and open V43-0642 to valve in Nitrogen bottles.	ROS, CB, EL. 757'	Action performed prior to venting; exclusive to HCVS
2. Load PCV4360	ROS, CB, EL. 757'	Action performed prior to venting; exclusive to HCVS
3. Load PCV4361	ROS, CB, EL. 757'	Action performed prior to venting; exclusive to HCVS

Primary Action	Primary Location/ Component	Notes
4. Breach the rupture disk (PSE4362) by pressurizing the piping between CV4361 and PSE4362.	MCR/Nitrogen supply valve key lock hand switch at panel 1C14 or manual valve lineup at ROS.	Not required during SA event. Only required if performing early venting for FLEX.
5. Open HCVS PCIVs CV4360 and CV4361	MCR/key lock hand switch at panel 1C14 or manual valve lineup in ROS.	Exclusive to HCVS
6. Confirm vent is open	MCR/PCIV position indication, temperature indication, and radiation monitor at 1C14.	Exclusive to HCVS
7. Perform nitrogen purge of HCVS vent path	MCR/Nitrogen supply valve key lock hand switch at panel 1C14 or manual valve lineup at ROS.	Exclusive to HCVS
8. Replenish pneumatics with replaceable nitrogen bottles.	ROS, CB, EL. 757'	Prior to depletion of pneumatic sources actions will be required to connect replacement nitrogen bottles in 1A3 switchgear room to support HCVS operation beyond 24 hours

Primary Action	Primary Location/ Component	Notes
9. Re-power UPS for sustained operation using receptacle or restore normal power to 1B15	ROS, CB, EL. 757' or 1A3 switchgear room	Prior to depletion of the installed power sources actions will be required to connect back-up sources to support HCVS operation beyond 24 hours

Permanently installed electrical power and pneumatic supplies are available to support operation and monitoring of the HCVS for a minimum of 24 hours. No portable equipment is required for the first 24 hours.

After 24 hours, available personnel will be able to connect supplemental electric power and pneumatic supplies for sustained operation of the HCVS for a minimum of 7 days. The FLEX generators and Nitrogen bottles provide this motive force. In all likelihood, these actions will be completed in less than 24 hours. However, the HCVS can be operated for at least 24 hours without any supplementation.

The above set of actions conform to the guidance in NEI 13-02 Revision 1 Section 4.2.6 for minimizing reliance on Operator actions and are acceptable for compliance with Order element A.1.1.1. These were identified in the OIP and subsequent NRC ISE.

Table 3-2: Failure Evaluation

Functional Failure Mode	Failure Cause	Alternate Action	Failure with Alternate Action Impact on Containment Venting?
Fail to Vent (Open) on Demand	Control Valves fail to open due to complete loss of dedicated power supply (UPS, long term)	Recharge batteries with FLEX provided generators via receptacle for direct connection, considering severe accident conditions. In	No

Functional Failure Mode	Failure Cause	Alternate Action	Failure with Alternate Action Impact on Containment Venting?
		addition, the PCIV's can be manually opened from the ROS with backup pneumatics, no electrical source is needed.	
Failure of solenoid valves to actuate	Mechanical or electrical failure causing loss of pneumatic supply to HCVS CVs and/or loss of purge capability	SVs have manual bypass valves located at the ROS that allow pneumatic supply to be restored. In this case the CVs are opened and closed by manual action.	No
Failure of Vent to Open on Demand	Control Valves fail to open due to loss of normal pneumatic nitrogen supply	The bank of eleven nitrogen bottles is sized to fully cycle the valves eight times during the first 24 hours. If the normal pneumatic supply is lost, nitrogen bottles can be connected at the ROS to provide the pneumatic supply for PCIV operation and system purging.	No
Failure of Vent to Open on Demand	Control Valves fail to open due to loss of alternate pneumatic nitrogen supply (long term)	Additional nitrogen bottles can be connected at the ROS to provide long term pneumatic supply.	No
Failure of Vent to Open on Demand	CVs fail to open due to local mechanical or electrical failure (i.e. binding)	Alternate vent path that is not hardened.	Yes. Vent location would likely not be elevated.

1.1.2 The HCVS shall be designed to minimize plant operators' exposure to occupational hazards, such as extreme heat stress, while operating the HCVS system.

Evaluation:

Primary control of the HCVS is accomplished from the main control room. Alternate control of the HCVS is accomplished from the ROS in the 1A3 switchgear room at EL. 757' in the Control Building. FLEX actions that will maintain the MCR and ROS habitable were implemented in response to NRC Order EA-12-049 (Reference 31). Actions specified in AOP 301.1 (Reference 59), SAMP 724 (Reference 56), SAMP 726 (Reference 58), and SAMP 729 (Reference 60) include:

1. Restoring MCR ventilation via the FLEX DG. This load is considered in CAL-E13-001 (Reference 34).
2. Opening MCR doors to establish natural circulation.
3. Operating portable generators and fans to move outside air through the MCR (if required)
4. Opening doors and a damper in the RB to establish natural circulation air flow in the RB.
5. Opening doors for the switchgear rooms to establish natural ventilation.
6. Use of portable heaters staged inside the power block or in outside areas for continuously manned areas that are cold.

Table 2 contains a thermal evaluation of all the operator actions that may be required to support HCVS operation. The relevant ventilation calculations and evaluations (References 54, 68, and 69) demonstrate that the final design meets the order requirements to minimize the plant operators' exposure to occupational hazards. Reference 57 (SA-AA-100-1008) provides DAEC administrative requirements for heat stress control.

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

Evaluation:

Primary control of the HCVS is accomplished from the Main Control Room. Under the postulated scenarios of order EA-13-109 the control room is adequately protected from excessive radiation dose and no further evaluation of its use is required. (Ref. HCVS-FAQ-06)

Alternate control of the HCVS is accomplished from the ROS. The ROS was evaluated for radiation effects due to a severe accident and determined to be acceptable. The ROS is located in a low dose area during normal operation. The HCVS piping is located on the south side of the reactor building while the ROS is located north of the reactor building in the Control Building which provides an abundance of concrete shielding. The additional distance and shielding combined with the short duration of actions required at the ROS show the ROS to be an acceptable location for alternate control. DAEC calculation CAL-R15-002 (Reference 44) determined that the peak dose rate at the ROS is extremely low (8.673E-06 R/hr). Therefore, there is no radiological concern at the ROS.

Table 2 contains a radiological evaluation of the operator actions that may be required to support HCVS operation in a severe accident. There are no abnormal radiological conditions present for HCVS operation without core damage. The evaluation of radiological hazards demonstrates that the final design meets the order requirements to minimize the plant operators' exposure to radiological hazards.

The HCVS vent is routed away from the MCR such that building structures provide shielding, thus per HCVS-FAQ-01 the MCR is the preferred control location. If venting operations create the potential for airborne contamination in the MCR, the ERO will provide personal protective equipment to minimize any operator exposure.

1.1.4 The HCVS controls and indications shall be accessible and functional under a range of plant conditions, including severe accident conditions, extended loss of AC power, and inadequate containment cooling.

Evaluation:

Primary control of the HCVS is accomplished from the main control room. Under the postulated scenarios of order EA-13-109 the control room is adequately protected from excessive radiation dose and no further evaluation of its use is required (HCVS-FAQ-06).

Alternate control of the HCVS is accomplished from the Remote Operating Station (ROS) located in the 1A3 switchgear room. The ROS (1A3 switchgear room) is in an area evaluated to be accessible before and during a severe accident.

For ELAP with injection, the HCVS the wetwell vent will be opened to protect the containment from overpressure. The operator actions and timing of those actions to perform this function under ELAP conditions were evaluated as part of DAEC response to NRC Order EA-12-049 as stated in Reference 35 (FLEX-FIP).

Table 2 contains a thermal and radiological evaluation of all the operator actions at the MCR or alternate location that may be required to support HCVS operation during a severe accident. The relevant ventilation and radiological calculations/evaluations (References 44, 68, and 69) demonstrate that the final design meets the order requirements to minimize the plant operators' exposure to occupational and radiological hazards.

Table 1 contains an evaluation of the controls and indications that are or may be required to operate the HCVS during a severe accident. The evaluation demonstrates that the controls and indications are accessible and functional during a severe accident with a loss of AC power and inadequate containment cooling.

1.2 The HCVS shall include the following design features:

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

<u>Evaluation</u>

Calculation CAL-M15-013 (Reference 45) contains the verification of 1% power flow capacity at the lesser of the primary containment design pressure (56 psig) and the Primary Containment Pressure Limit (PCPL of 52.9 psig based on a fully submerged wetwell). This analysis was performed by using a RELAP5 model created for the HCVS piping, valves, and fittings. Fitting losses were taken from Crane Technical Paper No. 410. To determine vent capacity, compressible flow was assumed with saturated steam only and the capacity was compared to 1% decay heat steam generation based on the latent heat of vaporization (h_{fg}) at the venting pressure.

The design pressure of the wetwell is 56 psig and the PCPL for a fully submerged wetwell is 52.9 psig. The calculation conservatively assumed that the differential pressure between the wetwell and the drywell was 8.1 psi based on 60°F water, and therefore a wetwell pressure of 44.8 psig was used for the vent sizing. At this conservative wetwell pressure, the HCVS has a capacity of ~84,700 lbm/hr compared to the required capacity of 71,750 lbm/hr which results in 118.0% of the required flow.

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

Evaluation

The wetwell vent exits the Primary Containment through a dedicated penetration in the torus air space. The 10" vent pipe is routed through a wall in the torus room to the southwest corner room where it turns up and goes through the RB first floor and into the south stairwell. The piping is then routed vertically up until it penetrates a block wall and enters the refueling floor where it goes up and through the roof for an elevated release. The end of the vent pipe is approximately four feet above the RB roof parapet wall (EL. 898'-8" per BECH-A009, Reference 46) and terminates at an elevation of at EL 902'-6" (ISO-HBC-140-04, Reference 47). Part of the HCVS-FAQ-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 the approximately 812' (BECH-A026, Reference 48) elevation which is approximately 90 feet below the HVCS pipe outlet. This intake is approximately 200 horizontal feet from the DAEC vent pipe, which would require the intake to be approximately 40 feet below the vent pipe. Therefore, the vent pipe is appropriately placed relative to this air intake.

The vent pipe extends approximately 4 ft. above the parapet wall of the RB roof. This satisfies the guidance for height from HCVS-FAQ-04.

HCVS-WP-04 provides criteria that demonstrate robustness of the HCVS pipe. DAEC meets all of the requirements of this white paper. This evaluation documents that the HCVS pipe is adequately protected from all external events and no further protection is required.

DAEC 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. For the portions of exposed piping below 30 feet above grade.

   The HCVS piping is located inside the reactor building from the torus, through the south stairwell, and then out through the reactor building roof. The reactor building is a substantially seismic building that was designed to withstand both the design basis earthquake and tornado. The instrumentation for the HCVS is either located inside the control building or the reactor building, both of which are designed to withstand the design basis tornado (and earthquake). Any components located less than 30 feet above grade are adequately protected by the structure that houses them.

2. The exposed piping greater than 30 feet above grade has the following characteristics:

   a. The total vent pipe exposed area is about 63 square feet which is less than 300 square feet.

   b. The pipe is made of schedule 40 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. Tornado missile hazard inspections are performed in OP-AA-102-1002 (Reference 49) on the refueling floor to remove and/or tie down potential tornado missile hazards.

3. Due to the small exposed target area and the removal of tornado missiles in the area during season readiness inspections, it is unlikely that the HCVS pipe will crimp and thus a cutting tool is not required for DAEC. However, DAEC has saws available in the FLEX buildings that are capable of cutting steel.

4. Hurricanes are not screened in for DAEC.

Based on the above description of the vent pipe design, the DAEC HCVS vent pipe design meets the order requirement to be robust with respect to all external hazards including wind-borne missiles.

1.2.3 The HCVS shall include design features to minimize unintended cross flow of vented fluids within a unit and between units on the site.

<u>Evaluation</u>

The DAEC is a single unit site and the design of the HCVS is such that it is a completely independent system that runs from the torus to the roof of the reactor building. Redundant check valves are provided in the purge line to prevent backflow of potentially hazardous gases or steam. Therefore, adequate design features have been incorporated into the HCVS to preclude cross flow of vented fluids within the unit.

Based on the above description, the DAEC design meets the requirements to minimize unintended cross-flow of vented fluids within a unit and between units on site.

1.2.4 The HCVS shall be designed to be manually operated during sustained operations from a control panel located in the main control room or a remote but readily accessible location.

Evaluation

The existing wetwell vent will allow initiating and then operating and monitoring from a control panel located in the MCR for the sustained operating period.

1.2.5 The HCVS shall 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.

Evaluation

To meet the requirement for an alternate means of operation of HCVS valves via pneumatic motive force, a readily accessible alternate location, called the ROS was added. The ROS contains manually operated valves that can supply nitrogen to the HCVS flow path valve actuators so that these valves may be opened without power to the actuator solenoid valves. Manual operation of the purge system from the ROS can also be performed by using manually operated valves. This provides a diverse method of HCVS operation improving system reliability.

The location for the ROS is on the ground floor of the Control Building, EL 757'. The ROS is readily accessible from the MCR and Turbine Building.

Refer to the sketch provided in Attachment 6 for the HCVS site layout. The controls available at the ROS location are accessible and functional under a range of plant conditions, including severe accident conditions with due consideration to source term and dose impact on operator exposure, extended loss of AC power (ELAP), inadequate containment cooling, and loss of reactor building ventilation. Table 1 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 contains a thermal and radiological evaluation of all the operator actions that may be required to support HCVS operation during a loss of AC power and severe accident and demonstrates that these actions will be possible without undue hazard to the operators. Attachment 6 contains a site layout showing the location of these HCVS actions.

1.2.6 The HCVS shall be capable of operating with dedicated and permanently installed equipment for at least 24 hours following the loss of normal power or loss of normal pneumatic supplies to air operated components during an extended loss of AC power.

Evaluation

HCVS-WP-01 contains clarification on the definition of "dedicated and permanently installed" with respect to the order. In summary, it is acceptable to use plant equipment that is used for other functions, but it is not acceptable to credit portable equipment that must be moved and connected for the first 24 hour period of the ELAP.

The FLEX generators will start and load, thus there will be no need to use other power sources for HCVS wetwell venting components during the first 24 hours. However, this order element does not allow crediting the FLEX generators for HCVS wetwell venting components for the first 24 hours. Therefore, backup electrical power required for operation of HCVS components in the first 24 hours will come from a new 125 VDC uninterruptible power supply (UPS099). The batteries are permanently installed in the Control Building ground floor (EL 757') where they are protected from screened in hazards, and have sufficient capacity to provide this power without recharging. Calculation CAL-E15-002 (Reference 42) demonstrated that the 125 VDC battery capacity is sufficient to supply HCVS wetwell venting components for 24 hours. At 24 hours, FLEX generators can be credited to repower the station instrument buses and/or the battery charger to recharge the 125 VDC batteries; gas control during recharging and room temperature control is per the response to order EA-12-049. Calculation CAL-E13-001 (Reference 34) included the 125 VDC battery chargers in the FLEX DG loading calculation, so there is no unanalyzed load on the FLEX DG and they are capable of carrying HCVS wetwell venting components electrical loads. 125 VDC battery voltage status will be indicated on the UPS (EL. 757' in the Control Building) so that operators will be able to monitor the status of the 125 VDC batteries. Attachment 3 contains a diagram of the HCVS electrical distribution system.

Pneumatic power for the HCVS valve actuator is normally provided by a bank of 11 bottles of compressed nitrogen located in the first floor of the reactor building in the control rod drive repair room (EL 757'). Following an ELAP event, adequate nitrogen is supplied to cycle the valves 8 times and provide 6 full purges of the HCVS piping (Reference 41). Therefore, for the first 24 hours post-ELAP initiation, pneumatic force will be supplied from the nitrogen bottle rack which has the capacity to supply the required motive force to those HCVS valves needed to maintain flow through the HCVS effluent piping for 24 hours without replenishment.

1.2.7 The HCVS shall include a means to prevent inadvertent actuation.

Evaluation

Emergency operating procedures provide clear guidance that the HCVS is not to be used to defeat containment integrity during any design basis transients and accidents. In addition, the HCVS was designed to provide features to prevent inadvertent actuation due to equipment malfunction or operator error. Also, these protections are designed such that any credited containment accident pressure (CAP) that would provide net positive suction head to the 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 open to permit vent flow. The physical features that prevent inadvertent actuation are:

- The key lock switch for valves CV4360 and CV4361.
- The locked closed pneumatic supply isolation valve, V43-0642, located at the ROS that isolates nitrogen supply pressure from both the purge line and the HCVS valve operators.
- The rupture disk, PSE4362, located downstream of CV4360 and CV4361 which also provides a zero leakage barrier.

These design features meet the requirement to prevent inadvertent actuation of the HCVS.

1.2.8 The HCVS shall include a means to monitor the status of the vent system (e.g., valve position indication) from the control panel required by 1.2.4. The monitoring system shall be designed for sustained operation during an extended loss of AC power.

<u>Evaluation</u>

The HCVS includes indications for HCVS valve position, vent pipe temperature and effluent radiation levels in the MCR, as well as information on the status of supporting systems which are HCVS 125 VDC battery voltage and nitrogen pressure which are located in the battery room corridor and at the ROS respectively.

This monitoring instrumentation provides the indication from the MCR per Requirement 1.2.4. In the event, that the FLEX DGs do not energize the emergency buses, the wetwell HCVS will be supplied by the HCVS 125VDC batteries and designed for sustained operation during an ELAP event using the FLEX equipment.

HCVS instrumentation performance (e.g., accuracy and range) need not exceed that of similar plant installed equipment. Additionally, radiation monitoring instrumentation accuracy and range is sufficient to confirm flow of radionuclides through the HCVS.

The HCVS instruments, including valve position indication, vent pipe temperature, radiation monitoring, and support system monitoring, are seismically qualified as indicated on Table 1 and they include the ability to handle harsh environmental conditions (although they may not be considered part of the site Environmental Qualification (EQ) program).

1.2.9 The HCVS shall include a means to monitor the effluent discharge for radioactivity that may be released from operation of the HCVS. The monitoring system shall provide indication from the control panel required by 1.2.4 and shall be designed for sustained operation during an extended loss of AC power.

Evaluation

The HCVS radiation monitoring system consists of an ion chamber detector located at the ground floor of the RB (EL. 757') in the south stairwell that is coupled to a process and control module. The process and control module is mounted in the MCR in the Control Building. The MCR has radiation indication on the 1C14 panel to verify venting operation. The RM 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 Control Building MCR. Both components are qualified for the seismic requirements. Table 1 includes a description and qualification information on the radiation monitor.

1.2.10 The HCVS shall be designed to withstand and remain functional during severe accident conditions, including containment pressure, temperature, and radiation while venting steam, hydrogen, and other non-condensable gases and aerosols. The design is not required to exceed the current capability of the limiting containment components.

Evaluation

The wetwell vent up to, and including, the second containment isolation valve is designed consistent with the design basis of the plant. These items include piping, piping supports, containment isolation valves, containment isolation valve actuators and containment isolation valve position indication components. The pipe supports and piping up to the second containment isolation valves are qualified in CAL-C15-006 (Reference 61) and CAL-M15-005 (Reference 62).

The existing hardened vent piping has been decommissioned and abandoned in place. The new wetwell vent piping and components installed are designed for beyond design basis conditions.

HCVS piping and components have been evaluated for radiological impact due to HCVS system operation under severe accident conditions using the guidance provided in HCVS-FAQ-08 and HCVS-WP-02. Radiological conditions have been calculated using the guidance of HCVS-WP-02 in calculations CAL-R15-001 and CAL-R15-002 (References 50 and 44). HCVS instruments are located in shielded areas remote from the Reactor Building.

Refer to EA-13-109, requirement 1.2.11 for a discussion on designing for combustible gas.

1.2.11 The HCVS shall be designed and operated to ensure the flammability limits of gases passing through the system are not reached; otherwise, the system shall be designed to withstand dynamic loading resulting from hydrogen deflagration and detonation.

Evaluation

In order to prevent a detonable mixture from developing in the pipe, a purge system is installed to purge hydrogen from the pipe with nitrogen after a period of venting and to purge oxygen from the pipe prior to resuming venting. The purge system was evaluated in CAL-M15-014 (Reference 41) and it is designed to provide a minimum of 3.5 ft/s in the 10" HCVS pipe with a minimum required purge volume of 1.10 times the vertical pipe volume plus 1.50 times the horizontal pipe volume in accordance with the American Gas Association "Purging Principles and Practice." The purge system has been designed with a capacity to rupture the rupture disc and perform 6 pre/post vent valve cycle purges. The use of a purge system meets the requirement to ensure the flammability limits of gases passing through the vent pipe will not be reached.

1.2.12 The HCVS shall be designed to minimize the potential for hydrogen gas migration and ingress into the reactor building or other buildings.

Evaluation

The response under Order element 1.2.3 explains how the potential for hydrogen migration into other systems, the reactor building or other buildings is minimized.

1.2.13 The HCVS shall include features and provisions for the operation, testing, inspection and maintenance adequate to ensure that reliable function and capability are maintained.

Evaluation:

As endorsed in the ISG, sections 5.4 and 6.2 of NEI 13-02 provide acceptable method(s) for satisfying the requirements for operation, testing, inspection, and maintenance of the HCVS.

Primary and secondary containment required leakage testing is covered under existing design basis testing programs. The HCVS outboard the containment boundary shall be tested to ensure that vent flow is released to the outside with minimal leakage, if any, through the interfacing boundaries with other systems or units.

DAEC has implemented the following operation, testing and inspection requirements for the HCVS to ensure reliable operation of the system. These are from NEI 13-02, Table 6.1. The implementing modification package, EC281991 (Reference 63), contains these as well as additional testing required for post-modification testing.

Table 3-3: Testing and Inspection Requirements

Description	**Frequency**
Cycle the HCVS valves[1] and the interfacing system valves not used to maintain containment integrity during operations.	Once per every[2] operating cycle.
Cycle the HCVS check valves not used to maintain containment integrity during unit operations.[3]	Once per every other[4] operating cycle.
Perform visual inspections and a walk down of HCVS components	Once per operating cycle
Functionally test the HCVS radiation monitors.	Once per operating cycle
Leak test the HCVS.	(1) Prior to first declaring the system functional; (2) Once every three operating cycles thereafter; and (3) After restoration of any breach of system boundary within the buildings

[1] Not required for HCVS check valves.
[2] After two consecutive successful performances, the test frequency may be reduced to a maximum of once per every other operating cycle.
[3] Not required if integrity of check function (open and closed) is demonstrated by other plant testing requirements.
[4] After two consecutive successful performances, the test frequency may be reduced by one operating cycle to a maximum of once per every fourth operating cycle.

Description	Frequency
Validate the HCVS operating procedures by conducting an open/close test of the HCVS control logic from its control panel (primary and alternate) and ensuring that all interfacing system boundary[5] valves move to their proper (intended) positions.	Once per every other operating cycle

2. HCVS Quality Standards:

2.1. The HCVS vent path up to and including the second containment isolation barrier shall be designed consistent with the design basis of the plant. Items in this path include piping, piping supports, containment isolation valves, containment isolation valve actuators, and containment isolation valve position indication components.

Evaluation:

The HCVS penetration and containment isolation valves are designed and installed consistent with the design basis of primary containment including pressure, temperature, radiation, and seismic loads. The torus penetration and containment isolation valves have also been designed to withstand the Mark I loads.

2.2. All other HCVS components shall be designed for reliable and rugged performance that is capable of ensuring HCVS functionality following a seismic event. These items include electrical power supply, valve actuator pneumatic supply, and instrumentation (local and remote) components.

Evaluation:

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 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

[5] Interfacing system boundary valves that are normally closed and fail closed under ELAP conditions (loss of power and/or air) do not require control function testing under this section. Performing existing plant design basis function testing or system operation that reposition the valve(s) to the HCVS required position will meet this requirement without the need for additional testing.

earthquake. This includes environmental qualification consistent with expected conditions at the equipment location.

Table 1 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.

Section IV: HCVS Phase 2 Final Integrated Plan

Section IV.A: The requirements of EA-13-109, Attachment 2, Section B for Phase 2

Licensees with BWRs Mark 1 and Mark II containments shall either:

(1) Design and install a HCVS, using a vent path from the containment drywell, that meets the requirements in section B.1 below, or

(2) Develop and implement a reliable containment venting strategy that makes it unlikely that a licensee would need to vent from the containment drywell before alternate reliable containment heat removal and pressure control is reestablished and meets the requirements in Section B.2 below.

1. HCVS Drywell Vent Functional Requirements

1.1 The drywell venting system shall be designed to vent the containment atmosphere (including steam, hydrogen, non-condensable gases, aerosols, and fission products), and control containment pressure within acceptable limits during severe accident conditions.

1.2 The same functional requirements (reflecting accident conditions in the drywell), quality requirements, and programmatic requirements defined in Section A of this Attachment for the wetwell venting system shall also apply to the drywell venting system.

2. Containment Venting Strategy Requirements

Licensees choosing to develop and implement a reliable containment venting strategy that does not require a reliable, severe accident capable drywell venting system shall meet the following requirements:

2.1 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.

2.2 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.

2.3 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 needed instrumentation.

Because the order contains just three requirements for the containment venting strategy, the compliance elements are in NEI 13-02, Revision 1. NEI 13-02, Revision 1, endorsed by NRC in JLD-ISG-2015-01, provides the guidance for the containment venting strategy (B.2) of the order. NEI 13-02, Revision 1, provides SAWA in conjunction with Severe Accident Water Management (SAWM), which is designed to maintain the wetwell vent in service until alternate reliable containment heat removal and pressure control are established, as the means for compliance with part B of the order.

DAEC has implemented Containment Venting Strategy (B.2), as the compliance method for Phase 2 of the Order and conforms to the associated guidance in NEI 13-02 Revision 1 for this compliance method.

Section IV.B: HCVS Existing System

There previously was neither a hardened drywell vent nor a strategy at DAEC that complied with Phase 2 of the order.

Section IV.C: HCVS Phase 2 SAWA System and SAWM Strategy

The HCVS Phase 2 SAWA system and SAWM strategy utilize the FLEX mitigation equipment and strategies to the extent practical. This approach is reasonable because the external hazards and the event initiator (ELAP) are the same for both FLEX mitigation strategies and HCVS. For SAWA, it is assumed that the initial FLEX response actions are unsuccessful in providing core cooling such that core damage contributes to significant radiological impacts that may impede the deployment, connection and use of FLEX equipment. These radiological impacts, including dose from containment and HCVS vent line shine were evaluated and modifications made as necessary to mitigate the radiological impacts such that the actions needed to implement SAWA and SAWM are feasible in the timeframes necessary to protect the containment from overpressure related failure. To the extent practical, the SAWA equipment, connection points, deployment locations and access routes are the same as the FLEX primary strategies so that a Unit that initially implements FLEX actions that later degrades to severe accident conditions can readily transition between FLEX and SAWA strategies. This approach further enhances the feasibility of SAWA under a variety of event sequences including timing.

DAEC has implemented the containment venting strategy utilizing SAWA and SAWM. The SAWA system consists of a FLEX (SAWA) pump injecting into the Reactor Pressure Vessel (RPV) and SAWM consists of flow control at the FLEX

(SAWA) pump along with instrumentation and procedures to ensure that the wetwell vent is not submerged (SAWM). Procedures have been issued to implement this strategy including revision 3 to the Severe Accident Management Guidelines (SAMG). This strategy has been shown via Modular Accident Analysis Program (MAAP) analysis to protect containment without requiring a drywell vent for at least seven days which is the guidance from NEI 13-02 for the period of sustained operation.

Section IV.C.1: Detailed SAWA Flow Path Description

The SAWA system, shown on Attachment 4, is the same as the FLEX primary injection path except that the hose run from the Turbine Building to the Southeast Corner Room (SECR) of the Reactor Building was replaced with a 4" carbon steel pipe. The primary connection was moved from the SECR to the Heater Bay of the Turbine Building. The additional piping and hoses have been evaluated in CAL-M13-005, Rev. 1 (Reference 36). The SAWA system, shown on Attachment 4, consists of a FLEX pump injecting into the Reactor Pressure Vessel (RPV) and SAWM consists of flow control at the FLEX pump along with wetwell level indication to ensure that the wetwell vent is not submerged (SAWM). The SAWA injection path starts at the Hotwell (flooded condition) or the circulating water pit (non-flooded condition), goes to the FLEX pump via suction hoses, goes through the FLEX pump to a flexible discharge hose, then to the FLEX/SAWA connection located in the heater bay of the Turbine Building. The hoses and pumps are stored in the FLEX Building which are protected from all hazards either by design or by separation. A portable in-line battery powered electromagnetic flow meter is placed in the hose run to provide indication of injection flow rate. The valves inside the reactor building will be lined-up so that water can be injected in to RPV via Low Pressure Coolant Injection (LPCI) system. This LPCI connection ties to the Reactor Pressure Vessel (RPV). BWROG generic assessment, BWROG-TP-15-008 (Reference 37), provides the principles of Severe Accident Water Addition to ensure protection of containment. This SAWA injection path is qualified for the all screened in hazards (Section 1) in addition to severe accident conditions.

Section IV.C.2: Severe Accident Assessment of Flow Path

The actions inside the RB where there could be a high radiation field due to a severe accident will be to manually open the inboard LPCI injection valve, strip loads off of MCC 1B34, and manually open the two 4" FLEX valves located in the SECR. The action to line-up valves and strip loads off of MCC 1B34 inside the RB can be performed before the dose is unacceptable, under the worst-case scenario within the first hour after the loss of RPV injection. This time was validated as part of the Time Sensitive Action validation for EA-13-109. Procedure SAMP-724 directs early accomplishment of 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 approximately 1 hour so that there will be no excessive radiation levels in the RB when the valves are operated. The other SAWA actions all take place outside the RB, at the Pump

House, MCR, Turbine Building, FLEX Buildings, and the deployment pathways. Since these locations are outside the RB, they are shielded from the severe accident radiation by the thick concrete walls of the RB. Once SAWA is initiated, the operators will monitor the response of containment from the MCR to determine that venting and SAWA are operating satisfactorily, maintaining containment pressure low to avoid containment failure. Stable or slowly rising trend in wetwell level with SAWA at the minimum flow rate indicates water on the drywell floor up to the vent pipe openings. After some period of time, as decay heat levels decrease, the operators will be able to reduce SAWA flow to keep the core debris cool while avoiding overfilling the torus to the point where the wetwell vent is submerged.

The pump deployment time for SAWA will be very similar to the pump deployment time for FLEX. An in-line flow meter will need to be installed for SAWA in the hose run which has 5" Storz connections on the inlet and outlet. Installation of the flow meter will not take a significant amount of time due to the ease of Storz connections. Furthermore, the hose run to the SAWA connection will be shorter to the heater bay than to the SECR. Therefore, it is judged that the deployment times for the two scenarios are similar.

Section IV.C.3: Severe Accident Assessment of Safety-Relief Valves

DAEC has methods available to extend the operational capability of manual pressure control using SRVs as provided in the plant specific order EA-12-049 submittal. Assessment of manual SRV pressure control capability for use of SAWA during the Order defined accident is unnecessary because RPV depressurization is directed by the EPGs in all cases prior to entry into the SAGs.

Section IV.C.4: Available Freeboard Use

The torus freeboard volume (above 10'-5 5/16" Maximum Normal Level) is 303,000 gallons before the water level reaches the top of the normal instrument range and an additional 375,119 gallons until level reaches the bottom of the wetwell vent pipe as shown in Attachment 1 (total volume of 678,119 gallons available). BWROG generic assessment BWROG-TP-15-011, provides the principles of Severe Accident Water Management to preserve the wetwell vent for a minimum of seven days. After containment parameters are stabilized with SAWA flow, SAWA flow will be reduced to a point where containment pressure will remain low while wetwell level is stable or very slowly rising. For DAEC, the SAWA flow rate is 272 gpm for first 4 hours followed by 55 gpm for 164 hours per EVAL-16-M01, (Reference 43). The total SAWA and SAWM water addition will be 606,480 gallons. Thus, the remaining freeboard volume will be 71,639 gallons. As shown in EVAL-16-M01 (Reference 43) Section 6.0, this freeboard volume translates to about 2.1 ft of air space above the torus water level, ensuring that the wetwell vent will remain operational as a result of SAWA/SAWM strategy for a seven-day period. It should be noted that Reference 43 is conservative as it does not include mass flow through the HCVS when determining the freeboard volumes and suppression pool level is expected to stabilize early in the event.

Section IV.C.5: Upper range of wetwell level indication

The wide range torus water level instrument LI4396A/B is acceptable for monitoring torus water level above the normal instrument range of 1.5-16 feet when adjusted for the drywell to torus differential pressure. The range of the instrument is 0-98 feet while the HCVS connection is located at approximately 24 feet (Reference 43). Operating instructions for applying a correction factor to LI-4396A/B are provided in Appendix 1 of SEP 301.3 (Reference 65) to account for pressure differential between the drywell and the wetwell.

Section IV.C.6: Wetwell vent service time

EVAL-16-M01 (Reference 43) and BWROG-TP-15-011 (Reference 38), demonstrate that throttling SAWA flow after containment parameters have stabilized, in conjunction with venting containment through the wetwell vent will result in a stable or slowly rising wetwell level. The references demonstrate that, for the scenario analyzed, wetwell level will remain below the wetwell vent pipe for greater than the seven days of sustained operation allowing significant time for restoration of alternate containment pressure control and heat removal.

Section IV.C.7: Strategy time line

The overall accident management plan for DAEC is developed from the BWR Owner's Group Emergency Procedure Guidelines and Severe Accident Guidelines (EPG/SAG). As such, the SAWA/SAWM implementing procedures are integrated into the DAEC SAMGs. In particular, EPG/SAG Revision 3, when implemented with Emergency Procedures Committee Generic Issue 1314, allows throttling of SAWA in order to protect containment while maintaining the wetwell vent in service. The SAMG flow charts direct use of the hardened vent as well as SAWA/SAWM when the appropriate plant conditions have been reached.

Using NEI 12-06 Appendix E (Reference 30), DAEC has validated that the SAWA pump can be deployed and commence injection in less than 8 hours (FLEX-VALIDATION REPORT, Reference 51). The studies referenced in NEI 13-02 demonstrated that establishing flow within 8 hours will protect containment. The initial SAWA flow rate will be at least 272 gpm per CAL-M13-005 (Reference 36). After a period of time, estimated to be about 4 hours, in 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.

NEI 13-02 generic analysis per NEI 13-02 Reference 7 demonstrated that, SAWA flow could be reduced to 55 gpm after four hours of initial SAWA flow rate and containment would be protected. At some point wetwell level will begin to rise indicating that the SAWA flow is greater than the steaming rate due to containment heat load such that flow can be reduced. While this is expected to be 4-6 hours, no time is specified in the procedures because the SAMGs are symptom based guidelines.

Section IV.C.8: SAWA Flow Control

DAEC will accomplish SAWA flow control by the use of valves at the FLEX/SAWA pump. The operators at the FLEX/SAWA pump will be in communication with the MCR via two-way radios or unaffected telephones and the exact time to throttle flow is not critical since there is a large margin between normal wetwell level and the level at which the wetwell vent will be submerged. The communications capabilities that will be used for communication between the MCR and the SAWA flow control location are the same as that evaluated and found acceptable for FLEX strategies. The communications capabilities have been tested to ensure functionality at the SAWA flow control and monitoring locations. Communication between the MCR and the operator at the FLEX pump and control station is discussed in Section 3.13 of FLEX-FIP (Reference 35) and are the same as those evaluated for FLEX strategies.

Section IV.C.9: SAWA/SAWM Element Assessment

Section IV.C.9.1: SAWA Pump

DAEC has two redundant portable diesel-driven fire pumps and uses one pump for FLEX and SAWA strategies. The pumps are capable of supplying 1000 gpm at 400 feet of head (FLEX-FIP, Reference 35). As documented in CAL-M13-005 (Reference 36) these pumps have been shown to be capable of supplying the required flow rates to the RPV and the SFP for FLEX and for SAWA scenarios. DAEC has procured two FLEX/SAWA pumps that are trailer mounted. The pumps are stored in redundant FLEX buildings located at the North and South ends of the DAEC site that are designed and/or located to withstand all screened-in hazards and are rugged, over the road, trailer-mounted units, and therefore will be available to function after a seismic event.

Section IV.C.9.2: SAWA analysis of flow rates and timing

For DAEC the SAWA generic flow rate is 272 gpm which is the site-specific flow rate when the site's rated thermal power is compared to the reference power level of NEI 13-02. The initial SAWA flow will be injecting to the RPV within 8 hours of the loss of injection. The reference flow rate is 500 gpm for a reactor with power level of 3514 MWth, equivalent to the reference plant rated thermal power level used in NUREG-1935, State of the Art Reactor Consequence Analysis (SOARCA). NUREG 1935 is Reference 9 of NEI 13-02 Revision 1. Since DAEC's rated power is 1912 MWth, the initial DAEC SAWA flow rate is 272 gpm (500 x 1912/3514). The long term SAWA flow rate is 55 gpm (100 x 1912/3514). DAEC will inject at 272 gpm for approximately 4 hours and at 55 gpm for remainder of the event.

Section IV.C.9.3: SAWA Pump Hydraulic Analysis

DAEC calculation CAL-M13-005 (Reference 36) analyzed the FLEX pumps and the lineup for RPV injection that would be used for SAWA. This calculation showed that the pumps have adequate capacity to meet the SAWA flow rates required to protect containment. This calculation evaluates both flooding and non-flooding events since different suction flow paths are utilized in these events.

Section IV.C.9.4: SAWA Method of backflow prevention

The DAEC SAWA flow path from FLEX/SAWA pump to the "A" LPCI injection line includes check valve V20-0082 inside the Reactor Building as shown on Attachment 4 (BECH-M120). This valve will prevent any radioactive gaseous or liquid leakage from the RPV/drywell back through the SAWA line. Additionally, a check valve is provided at the SAWA pump discharge which is a part of the portable SAWA system.

The SAWA (LPCI) backflow prevention valve is also a Primary Containment Isolation Valve (PCIV) whose integrity of check function (open and closed) is demonstrated by other plant testing requirements such that additional testing per NEI 13-02 Revision 1 Section 6.2 is not required for these valves per NEI 13-02 Revision 1 Table 6-1 Note 3. The SAWA pump discharge check valves (1P298-V06 and 1P299-V06) are cycled at least once a year during annual pump testing via NS130009 and NS130010 (Reference 52, 53).

Section IV.C.9.5: SAWA Water Source

The initial source of water for SAWA for a non-flood condition is the Circulating Water Pit located in the pump house which can provide approximately 3 days and 3 hours of water injection without makeup based on the FLEX analysis (Reference 54). The initial source of water for SAWA in a flood condition is the CST/Hotwell/Demineralized Water Tank which can provide approximately 3 days and 8 hours of water injection without makeup based on the FLEX analysis (Reference 54). Prior to depletion of the initial supply, the NSRC-supplied pump will be deployed to re-fill the desired suction source from the Cedar River per SAMP 728 (Reference 55). This long-term strategy of water supply was qualified for order EA-12-049 response and is available during a severe accident. Therefore there will be sufficient water injection to protect containment during the period of sustained operation.

Section IV.C.9.6: SAWA/SAWM Motive Force

Section IV.C.9.6.1: SAWA Pump Power Source

The SAWA pumps are stored in redundant FLEX buildings where they are protected from all screened-in hazards either by qualification or adequate separation. The SAWA pumps are commercial fire pumps rated for long-term outdoor use in emergency scenarios. The pumps are diesel-driven by an engine mounted skid with the pump. The pumps will be refueled by the FLEX refueling equipment that has been qualified for long-term refueling operations per EA-12-049. The action to refuel the SAWA pumps was evaluated under severe accident conditions in Table 2, and demonstrated to be acceptable. Since the pumps are stored in a protected structure, are qualified for the environment in which they will be used, and will be refueled by a qualified refueling strategy, they will perform their function to maintain SAWA flow needed to protect primary containment per EA-13-109.

Section IV.C.9.6.2: DG loading calculation for SAWA/SAWM equipment

Table 1 shows the electrical power source for the SAWA/SAWM instruments. For the instruments powered by the HCVS 125VDC battery, calculation CAL-E15-002 (Reference 42) demonstrates that they can provide power until the FLEX generator restores power to the battery charger.

The FLEX load on the FLEX DG per EA-12-049 was evaluated in calculation CAL-E13-001 (Reference 34). This calculation demonstrated the total running load is 238.1 KVA which provides 59% margin. The worst-case momentary starting load is 356.4 KVA which provides 12% margin. The buses that provide power for the torus level and drywell pressure instruments are included in the FLEX DG calculation. Circuit breakers for the required motor operated valves are included in SAMP 723 (Reference 70 and their loads are within the capabilities of the FLEX DG. The FLEX generator was qualified to carry the rest of the FLEX loads as part of Order EA-12-049 compliance.

Section IV.C.10: SAWA/SAWM Instrumentation

1) The instruments credited for SAWA/SAWM are the portable flow meters, the wetwell level indicators (LI4396A/B and LI4397A/B), drywell pressure indicators (PI4396C/D), and the torus pressure indicators (PI4395A/B).

2) SAWA pump flow is measured by an electromagnetic flow meter that is capable of measuring flow from 55 – 1761 gpm range with error less than 1% (AR02221891-04).

3) For SAWA instrumentation qualification, refer to Table 1.

4) The flow meter is an electromagnetic flow meter that has a battery life of 6-10 years of maintenance free operation. In plant instrumentation is powered initially by station batteries and then by the FLEX DG for the sustained operation period.

5) Containment pressure and wetwell level instrumentation will be repowered through their respective electrical buses by the use of the FLEX Diesel Generator.

Section IV.C.10.1: SAWA/SAWM instruments

Table 1 contains a listing of all the instruments needed for SAWA and SAWM implementation. This table also contains the expected environmental parameters for each instrument, its qualifications, and its power supply for sustained operation.

Section IV.C.10.2: Describe SAWA instruments and guidance

The drywell pressure and wetwell level instruments, used to monitor the condition of containment, are pressure and differential pressure detectors that are safety-related and qualified for post-accident use. These instruments are referenced in Severe Accident Guidelines for control of SAWA flow to maintain the wetwell vent in service while maintaining containment protection. These instruments are powered initially by batteries until the FLEX generator is deployed and connected and then by FLEX generator systems for the sustained operating period. Note that other indications of these parameters may be available depending on the exact scenario.

The SAWA flow meter is an electromagnetic flow meter provided with 5" Storz connections that may be placed anywhere along the hose run. It is powered by internal batteries capable of providing power for much greater than 7 days (6 years minimum).

No containment temperature instrumentation is required for compliance with HCVS Phase 2. However, most FLEX electrical strategies repower other containment instruments that include drywell temperature, which may provide information for the operations staff to evaluate plant conditions under a severe accident and provide confirmation to adjust SAWA flow rates. SAMG strategies will evaluate and use drywell temperature indication if available consistent with the symptom based approach. NEI 13-02 Revision 1 Section C.8.3 discusses installed drywell temperature indication.

Section IV.C.10.3: Qualification of SAWA/SAWM instruments

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 were qualified for severe accident use in ECP 283904 Attachment 5.4 (Reference 54). Refer to Table 1 for a summary of instrument qualification.

The SAWA flow meter is rated for continuous use under the expected ambient conditions and will be available for sustained operation. In extreme cold conditions, the flow meter will need to be located in the Turbine building and portable heaters are available to provide area heating if needed using SAMP 726 (Reference 58).

Section IV.C.10.4: Instrument Power Supply through Sustained Operation

DAEC FLEX strategies will restore the containment instruments, containment pressure and wetwell level, necessary to successfully implement SAWA. The strategy will be to use the FLEX generator to re-power battery chargers before the batteries supplying the instruments are depleted. Since the FLEX generators are refueled per FLEX strategies for a sustained period of operation, the instruments will be powered for the sustained operating period.

Section IV.C.11: SAWA/SAWM Severe Accident Considerations

DAEC calculations CAL-R15-002 (Reference 44) and evaluation EVAL-16-M18 (Reference 68) determine the expected radiological and environmental conditions during an ELAP event. Radiological assessments for operator actions, permanently installed equipment used for HCVS/SAWA, and portable equipment staged for HCVS/SAWA are contained in CAL-R15-002 (Reference 44). Temperature profiles for environmental assessment of the reactor building are provided in EVAL-16-M18 (Reference 68) and have been evaluated for the effect on equipment used for HCVS/SAWA in ECP 283904 Attachment 5.4 (Reference 54). Temperatures in the control room are expected to be consistent with the room heat-up calculations for station blackout performed in CAL-M06-007 (Reference 69) and are evaluated in EC283904 Attachment 5.3 (Reference 54) for FLEX. The SAWA piping and pipe supports have been evaluated using seismic category 1 criteria in CAL-M17-001 (Reference 66).

Section IV.C.11.1: Severe Accident Effect on SAWA Pump and Flowpath

Since the SAWA pumps are stored in the FLEX Buildings and will be operated from outside the RB, either at the pump-house or in the Turbine Building, there will be no issues with radiation dose rates at the SAWA pump control location and there will be no significant dose to the SAWA pump.

Inside the RB the SAWA flow path consists of piping that will be unaffected by the radiation dose. Hoses will be run outside of the Reactor Building and are qualified for the temperatures expected in the areas they will be run. For a flood condition, the pump will be positioned in the Turbine Building such that it will be adequately shielded from radiation by the reactor building floors and walls. Therefore, the SAWA flow path will not be affected by radiation or temperature effects due to a severe accident.

Section IV.C.11.2: Severe Accident Effect on SAWA/SAWM instruments

The SAWA/SAWM instruments are described in section IV.C.10.3, that section provides severe accident effects.

Section IV.C.11.3: Severe Accident Effect on personnel actions

Section IV.C.2 describes the RB actions within the first 7 hours. The actions including access routes outside the Reactor Building that will be performed after the first use of the vent during severe accident conditions (assumed to be 7 hours per HCVS-FAQ-12) are located such that they are either shielded from direct exposure to the vent line or are a significant distance from the vent line so that expected dose is maintained below the ERO exposure guidelines.

As part of the response to Order EA-12-049, DAEC used the results of EVAL-M16-18 (Reference 68) and CAL-M06-007 (Reference 69) for determining expected temperatures in the Reactor Building and Control Building. This calculation and evaluation provide temperature response of the Reactor and Control Buildings during a FLEX event and a station blackout event respectively. Since, in the severe accident, the core materials are contained inside the primary containment, the temperature response of the RB and CB is driven by the loss of ventilation and ambient conditions and therefore will not change. Thus, the FLEX and station blackout calculations are bounding and acceptable for severe accident use.

Table 2 provides a list of SAWA/SAWM operator actions as well as an evaluation of each for suitability during a severe accident. Attachment 6 shows the approximate locations of the actions.

After the SAWA pipe is aligned inside the RB, the operators can control SAWA/SAWM as well as observe the necessary instruments from outside the RB. The thick concrete RB walls as well as the distance to the core materials means that there is no radiological concern with any actions outside the RB. Therefore, all SAWA controls and indications are accessible during severe accident conditions.

The SAWA pump and flow monitoring equipment can all be operated from outside the RB at ground level. The DAEC FLEX response ensures that the SAWA pump, FLEX generators and other equipment can all be run for a sustained period by refueling. All the refueling locations are located in shielded or protected areas so that there is no radiation hazard from core material during a severe accident. The monitoring instrumentation includes SAWA flow at the SAWA flow meter, wetwell level and containment pressure in the MCR.

<u>Section V</u>: HCVS Programmatic Requirements

<u>Section V.A</u>: HCVS Procedure Requirements

Licensees shall develop, implement, and maintain procedures necessary for the safe operation of the HCVS. Procedures shall be established for system operations when normal and backup power is available, and during an extended loss of AC power.

<u>Evaluation:</u>

Procedures have been established for system operations when normal and backup power is available, and during ELAP conditions. The implementing design change documents for EC281991 (Reference 63) contain instructions for modifying the HCVS specific procedures.

The HCVS and SAWA procedures have been developed and implemented following the DAEC process for initiating and/or revising procedures and contain the following details:

- appropriate conditions and criteria for use of the system
- when and how to place the system in operation,
- the location of system components,
- instrumentation available,
- normal and backup power supplies,
- directions for sustained operation, including the storage location of portable equipment,
- training on operating the portable equipment, and
- testing portable equipment
- Since DAEC relies on Containment Accident Pressure (CAP) to achieve net positive suction head (NPSH) for the Emergency Core Cooling System (ECCS) pumps, the procedures include precautions that use of the vent may impact NPSH (CAP) available to the ECCS pumps.

DAEC has implemented the BWROG Emergency Procedures Committee Issue 1314 that implements the Severe Accident Water Management (SAWM) strategy in the Severe Accident Management Guidelines (SAMGs). The following general cautions, priorities and methods have been evaluated for plant specific applicability and incorporated as appropriate into the plant specific SAMGs using administrative procedures for EPG/SAG change control process and implementation. SAMGs are symptom based guidelines and therefore address a wide variety of possible plant conditions and capabilities. While these changes are intended to accommodate those specific conditions assumed in Order EA-13-109, the changes were made in a way that maintains the use of SAMGs in a symptom based mode while at the same time addressing those conditions that may exist under extended loss of AC power (ELAP) conditions with significant core damage including ex-vessel core debris.

<u>Cautions</u>

- Addressing the possible plant response associated with adding water to hot core debris and the resulting pressurization of the primary containment by rapid steam generation.

- Addressing the plant impact that raising suppression pool water level above the elevation of the suppression chamber vent opening elevation will flood the suppression chamber vent path.

Priorities – With significant core damage and RPV breach, SAMGs prioritize the preservation of primary containment integrity while limiting radioactivity releases as follows:

- Core debris in the primary containment is stabilized by water addition (SAWA).
- Primary containment pressure is controlled below the Primary Containment Pressure Limit (Wetwell venting)
- Water addition is managed to preserve the Mark I/II suppression chamber vent paths, thereby retaining the benefits of suppression pool scrubbing and minimizing the likelihood of radioactivity and hydrogen release into the secondary containment (SAWM)

Methods – Identify systems and capabilities to add water to the RPV or drywell, with the following generic guidance:

- Use controlled injection if possible
- Inject into the RPV if possible
- Maintain injection from external sources of water as low as possible to preserve the suppression chamber vent capability

Section V.B: HCVS Out of Service Requirements

Provisions for out-of-service requirements for FLEX and HCVS are provided in FLEX-AB-100-1000 (Reference 67).

Programmatic controls have been implemented to document and control the following:

NOTE: Out of service times and required actions noted below are for HCVS and SAWA functions. Equipment that also supports a FLEX function that is found to be non-functional must also be addressed using the out of service times and actions in accordance with the FLEX program.

The provisions for out-of-service requirements for HCVS and SAWA functionality are applicable in Modes 1, 2, and 3 per NEI 13-02, 6.3.

- If for up to 90 consecutive days, the primary or alternate means of HCVS operation are non-functional, no compensatory actions are necessary.
- If for up to 30 days, the primary and alternate means of HCVS operation or SAWA are non-functional, no compensatory actions are necessary.
- If the out of service times projected to exceed 30 or 90 days as described above, the following actions will be performed through the corrective action system determine:
    - The cause(s) of the non-functionality,
    - The actions to be taken and the schedule for restoring the system to functional status and prevent recurrence,
    - Initiate action to implement appropriate compensatory actions, and
    - Restore full HCVS functionality at the earliest opportunity not to exceed one full operating cycle.

The HCVS system is functional when piping, valves, instrumentation and controls including motive force necessary to support system operation are available. Since the system is designed to allow a primary control and monitoring or alternate valve control by Order criteria 1.2.4 or 1.2.5, allowing for a longer out of service time with either of the functional capabilities maintained is justified. A shorter length of time when both primary control and monitoring and alternate valve control are unavailable is needed to restore system functionality in a timely manner while at the same time allowing for component repair or replacement in a time frame consistent with most high priority maintenance scheduling and repair programs, not to exceed 30 days unless compensatory actions are established per NEI 13-02 Section 6.3.1.3.3.

SAWA is functional when piping, valves, motive force, instrumentation and controls necessary to support system operation are functional.

The system functionality basis is for coping with beyond design basis events and therefore plant shutdown to address non-functional conditions is not warranted. However, such conditions should be addressed by the corrective action program and compensatory actions to address the non-functional condition should be established. These compensatory actions may include alternative containment venting strategies or other strategies needed to reduce the likelihood of loss of fission product cladding integrity during design basis and beyond design basis events even though the severe accident capability of the vent system is degraded or non-functional. Compensatory actions may include actions to reduce the likelihood of needing the vent but may not provide redundant vent capability.

Applicability for allowed out of service time for HCVS and SAWA for system functional requirements is limited to startup, power operation and hot shutdown conditions when primary containment is required to be operable and containment integrity may be challenged by decay heat generation.

Section V.C: HCVS Training Requirements

Licensee shall train appropriate personnel in the use of the HCVS. The training curricula shall include system operations when normal and backup power is available, and during an extended loss of AC power.

Evaluation:

Personnel expected to perform direct execution of the HCVS have received necessary training in the use of plant procedures for system operations when normal and backup power is available and during ELAP conditions. The training will be refreshed on a periodic basis and as any changes occur to the HCVS. The personnel trained and the frequency of training was determined using a systematic analysis of the tasks to be performed using the Systems Approach to Training (SAT) process.

In addition, per NEI 12-06 (Reference 30), any non-trained personnel on-site will be available to supplement trained personnel.

Section V.D: Demonstration with other Post Fukushima Measures

DAEC will demonstrate use of the HCVS and SAWA systems in drills, tabletops or exercises as follows:

1. Hardened containment vent operation on normal power sources (no ELAP)
2. During FLEX demonstrations (as required by EA-12-049 (Reference 31): Hardened containment vent operation on backup power and from primary or alternate locations during conditions of ELAP/loss of UHS with no core damage.) System use is for containment heat removal AND containment pressure control.
3. HCVS operation on backup power and from primary or alternate location during conditions of ELAP/loss of UHS with core damage. System use is for containment heat removal AND containment pressure control with potential for combustible gases.

Evaluation

NOTE: Items 1 and 2 above are not applicable to SAWA.

The use of the HCVS and SAWA capabilities will be demonstrated during drills, tabletops or exercises consistent with NEI 13-06 and on a frequency consistent with 10 CFR 50.155(e)(4). DAEC will perform the first drill demonstrating at least one of the above capabilities by November 15, 2021 which is within four years of the first unit compliance with Phase 2 of Order EA-13-109. Subsequent drills, tabletops or exercises will be performed to demonstrate the capabilities of different elements of Items 1, 2 and/or 3 above that is applicable to DAEC in subsequent eight year intervals.

Section VI: References

Number	Rev	Title	Location[6]
1. GL-89-16	0	Installation of a Hardened Wetwell Vent (Generic Letter 89-16), dated September 1, 1989.	ML031140220
2. SECY-12-0157	0	Consideration of Additional Requirements for Containment Venting Systems for Boiling Water Reactors with Mark I and Mark II Containments	ML12345A030
3. SRM-SECY-12-0157	0	Staff Requirements – SECY-12-0157 – Consideration of Additional Requirements for Containment Venting Systems for Boiling Water Reactors with Mark I and Mark II Containments	ML13078A017
4. EA-12-050	0	Order to Modify Licenses with Regard to Reliable Hardened Containment Vents	ML12054A694
5. EA-13-109	0	Order to Modify Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions	ML13143A334
6. NEI 13-02	0	Industry Guidance for Compliance with Order EA-13-109, BWR Mark I & II Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions	ML13316A853
7. NEI 13-02[7]	1	Industry Guidance for Compliance with Order EA-13-109, BWR Mark I & II Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions	ML15113B318
8. HCVS-WP-01	0	Hardened Containment Vent System Dedicated and Permanently Installed Motive Force, Revision 0, April 14, 2014	ML14120A295 ML14126A374
9. HCVS-WP-02	0	Sequences for HCVS Design and Method for Determining Radiological Dose from HCVS Piping, Revision 0, October 23, 2014	ML14358A038 ML14358A040
10. HCVS-WP-03	1	Hydrogen/Carbon Monoxide Control Measures Revision 1, October 2014	ML14302A066 ML15040A038
11. HCVS-WP-04	0	Missile Evaluation for HCVS Components 30 Feet Above Grade	ML15244A923 ML15240A072

[6] Where two ADAMS accession numbers are listed, the first is the reference document and the second is the NRC endorsement of that document.
[7] NEI 13-02 Revision 1 Appendix J contains HCVS-FAQ-01 through HCVS-FAQ-09.

Number	Rev	Title	Location[6]
12. JLD-ISG-2013-02	0	Compliance with Order EA-13-109, Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation under Severe Accident Conditions	ML13304B836
13. JLD-ISG-2015-01	0	Compliance with Order EA-13-109, Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation under Severe Accident Conditions	ML15104A118
14. HCVS-FAQ-10	1	Severe Accident Multiple Unit Response	ML15273A141 ML15271A148
15. HCVS-FAQ-11	0	Plant Response During a Severe Accident	ML15273A141 ML15271A148
16. HCVS-FAQ-12	0	Radiological Evaluations on Plant Actions Prior to HCVS Initial Use	ML15273A141 ML15271A148
17. HCVS-FAQ-13	0	Severe Accident Venting Actions Validation	ML15273A141 ML15271A148
18. Phase 1 OIP	0	HCVS Phase 1 Overall Integrated Plan (OIP)	ML14182A423
19. Combined OIP	0	Combined HCVS Phase 1 and 2 Overall Integrated Plan (OIP), Dec. 2015	ML15358A043
20. Phase 1 ISE	0	HCVS Phase 1 Interim Staff Evaluation (ISE)	ML15006A319
21. Phase 2 ISE	0	HCVS Phase 2 Interim Staff Evaluation (ISE)	ML16248A001
22. 1st Update	0	First Six-Month Update, Dec. 2014	ML14349A324
23. 2nd Update	0	Second Six-Month Update, June 2015	ML15170A333
24. 3rd Update	0	Third Six-Month Update (same as Ref 19)	ML15358A043
25. 4th Update	0	Fourth Six-Month Update, June 2016	ML16178A261
26. 5th Update	0	Fifth Six-Month Update, Dec. 2016	ML16362A211
27. 6th Update	0	Sixth-Six Month Update, June 2017	ML17180A217
28. 7th Update	0	Seventh-Six Month Update, December 2017	ML17353A668
29. 8th Update	0	Eighth-Six Month Update, June 2018	ML18177A261
30. NEI 12-06	0	Diverse and Flexible Coping Strategies (FLEX) Implementation Guide	ML12221A205
31. EA-12-049	0	Issuance of Order to Modify Licenses With Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events, dated March 12, 2012.	ML12054A735

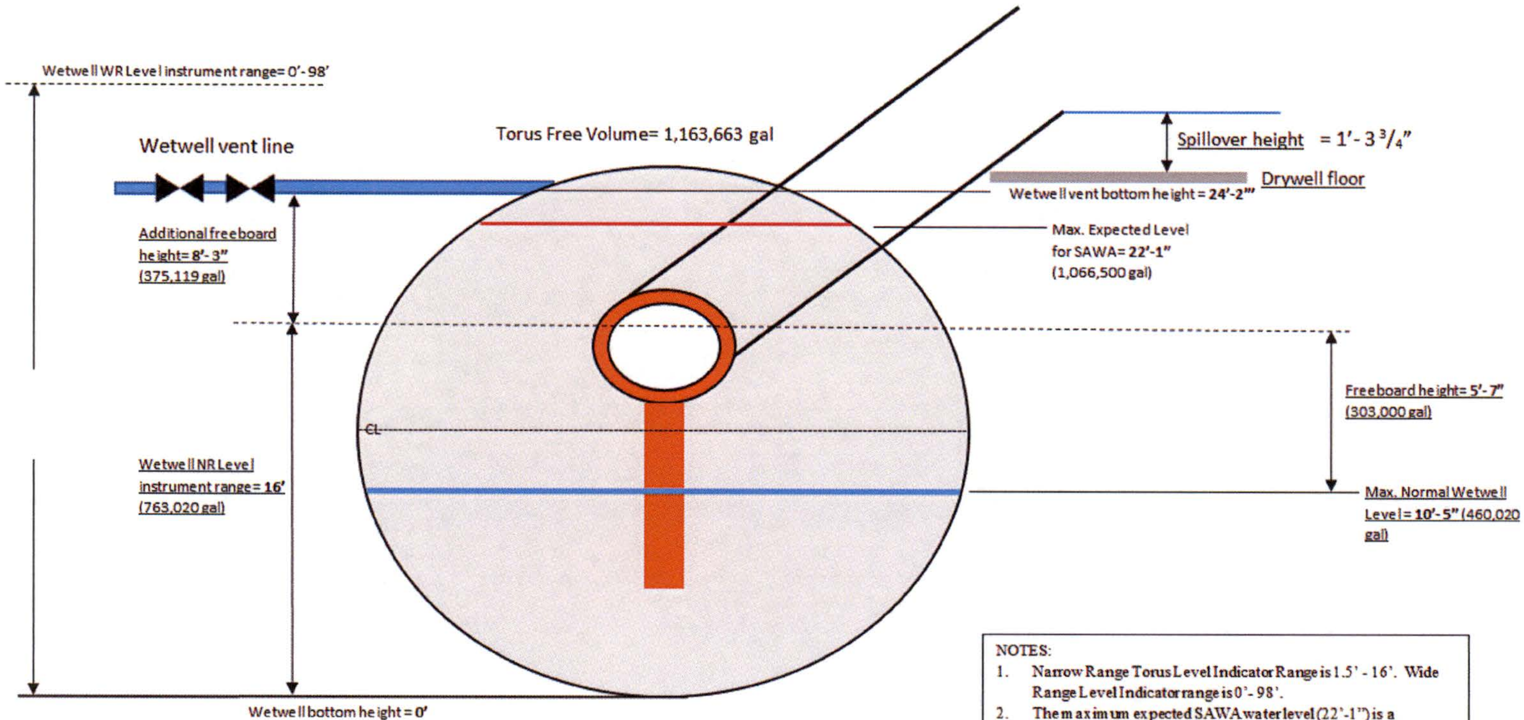
Number	Rev	Title	Location[6]
32. RG 1.97	3	Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Conditions During and Following an Accident	ML003740282
33. TR-1026539	0	EPRI Investigation of Strategies for Mitigating Radiological Releases in Severe Accidents BWR, Mark I and Mark II Studies, October 2012	N/A
34. CAL-E13-001	0	FLEX Electrical Equipment Sizing	N/A
35. FLEX-FIP	0	Final Integrated Plan for NRC Order EA-12-049 Mitigating Beyond Design Basis Events	N/A
36. CAL-M13-005	1	FLEX Diesel Pump Suction Hydraulic Analysis	N/A
37. BWROG-TP-15-008	0	BWROG Fukushima Response Committee, Severe Accident Water Addition Timing, Sept. 2015	N/A
38. BWROG-TP-15-011	0	BWROG Fukushima Response Committee, Severe Accident Water Management Supporting Evaluations, Oct. 2015	N/A
39. TP-17-3-0375	0	BWROG Fukushima Response Committee Owners' Group Positions (OGPs), HCVS-OGP-001 through -003. Oct. 2017	N/A
40. TP-17-5-0375	0	BWROG Fukushima Response Committee Owners' Group Positions (OGPs), HCVS-OGP-005 through -008. Oct. 2017	N/A
41. CAL-M15-014	0	Nitrogen Supply for Hardened Containment Vent	N/A
42. CAL-E15-002	0	125VDC Battery/Battery Charger Sizing and Voltage Drop Calculation	N/A
43. EVAL-16-M01	0	Determination of Suppression Pool Volume at Specific Water Levels to Support Severe Accident Water Management (SAWM) Strategies	N/A
44. CAL-R15-002	1	Duane Arnold Energy Center Hardened Containment Vent System Dose Assessment	N/A

Number	Rev	Title	Location[6]
45. CAL-M15-013	0	Duane Arnold Energy Center Hardened Containment Vent System Pipe Sizing Analysis	N/A
46. BECH-A009	23	North/South Partial Exterior Elevation	N/A
47. ISO-HBC-140-04	0	Reactor Building Hardened Containment Vent System	N/A
48. BECH-A026	7	Control Building Precast Panel Elevations	N/A
49. OP-AA-102-1002	28	Seasonal Readiness	N/A
50. CAL-R15-001	0	Duane Arnold Energy Center Hardened Containment Vent System Source Term	N/A
51. FLEX-VALIDATION-REPORT	0	DAEC FLEX Validation Report	N/A
52. NS130009	25	John Deere Portable Diesel Fire Pump Operability	N/A
53. NS130010	11	Caterpillar Portable Diesel Fire Pump Operability	N/A
54. EC283904; Attachments 5.1-5.9	0	FLEX Evaluations	N/A
55. SAMP 728	1	FLEX Replenishment of Water Inventories	N/A
56. SAMP 724	6	FLEX Damage Assessment and Portable Equipment Deployment	N/A

Number	Rev	Title	Location[6]
57. SA-AA-100-1008	8	Heat Stress Control	N/A
58. SAMP 726	1	FLEX Adverse Environmental Conditions Guideline	N/A
59. AOP 301.1	77	Station Blackout	N/A
60. SAMP 729	1	FLEX Ventilation of the Reactor Building without AC Power	N/A
61. CAL-C15-006	0	Hardened Containment Vent System Pipe Support Evaluation	N/A
62. CAL-M15-005	0	Evaluation of Hardened Containment Vent System at Torus Penetration N-230A	N/A
63. EC281991	24	Reliable Hardened Containment Vent – Wetwell NRC Order EA-13-109	N/A
64. EC286539	5	Severe Accident Water Addition	N/A
65. SEP 301.3	16	Torus Vent Via Hard Pipe Vent	N/A
66. CAL-M17-001	0	Severe Accident Water Addition Piping Analysis, 4" GBB-4 and GBD-70	N/A
67. FLEX-AB-100-1000	4	Guidance for FLEX Equipment when it is Unavailable	N/A
68. EVAL-16-M18	0	Reactor Building Environmental Analysis for FLEX	N/A

Number	Rev	Title	Location[6]
69. CAL-M06-007	1	NAI-1529-03, Room Heatup Analysis for Duane Arnold Energy During Station Blackout	N/A
70. SAMP 723	2	FLEX Repowering MCC 1B32 from a FLEX 480 VAC Portable Diesel Generator	N/A

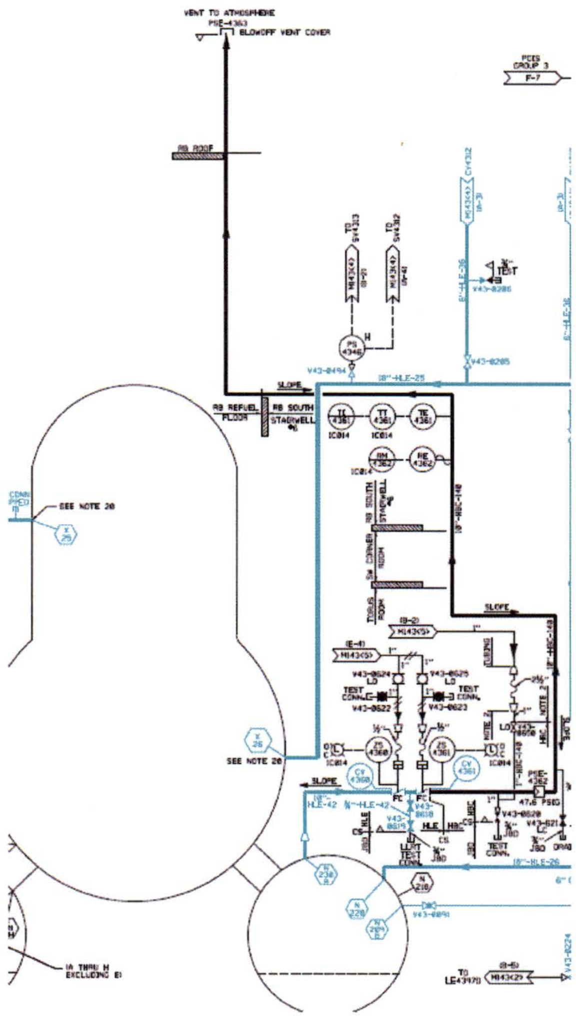
Attachment 1: Phase 2 Freeboard diagram



NOTES:

1. Narrow Range Torus Level Indicator Range is 1.5' - 16'. Wide Range Level Indicator range is 0'- 98'.
2. The maximum expected SAWA water level (22'-1") is a conservative calculation based on water addition only. This does not reflect any mass loss due to venting. This is intended to provide a conservative and bounding torus water level.
3. SAWA injection flowrates are 272 gpm for 4 hours and 55 gpm for the sustained operating period (7 days). Based on these flowrates, the torus level is expected to change as follows:
   - Flowrate of 272 gpm results in a rate of rise of approx. 0.28 ft/ hr.
   - Flowrate of 55 gpm results in a rate of rise of approx. 0.057 ft/ hr.

Attachment 2a: **One Line Diagram of HCVS Vent Path**



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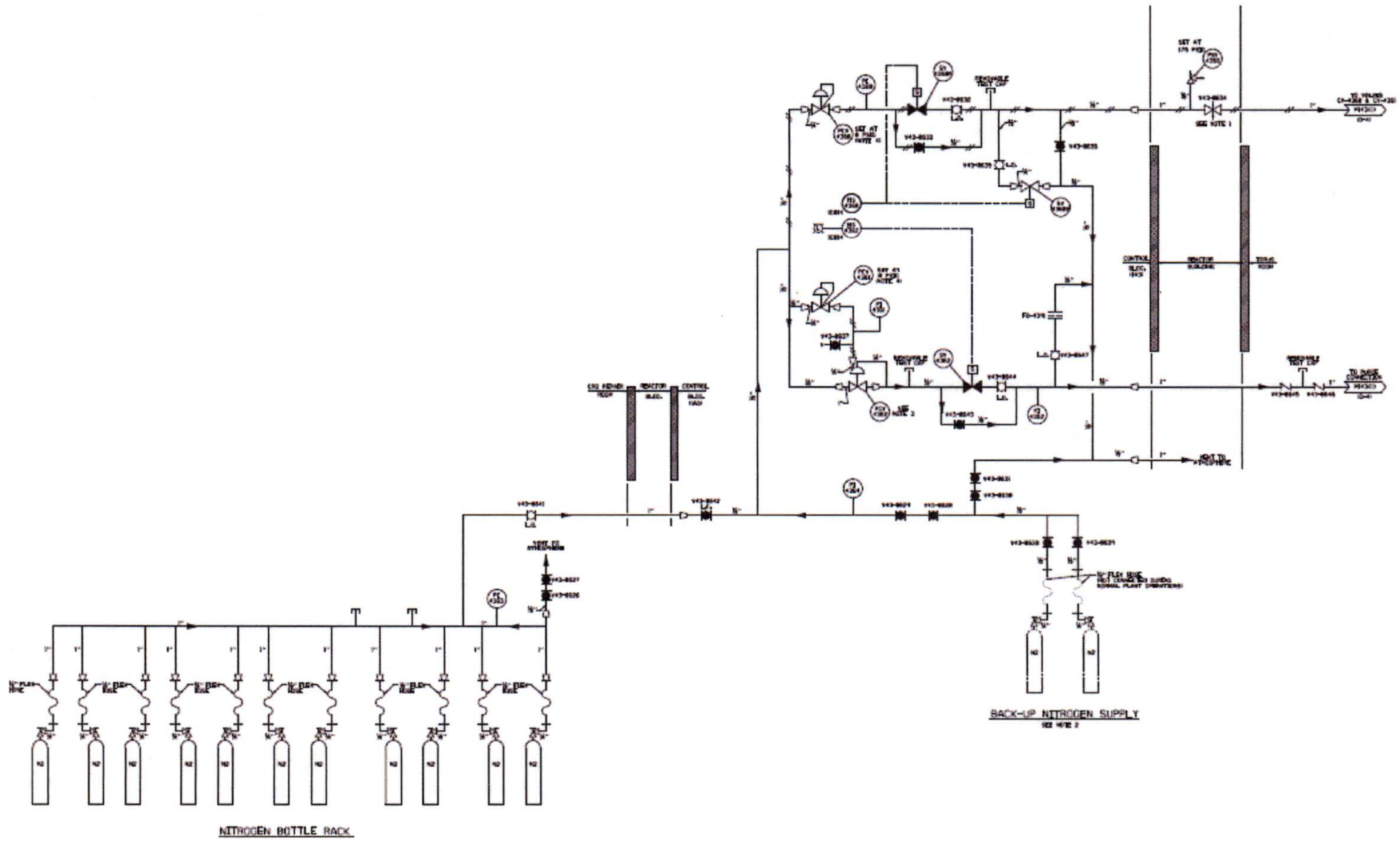
Attachment 2b: One Line Diagram of HCVS Control Valve and Purge Gas System



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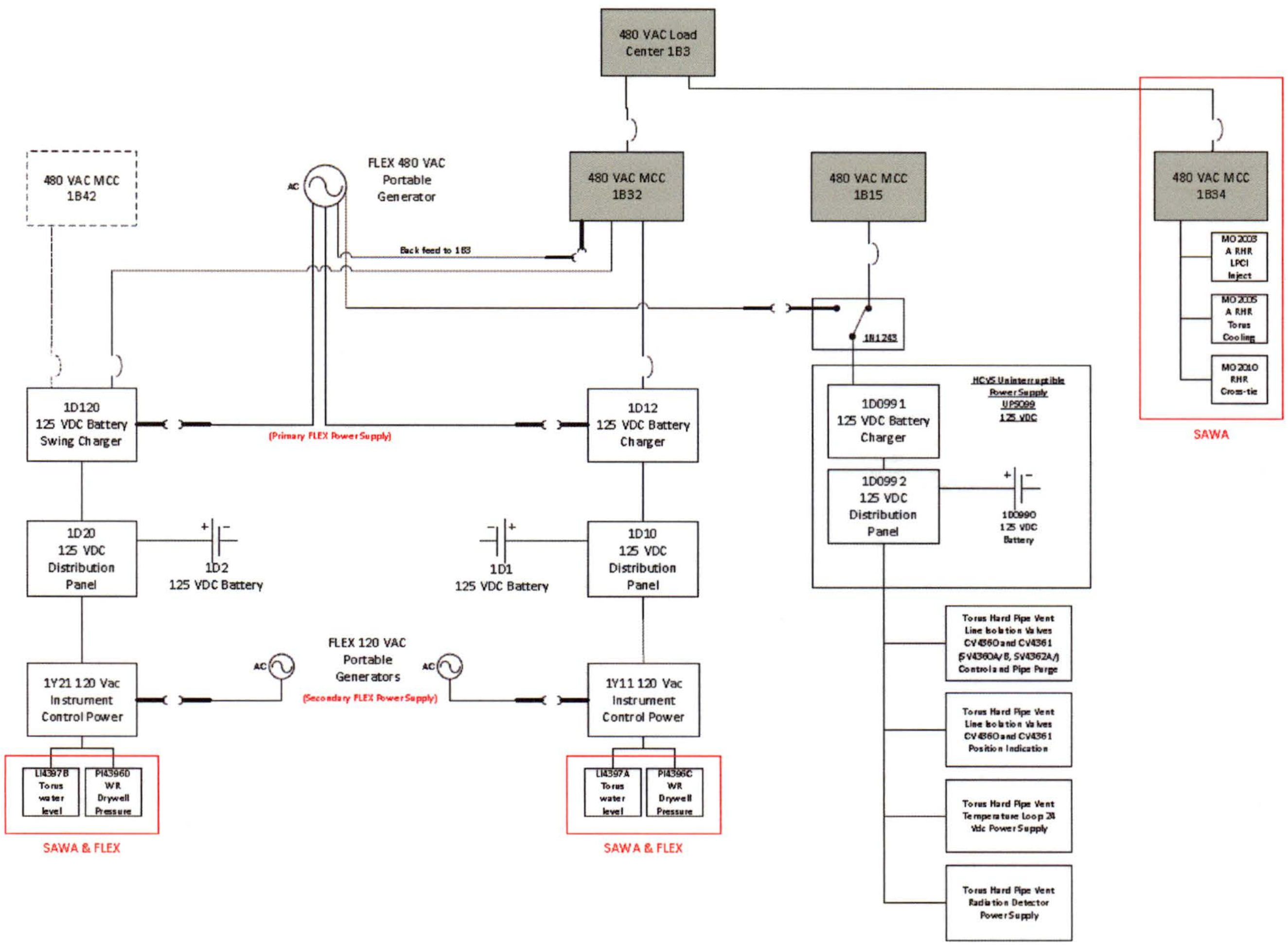
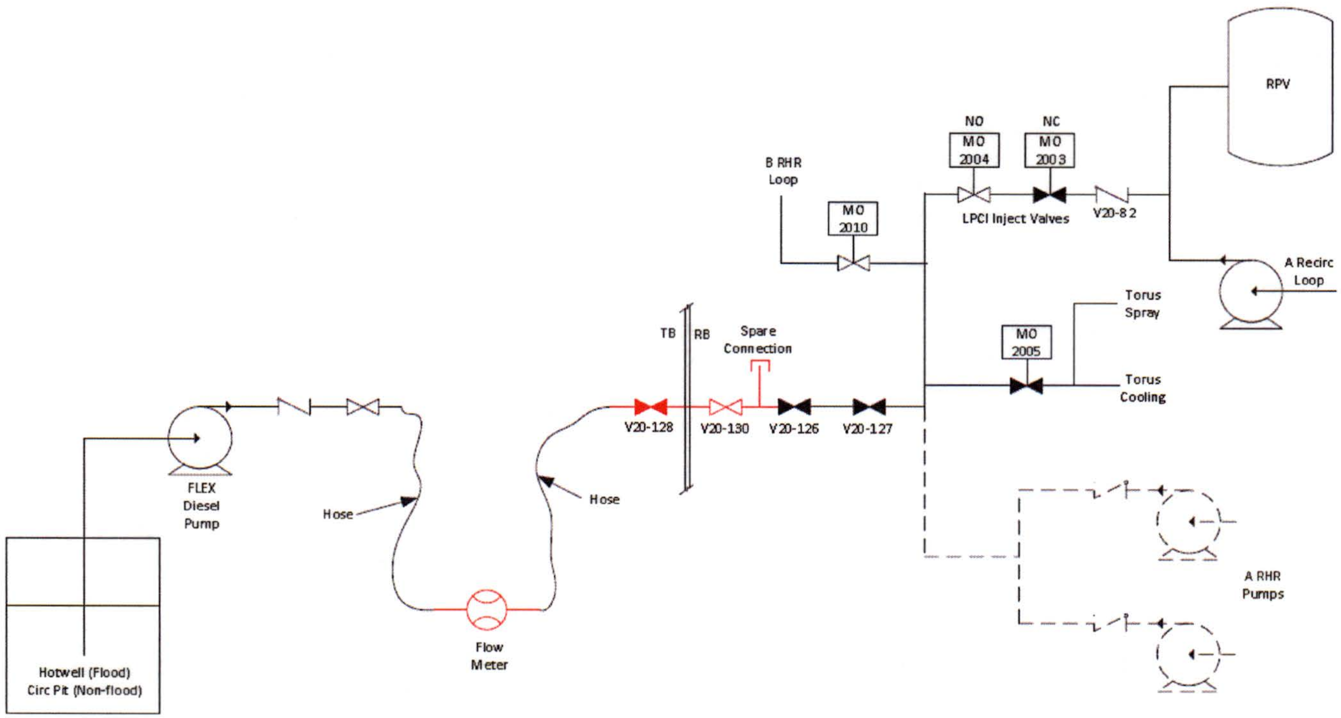
Attachment 3: One Line Diagram of HCVS Electrical Power Supply – DAEC Unit 1



Attachment 4: One Line Diagram of SAWA Flow Path

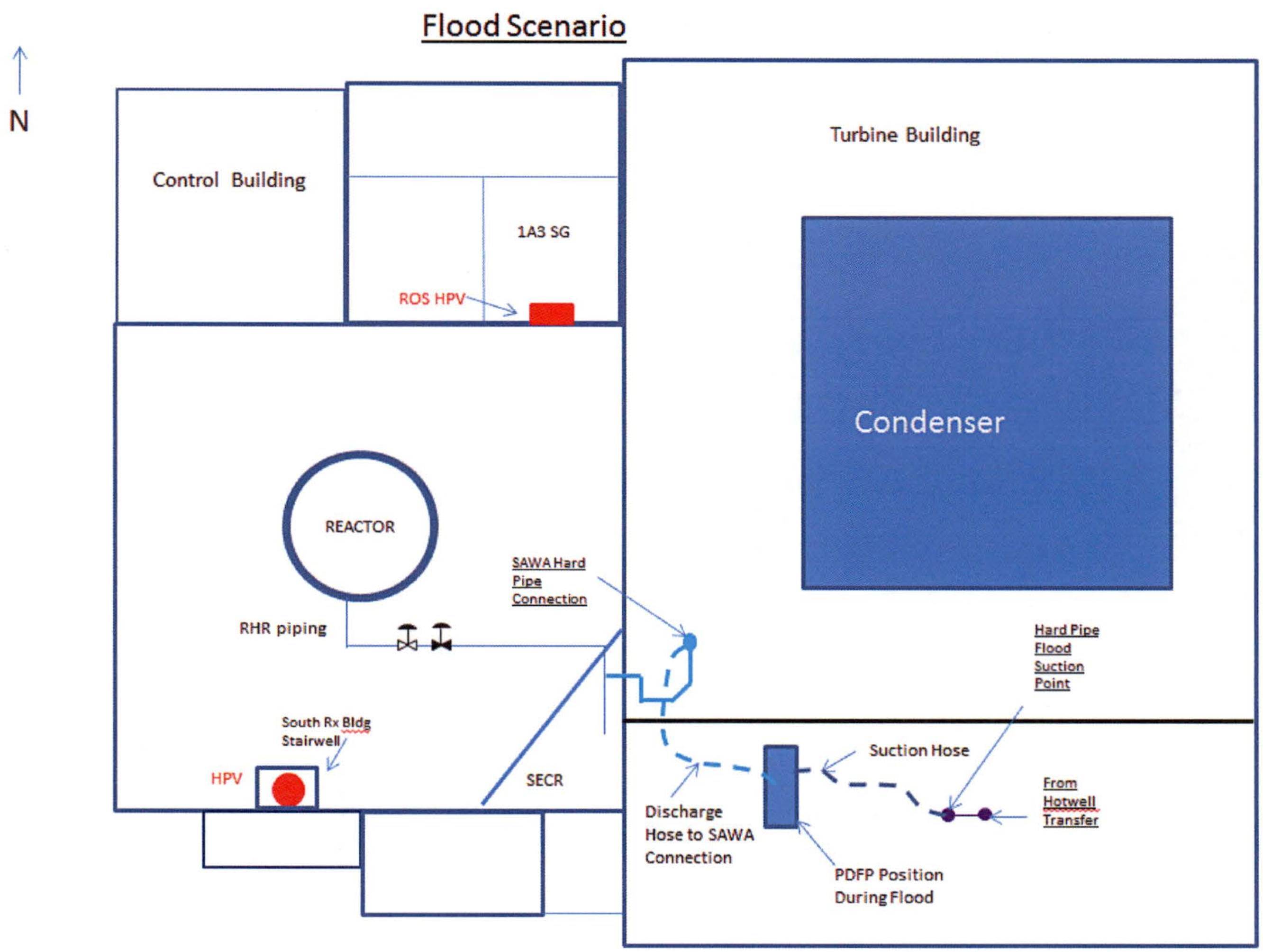


Attachment 5: One Line Diagram of SAWA Electrical Power Supply

Not required for DAEC

Attachment 6: Plant Layout Showing Operator Action Locations

Attachment 6A: Flood Condition



Attachment 6B: Non-Flood Scenario

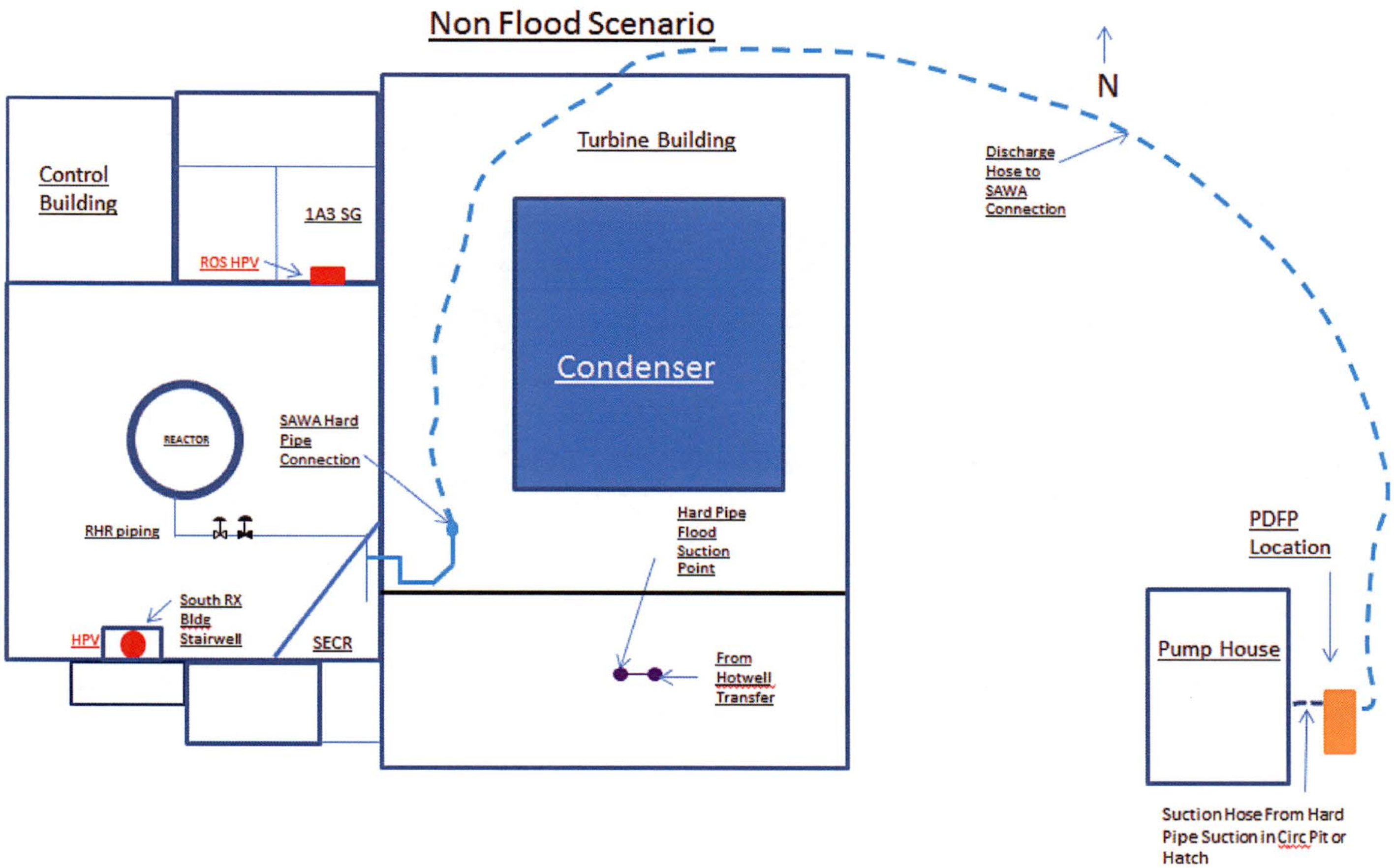


Table 1: List of HCVS Component, Control and Instrument Qualifications

Component Name	Equipment ID	Range	Location	Local Accident Temp	Local Accident Humidity	Local Radiation Level	Qualification[8]	Qualification Temp	Qualification Humidity	Qualification Radiation	Power Supply
Wetwell Vent Instruments and Components											
HCVS Position Indicating Switches	ZS4360 ZS4361	Open or Close	Torus Room	200°F	90%	2.6E6 Rads	IEEE 344-1975 IEEE 323-1974 IEEE 382-1972	340°F	100%	204E6 Rads	UPS099
HCVS Radiation Element	RE4362	N/A	RB Stairway 6, EL. 757'	120°F	90%	8.23E3 R/hr	IEEE-323-1974 IEEE-344-1975	160°F	100%	1E4 R/hr	UPS099
HCVS Radiation Monitor	RM4362	Up to 1E4 R/hr	MCR	122°F	50%	N/R (MCR)	IEEE-323-1974 IEEE-344-1975	131°F	90%	N/R (MCR)	UPS099
HCVS Temperature Element	TE4361	50-400°F	RB Stairway 6, EL. 790'	130°F	100%	2.6E6 Rads	IEEE-323-1974 IEEE-344-1975	900°F (process) 135° (ambient)	Not Listed	300E6 Rads	UPS099
HCVS Temperature Transmitter	TT4361	50-400°F	MCR	122°F	50%	N/R (MCR)	IEEE-344-2004	180°F	Acceptable (Industrial Grade)	N/R (MCR)	UPS099
HCVS Temperature Indication	TI4361	50-400°F	MCR	122°F	50%	N/R (MCR)	1EEE-344-2004	150°F	Acceptable (Industrial Grade)	N/R (MCR)	UPS099
125VDC Uninterruptible Power Supply	UPS099 1D0990 1D0991 1D0992	N/A	CB EL 757'	120°F	90%	N/R (CB)	IEEE-344-1975	122°F	95%	N/R (CB)	1B15 or FLEX DG
N2 Supply Pressure Indication	PI4360 PI4361 PI4362 PI4364	0-300 psig, 0-5000 psig	CB EL 757'	120°F	90%	N/R (CB)	Similarity to qualified instruments	150°F	Acceptable (Industrial Grade)	N/R (CB)	N/A
SAWA flow instrument and readout	N/A	1-1761 gpm	Portable	<140°F	100%	N/R (Shielded)	Commercial instrument robust per HCVS-OGP-011	-4 to 140°F	100%	N/R (Outside RB)	Internal Battery

[8] See UFSAR Chapters 7-2 and 3-10 for qualification code of record IEEE-323-1974 and IEEE-344-1971, 1975. Where later code years are referenced, this was reconciled in the design process.

Component Name	Equipment ID	Range	Location	Local Accident Temp	Local Accident Humidity	Local Radiation Level	Qualification[8]	Qualification Temp	Qualification Humidity	Qualification Radiation	Power Supply
Drywell Pressure Indication	PI4396C PI4396D	0-100 psig	MCR	122°F	50%	N/R (MCR)	RG 1.97 1B	RG 1.97 1B	RG 1.97 1B	N/R (MCR)	FLEX DG
Wetwell/Drywell Level Indication	LI4397A/B LI4396A/B***	1.5-16 feet 0-98 feet	MCR	122°F	50%	N/R (MCR)	RG 1.97 1C	RG 1.97 1C	RG 1.971C	N/R (MCR)	FLEX DG
Torus Pressure	PI4395A/B	0-100 psig	MCR	122°F	50%	N/R (MCR)	***	***	***	***	FLEX DG

* Denotes non-required item, added for site-specific design.
** Denotes Control Room where local radiation levels are not applicable. Building has no significant radiation sources.
*** This instrument is the same model as LI4397A/B (VX-252) and is qualified by comparison.

Table 2: Operator Actions Evaluation

Operator Action		Evaluation Time[9]	Validation Time	Location	Thermal conditions	Radiological Conditions	Evaluation
1	SAWA manual valve alignment in RB (3 valves)	0-1 hour	20 minutes	RHR Valve Room, SECR	Done in the first hour, so no concerns.	Done in the first hour, so no concerns.	Acceptable
2	MCC 1B34 Load Shed	0-1 hour	10 minutes	RB EL 786', South Side	Done in the first hour, so no concerns.	Done in the first hours, so no concerns.	Acceptable
3	Unlock and openV43-642, HCVS N_2 Supply	≤ 7 hours	15 minutes	CB, EL 757', 1A3 Switchgear Room	No concerns in CB	No concerns in CB	Acceptable
4	HCVS Valves switch actuation and instrument monitoring	≤ 7 hours	10 minutes	MCR	No concerns in MCR.	No concerns in MCR.	Acceptable
5	Backup HCVS valve operation (ROS)	≤ 7 hours	30 minutes	CB, EL 757', 1A3 Switchgear Room	No concerns in CB.	No concerns in CB.	Acceptable

[9] Evaluation timing is from NEI 13-02 to support radiological evaluations.

Operator Action		Evaluation Time[9]	Validation Time	Location	Thermal conditions	Radiological Conditions	Evaluation
6	SAWA pump staging and hoses	≤ 7 hours	5 hr 26 min	TB (Flood) East of RB, TB, and near Pump-House (Non-flood)	Outside, so ambient conditions. For flood, actions are performed prior to event, so no concerns.	Outside of RB, so no concerns.	Acceptable
7	SAWA pump operation and fueling	≤ 8 hours	< 7 hours	TB (Flood) East of RB, TB, and near Pump-House (Non-flood)	Outside or TB, so ambient or near ambient conditions.	Pumps and valves are located in shielded areas of plant.	Acceptable
8	FLEX Generator connection and alignment	≤ 7 hours	< 7 hours	FLEX Buildings, inside of TB, outside of TB	No heat source during this event, so no thermal concern.	Located inside/outside of TB and FLEX buildings are far from RB, shielded from RB.	Acceptable
9	FLEX Generator operation and refueling	≤ 8 hours	< 7 hours	FLEX Buildings, inside of TB, outside of TB.	No heat source during this event, so no thermal concern.	Located inside/outside of TB and FLEX buildings are far from RB, shielded from RB.	Acceptable