Exelon Generation

Order No. EA-13-109

RS-18-003

January 12, 2018

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

Dresden Nuclear Power Station, Units 2 and 3
Renewed Facility Operating License Nos. DPR-19 and DPR-25
NRC Docket Nos. 50-237 and 50-249

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. Exelon Generation Company, LLC Phase 1 Overall Integrated Plan in Response to June 6, 2013 Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109), dated June 30, 2014 (RS-14-058)
6. Exelon Generation Company, LLC First Six-Month Status Report 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 (RS-14-302)
7. Exelon Generation Company, LLC Second Six-Month Status Report 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 (RS-15-148)

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-15-299)
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 (RS-16-106)
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 14, 2016 (RS-16-232)
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 27, 2017 (RS-17-063)
12. NRC letter to Exelon Generation Company, LLC, Dresden Nuclear Power Station, Units 2 and 3 – 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. MF4462 and MF4463), dated February 11, 2015
13. NRC letter to Exelon Generation Company, LLC, Dresden Nuclear Power Station, Units 2 and 3 – 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. MF4462 and MF4463), dated September 30, 2016
14. NRC letter to Exelon Generation Company, LLC, Dresden Nuclear Power Station, Units 2 and 3 – Report for the Audit of Licensee Responses to Interim Staff Evaluations Open Items Related to NRC Order EA-13-109 to Modify Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions, dated December 20, 2017

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 Dresden

Nuclear Power Station, Units 2 and 3 Phase 1 Overall Integrated Plan (OIP), which was replaced with the Phase 1 (Updated) and Phase 2 OIP (Reference 8). References 12 and 13 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, and 11 provided the first, second, third, fourth, fifth, and sixth six-month status reports, respectively, pursuant to Section IV, Condition D.3, of Reference 1 for Dresden Nuclear Power Station, Units 2 and 3.

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 Dresden Nuclear Power Station, Units 2 and 3.

Dresden Nuclear Power Station, Units 2 and 3 have 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. Dresden Nuclear Power Station, Units 2 and 3 have 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.

Dresden Nuclear Power Station, Units 2 and 3 Phase 1 and Phase 2 OIP Open Items have been addressed and closed as documented in References 6, 7, 8, 9, 10, 11, and below, and are considered complete per Reference 14. The information provided herein documents full compliance for Dresden Nuclear Power Station, Units 2 and 3 with NRC Order EA-13-109.

EGC's response to the NRC Interim Staff Evaluation (ISE) Phase 1 Open Items identified in Reference 12 have been addressed and closed as documented in References 9, 10, and 11, and are considered complete per Reference 14. The following table provides completion references for each OIP and ISE Phase 1 Open Item.

Reference 14 provided the results of the audit of ISE Open Item closure information provided in References 9, 10, and 11. All Phase 1 and Phase 2 ISE Open Items are statused as closed in Reference 14.

OIP Phase 1 Open Item No. 1 Confirm that at least 6 hours battery coping time is available.	Deleted (Closed to ISE Open Item No. 1 below)
OIP Phase 1 Open Item No. 2 Determine actions to enable wetwell (WW) venting following a flooding around the torus.	Deleted (Closed to ISE Open Item No. 2 below)
OIP Phase 1 Open Item No. 3	Deleted (Closed to ISE Open Item No. 3 below)

Determine how Motive Power and/or HCVS Battery Power will be disabled during normal operation.	
OIP Phase 1 Open Item No. 4 Confirm that the Remote Operating Station (ROS) will be in an accessible area following a Severe Accident (SA).	Deleted (Closed to ISE Open Item No. 12 below)
OIP Phase 1 Open Item No. 5 Confirm diameter on new common HCVS Piping.	Deleted (Closed to ISE Open Item No. 5 below)
OIP Phase 1 Open Item No. 6 Confirm suppression pool heat capacity.	Deleted (Closed to ISE Open Item No. 6 below)
OIP Phase 1 Open Item No. 7 Determine the approach for combustible gases.	Deleted (Closed to ISE Open Item No. 7 below)
OIP Phase 1 Open Item No. 8 Provide procedures for HCVS Operation.	Deleted (Closed to ISE Open Item No. 18 below)
OIP Phase 1 Open Item No. 9 Perform radiological evaluation for Phase 1 vent line on ERO response actions.	Closed per Reference 10.
ISE Phase 1 Open Item No. 1 Make available for NRC staff audit documentation confirming that at least 6 hours battery coping time is available.	Closed per References 9 and 14.
ISE Phase 1 Open Item No. 2 Make available for NRC staff audit documentation that confirms the ability to operate HCVS following flooding around the suppression pool.	Closed per References 10 and 14.
ISE Phase 1 Open Item No. 3 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.	Closed per References 9 and 14.
ISE Phase 1 Open Item No. 4	Closed per References 11 and 14.

Make available for NRC staff audit the seismic and tornado missile final design criteria for the HCVS stack.	
ISE Phase 1 Open Item No. 5 Make available for NRC staff audit documentation of the licensee design effort to confirm the diameter on the new common HCVS piping.	Closed per References 9 and 14.
ISE Phase 1 Open Item No. 6 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.	Closed per References 9 and 14.
ISE Phase 1 Open Item No. 7 Provide a description of the final design of the HCVS to address hydrogen detonation and deflagration.	Closed per References 10 and 14.
ISE Phase 1 Open Item No. 8 Make available for NRC staff audit documentation of a determination of seismic adequacy for the ROS location.	Closed per References 10 and 14.
ISE Phase 1 Open Item No. 9 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.	Closed per References 9 and 14.
ISE Phase 1 Open Item No. 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.	Closed per References 9 and 14.
ISE Phase 1 Open Item No. 11 Provide descriptions of design details that minimize unintended cross flow of vented fluids within a unit and between units on the site.	Closed per References 9 and 14.

ISE Phase 1 Open Item No. 12 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.	Closed per References 10 and 14.
ISE Phase 1 Open Item No. 13 Make available for NRC staff audit the final sizing evaluation for HCVS batteries/battery charger including incorporation into FLEX DG loading calculation.	Closed per References 10 and 14.
ISE Phase 1 Open Item No. 14 Make available for NRC staff audit documentation of the HCVS nitrogen pneumatic system design including sizing and location.	Closed per References 10 and 14.
ISE Phase 1 Open Item No. 15 Make available for NRC staff audit descriptions of all instrumentation and controls (existing and planned) necessary to implement this order including qualification methods.	Closed per References 10 and 14.
ISE Phase 1 Open Item No. 16 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.	Closed per References 10 and 14.
ISE Phase 1 Open Item No. 17 Make available for NRC staff audit documentation of an evaluation verifying the existing containment isolation valves, relied upon for the HCVS, will open under the maximum expected differential pressure during BDBEE and severe accident wetwell venting.	Closed per References 10 and 14.
ISE Phase 1 Open Item No. 18 Make available for NRC staff audit procedures for HCVS operation.	Closed per References 10 and 14.

EGC's response to the NRC Interim Staff Evaluation (ISE) Phase 2 Open Items identified in Reference 13 have been addressed and closed as documented in References 10, 11, and below, and are considered complete per Reference 14. The following table provides completion references for each OIP and ISE Phase 2 Open Item.

OIP Phase 2 Open Item No. 1 Determine SAWA flow control.	Closed per Reference 11.
OIP Phase 2 Open Item No. 2 Resolve location of the FLEX DG to mitigate radiological consequences during severe accident conditions.	Closed per Reference 10.
OIP Phase 2 Open Item No. 3 Validate time-line for Reactor Building hose connections does not exceed 1 hour.	Complete with this submittal. For Dresden the hose connection time is 1.3 hours due to an isolation condenser. Dresden SAWA/SAWM validation plan confirms that Reactor Building hose connentions can be completed within 1.3 hours.
ISE Phase 2 Open Item No. 1 Make available for NRC an evaluation for the locations of the SAWA equipment and controls, as well as ingress and egress paths for the expected Severe Accident conditions (temperature, humidity, radiation) for the Sustained Operating period.	Closed per References 11 and 14 utilizing BWROG generic response template.
ISE Phase 2 Open Item No. 2 Make available for NRC staff an evaluation showing that instrumentation and equipment being used for SAWA and supporting equipment is capable to perform for the sustained operating period under the expected temperature and radiological conditions.	Closed per References 11 and 14 utilizing BWROG generic response template.
ISE Phase 2 Open Item No. 3 Make available for NRC staff supporting documentation demonstrating that containment failure as a result of overpressure can be prevented without a drywell vent during severe accident conditions.	Closed per References 11 and 14 utilizing BWROG generic response template.
ISE Phase 2 Open Item No. 4 Make available for the NRC staff a description of how the plant is bounded by the reference plant analysis that shows the SAWM strategy is	Closed per References 11 and 14 utilizing BWROG generic response template.

successful in making it unlikely that a drywell vent is needed.	
ISE Phase 2 Open Item No. 5 Make available for NRC staff documentation that demonstrates adequate communication between the MCR and the operator at the FLEX pump during severe accident conditions.	Closed per References 11 and 14 utilizing BWROG generic response template.
ISE Phase 2 Open Item No. 6 Make available for the NRC staff the SAWM flow instrumentation qualification for the expected environmental conditions.	Closed per References 11 and 14 utilizing BWROG generic response template.

MILESTONE SCHEDULE – ITEMS COMPLETE

Dresden Nuclear Power Station, Units 2 and 3 - Phases 1 and 2 Specific Milestone Schedule

Milestone	Completion Date
Submit Overall Integrated Plan	June 2014
Submit 6 Month Updates:	
Update 1	Dec. 2014
Update 2	June 2015
Update 3 [Simultaneous with Phase 2 OIP]	Dec. 2015
Update 4	June 2016
Update 5	Dec. 2016
Update 6	June 2017
Phase 1 U3 (Lead Unit) Modifications:	
Begin Conceptual Design	Sep. 2012
Complete Conceptual Design	Mar. 2013
Begin Detailed Design	Nov. 2014
Complete Detailed Design and Issue Modification Package	Jan. 2016

Milestone	Completion Date
Begin Online Portion of the Installation	Nov. 2015
Complete Online Installation	Oct. 2016
Begin Outage Portion of the Installation	Oct. 2016
Complete Outage Installation and put system into service	Nov. 2016
Phase 1 Procedure Changes Active	
Operations Procedure Changes Developed	Oct. 2016
Site Specific Maintenance Procedure Developed	Oct. 2016
Procedure Changes Active	Nov. 2016
Phase 1 Training:	
Training Complete	Oct. 2016
Phase 1 Completion	
U3 Phase 1 HCVS Implementation	Nov. 2016
Phase 1 U2 (Lag Unit) Modifications:	
Begin Conceptual Design	Sep. 2012
Complete Conceptual Design	Mar. 2013
Begin Detailed Design	Nov. 2014
Complete Detailed Design and Issue Modification Package	Sep. 2016
Begin Online Portion of the Installation	Mar. 2016
Complete Online Installation	Oct. 2017
Begin Outage Portion of the Installation	Oct. 2017
Complete Outage Installation and put system into service	Nov. 2017
Phase 1 Procedure Changes Active	
Operations Procedure Changes Developed	Nov. 2017
Site Specific Maintenance Procedure Developed	Nov. 2017
Procedure Changes Active	Nov. 2017
Phase 1 Training:	
Training Complete	Nov. 2017
Phase 1 Completion	
U2 Phase 1 HCVS Implementation	Nov. 2017
Phase 2 U2 (Lead Unit) Modifications:	

Milestone	Completion Date
Begin Conceptual Design	March 2016
Complete Conceptual Design	Aug. 2016
Begin Detailed Design	Nov. 2016
Complete Detailed Design and Issue Modification Package	June 2017
Begin Online Portion of the Installation	June 2017
Complete Online Installation	Oct. 2017
Begin Outage Portion of the Installation	N/A*
Complete Outage Installation and put system into service	Nov. 2017
Phase 2 Procedure Changes Active	
Operations Procedure Changes Developed	Oct. 2017
Site Specific Maintenance Procedure Developed	Oct. 2017
Procedure Changes Active	Oct. 2017
Phase 2 Training:	
Training Complete	Nov. 2017
Phase 2 Completion	
U2 Phase 2 HCVS Implementation	Nov. 2017
Submit Unit 2 Phase 1 and Phase 2 full compliance Report [60 days after Unit achieves compliance]	Jan. 2018
Phase 2 U3 (Lag Unit) Modifications:	
Begin Conceptual Design	Mar. 2016
Complete Conceptual Design	Aug. 2016
Begin Detailed Design	Apr. 2017
Complete Detailed Design and Issue Modification Package	Aug. 2017
Begin Online Portion of the Installation	Aug. 2017
Complete Online Installation	Oct. 2017
Begin Outage Portion of the Installation	N/A*
Complete Outage Installation and put system into service	Nov. 2017
Phase 2 Procedure Changes Active	

Milestone	Completion Date
Operations Procedure Changes Developed	Nov. 2017
Site Specific Maintenance Procedure Developed	Nov. 2017
Procedure Changes Active	Nov. 2017
Phase 2 Training:	
Training Complete	Nov. 2017
Phase 2 Completion	
U3 Phase 2 HCVS Implementation	Nov. 2017
Submit Unit 3 Phase 1 and Phase 2 Full Compliance Report [60 days after full site compliance]	Jan. 2018

*All installation work was completed online

ORDER EA-13-109 COMPLIANCE ELEMENTS SUMMARY

The elements identified below for Dresden Nuclear Power Station, Units 2 and 3, as well as the Phase 1 (Updated) and Phase 2 OIP response submittal (Reference 8), and the 6-Month Status Reports (References 6, 7, 8, 9, 10, and 11), demonstrate compliance with NRC Order EA-13-109. The Dresden Nuclear Power Station, Units 2 and 3 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 Dresden Nuclear Power Station, Units 2 and 3, 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 Dresden Nuclear Power Station, Units 2 and 3, 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 Dresden Nuclear Power Station, Units 2 and 3, 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 Dresden Nuclear Power Station, Units 2 and 3, Phase 1 and Phase 2 HCVS strategies are in compliance with Order EA-13-109. The modifications required to support the HCVS strategies for Dresden Nuclear Power Station, Units 2 and 3 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 Dresden Nuclear Power Station, Units 2 and 3 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 Dresden Nuclear Power Station, Units 2 and 3 Phase 1 and Phase 2 HCVS use provides adequate protection from applicable site hazards, and 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 Dresden Nuclear Power Station, Units 2 and 3 has been completed in accordance with an accepted training process as recommended in NEI 13-02, Revision 1, Section 6.1.3.

Operating and maintenance procedures for Dresden Nuclear Power Station, Units 2 and 3 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.

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.

Dresden Nuclear Power Station, Units 2 and 3 have 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).

> Dresden Nuclear Power Station, Units 2 and 3 have completed evaluations to confirm accessibility, habitability, staffing sufficiency, and communication capability in accordance with NEI 13-02, 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 12th day of January 2018.

Respectfully,

Patrick R. Simpson
Licensing Manager
Exelon Generation Company, LLC

Enclosure: Dresden Nuclear Power Station, Units 2 and 3 Final Integrated Plan Document – Hardened Containment Vent System NRC Order EA-13-109

cc: Director, Office of Nuclear Reactor Regulation
NRC Regional Administrator - Region III
NRC Senior Resident Inspector – Dresden Nuclear Power Station
NRC Project Manager, NRR – Dresden Nuclear Power Station
Mr. John P. Boska, NRR/JLD/JOMB, NRC
Mr. Brian E. Lee, NRR/JLD/JCBB, NRC
Mr. Rajender Auluck, NRR/JLD/JCBB, NRC
Illinois Emergency Management Agency – Division of Nuclear Safety

Final Integrated Plan

HCVS Order EA-13-109

for

Dresden Nuclear Power Station (DNPS)
Units 2&3

January 3, 2018

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Section I: Introduction

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

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

Dresden Nuclear Power Station (DNPS) 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. DNPS achieved Phase 1 compliance in November 2016 for U3 and in November 2017 for U2.

- Phase 2 provided additional protections for severe accident conditions through the development of a reliable containment venting strategy that makes it unlikely that Dresden Nuclear Power Station would need to vent from the containment drywell during severe accident conditions. DNPS achieved Phase 2 compliance in November 2017 for both Units 2 and 3.

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, DNPS 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 NEI 13-02 Revision 0 and 1 respectively, Compliance with Order EA-13-109, Severe Accident Reliable Hardened Containment Vents. The NRC staff used the methods described in the ISGs to evaluate licensee compliance as presented in the Order EA-13-109 OIPs. While the Phase 1 and combined Phase 1 and 2 OIPs where written to different revisions of NEI 13-02, DNPS conform 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 DNPS with Interim Staff Evaluations (ISEs) (References 20 and 21) assessing the site's compliance methods. In the ISEs the NRC identified open items which the site needed to address before that phase of compliance was reached. Six-month progress reports (References 22 through 27) 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 DNPS has addressed all the elements of NRC Order EA-13-109 utilizing the endorsed guidance in NEI 13-02, Rev 1 and the related HCVS-FAQs and HCVS-WPs documents. In addition, the site has addressed the NRC Phase 1 and Phase 2 ISE Open Items as documented in previous six-month updates.

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

Section I.A: Summary of Compliance

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

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

The HCVS is initiated via manual action from the Main Control Room (MCR) or Remote Operating Station (ROS) at the appropriate time based on procedural guidance in response to plant conditions from observed or derived symptoms.

- The vent utilizes containment parameters of pressure and level from the MCR instrumentation to monitor effectiveness of the venting actions.
- The vent operation is monitored by HCVS valve position, temperature and effluent radiation levels.
- The HCVS motive force is monitored and has the capacity to operate for 24 hours with installed equipment. Replenishment of the motive force will be by use of portable equipment once the installed motive force is exhausted.
- Venting actions are capable of being maintained for a sustained period of at least 7 days.

The operation of the HCVS is designed to minimize the reliance on operator actions in response to external hazards. The screened in external hazards for DNPS are seismic, external flooding, high winds, extreme high temperature, and extreme cold – ice only. Initial operator actions are completed by plant personnel and include the capability for remote-manual initiation from the HCVS control station. Initial operator actions are completed by plant personnel to perform initial valve line-up at the ROS. Then, the primary location of vent operation is the main control room (MCR). The HCVS system can also be operated manually from the 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 wetwell vent will remain functional for the removal of heat from the containment.

- Heat can be removed from the containment for at least seven (7) days using the HCVS or until alternate means of heat removal are established that make it unlikely the drywell vent will be required for containment pressure control.

- The SAWA and SAWM actions can be manually activated and controlled from areas that are accessible during severe accident conditions.

- Parameters measured are Drywell pressure, Suppression Pool level, SAWA flowrate and the HCVS Phase 1 vent path parameters.

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

The SAWA flow path is the same as the FLEX primary injection flow path. Attachment 4 contains a one-line diagram of the SAWA flowpath. Two new Reactor Building wall penetrations were made to access the FLEX injection flow path.

For severe accident (SA) conditions, the operators will follow FSG-01-01 that provides a flow chart for various scenarios where one unit is under FLEX and the other under SA conditions or both units are under SA conditions. FLEX procedures guide implementation of FLEX strategies for the FLEX unit. For the unit under SA conditions, Dresden will inject 421 gpm for 4 hours and 85 gpm for the remaining 164 hours. To control the injection rate, an external manifold (termed as FLEX/SAWA Manifold) will be staged near the reactor building west wall just behind the FLEX robust building A. This is the primary location for the manifold. An alternate location for the FLEX/SAWA manifold is the Mechanical Maintenance Department (MMD) shop on the east side of the reactor building. Both locations have been analyzed for hydraulics and dose rates. Two new injection points (one for each unit) have been added to the existing FLEX connection in the reactor building. The injection pipes penetrate through the reactor building south wall, a few feet above the floor at 517’-6”. Outside, these injection points are missile protected by cover plates. After the initiating event, the protective cover plates will be removed to hookup hoses that run to the manifold.

Two in-line flow meters will be attached to the manifold. Flow will be controlled by throttling valves installed on the manifold. Since the hardened vents for both U2 and U3 are supported by a platform attached to the RB south wall, the primary and the secondary manifold locations will provide necessary shielding for long term operators’ actions. All the hose connections and valves lineup will be completed in 1.3 hours. Note that the generic industry guidance for core damage is 1 hour. Since DNPS has isolation condensers, the initial isolation condenser volume provides the 20 minutes additional time to core damage. Thus, all evaluations used 1.3 hours to core damage.

Concurrently, activities will initiate to deploy the SAWA submersible pump in the Ultimate Heat Sink (UHS) at the Cribhouse intake. The SAWA Pump will be ready to deliver flow to the FLEX/SAWA manifold in 7 hours. This pump is, capable of meeting all water makeup requirements for both units under any combination of FLEX or SA conditions. As discussed in OIP (Reference 19), the total amount of water added will not completely fill up the torus to render wet-well venting inoperable.

The SAWA electrical loads are included in the FLEX DG loading calculation reviewed for EA-12-049 compliance. A FLEX DG is located in a robust building “A” west of the Reactor Building. The second FLEX DG is located in a commercial building “C”. See Attachment 6 for applicable locations. Refueling of the FLEX DG is accomplished from the EDG fuel oil tanks as described in the FSG-32, Fueling FLEX portable equipment.

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

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

Section II: List of Acronyms

AC	Alternating Current
AEER	Aux Electric Equipment Room
AOV	Air Operated Valve
APCVS	Augmented Primary Containment Vent System
BDB	Beyond Design Basis
BDBEE	Beyond Design Basis External Event
BWROG	Boiling Water Reactor Owners' Group
CAP	Containment Accident Pressure
DBA	Design Basis Accident
DBLOCA	Design Basis Loss of Coolant Accident
DC	Direct Current
DNPS	Dresden Nuclear Power Station
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
FSB	FLEX Storage Building

GPM	Gallons per minute
HCVS	Hardened Containment Vent System
IC	Isolation Condenser
ISE	Interim Staff Evaluation
ISG	Interim Staff Guidance
JLD	Japan Lessons Learned Project Directorate
LOCA	Loss of Coolant Accident
LPCI	Low Pressure Coolant Injection System
MAAP	Modular Accident Analysis Program
MCR	Main Control Room
MMD	Mechanical Maintenance Department
N_2	Nitrogen
NEI	Nuclear Energy Institute
NPSH	Net Positive Suction Head
NRC	Nuclear Regulatory Commission
OIP	Overall Integrated Plan
PCPL	Primary Containment Pressure Limit
RB	Reactor Building
RM	Radiation Monitor
ROS	Remote Operating Station
RPV	Reactor Pressure Vessel
SA	Severe Accident
SAMG	Severe Accident Management Guidelines

SAWA	Severe Accident Water Addition
SAWM	Severe Accident Water Management
SBGT	Standby Gas Treatment System
SBLC	Standby Liquid Control
SFP	Spent Fuel Pool
SRV	Safety-Relief Valve
TB	Turbine Building
TPDU	Temporary Power Distribution Unit
UFSAR	Updated Final Safety Analysis Report
UHS	Ultimate Heat Sink
VAC	Voltage AC
VDC	Voltage DC
WEC	Work Execution Center
WW	Wetwell

Section III: Phase 1 Final Integrated Plan Details

Section III.A: HCVS Phase 1 Compliance Overview

DNPS modified the existing hardened wetwell vent path installed in response to NRC Generic Letter 89-16 to comply with NRC Order EA-13-109.

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

DNPS installed a hardened wetwell vent (Augmented Primary Containment Vent System, APCVS) in response to NRC Generic Letter 89-16, under Plant Modifications 04295, 04296, 04311 and 10969. The description of the vent system below is common to both units.

The APCVS provides a direct vent path from the pressure suppression chamber or from the drywell to the chimney. This containment emergency vent path will prevent a containment breach with the subsequent uncontrolled radioactivity release.

The design assumes a maximum pressure of 62 psig, measured at the bottom of the pressure suppression chamber coincident with a maximum water level in the pressure suppression chamber. The vent is sized such that, under conditions of constant heat input at a rate equal to 1% of rated thermal power and containment pressure equal to the Primary Containment Pressure Limit (PCPL), the exhaust flow through the vent (78,910 lb/hr) is sufficient to prevent the containment pressure from increasing. This vent is capable of operating up to the PCPL. The design is such that the APCVS will not create a combustible gas mixture through introduction of air.

The APCVS is comprised of piping, round duct, square duct, air-operated valves, and the associated electrical components for operation and indication. The air-operated valves each have an accumulator for storage of compressed air in the event of a loss of instrument air.

The piping interfaces with the suppression chamber main exhaust and the drywell main exhaust lines. It is routed through the reactor building into the turbine building via an 18-inch diameter vent and purge duct. The APCVS vent valve, AO-1601-92, is located in a 10-inch diameter branch line connected upstream of the vent and purge system prefilters. This 10-inch line is routed below the turbine building roof above the Unit 3 turbine, passes through the turbine building wall below the radwaste building roof, is routed under the radwaste building roof, penetrates the exterior wall, and ties into the radwaste ventilation exhaust duct which flows to the chimney.

The APCVS controls are located in the main control room. The APCVS mode switch, three keylock containment isolation valve (CIV) override switches, and valve control switches are located on the 902(3)-3 panel. Annunciation for the APCVS mode switch position and CIV override is also on the 902(3)-3 panel.

Because Dresden is a dual unit station, the Unit 2 and Unit 3 APCVSs are cross-tied, and a common line directs the effluent of both units to the chimney. Although extremely unlikely, simultaneous venting of both units is precluded administratively, through procedures and communication between units. Venting from one unit does not compromise the safety of the other unit. System design precludes backflow from the venting unit to the other unit.

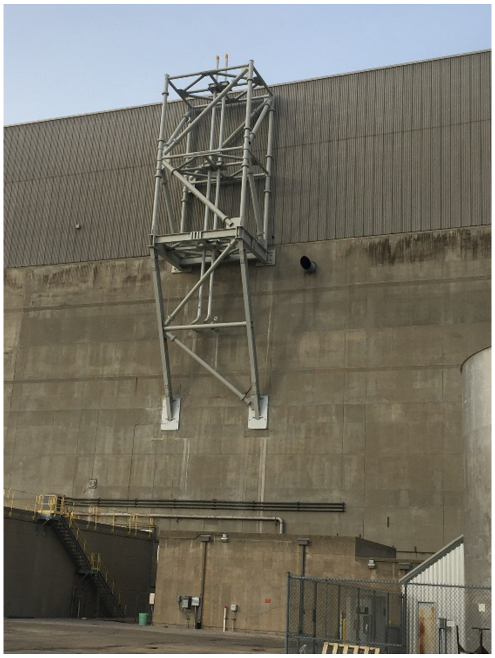
Section III.A.2: EA-13-109 Hardened Containment Vent System (HCVS)

The EA-13-109 compliant HCVS system utilizes part of the GL-89-16 wetwell vent system as shown in Attachment 2. After initial valve line-up at ROS, the vent system is initiated, operated and monitored from the MCR. The vent system can also be initiated and operated from the ROS located on the Turbine Building adjacent to the Reactor Building north wall. Table 2 contains the evaluation of the acceptability of the ROS location with respect to severe accident conditions.

The layout for the new 10” vent line was based on an accessible location for connection to the existing 2(3)-1605-18”-LX vent line and the ability to route the vent pipe to a suitable location for exiting the Reactor Building at a sufficient height and supporting the pipe on the outside of the Reactor Building. The 10” vent lines for both units are routed outside the reactor building at floor elevation of 589’. Section 4.1.5.2 of NEI 13-02, Rev. 1 requires that, if the release from HCVS is through a stack different than the plant meteorological stack, the elevation of the stack should be higher than the nearest power block building. HCVS-FAQ-04 further clarified that the elevated release point should be at least 3 feet above the roof and related structures. For DNPS, the top of the HCVS pipe is 665’-5” and the top of the roof parapet is 660’-5”, resulting in a release point 5-feet higher than the reactor building roof as shown below.

Table 1 provides HCVS instrumentation and equipment environment and qualifications.

The vent lines for both units are 10” diameter pipes connected to the existing 18” vent line at EL 579’-11” accessible from the 570’ floor elevation. New isolation valves 2(3) 1601-93 are installed close to the connection point. Both vent lines are then routed to Unit 2 floor elevation of 589’ near the U2 Isolation Condenser. As shown in Attachment 2, each vent line has a rupture disc and radiation monitoring unit at EL 589’. The two vent lines are then routed outside the reactor building at EL 591’ (74’ above the plant grade of 517’). Since the refuel floor of the reactor building has sheet metal siding, the vertical runs of about 74’-5” of the two vent lines are supported by a 46’-8” high steel tower bolted to a structural steel platform attached to the reactor building south wall. The 16’ x 24’-6” platform is approximately at elevation 610’ attached to the reactor building floors at 570’ and 613’ using diagonal structural steel members. The two vent lines have weather caps for weather protection. There is no cross connection between the two vent lines at any point.



As shown in Attachment 2 nitrogen gas bottles in ROS provide the motive force to manipulate the two isolation valves 2(3)-1601-60 and 2(3)-1601-93. Argon bottles are provided to inert the vent line after each vent operation to sweep out the combustibles in the vent line. Additionally, argon is also used to rupture the rupture disc prior to any venting operation. The system is designed such that existing valve 2(3)-1601-60 remains open all the time once a BDBEE occurs and venting is needed to control the primary containment pressure. Valve 2(3)-1601-93 is operated to initiate and complete the venting cycle. Each vent cycle is followed by the argon purge. Dresden argon purge system was initially designed to perform 8 vent and purge cycles in 24 hours following generic industry's guidance. However, subsequent Dresden specific MAAP analysis (DR-MISC-058) shows that only 3 vent cycles will be required in 24 hours and a total of 8 cycles in 7 days. Thus, the installed Argon capacity is sufficient for 7 days. Provisions have been made to replenish nitrogen or argon bottles using a manual lifting device to transport gas bottles from ground floor at 517' to turbine deck floor at 561'.

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

The primary location for vent operation is Main Control Room(MCR). Even during an ELAP, if the FLEX generators successfully restore FLEX power to the station as expected, there will be power for operating the vent valves. The alternate location is Remote Operating Station (ROS) on the turbine deck at EL 561, next to the reactor building north wall. ROS is at a readily accessible yet missile protected location. ROS provides means to manually operate the wetwell vent in case the MCR is not accessible. The controls available at the ROS will be accessible and functional under a range of plant conditions, including severe accident conditions. The ROS location is in the Turbine Building 561' elevation, adjacent to the Reactor Building north wall near Reactor Building interlock at 570' elevation. DC battery system, battery charger, argon and nitrogen bottle racks are installed in ROS.

ROS Evaluation

Missile Protection

In accordance with the design requirements, the ROS components and their supports must remain functional post seismic and tornado events. For the tornado event, both tornado wind and missile impact must be considered. A walkdown determined that the ROS components will be located in an area where they will be partially protected from a tornado missile strike by existing structures and robust equipment. However, there are areas where missile barriers were required.

DRE16-0029 designed barriers to protect the U2 and U3 ROS components from tornado generated missiles. These missile barriers have been installed. Additionally, the in-place concrete structure was found to be adequate for load imparted by the barrier anchorage.

Temperature Analysis

Per UFSAR 9.4.4. turbine building ventilation system has been designed to maintain area temperature between 65 and 120 F with outside temperatures varying between -6 and +93 F. Normal summer temperatures on the turbine deck are around 104 F. Under accident conditions, the reactors will be shut down and steam to the turbines will be cut off. For extremely low ambient temperatures, a technical evaluation (EC-EVAL 403298) was performed to estimate temperatures on the turbine floor. Due to large thermal masses surrounding the ROS area, it was determined that the temperature in the ROS area will drop from 65 to 55 degrees in 24 hours, while the outside temperature is at 0 deg. F. Per Section 2.3.2 of the UFSAR, the extreme maximum temperatures appropriate at the Dresden site for general plant design is 94 F. Due to the thermal mass initially at 104 F, the maximum temperature will not exceed 120 F. A separate evaluation of high temperature was not performed since the heat source of turbine steam is taken away and 120 F is used as the maximum temperature for ROS. Note that FSG-31 provides FLEX Ventilation Strategies for various areas where operators' actions will take place, including the turbine building. Per Attachment G of FSG-31, four doors on the turbine deck at 561' elevation and two large roll-up doors at 517' elevation will be opened to establish a natural circulation of air. Additionally, use of ice vests is also recommended in FSG-31 for extended periods of extreme heat. It is estimated that each vent cycle followed by a purge cycle can be completed in less than 30 minutes including travel time to and from ROS. Thus, with a combination of ventilation and use of ice vests the operator's safety is ensured under extreme heat conditions.

Under flooding scenario, the FLEX diesel generator will be placed on the turbine deck. Under these conditions, the radiator heat from the FLEX DG will be heating up the turbine building. An analysis, DRE17-0013 was performed to determine the maximum temperature on the turbine deck with DG operating. This analysis shows that, in order to keep the turbine building temperature less than 122 F (upper limit for the DG operation), the blow out panels on the turbine building north and south walls need to be removed as preparatory actions for flooding. FLOODS procedure DOA 0010-04 provides guidance for removal of these blow out panels.

Dose Assessment

DRE16-0010 Rev 1 provides dose values at various locations in the plant where accident mitigation activities will be performed. Tables 8-1 through 8-4 of this calculation summarize locations for operators' actions under FLEX and Severe Accident conditions at different time periods. For example, if Unit 2 is under FLEX and Unit 3 vent is in service, U2 ROS will have insignificant dose and U3 ROS dose will be 3.316 mR/hr. Thus, for a 30 minutes stay at ROS will result in less than 2 mR.

Seismic Evaluation

In accordance with the ROS design requirements, the ROS equipment must remain functional post SSE seismic and tornado events. Therefore, it must be protected from interaction with the surrounding area including the ventilation floor (VF) above. DRE16-0028 provides an evaluation to meet these requirements.

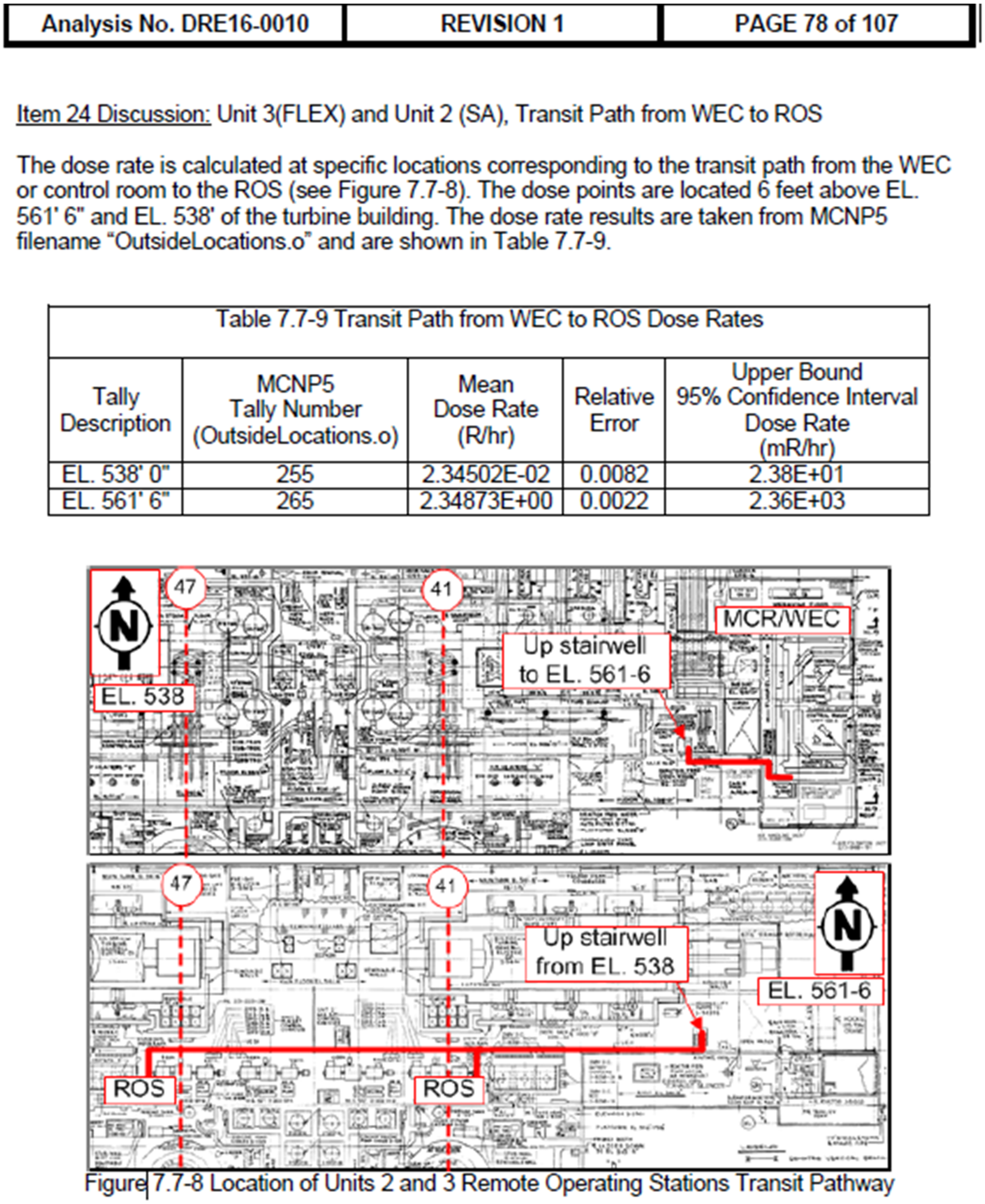
The analysis concluded that the VF above the ROS area will not fail during an SSE or Tornado (including missile) event and impact the HCVS system components below.

Accessibility

The main route to the ROS is from the MCR to 538' TB EL. up the stairs to 561' TB EL. Across 561' TB EL. to the U2 or U3 ROS. (see figure below 7.7-8 from DRE 16-0010 Rev.1.

Attachment 3 contains a one-line diagram of the HCVS electrical distribution system for both Units 2 and 3.

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



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Item 24 Discussion: Unit 3(FLEX) and Unit 2 (SA), Transit Path from WEC to ROS

The dose rate is calculated at specific locations corresponding to the transit path from the WEC or control room to the ROS (see Figure 7.7-8). The dose points are located 6 feet above EL. 561' 6" and EL. 538' of the turbine building. The dose rate results are taken from MCNP5 filename "OutsideLocations.o" and are shown in Table 7.7-9.

Table 7.7-9 Transit Path from WEC to ROS Dose Rates

Tally Description	MCNP5 Tally Number (OutsideLocations.o)	Mean Dose Rate (R/hr)	Relative Error	Upper Bound 95% Confidence Interval Dose Rate (mR/hr)
EL. 538' 0"	255	2.34502E-02	0.0082	2.38E+01
EL. 561' 6"	265	2.34873E+00	0.0022	2.36E+03

Figure 7.7-8 Location of Units 2 and 3 Remote Operating Stations Transit Pathway

Oxygen Monitoring

An oxygen monitoring system has been installed for each ROS location for U2 and U3 to alert personnel of a low oxygen environment due to a gas release from the ROS argon compressed gas bottles. The oxygen monitors at the ROS are non-safety and non-seismic as it is not required under EA-13-109. The oxygen monitoring system will alert (via strobe lights and horns) any personnel in the area when the oxygen concentration at the bottle area in the ROS is below 19.5%. Details of oxygen monitoring are provided in EC 400930 DCS sections 4.1.19 and 4.1.35.

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. DNPS Appendix B to EC 401069 DCS provides a justification of using the existing 2(3)-1601-60 valves that are rated to 300°F. The justification is based on PCPL of 60 psig (Figure D of DEOP 0200-1) when torus is at normal level (15 ft). Since PCPL is measured at the torus bottom, the freeboard space pressure needs hydrostatic correction. The freeboard space pressure will not exceed 53 psig. Since the intent of the Emergency Operating Procedures is to vent containment to stay below the PCPL, 301°F can be considered the maximum operating temperature.

Per NEI 13-02, it is acceptable to assume saturation conditions in containment (2.4.3.1) so that these design parameters are acceptable.

Section III.B: 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 DNPS response to maintain compliance with the Order and guidance from JLD-ISG-2015-01. Due to the difference between NEI 13-02, Revision 0 and Revision 1, only Revision 1 will be evaluated. Per JLD-ISG-2015-01, this is acceptable as Revision 1 provides acceptable guidance for compliance with Phase 1 and Phase 2 of the Order.

1. HCVS Functional Requirements

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

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

Evaluation:

The operation of the HCVS was designed to minimize the reliance on operator actions in response to hazards identified in NEI 12-06, *Diverse and Flexible Coping Strategies (FLEX) Implementation Guide* (Reference 30), which are applicable to the plant site. Operator actions to initiate the HCVS vent path can be completed by plant personnel and include the capability for remote-manual initiation from the HCVS control station. A list of the remote manual actions performed by plant personnel to open the HCVS vent path is in the following table:

Table 3-1: HCVS Operator Actions

Primary Action	Primary Location/ Component	Notes
1. Energize the system by placing HS 2(3)-1604-1, HCVS CONTROL POWER, in ON.	MCR 902(3)-13 key lock switch	Powered by the HCVS 125 VDC batteries
2. Unlock and open 2(3)-1604-31, HCVS NITROGEN VLV.	ROS 561'TB EL	
3. Unlock and open 2(3)-1604-14 HCVS TORUS VENT VLV. NITROGEN ISOL VLV.	ROS 561' TB EL.	
4. Unlock and open 2(3)-1604-24 HCVS PCI VLV. NITROGEN ISOL VLV.	ROS 561' TB EL.	
5. Unlock and reposition 2(3)-1605-14 HCVS ARGON SUPPLY 3-WAY VLV.	ROS 561' TB EL.	
6. Valve in Argon gas bottles (14) and Nitrogen gas bottles (2)	ROS 561' TB EL.	

Primary Action	Primary Location/ Component	Notes
7. Rupture 2(3)-1601-01, HCVS VENT LINE RUPTURE DISC	MCR 902(3)-13 panel	Place SO 2(3)-1605-25A, HCVS ARGON PURGE SOL VALVE to PURGE FOR 26 seconds. Ref. DRE 15-0047
8. Open AO 2(3)-1601-60, TORUS VENT VLV.	MCR 902(3)-3 panel	
9. Open AO 2(3)-1601-93, HCVS PRI CNTMT ISOL VLV.	MCR 902(3)-13 panel	This action starts venting primary containment from the TORUS

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

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

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

Table 3-2: Failure Evaluation

Functional Failure Mode	Failure Cause	Alternate Action	Failure with Alternate Action Impact on Containment Venting?
Fail to Vent (Open) on Demand	Valves fail to open/close due to loss of normal DC power	Manually bypass solenoids at ROS 561' TB EL.	No
Fail to Vent (Open) on Demand	Valves fail to open/close due to loss of Nitrogen pneumatic supply	Replenish Nitrogen bottles	Yes
Fail to Vent (Open) on Demand	Valve fails to open/close due to SOV failure	Manually bypass solenoids at ROS 561' TB EL.	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.

Evaluation:

Primary control of the HCVS is accomplished from the main control room. Alternate control of the HCVS is accomplished from the ROS at the 561' elevation of the turbine building. FLEX actions that will maintain the MCR and ROS habitable were implemented in response to NRC Order EA-12-049 (Reference 31). Actions specified in FSG-31 include:

1. Restoring MCR ventilation via the FLEX DG. The MCR ventilation loads were included in FLEX DG load calculations.
2. Opening MCR doors to the outside (if required)
3. Operating portable generators and fans to move outside air through the MCR (if required)
4. Opening doors and a roof hatch in the RB to establish natural circulation air flow in the RB.
5. Opening U2 and U3 trackway rollup doors.
6. Ice vests are available for use in the MCR and the ROS area. (Located in the B MCR HVAC room and U3 545' RB EL. freezers)
7. It is estimated that each vent cycle followed by a purge cycle can be completed in less than 30 minutes including travel time to and from ROS. Thus, with a combination of ventilation and use of ice vests the operator's safety is ensured under extreme heat conditions.
8. For extreme cold temperatures, the estimated ROS temperature will drop to 55 F in 24 hours. The ROS temperature will not be less than outside ambient temperature conditions for the remainder of the seven-day period of sustained operation and this does not pose any occupational hazard.

Table 2 contains a thermal evaluation of all the operator actions that may be required to support HCVS operation. The relevant ventilation calculations (References 28,29 and 36) 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. (Ref. HCVS-FAQ-06)

Alternate control of the HCVS is accomplished from the ROS. The ROS was evaluated for radiation effects due to a severe accident and determined to be acceptable. The ROS is located in a low dose area during normal operation. During an accident, the core material will be further from the ROS than during normal operation. In addition, there will be additional shielding from the two additional concrete floors after the core has re-located to the pedestal area. The additional distance and shielding combined with the short duration of actions required at the ROS show the ROS to be an acceptable location for alternate control.

DRE16-0010 Rev. 1 “FLEX Activity and Phase 2 Dose Assessment” provides a radiological evaluation of all the operator actions that may be required to support HCVS operation. The evaluation of radiological hazards demonstrates that the final design meets the order requirements to minimize the plant operators’ exposure to radiological hazards.

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

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

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

Evaluation:

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

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

For ELAP with injection, HCVS containment venting is not required to protect containment from overpressure. Containment pressure was evaluated as part of DNPS response to NRC Order EA-12-049 as stated in CC-DR-118-1003 (Reference 35).

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 calculations (Reference 28 and 29) demonstrate that the final design meets the order requirements to minimize the plant operators' exposure to occupational and radiological hazards.

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

1.2 The HCVS shall include the following design features:

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

Evaluation

Calculations DRE15-0046 (for U3) and DRE16-0019 (for U2) contain the verification of 1% power flow capacity at the lesser of the primary containment design pressure and the Primary Containment Pressure Limit (PCPL). Theses analyses were performed by RELAP5 models created for the HCVS piping and fittings.

Note that the PCPL is based on the pressure at the bottom of the torus, so hydrostatic head must be considered when determining the pressure above the torus water level where the HCVS system is attached to the torus. The steady state venting capacity of the Dresden HCVS was determined at a torus vapor space pressure of 47 psig with RELAP5, which corresponds to the PCPL with the torus completely full of water. Note that the torus will not be filled completely with water due to HCVS

Phase 2 water addition. However, for analysis purpose a lower value of 47 psig is used. A higher torus air space pressure will result in higher flow rates through the vent line. For U3, at a venting pressure of 47 psig, the HCVS can vent 111,071 lbm/hr of steam. At 1% reactor thermal power, the required vent capacity is110,381 lbm/hr. Therefore, the vent design can accommodate a saturated steam flow rate equivalent to one percent licensed rated power. For U2, at a torus pressure of 47 psig, the HCVS can vent 121,442 lbm /hr of steam.

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

Evaluation

The wetwell vent exits the Primary Containment through the reactor building at EL 591'. Vent lines for both units are 10" diameter pipes connected to the existing 18" vent line at EL 579'-11" accessible from the 570' floor elevation. Both vent lines are then routed to Unit 2 floor elevation of 589' near the U2 Isolation Condenser where they exit the reactor building at EL 591' (74' above the plant grade of 517'). Since the reactor building refuel floor has sheet metal siding, the 74'-5" vertical run (from EL 591' to 665'-5") of the two vent lines is supported by a structural steel tower bolted to a structural steel platform attached to the reactor building south wall. The top of the HCVS pipe is 665'-5" and the top of the roof parapet is 660'-5", resulting in a release point 5-feet higher than the reactor building roof. This satisfies the guidance for height from HCVS-FAQ-04. Part of the HCVS-FAQ-04 guidance is designed to ensure that vented fluids are not drawn immediately back into any emergency ventilation intakes. Such ventilation intakes should be below a level of the pipe by 1 foot for every 5 horizontal feet. The MCR emergency intake in the ELAP event is at the 540 ft elevation which is approximately 125 feet below the HVCS pipe outlet. This intake is approximately 275 horizontal feet from the Unit 2 and U3 vent pipes, which would require the intake to be approximately 55 feet below the vent pipe. Therefore, the vent pipe is appropriately placed relative to this air intake.

The vent pipe extends approximately 5 ft. above the parapet wall of the RB roof. This satisfies the guidance for height from HCVS-FAQ-04.

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

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

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

   The two SAWA penetrations near plant grade level are missile protected by thick plates. The two HCVS vent lines exit the reactor building at EL 591' (74' above the plant grade).

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

   a. The total vent pipe exposed area is about 152 square feet for both vent lines (about 85' long, 10.75" OD each). This is less than the 300 square feet.

   b. The pipe is made of schedule 40 steel and is not plastic and the pipe components have no small tubing susceptible to missiles.

   c. There are no obvious sources of missiles located in the proximity of the exposed HCVS components.

3. The only credible missile for DNPS above 30' elevation is 1" diameter steel rod. Dresden HCVS pipe thickness is nominally 0.365" thick and the thickness of steel required to stop the 1" diameter steel rod missile is 1" thick steel. Therefore, the missile would penetrate the pipe section but is unlikely to crimp the vent line, thus a cutting tool is not required for DNPS.

4. DNPS is not screened in for hurricanes.

Based on the above description of the vent pipe design, the DNPS 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 2 & 3 for DNPS are fully independent of each other. Therefore, the status at each unit is independent of the status of the other unit. The two vent lines are supported by a common tower/platform but hydraulically there is no cross tie between them.

The existing Augmented Primary Containment Vent System has two valves 2(3)-1601-24 and 63 downstream of the new HCVS connection point as shown in Attachment 2. Both of these valves are part of Appendix J Program and go through periodic surveillance to ensure the leak rates to be within the acceptable limits.

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

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

Evaluation

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

1.2.5 The HCVS shall be capable of manual operation (e.g., reach-rod with hand wheel or manual operation of pneumatic supply valves from a shielded location), which is accessible to plant operators during sustained operations.

Evaluation

To meet the requirement for an alternate means of operation of HCVS valves via pneumatic motive force, a readily accessible alternate location, called the ROS was added. The ROS contains manually operated valves that 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 on the Turbine deck at EL 561’ adjacent to the reactor building north wall between columns 41 and 48. Each unit has a separate ROS area except for the batteries which are located on the U2 side. The ROS is readily accessible from MCR and WEC.

Refer to the sketch provided in Attachment 6 for the HCVS site layout. The controls available at the ROS location are accessible and functional under a range of plant conditions, including severe accident conditions with due consideration to source term and dose impact on operator exposure, extended loss of AC power (ELAP), inadequate containment cooling, and loss of reactor building ventilation. Table 1 contains an evaluation of all the required controls and instruments that are required for severe accident response and demonstrates that all these controls and instruments will be functional during a loss of AC power and severe accident. Table 2 contains a thermal and radiological evaluation of all the operator actions that may be required to support HCVS operation during a loss of AC power and severe accident and demonstrates that these actions will be possible without undue hazard to the operators. Attachment 6 contains a site layout showing the location of these HCVS actions.

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

Evaluation

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

Electrical power required for operation of HCVS components in the first 24 hours will come from the HCVS 125 VDC battery. These batteries are permanently installed on the south side of the turbine floor where they are protected from screened in hazards, and have sufficient capacity to provide this power without recharging. Calculation DRE15-0056 demonstrated that the 125VDC battery capacity is sufficient to supply HCVS wetwell venting components for 24 hours. At 24 hours, FLEX generators can be credited to repower the battery charger to recharge the HCVS batteries. EC 400578 concluded that the installation of these batteries would not result in an unacceptable level of hydrogen concentration in this area following a severe accident requiring HCVS operation. Calculation DRE14-0037 included the 125VDC battery chargers in the FLEX DG loading calculation, and the system is capable of carrying HCVS wetwell venting components electrical loads. 125VDC battery voltage status will be indicated on the HCVS battery chargers so that operators will be able to monitor the status of the 125VDC batteries. Attachment 3 shows a diagram of the HCVS electrical distribution system.

The pneumatic motive force is provided by two nitrogen bottles in each ROS area. The designed capacity of pneumatic system is sufficient to perform 8 vent cycles. For DNPS, only 3 cycles are calculated in first 24 hours and 8 cycles for a 7-day period. Thus, the installed capacity of the motive force is sufficient for 7 days. A manual lifting device is staged at ROS in order to transport additional gas bottles from 517’ elevation to 561’ elevation as needed.

Per EC 401069 DCS, Section 4.1.19, the nitrogen system has been sized to open valves 2(3)-1601-60 twice and to perform up to twelve (12) open and close cycles of HCVS isolation valve 2(3)-1601-93 over the course of a 24-hour period. Note that only valve 2(3)-1601-93 is cycled for venting operation while 2(3)-1601-60 will remain open once venting process is initiated. DR-MISC-058 Rev. 0 analyzed that only 3 venting cycles in 24 hours and 8 venting cycles in 7 days will be needed.

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

Evaluation

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

Dresden credits CAP for its DBLOCA. The features that prevent inadvertent actuation are two PCIVs in series with a downstream rupture disc. The downstream PCIV is a normally shut, fail-shut AOV dedicated to the HCVS function. This valve is air to open; spring to shut that requires energizing a SOV to allow the motive air to open the valve. This PCIV is controlled by its own key-locked switch. In addition, the DC power to its SOV and the motive air supplied will normally be disabled to prevent inadvertent operation.

The containment isolation valves must be opened to permit vent flow. The physical features that prevent inadvertent actuation are the key lock switches for 2(3)-1604-1, 2(3)-1604-10A, 2(3)-1604-20A and 2(3)-1605-25A at the 902(3)-13 panel in the MCR and locked closed valves at the ROS. These design features meet the requirement to prevent inadvertent actuation of HCVS.

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

Evaluation

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

This monitoring instrumentation provides the indication from the MCR per Requirement 1.2.4. In the event, that the FLEX DGs do not energize the emergency buses, the wetwell HCVS will be supplied by the HCVS 125VDC batteries and designed for sustained operation during an ELAP event using the FLEX equipment. Containment pressure and wetwell level instrumentation may be read by portable measuring equipment using FSG-30 if the FLEX DGs do not energize the emergency buses.

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

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

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

<u>Evaluation</u>

The HCVS radiation monitoring system consists of an ion chamber detector at 589’ floor, coupled to a process and control module. The process and control module is mounted in the ROS at the Turbine Building 561’ elevation. The MCR has radiation indicator on 902(3)-13 panel to verify venting operation. The RM detector is fully qualified for the expected environment at the vent pipe during accident conditions, and the process and control module is qualified for the environment in the Turbine Building ROS. Both components are qualified for the seismic requirements. Table 1 includes a description and qualification information on the radiation monitor.

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

Evaluation

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

The existing hardened vent piping, between the wetwell and the Reactor Building roof, including 2(3)-1601-60, 2(3)-1601-93, 2(3)-1601-01 are designed to 53 psig and 300 ºF. The rupture disc 2(3)-1601-01 is designed to burst at 20 psig. Wetwell vent piping and components installed downstream of the containment isolation boundary are designed for beyond design basis conditions.

HCVS piping and components have been evaluated for radiological impact due to HCVS system operation under severe accident conditions using the guidance provided in HCVS-FAQ-08 and HCVS-WP-02.

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

Evaluation

In order to prevent a detonable mixture from developing in the pipe, a purge system is installed to purge hydrogen from the pipe with argon after a period of venting and to purge oxygen from the pipe prior to resuming venting. The purge system is described in EC 400578. After an initial line-up of locked valve 2(3)-1605-14 in ROS and opening argon bottle manifold valves, the system can be operated from MCR by energizing the solenoid valve 2(3)-1605-25A. Per DRE15-0047, a 26-second purge time is required to burst the rupture disc. For purging the combustibles after a vent cycle, a 40-second purge time has been calculated.

Using the purge system described above meets the requirement to ensure the flammability limits of gases passing through the vent pipe will not be reached.

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

Evaluation

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

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

Evaluation:

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

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

DNPS has implemented the following operation, testing and inspection requirements for the HCVS to ensure reliable operation of the system. These are from NEI 13-02, Table 6.1. The implementing modification packages contain these as well as additional testing required for post-modification testing.

Table 3-3: Testing and Inspection Requirements

Description	**Frequency**
Cycle the HCVS valves[1] and the interfacing system valves not used to maintain containment integrity during operations.	Once per every[2] operating cycle.
Cycle the HCVS check valves not used to maintain containment integrity during unit operations.[3]	Once per every other[4] operating cycle.

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[1] Not required for HCVS check valves.

[2] After two consecutive successful performances, the test frequency may be reduced to a maximum of once per every other operating cycle.

[3] Not required if integrity of check function (open and closed) is demonstrated by other plant testing requirements.

[4] After two consecutive successful performances, the test frequency may be reduced by one operating cycle to a maximum of once per every fourth operating cycle.

Description	Frequency
Perform visual inspections and a walk down of HCVS components	Once per operating cycle
Functionally test the HCVS radiation monitors.	Once per operating cycle
Leak test the HCVS.	(1) Prior to first declaring the system functional; (2) Once every three operating cycles thereafter; and (3) After restoration of any breach of system boundary within the buildings
Validate the HCVS operating procedures by conducting an open/close test of the HCVS control logic from its control panel (primary and alternate) and ensuring that all interfacing system boundary[5] valves move to their proper (intended) positions.	Once per every other operating cycle

2. HCVS Quality Standards:

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

Evaluation:

The HCVS upstream of and including the second containment isolation valve and penetrations are not being modified for order compliance so that they continue to be designed consistent with the design basis of primary containment including pressure, temperature, radiation, and seismic loads.

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

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

instrumentation (local and remote) components.

Evaluation:

The HCVS components downstream of the outboard containment isolation valve and components that interface with the HCVS are routed in seismically qualified structures or supported from seismically qualified structures.

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

Table 1 contains a list of components and instruments required to operate HCVS, their qualification and evaluation against the expected conditions. All instruments are fully qualified for the expected seismic conditions so that they will remain functional following a seismic event.

Section IV: HCVS Phase 2 Final Integrated Plan

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

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

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

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

1. HCVS Drywell Vent Functional Requirements

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

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

2. Containment Venting Strategy Requirements

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

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

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

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

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

DNPS 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.

<u>Section IV.B</u>: HCVS Existing System

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

<u>Section IV.C</u>: 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.

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

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

The SAWA system, shown on Attachment 4, uses FLEX flow paths inside the reactor building. The system consists of a SAWA pump injecting into the Reactor Pressure Vessel (RPV) and SAWM consists of flow control at the FLEX/SAWA manifold along with wetwell level indication in the MCR, to ensure that the wetwell vent is not submerged (SAWM). The SAWA injection path, starts at the Ultimate Heat Sink (UHS) where the SAWA pump suction will be submerged near the Cribhouse intake. The pump discharge goes to the SAWA Pump Trailer where it will be routed, using lay-flat hoses, to the FLEX/SAWA manifold near the west wall of the Reactor Building (primary location) or MMD shop on the east side (alternate location). The water goes through FLEX/SAWA manifold, throttling valves, flow meters and hoses connected to the reactor building penetrations. The valves inside the reactor building will be lined-up so that water can be injected in to RPV via Low Pressure Coolant Injection (LPCI) system. This LPCI connection ties to the Reactor Pressure Vessel (RPV). BWROG generic assessment, BWROG-TP-15-008 (Reference 37), provides the principles of Severe Accident Water Addition to ensure protection of containment. This SAWA injection path is qualified for the all screened in hazards (Section 1) in addition to severe accident conditions.

Once the hose deployment and valve line-up is complete, all actions of flow control and measurement will be performed at the manifold location(s) that have been evaluated to be low dose areas. Operators at the manifold will be in communication with the MCR where other parameters such as suppression pool level is monitored. Operators at the SAWA pump and FLEX/SAWA manifold will be in low dose areas when no equipment manipulation is needed.

Note that flow path described above applies for all BDBEEs except for river flooding. For DNPS, the Probable Maximum Flood (PMF) is 529' including 4' of waves. This Probable Maximum Flood (PMF) is about 12 feet above the plant grade of 517'. Instead using the SAWA pump, DNPS will use two barge mounted diesel pumps (Flood Pumps) as part of FLEX flood strategy. One pump will be able to provide all water make-up needs for both units under FLEX and/or Severe Accident conditions. The second pump provides redundancy.

Since flooding is a prediction based event with about 24 hours of advance warning, DNPS procedure DOA 0010-04 “Floods” describes the strategy to deploy all necessary equipment if a flood is predicted. The Reactor Building will be secured by flood barriers to keep the flood waters entering the torus basement and rendering the wetwell vent inoperable. The barge mounted flood pumps will be staged in U3 TB trackway prior to flooding. As the flood waters rise or recede, the flood pumps will remain functional. FSG-60 describes the FLEX Flood Pump Deployment-Operation. The flood pump will take suction from the flood water and deliver it to the FLEX/SAWA manifold with flow measuring devices staged at TB mezzanine at EL 538'. Hoses from the manifold will be run to the turbine deck at EL 561' and then through the 570' interlock to the reactor building. Attachment 6G and 6H schematically show the SAWA flow path during a flooding event. Flooding at Dresden grade level of 517' has been determine to be a very low probability event (less than 1 in 10,000 years) as documented in Dresden Integrated Assessment Report (Ref. 34).

<u>Section IV.C.2</u>: Severe Accident Assessment of Flow Path

The actions inside the RB where there could be a high radiation field due to a severe accident will be to line-up valves inside the RB penetrations and the LPCI connections accessed from the 517' level. The action to line-up valves inside the RB can be performed before the dose is unacceptable, under the worst-case scenario within the first 1.3 hours after the loss of RPV injection. This time was validated as part of the Time Sensitive Action validation for EA-13-109. Procedure FSG-04 directs early accomplishment of actions that must be done early in the severe accident event where there is a loss of All AC power and a loss of all high-pressure injection to the core. In this event, core damage is not expected for at least 1.3 hours so that there will be no excessive radiation levels in the RB when the valves are operated. The other SAWA actions all take place outside the RB (or inside the RB at a safe location) at the UHS, MCR, CST, FLEX/SAWA manifold, RB outer wall, FLEX Buildings A & B, and the deployment pathways. Since these locations are outside the RB, they are shielded from the severe accident radiation by the thick concrete walls of the RB. Once SAWA is initiated, the operators will monitor the response of containment from the MCR to determine that venting and SAWA are operating satisfactorily, maintaining containment pressure low to avoid containment failure. Stable or slowly rising trend in wetwell level with SAWA at the minimum flow rate indicates water on the drywell floor up to the vent pipe openings. After some period of time, as decay heat levels decrease, the operators will be able to reduce SAWA flow to keep the core debris cool while avoiding overfill the torus to the point where the wetwell vent is submerged.

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

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

Section IV.C.4: Available Freeboard Use

The torus freeboard volume (above 14.9’ max. LCO water level) is 1,021,500 gallons before the water level reaches the bottom of the wetwell vent pipe as shown in Attachment 1. BWROG generic assessment BWROG-TP-15-011, provides the principles of Severe Accident Water Management to preserve the wetwell vent for a minimum of seven days. After containment parameters are stabilized with SAWA flow, SAWA flow will be reduced to a point where containment pressure will remain low while wetwell level is stable or very slowly rising. For DNPS, the SAWA flow rate is 421 gpm for first 4 hours followed by 85 gpm for 164 hours. The total SAWA and SAWM water addition will be 937,440 rounded up to 940,000 gallons. Thus, the remaining freeboard space will be 81,500 gallons. As shown in DRE14-0008 Table 1, this freeboard volume translates to about 2.7 ft high air space above the torus water, ensuring that the wetwell vent will remain operational as a result of SAWA/SAWM strategy for a seven-day period.

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

The upper range of wetwell level indication (LI 2(3)-1640-10A/B) provided for SAWA/SAWM is 30 feet elevation, which is the same as the elevation of the wetwell vent line. The wetwell level indication spans the entire volume of the torus and defines the upper limit of wetwell volume that will preserve the wetwell vent function as shown in Attachment 1.

Section IV.C.6: Wetwell vent service time

EPRI Technical Report 3002003301 and BWROG-TP-15-011 (Reference 38), demonstrate that throttling SAWA flow after containment parameters have stabilized, in conjunction with venting containment through the wetwell vent will result in a stable or slowly rising wetwell level. The references demonstrate that, for the scenario analyzed, wetwell level will remain below the wetwell vent pipe for greater than the seven days of sustained operation allowing significant time for restoration of alternate containment pressure control and heat removal.

Section IV.C.7: Strategy time line

The overall accident management plan for DNPS 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 DNPS SAMGs. In particular, EPG/SAG Revision 3, when implemented with Emergency Procedures Committee Generic Issue 1314, allows throttling of SAWA in order to protect containment while maintaining the wetwell vent in service. The SAMG flow charts direct use of the hardened vent as well as SAWA/SAWM when the appropriate plant conditions have been reached.

Using NEI 12-06 Appendix E, DNPS has validated that the SAWA pump can be deployed and commence injection in less than 8 hours. 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 421 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 wetwell level.

NEI 13-02 generic analysis per NEI 13-02 Reference 27 demonstrated that, SAWA flow could be reduced to 85 gpm after four hours of initial SAWA flow rate and containment would be protected. At some point wetwell level will begin to rise indicating that the SAWA flow is greater than the steaming rate due to containment heat load such that flow can be reduced. While this is expected to be 4-6 hours, no time is specified in the procedures because the SAMGs are symptom based guidelines.

Section IV.C.8: SAWA Flow Control

DNPS will accomplish SAWA flow control by the use of throttle valves on the FLEX/SAWA manifold. The operators at the FLEX/SAWA manifold will be in communication with the MCR via radios or unaffected telephones and the exact time to throttle flow is not critical since there is a large margin between normal wetwell level and the level at which the wetwell vent will be submerged. The communications capabilities that will be used for communication between the MCR and the SAWA flow control location are the same as that evaluated and found acceptable for FLEX strategies. The communications capabilities have been tested to ensure functionality at the SAWA flow control and monitoring locations. DNPS utilizes FSG-39, “FLEX Communication Options” to communicate between the MCR and remote locations such as the Cribhouse Intake and FLEX/SAWA flow control manifold.

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

Section IV.C.9.1: SAWA Pump

DNPS uses one portable diesel-driven pump for FLEX and SAWA strategies for all BDBEEs except for flooding where a barge mounted diesel pump (Flood Pump) will be deployed. Two barge mounted pumps were procured as part of FLEX implementation. As documented in DRE17-0008 these pumps have been shown to be capable of supplying the required flow rates to the RPV, Isolation condenser and the SFP for all SAWA and FLEX scenarios. DNPS has procured two identical SAWA pumps that are trailer mounted. Each trailer has diesel driven hydraulic unit, hydraulically driven submersible pump, a crane to deploy the pump, instrumentation and hydraulic hose reels. This fully contained pump unit is key to a rapid deployment of the pump in the UHS. Both pump trailers are stored in the FLEX robust Building B, and are therefore qualified to function after a seismic event. The flood pumps are stored in a commercial building FLEX Building C and will be moved and deployed prior to site flooding.

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

For DNPS the SAWA generic flow rate is 421 gpm which is the site-specific flow rate when the site's rated thermal power is compared to the reference power level of NEI 13-02. The initial SAWA flow will be injecting to the RPV within 8 hours of the loss of injection. The reference flow rate is 500 gpm for a reactor with power level of 3514 MWth, equivalent to the reference plant rated thermal power level used in NUREG-1935, State of the Art Reactor Consequence Analysis (SOARCA). NUREG 1935 is Reference 9 of NEI 13-02 Revision 1. Since DNPS rated power is 2957 MWth, the initial DNPS SAWA flow rate will be 421 gpm (500 x 2957/3514).

Section IV.C.9.3: SAWA Pump Hydraulic Analysis

Calculation DRE17-0008 analyzed the SAWA and Flood pumps and the lineup for RPV injection that would be used for SAWA. This calculation showed that the SAWA and Flood pumps have adequate capacity to meet the SAWA/FLEX flow rates required to protect containment under various scenarios where either one or both units are under FLEX or SA conditions. Note that this calculation includes analyses for both flooding and non-flooding events since different equipment is employed for these events.

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

The DNPS SAWA flow path from FLEX/SAWA manifold to the LPCI lines includes check valves 2(3)-1501-25A inside the Reactor Building as shown on Attachment 4. These valves will prevent any backflow to the FLEX/SAWA manifold.

The SAWA (LPCI) backflow prevention valves are also Primary Containment Isolation Valves (PCIVs) whose integrity of check function (open and closed) is demonstrated by other plant testing requirements such that additional testing per NEI 13-02 Revision 1 Section 6.2 is not required for these valves per NEI 13-02 Revision 1 Table 6-1 Note 3. Thus backflow is prevented by check valves in the SAWA flow path inside the RB.

Note that the SAWA pump delivers UHS water to the FLEX/SAWA manifold using two 5” hoses running in parallel. This was necessary to reduce the friction losses and keeping the system pressure below 200 psi (hose pressure rating). Under extreme cold conditions, when water is not running in the system, freezing of hose water was postulated. In order to mitigate this, the hose system is designed such that with proper valve line up, one 5” hose can deliver the water to the manifold and the other 5” hose will return the flow back to UHS. Only a small amount of recirculation will keep the system from freezing. No water from the Reactor building will run back during this recirculation mode.

Section IV.C.9.5: SAWA Water Source

The SAWA water source for DNPS is the Ultimate Heat Sink (UHS) that comprises of intake canal and the discharge canal volume. Under a flooding scenario, the initial water source will be the flood waters until it recedes and then UHS will be the source. Under normal river flow conditions this source can provide water for very prolonged operation. Under Dresden Lock and Dam failure scenario, the river pool near the intake canal will drop to a very low level and the high point at the intake canal (EL 494.2’) will be exposed. All the water in the intake and the discharge canals below this elevation will be trapped. To support FLEX and SAWA strategies, the trapped water will be sufficient for about 3 days. For flooding, Dresden will follow the EA-12-049 compliant strategy. DOA 0010-01, Dresden Lock and Dam Failure provides guidance to refill the UHS within 24-hour period using two high-volume, low-head pumps taking suction from the river stream. These pumps and other river access equipment are readily available from local rental companies. Note that the River system has a minimum flow of 3000 ft3/s on 98% of the days (UFSAR 2.4.1). This is much more than the water needs during FLEX/SAWA operations.

Based upon the above considerations, DNPS has ample supply of water to support FLEX/SAWA strategies for long-term.

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

Section IV.C.9.6.1: SAWA Pump Power Source

DNPS has procured two identical pumps that are trailer mounted. Each trailer has diesel driven hydraulic unit, hydraulically driven submersible pump, a crane to deploy the pump, instrumentation and hydraulic hose reels. This fully contained pump unit is key to a rapid deployment of the pump in the UHS. The hydraulic units are diesel driven. Each trailer has a double wall 375-gallon capacity tank. The full-load consumption of the diesel engine is 15.3 GPH. Thus, the pump will run for about 24 hours before refueling is needed. DNPS maintains sufficient supply of diesel fuel for a sustained operation for more than 7 days. FSG-32 provides guidance for fueling FLEX equipment including the UHS pump. Both of these SAWA pumps are stored in a fully protected (except for flooding) FLEX Building B.

For a flooding event two Barge mounted diesel driven pumps (termed as Flood Pumps) will be deployed per FSG-60 in U3 TB Trackway. These pumps are capable of providing 1000 gpm of flow at a head of 270 ft. FSG-32 provides guidance for fueling FLEX equipment including the Flood pumps. The two diesel driven pumps and the barge are stored in a commercial building C.

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

Table 1 shows the electrical power source for the SAWA/SAWM instruments. For the instruments powered by the HCVS 125VDC battery, calculation DRE15-0056 demonstrates that the batteries can provide power until the FLEX generator restores power to the battery charger.

The HCVS loads were added to the FLEX load on the FLEX DG (per EA-12-049) and was evaluated in calculation DRE14-0037. This calculation demonstrated that the total kW and kVA loading is less than machine rating of 800kW and 1000KVA, and therefore, the loading meets the acceptance criteria of the calculation. There are no additional loads on the FLEX DGs for SAWA and SAWM. The FLEX generator was qualified to carry the rest of the FLEX loads as part of Order EA-12-049 compliance.

Section IV.C.10: SAWA/SAWM Instrumentation

1) The new SAWA/SAWM flow meter is capable of measuring flow in 80 – 2300 gpm range.

2) The SAWA/SAWM flow meter is required to determine the flow of water going to the Reactor Pressure Vessel if additional cooling is required. The flow meter is an instrument that will measure flow rate directly without using charts or doing calculations. The instrument is designed around a digital meter with a paddlewheel type flow sensor and pressure sensor mounted in a flow tube.

3) The flow meter is capable of withstanding pressure up to 300 PSI which exceeds the 200 PSIG requirement. While no temperature range is given, talks with the vendor have stated that the flow meter should function as low as -25°F. Furthermore, the flow meter is only required when changing the flow through the manifold and can be disconnected and brought to a warm location when not required. The flow meter is stored in a robust case in a seismically qualified building. Radiation exposure will be kept minimal based on the storage location and use.

4) The unit is powered by an internal lead acid battery which will power the flow meter for 6 hours. As a backup, the flow meter may be powered by a 120/240 VAC source, which can be provided from the FLEX diesel generator.

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

Section IV.C.10.1: SAWA/SAWM instruments

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

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

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

The SAWA flow meter is a paddle-wheel flow meter mounted in the piping that is attached to the discharge side of the FLEX/SAWA manifold and is powered by its own internal battery.

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

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

The drywell pressure and wetwell level instruments are pressure and differential pressure detectors that are safety-related and qualified for post-accident use. These instruments are qualified per RG-1.97 Revision 2 (Reference 32) which is the DNPS committed version per UFSAR Section 7.5 as post-accident instruments and are therefore qualified for EA-13-109 events.

The SAWA flow meter is rated for intermittent use under the expected ambient conditions and so will be available for the entire period of sustained operation. The flowmeter battery is rated for 6 hours of continuous operation. Furthermore, since the pump is deployed outside the RB, and on the opposite side of the RB from the vent pipe, there is no concern for any effects of radiation exposure to the flow instruments mounted on the SAWA pump trailer. The FLEX/SAWA manifold flowmeters will be on the west side (primary location) of the RB or on the east side (alternate location) in low dose areas. The SAWA pump trailers also have flowmeters but these are not credited as SAWA/SAWM instruments.

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

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

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

The most important Severe Accident consideration is the radiological dose as a result of the accident and operation of the HCVS. DRE16-0010, Rev. 1 analyzed dose at different locations and times where operator actions will take place during FLEX/SAWA/SAWM activities. Tables 8-1 to 8-4 of DRE16-0010 provide this dose information. Key locations are MCR, ROS, travel paths for hose routing, UHS and FLEX/SAWA manifold location. FSG-31 provides guidance for ventilation strategies at various location to mitigate high temperature conditions, including use of ice vests. DRE17-0013 provides thermal analysis of Turbine Building (ROS location) during SAWA.

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

Since the SAWA pumps are stored in the FLEX Building B and will be operated from outside the RB, on the opposite side of the RB 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.

Inside the RB the SAWA flow path consists of piping that will be unaffected by the radiation dose and hoses that will be run only in locations that are shielded from significant radiation dose or that have been evaluated for the integrated dose effects over the period of Sustained Operation. These hoses are qualified for the temperatures expected in the areas they will be run. 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 RB actions within the first 7 hours. The actions including access routes outside the Reactor Building that will be performed after the first use of the vent during severe accident conditions (assumed to be 7 hours per HCVS-FAQ-12) are located such that they are either shielded from direct exposure to the vent line or are a significant distance from the vent line so that expected dose is maintained below the ERO exposure guidelines.

As part of the response to Order EA-12-049, DNPS used the results of calculation DRE97-0214. This provides temperature response of the Reactor and Control Buildings during a DBA LOCA event. Since, in the severe accident, the core materials are contained inside the primary containment, the temperature response of the RB and CB is driven by the loss of ventilation and ambient conditions and therefore will not change. Thus, the DBA LOCA calculations are bounding and acceptable for severe accident use.

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

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

The SAWA pump and flow monitoring equipment can all be operated from outside the RB at ground level. The DNPS 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 FLEX/SAWA manifold, wetwell 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 DNPS process for initiating and/or revising procedures and contain the following details:

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

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

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, SAMGs prioritize the preservation of primary containment integrity while limiting radioactivity releases as follows:

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

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

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

Section V.B: HCVS Out of Service Requirements

Provisions for out-of-service requirements for FLEX and HCVS are provided in CC-DR-118 Rev 3, Attachments 11 through 14.

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

DNPS 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. Item 2 is not applicable because DNPS credits the Isolation Condenser for containment heat removal and the HCVS is not needed to support FLEX strategies.

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). DNPS will perform the first drill demonstrating at least one of the above capabilities by November 15, 2021 which is within four years of the first unit compliance with Phase 2 of Order EA-13-109. Subsequent drills, tabletops or exercises will be performed to demonstrate the capabilities of different elements of Items 1, 2 and/or 3 above that is applicable to DNPS in subsequent eight year intervals.

Section VI: References

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

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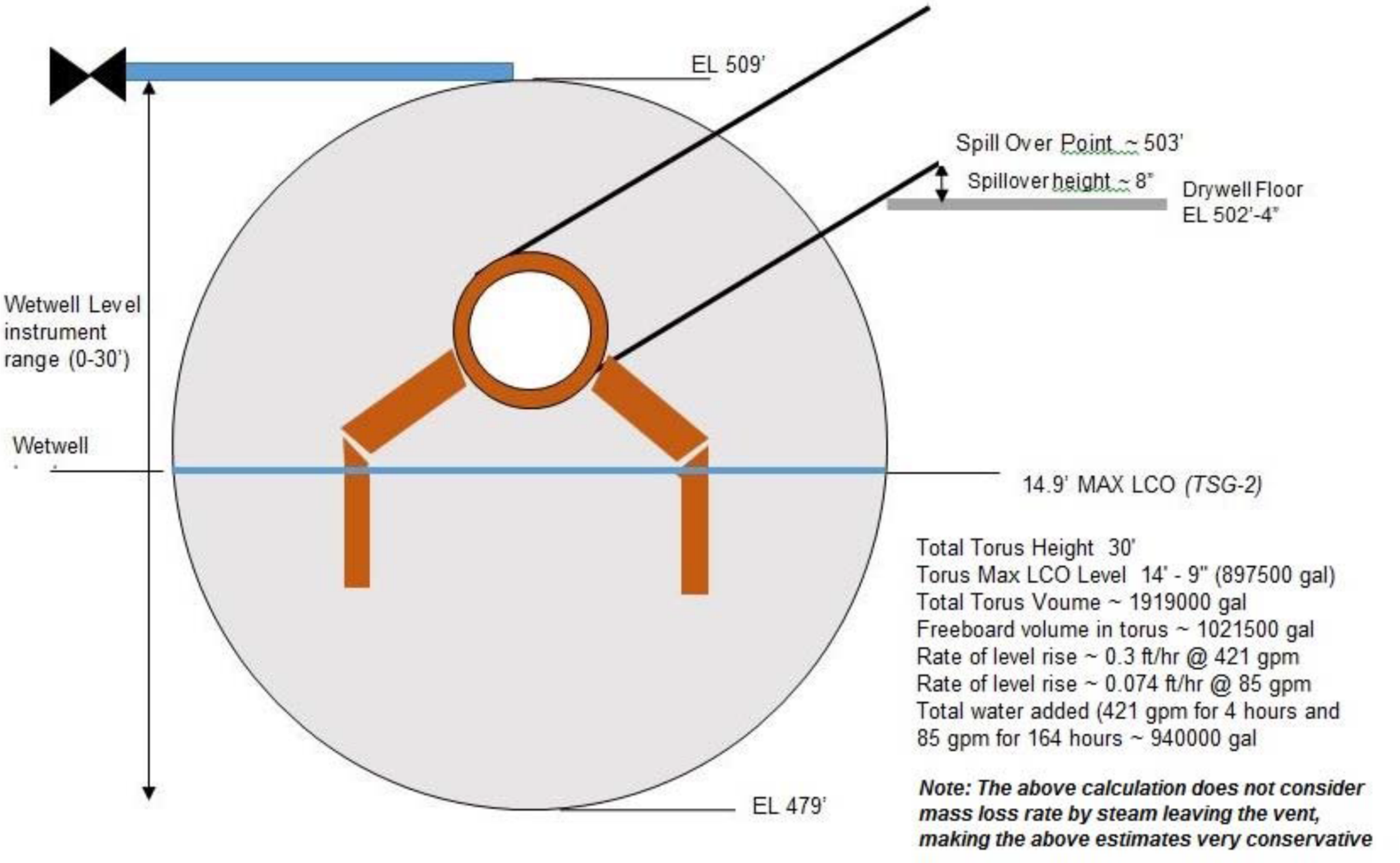
[6] Where two ADAMS accession numbers are listed, the first is the reference document and the second is the NRC endorsement of that document.

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

Number	Rev	Title	Location[6]
12. JLD-ISG-2013-02	0	Compliance with Order EA-13-109, Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation under Severe Accident Conditions	ML13304B836
13. JLD-ISG-2015-01	0	Compliance with Order EA-13-109, Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation under Severe Accident Conditions	ML15104A118
14. HCVS-FAQ-10	1	Severe Accident Multiple Unit Response	ML15273A141 ML15271A148
15. HCVS-FAQ-11	0	Plant Response During a Severe Accident	ML15273A141 ML15271A148
16. HCVS-FAQ-12	0	Radiological Evaluations on Plant Actions Prior to HCVS Initial Use	ML15273A141 ML15271A148
17. HCVS-FAQ-13	0	Severe Accident Venting Actions Validation	ML15273A141 ML15271A148
18. Phase 1 OIP	0	HCVS Phase 1 Overall Integrated Plan (OIP)	ML14184A018
19. Combined OIP	0	Combined HCVS Phase 1 and 2 Overall Integrated Plan (OIP), Dec. 2015	ML15352A027
20. Phase 1 ISE	0	HCVS Phase 1 Interim Staff Evaluation (ISE)	ML15007A491
21. Phase 2 ISE	0	HCVS Phase 2 Interim Staff Evaluation (ISE)	ML16273A430
22. 1st Update	0	First Six-Month Update, Dec. 2014	ML14351A442
23. 2nd Update	0	Second Six-Month Update, June 2015	ML15181A220
24. 3rd Update	0	Third Six-Month Update (same as Ref 19)	ML15352A027
25. 4th Update	0	Fourth Six-Month Update, June 2016	ML16182A393
26. 5th Update	0	Fifth Six-Month Update, Dec. 2016	ML17353A045
27. 6th Update	0	Sixth-Six Month Update, June 2017	ML17178A078
28. TB FLEX/SAWA Heat-up Calc.	0	DRE17-0013, Transient Thermal Analysis of Turbine Building for FLEX During SAWA	N/A
29. TB ROS Temp. Evaluation	0	EC Eval. 403298 ROS Temp Evaluation	N/A
30. NEI 12-06	0	Diverse and Flexible Coping Strategies (FLEX) Implementation Guide	ML12221A205
31. EA-12-049	0	Issuance of Order to Modify Licenses With Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events, dated March 12, 2012.	ML12054A735

Number	Rev	Title	Location[6]
32. RG 1.97	3	Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Conditions During and Following an Accident	ML003740282
33. TR-1026539	0	EPRI Investigation of Strategies for Mitigating Radiological Releases in Severe Accidents BWR, Mark I and Mark II Studies, October 2012	N/A
34. RS-17-088		Exelon Generation Company, LLC Response to March 12, 2012, Request for Information Enclosure 2, Recommendation 2.1, Flooding, Required Response 3, Flooding Integrated Assessment Submittal, September 8, 2017	N/A
35. CC-DR-118-1003	1	Dresden FLEX Final Integrated Plan Document, November, 2017	N/A
36. DRE97-0214	1	Reactor Building Post-LOCA Temperature Analysis, July 1998	N/A
37. BWROG-TP-15-008	0	BWROG Fukushima Response Committee, Severe Accident Water Addition Timing, Sept. 2015	N/A
38. BWROG-TP-15-011	0	BWROG Fukushima Response Committee, Severe Accident Water Management Supporting Evaluations, Oct. 2015	N/A
39. TP-17-3-0375	0	BWROG Fukushima Response Committee Owners' Group Positions (OGPs), HCVS-OGP-001 through -003. Oct. 2017	N/A
40. TP-17-5-0375	0	BWROG Fukushima Response Committee Owners' Group Positions (OGPs), HCVS-OGP-005 through -008. Oct. 2017	N/A

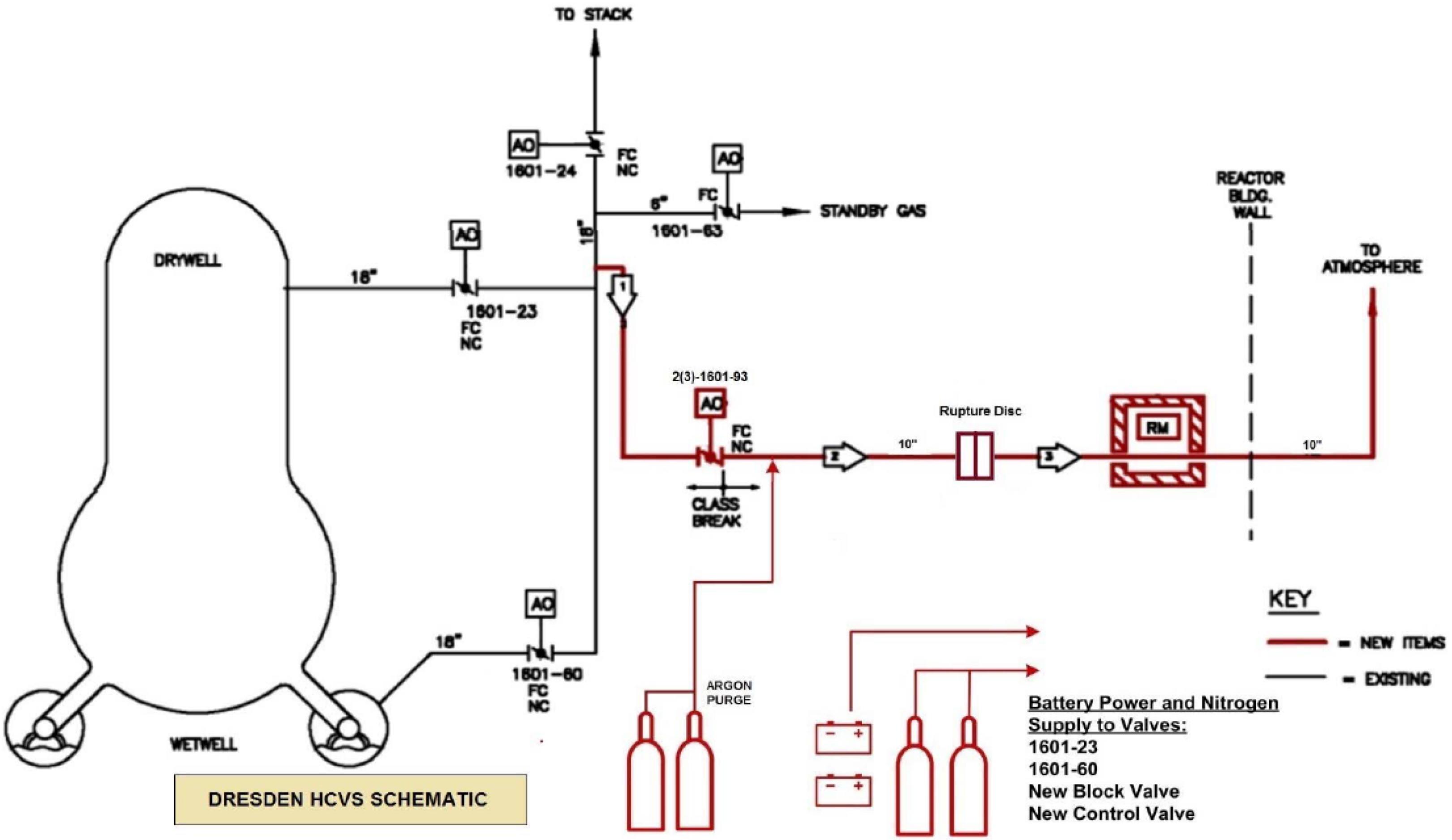
Attachment 1: **Phase 2 Freeboard diagram**



Total Torus Height 30'
Torus Max LCO Level 14' - 9" (897500 gal)
Total Torus Voume ~ 1919000 gal
Freeboard volume in torus ~ 1021500 gal
Rate of level rise ~ 0.3 ft/hr @ 421 gpm
Rate of level rise ~ 0.074 ft/hr @ 85 gpm
Total water added (421 gpm for 4 hours and
85 gpm for 164 hours ~ 940000 gal

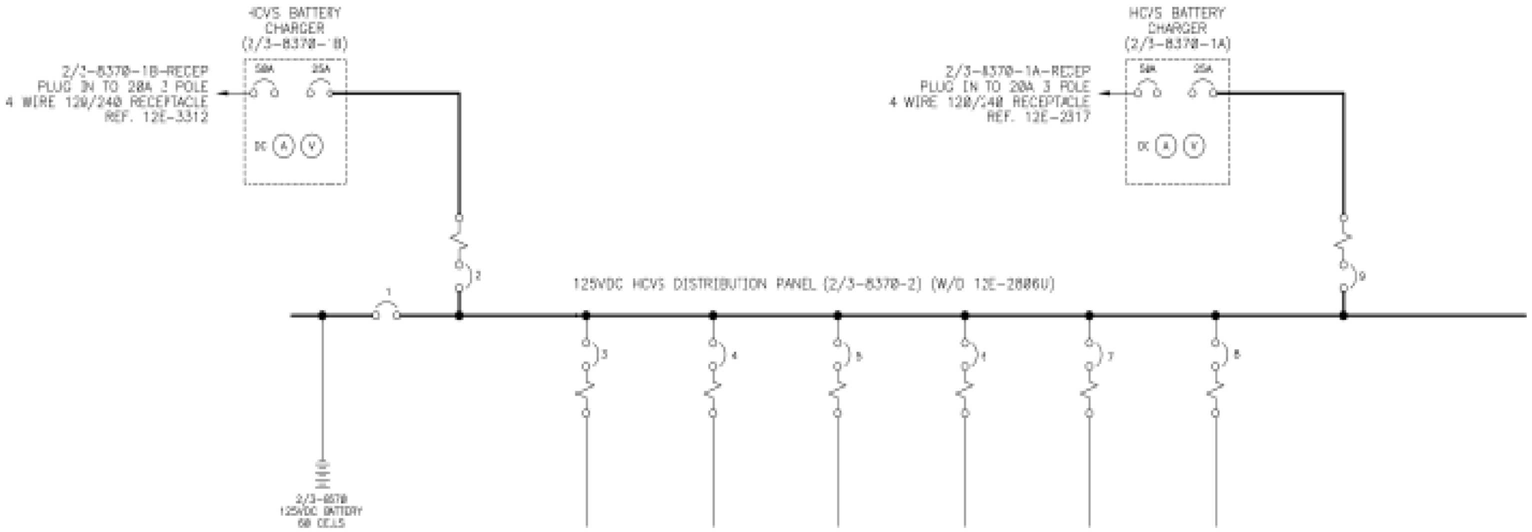
Note: The above calculation does not consider mass loss rate by steam leaving the vent, making the above estimates very conservative

Attachment 2: One Line Diagram of HCVS Vent Path



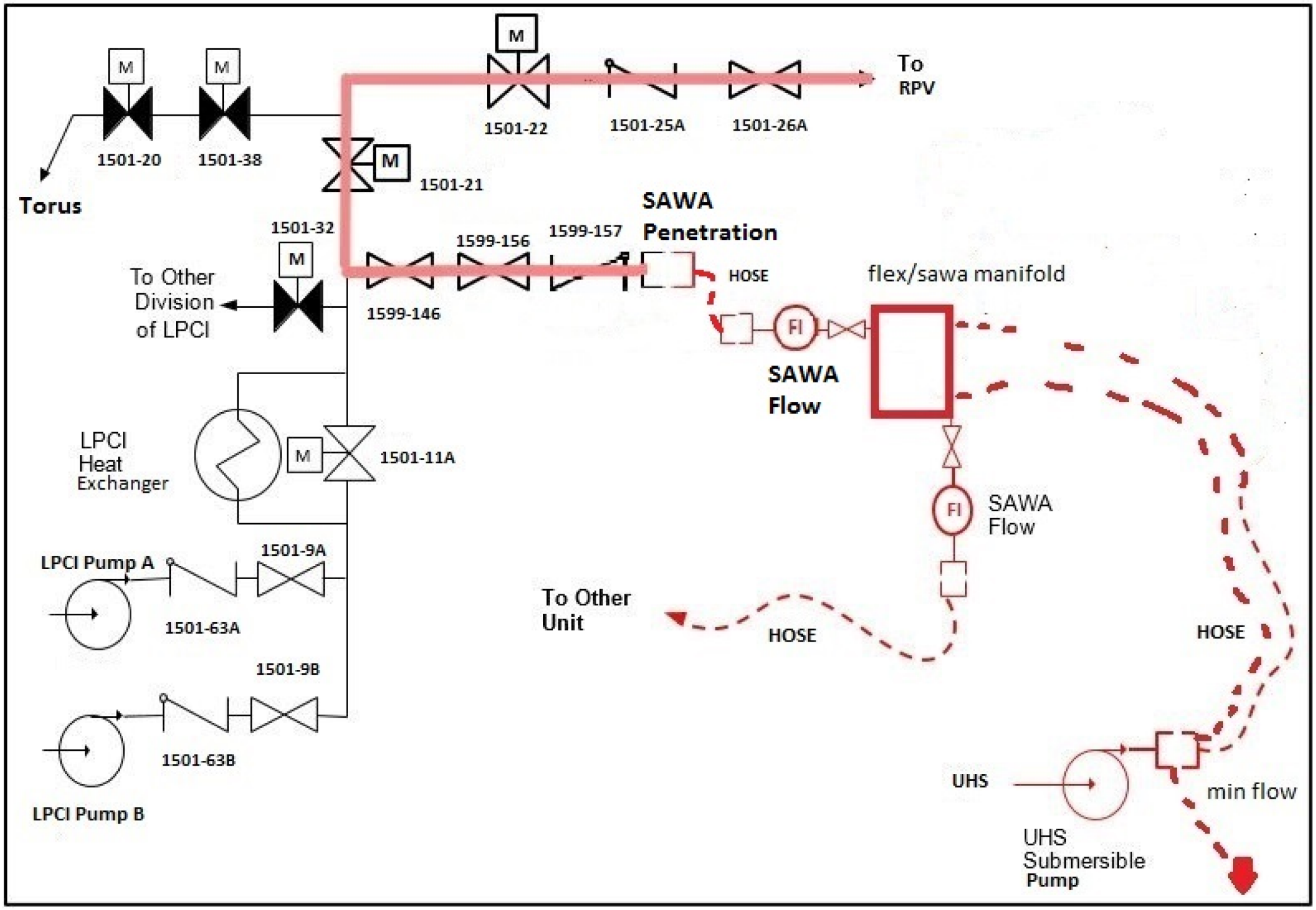
Battery Power and Nitrogen Supply to Valves:
1601-23
1601-60
New Block Valve
New Control Valve

<u>Attachment 3</u>: One Line Diagram of HCVS Electrical Power Supply - Units 2 & 3

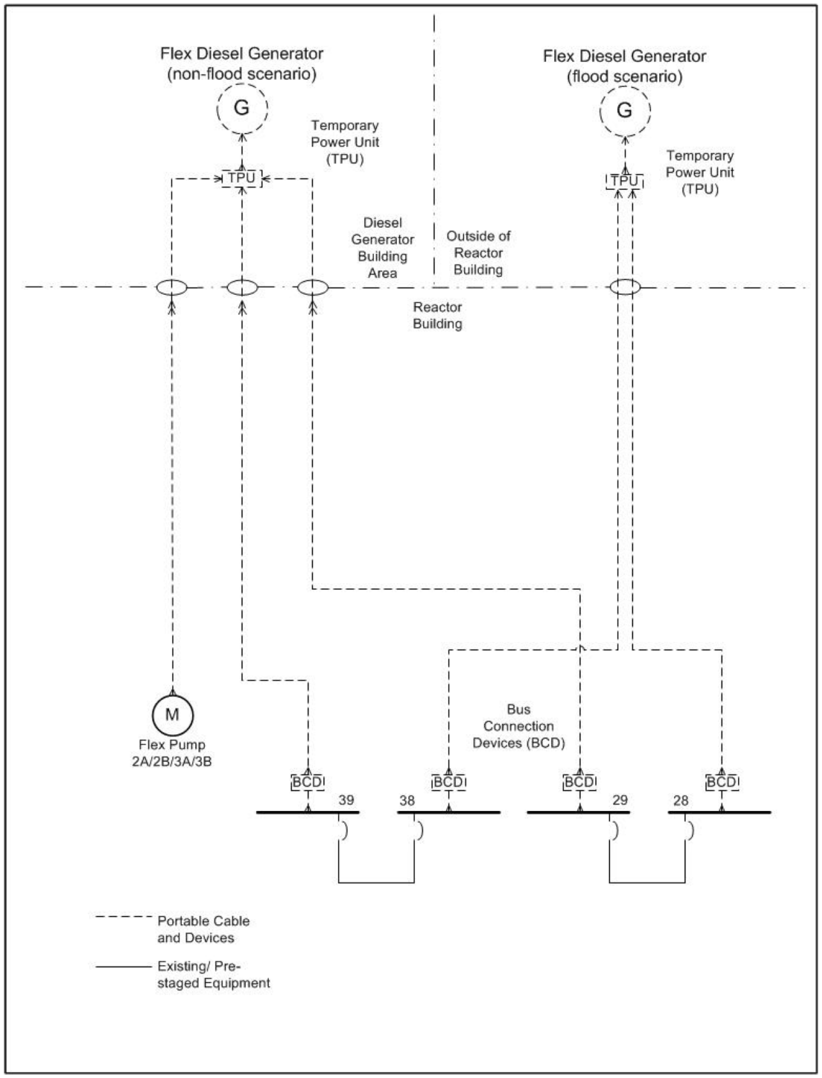


SCHEMATIC DIAGRAM	—	—	12E-3512B	12E-3512C			12E-2512C	12E-2512B	—
WIRING DIAGRAM	12E-2806U	12E-2806U	12E-3706B	12E-3806C			12E-2806D	12E-2746B	12E-2806U
ACB TRIP RATING (AMP)	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
LOAD RATING	—	—	—					—	—
SERVICE	125VDC HCVS BATTERY (2/3-8370)	125VDC HCVS BATTERY CHARGER B (2/3-8370-1B)	HCVS PANEL 903-13	HCVS RADIATION MONITOR (3-1603-21)	BATTERY TESTING LOAD CART CONNECTION	SPARE	HCVS RADIATION MONITOR (2-1603-21)	HCVS PANEL 902-13	125VDC HCVS BATTERY CHARGER A (2/3-8370-1A)

Attachment 4: One Line Diagram of SAWA Flow Path

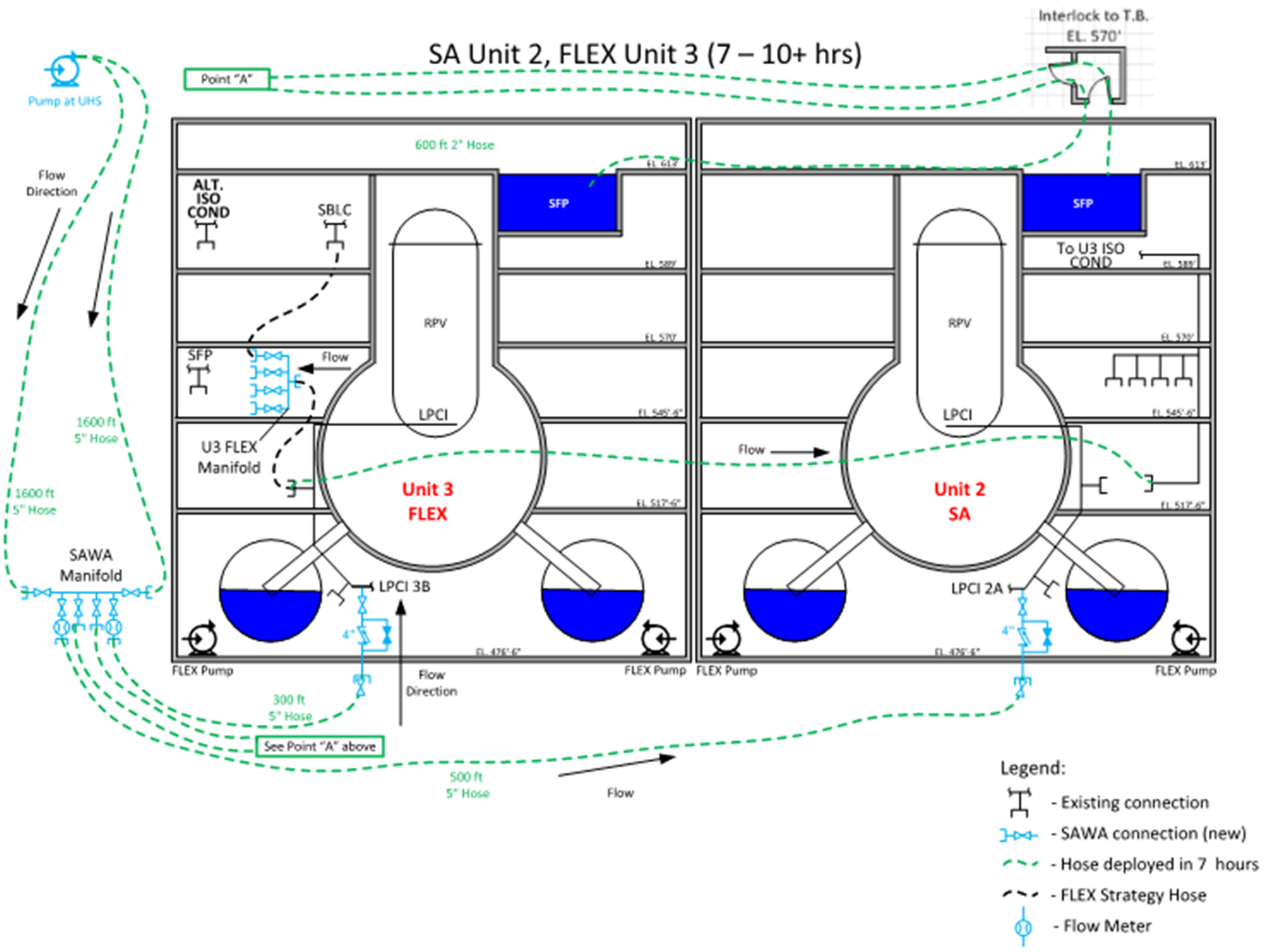


Attachment 5: One Line Diagram of SAWA Electrical Power Supply

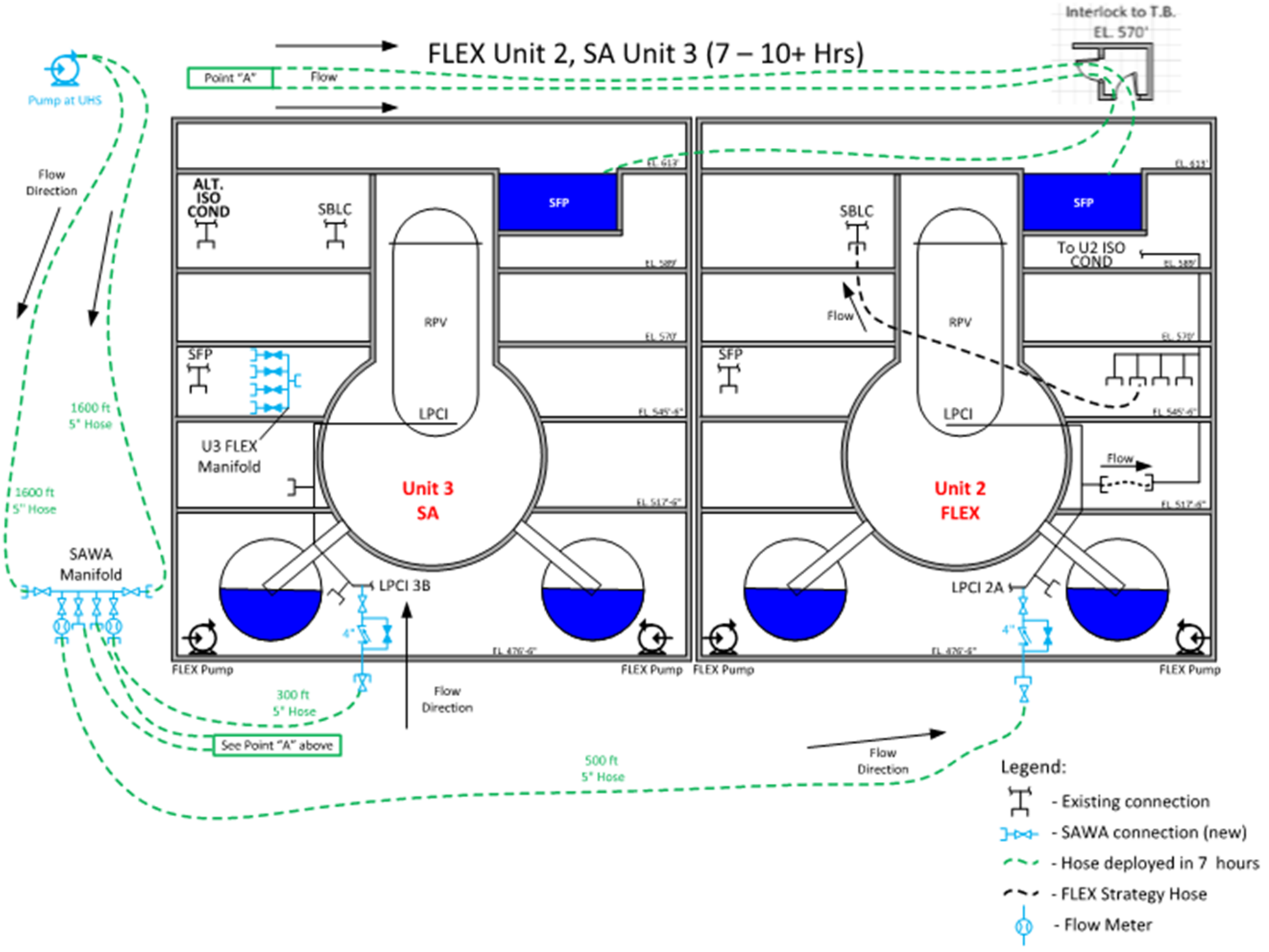


Attachment 6: Plant Layout Showing Operator Action Locations

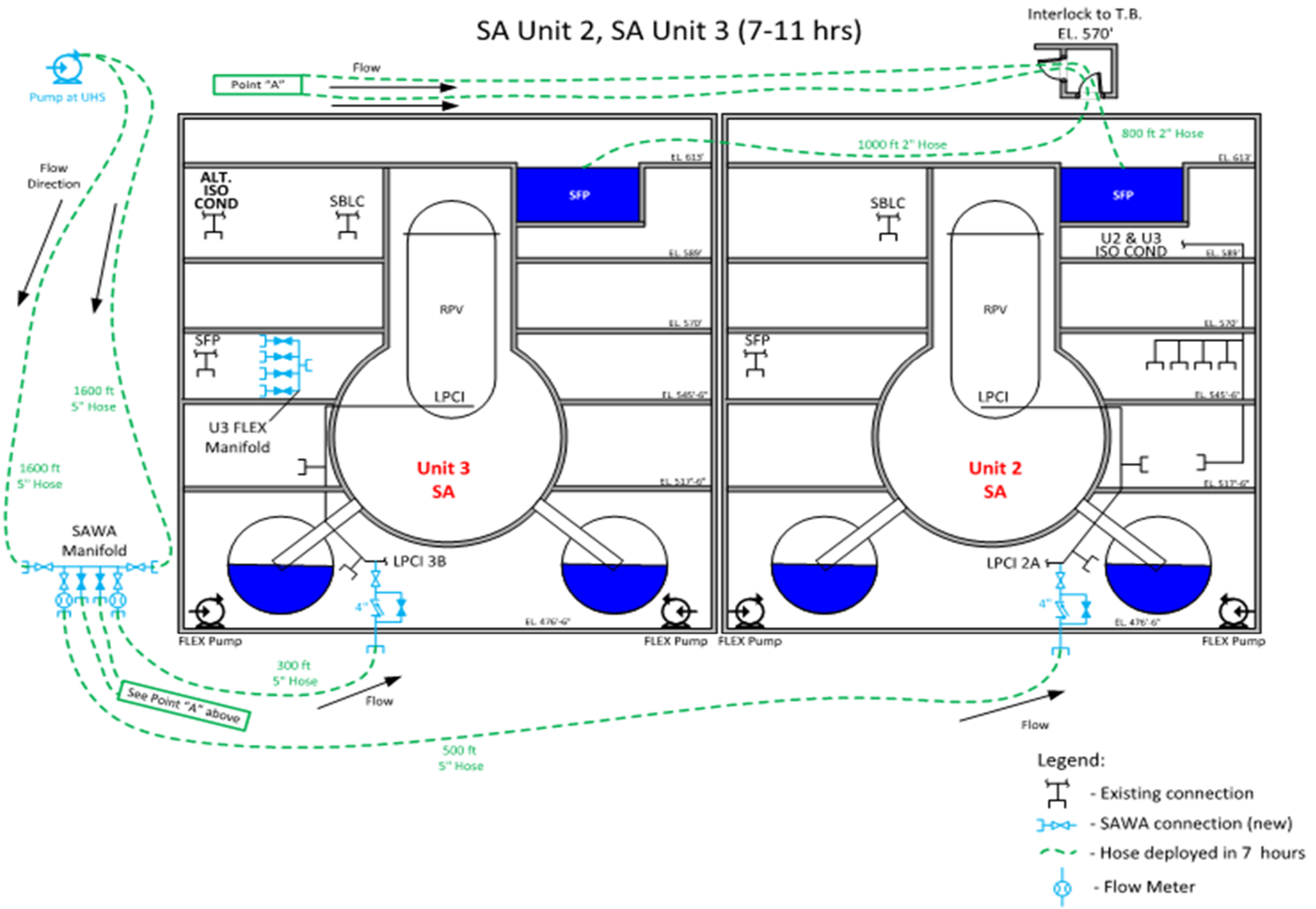
Attachment 6A



Attachment 6B

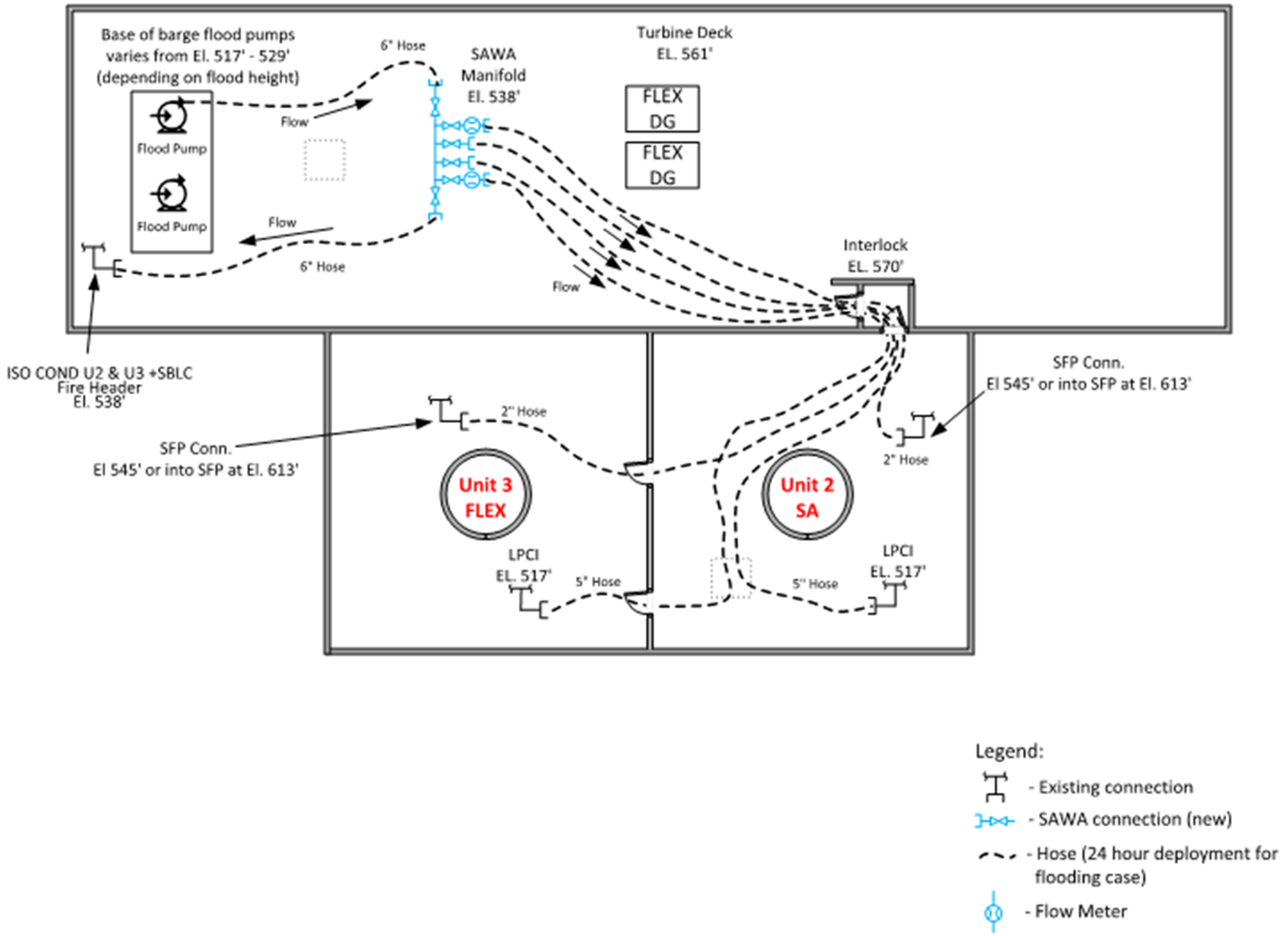


Attachment 6C



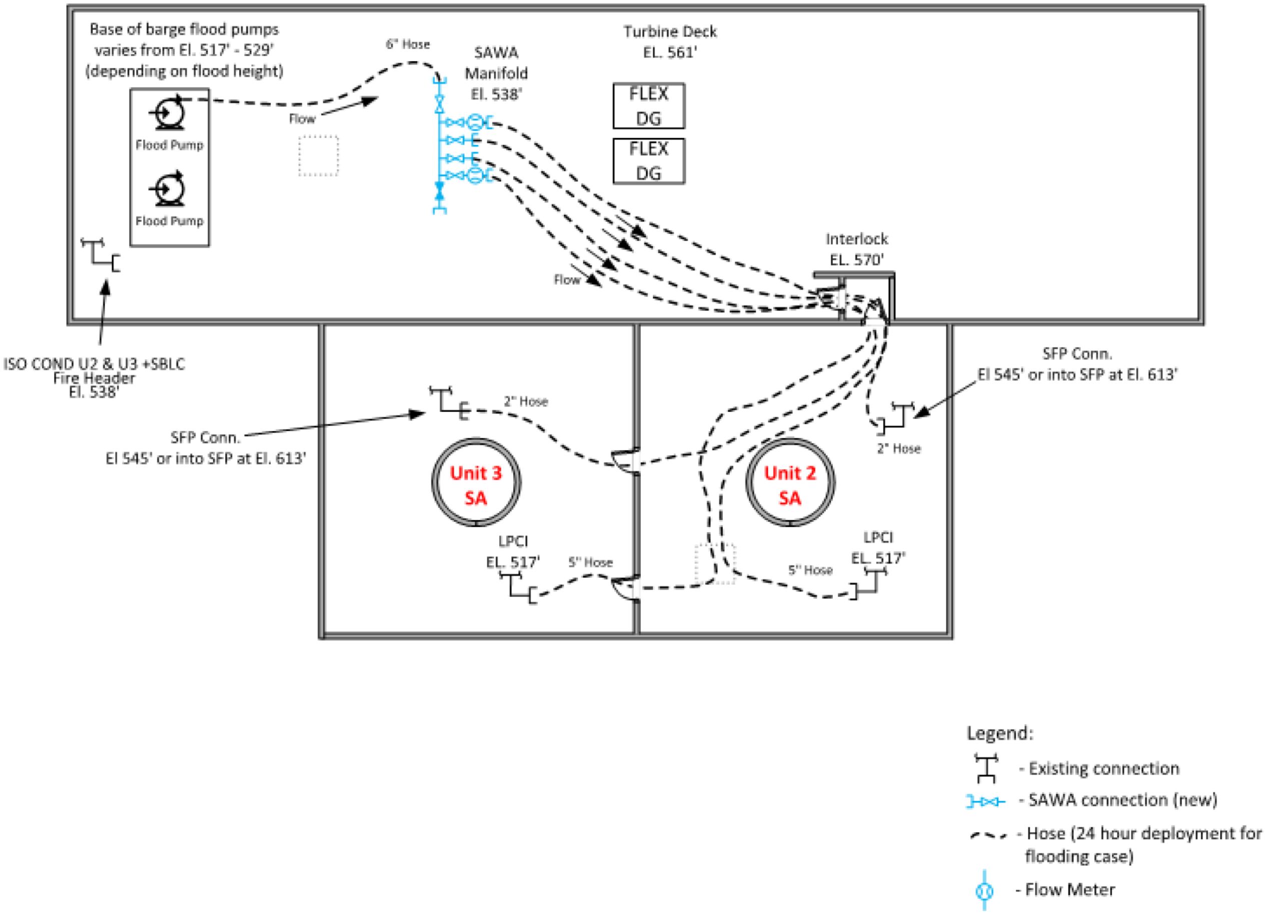
Attachment 6D

Case 4b – Flood, SA Unit 2, FLEX Unit 3



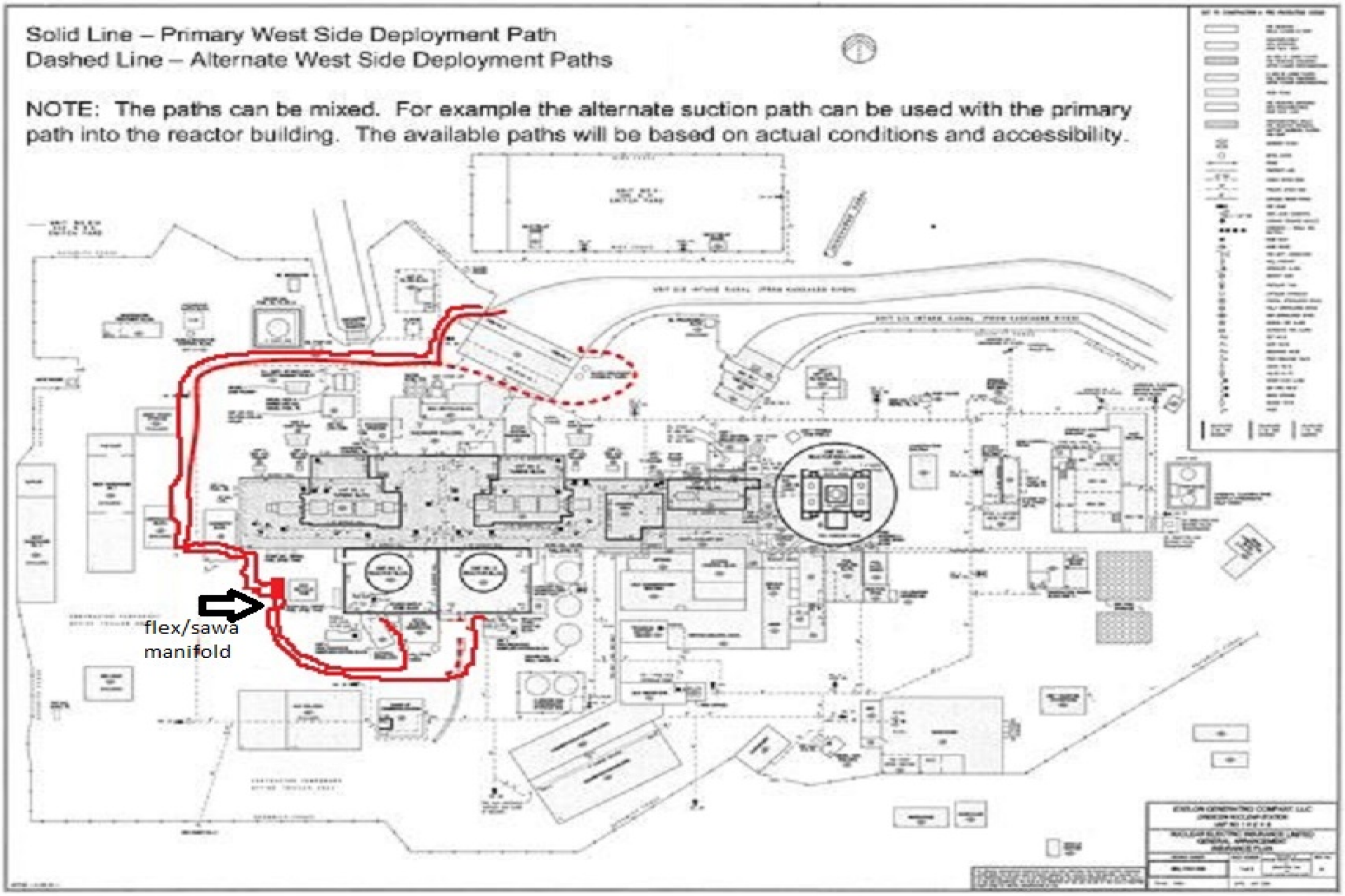
Attachment 6E

Case 5 – Flood, SA Unit 2, SA Unit 3



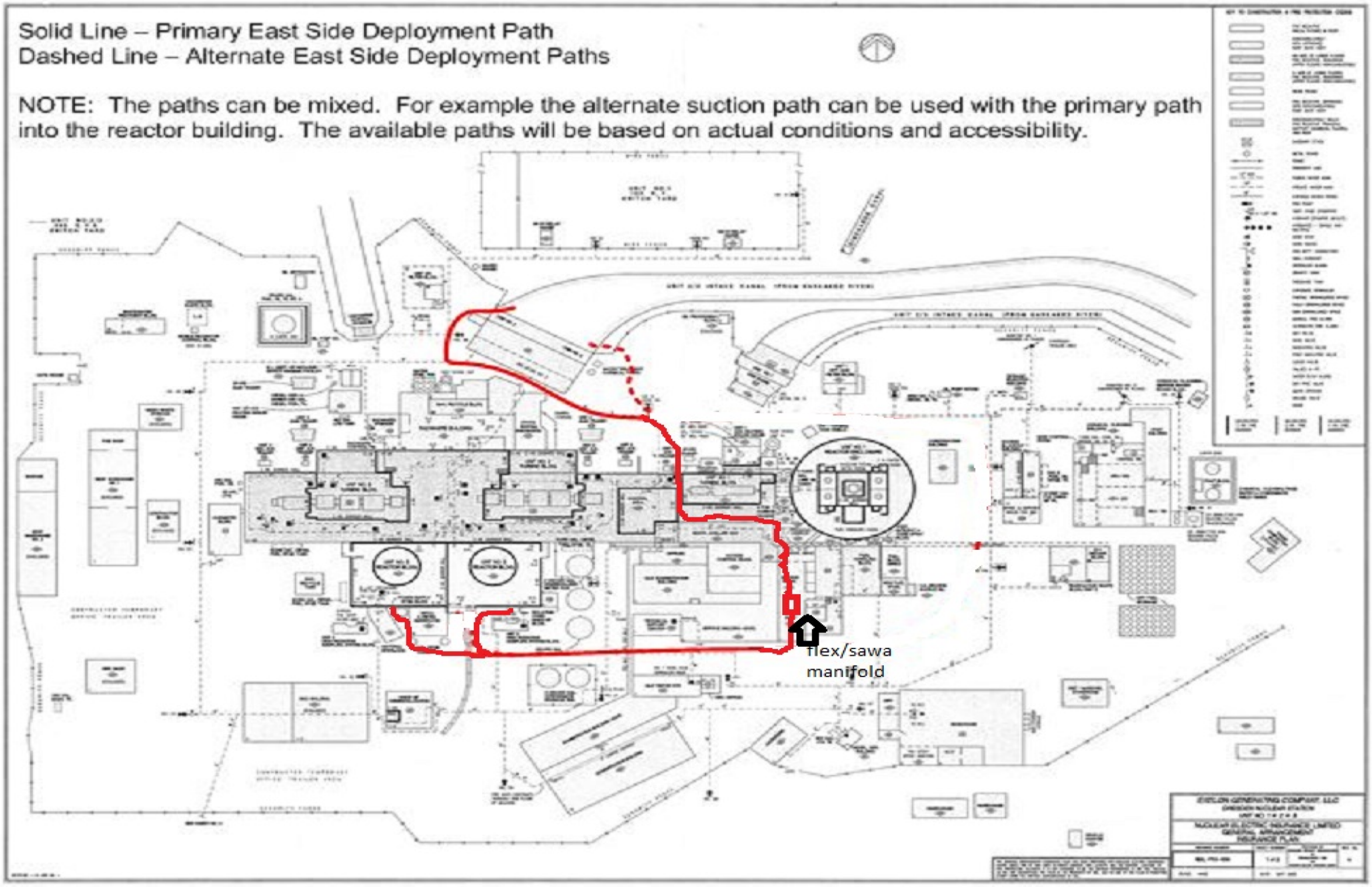
Attachment 6F

West hose route



Attachment 6G

East hose route

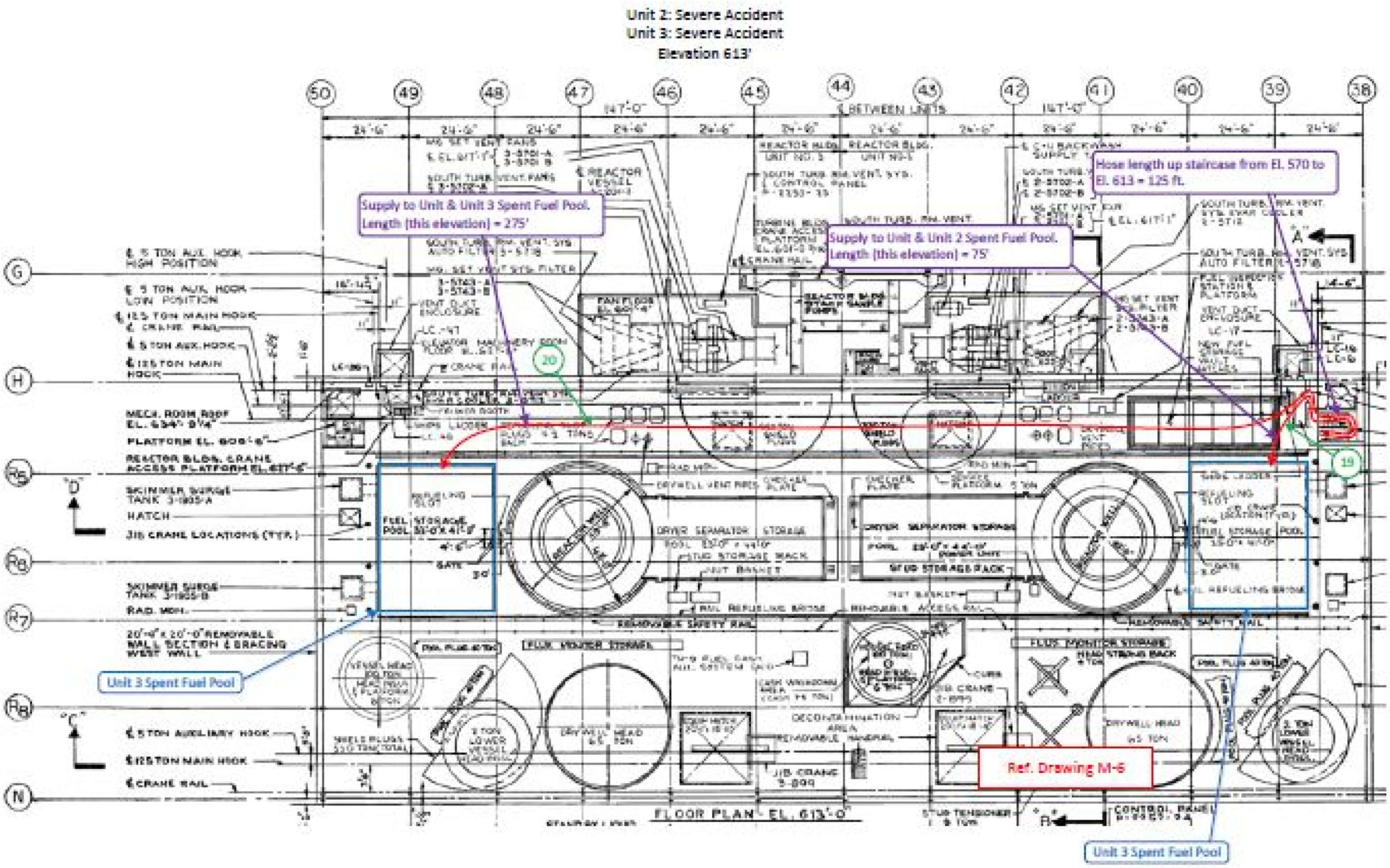


Solid Line – Primary East Side Deployment Path
Dashed Line – Alternate East Side Deployment Paths

NOTE: The paths can be mixed. For example the alternate suction path can be used with the primary path into the reactor building. The available paths will be based on actual conditions and accessibility.

Attachment 6H

SFP hose route Reactor Building



Attachment 6I

SFP hose route Turbine Building

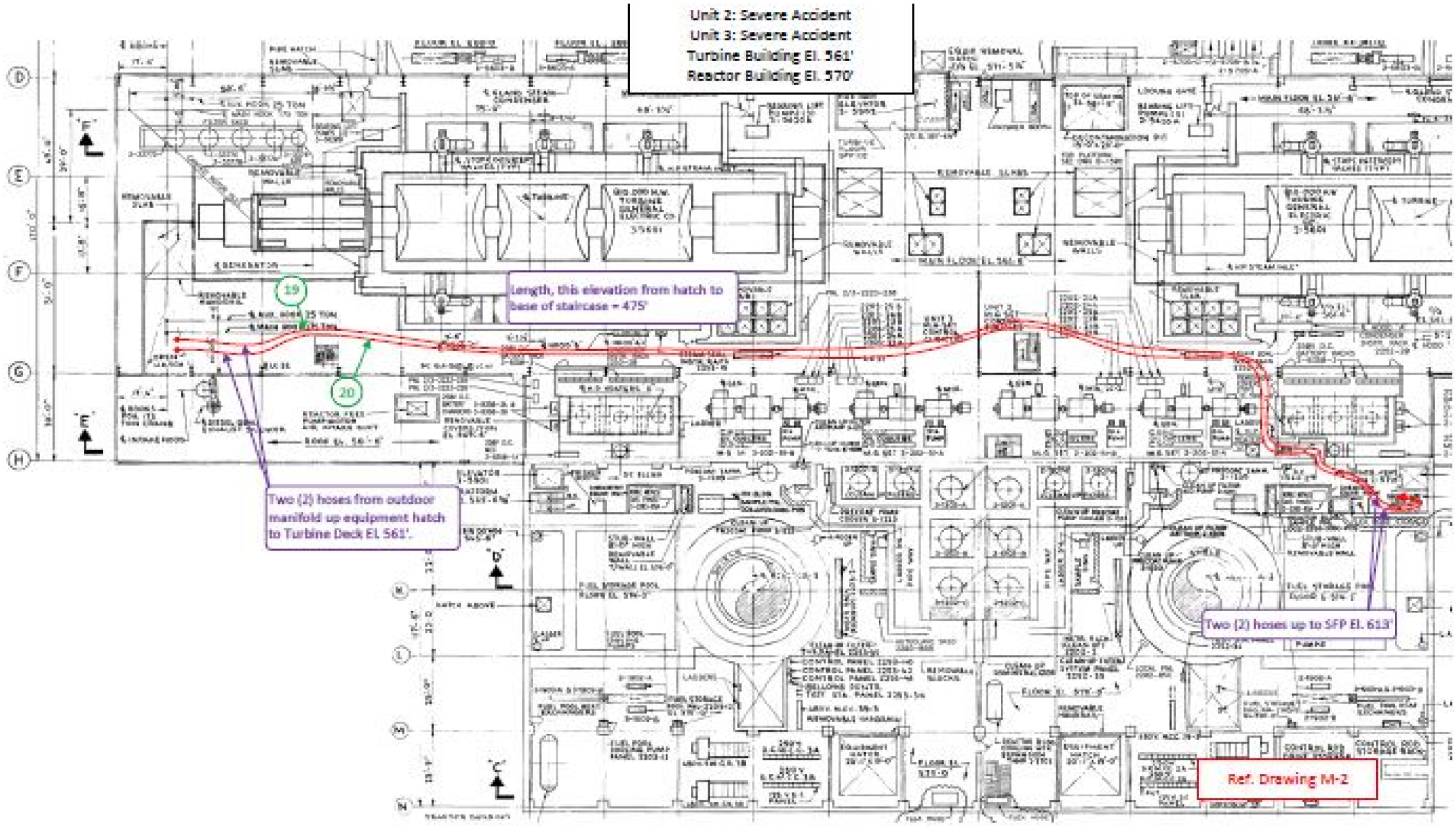


Table 1: List of HCVS Component, Control and Instrument Qualifications

Component Name	Equipment ID	Range	Location	Local Accident Temp	Local Accident Humidity	Local Radiation Level	Qualification[8]	Qualification Temp	Qualification Humidity	Qualification Radiation	Power Supply
Wetwell Vent Instruments and Components											
HCVS effluent temperature sensor	2(3)-1603-10	0-500°F	570' RB Floor	301°F	100%	3.0E+07 Rads TID	IEEE-323-1974, IEEE-323-1983, IEEE-344-1975 and IEEE-344-1987	0-500°F	No electronics, not susceptible	3.00E+08 Rads TID	None required
HCVS effluent temperature indication	2(3)-1603-12	0-500°F	MCR	120°F	90%	**CR	N/A - insensitive	N/A	N/A	N/A	125VDC Battery
125VDC battery voltage meter (internal to chargers)	2/3-8370-1A(B)	0-195 VDC	ROS	120°F	90%	Low	IEEE 344-1975	122°F	95%	N/A	125 VDC Battery
125VDC battery	2/3-8370	125 VDC	ROS	120°F	90%	Low	IEEE 344-1975	120°F	N/A	N/A	Self for 24 hours, then FLEX generator powers charger
Wetwell Vent line rad. Detector	2-1603-20	10E-2 to 10E+4 Rad/hr	589' RB Floor	295°F	100%	4.5E+06 Rads TID	IEEE-323-1974, IEEE-323-1983, IEEE-344-1987 and IEEE-381-1977	350°F	100%	2E+10 Rads TID	125 VDC battery bus
Wetwell vent radiation monitor/ processor	2(3)-1603-21	10E-2 to 10E+4 Rad/hr	ROS	120°F	90%	Low	IEEE-323-1974, IEEE-323-1983, IEEE-344-1987 and IEEE-381-1977	131°F	95%	1E+3 Rads TID	125 VDC battery bus
N2 supply pressure meter	2(3)-1604-40, 2(3)-1604-50	0-160 psig and 0-3000 psig	ROS	120°F	90%	Low	IEEE 323-1974, IEEE 344-1975	RG 1.97	RG 1.97	RG 1.97	None required

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

Component Name	Equipment ID	Range	Location	Local Accident Temp	Local Accident Humidity	Local Radiation Level	Qualification[8]	Qualification Temp	Qualification Humidity	Qualification Radiation	Power Supply
SAWA flow instrument and readout	2/3-1570-A(B)	80-2300gpm	Portable	120°F	90%	Outside, radiation not a concern	Commercial instrument qualified for over the road use, therefore qualified per NEI 12-06	120°F	100%	N/A	Internal Batteries or FLEX DG
Drywell Pressure Indication	2(3)-1640-11A(B)	-5 to 250 Psig	MCR	120°F	90%	**CR	IEEE 323-1974, IEEE 344-1975	RG 1.97	RG 1.97	RG 1.97	FLEX DG
Wetwell Level Indication	2(3)-1640-10A(B)	0 to 30 Ft	MCR	120°F	90%	**CR	IEEE 323-1974, IEEE 344-1975	RG 1.97	RG 1.97	RG 1.97	FLEX DG

* Denotes non-required item, added for site-specific design.
** Denotes Control Room where local radiation levels are not applicable. Building has no significant radiation sources.

Table 2: Operator Actions Evaluation

Operator Action		Evaluation Time[9]	Validation Time	Location	Thermal conditions	Radiological Conditions	Evaluation
1	Open Control Room Doors for ventilation, FGS-31	0-1.3 hour	30 minutes	Main Control Room	Done in the first 1.3 hour, so no temperature concerns.	Done in the first 1.3 hour, so no radiological concerns.	Acceptable
2	DGA-3/DGA-13 Load Shed	0-1.3 hour	30 minutes	AEER U2TB	Done in the first 1.3 hour, so no temperature concerns.	Done in the first 1.3 hour, so no radiological concerns.	Acceptable
3	DGA-3/DGA-13 Load Shed	0-1.3 hour	30 minutes	U3 TB.	Done in the first 1.3 hour, so no temperature concerns.	Done in the first 1.3 hour, so no radiological concerns.	Acceptable
4	DGA-3/DGA-13 Load Shed	0-1.3 hour	30 minutes	U2/3 RB.	Done in the first 1.3 hour, so no temperature concerns.	Done in the first 1.3 hour, so no radiological concerns.	Acceptable
5	Route Cables from FLEX Pump FSG-03	0-1.3 hour	50 minutes	RB Basement and EL 517'	Done in the first 1.3 hour, so no temperature concerns.	Done in the first 1.3 hour, so no radiological concerns.	Acceptable
6	Line up U2 FLEX Manifold to U2 IC FSG-05	0-1.3 hour	1.13 hours	U2 RB 545' EL	Done in the first 1.3 hour, so no temperature concerns.	Done in the first 1.3 hour, so no radiological concerns.	Acceptable

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

Operator Action		Evaluation Time[9]	Validation Time	Location	Thermal conditions	Radiological Conditions	Evaluation
7	Line up U3 FLEX Manifold to U3 IC FSG-05	0-1.3 hour	1.13 hours	U3 RB 545' EL	Done in the first 1.3 hour, so no temperature concerns.	Done in the first 1.3 hour, so no radiological concerns.	Acceptable
8	Line up FLEX Pump to U2 Makeup Demin U3 FLEX Manifold FSG-04	0-1.3 hour	1.17 hours	RB Basement and U3 RB 545' EL	Done in the first 1.3 hour, so no temperature concerns.	Done in the first 1.3 hour, so no radiological concerns.	Acceptable
9	Route BCD cables to appropriate RB penetration FSG-06	0-1.3 hour	1.15 hours	Inside RB 517' EL and Basement	Done in the first 1.3 hour, so no temperature concerns.	Done in the first 1.3 hour, so no radiological concerns.	Acceptable
10	Route cables from RB penetration to TPDU FSG-6	≤ 2.5 hours	1.83 hours	Outside RB west wall to FLEX Bldg A	Outside, so ambient conditions	Action will be complete prior to venting start so no radiological concern.	Acceptable
11	Start FLEX Diesel FSG-03, -13	≤ 2.5 hours	2.08 hours	FLEX Building A	FLEX Building A is designed to keep indoor temperature in 40 -109.4 F range DRE14-0040	Action will be complete prior to venting start so no radiological concern	Acceptable

Operator Action		Evaluation Time[9]	Validation Time	Location	Thermal conditions	Radiological Conditions	Evaluation
12	U2 and U3 FLEX Manifold to SBLC	≤ 2.5 hours	2.0 hours	RB EL 545' to 589' of the non-severe accident Unit implementing FLEX actions. This action is not needed for a Unit implementing SAWA/SAWM with severe accident conditions.	Per calc DRE97-0214, the RB temperature at 545' EL will be 129°F @ 5 days under DBA LOCA conditions, based upon 105°F initial RB temperature. For ≤ 2.5 hours, the temperature will be close to 105°F. For SLBC area at 589' EL, CC-DR-118, Rev. 3, Att. 6 provides a discussion that SBLC area temperature will remain accessible under extreme cold and extreme heat ambient conditions.	Action will be complete prior to venting start so no radiological concern	Acceptable
13	Aligning FLEX/SAWA Manifold to RB penetration FSG-04	≤ 7 hours	2.0 hours	Plant grade level 517' EL near RB west wall and south wall.	Outside, so outdoor ambient conditions do not cause a temperature concern.	Action will be complete prior to venting start so no radiological concern	Acceptable
14	UHS to FLEX/SAWA Manifold, SAWA Pump and equipment	≤ 7 hours	5.0 hours	Plant grade level 517' EL from UHS to RB west wall.	Outside, so outdoor ambient conditions do not cause a temperature concern.	Action will be complete prior to venting start so no radiological concern	Acceptable

Operator Action		Evaluation Time[9]	Validation Time	Location	Thermal conditions	Radiological Conditions	Evaluation
	deployment FSG-04, -09, -38						
15	U2 and U3 SFP hose runs to FLEX/SAWA Manifold FSG-10	≤ 7 hours	4.33 hours	RB 545', RB 570' and 613'	Per calc DRE97-0214, the RB temperature at these elevations will be <129°F @ 5 days under DBA LOCA conditions, based upon 105°F initial RB temperature. (DRE97-0214). For ≤ 4.33 hours, the temperature will be close to 105°F	Action will be complete prior to venting start so no radiological concern. The dose rates after 7 hours at 545' and 613' will be < 1 mR/hr and 3.8R/hr, respectively.	Acceptable
16	Open FLEX/SAWA Manifold valves	≤ 7 hours	6.42 hours	Plant grade, outside RB west wall	Outside, so outdoor ambient conditions do not cause a temperature concern.	Action will be complete prior to venting start so no radiological concern	Acceptable
17	Operate submersible SAWA Pump at UHS	≤ 7 hours	6.42 hours	Plant grade, Cribhouse	Outside, so outdoor ambient conditions do not cause a temperature concern.	Action will be complete prior to venting start so no radiological concern	Acceptable

Operator Action		Evaluation Time[9]	Validation Time	Location	Thermal conditions	Radiological Conditions	Evaluation
18	MCR energizes the HCVS system. Valve line-up at ROS FSG-15	≤ 7 hours	40 minutes	MCR, ROS	Per calc DRE97-0214, MCR max. temp at 1 hour is 117°F. The ROS temperature will be close to the normal temperature of 104°F due to large thermal masses in the area. FSG-31 provides ventilation strategies for these locations.	Action will be complete prior to venting start so no radiological concern	Acceptable
19	SAWA pump operation and refueling	>7 hours (maximum injection start time is 8 hours)	Pump is ready for operation at 6.42 hours. The pump will be operated for long term as needed.	Plant grade, Cribhouse	Outside, so outdoor ambient conditions do not cause a temperature concern	Per DRE16-0010 R3, Table 8-3, the east side of the Cribhouse dose levels will 531 mR/hr during the venting operation. Since only 8 venting cycles are calculated for 7-day period, the SAWA pump operation and refueling activities will be coordinated to minimize dose.	Acceptable
20	FLEX Diesel Generator operation and refueling	>7 hours	Generator is ready for operation at 2.08 hours. The generator will be	FLEX Bldg A or Turbine Deck at 561' EL for flooding scenario	FLEX Bldg A temperature is kept in 40 -109.4°F range (DRE14-0040). The TB deck temperature will be less than 122°F (DRE17-0013)	FLEX Bldg A dose rates will be 14.9 mR/hr. The TB 561' dose rates will be 732 mR/hr during venting operation. Refueling/equipment	Acceptable

Operator Action		Evaluation Time[9]	Validation Time	Location	Thermal conditions	Radiological Conditions	Evaluation
			operated for long term as needed.			manipulation will be performed when the vent is not operating.	
21	SAWM flow control	>7 hours	SAWA flow is ready for injection at 6.42 hours. The SAWA flow control valve will be operated for long term as needed.	Plant grade, outside RB west wall	Outside, so outdoor ambient conditions do not cause a temperature concern.	The FLEX/SAWA Manifold near the west wall of RB (EDG Tank location) will see a dose rate of 835 mR/hr during the venting operation. Any valve manipulation at this location will be performed when the vent is not operating.	Acceptable
22	Flood Pump operation and refueling	>24 hours	N/A	U3 TB trackway	The trackway door will be open so the temperature will be close to outdoor ambient conditions so there is no temperature concern.	The maximum dose at this location will be in 309-429 mR/hr range during venting operation. Refueling/equipment manipulation will be performed when the vent is not operating.	Acceptable