Exelon Generation.

RS-18-106

Order No. EA-13-109

November 14, 2018

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

Limerick Generating Station, Unit 2
Renewed Facility Operating License No. NPF-85
NRC Docket No. 50-353

Subject: Report of Full Compliance with Phase 1 and Phase 2 of June 6, 2013 Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109)

References:

1. NRC Order Number EA-13-109, "Issuance of Order to Modify Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions," dated June 6, 2013
2. Exelon Generation Company, LLC's Answer 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, 2013
3. NRC Interim Staff Guidance 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," Revision 0, dated April 2015
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
5. Limerick Generating Station, Units 1 and 2, Overall Integrated Plan in Response to June 6, 2013 Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109)," dated June 30, 2014
6. Exelon Generation Company, LLC, First Six-Month Status Report for Phase 1 Overall Integrated Plan in Response to June 6, 2013 Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109), dated December 17, 2014
7. Exelon Generation Company, LLC, Second Six-Month Status Report for Phase 1 Overall Integrated Plan in Response to June 6, 2013 Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109), dated June 30, 2015

8. Exelon Generation Company, LLC Phase 1 (Updated) and Phase 2 Overall Integrated Plan in Response to June 6, 2013 Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109), dated December 15, 2015 (RS-15-301)
9. Exelon Generation Company, LLC, Fourth Six-Month Status Report For Phases 1 and 2 Overall Integrated Plan in Response to June 6, 2013 Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109), dated June 30, 2016
10. Exelon Generation Company, LLC, Fifth Six-Month Status Report For Phases 1 and 2 Overall Integrated Plan in Response to June 6, 2013 Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109) dated December 15, 2016
11. Exelon Generation Company, LLC, Sixth Six-Month Status Report For Phases 1 and 2 Overall Integrated Plan in Response to June 6, 2013 Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109) dated June 30, 2017
12. Exelon Generation Company, LLC, Seventh Six-Month Status Report For Phases 1 and 2 Overall Integrated Plan in Response to June 6, 2013 Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109) dated December 15, 2017
13. Exelon Generation Company, LLC, Eighth Six-Month Status Report For Phases 1 and 2 Overall Integrated Plan in Response to June 6, 2013 Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109) dated June 29, 2018
14. NRC letter to Exelon Generation Company, LLC, Limerick Generating Station, Units 1 and 2 – Interim Staff Evaluation Relating to Overall Integrated Plan in Response to Phase 1 of Order EA-13-109 (Severe Accident Capable Hardened Vents) (TAC Nos. MF4418 and MF4419), dated April 1, 2015
15. NRC letter to Exelon Generation Company, LLC, Limerick Generating Station, Units 1 and 2 – Interim Staff Evaluation Relating to Overall Integrated Plan in Response to Phase 2 of Order EA-13-109 (Severe Accident Capable Hardened Vents) (TAC Nos. MF4418 and MF4419), dated August 2, 2016
16. NRC letter to Exelon Generation Company, LLC, Limerick Generating Station, Units 1 and 2 – Report for the Audit of Licensee Responses to Interim Staff Evaluations Open Items Related to NRC Order EA-13-109 to Modify Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions, dated May 29, 2018

On June 6, 2013, the Nuclear Regulatory Commission ("NRC" or "Commission") issued Order EA-13-109, "Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions," (Reference 1) to Exelon Generation Company, LLC (EGC). Reference 1 was immediately effective and directs EGC to require their BWRs with Mark I and Mark II containments to take certain actions to ensure that these facilities have a hardened containment vent system (HCVS) to remove decay heat from the containment, and maintain control of containment pressure within acceptable limits following events that result in 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). Specific requirements are outlined in Attachment 2 of Reference 1. Reference 2 provided EGC's initial answer to the Order.

Reference 3 provided the NRC interim staff guidance on methodologies for compliance with Phases 1 and 2 of Reference 1 and endorsed industry guidance document NEI 13-02, Revision 1 (Reference 4) with clarifications and exceptions. Reference 5 provided the Limerick Generating Station, Unit 2 Phase 1 Overall Integrated Plan (OIP), which was replaced with the Phase 1 (Updated) and Phase 2 OIP (Reference 8). References 14 and 15 provided the NRC review of the Phase 1 and Phase 2 OIP, respectively, in an Interim Staff Evaluation (ISE).

Reference 1 required submission of a status report at six-month intervals following submittal of the OIP. References 6, 7, 8, 9, 10, 11, 12, and 13 provided the first, second, third, fourth, fifth, sixth, seventh, and eighth six-month status reports, respectively, pursuant to Section IV, Condition D.3, of Reference 1 for Limerick Generating Station, Unit 2.

The purpose of this letter is to provide the report of full compliance with Phase 1 and Phase 2 of the 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) (Reference 1) pursuant to Section IV, Condition D.4 of the Order for Limerick Generating Station, Unit 2.

Limerick Generating Station, Unit 2 has designed and installed a venting system that provides venting capability from the wetwell during severe accident conditions in response to Phase 1 of NRC Order EA-13-109. Limerick Generating Station, Unit 2 has implemented a reliable containment venting strategy that makes it unlikely that the plant would need to vent from the containment drywell before alternative reliable containment heat removal and pressure control is reestablished in response to Phase 2 of NRC Order EA-13-109. The information provided herein documents full compliance for Limerick Generating Station, Unit 2 with NRC Order EA-13-109.

EGC's response to the NRC Interim Staff Evaluation (ISE) Phase 1 Open Items identified in Reference 14 have been addressed and closed as documented in Reference 13 and as described below, and are considered complete per Reference 16. The following table provides completion references for each OIP and ISE Phase 1 Open Item.

Reference 16 provides the results of the audit of ISE Open Item closure information provided in Reference 13. All Phase 1 and Phase 2 ISE Open Items are statused as closed as discussed in Reference 16.

There were no Phase 2 OIP Open Items.

Combined Phase 1 and Phase 2 OIP Open Items		Status
Phase 1 Open Items		
OI-1	*Determine how Motive Power and/or HCVS Battery Power will be disabled during normal operation.*	*Closed to ISE -1*
OI-2	*Confirm that the Remote Operating Station (ROS) will be in an accessible area following a Severe Accident (SA).*	*Closed to ISE-3*
OI-3	*Determine wetwell line size to meet 1% venting criteria.*	*Closed to ISE- 4*
OI-4	*Confirm suppression pool heat capacity.*	*Closed to ISE-4*
OI-5	*Determine the approach for combustible gases.*	*Closed to ISE-9 and ISE-10*
OI-6	*Provide procedures for HCVS Operation.*	*Closed to ISE-13*
OI-7	*Verify the external piping consists solely of large bore piping and its supports have less than 300 square feet of cross section.*	*Complete. (Reference EC 423331, Attachment 8 (formally known as ECR 16-00011)). EC 423331 is available in ePortal.*
OI-8	*Evaluate drywell pressure indication for environmental qualifications to ensure this instrument can survive for 7 days after an event.*	*Complete.* *EC 423381 is available in ePortal.*
OI-9	*Determine Performance Criteria for Motive gas Cylinders, Argon Cylinders, FLEX Diesel Generator, and FLEX (SAWA) pump pressure at 500 gpm.*	*Complete.* *The performance criteria for the Motive gas Cylinders and the Argon Cylinder has been defined and the system will meet the requirements of the order. (Reference EC 423333 sections 3.5 and 3.33. EC 423333 is available in ePortal.)* *See ISEP2-6 for FLEX SAWA response.*
OI-10	*Perform radiological evaluation for Phase 1 vent line impact on ERO response actions.*	*Complete.* *The peak dose rates and 7-day integrated doses at operating stations, equipment locations, and along transit pathways required for sustained operation of the HCVS have been calculated. The peak dose rates along potential operator transit pathways external to the Reactor Building are bounded by the peak dose rate outside the FLEX storage building. (Reference*

Combined Phase 1 and Phase 2 OIP Open Items		**Status**
	Phase 1 Open Items	
		Calculation LM-0721). Calculation LM-0721 is available in ePortal.

Phase 1 Interim Staff Evaluation Open Items		**Status**
ISE-1	*Make available for NRC staff audit documentation of a method to disable HCVS during normal operation to provide assurances against inadvertent operation that also minimizes actions to enable HCVS operation following an ELAP.*	*Complete.* *The system is designed to prevent inadvertent operation. The new control switch HS-057V-283 installed in the MCR panel 20-C689 is a key-lock switch. The switch is kept locked in "OFF" position (with key removed) to prevent inadvertent powering of the HCVS components from 125 Vdc HCVS battery source. Additionally, locked valves are used with the gas bottles to prevent inadvertent operation. (Reference EC 423333 section 3.19). EC 423333 is available in ePortal.*
ISE-2	*Make available for NRC staff audit the final sizing evaluation for HCVS batteries/battery charger including incorporation into FLEX DG loading calculation.*	*Complete.* *The HCVS batteries have been sized to meet the requirements of the HCVS system and function for the initial 24 hours into the event. (Reference Calculation LE-0128).* *The FLEX diesel generator loading is acceptable and rated loading of the FLEX diesel generator will not be exceeded due to the additional HCVS loading. (Reference EC 423333 section 3.35). LE-0128 and EC 423333 are available in ePortal.*
ISE-3	*Make available for NRC staff audit an evaluation of temperature and radiological conditions to ensure that operating personnel can safely access and operate controls and support equipment.*	*Complete.* *The primary operating station for HCVS operation is located in the Main Control Room. A remote operating station*

Phase 1 Interim Staff Evaluation Open Items		Status
		(ROS) is located in the EDG Corridor, EL. 217' (Room 317). The ROS location and travel path to ROS location were evaluated for habitability and accessibility during a severe accident. (Reference EC 423281 section 3.19). EC 423281 is available in ePortal. See Note 1 on page 15 of this Order response for ROS temperature discussion.
ISE-4	*Make available for NRC staff audit analyses demonstrating that HCVS has the capacity to vent the steam/energy equivalent of one percent of licensed/rated thermal power (unless a lower value is justified), and that the suppression pool and the HCVS together are able to absorb and reject decay heat, such that following a reactor shutdown from full power containment pressure is restored and then maintained below the primary containment design pressure and the primary containment pressure limit.*	*Complete.* *The required one percent capacity at the lower of Primary Containment Pressure Limit or containment design pressure is verified using Reactor Excursion and Leak Analysis Program (RELAP). In addition, Modular Accident Analysis Program (MAAP) analyses are credited to verify that venting can be delayed for at least three hours and that anticipatory venting can be credited to maintain Reactor Core Isolation Cooling (RCIC) functional.* *(Reference EC 423281 section 3.33 and LM-709).* *EC 423281 and LM-709 are available in ePortal.*
ISE-5	*Make available for NRC staff audit the seismic and tornado missile final design criteria for the HCVS stack.*	*Complete.* *(Reference EC 423331 section 3.2, 3.5, 3.9, and 3.38 (formally known as 16-00011) and EC 423332 section 3.38 (formally known as 16-00012), and EC 422831 section 3.24 (formally known as 13-264)) describe seismic and tornado missile design criteria for HCVS stack. EC pkgs 423331, 423332, and 422831 are available in ePortal for review.*

Phase 1 Interim Staff Evaluation Open Items		Status
ISE-6	*Make available for NRC staff audit the descriptions of local conditions (temperature, radiation and humidity) anticipated during ELAP and severe accident for the components (valves, instrumentation, sensors, transmitters, indicators, electronics, control devices, etc.) required for HCVS venting including confirmation that the components are capable of performing their functions during ELAP and severe accident conditions.*	*Complete.* *HCVS is designed to minimize the impact of elevated temperatures, due to the potential loss of ventilation, radiation and humidity impact on the ability of operators to initiate and maintain the functionality of the HCVS. The locations of system equipment that require operator action and the travel paths to reach the controls and indications are in mild environments. (Reference EC 423281 section 3.19 and 3.24). EC 423281 is available in ePortal for review. The loss of all general area lighting, coincident with the ELAP, does not pose a threat to the operators' ability to access and operate HCVS, since self-contained emergency lights illuminate the travel paths and handheld or portable lighting is available to manipulate HCVS equipment.*
ISE-7	*Make available for NRC staff audit documentation of the HCVS nitrogen pneumatic system design including sizing and location.*	*Complete.* *HCVS is designed to operate for first 24 hours with installed independent pneumatic air supply, thereby eliminating the reliance on portable equipment. HCVS is also designed for multiple venting and purge cycles during the first 24-hour period without the need to recharge pneumatic air supplies. The pneumatic air supply is located in the emergency diesel corridor.* *(Reference EC 423333 section 3.19 and Calculation LM-*

Phase 1 Interim Staff Evaluation Open Items		Status
		0723). EC 423333 and Calculation LM-0723 are available in ePortal for review.
ISE-8	*Make available for NRC staff audit documentation that demonstrates adequate communication between the remote HCVS operation locations and HCVS decision makers during ELAP and severe accident conditions.*	*Complete.* *This communication method is the same as accepted in Order EA-12-049. These items will be powered and remain powered using the same methods as evaluated under EA-12-049 for the period of sustained operation, which may be longer than identified for EA-12-049.* *Communication will be via the plant radio system if available. If the radio system is not available, the Plant page system can be used. The page system was modified for FLEX to include a UPS that can be manually aligned to repower the system. (Reference AR 2492527-42). AR 2492527-42 is available in ePortal for review.*
ISE-9	*Provide a description of the final design of the HCVS to address hydrogen detonation and deflagration.*	*Complete.* *HCVS has been designed to ensure the flammability limits of gases passing through the system are not reached. A purge gas (argon) supply system has been provided to displace potentially flammable/ detonable mixtures of gases that may be present in the vent after system actuation. The purge gas supply system is designed for four purge cycles during the first 24-hour period without the need to recharge. (Reference EC 423333 section 3.19) EC 423333 is available in ePortal for review.*

Phase 1 Interim Staff Evaluation Open Items		Status
ISE-10	*Provide a description of the strategies for hydrogen control that minimizes the potential for hydrogen gas migration and ingress into the reactor building or other buildings.*	*Complete.* *As discussed in the December 2015 OIP, the Limerick wetwell vent line for each unit has a dedicated HCVS flowpath from the wetwell penetration to the outside with no interconnected system. The discharge point meets the guidance of "HCVS Release Point", HCVS-FAQ-04 (Reference 11).* *(Reference EC 423281 and Calculation LM-0709).* *EC 423281 and Calculation LM-0709 are available in ePortal for review.*
ISE-11	*Make available for NRC staff audit documentation of a seismic qualification evaluation of HCVS components.*	*Complete.* *Seismic documentation has been provided in Reference EC 423331 section 3.4 and 3.38, EC 423333 section 3.4, 3.38, and attachment 45. EC 423331 and EC 423333 are available in ePortal for review.*
ISE-12	*Make available for NRC staff audit descriptions of all instrumentation and controls (existing and planned) necessary to implement this order including qualification methods.*	*Complete.* *EC 423333 installed and qualified the following components in the MCR and in the plant:* *valve position indicating lights, power key-locked switch, temperature indicator displays, radiation monitoring system consisting of an element local to the HCVS vent pipe, and a monitor.* *(Reference EC 423333 section 3.19 and 3.36)* *Existing pressure instrument PI-042-270-1 will be used to monitor containment pressure in the drywell. See EC 617568 section 3.2 for qualification of the component.* *EC 423333 and EC 617568*

Phase 1 Interim Staff Evaluation Open Items		Status
		are available in ePortal for review.
ISE-13	*Make available for NRC staff audit the procedures for HCVS operation.*	*Complete.* *Reference the following procedures.* *SAMP-1: RPV Control* *SAMP-2: Containment and Radioactivity Release Control* *T-101: RPV Control* *T-102: Primary Containment Control SP/T, SP/L, PC/P, DW/T, PC/H* *T-341: Primary Containment Venting Via Hardened Containment Vent System.* *These procedures are in ePortal for review.*

EGC's response to the NRC ISE Phase 2 Open Items identified in Reference 15 have been addressed and closed as documented in Reference 13 and as described below, and are considered complete per Reference 16. The following table provides completion references for each ISE Phase 2 Open Item.

Phase 2 Interim Staff Evaluation Open Items		Status
ISEP2-1	*Licensee to demonstrate that the HCVS components meeting reasonable protection from tornado missiles is at least 30 feet above the highest grade within 300 yards.*	*Complete.* *Per Drawing HBD-842-01, HCVS pipe leaves the protected structure more than 120 feet above grade elevation, which is 217 feet MSL, as indicated on site topographical drawing C-0062 that shows grade elevation referenced to MSL within 300 yards of the HCVS components evaluated.*
ISEP2-2	*Licensee to confirm through analysis the temperature and radiological conditions to ensure that operating personnel can safely access and operate controls and support equipment.*	*Complete.* *Actions taken within the first hour (prior to start of core damage) from the start of the ELAP are acceptable from an environmental and radiological perspective without further evaluation.*

Phase 2 Interim Staff Evaluation Open Items		Status
		Actions within the MCR are acceptable for the entire period of Sustained Operation per HCVS-FAQ-01. *Actions within the Reactor Building and between 1 and 7 hours, evaluation of expected temperatures and dose rates has been performed and determined them to be acceptable. (Reference EC 622673, and calculations LM-0721 and LM-0725).* *For locations outside the Reactor Building between 7 hours and 7 days, Limerick performed evaluations for the temperature and radiological conditions for the equipment and deployment locations, including ingress/egress paths and determined them to be acceptable. (Reference EC 622673, and calculations LM-0721 and LM-0725). EC 622673, LM-0721 and LM-0725 are available in ePortal for review.*
ISEP2-3	*Licensee to evaluate the SAWA equipment and controls, as well as the ingress and egress paths for the expected severe accident conditions (temperature, humidity, radiation) for the sustained operating period.*	*Complete.* *Equipment and Controls:* *Plant instrumentation for SAWA/SAWM that is qualified to RG 1.97 or equivalent is considered qualified for the sustained operating period without further evaluation.* *Passive components that do not need to change state after initially establishing SAWA flow do not require evaluation beyond the first 8 hours, at*

Phase 2 Interim Staff Evaluation Open Items		Status
		which time they are expected to be installed and ready for use to support SAWA/SAWM. *The following additional equipment performing an active SAWA/SAWM function is considered:* *SAWA/SAWM flow instrument* *SAWA/SAWM/FLEX pump* *SAWA/SAWM/FLEX generator* *Active valves in SAWA flow path.* *Ingress and Egress:* *For locations outside the Reactor Building between 7 hours and 7 days when SAWA is being utilized, Limerick performed evaluations of expected temperatures, humidity and the dose rates and determined them to be acceptable. (Reference EC 622673, and calculations LM-0721 and LM-0725).* *EC 622673, LM-0721 and LM-0725 are available in ePortal for review.*
ISEP2-4	*Licensee to demonstrate that containment failure as a result of overpressure can be prevented without a drywell vent during severe accident conditions.*	*Complete.* *The wetwell vent has been designed and installed to meet NEI 13-02 Rev 1 guidance, which will ensure that it is adequately sized to prevent containment overpressure under severe accident conditions.* *The SAWM strategy will ensure that the wetwell vent remains functional for the period of sustained operation. LGS will follow the guidance (flow rate and timing) for*

<table>
<tr><th colspan="2">Phase 2 Interim Staff Evaluation Open Items</th><th>Status</th></tr>
<tr><td></td><td></td><td>SAWA/SAWM described in BWROG-TP-15-008 and BWROG-TP-15-011.These documents have been posted to the ePortal for NRC staff review. The wetwell vent will be opened prior to exceeding the PCPL value of 60 PSIG. Therefore, containment over pressurization is prevented without the need for a drywell vent.</td></tr>
<tr><td>ISEP2-5</td><td>Licensee shall demonstrate how the plant is bounded by the reference plant analysis that shows the SAWM strategy is successful in making it unlikely that a drywell vent is needed.</td><td>Complete.
Using Figure 2.1.C from the combined Phases 1 and 2 OIP, compare the reference plant parameters to the plant specific parameters.
<table><tr><th>Reference Plant</th><th>LGS</th></tr><tr><td>Torus freeboard volume is 525,000 gallons</td><td>Suppression Pool freeboard volume is 147,670 ft3 (1,104,572 gallons)</td></tr><tr><td>SAWA flow is 500 GPM at 8 hours followed by 100 GPM from 12 hours to 168 hours</td><td>SAWA flow is 500 GPM at 8 hours followed by 100 GPM from 12 hours to 168 hours</td></tr></table>The above parameters for LGS compared to the reference plant that determine success of the SAWM strategy demonstrate that the reference plant values are bounding. Therefore, the SAWM strategy implemented at LGS makes it unlikely that a DW vent is needed to prevent containment</td></tr>
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<table>
<tr><th colspan="2">Phase 2 Interim Staff Evaluation Open Items</th><th>Status</th></tr>
<tr><td></td><td></td><td>overpressure related failure.</td></tr>
<tr><td>ISEP2-6</td><td>Licensee to demonstrate that there is adequate communication between the MCR and the operator at the FLEX pump during severe accident conditions.</td><td>Complete.
This communication method is the same as accepted in Order EA-12-049. These items will be powered and remain powered using the same methods as evaluated under EA-12-049 for the period of sustained operation, which may be longer than identified for EA-12-049.
Communication will be via the plant radio system if available. If the radio system is not available, the Plant page system can be used. The page system was modified for FLEX to include a UPS that can be manually aligned to repower the system. (Reference AR 2492527-42)</td></tr>
<tr><td>ISEP2-7</td><td>Licensee to demonstrate the SAWM flow instrumentation qualification for the expected environmental conditions</td><td>Complete.
For locations outside the Reactor Building between 7 hours and 7 days when SAWA is being utilized, Limerick Generating Station performed evaluation of expected temperatures, humidity and the dose rates and determined them to be acceptable. (Reference EC 622673).
<table><tr><th>SAWA Pump Flow Instrument Qualification</th><th>Expected SAWA Parameter Range</th></tr><tr><td>37 to 1246 GPM</td><td>100 to 500 GPM</td></tr><tr><td>32 to 140 °F fluid temperature
14 to 122 °F Instrument Electronics[2]</td><td>32 to 95 °F fluid temperature
0 to 100 °F Ambient air temperature</td></tr></table></td></tr>
</table>

Phase 2 Interim Staff Evaluation Open Items		Status
		275 PSI maximum | *239.7 PSI maximum* [2] *Below 14 °F, the LCD may become sluggish or unresponsive; however, it will continue to measure and function to at least -4 °F. (Reference MS2500-DataSheet).* *MS2500-DataSheet and EC 622673 are available in ePortal for review.*

Note 1:
For the location of the ROS in the DG corridor, there is a maximum expected temperature of 121 °F. This temperature is expected to occur due to a non-safety related heating steam pipe rupturing during a seismic event. To mitigate this issue, the heating steam pipe was analyzed and additional supports have been installed to ensure the piping will not rupture (EC 423333). There are no additional process fluid piping or heat generating equipment that would add significant heat to this area. Therefore, the area will then be at outside ambient conditions which does not normally exceed 100 °F.

The performance validation for T-341 to align the HCVS for operation determined the longest duration of 16 minutes in the EDG corridor would be required to align the system. Activation of the system included opening the argon and air bottles and repositioning a three-way valve. This would be the longest duration of any operator at the ROS during the event. If required, operating personnel working in high temperature areas will be protected using SA-AA-111, Heat Stress Control. With the use of SA-AA-111 heat stress controls, it is reasonable to assume the operator actions required to implement the HCVS and SAWA/SAWM strategies can be accomplished. SA-AA-111 and the validation study are available in ePortal.

MILESTONE SCHEDULE – ITEMS COMPLETE

Limerick Generating Station, Unit 2 - Phases 1 and 2 Specific Milestone Schedule

Milestone	Completion Date
Submit Overall Integrated Plan	June 2014
Submit 6 Month Updates	
Update 1	December 2014
Update 2	June 2015

Milestone	Completion Date
Update 3 [Simultaneous with Phase 2 OIP]	December 2015
Update 4	June 2016
Update 5	December 2016
Update 6	June 2017
Update 7	December 2017
Update 8	June 2018
Phase 1 Modifications	
Hold preliminary/conceptual design meeting	June 2014
Unit 2 Modifications Evaluation	March 2017
Unit 2 Design Engineering On-site/Complete	May 2017
Unit 2 Implementation Outage	May 2017
Unit 2 Walk Through Demonstration/Functional Test	May 2017
Phase 1 Procedure Changes Active	
Unit 2 Operations Procedure Changes Developed	February 2017
Unit 2 Site Specific Maintenance Procedure Developed	February 2017
Unit 2 Procedure Changes Active	May 2017
Phase 1 Training	
Unit 2 Training Complete	February 2017
Phase 1 Completion	
Unit 2 HCVS Implementation	May 2017
Phase 2 Modifications	
Hold preliminary/conceptual design meeting	June 2016
Modifications Evaluation	March 2018
Unit 2 Design Engineering On-site/Complete	March 2018
Unit 2 Implementation Outage	N/A
Unit 2 Walk Through Demonstration/Functional Test	September 2018
Phase 2 Procedure Changes Active	
Unit 2 Operations Procedure Changes Developed	September 2018
Unit 2 Site Specific Maintenance Procedure Developed	September 2018
Unit 2 Procedure Changes Active	September 2018

Milestone	Completion Date
Phase 2 Training	
Unit 2 Training Complete	September 2018
Phase 2 Completion	
Unit 2 HCVS Implementation	September 28, 2018
Submit Unit 2, Phase 1 & Phase 2, Completion Report [60 days after Unit 2 compliance]	November 2018 Completed with this submitial

ORDER EA-13-109 COMPLIANCE ELEMENTS SUMMARY

The elements identified below for Limerick Generating Station, Unit 2, Phase 1 and Phase 2 OIP response submittal (References 5 and 8), and the 6-Month Status Reports (References 6, 7, 8, 9, 10, 11, 12, and 13), demonstrate compliance with NRC Order EA-13-109. The Limerick Generating Station, Units 1 and 2 Final Integrated Plan for reliable hardened containment vent Phase 1 and Phase 2 strategies is provided in the enclosure to this letter.

HCVS PHASE 1 AND PHASE 2 FUNCTIONAL REQUIREMENTS AND DESIGN FEATURES – COMPLETE

The Limerick Generating Station, Unit 2, Phase 1 HCVS provides a vent path from the wetwell to remove decay heat, vent the containment atmosphere, and control containment pressure within acceptable limits. The Phase 1 HCVS will function for those accident conditions for which containment venting is relied upon to reduce the probability of containment failure, including accident sequences that result in the loss of active containment heat removal capability during an extended loss of alternating current power.

The Limerick Generating Station, Unit 2, Phase 2 HCVS provides a reliable containment venting strategy that makes it unlikely that the plant would need to vent from the containment drywell before alternative reliable containment heat removal and pressure control is reestablished. The Limerick Generating Station, Unit 2, Phase 2 HCVS strategies implement Severe Accident Water Addition (SAWA) with Severe Accident Water Management (SAWM) as an alternative venting strategy. This strategy consists of the use of the Phase 1 wetwell vent and SAWA hardware to implement a water management strategy that will preserve the wetwell vent path until alternate reliable containment heat removal can be established.

The Limerick Generating Station, Unit 2, Phase 1 and Phase 2 HCVS strategies are in compliance with Order EA-13-109. The modifications required to support the HCVS strategies for Limerick Generating Station, Unit 2 have been fully implemented in accordance with the station processes.

HCVS PHASE 1 AND PHASE 2 QUALITY STANDARDS – COMPLETE

The design and operational considerations of the Phase 1 and Phase 2 HCVS installed at Limerick Generating Station, Unit 2 complies with the requirements specified in the Order and described in NEI 13-02, Revision 1, "Industry Guidance for Compliance with Order EA-13-109". The Phase 1 and Phase 2 HCVS has been installed in accordance with the station design control process.

The Phase 1 and Phase 2 HCVS components including piping, piping supports, containment isolation valves, containment isolation valve actuators and containment isolation valve position indication have been designed consistent with the design basis of the plant. All other Phase 1 and Phase 2 HCVS components including electrical power supply, valve actuator pneumatic supply and instrumentation have been designed for reliable and rugged performance that is capable of ensuring Phase 1 and Phase 2 HCVS functionality following a seismic event.

HCVS PHASE 1 AND PHASE 2 PROGRAMMATIC FEATURES - COMPLETE

Storage of portable equipment for Limerick Generating Station, Unit 2 Phase 1 and Phase 2 HCVS use provides adequate protection from applicable site hazards. Procedurally identified paths and deployment areas will be accessible during all modes of operation and during severe accidents, as recommended in NEI 13-02, Revision 1, Section 6.1.2.

Training in the use of the Phase 1 and Phase 2 HCVS for Limerick Generating Station, Unit 2 has been completed in accordance with an accepted training process as recommended in NEI 13-02, Revision 1, Section 6.1.3.

Operating procedures for Limerick Generating Station, Unit 2 have been developed and integrated with existing procedures to ensure safe operation of the Phase 1 and Phase 2 HCVS. Procedures have been verified and are available for use in accordance with the site procedure control program. Maintenance procedures for Limerick Generating Station, Unit 2 have been developed or have open tracking mechanisms created so that the procedures will be issued prior to being required. Limerick Generating Station, Unit 2 has implemented operation, testing, and inspection requirements for the HCVS and SAWA that follows the existing plant procedures and process to ensure reliable operation of the systems. The existing plant maintenance program will be applied to the HCVS and SAWA valves, instead of the maintenance frequency that has been listed in NEI 13-02, Section 6.2.4. The maintenance program uses PCM (Performance Centered Maintenance) template which is currently used to maintain the plant's safety related and non-safety related systems.

Site processes have been established to ensure the Phase 1 and Phase 2 HCVS is tested and maintained as recommended in NEI 13-02, Revision 1, Sections 5.4 and 6.2.

Limerick Generating Station, Unit 2 has completed validation in accordance with industry developed guidance to assure required tasks, manual actions and decisions for HCVS strategies are feasible and may be executed within the constraints identified in the HCVS Phases 1 and 2 OIP for Order EA-13-109 (Reference 8).

Limerick Generating Station, Unit 2 has completed evaluations to confirm accessibility, habitability, staffing sufficiency, and communication capability in accordance with NEI 13-02, Revision 1, Sections 4.2.2 and 4.2.3.

This letter contains no new regulatory commitments. If you have any questions regarding this report, please contact David J. Distel at 610-765-5517.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 14th day of November 2018.

Respectfully submitted,

D. P. Helker

David P. Helker
Manager - Licensing & Regulatory Affairs
Exelon Generation Company, LLC

Enclosure: Limerick Generating Station, Units 1 and 2 Final Integrated Plan Document – Hardened Containment Vent System NRC Order EA-13-109

cc: Director, Office of Nuclear Reactor Regulation
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NRC Senior Resident Inspector – Limerick Generating Station
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Enclosure

Limerick Generating Station, Units 1 and 2

Final Integrated Plan Document – Hardened Containment Vent System
NRC Order EA-13-109

(64 pages)

Final Integrated Plan

HCVS Order EA-13-109

for

Limerick Generating Station (LGS)

November 14, 2018

Table of Contents

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).

Limerick Generating Station (LGS) 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. LGS achieved Phase 1 compliance on April 15, 2018.
- Phase 2 provided additional protections for severe accident conditions through the development of a reliable containment venting strategy that makes it unlikely that LGS would need to vent from the containment drywell during severe accident conditions. LGS achieved Phase 2 compliance on September 28, 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, LGS 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 Interim Staff Guidance (ISG) 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, LGS 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 LGS 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 23 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 LGS 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 or within the Phase 1 and 2 Compliance Letter for the first compliance of LGS (References 30).

Section III contains the LGS 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 suppression pool 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 LGS are seismic, external flooding (Storage and Transportation of Equipment during a Local Intense Precipitation), Severe Storms with High Winds, Tornados, Snow, Ice, Extreme Cold and High Temperature. Initial operator actions are completed by plant personnel and include the capability for remote-manual initiation from the HCVS ROS. 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 suppression pool 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 Emergency Response Organization (ERO) dose or plant safety guidelines for temperature and humidity.

The SAWA flow path is the same as the primary FLEX flow path. The SAWA flow path starts from the spray pond into the FLEX pump. The SAWA flow passes through the discharge hose, into the RHRSW piping near the RHRSW pumps. From there the flow goes into the Reactor Enclosure (RE). The flow bypasses RHR heat exchangers via RHR valves HV-051-1F073/2F073 and HV-051-1F075/2F075 to the RPV through RHR Low Pressure Core Injection valve (LPCI) valve HV-051-1F017B/2F017A. DW pressure and suppression pool level are monitored and the flow rate is adjusted by varying pump speed or by other means described in the station procedures (Reference 37). Communication is established between the MCR and the FLEX pump location. Attachment 4 contains a one-line diagram of the SAWA flowpath.

There are no additional electrical loads on the FLEX DG due to SAWA/SAWM. The FLEX DGs are located south of the RE and are a significant distance from the discharge of the HCVS piping on the south side on the REs. See Attachment 6 for applicable locations. Refueling of the FLEX DG is accomplished from the Emergency Diesel Generator (EDG) underground fuel oil tanks as described in the procedure T-360 (Reference 60).

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(s). The battery chargers are also powered from the FLEX generator(s) to maintain the battery capacities during the sustained operating period.

Section II: List of Acronyms

AC	Alternating Current
AOV	Air Operated Valve
BDBEE	Beyond Design Basis External Event
BWROG	Boiling Water Reactor Owners' Group
CAC	Containment Atmospheric Control System
CAP	Containment Accident Pressure
DC	Direct Current
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
FPSB	FLEX Pump Storage Building
GPM	Gallons per minute
HCVS	Hardened Containment Vent System
ISE	Interim Staff Evaluation
ISG	Interim Staff Guidance
JLD	Japan Lessons Learned Project Directorate

LPCI	Low Pressure Coolant Injection
LGS	Limerick Generating Station
MAAP	Modular Accident Analysis Program
MCR	Main Control Room
NEI	Nuclear Energy Institute
NPSH	Net Positive Suction Head
NRC	Nuclear Regulatory Commission
OIP	Overall Integrated Plan
PCIV	Primary Containment Isolation Valve
PCPL	Primary Containment Pressure Limit
RCIC	Reactor Core Isolation Cooling System
RE	Reactor Enclosure
RHR	Residual Heat Removal System
RHRSW	Residual Heat Removal Service Water System
RM	Radiation Monitor
ROS	Remote Operating Station
RPV	Reactor Pressure Vessel
RWCU	Reactor Water Cleanup
SA	Severe Accident
SAMP	Severe Accident Management Procedure
SAWA	Severe Accident Water Addition
SAWM	Severe Accident Water Management
SFP	Spent Fuel Pool

SRV	Safety-Relief Valve
UFSAR	Updated Final Safety Analysis Report
VAC	Voltage AC
VDC	Voltage DC
WW	Wetwell

Section III: Phase 1 Final Integrated Plan Details

Section III.A: HCVS Phase 1 Compliance Overview

LGS installed a hardened suppression pool vent path to comply with NRC Order EA-13-109.

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

LGS has a Mark II primary containment design and was not required to comply with NRC Generic Letter 89-16.

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

LGS installed a suppression pool vent flow path in each unit that has two dedicated primary containment isolation valves and a downstream rupture disc that is routed separate from the other unit. The discharge from each unit is routed separately through a pipe that discharges above the Reactor Enclosure's roof. Each unit has dedicated motive gas bottles for HCVS valves, Argon Purge system, and DC power for HCVS components that are not shared with any other system or function. The HCVS operation does not rely on FLEX for the first 24 hours of operations. The existing containment instrumentation (pressure and suppression pool level) are not considered HCVS components, and power for containment instrumentation is through the FLEX Diesel Generator (DG) provided through the actions for EA-12-049. Also, the FLEX DG will be credited for recharging the HCVS battery after the initial 24 hours after the event.

The operation of the HCVS has been designed to minimize the reliance on operator actions in response to hazards. Initial operator actions will be completed by trained plant personnel and will include the capability for remote-manual initiation from the HCVS ROS.

The vent system is normally operated and monitored from the MCR. A ROS has been installed in a readily accessible location and provides a means to manually operate the suppression pool vent. The controls available at the ROS are accessible and functional under a range of plant conditions, including severe accident conditions. The ROS location is in the diesel generator corridor 217' elevation, accessible from outside the Reactor Enclosure. Table 2 contains the evaluation of the acceptability of the ROS location with respect to severe accident conditions.

The HCVS does not contain any new electrical circuitry for bypassing isolation signals. The ROS can open the Primary Containment Isolation Valves (PCIV's) directly with compressed air so that no electrical signal overrides are needed.

The MCR 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 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.

At the MCR location, the operators can operate the HCVS power control, PCIVs switches, monitor HCVS PCIV position, vent pipe temperature, argon pressure, argon purge control switch, and the HCVS radiation monitor.

The ROS consists of manual valves that directly port air to the PCIV actuators and argon purge system. The ROS has local pressure indication available for the pneumatics air supply and argon supply, but no other indication is available. Table 1 contains a complete list of instruments available to the operators for operating and monitoring the HCVS.

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

The suppression pool vent up to, and including, the second containment isolation barrier is designed consistent with the design basis of the plant. These items include piping, piping supports, containment isolation valves, containment isolation valve actuators and containment isolation valve position indication components.

NEI 13-02 suggests a 350°F value for HCVS design temperature based on the highest Primary Containment Pressure Limit (PCPL) among the Mark I and II plants. Unit 1 HCVS piping follows the guidance from NEI 13-02 for all the components and valves.

Unit 2 HCVS has been designed to a PCPL of 60 psig and a minimum corresponding saturation temperature of 308°F. Per NEI 13-02, it is acceptable to assume saturation conditions in containment so that these design parameters are acceptable.

To prevent leakage of vented effluent to other parts of the Reactor Enclosure or other systems, Unit 1 HCVS does not share a containment penetration with any other system. Therefore, leakage of vented effluent to other parts of the Unit 1 Reactor Enclosure or other systems is not a concern.

To prevent leakage of vented effluent to other parts of the Reactor Enclosure or other systems for Unit 2, the Containment Atmospheric Control (CAC) HV-057-224 and HV-057-231 valves are required to be closed. These valves are normally closed, HV-057-224 fails closed, and neither are required to change state in order to perform their safety related containment isolation function; therefore, they can be assumed to be closed when required. The Unit 2 CAC valves are part of the In-Service Testing (IST) program and are leak tested in accordance with 10CFR50, Appendix J. This is acceptable for prevention of inadvertent cross-flow of vented fluids per HCVS-FAQ-05.

HCVS features to prevent inadvertent actuation include a key lock switch at the primary control station and locked closed valves at the ROS which is an acceptable method of preventing inadvertent actuation per NEI 13-02. In addition, the argon and pneumatic bottles are normally isolated from the main header at the ROS.

As required by EA-13-109, Section 1.2.11, the suppression pool vent is designed to prevent air/oxygen backflow into the discharge piping to ensure the flammability limits of hydrogen, and other non-condensable gases, are not reached. The LGS design includes a purge system that injects inert gas (Argon) into the vent piping (Reference 43). Guidance for this design is contained in HCVS-WP-03. The relevant design calculations conclude that the purge system will preclude a flammable mixture from occurring in the vent pipe.

The HCVS Radiation Monitor (RM) 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 LGS 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.

<u>Evaluation:</u>

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 33), 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. Open argon and pneumatic air supply valves	EDG corridor ROS	
2. Turn on power to the HCVS system	Key switch in MCR	
3. Open Hardened Suppression Pool Vent Valve HV-057V-181/281 and HV-057V-180/280	Hand-switch located in the MCR or via manual valves located at the ROS.	
4. Replenish pneumatics and Argon bottle supply	Pneumatics and Argon bottle supply have been located in FLEX Pump Storage Building that accessible to operators during a severe accident.	Action required to supplement the pneumatics and Argon backup system after a minimum of 24 hours.
5. Re-power the HCVS battery chargers for sustained operations (post-24 hours).	FLEX diesels are located in an area that meets the requirements of EA-12-049 and is accessible to operators during a severe accident.	Action required to provide power to HCVS equipment after a minimum of 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.

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 pneumatics and Argon bottle supply 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. Additional argon and pneumatics bottle supply has been stored in the FLEX pump storage building to replenish the HCVS after 24 hours.

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 below provides a list of functional failure modes and the corresponding mitigating actions.

Table 3-2: Failure Evaluation

Functional Failure Mode	Failure Cause	Alternate Action	Failure with Alternate Action Prevents Containment Venting?
Fail to Vent (Open) on Demand	Valves fail to open/close due to loss of normal plant AC power/DC batteries.	None required – HCVS utilize a dedicated 24-hour battery power supply.	No
	Valves fail to open/close due to depletion of dedicated battery power supply.	Recharge system with FLEX diesel generators.	No
	Valves fail to open/close due to complete loss of dedicated battery power supply.	Manually operate backup pneumatic supply/vent lines/valves at ROS.	No
	Valves fail to open/close due to loss of normal plant pneumatic supply.	No action needed. Valves are provided with dedicated pneumatic supply capable of 24-hour operation.	No
	Valve fails to open/close due to component failure (solenoid valve, key switch, ect.) failure.	Manually operate backup pneumatic supply/vent lines/valves at ROS.	No

Functional Failure Mode	Failure Cause	Alternate Action	Failure with Alternate Action Prevents Containment Venting?
Fail to stop venting (Close) on demand	Not credible as there is not a common mode failure that would prevent the closure of at least 1 of the 2 - PCIVs needed for venting. Both PCIVs are designed to fail close.	N/A	No
Spurious Opening	Not credible as key-locked switches prevent mispositioning of the HCVS PCIVs. Additionally, DC power for the HCVS is de-energized during normal plant operation.	N/A	No
Spurious Closure	Valves fail to remain open due to depletion of dedicated power supply.	Recharge the dedicated power supply with FLEX diesel generators.	No
	Valves fail to remain open due to complete loss of power supplies.	Manually operate backup pneumatic supply/vent lines/valves at ROS.	No
	Valves fail to remain open due to loss of pneumatic supply.	Replace pneumatic supply as needed.	No

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.

<u>Evaluation:</u>

Primary control of the HCVS is accomplished from the main control room. Alternate control of the HCVS is accomplished from the ROS at the EDG corridor outside of RE. FLEX actions that will maintain the MCR habitable were implemented in response to NRC Order EA-12-049 (Reference 34).

The ROS has been evaluated to be acceptable during the event and no action is required to keep ROS habitable. These include opening MCR doors to the Turbine Enclosure and operating portable generators and fans to move air through the MCR (if required). (Refence 58) The ROS was evaluated, and no additional actions are required.

Table 2 contains a thermal evaluation of all the operator actions that may be required to support HCVS operation. The relevant evaluation (Reference 31) demonstrate that the final design meets the order requirements to minimize the plant operators' exposure to occupational hazards.

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. (Reference 7)

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 outside of the RE. The distance and concrete RE walls combined with the short duration of actions required at the ROS, show the ROS to be an acceptable location for alternate control.

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, 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 (Reference 7).

Alternate control of the HCVS is accomplished from the ROS in the EDG Corridor. The ROS EDG corridor is in an area evaluated to be accessible before and during a severe accident.

For ELAP with injection, the HCVS suppression pool 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 the engineering change that installed the HCVS at LGS.

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 evaluation (Reference 31) demonstrates 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.

Evaluation

Calculation LM-709 (Reference 45) contains the verification of 1% power flow capacity at design pressure for Unit 1 and 2. This calculation models all the piping, elbows, valves and components using either specific or industry standard flow coefficients to determine an equivalent length of piping. All of the 10" (Unit 1 only), 12" and 14" piping sections are modeled. The model is input into RELAP5 code which is an industry standard program for modeling compressible flow in piping. At 1% reactor thermal power, the required vent capacity is 147,783 lbm/hour. Calculation

LM-709 verifies that the piping can pass greater than 1% flow. Additional assumptions and modeling details are contained in Calculation LM-709.

The decay heat absorbing capacity of the suppression pool and the selection of venting pressure were made such that the HCVS will have sufficient capacity to maintain containment pressure at or below the lower of the containment design pressure PCPL. This calculation of containment response is contained in calculation LM-0709 that was submitted in Reference 28 and shows that containment is maintained below the design pressure once the vent is opened, even if it is not opened until PCPL is reached.

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

Evaluation

The HCVS vent pipe release point to the outside atmosphere is at an elevation that is higher than the adjacent power block structures. The 14" diameter HCVS vent pipe runs vertically outside of the RE above the South Stack and extends approximately 4 feet above the roof of the South Stack Instrument Room (El. 426'). The release point is on the south side of the RE. Since the effluent release velocity of the vent exceeds 8000 fpm (Reference 45), then it is assured that the effluent plume will not be entrained into the recirculation zone of the RE and CE, or LGS Units 1 and 2 ventilation systems, and open doors used for natural circulation in the BDBEE/severe accident response. The routing of the vent pipe and the location of the release point has been established to minimize the radiological impact on plant operators and off-site help arriving at the plant. The HCVS vent pipe design meets the standard for a risk-informed approach to evaluate the threat posed to exposed portions of the HCVS vent pipe by wind-borne missiles, as provided in HCVS-WP-04. The HCVS vent pipe design meets the criteria set forth in HCVS-WP-04:

a. The exposed portion of vent pipe is greater than 30 feet above grade. (Reference 47 and 50)
b. The target area of that portion of pipe not housed in a missile protected structure is less than 300 ft^2. (Reference 50)
c. The vent pipe is substantial and robust.
d. There is no source of obvious potential missiles in the proximity.

Based on the above description of the vent pipe design, the LGS 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.

Evaluation

The HCVS for Units 1 & 2 are fully independent of each other. Therefore, the status at each unit is independent of the status of the other unit.

The HCVS design has effectively eliminated the cross flow of fluids and gases, from the HCVS into other systems or buildings. The HCVS vent pipe has been designed with two PCIVs, in series, in compliance with GDC-56. The valves are located outside of primary containment, as close to the suppression pool air space attached piping as practical and are normally held closed by their actuator spring. Furthermore, to prevent inadvertent opening, the PCIVs are isolated from their motive force supply by locked closed manual valves and require manual operation of a key-lock control switch at the primary operating station in the MCR to provide 125 Vdc control power to HCVS components including PCIVs. The PCIVs and vent pipe have been designed and procured as fully qualified components for their use in the HCVS. HCVS for any LGS Unit is free of physical and control interfaces with the opposite LGS Unit plant system. The vent pipe, adjacent to the PCIVs, has been designed with test connections to facilitate periodic Appendix J testing of the PCIVs, in compliance with GDC-54. (Reference 47, 46, 49, 51, and 59)

The existing PCIVs on the Containment Atmospheric Control (CAC) piping which the Unit 2 HCVS ties into are already exposed to design basis and beyond design basis conditions even without the installation of the new HCVS piping and PCIVs. Therefore, no new system boundaries are created.

Based on the above description, the LGS 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

HCVS design allows for remote manual operation of the system. HCVS can be aligned by opening pneumatic and purge manual isolation valves at the ROS. (Reference 47 and 50)

Attachment 6 shows the location of ROS and MCR. Table 2 contains a list and evaluation of the HCVS required actions. These evaluations demonstrate that the design meets the requirement to be manually operated from a readily accessible location during sustained operation.

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, the ROS has been located in the Diesel Corridor. The pneumatic supply valves are in a readily accessible at the ROS. The ROS contains manually operated valves that supply pneumatics to the HCVS flow path valve actuators so that these valves may be opened without power to the valve actuator solenoids and regardless of any containment isolation signals that may be actuated. This provides a diverse method of valve operation, improving system reliability.

The location for the ROS is in the respective units Diesel Generator Corridor south of the REs. The ROS is located outside of the RE and removed from the outside portion of the HCVS vent pipe by more than 100 ft and concrete walls. 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 RE 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.

HCVS design consists of a fully dedicated and permanently installed system of components that are capable of operating for a minimum of 24 hours. When required to be in operation, HCVS operates independent of any other plant system. The system is designed for multiple vent and purge cycles during the first 24-hour period without the need to recharge pneumatic and electrical power supplies. Additional gas bottles are readily available for installation to support sustained operation beyond the first 24 hours. HCVS controls and indications have been designed to meet the requirement for monitoring system status to support sustained operations during an Extended Loss of AC Power (ELAP). The MCR is provided with a primary operating station, equipped with manually operated control switches for system operation, valve position indicating lights, and indicators that will display purge pneumatic supply pressure, HCVS vent temperature, and HCVS vent radiation. Local gauges and indicators at the ROS provide indication of purge pneumatic supply and discharge pressure, valve motive force pneumatic supply and discharge pressure. The battery charger located at the ROS provides voltage indication for the dedicated HCVS batteries. Controls and indications are powered by a bank of dedicated batteries that can provide power for a minimum of 24 hours. Primary back up power, to support sustained operation, is provided by the FLEX diesel generator. (Reference 46 to 51 and Reference 59)

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

Evaluation

HCVS design precludes inadvertent actuation of the system the system through passive design features. The HCVS vent pipe has been designed with two PCIVs, in series, in compliance with GDC-56. The PCIVs are operated independent of other components, thereby precluding inadvertent actuation by a single component failure or misalignment. Each PCIV isolates the vent line through its normally held closed actuator spring. A rupture disk is installed downstream of the PCIVs. Furthermore, to prevent inadvertent opening, the PCIVs are isolated from their motive pneumatic supply by locked closed manual valves. Similarly, purge gas supply is isolated from the vent line by locked closed manual valve and a locked closed manual valve to bypass the primary operating station. Additionally, the control panel in the MCR has a key locked power switch, which controls power for the HCVS system and prevents power to the PCIV and argon purge valves. Since there are no interfacing systems downstream of the PCIVs, no inadvertent venting cross flow can occur. Additionally, for Unit 2, the existing CAC PCIVs are fail closed. (Reference 46 to 51 and Reference 59)

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.

Evaluation

HCVS controls and indications have been designed to meet the requirement for monitoring system status to support sustained operations during an ELAP. The MCR is provided with a primary operating station, equipped with manually operated control switches for system operation, valve position indicating lights, and indicators that will display purge pneumatic supply pressure, HCVS vent temperature, and HCVS vent radiation. Local gauges and indicators at the ROS provide indication of purge pneumatic supply and discharge pressure, valve motive force pneumatic supply and discharge pressure. The battery charger located at the ROS provides voltage indication for the dedicated HCVS batteries. Controls and indications are powered by a bank of dedicated batteries that can provide power for a minimum of 24 hours. Primary back up power, to support sustained operation during an ELAP, is provided by the FLEX diesel generator. This power source will provide power to the system, as well as, an installed HCVS battery charger, to re-charge the batteries. This ensures power to PCIV controls and indication for the period of sustained operation. The controls and indication are and have been designed for the environmental and radiological effects of BDB/severe accident conditions. (Reference 46 to 51 and Reference 59)

The HCVS instruments, including valve position indication, vent pipe temperature, radiation monitoring, and support system monitoring, are indicated in 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.) All the components listed in Table 1 have been seismically qualified for their installed location.

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 element local to the HCVS vent pipe, and a monitor located in the MCR on panel. This system is used to monitor vent pipe radiation as a gross instrumentation means to verify venting. The RM element is fully qualified for the expected environment at the vent pipe during accident conditions, and the monitor is qualified for the mild environment in the MCR. Both components are qualified for the seismic requirements. Table 1 includes a description and qualification information on the radiation monitor. (Reference 48 and 50)

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.

HCVS has been designed to fulfill its design function and withstand the effects of BDBEE/severe accident conditions. The HCVS piping and components have been selected based on their ability to withstand the pressure, temperature and radiation expected. The vent line and components subjected to venting pressure have been designed to a pressure equal to the PCPL. The piping and associated components have been designed to withstand the dynamic loading resulting from the actuation of the system during multiple venting cycles. A purge gas (argon) supply system has been provided to displace potentially flammable/denotable mixtures of gases that may be present in the vent after system actuation. (Reference 46 to 51 and Reference 59)

HCVS provides sufficient venting capacity to prevent a long-term overpressure failure of the containment by keeping the containment pressure below the containment design pressure. HCVS has the capacity to vent the steam/energy equivalent of 1 percent of licensed/rated thermal power. (Reference 45) The HCVS piping and components have been selected based on their ability to withstand the pressure and temperature expected during a BDB/severe accident.

HCVS equipment required for operation of the vent system has been located in areas of the plant where impact from environmental conditions will be minimal. The equipment that comprises the system is selected to withstand the environmental conditions to which they will be subjected and their ability to withstand the pressure and temperature expected during a severe accident. HCVS components are protected from the effects of tornado winds.

HCVS is designed consistent with the design basis of the plant up to the second containment isolation barrier. All suppression pool air space attached piping has been analyzed for seismic loading using the Primary Containment Structure seismic spectra from Specification G-019 and including applicable hydrodynamic load cases for containment attached piping to the first structural anchor. The remaining HCVS piping was evaluated using the Adjacent Structure (Reactor Enclosure) for seismic spectra. All of the new HCVS components, solely dedicated to HCVS operation, including pneumatic supplies, batteries, and control panels, are designed to the seismic design requirements of LGS and are evaluated as Seismic I systems. The MCR, where the primary operating station is located, is classified as a Seismic Category I area. The ROS is located in the Seismic Category I EDG Corridor.

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

HCVS has been designed to ensure the flammability limits of gases passing through the system are not reached. The vent piping is routed with a continuously upward slope. A purge gas (argon) supply system has been provided to displace potentially flammable/denotable mixtures of gases that may be present in the vent after system actuation. The purge gas supply system is designed for four purge cycles during the first 24-hour period without the need to recharge. The argon purge system is utilized to provide the pressure needed to burst the rupture disc, which has been considered as part of the volume of argon gas. Therefore, considerations of dynamic loading, resulting from hydrogen deflagration and detonation on the vent piping is not required.

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.

The HCVS design has effectively eliminated the cross flow of fluids and gases, from the HCVS into other systems or buildings. The HCVS has been designed with two PCIVs, in series, which are located outside of primary containment, as close to the suppression pool air space attached piping as practical. The vent pipe, adjacent to the PCIVs, has been designed with branch connections to facilitate periodic Appendix J testing of the PCIVs, ensuring leakage of flammable gases remain very low. The vent pipe has also been designed with a branch connection to facilitate the introduction of an inert gas purge. HCVS is designed for multiple venting and purge cycles during the first 24-hour period. Purging the vent line following each venting cycle will eliminate the combustible gases and render the line free of any detonable gas mixture. As a result, oxygen infiltration resulting from steam collapse is not a concern. The portion of the line between the PCIVs is steam inerted, such that any combustible gas is below the flammability limit. (Reference 60 and 56)

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 RE 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.

LGS implemented operation, testing, and inspection requirements for the HCVS and SAWA that follows the existing plant procedures and process to ensure reliable operation of the systems. The existing plant maintenance program is applied to the HCVS and SAWA valves, instead of the maintenance frequency that has been listed in NEI 13-02, Section 6.2.4. The maintenance program uses PCM (Performance Centered

Maintenance) templates, which are used to develop preventive maintenance tasks to maintain the plant's components.

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 components are selected to ensure system reliability and functionality, through the quality of design and materials. The HCVS vent path up to and including the second containment isolation barrier is designed and procured as suitable for the BDBEE/severe accident environmental and process conditions, and HCVS mission time. The components incorporated in this portion of the system design are designed to the seismic design requirements of the plant and are evaluated as a Seismic I system. All suppression pool air space attached piping, which includes a segment of the HCVS piping downstream of the second containment isolation barrier, is designed as ASME Section III, Class 2 piping. This is consistent with the existing design basis of the plant. Electrical power to HCVS components is supplied from a dedicated battery and does not impact existing Class 1E station battery system. The HCVS battery charger is supplied electrical power from an existing Class 1E MCC and will be shunt tripped on a LOCA signal. There is a minimal impact on Class 1E MCC loading during normal operating mode of the plant. All documentation and analyses supporting the quality of system design is maintained in the site document control system. (Reference 46 to 51 and Reference 59)

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 were selected to ensure system reliability and functionality, through the quality of design and materials. All HCVS components are designed and procured as suitable for the BDBEE/severe accident environmental and process conditions, and HCVS mission time. The HCVS vent path up to and including the second containment isolation valve are designed consistent with the design basis of the current containment isolation systems. All other HCVS components have been procured and designed for reliable and rugged performance. All of the new HCVS components, solely dedicated to HCVS operation, including pneumatic supplies, batteries, and control panels, are procured with augmented requirements, designed to the seismic design requirements of the plant and are evaluated as a Seismic Category I system. Vent piping beyond the second containment isolation valve (the outboard PCIV) is designed to ANSI/ASME B31.1 and Seismic Category I criteria. The application of ANSI/ASME B31.1 is consistent with the site design basis and the code of record. (Reference 46 to 51 and Reference 59)

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 suppression pool 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 suppression pool 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.

LGS 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 LGS 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.

LGS 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 suppression pool vent is not submerged (SAWM). Procedures have been issued to implement this strategy. 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 flow path is the same as the FLEX primary injection path. 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 suppression pool level indication to ensure that the suppression pool vent is not submerged (SAWM). The SAWA injection path, starts at the Spray Pond, goes to the FLEX pump via suction hoses, goes through the FLEX pump to a flexible discharge hose, then to the RHRSW piping near RHRSW pumps. From there the flow is going into the RE. In the RE the flow bypassing RHR heat exchangers via RHR valves to the RPV through RHR Low Pressure Coolant Injection valve (LPCI) valve (Reference 37). The hoses and pumps are stored in the FLEX Pump Storage Building (FPSB) which is protected from all hazards. BWROG generic assessment, BWROG-TP-15-008, provides the principles of Severe Accident Water Addition to ensure protection of containment. This SAWA injection path is qualified for the all the screened in hazards (Section III) in addition to severe accident conditions.

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

The actions inside the RE where there could be a high radiation field due to a severe accident will be to manipulate valves, perform load shedding and other activities in various locations. The FLEX (SAWA) pump deployment time is the same as the deployment time for FLEX. The action inside the RE can be performed before the dose is unacceptable, under the worst-case scenario within the first seven hours into the event. Procedures T-300 and T-301 direct accomplishment of actions without delay that must be done early in the severe accident event where there is a loss of all AC power and a loss of all high-pressure injection to the core. In this event, core damage is not expected for at least one hour and vessel breach for another six hours (assumed at T=7 hours after the ELAP) so that there will be no excessive radiation levels or heat related concerns in the RE when the actions are performed (Reference 56 and 39). The other SAWA actions beyond 7 hours all take place outside the RE at the MCR, Spray Pond, FLEX Generators, FPSB, and the deployment pathways. Since these locations are outside the RE, they are shielded from the severe accident radiation by the thick concrete walls of the RE. 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 suppression pool level with SAWA at the minimum flow rate indicates water on the drywell floor up to the downcommer pipes. 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 overfill the suppression pool to the point where the suppression pool vent is submerged.

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

LGS 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.

Section IV.C.4: Available Freeboard Use

The freeboard between 23 feet normal level and 39 feet bottom of the suppression pool vent pipe in the suppression pool provides approximately 1,104,572 gallons of water volume before the water level reaches the bottom of the vent pipe (Reference 13). BWROG generic assessment BWROG-TP-15-011 (Reference 42), provides the principles of Severe Accident Water Management to preserve the suppression pool 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 suppression pool level is stable or very slowly rising. As shown in calculation LG-MISC-018 (Reference 41), the suppression pool level will not reach the suppression pool vent for at least seven days. A diagram of the available freeboard is shown on Attachment 1.

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

The upper range of suppression pool level indication provided for SAWA/SAWM is 39 feet water elevation. This defines the upper limit of suppression pool volume that will preserve the suppression pool vent function as shown in Attachment 1.

Section IV.C.6: Wetwell vent service time

The LG-MISC-018 demonstrate that throttling SAWA flow after containment parameters have stabilized, in conjunction with venting containment through the suppression pool vent will result in a stable or slowly rising suppression pool level. The LG-MISC-018 demonstrate that for the scenario analyzed, suppression pool level will remain below the suppression pool 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 LGS 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 LGS SAMPs. In particular, EPG/SAG Revision 3, have been implemented with Emergency Procedures Committee Generic Issue 1314, allows throttling of SAWA in order to protect containment while maintaining the suppression pool vent in service. The SAMP 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, LGS has validated that the SAWA pump can be deployed and commence injection in less than 8 hours. The SAWA pump deployment location is the same as the FLEX deployment location. 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 500 gpm. 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 suppression pool level.

LG-MISC-018 demonstrated that, SAWA flow could be reduced to 100 gpm after four hours of initial SAWA flow rate and containment would be protected. At some point suppression pool 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 SAMPs are symptom-based guidelines.

Section IV.C.8: SAWA Flow Control

LGS will accomplish SAWA flow control by the use of throttle valves and variation of pump speed. A flow meter mounted on the SAWA pumps allows monitoring of injection flow. The operators at the SAWA pump will be in communication with the MCR via the plant radio system or runners and the exact time to throttle flow is not critical since there is a large margin between normal suppression pool level and the level at which the suppression pool 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. (Reference 29)

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

Section IV.C.9.1: SAWA Pump

LGS uses one portable diesel-driven pump per unit for FLEX and SAWA. All pumps are capable of delivering greater than 500 gpm at the pressures required for RPV injection during an ELAP. Each of these pumps has been shown to be capable of supplying the required flow rate to the RPV and the SFP for FLEX and for SAWA scenarios. (Reference 54) The pumps are stored in the FPSB where they are protected from 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

LGS SAWA flow is 500 gpm which is the amount assumed in NEI 13-02 Section 4.1.1.2.1. The initial SAWA flow will be injecting to the RPV within 8 hours of the loss of injection. The reference power level is 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.

Section IV.C.9.3: SAWA Pump Hydraulic Analysis

Calculation LM-0706 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 rate required to protect containment.

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

The LGS SAWA flow path goes through a series of check valves. One on the FLEX pump and in the rest are in the RHR system. The RHR backflow prevention valve is also 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 this valve per NEI 13-02 Revision 1 Table 6-1 Note 3. Thus, backflow is prevented by check valves in the SAWA flow path inside the RE.

Section IV.C.9.5: SAWA Water Source

The source of water for SAWA is the spray pond which can provide water injection without makeup based on the FLEX analysis. 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 for injection to protect containment during the period of sustained operation (Reference 58).

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

Section IV.C.9.6.1: SAWA Pump Power Source

The SAWA/FLEX pumps are stored in the FPSB where they are protected from all screened-in hazards. The SAWA pumps are commercial pumps rated for long-term outdoor use in emergency scenarios. The pumps are diesel-driven by an engine mounted on the 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 following procedures from a protected fuel source, 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/FLEX instruments. For the instruments powered by the HCVS 125VDC battery, calculation LE-0128 (Reference 56) demonstrates that the batteries can provide power for 24 hours until the FLEX generator restores power to the battery charger.

The FLEX load on the FLEX DG per EA-12-049 was evaluated (Reference 48 and 49). This EC computation demonstrated there is approximately 329A at 480Vac of margin to full load. There are no additional loads on the FLEX DG due to SAWA. Therefore, the existing evaluation of the HCVS added the FLEX DG is bounding for SAWA.

Section IV.C.10: SAWA/SAWM Instrumentation

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 and its power supply for sustained operation.

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

The drywell pressure and suppression pool level instruments, used to monitor the condition of containment, are qualified for post-accident use. These instruments are referenced in Severe Accident Guidelines for control of SAWA flow to maintain the suppression pool vent in service while maintaining containment protection. These instruments are powered by station batteries and will be re-powered by FLEX generator systems for the sustained operating period. These instruments are on buses included in the FLEX generator loading calculations for EA-12-049 (Reference 57). Note that other instrument indications may be available depending on the exact scenario.

The SAWA flow meter is an electromagnetic flow meter mounted in the piping on the pumps skid and powered by the pump's electrical system.

No containment temperature instrumentation is required for compliance with HCVS Phase 2. However, most FLEX electrical strategies repower other containment instruments. The drywell temperature is directly read from a portable thermocouple reader. These instruments provide information for the operations staff to evaluate plant conditions under a severe accident and to provide confirmation for adjusting SAWA flow rates. SAMP 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 evaluation of each instrument listed in Table 1 was performed in EC 622673 (Reference 31) that demonstrated qualification of each instrument for the expected accident environmental and radiological conditions.

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

LGS FLEX strategies will restore the containment instruments, containment pressure and suppression pool 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

The thermal and radiological accident conditions do not impact the personnel and equipment. The radiological accident conditions would not a affect personnel access to the MCR, travel paths, HCVS ROS or FLEX/SAWA pump operation location. The components or operators performing necessary actions for the SAWA/SAWM strategy are capable of completing the operator actions during the severe accident condition. The thermal and radiological evaluation of impacts on the installed or portable equipment and instrumentation credited for SAWA/SAWM and credited operator action is listed in Table 1 and Table 2 of this FIP. (Reference 31)

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

Since the SAWA pump is stored in the FPSB and will be operated from outside the RE, on the opposite side of the RE from the vent pipe, 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. The hoses used to move water from the spray pond through the pump into the RHRSW in the spray pond pump house are also stored in the FPSB and will be deployed on the opposite side of the RE from the vent pipe. The hoses are qualified for the temperatures expected in the outside areas they will be run.

Inside the RE the SAWA flow path consists of RHR and RHRSW system piping. The RHR and RHRSW system piping is steel which will remain unaffected by the radiation or elevated temperatures inside the RE. 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.9.3, that section provides severe accident effects.

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

Section IV.C.2 describes the RE 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.

Since, in the severe accident, the core materials are contained inside the primary containment, the temperature response of the RE and CB is driven by the loss of ventilation during the ELAP and ambient conditions and are acceptable for severe accident use within the first 7 hours. 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 flow path is aligned inside the RE, the operators can control SAWA/SAWM as well as observe the necessary instruments from outside the RE. The thick concrete RE walls as well as the distance to the core materials mean that there is no radiological concern with any actions outside the RE. Therefore, all SAWA controls and indications are accessible during severe accident conditions.

The SAWA pump and monitoring equipment can all be operated locally at the pump from outside the RE at ground level. The LGS 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 pump, and suppression pool level and containment pressure in the MCR.

Section V: HCVS Programmatic Requirements

Section V.A: 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.

Evaluation:

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

The HCVS and SAWA procedures have been developed and implemented following LGS 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

LGS has implemented the BWROG Emergency Procedures Committee Issue 1314 that implements the Severe Accident Water Management (SAWM) strategy in the Severe Accident Management Guidelines (SAMPs). The following general cautions, priorities and methods have been evaluated for plant specific applicability and incorporated as appropriate into the plant specific SAMPs using administrative procedures for EPG/SAG change control process and implementation. SAMPs 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 SAMPs 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.

Cautions

- 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 RPB breach, SAMPs 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 (Suppression pool venting).
- Water addition is managed to preserve the Mark 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 of the HCVS and compensatory measures have been added to the site FLEX program document, CC-LG-118 (Reference 32) so that it is with the FLEX out-of-service program.

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 up for 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, any non-trained personnel on-site will be available to supplement trained personnel.

Section V.D: Demonstration with other Post Fukushima Measures

LGS 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: 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). LGS will perform the first drill demonstrating at least one of the above capabilities by April 2022 which is within four years of the first unit compliance with Phase 2 of Order EA-13-109, or consistent with the next FLEX strategy drill or exercise. 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 LGS in subsequent eight-year intervals.

Section VI: References

Number	Rev	Title	Location[1]
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	ML13143A321
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[2]	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

[1] Where two ADAMS accession numbers are listed, the first is the reference document and the second is the NRC endorsement of that document.

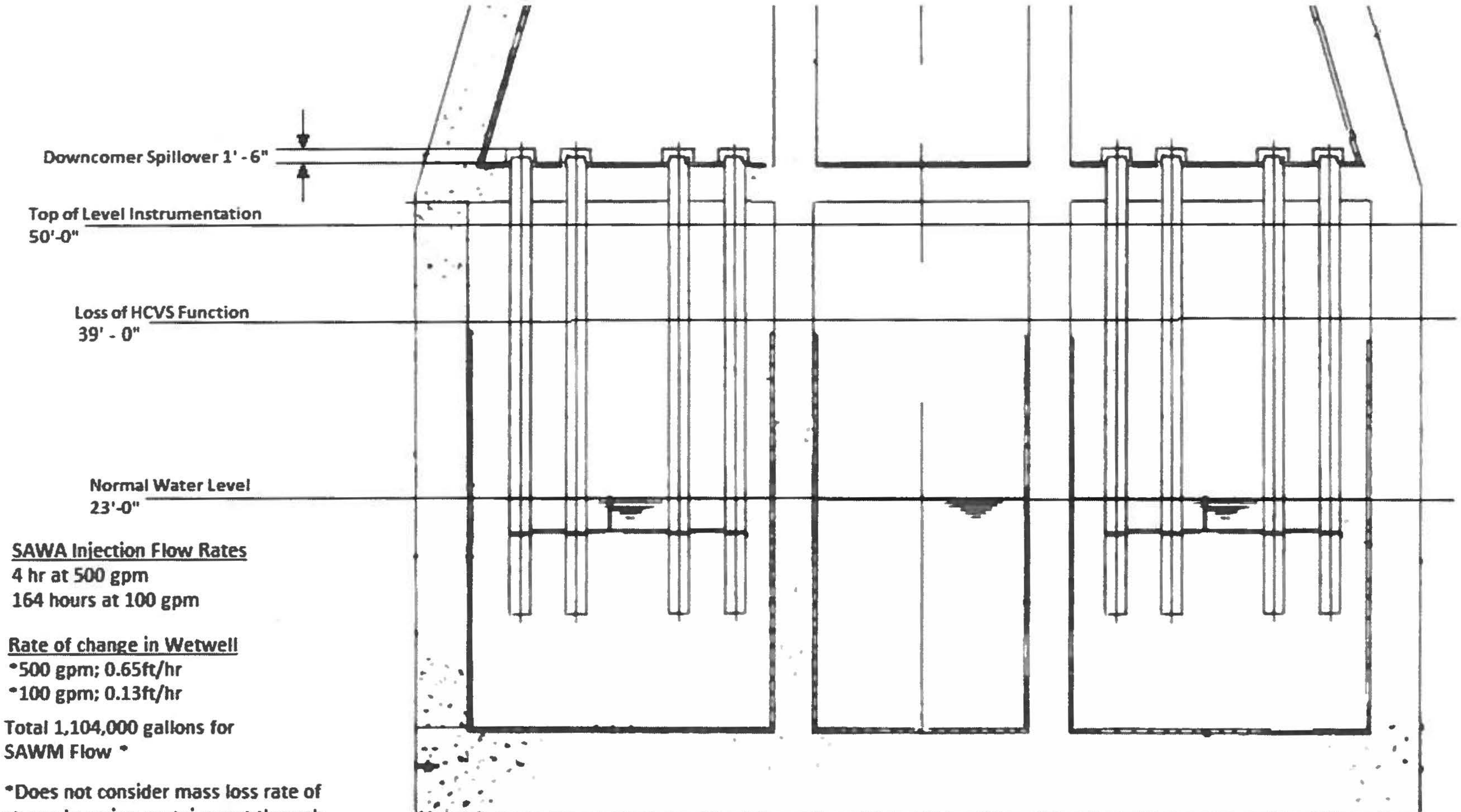
[2] NEI 13-02 Revision 1 Appendix J contains HCVS-FAQ-01 through HCVS-FAQ-09.

Number	Rev	Title	Location[1]
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. Overall Integrated Plan	0	Overall Integrated Plan in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Reliable Hardened Containment Vents (Order Number EA-12-050).	ML13059A267
19. Combined OIP	0	Combined HCVS Phase 1 and 2 Overall Integrated Plan (OIP)	ML14181A418
20. Combined OIP Phase 1 (Updated) & Phase 2	0	Combined HCVS Phase 1 (Updated) and 2 Overall Integrated Plan (OIP)	ML15364A014
21. Phase 1 & Phase 2 ISE	0	HCVS Phase 1 & Phase 2 Interim Staff Evaluation (ISE)	ML15082A433
22. Phase 2 ISE	0	HCVS Phase 2 Interim Staff Evaluation (ISE)	ML16116A320
23. 1st Update	0	First Six-Month Update	ML14353A110
24. 2nd Update	0	Second Six-Month Update	ML15181A016
25. 3rd Update	0	Third Six-Month Update	ML18081A195
26. 4th Update	0	Fourth Six-Month Update	ML16182A011
27. 5th Update	0	Fifth Six-Month Update	ML16350A266
28. 6th Update	0	Sixth Six-Month Update	ML17181A031
29. 7th Update	0	Seventh Six-Month Update	ML17349A035
30. Compliance Letter	0	HCVS Phase 1 and Phase 2 compliance letter	ML18159A142

Number	Rev	Title	Location[1]
31. EC 622673	1	Temperature, Humidity and Radiological Evaluation HCVS & SAWA	N/A
32. CC-LG-118	5	Site Implementation of Diverse and Flexible Coping Strategies (FLEX) and Spent Fuel Pool Instrumentation Program	N/A
33. NEI 12-06	0	Diverse and Flexible Coping Strategies (FLEX) Implementation Guide	ML12221A205
34. 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
35. RG 1.97	3	Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Conditions During and Following an Accident	ML003740282
36. 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
37. EC 622483	0	Evaluation of Potential SAWA Diversionary Flow Paths	N/A
38. RS-15-301	N/A	Exelon Generation Company, LLC Phase 1 (Updated) and Phase 2 Overall Integrated Plan in Response to June 6, 2013 Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109), dated December 15, 2015	N/A
39. LM-0725	1	FLEX Activity and HCVS Phase 2 Dose Assessment	N/A
40. RS-18-051	0	Report of Full Compliance with March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis	N/A
41. LG-MISC-018	0	MAAP Analysis to Support HCVS Design	N/A
42. BWROG-TP-15-011	0	Severe Accident Water Management Supporting Evaluations	N/A
43. LM-0728	0	Hardened Containment Vent Purge System Design Calculation	
44. M-0057 Sheet 8	0	P&ID Containment Hardened Vent (Unit 1)	N/A

Number	Rev	Title	Location[1]
45. LM-0709	1	Limerick Hardened Containment Vent Capacity	N/A
46. EC 423281	1	2R14 MOD: Fukushima Hardened Vent - Outage Tie-In to Wetwell	N/A
47. EC 423382	2	1R17 MOD: Fukushima Hardened Vent - Outage Tie-In to Wetwell	N/A
48. EC 423333	4	2R14 MOD - Fukushima Hardened Vent - Online Elect/I&C Work	N/A
49. EC 423381	5	1R17 MOD - Fukushima Hardened Vent - Online Work	N/A
50. EC 423281	1	2R14 MOD: Fukushima Hardened Vent - Outage Tie-In to Wetwell	N/A
51. EC 422831	3	UNIT 2 HCVS Safeguards Room / Train Bay Large Bore Piping	N/A
52. T-301 Unit 1 T-301 Unit 2	4 5	RPV Injection from Spray Pond	N/A
53. LM-0721	1	Hardened Containment Vent System Dose Assessment	N/A
54. LM-0706	3	Fukushima FLEX Hydraulic Analysis	N/A
55. T-300	3	FLEX Pump Setup at Spray Pond	N/A
56. LE-0128	0	HCVS Battery and Battery Charger Sizing	N/A
57. ECR 14-00019	1	Fukushima-FLEX - Electrical Engineering Modification	
58. EC 622482	0	Evaluation of the Spray Pond Water Inventory for SAWA	N/A
59. EC 423331	2	2R14 MOD - Fukushima Hardened Vent - Online Elect/I&C Work	N/A
60. T-360	3	Diesel Fuel Transfer from EDG Day Tank or D/G Fuel Tank for Flex Equipment.	N/A

Attachment 1: Phase 2 Freeboard diagram



SAWA Injection Flow Rates
4 hr at 500 gpm
164 hours at 100 gpm

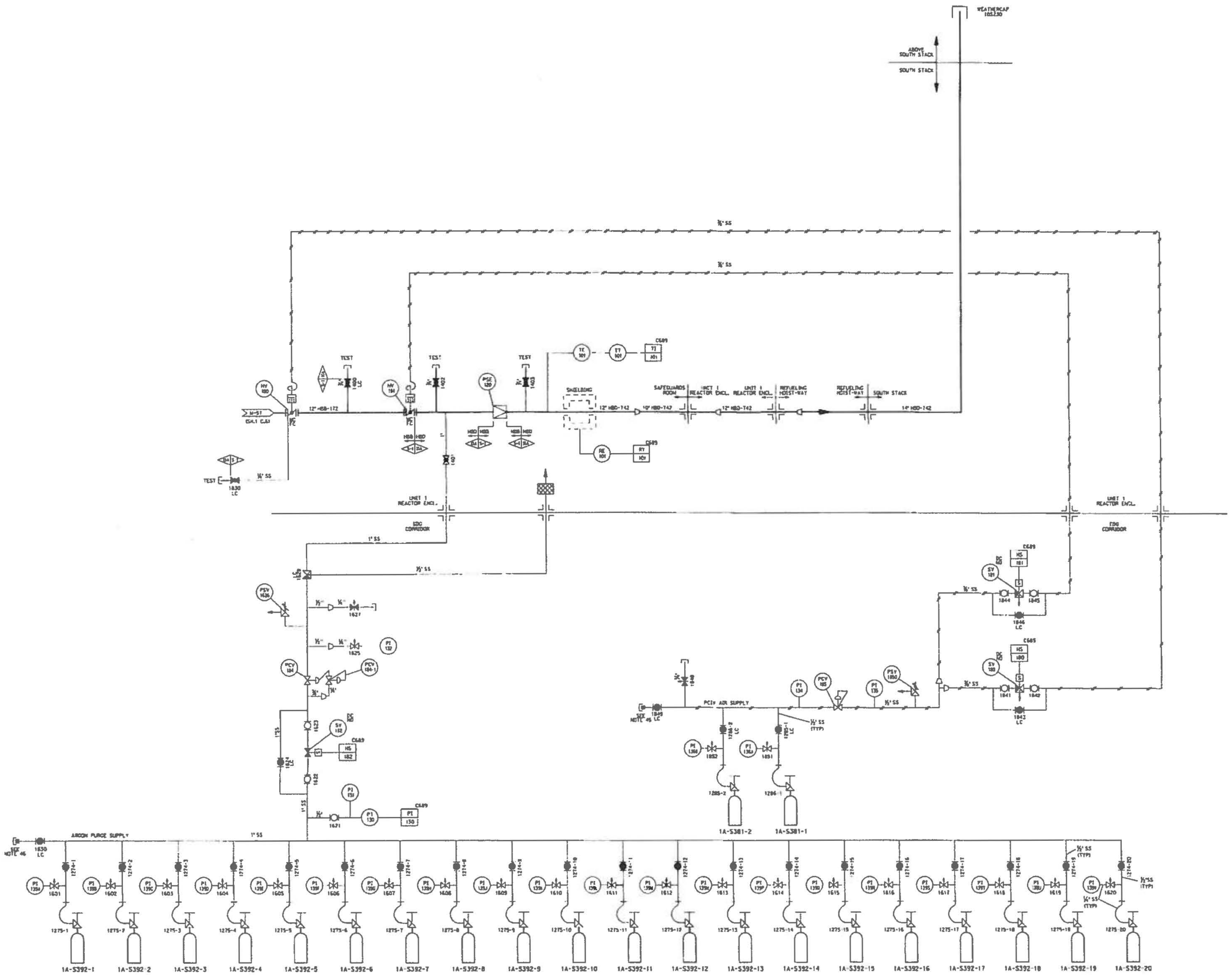
Rate of change in Wetwell
*500 gpm; 0.65ft/hr
*100 gpm; 0.13ft/hr

Total 1,104,000 gallons for SAWM Flow *

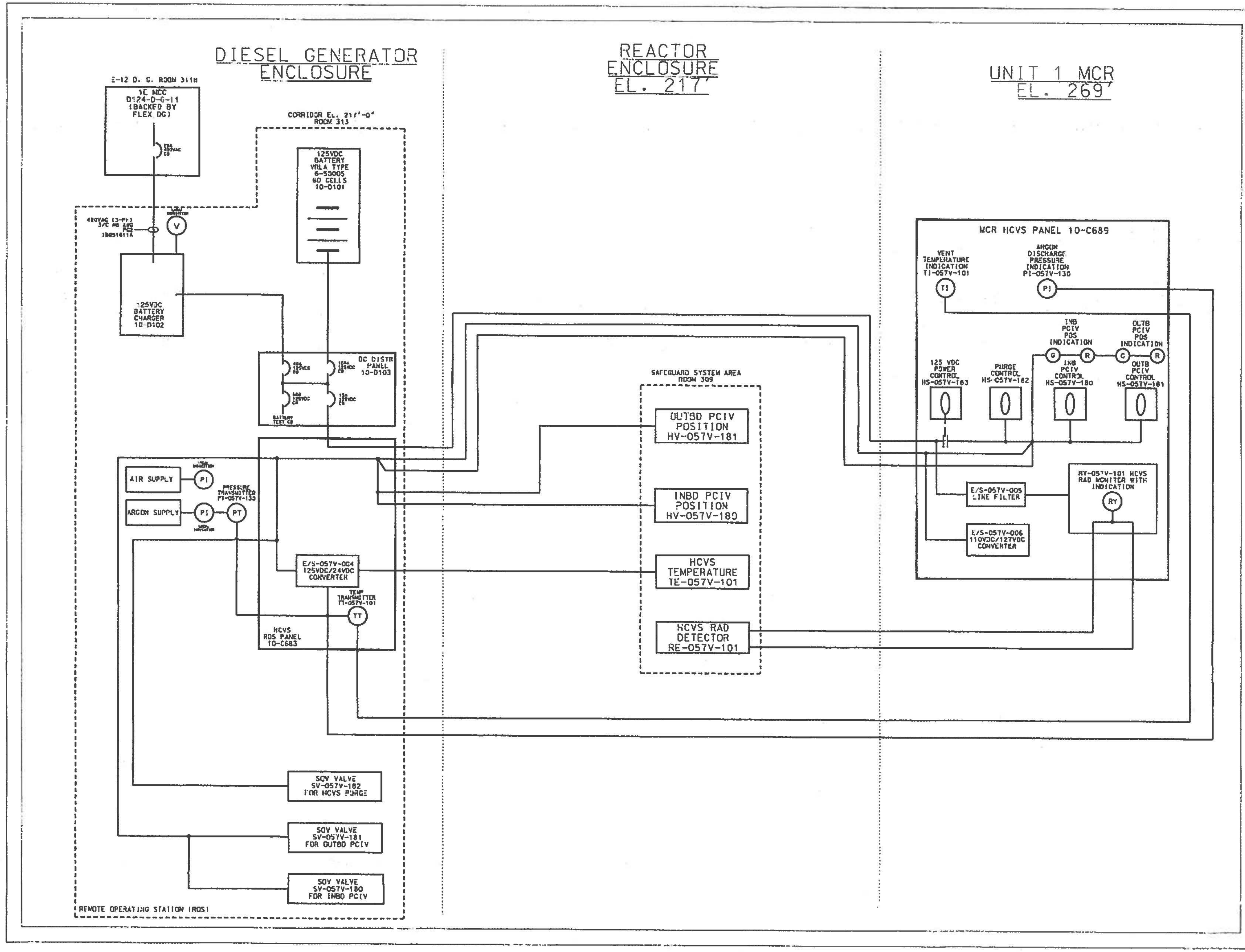
*Does not consider mass loss rate of steam leaveing containment through wetwell vent path

Not To Scale

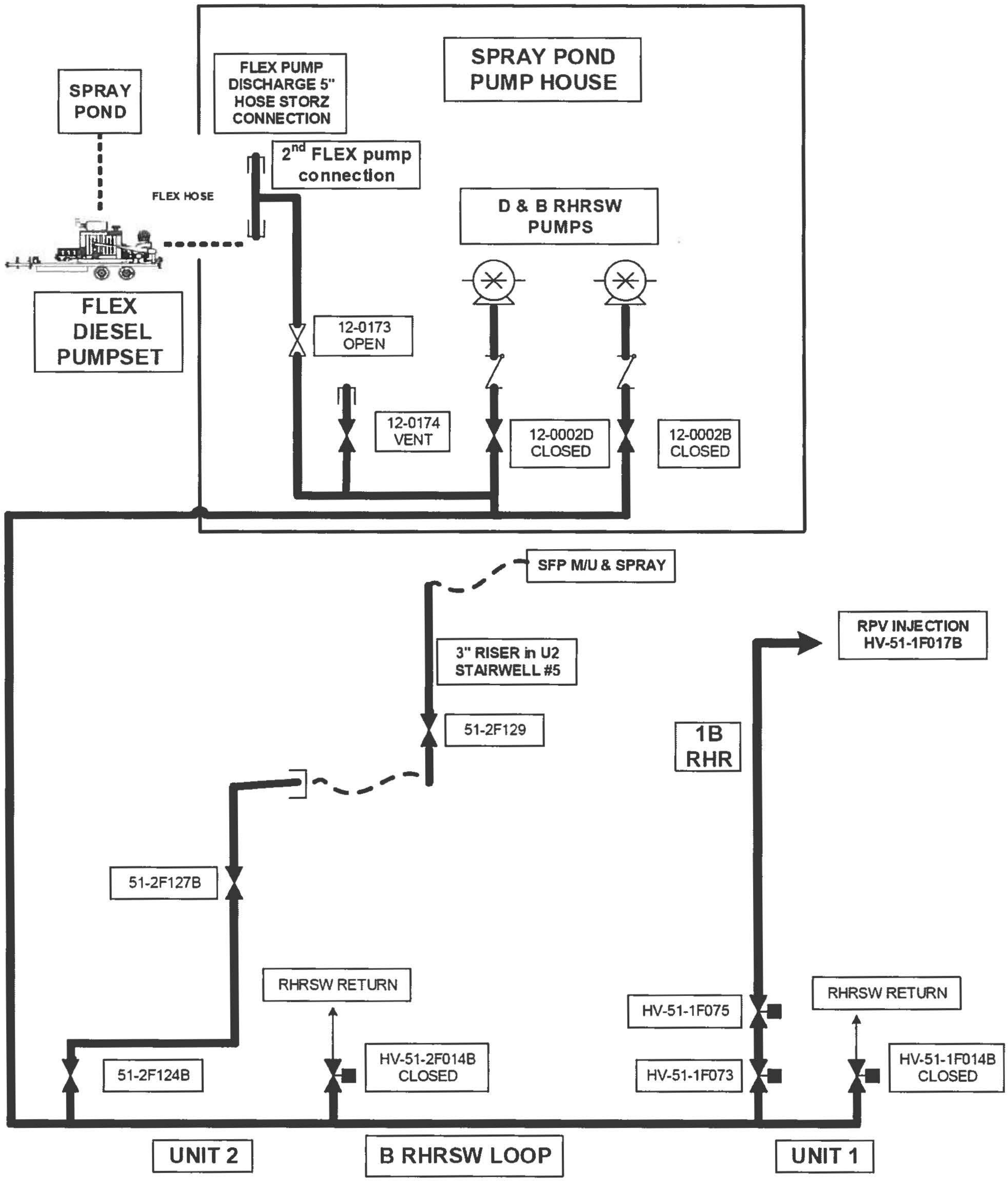
Attachment 2: One Line Diagram of HCVS Vent Path (Unit 1 shown, Typical Unit 2) (Reference 44)



Attachment 3: One Line Diagram of HCVS Electrical Power Supply (Unit 1 shown, Unit 2 typical) (Reference 48 and 59)

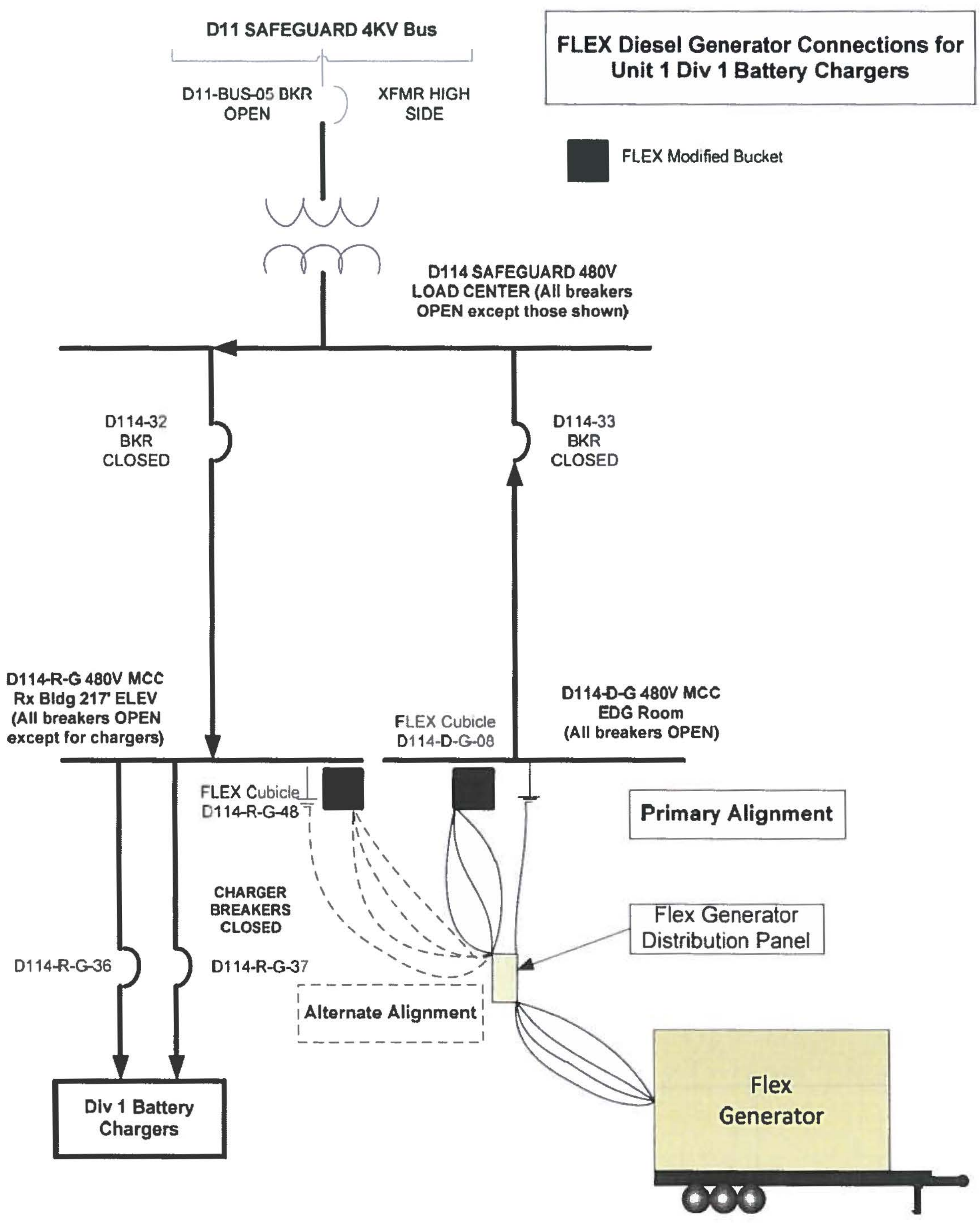


Attachment 4: One Line Diagram of SAWA Flow Path (Unit 1 shown, typical Unit 2) (Reference 52)



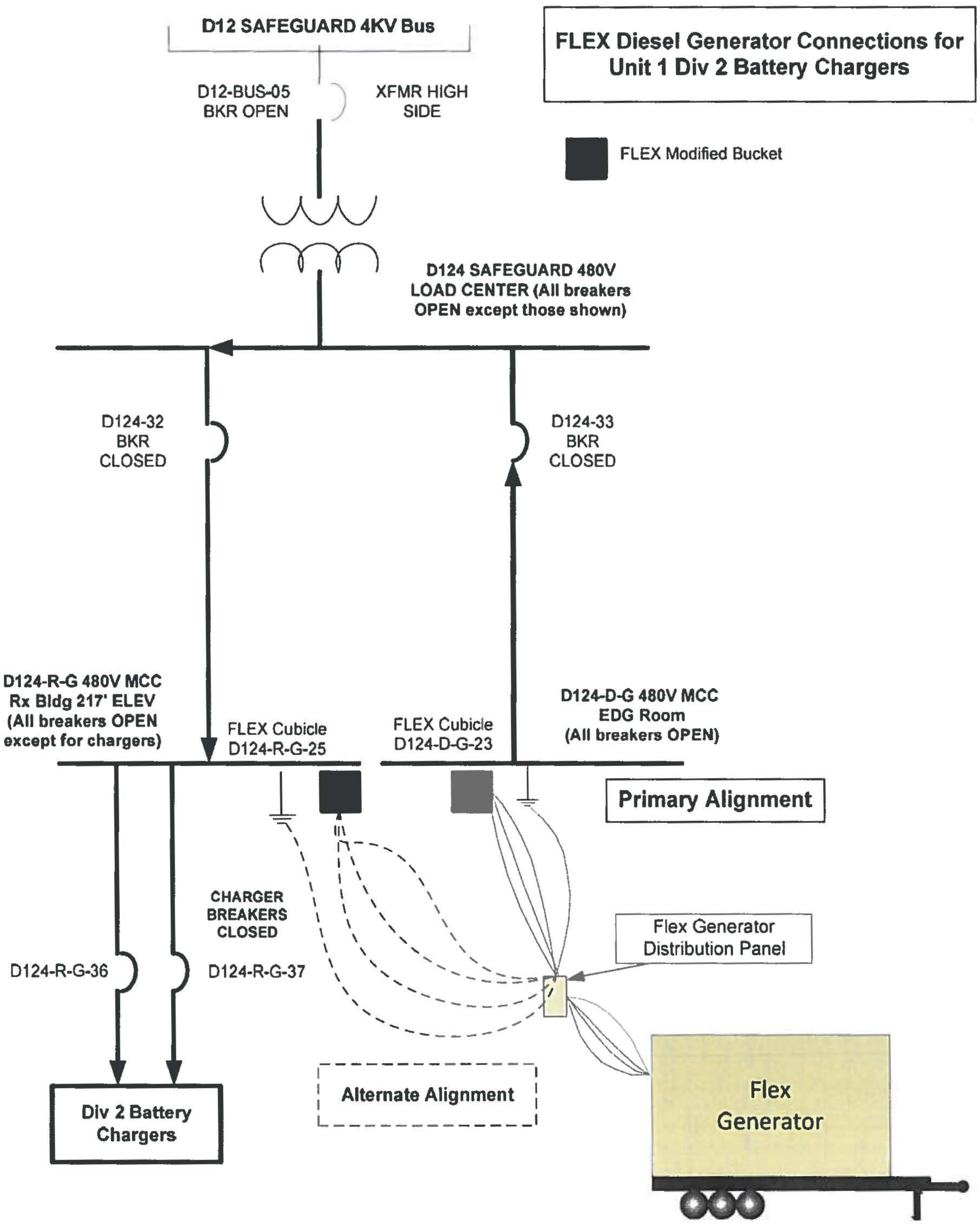
Attachment 5A: One Line Diagram of SAWA/FLEX Electrical Power Supply Div 1 (Same as FLEX, Unit 1 Shown, Unit 2 Typical)

FLEX DIESEL GENERATOR ALIGNMENT STRATEGY

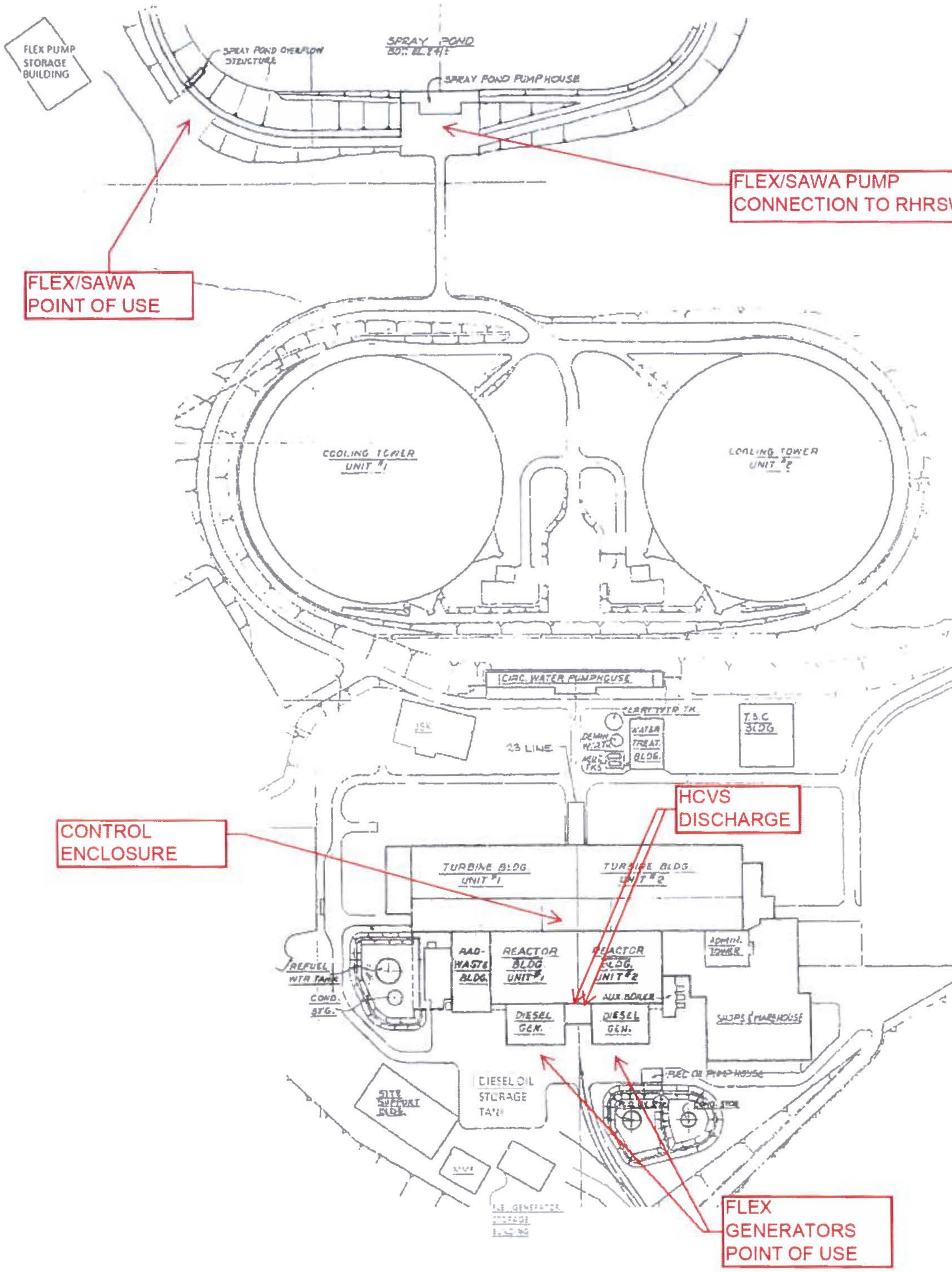


Attachment 5B: One Line Diagram of SAWA/FLEX Electrical Power Supply Div 2 (Same as FLEX, Unit 1 Shown, Unit 2 Typical)

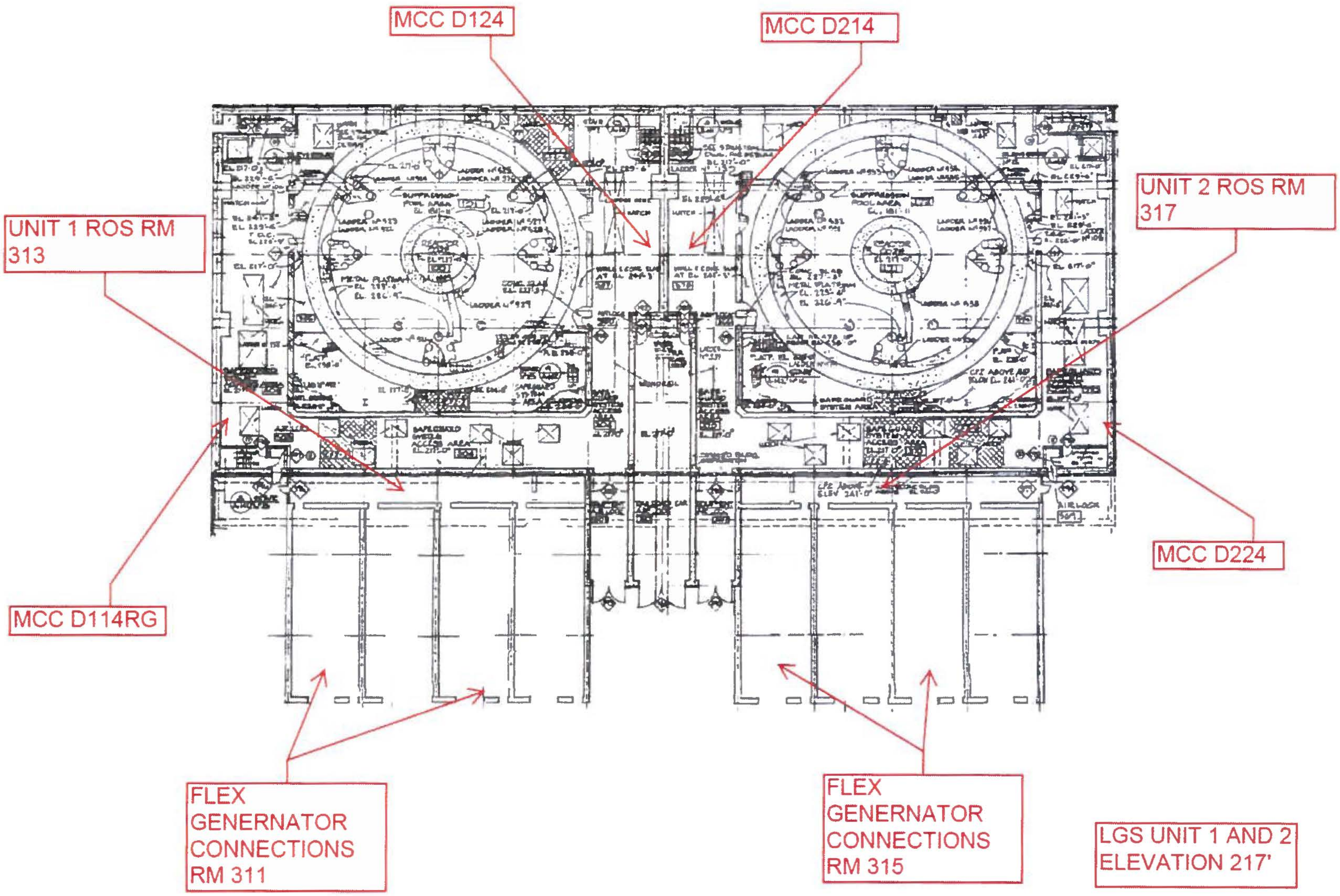
FLEX DIESEL GENERATOR ALIGNMENT STRATEGY



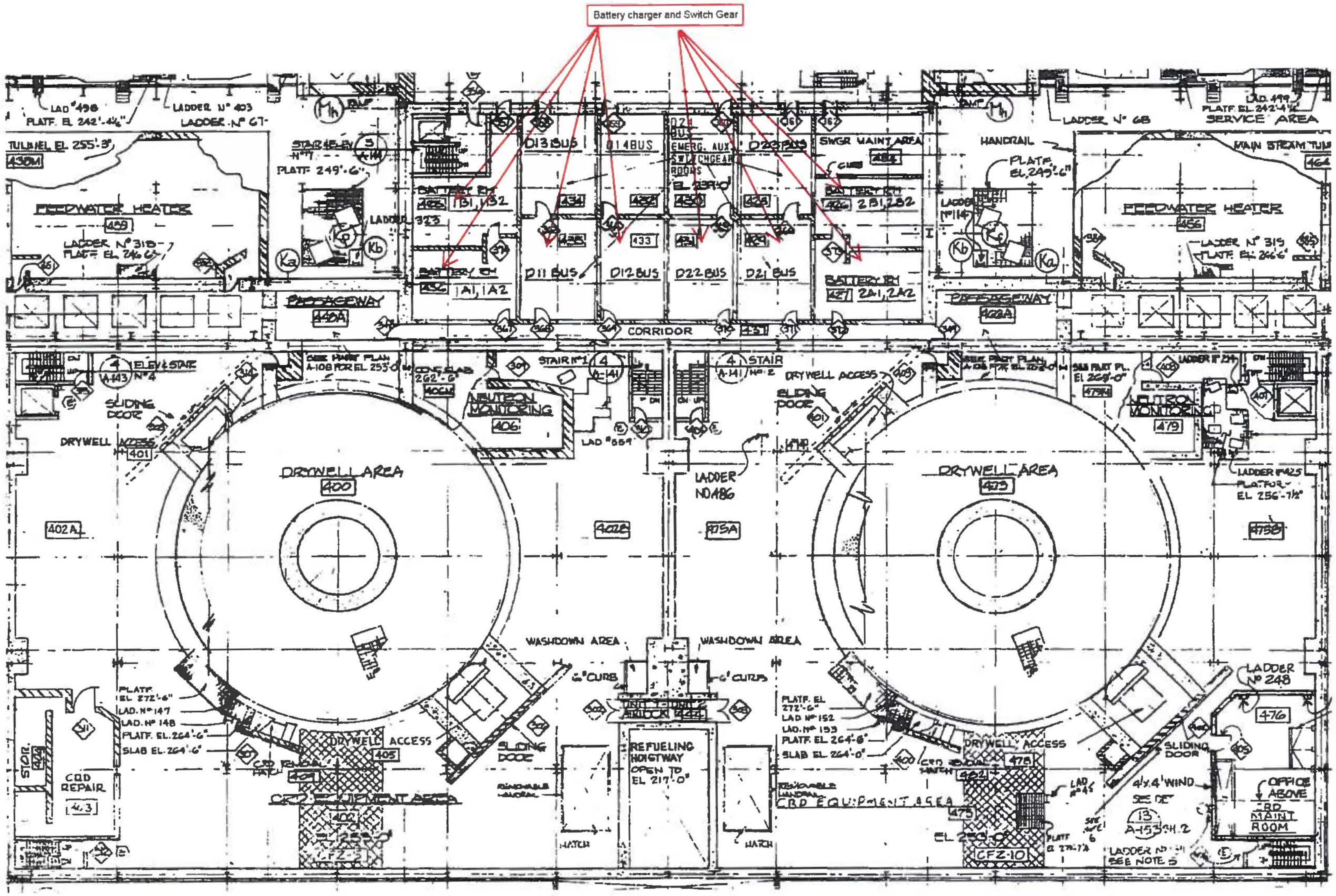
Attachment 6A: Plant Layout Showing Operator Action Locations General plant layout



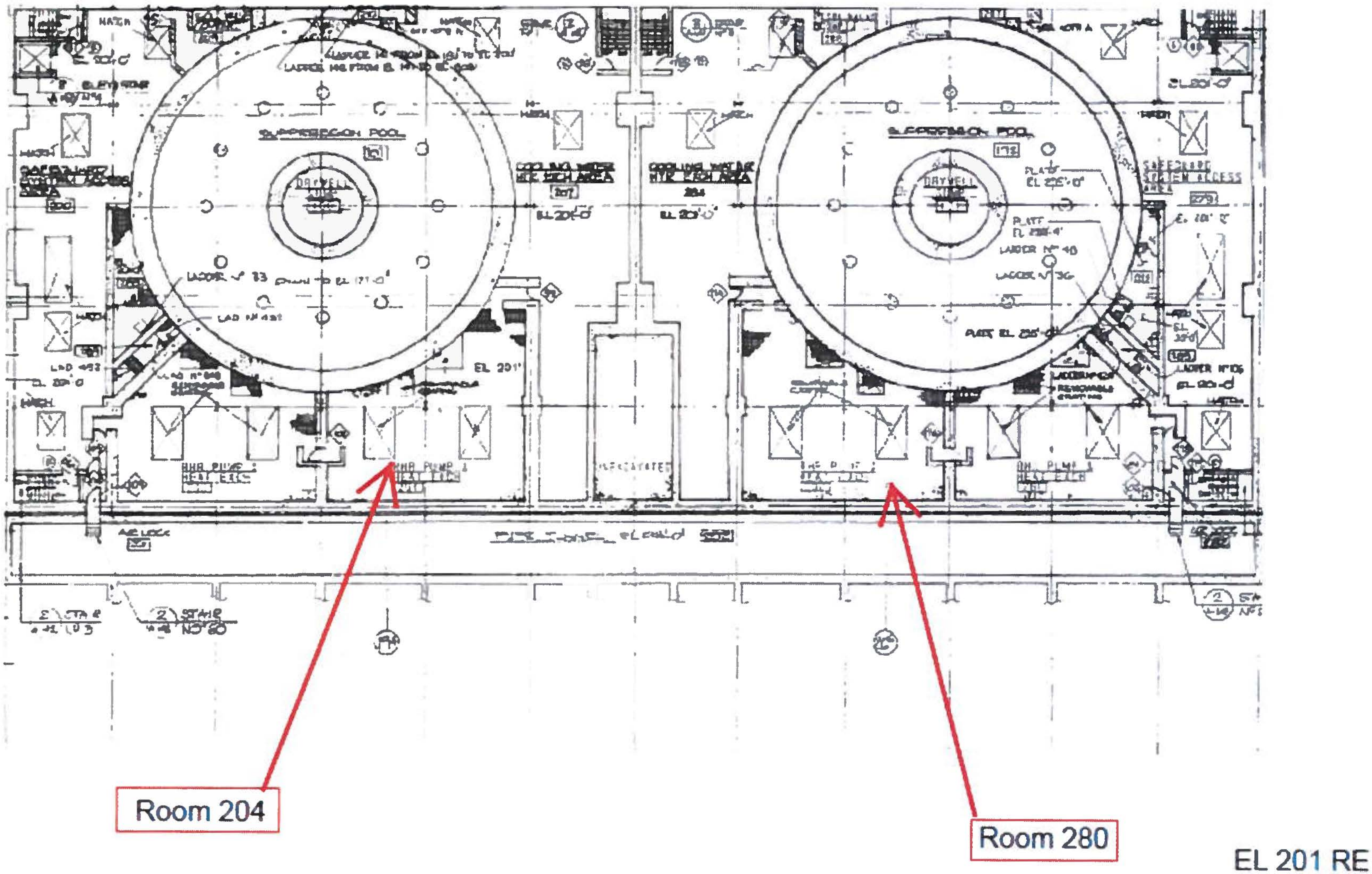
Attachment 6B: Plant Layout Showing Operator Action Locations RB and DG El. 217'



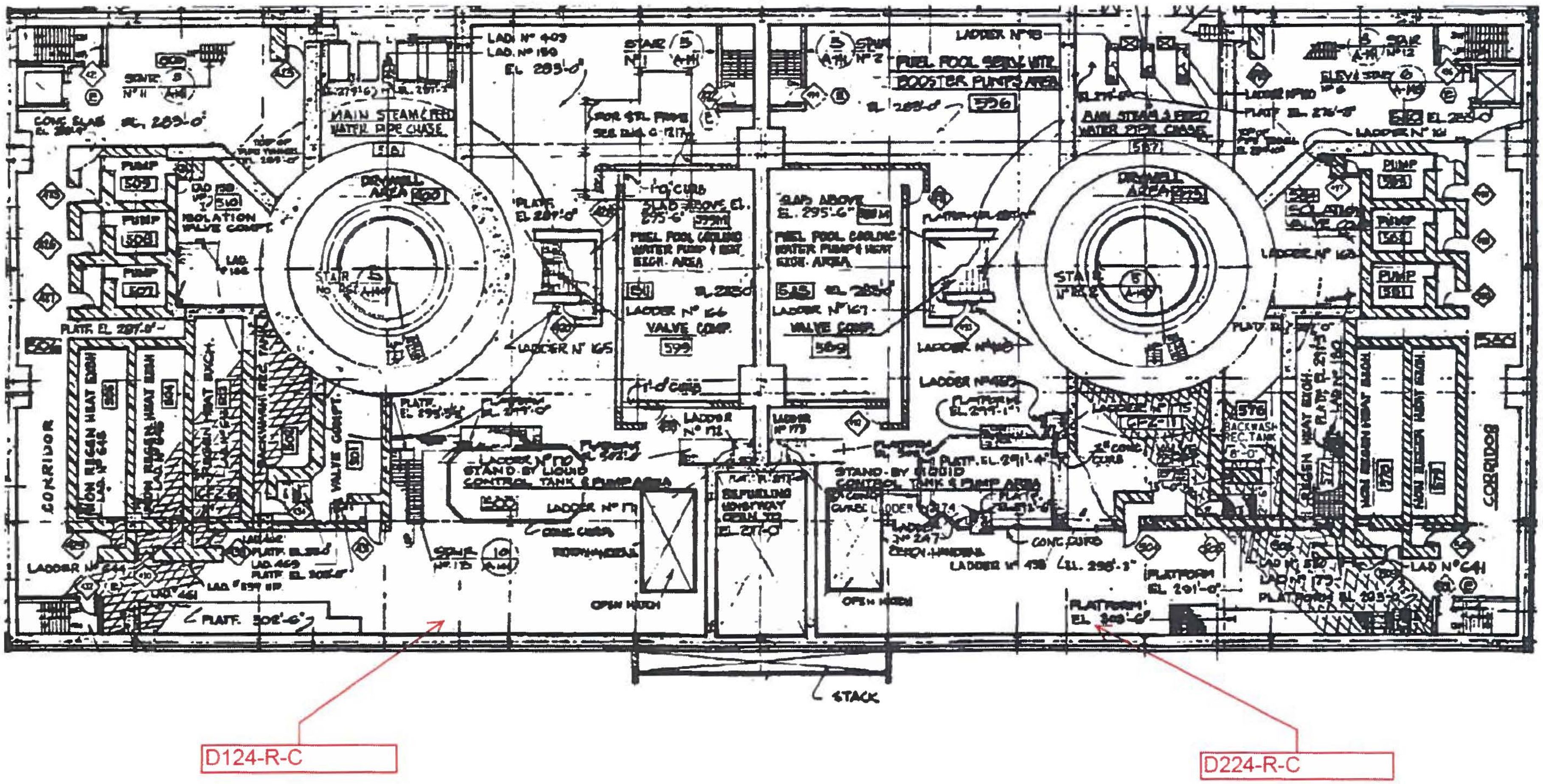
Attachment 6C: Plant Layout Showing Operator Action Locations RB and Control Enclosure El. 239'



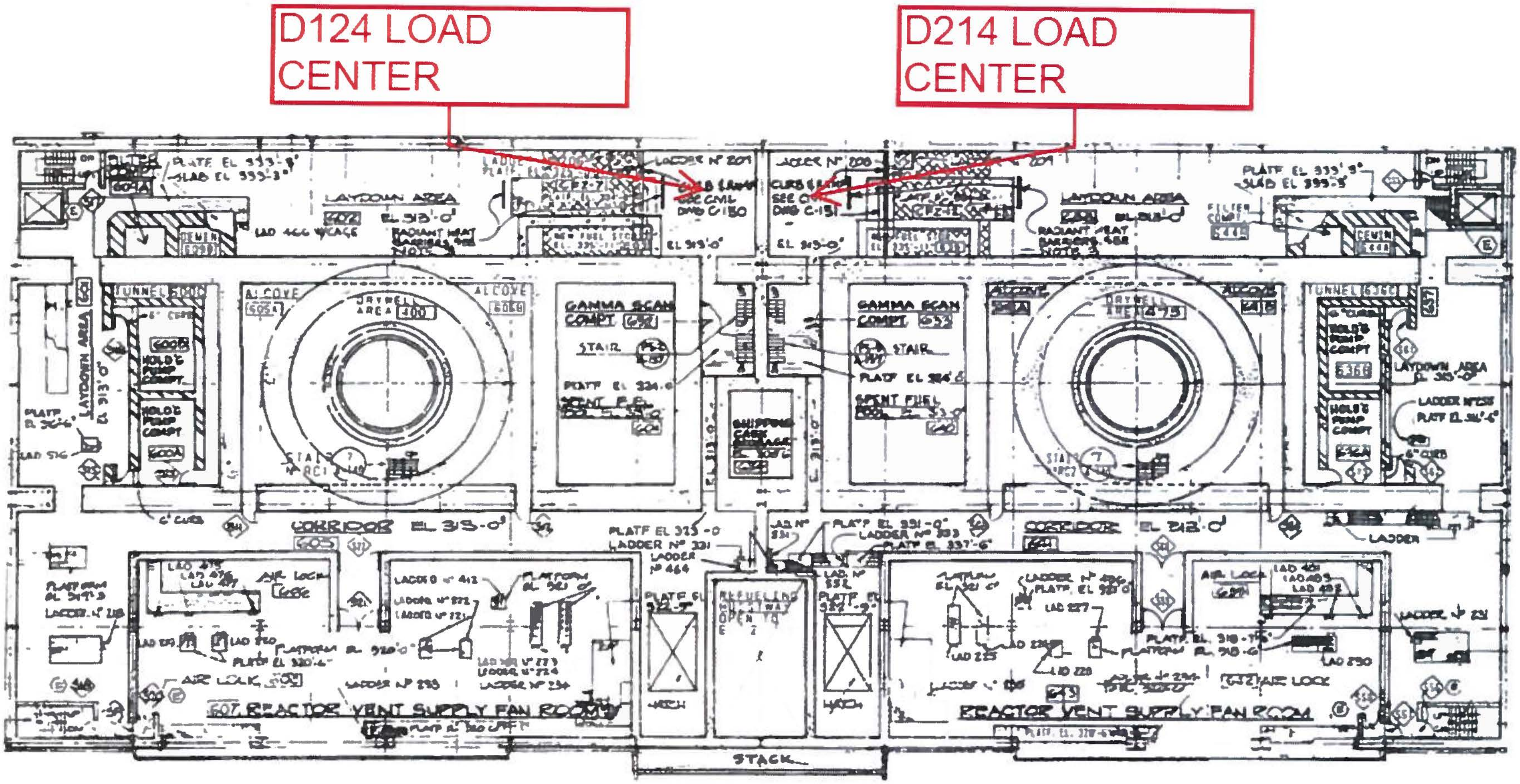
Attachment 6D: Plant Layout Showing Operator Action Locations RE El. 201'



Attachment 6E: Plant Layout Showing Operator Action Locations RE El. 283'



Attachment 6E: Plant Layout Showing Operator Action Locations RE El. 313'



Attachment 6F: Plant Layout Showing Operator Action Locations RE El. 269'

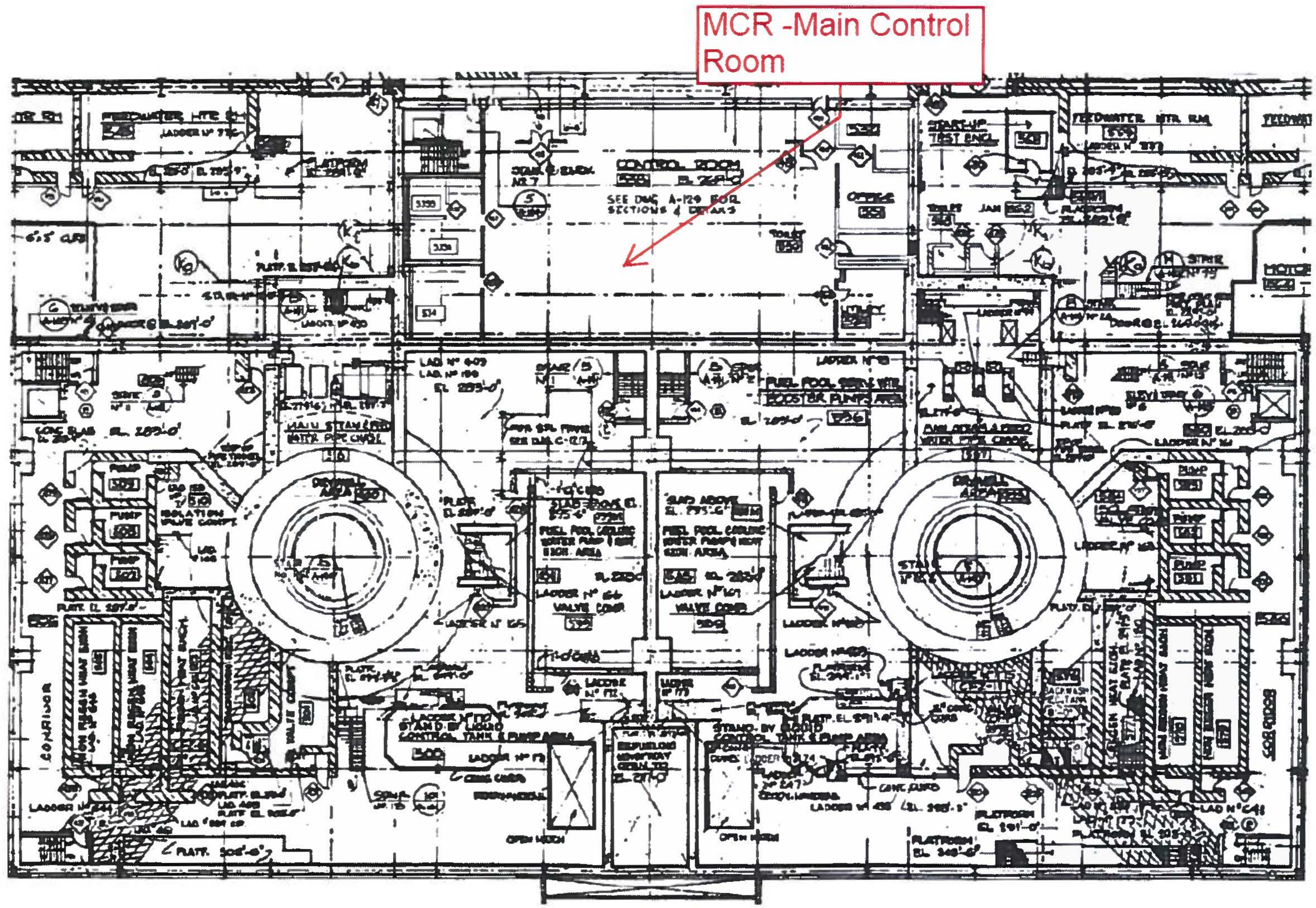


Table 1: List of HCVS Component, Control and Instrument Qualifications (Reference 31)

Component Name	Equipment ID	Range	Location	Local Accident Temp	Local Accident Humidity	Local Radiation Level	Qualification	Qualification Temp	Qualification Humidity	Qualification Radiation	Power Supply
SAWA flow instrument and readout	N/A	37- 1246 GPM	Outside, mounted on the FLEX pump	106 °F	100%	Outside. More than 1900 feet away from the HCVS pipe. Radiation not a concern	Commercial instrument qualified for over the road use, therefore qualified per NEI 12-06	+32 to 140°F	100%	N/A	FLEX Pump Batteries (on the pump)
Drywell Pressure Transmitter	PT-042-170	0-150 PSI	Reactor Enclosure Room 402, El 253'-00"	120 °F	90%	2.89E+04 Rads (Note 3)	IEEE Std 323™-1974/1983/2003 IEEE Std 344™-1975/1987/2004	200°F	0 to 100%	6.5E+6 Rads	Division 1 battery via FLEX generator and battery charger
Drywell Pressure Indicator	PI-042-170-1	0-150 PSIG	Main Control Room, Room 533, El 269'-00"	<110°F Per AR 1550669-04	50-90%	MCR (Note 4)	These PI's are not RG 1.97 qualified. However, they are safety related indicators which are located in the control room.	N/A (Note 4)	N/A (Note 4)	N/A (Note 4)	Division 1 battery via FLEX generator and battery charger
Drywell Pressure Transmitter	PT-042-270	0-150 PSIG	Reactor Enclosure, Room 475, El. 253'-00"	120 °F	90%	2.89E+04 Rads (Note 3)	By comparison to the same model (1153GB7PJ) RG 1.97 qualification	N/A (Note 1)	N/A (Note 1)	N/A (Note 1)	Division 1 battery via FLEX generator and battery charger
Drywell Pressure Indicator	PI-042-270-1	0-150 PSIG	Main Control Room, Room 533, El 269'-00"	<110°F Per AR 1550669-04	50-90%	MCR (Note 4)	These PI's are not RG 1.97 qualified. However, they are safety related indicators which are located in	N/A (Note 4)	N/A (Note 4)	N/A (Note 4)	Division 1 battery via FLEX generator and battery charger

Component Name	Equipment ID	Range	Location	Local Accident Temp	Local Accident Humidity	Local Radiation Level	Qualification	Qualification Temp	Qualification Humidity	Qualification Radiation	Power Supply
							the control room.				
Suppression Pool Level Transmitter	LT-052-140A	0 - 50 ft H_2O	Reactor Enclosure Room 118, El. 177'-00"	120°F	90%	3.77E+06 Rads (Note 2)	RG 1.97	N/A (Note 1)	N/A (Note 1)	N/A (Note 1)	RG 1.97 Division 1 battery via FLEX generator and battery charger
Suppression Pool Level Indicator	LI-052-140A	0 - 50 ft H_2O	Main Control Room, Room 533, El 269'-00"	<110°F Per AR 1550669-04	50-90%	MCR (Note 4)	RG 1.97	N/A (Note 1)	N/A (Note 1)	N/A (Note 1)	RG 1.97 Division 1 battery via FLEX generator and battery charger
Suppression Pool Level Transmitter	LT-052-240A	0 - 50 ft H_2O	Reactor Enclosure Room 189, Elev. 177'-00"	120°F	90%	3.77E+06 Rads (Note 2)	RG 1.97	N/A (Note 1)	N/A (Note 1)	N/A (Note 1)	RG 1.97 Division 1 battery via FLEX generator and battery charger
Suppression Pool Level Indicator	LI-052-240A	0 - 50 ft H_2O	Main Control Room, Room 533, El 269'-00"	<110°F Per AR 1550669-04	50-90%	MCR (Note 4)	RG 1.97	N/A (Note 1)	N/A (Note 1)	N/A (Note 1)	RG 1.97 Division 1 battery via FLEX generator and battery charger
HCVS Radiation Detector	RE-057V-101	N/A	Safeguards Room, Room 309, El 217'-00"	120°F (LOCA)	100%	3.53E+06 Rads (Note 5)	Commercial Grade.	350 °F	100% maximum	2E+08 Rads	10-D101 battery backed up by FLEX Diesel Generator
HCVS Radiation Monitor Processor	RY-057V-101	1.00E-2 to 1.00E+4 Rad/hr	Main Control Room, Room 533, El 269'-00"	<110°F Per AR 1550669-04 performed	50-90%	MCR (Note 4)	This Radiation Monitor Processor is not RG 1.97 qualified.	131 °F	0% to 95%, noncondensing	N/A (Note 4)	10-D101 battery backed up by FLEX Diesel

Component Name	Equipment ID	Range	Location	Local Accident Temp	Local Accident Humidity	Local Radiation Level	Qualification	Qualification Temp	Qualification Humidity	Qualification Radiation	Power Supply
				for FLEX actions			However, it is safety related and located in the control room.				Generator
HCVS Radiation Detector	RE-057V-201	N/A	Safeguards Room, Room 376, El 217'-00"	120°F (LOCA)	100%	3.53E+06 Rads (Note 5)	Commercial Grade.	350 °F	100% maximum	2E+08 Rads	20-D101 battery backed up by FLEX Diesel Generator
HCVS Radiation Monitor Processor	RY-057V-201	1.00E-2 to 1.00E+4 Rad/hr	Main Control Room, Room 533, El 269'-00"	<110°F Per AR 1550669-04 performed for FLEX actions	50-90%	MCR (Note 4)	This Radiation Monitor Processor is not RG 1.97 qualified. However, it is safety related and located in the control room.	131 °F	0% to 95%, noncondensing	N/A (Note 4)	20-D101 battery backed up by FLEX Diesel Generator
Limit switches Position indicating for PCIV HV-057V-180	HV-057V-180	N/A	Safeguards Room, Room 309, El 217'-00"	120°F (LOCA)	100%	3.53E+06 Rads (Note 5)	Nuclear Qualified Products. IEEE Standards 344-1975, 323-1974, and 382-1972.	340°F	Enclosure meets NEMA 1, 4 and 13 requirements for dust-tight, water-tight and oil-tight applications	204E+6 Rads	10-D101 battery backed up by FLEX Diesel Generator
Limit switches Position indicating for PCIV HV-057V-181	HV-057V-181	N/A	Safeguards Room, Room 309, El 217'-00"	120°F (LOCA)	100%	3.53E+06 Rads (Note 5)	Nuclear Qualified Products. IEEE Standards 344-1975, 323-1974, and 382-1972.	340°F	Enclosure meets NEMA 1, 4 and 13 requirements for dust-tight, water-tight and oil-tight applications	204E+6 Rads	10-D101 battery backed up by FLEX Diesel Generator

Component Name	Equipment ID	Range	Location	Local Accident Temp	Local Accident Humidity	Local Radiation Level	Qualification	Qualification Temp	Qualification Humidity	Qualification Radiation	Power Supply
Limit switches Position indicating for PCIV HV-057V-280	HV-057V-280	N/A	Safeguards Room, Room 376, El 217'-00"	120°F (LOCA)	100%	3.53E+06 Rads (Note 5)	Nuclear Qualified Products. IEEE Standards 344-1975, 323-1974, and 382-1972.	340°F	Enclosure meets NEMA 1, 4 and 13 requirements for dust-tight, water-tight and oil-tight applications	204E+6 Rads	20-D101 battery backed up by FLEX Diesel Generator
Limit switches Position indicating for PCIV HV-057V-281	HV-057V-281	N/A	Safeguards Room, Room 376, El 217'-00"	120°F (LOCA)	100%	3.53E+06 Rads (Note 5)	Nuclear Qualified Products. IEEE Standards 344-1975, 323-1974, and 382-1972.	340°F	Enclosure meets NEMA 1, 4 and 13 requirements for dust-tight, water-tight and oil-tight applications	204E+6 Rads	20-D101 battery backed up by FLEX Diesel Generator
HCVS vent pipe temperature transmitter	TT-057V-101	0-400 F	DG Enclosure, Room 313, El 217'-00"	121°F (LOCA) Note 8	100%	1.45E+02 Rads (Note 5)	Nuclear Qualified Products.	-15 to 185 °F	N/A (Note 6)	N/A (Note 7)	10-D101 battery backed up by FLEX Diesel Generator
HCVS vent pipe temperature element	TE-057V-101	0-400 F	Safeguards Room, Room 307, El 217'-00"	120°F (LOCA)	100%	3.53E+06 Rads (Note 5)	Nuclear Qualified Products. IEEE 323-1974 & 1983, 344-1975 & 1987, and NUREG 0588	Up to 500 °F	N/A (Note 6)	3E+8 Rads	10-D101 battery backed up by FLEX Diesel Generator
HCVS vent pipe temperature indicator	TI-057V-101	0-400 F	Main Control Room, Room 533, El 269'-00"	<110°F Per AR 1550669-04	50-90%	MCR (Note 4)	This temperature indicator is compliant to NUREG 0700 and IEEE Standard 344-1987.	N/A (Note 4)	N/A (Note 4)	N/A (Note 4)	10-D101 battery backed up by FLEX Diesel Generator

Component Name	Equipment ID	Range	Location	Local Accident Temp	Local Accident Humidity	Local Radiation Level	Qualification	Qualification Temp	Qualification Humidity	Qualification Radiation	Power Supply
HCVS vent pipe temperature transmitter	TT-057V-201	0-400 F	DG Enclosure, Room 317, El 217'-00"	121°F (LOCA) Note 8	100%	1.45E+02 Rads (Note 5)	Nuclear Qualified Products.	-15 to 185 °F	N/A (Note 6)	N/A (Note 7)	20-D101 battery backed up by FLEX Diesel Generator
HCVS vent pipe temperature element	TE-057V-201	0-400 F	Safeguards Room, Room 376, El 217'-00"	120°F (LOCA)	100%	3.53E+06 Rads (Note 5)	Nuclear Qualified Products. IEEE 323-1974 & 1983, 344-1975 & 1987, and NUREG 0588	Up to 500 °F	N/A (Note 6)	3E+8 Rads	20-D101 battery backed up by FLEX Diesel Generator
HCVS vent pipe temperature indicator	TI-057V-201	0-400 F	Main Control Room, Room 533, El 269'-00"	<110°F Per AR 1550669-04	50-90%	MCR (Note 4)	This temperature indicator is compliant to NUREG 0700 and IEEE Standard 344-1987	N/A (Note 4)	N/A (Note 4)	N/A (Note 4)	20-D101 battery backed up by FLEX Diesel Generator
Battery Unit 1	10-D101	N/A	DG Enclosure, Room 313, El 217'-00"	121°F (LOCA) Note 8	50% (LOCA)	1.45E+02 Rads (Note 5)	Commercial Grade. IEEE Standards 485 and 946.	122 °F	0% to 90%, noncondensing	N/A (Note 7)	D124-D-G-11 Normal power backed up by FLEX Diesel Generator
Battery Unit 2	20-D101	N/A	DG Enclosure, Room 317, El 217'-00"	121°F (LOCA) Note 8	50% (LOCA)	1.45E+02 Rads (Note 5)	Commercial Grade. IEEE Standards 485 and 946.	122 °F	0% to 90%, noncondensing	N/A (Note 7)	D224-D-G-11 Normal power backed up by FLEX Diesel Generator

NOTES:

1. Instrument is qualified to RG 1.97 or equivalent is considered qualified for the sustained operating period without further evaluation.
2. The severe accident dose to wetwell level transmitters LT-052-140A and LT-052-240A for Unit 1 in a severe accident condition was considered negligible due to the shielding provided by the containment wall and the water in the wetwell. Therefore, the TID will be less than the TID of 3.77E+06 Rads for the design basis accident (i.e., LOCA).
3. The TID (i.e., normal integrated dose plus the integrated dose for the 7-day sustained operation period) for drywell pressure transmitters PT-042-170 for Unit 1 in a severe accident condition is approximately 2.89E+04 Rads. This dose is the normal operating dose since the severe accident dose to the drywell pressure transmitter location is negligible (relative to the normal operating dose). This TID is also considered to be applicable to drywell pressure transmitter PT-042-270, for Unit 2 in a severe accident condition, because the Unit 1 location is bounding for Unit 2 in this scenario, and because the normal integrated dose is the dominant contributor and a slight difference in the 7-day severe accident dose would have a negligible impact.
4. Denotes Main Control Room where local temperature, humidity and radiation levels are not applicable. MCR has no radiation sources and provides adequate shielding. The MCR instrumentation is qualified to operate in the design basis accident temperature and humidity. The design basis accident temperature and humidity does not exceed the temperature and humidity experienced during HCVS and SAWA/SAWM.
5. LM-0721 (Reference 53), Table 8-1 has been provided as TID (i.e. normal integrated dose plus the 7-day integrated dose.)
6. Weed N9002 Series temperature sensor. This model has previously been environmentally and seismically qualified to use in Class 1E applications in nuclear power plants.
7. There are no acceptance criteria associated with HCVS equipment at the ROS. The equipment in the ROS is located in a low radiation area and, by design, would not be subject to high doses given a severe accident.
8. The minimum temperature is ~26 °F. The equipment has been designed for minimum ambient temperature as this is outside of the Reactor Building.

Table 2: Operator Actions Evaluation (Reference 31)

Item	Operator Actions	Evaluation Time	Location	Thermal conditions	Radiological Conditions	Evaluation
1	-Energize the HCVS power supply to the HCVS components; -Breach the rupture Disc by opening the Argon Purge Line for the specified amount of time; -Open Wetwell PCIVs; SAWA valve alignment in RB to RPV - 1 valve (HV-051-1(2)F017(A)B); -HCVS Valves switch actuation and instrument monitoring	≤ 7 hours	Room 533, Main Control Room, El 269'-00"	N/A	N/A	Acceptable per HCVS-FAQ-01.
2	–Enable the motive air for the HCVS valves and enable the Argon purge system; -Isolate leak-off connection upstream of the rupture disc; -Backup HCVS valve operation (if primary method fails)	≤ 7 hours	Rooms 313 and 317, Remote Operating Station (ROS) Unit 1 and Unit 2, DG Enclosure, El 217'-00"	121°F	Negligible (Note 1)	Acceptable.
3	Cross Path for Unit 1 to Unit 2 (operator travel path between the unit 1 and unit 2)	≤ 7 hours	Room 202, Pipe Tunnel, EL. 198'-00"	123 °F	Negligible (Note 1)	Acceptable.
4	-Load shedding/electrical switching at MCC D114-R-G (D214-R-G) -Load shedding/electrical switching at MCC D124-R-G (D224-R-G)	≤ 7 hours	Rooms 304 and 370, EL. 217'-00"	120 °F	Within the range of 9E+03 mR/hr to 1.3E+04 mR/hr	Acceptable.

Item	Operator Actions	Evaluation Time	Location	Thermal conditions	Radiological Conditions	Evaluation
5	-Load shedding FLEX generator electrical connections Division I MCC D114-D-G (D214-D-G), -Load shedding FLEX generator electrical connections Division II MCC D124-D-G (D224-D-G) -FLEX Generator connection and alignment	≤ 7 hours	Rooms 311 and 315, EL. 217'-00",	115 °F	Peak dose rate is 5.9E-01 mR/hr	Acceptable (Note 2).
6	Provide backup power for plant paging system Gaitronics SE-12	≤ 7 hours	Rooms 542 and 619, EL. 289'-00",	Rm. 542 - 82 °F	Negligible (Note 1)	Acceptable.
7	SAWA manual valve alignment in RB to RPV - 2 valves (HV-051-1(2)F073, HV-051-1(2)F075) (Note 4)	≤ 7 hours (approximate venting start)	Rooms 204 and 280, EL. 201'-00"	133°F	Negligible (Note 1)	Acceptable.
8	Battery charger recovery at Battery and Switchgear Room at El. 239'	≤ 7 hours	Rooms 436/435/433 and 431/429/427, EL. 239'-00"	~106 °F	Negligible (Note 1)	Acceptable.
9	Load shed in the inverter rooms Per E-1 (two locations)	≤ 7 hours	Rooms 452 and 453, EL. 254'-00"	104 °F	Negligible (Note 1)	Acceptable.
10	LPCI Injection (if manual action required to open HV-051-1(2)F017B(A))	≤ 7 hours	Rooms 599 and 589, EL. 283'-00"	120°F	Negligible (Note 1)	Acceptable.
11	Load shed D124-R-C and D224-R-C Div II MCC	≤ 7 hours	Rooms 506 and 580, EL. 283'-00"	120°F	Negligible (Note 1)	Acceptable.
12	-Electrical switching/load shedding: -D114 Load Center -D124 Load Center	≤ 7 hours	Rooms 602 and 638, EL. 313'-00"	120 °F	Negligible (Note 1)	Acceptable.

Item	Operator Actions	Evaluation Time	Location	Thermal conditions	Radiological Conditions	Evaluation
13	Door Opening on the refuel floor	≤ 7 hours	Rooms 700 and 708, EL. 352'-00"	<114 °F for at least the first six hours AR 1550669-13	Negligible (Note 1)	Acceptable.
14	Unit 1 to Unit 2 DG Travel Path	≤ 7 hours	South of the Reactor Building	Outside, ambient conditions	Negligible (Note 1)	Acceptable.
15	SAWA pump staging, operation, hose connection, and refueling	≤ 7 hours	North west of the RB near the spray pond. Approximately 1900 feet away from the HCVS pipe.	Outdoor ambient conditions	Opposite side of the RBs from the vent pipes, well shielded by structure and distance	Acceptable.
16	FLEX generator connection, alignment, operation and refueling	≤ 7 hours (Continued)	DG enclosure (inside and outside). Approximately 250 feet away from HCVS pipe.	Outside, vented enclosure, near ambient conditions	Between 0.6043R/hr and 1.389 R/hr	Acceptable (Note 2).
17	- Align generator to HCVS battery charger; Replace pressurized gas source for HCVS operation; - Replenish Argon bottles	> 24 hours	Rooms 313 and 317, Remote Operating Station (ROS) Unit 1 and Unit 2, DG Enclosure, El 217'-00"	121°F	Peak dose rate is 5.9E-01 mR/hr	Acceptable (Note 2).

Item	Operator Actions	Evaluation Time	Location	Thermal conditions	Radiological Conditions	Evaluation
18	SFP Instrumentation monitoring	Continued/intermittent	Rooms 542, EL. 289'-00"	Rm. 542 - 82 °F Rm. 619 -104 °F	Negligible (Note 3)	Acceptable.
19	Access to FLEX Generator Storage Building Outside of the Reactor Building (inside and outside of building)	Continued	South of the Reactor Building, Approximately 250 feet away from HCVS pipe	Outside, ambient conditions	1.389E+03 mR/hr (outside) Approximately 2.32E+01 mR/hr (inside) (Note 5)	Acceptable.