Nebraska Public Power District
Always there when you need us

NLS2019001
January 14, 2019

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

Subject: Completion of Required Action for NRC Order EA-13-109 - Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions
Cooper Nuclear Station, Docket No. 50-298, DPR-46

Dear Sir or Madam:

On June 6, 2013, the Nuclear Regulatory Commission (NRC) issued Order EA-13-109, Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions, to Nebraska Public Power District (NPPD). This Order was immediately effective and directed NPPD to install at Cooper Nuclear Station (CNS), a reliable hardened venting capability for pre-core damage and under severe accident conditions, including those involving a breach of the reactor vessel by molten core debris.

This letter and its attachment provide the notification required by Section IV.D.4 of Order EA-13-109 that full compliance (i.e., Phase 1 and Phase 2) with the requirements described in Attachment 2 of the Order has been achieved for CNS. The enclosure provides the CNS Final Integrated Plan for reliable hardened containment vent strategies.

This letter contains no new regulatory commitments. If you have any questions, please contact Jim Shaw, Licensing Manager, at (402) 825-2788.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on: 1/14/2019

Sincerely,

John Dent, Jr.
Vice President - Nuclear and
Chief Nuclear Officer

/bk

A153
NRR

COOPER NUCLEAR STATION
P.O. Box 98 / Brownville, NE 68321-0098
***Telephone:** (402) 825-3811 / **Fax:** (402) 825-5211*
www.nppd.com

Attachment: Completion of Required Action for NRC Order EA-13-109, Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions

Enclosure: Cooper Nuclear Station - HCVS Order EA-13-109 Final Integrated Plan

cc: Regional Administrator, w/attachment and enclosure
USNRC - Region IV

Director, w/attachment and enclosure
USNRC - Office of Nuclear Reactor Regulation

Cooper Project Manager, w/attachment and enclosure
USNRC - NRR Plant Licensing Branch IV

Senior Resident Inspector, w/attachment and enclosure
USNRC - CNS

NPG Distribution, w/attachment and w/o enclosure

CNS Records, w/attachment and enclosure

ATTACHMENT

COMPLETION OF REQUIRED ACTION FOR NRC ORDER EA-13-109, RELIABLE HARDENED CONTAINMENT VENTS CAPABLE OF OPERATION UNDER SEVERE ACCIDENT CONDITIONS

COMPLETION OF REQUIRED ACTION FOR NRC ORDER EA-13-109, RELIABLE HARDENED CONTAINMENT VENTS CAPABLE OF OPERATION UNDER SEVERE ACCIDENT CONDITIONS

BACKGROUND

On June 6, 2013, the Nuclear Regulatory Commission (NRC) 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 Nebraska Public Power District (NPPD). This Order was immediately effective and directed NPPD to install at Cooper Nuclear Station (CNS), a reliable hardened venting capability for pre-core damage and under severe accident conditions, including those involving a breach of the reactor vessel by molten core debris.

NPPD developed an Overall Integrated Plan (OIP) (Reference 2) to address the requirements of Phase 1 of the Order, which requires a Hardened Containment Vent System (HCVS). NPPD provided six-month status reports of Order implementation for CNS via References 3, 5, 7, 8, 10, 11, 12, 14, and 15. Reference 3 included a revised OIP for a change in method of compliance with regard to the design of the wetwell vent, and Reference 7 included a combined Phase 1 and Phase 2 OIP to describe a Severe Accident Water Addition / Severe Accident Water Management (SAWA/SAWM) strategy.

The information provided herein, and referenced docketed correspondence, documents full compliance for NPPD in response to Order EA-13-109.

OPEN ITEM RESOLUTION

Overall Integrated Plan Open Items - Complete

Licensee identified open items documented in the Combined Phase 1 and 2 OIP (OIP for Phase 1 in References 2 and 3, and Combined OIP for Phases 1 and 2 in Reference 7) have been addressed and responses documented in Order EA-13-109 six-month status reports as noted in the following table. These items are considered complete.

Combined Phase 1 and 2 OIP Open Items	
Phase 1 Open Items	
OIP OI #	**Status/Comment**
1	Closed. Response provided in Reference 8.
2	Closed. Response provided in Reference 8.
3	Closed. Response provided in Reference 8.
4	Closed. Response provided in Reference 8.
5	Closed. Response provided in Reference 8.
6	Closed. Response provided in Reference 8.

Combined Phase 1 and 2 OIP Open Items	
Phase 1 Open Items	
OIP OI #	**Status/Comment**
7	Closed. Response provided in Reference 8.
8	Closed. Response provided in Reference 8.
9	Closed. Response provided in Reference 8.
10	Closed. Response provided in Reference 8.
11	Closed. Response provided in Reference 8.
12	Closed. Response provided in Reference 10.
Phase 2 Open Items	
None.	--

Interim Staff Evaluation (ISE) Open Items - Complete

Open items documented in the Phase 1 and Phase 2 ISEs (References 6 and 9) have been addressed and responses documented in Order EA-13-109 six-month status reports as noted in the following table. The ISE open item responses were reviewed as part of an NRC staff audit and closure documented in an NRC audit report (Reference 13). These items are considered complete.

Phase 1 Interim Staff Evaluation Open Items	
ISE OI #	**Status**
1	Response provided in Reference 8 and open item closed by NRC per Reference 13.
2	Response provided in Reference 8 and open item closed by NRC per Reference 13.
3	Response provided in Reference 8 and open item closed by NRC per Reference 13.
4	Response provided in Reference 8 and open item closed by NRC per Reference 13.
5	Response provided in Reference 10 and open item closed by NRC per Reference 13.
6	Response provided in Reference 10 and open item closed by NRC per Reference 13.
7	Response provided in Reference 8 and open item closed by NRC per Reference 13.
8	Response provided in Reference 8 and open item closed by NRC per Reference 13.
9	Response provided in Reference 8 and open item closed by NRC per Reference 13.
10	Response provided in Reference 8 and open item closed by NRC per Reference 13.
11	Response provided in Reference 8 and open item closed by NRC per Reference 13.
Phase 2 Interim Staff Evaluation Open Items	
ISE OI #	**Status**
1	Response provided in Reference 10 and open item closed by NRC per Reference 13.
2	Response provided in Reference 10 and open item closed by NRC per Reference 13.
3	Responses provided in References 11 and 14 and open item closed by NRC per Reference 13.

MILESTONE SCHEDULE

Phase 1 and Phase 2 Milestones - Complete

Submittals	
CNS Milestone	**Status**
Submit Overall Integrated Plan	Complete (References 2 and 3)
Submit Combined Phase 1 and Phase 2 Overall Integrated Plan	Complete (Reference 7)
Six-Month Updates	Complete (References 3, 5, 7, 8, 10, 11, 12, 14, 15)
Completion Report	Complete with this submittal
Phase 1 Milestones	
CNS Milestone	**Status**
Hold preliminary/conceptual design meeting	Complete
Design Engineering On-site/Complete	Complete
Operations Procedure Changes Developed	Complete
Site Specific Maintenance Procedure Developed	Complete
Training Complete	Complete
Procedure Changes Active	Complete
Walk Through Demonstration/Functional Test	Complete
Phase 2 Milestones	
CNS Milestone	**Status**
Hold preliminary/conceptual design meeting	Complete
Design Engineering On-site/Complete	Complete
Procedure Changes Developed	Complete
Training Complete	Complete
Implementation Outage	Complete
Walk Through Demonstration/Functional Test	Complete
Procedure Changes Active	Complete

ORDER EA-13-109 COMPLIANCE ELEMENTS SUMMARY

The elements identified below for CNS, as well as the Combined Phase 1 and Phase 2 OIP (Reference 7) and six-month status reports (References 3, 5, 7, 8, 10, 11, 12, 14, 15), demonstrate compliance with NRC Order EA-13-109.

HCVS Phase 1 and Phase 2 Functional Requirements and Design Features – Complete

The 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 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 CNS Phase 2 HCVS strategies implement SAWA with 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 Phase 1 and Phase 2 HCVS strategies are in compliance with Order EA-13-109. The modifications required to support the HCVS strategies 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 CNS complies with the requirements specified in Order EA-13-109 and described in Nuclear Energy Institute (NEI) 13-02, Revision 1 (Reference 4). 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. 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 CNS Phase 1 and Phase 2 HCVS use provides adequate protection from applicable site hazards. 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 CNS 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 CNS 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.

CNS has completed validation in accordance with industry developed guidance to assure required tasks, manual actions and decisions for HCVS strategies are feasible and may be executed within the constraints identified in the HCVS Phase 1 and 2 OIP for Order EA-13-109.

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

REFERENCES

The following references support CNS' compliance with the requirements of Order EA-13-109:

1. NRC Order EA-13-109 to All Operating Boiling-Water Reactor Licensees with Mark I and Mark II Containments, "Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions," dated June 6, 2013
2. NPPD letter to NRC, "Nebraska Public Power District's Phase 1 Overall Integrated Plan in Response to June 6, 2013, Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109)," dated June 30, 2014
3. NPPD letter to NRC, "Nebraska Public Power District's First Six-Month Status Report in Response to June 6, 2013, Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109)," dated December 19, 2014
4. NEI 13-02, "Industry Guidance for Compliance with Order EA-13-109: BWR Mark I and II Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions," Revision 1, dated April 2015
5. NPPD letter to NRC, "Nebraska Public Power District's Second Six-Month Status Report in Response to June 6, 2013, Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109)," dated June 30, 2015
6. NRC letter to NPPD, "Cooper Nuclear Station - Interim Staff Evaluation Relating to Overall Integrated Plan in Response to Phase 1 of Order EA-13-109 (Severe Accident Capable Hardened Vents) (TAC NO. MF4384)," dated February 11, 2015

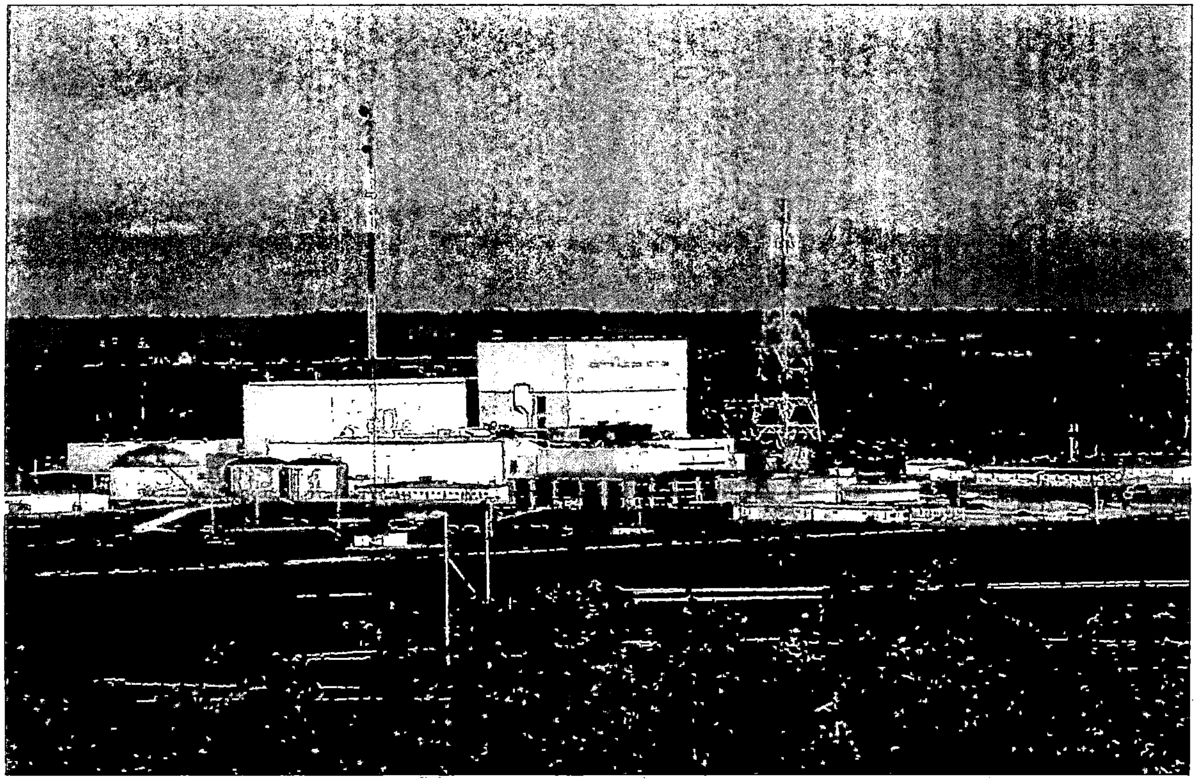
7. NPPD letter to NRC, "Nebraska Public Power District's Phase 1 and Phase 2 Overall Integrated Plan in Response to June 6, 2013, Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109)," dated December 21, 2015
8. NPPD letter to NRC, "Nebraska Public Power District's Fourth Six-Month Status Report in Response to June 6, 2013, Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109)," dated June 30, 2016
9. NRC letter to NPPD, "Cooper Nuclear Station - Interim Staff Evaluation Relating to Overall Integrated Plan in Response to Phase 2 of Order EA-13-109 (Severe Accident Capable Hardened Vents) (CAC NO. MF4384)," dated September 29, 2016
10. NPPD letter to NRC, "Nebraska Public Power District's Fifth Six-Month Status Report in Response to June 6, 2013, Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109)," dated December 28, 2016
11. NPPD letter to NRC, "Nebraska Public Power District's Sixth Six-Month Status Report in Response to June 6, 2013, Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109)," dated June 19, 2017
12. NPPD letter to NRC, "Nebraska Public Power District's Seventh Six-Month Status Report in Response to June 6, 2013, Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109)," dated December 21, 2017
13. NRC letter to NPPD, "Cooper Nuclear Station - Report for the Audit of Licensee Responses to Interim Staff Evaluations Open Items Related to NRC Order EA-13-109 to Modify Licenses With Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (CAC NO. MF4384; EPID L-2014-JLD-0046)," dated March 29, 2018
14. NPPD letter to NRC, "Nebraska Public Power District's Eighth Six-Month Status Report in Response to June 6, 2013, Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109)," dated June 26, 2018
15. NPPD letter to NRC, "Nebraska Public Power District's Ninth Six-Month Status Report in Response to June 6, 2013, Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109)," dated December 4, 2018

ENCLOSURE

COOPER NUCLEAR STATION
HCVS ORDER EA-13-109 FINAL INTEGRATED PLAN

FINAL INTEGRATED PLAN

HCVS Order EA-13-109
for
Cooper Nuclear Station



Revision 0

January 11, 2019

Table of Contents

Table of Contents

Section I: Introduction

In 1989, the NRC issued GL 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 NRC Commissioners directed the staff per 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 conditions resulting from an ELAP.

CNS is required by NRC Order EA-13-109 to have a reliable, severe accident capable 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. CNS achieved Phase 1 compliance on November 6, 2016.

- Phase 2 provided additional protections for severe accident conditions through the development of a reliable containment venting strategy that makes it unlikely that CNS would need to vent from the containment drywell during severe accident conditions. CNS achieved Phase 2 compliance on November 14, 2018.

NEI developed guidance for complying with NRC Order EA-13-109 in NEI 13-02, *Industry Guidance for Compliance with Order EA-13-109, BWR Mark I & II Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions*, Revision 0 (Reference 6) with significant interaction with the NRC and licensees. NEI issued Revision 1 to NEI 13-02 in April 2015 (Reference 7) which contained guidance for compliance with both Phase 1 and Phase 2 of the Order. NEI 13-02, Revision 1, also includes HCVS-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, CNS submitted a Phase 1 OIP in June of 2014 (Reference 18) and subsequently submitted a combined Phase 1 and 2 OIP in December 2015 (Reference 23). These OIPs followed the guidance NEI 13-02, Revisions 0 and 1, respectively. The NRC staff used the methods described in the ISGs to evaluate licensee compliance as presented in the Order EA-13-109 OIPs. While the Phase 1 and combined Phase 1 and 2 OIPs were written to different revisions of NEI 13-02, CNS conforms to NEI 13-02, Revision 1, for both Phases of Order EA-13-109.

The NRC performed a review of each OIP submittal and provided CNS with ISEs (References 19 and 20) 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 21 through 29) were provided consistent with the requirements of Order EA-13-109. These status reports were used to close many of the ISE open items. In addition, the site participated in NRC ISE Open Item audit calls where the information provided in the six month updates and on the E-Portal were used by the NRC staff to determine whether the ISE Open Item appeared to be addressed.

By submittal of this Final Integrated Plan, CNS has addressed the elements of NRC Order EA-13-109 utilizing the endorsed guidance in NEI 13-02, Revision 1, and the related HCVS-FAQ and HCVS-WP documents. In addition, the site has addressed the NRC Phase 1 and Phase 2 ISE Open Items as documented in previous six month updates (Reference 30).

Section III contains the CNS 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 Order 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 MCR or MROS 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 CNS are seismic, extreme cold, high winds, and extreme high temperature. Initial operator actions are completed by plant personnel and include the capability for remote-manual initiation from the HCVS control station. 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 SAWA to initially inject water into the RPV.
- Utilization of 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 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.

As the equipment utilized in SAWA and SAWM are all part of the FLEX equipment. 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 (Reference 36). Equipment has been evaluated to remain operational throughout the sustained operating period. Additionally, radiological calculations were performed specifically for operator actions during this event that covered (1) a location where plant personnel are stationed during a severe accident and (2) egress pathway for operator action (References 49 & 50). For both events, 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 alternate injection flow paths (Reference 36). The flow path's primary source is from the Missouri River with a backup suction source from the CST, if available (Reference 45). Both flow paths utilize the FLEX pump and include a SAWA flow indicator. The primary SAWA flow path hose routing is from the FLEX pump to SW-V-1531, RHRSW FLEX Connection Isolation, in the Control Building (Reference 37). This connection then passes injection flow via the normal RHRSW crosstie to the Division 1 RHR injection flow path. RPV pressure is below the shutoff head of the FLEX pump. The RHRSW to RHR flow path is established by opening valve SW-120 (Reference 37) to allow flow into the 24" line to the LPCI valves, RHR-MO-27A and RHR-MO-25A (Reference 38). This provides the flow path into the RPV. The basic pictorial overview of the SAWA flow path(s) is shown in Attachment 6, Figure 6.

Drywell pressure and suppression pool level are monitored and flow rate is adjusted by use of the FLEX pump speed control. Communication is established between the MCR and the FLEX pump location. (Reference 56)

When a Station Blackout event starts, CNS will enter Procedure 5.3SBO (Reference 48). As long as an injection source is available, the station initially reacts within design basis and then transitions into an ELAP or BDB event in about 1 hour, if conditions dictate. This procedure is the primary driver for CNS FLEX actions. When there is no RPV injection available from either HPCI or RCIC, then actions both directly or indirectly associated with SAWA and SAWM are started from this procedure (Reference 48), even before fuel failure (T+1 hour after loss of injection per assumptions of the Order).

Additionally, when any severe accident entry conditions are met, the operators will exit the EOPs and enter SAGs (Reference 40). The operators will transition into the SAGs following guidance in Procedure 5.9SAMG (Reference 44) and enter the Severe Accident Procedure flow chart SAG 1 (Reference 42) and from SAG 1 will enter SAG 2B, (Reference 43) when the determination is made that "Core debris has breached the RPV." Using the guidance of SAG 2B and Procedure 5.9SAMG, CNS will utilize FSG 5.10FLEX.25 (Reference 45) along with the applicable Technical Support Guidelines (Reference 46) to guide implementation of the FLEX SAWA injection strategy. CNS will inject at ~344 gpm for 4 to 8 hours to obtain core stabilization and then reduce flow to ~69 gpm for the remaining 160 to 164 hours. To control the injection rate, FLEX flow meter will be staged near the FLEX pump to provide the FLEX pump operator direct feedback as to the injection rate.

Based upon timed validations, the hose connections and valve lineups will be completed and injection will commence within 4.13 hours of starting the evolution (loss of injection). Note that the generic industry guidance for core damage is 1 hour. Thus, all evaluations used 1.0 hours to core damage.

The FLEX pump is capable of meeting all water makeup requirements for CNS. As discussed in the Combined OIP (Reference 23), 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 generator loading calculation reviewed for Order EA-12-049 compliance.

Refueling of the FLEX generator and FLEX pump is accomplished from the Emergency DG fuel oil tanks as described in the Order EA-12-049 FIP per FSG 5.10FLEX.31 (Reference 47).

Evaluations for projected severe accident 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 (References 49 and 51).

Electrical equipment and instrumentation is powered from the existing station DC distribution systems including at least one division of the 125 VDC and 250 VDC station batteries. The station batteries and instrumentation required for this event are powered from FLEX generator(s) during the sustained operating period (Reference 36).

Section II: List of Acronyms

AC	Alternating Current
AOV	Air Operated Valve
BDB	Beyond Design Basis
BDBEE	Beyond Design Basis External Event
BWR	Boiling Water Reactor
BWROG	Boiling Water Reactor Owners' Group
CB	Control Building
CAP	Containment Accident Pressure
CNS	Cooper Nuclear Station
CREF	Control Room Emergency Filter
CS	Core Spray
CST	Condensate Storage Tank
DC	Direct Current
DG	Diesel Generator
ECCS	Emergency Core Cooling Systems
EL	Elevation
ELAP	Extended Loss of AC Power
EOP	Emergency Operating Procedure
EPG/SAG	Emergency Procedure and Severe Accident Guidelines
EPRI	Electric Power Research Institute
EQ	Environmental Qualification
ERO	Emergency Response Organization
°F	Degrees Fahrenheit
FAQ	Frequently Asked Question
FIP	Final Integrated Plan
FLEX	Diverse & Flexible Coping Strategy
FSB	FLEX Storage Building
FSG	FLEX Support Guide
gpm	Gallons per Minute
GL	Generic Letter
HCVS	Hardened Containment Vent System
HVAC	Heating, Ventilation, and Air Conditioning
IA	Instrument Air
ISE	Interim Staff Evaluation
ISG	Interim Staff Guidance
IST	Inservice Testing
JLD	Japan Lessons Learned Project Directorate
lbm/hr	Pound Mass per Hour
LLRT	Local Leak Rate Testing
LPCI	Low Pressure Coolant Injection
MAAP	Modular Accident Analysis Program
MACCS	MELCOR Accident Consequence Code System
MCR	Main Control Room
MOV	Motor Operated Valve

MROS	Mechanical Remote Operating Station
MWth	Megawatts Thermal
N_2	Nitrogen
NEI	Nuclear Energy Institute
NPPD	Nebraska Public Power District
NPSH	Net Positive Suction Head
NRC	Nuclear Regulatory Commission
NSRC	National SAFER Response Center
OIP	Overall Integrated Plan
PC	Primary Containment
PCIV	Primary Containment Isolation Valve
PCPL	Primary Containment Pressure Limit
PMIS	Plant Management Information System
psig	Pounds per Square Inch Gauge
RB	Reactor Building
RCIC	Reactor Core Isolation Cooling System
RG	Regulatory Guide
RHR	Residual Heat Removal
RHRSW	Residual Heat Removal Service Water
RM	Radiation Monitor
RO	Reactor Operator
RPB	Reactor Pressure Boundary
RPV	Reactor Pressure Vessel
RTP	Rated Thermal Power
SAMG	Severe Accident Management Guidelines
SAWA	Severe Accident Water Addition
SAWM	Severe Accident Water Management
SGT	Standby Gas Treatment
SBNI	Standby Nitrogen Injection
SOV	Solenoid Operated Valve
SRM	Staff Requirements Memorandum
SRV	Safety Relief Valve
SSE	Safe Shutdown Earthquake
TB	Turbine Building
THPV	Torus Hard Pipe Vent
TRM	Technical Requirements Manual
USAR	Updated Safety Analysis Report
UHS	Ultimate Heat Sink
UPS	Uninterruptible Power Supply
VAC	Voltage AC
VDC	Voltage DC

Section III: Phase 1 Final Integrated Plan Details

Section III.A HCVS Phase 1 Compliance Overview

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

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

CNS installed a hardened wetwell vent in response to NRC GL 89-16, under Design Change 91-041. This design change installed a THPV consistent with GL 89-16 and BWROG hardened vent general design criteria. The THPV modification consisted of the following:

1. A 10" pipe connecting the THPV Supply Line downstream of outboard containment isolation valve PC-AOV-237AV to the SGT discharge line in the torus area.
2. A 10" air-operated butterfly valve, PC-AOV-AO32, and a 10" rupture disk, PC-RD-32, in the THPV line. The rupture disk provides isolation of the SGT discharge line and provides a means to prevent inadvertent actuation of the THPV.
3. Indication and keylock controls in the Control Room for THPV valve line-up and THPV operation.
4. Accumulator tank, IA-ACC-AO32, (sized for five valve cycles) and instrument air supply lines to PC-AOV-AO32. This accumulator tank was installed to provide actuation of PC-AOV-AO32 with a loss of IA.
5. Accumulator tanks, IA-ACC-237AV(1) and IA-ACC-237AV(2) (total volume sized for one valve cycle) for outboard containment isolation valve, PC-237AV.
6. The addition of a drain trap, SGT-TP-10, in the SGT discharge cross-connect piping drain. This drain trap is required since the existing loop seal will not maintain the SGT discharge pressure boundary during operation of THPV.
7. A solenoid valve, SBNI-SOV-50, and connections for recharge of the accumulators with nitrogen via SBNI Train B. SBNI will serve as a backup to the IA system to provide pressure for accumulators IA-ACC-AO32, IA-ACC-237AV(1), and IA-ACC-237AV(2).
8. An area radiation monitor along with mounting supports installed adjacent to the THPV piping. This monitor will serve to alert the Control Room operators of radioactive release during THPV venting.

9. New supports and existing support modifications required for the new 10" line and existing 24" duct. Supports were modified to withstand THPV design conditions.

10. Installation of a pressure switch, PC-PS-20, for indication of high pressure in the 10" THPV line. This provides indication that the rupture disk has burst due to actuation of THPV or over-pressurization due to leakage past PC-AOV-AO32 during LLRT of PCIVs.

11. Installation of a pressure switch, IA-PS-3, for indication of low pressure to the new IA accumulators previously mentioned. An indication of decreasing pressure in the instrument airline will alert the Control Room operator of a potential loss of IA for valve actuation.

12. Replacement of solenoid pilot valves and air operators for valves PC-AOV-235AV and PC-AOV-239AV. Replacement of these valve operators and solenoid pilot valves enhances the valves ability to fail in their safe position to provide isolation of the THPV path.

13. Installation of new annunciator points and the modification of existing annunciator points. New windows for Torus HPV Line High Pressure, Torus HPV Accumulator Low Pressure, and Torus HPV Release In Progress were installed in Panel P-2. The new area radiation monitor was incorporated into the Reactor Building High Rad and Area Rad Monitor Downscale windows on Annunciator 9-3-1.

14. Installation of PMIS points. A new digital input was added to PMIS MUX 9-84 in the Reactor Building. This point monitors valve position for PC-AOV-AO32. In addition PMIS Point N117, which was spared, is now used for the THPV Area Radiation Monitor.

15. Installation of a work platform for valve PC-AOV-AO32.

Section III.A.2 EA-13-109 Hardened Containment Vent System

The Order EA-13-109 compliant HCVS system utilizes the GL 89-16 wetwell vent system connection to the torus as shown in Attachment 2. Most of the GL 89-16 system was abandoned and replaced to conform to the requirements of Order EA-13-109. After switching the power supply for PC-MOV-233MV at the Reactor Building EL 958' to a dedicated UPS unit very early in the event, the HCVS is initiated, operated and monitored from the MCR. The AOVs for the HCVS can also be operated from the MROS located in the Main Power Transformer yard adjacent to the Reactor Building south wall. Table 2 contains the evaluation of the acceptability of the MROS location with respect to severe accident conditions.

The layout for the new 12" vent line was based on an accessible location for connection to the existing PC vent and purge piping and the ability to route the vent pipe through the Reactor Building to a suitable exit location. The 12" vent line is routed internal to the Reactor Building until it exits through the building roof at EL 1049'. Section 4.1.5.2 of NEI 13-02, Revision 1, requires that, if the release from HCVS is through a stack different than the plant meteorological stack, the elevation of the stack should be higher than the nearest power block building. HCVS-FAQ-04 further clarified that the elevated release point should be at least 3 feet above the roof and related structures. For CNS, the top of the HCVS pipe is 1056' and the top of the roof parapet is 1052'-10", resulting in a release point 3'-2" higher than the Reactor Building roof as shown in Attachment 9.

Table 1 provides HCVS instrumentation and equipment environment and qualifications.

The vent line is 12" diameter pipe connected to the existing 24" PC vent and purge piping at EL 897' accessible from the 903' floor elevation. New isolation valve PC-AOV-AO32 is installed close to the connection point. The vent line is then routed through the torus area and southwest quad to the Reactor Building southwest stairwell. The vent line then travels upward through the stairwell until it exits the Reactor Building roof. As shown in Attachment 2, the vent line has a radiation monitoring unit, temperature transmitter, and pressure transmitter at approximately EL 925'. The vent line has a weather cap for weather protection.

As shown in Attachment 2, nitrogen gas bottles in the MROS provide the motive force to manipulate the two isolation valves, PC-AOV-237AV and PC-AOV-AO32. The system is designed such that existing valves PC-MOV-233MV and PC-AOV-237AV remain open all the time once a BDBEE occurs and venting is needed to control the primary containment pressure. Valve PC-AOV-AO32 is operated to initiate and complete the venting cycle. CNS' nitrogen system was designed to perform 8 vent cycles in 24 hours following generic industry's guidance. Provisions have been made to replace nitrogen bottles when needed.

The MCR is the primary operating station for the HCVS. During an ELAP, electric power to operate the vent valves will be provided by batteries with a capacity to supply required loads for at least the first 24 hours. Before the batteries are depleted, the FLEX generator will supplement and recharge batteries to support operation of the vent valves. The MROS is designated as the alternate control location and method for operating valve PC-AOV-AO32. Since the MROS does not require any electrical power to operate, the valve solenoid does not need any additional backup electrical power. Attachment 2 shows the HCVS vent flow path.

The primary location for vent operation is the 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 MROS within the Main Power Transformer yard, EL 903', adjacent to the Reactor Building south wall. The MROS is readily accessible and has been designed and constructed to provide missile protection for the internal components. The MROS provides a back-up means to manually operate the wetwell vent. The controls available at the MROS will be accessible and functional under a range of plant conditions, including severe accident conditions. Nitrogen bottle racks and manual valves for operating valves PC-AOV-237AV and PC-AOV-AO32 are installed in the MROS.

At the MCR location, the operators can operate the HCVS isolation valves if electrical power has been restored, monitor HCVS vent valve position, drywell pressure, and wetwell level. Also in the MCR area are the HCVS radiation monitor, vent pipe temperature, and vent pipe pressure indications. The MROS consists of manual valves that directly port nitrogen to the pneumatic actuators of the HCVS isolation valves. There is no instrumentation provided at the MROS. Table 1 contains a complete list of instruments required for operating and monitoring the HCVS.

MROS Evaluation:

Missile Protection

In accordance with the design requirements, the MROS components and their supports must remain functional post seismic and tornado events. CNS designed and built a new structure for the MROS which is analyzed and designed to withstand tornado wind and missile impacts. As such, the MROS components are located in an area where they are protected from a tornado missile strike (Reference 58).

Temperature Analysis

The MROS is within the Main Power Transformer yard area adjacent to the south wall of the Reactor Building. Per USAR II-3.2.1, the design extreme temperatures for CNS are -5°F and +97°F.

Dose Assessment

CNS calculation NEDC 15-024 (Reference 49) provides dose values at various locations in the plant where accident mitigation activities will be performed. Table 6 of this calculation summarizes locations for operators' actions under FLEX and Severe Accident conditions at different time periods.

Seismic Evaluation

In accordance with the MROS design requirements, the MROS equipment must remain functional post SSE seismic and tornado events. Therefore, it must be protected from interaction with the surrounding area. CNS calculation NEDC 15-025 (Reference 58) provides an evaluation to meet these requirements.

The analysis concluded the MROS building is qualified for all anticipated environmental events.

Accessibility

The main route to the MROS is from the outside yard area of the plant (Attachment 8).

Control Building Accessibility / Reactor Building Accessibility

The personnel access to Reactor Building EL 958' and EL 1001' is performed in the first hour. Therefore, no radiation issues exist. The Control Building access is via the Turbine Building EL 903' north area and has shielding and distance from the Reactor Building; therefore, there is not a radiation concern. Access Pathways are shown in Attachments 6 and 8.

Attachment 3 contains a one-line diagram of the HCVS electrical distribution system providing power to required instrumentation.

The HCVS RM with an ion chamber detector is qualified for the ELAP and external event conditions. In addition to the RM, temperature element and pressure sensors are installed on the vent line to allow 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 EQ program).

The wetwell vent up to, and including, the second containment isolation barrier is designed consistent with the design basis of the plant. These items include piping, piping supports, containment isolation valves, containment isolation valve actuators and containment isolation valve position indication components. The hardened vent piping, between the wetwell and the Reactor Building roof, including boundary isolation valve PC-AOV-AO32 is designed to 62.7 psig at 310°F.

NEI 13-02 suggests a 350°F value for HCVS design temperature based on the highest PCPL among the Mark I and II plants. CNS calculation NEDC 15-023 (Reference 63) determines that the maximum operating temperature of the vent piping is 309.4°F (conservatively rounded to 310°F). The justification is based on the saturation temperature of the vented steam at the PCPL of 62.7 psig. Per NEI 13-02, Section 2.4.3.1, it is acceptable to assume saturation conditions in containment so that these design parameters are acceptable.

To prevent leakage of vented effluent to other parts of the Reactor Building or other systems (SGT), boundary valves PC-AOV-235AV and PC-AOV-239AV must close before wetwell venting. Valves PC-AOV-AO235 and PC-AOV-239AV are the only boundary between the HCVS and the interfacing SGT system. These valves are normally closed, fail closed, and are not required to change state in order to perform their support function for wetwell venting; therefore, they can be assumed to be closed when required. Valves PC-AOV-AO235 and PC-AOV-239AV are not part of the IST program but are leak tested using the guidance of CNS' 10CFR50 Appendix J Program. This is acceptable for prevention of inadvertent cross-flow of vented gasses per HCVS-FAQ-05.

HCVS features to prevent inadvertent actuation include a key lock switch at the primary control station and locked closed valves at the MROS which is an acceptable method of preventing inadvertent actuation per NEI 13-02.

As required by Order EA-13-109, Section 1.2.11, the wetwell vent is designed to prevent air/oxygen backflow into the discharge piping to ensure the flammability limits of hydrogen, and other non-condensable gases, are not reached. CNS design includes a check valve near the end of the vent pipe. Guidance for this design is contained in HCVS-WP-03. The relevant design calculations conclude that the check valve will preclude a flammable mixture from occurring in the vent pipe.

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 CNS 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 31), 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. Manually transfer power for MC-AOV-AO32 to HCVS UPS.	MCR Panel P2	EE-SW-P2 This dedicated UPS provides 24 hours of power to a dedicated HCVS set of loads (see Attachment 3) Requires RO Key 90.
2. Manually transfer power for MC-AOV-237AV to HCVS UPS.	MCR Vertical Board H	EE-SW-H This dedicated UPS provides 24 hours of power to a dedicated HCVS set of loads (see Attachment 3). Requires RO Key 90.
3. Manually switch PC-MOV-233MV power from Division I AC to dedicated PC233MV UPS.	Reactor Building, EL 958', at or near MCC-RA	This dedicated UPS provides three operating cycles of PC-MOV-233MV. This valve is expected to be opened once and then de-energized in the open position. Performed in first hour after loss of injection.
4. Ensure N_2 purge to torus valve AO-239 is closed.	MCR Vertical Board H	This valve is normally closed, fails-closed.
5. Ensure torus inlet purge shutoff valve AO-235 is closed.	MCR Vertical Board H	This valve is normally closed, fails-closed.
6. Place PC-MO-233 ISOLATION OVERRIDE to OVERRIDE.	MCR Panel P2	Override in place before FLEX/HCVS. Requires Key PA2235 (in MCR).
7. Place PC-AO-237 ISOLATION OVERRIDE to OVERRIDE.	MCR Panel P2	Override in place before FLEX/HCVS. Requires Key PA2235 (in MCR).

Primary Action	Primary Location / Component	Notes
8. Open torus inlet outboard isolation valve PC-AO-237AV.	MCR Vertical Board H	This valve is normally closed, and fails-closed on loss of air or electricity. Also can be controlled from MROS.
9. Open torus inlet inboard isolation valve PC-MO-233MV.	MCR Vertical Board H	This valve is normally closed.
10. Open torus HCVS valve PC-AO-32.	MCR Key PA2235 Panel P2	AO-32 is the venting valve. This valve is normally closed, and fails-closed on loss of air and electricity. Also can be controlled from MROS.
11. Connect FLEX generator to emergency connection of the UPS system.	HCVS UPS in Control Building Corridor	Prior to depletion of the HCVS dedicated power supply (the UPS battery), actions will be required to connect back-up sources at a time greater than 24 hours.
12. Switch UPS power from 120 VDC battery to bypass source.	HCVS UPS in Control Building Corridor	Prior to depletion of the HCVS dedicated power supply (the UPS battery), actions will be required to connect back-up sources at a time greater than 24 hours.

Primary Action	Primary Location / Component	Notes
13. Replenish pneumatics with replaceable nitrogen bottles to pre-installed connections.	MROS N_2 bottles will be located in the MROS.	Nitrogen bottles will be pre-connected at the MROS allowing for 6 additional days of operation [total of 7 days] (Reference 55). This method will be utilized prior to depletion of the pneumatic sources; actions will be required to connect back-up sources at a time greater than 24 hours.

Permanently installed electrical power and pneumatic supplies are available to support operation and monitoring of the HCVS for a minimum of 24 hours. No large 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 replacement 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 Order compliance. All actions except Actions 1 and 2 were previously identified in the OIP and subsequent NRC ISE. These additional actions do not provide new areas or hazards and are provided for completeness of operator actions supporting opening HCVS vent path.

Table 3-2: Failure Evaluation

Functional Failure Mode	Failure Cause	Alternate Action	Failure with Alternate Action Impact on Containment Venting?
Failure of Vent to Open on Demand	Valves fail to open/close due to loss of normal AC power.	No action needed, as power from dedicated UPS system provides 24-hour supply. Or, station service battery via inverter for minimum 9 hours.	No
Failure of Vent to Open on Demand	Valves fail to open/close due to loss of alternate AC power (long term) or depletion of dedicated power supply.	UPS system can supply power for 24 hours. After that, UPS system can be supplied power directly (bypassing battery charger) from FLEX provided generators.	No
Failure of Vent to Open on Demand	Valves fail to open/close due to complete loss of batteries (long term).	Recharge station service batteries with FLEX provided generators, considering severe accident conditions. Or, power UPS system directly (bypassing battery charger) with FLEX provided generators, and/or recharge UPS system battery.	No
Failure of Vent to Open on Demand	Valves fail to open/close due to loss of normal pneumatic air	No action needed, air can be supplied by accumulator tanks, which is	No

Functional Failure Mode	Failure Cause	Alternate Action	Failure with Alternate Action Impact on Containment Venting?
	supply.	sufficient for at least 8 cycles of PC-AOV-AO32 valve over first 24 hours.	
Failure of Vent to Open on Demand	Valves fail to open/close due to loss of alternate pneumatic air supply (long term).	At MROS, open manual valves of pre-connected nitrogen cylinders to air system supporting HCVS valves, replace bottles as needed with on-site nitrogen bottles.	No
Failure of Vent to Open on Demand	Valves fail to open/close due to SOV failure.	Go to the MROS to supply nitrogen to the shuttle valves associated with air-operated valves PC-AOV-237AV and PC-AOV-AO32 to open the valves with pneumatic motive force.	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 MCR. Alternate control of the HCVS is accomplished from the MROS at the south exterior wall of the Reactor Building. FLEX actions that will maintain the MCR and MROS habitable were implemented in response to NRC Order EA-12-049 (Reference 32). These include:

1. Ventilating the MCR by opening MCR doors to the outside, operating portable generator and fan to move air out of the

MCR (Reference 52).

2. Opening doors and a roof hatch in the Reactor Building to establish natural circulation air flow in the Reactor Building. (Reference 53).

Table 2 contains a thermal evaluation of all the operator actions that may be required to support HCVS operation. The relevant ventilation calculations (References 49, 50, and 51) 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 MCR. Per HCVS-FAQ-06, 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.

Alternate control of the HCVS is accomplished from the MROS. The MROS was evaluated for radiation effects due to a severe accident and determined to be acceptable. The MROS is located external to the Reactor Building in a low dose area during normal operation. During an accident, the distance and shielding combined with the short duration of actions required at the MROS show the MROS to be an acceptable location for alternate control (Reference 49).

NEDC 15-024 (Reference 49) provides a radiological evaluation of 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 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 MCR. Under the postulated scenarios of Order EA-13-109, the MCR is adequately protected from excessive radiation dose and no further evaluation of its use is required (HCVS-FAQ-06).

Alternate control of the HCVS is accomplished from the MROS located against the south wall of the Reactor Building on the exterior side. This location is in an area evaluated to be accessible before and during a severe accident.

For ELAP with injection, the HCVS wetwell vent will be opened to protect the containment from overpressure. The operator actions and timing of those actions to perform this function under ELAP conditions were evaluated as part of CNS' response to NRC Order EA-12- 049 as stated in Reference 36.

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 (References 49, 50, and 51) 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% of licensed/rated thermal power (unless a lower value is justified by analysis), and be able to maintain containment pressure below the primary containment design pressure.

Evaluation:

Calculation NEDC 15-020 (Reference 69) contains the verification of 1% power flow capacity at PCPL (62.7 psig). This calculation models all the piping elbows, valves and other components using industry standard flow coefficients to determine an equivalent length of piping. Since the piping consists of 24" and 12" sections, both are modeled. The minimum flow at design pressure to pass 1% RTP is 75,500 lbm/hr. NEDC 15-020 verifies that the piping can pass greater than 1% flow.

Additional assumptions and modeling details are contained in NEDC 15-020.

The decay heat absorbing capacity of the suppression pool and the selection of venting pressure were made such that the HCVS will have sufficient capacity to maintain containment pressure at or below the lower of the containment design pressure (56 psig) or the PCPL (62.7 psig).

This calculation of containment response is contained in MAAP calculation NEDC 14-026 (Reference 35) that was submitted in Reference 24 and which shows that containment is maintained below the design pressure once the vent is opened, even if it is not opened until PCPL.

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

Evaluation:

The HCVS vent path at CNS consists of a wetwell vent. The HCVS will use the existing THPV piping between the wetwell penetration X-205 and PCIV PC-AOV-237AV. Penetration X-205 is a 20" piping penetration located at the top of the torus, midway between ring girders in a vent pipe bay. The piping enlarges to a 24" pipe right beyond the penetration. This pipe contains two butterfly PCIVs, PC-MOV-233MV and PC-AOV-237AV. Currently, further downstream, the 24" pipe changes to a 24" piping/thin-walled piping. This thin-walled piping has been evaluated in Calculation NEDC 92-054 (Reference 64) and determined to meet the design requirements of the HCVS, and a new 12" line has been tied into this 24" line. A new 12" control valve has been installed in the new 12" line in the torus room area. The pipe then travels along the south wall of the Reactor Building, to the southwest corner room. The pipe enters the corner room using a new penetration in the southwest diagonal wall. The pipe then travels across the corner room to enter the southwest staircase "A2" below floor EL 903'. Once in the staircase, the pipe follows the underside of the staircase and penetrates the southwest corner of the stairwell landing (i.e., the first stairwell landing on the west wall above EL 903'). The pipe travels through the staircase all the way to the refueling floor (EL 1001'). It penetrates the EL 1001' concrete floor slab in the southwest corner of the stairwell landing, and exits the top of the stairwell concrete structure (9' above EL 1001') on the refuel floor. The vent line then follows the west wall to a structural beam. The vent line then goes vertically out to the Reactor Building roof for the release point. The effluent will exit out of the Reactor Building.

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.

Intake and exhaust pathways of concern are the Control Building essential HVAC, and CREF system HVAC. Drawings 2206, 2210, and 4506, (References 60, 61 & 62) illustrate the proximity of the HCVS exhaust to these components. The Control Building essential HVAC intake and exhaust are located on the lower roof of the Reactor Building at EL 950', approximately 200' northeast of the HCVS exhaust. The CREF system HVAC intake and exhaust are located on the Control Building roof at EL 950', approximately 180' north of the HCVS exhaust. At these distances, the HCVS exhaust is high enough to assure that no appreciable effluent will reach Emergency Filter Intake and Exhaust Pathways. Although the distance between the HCVS exhaust and the normal building HVAC is not subject to any specific requirements, the Reactor Building HVAC intake is located a horizontal distance of 140' and vertical distance of 100' from the HCVS release point; and thus adheres to the reasonable assurance guidance.

NEI 13-02 states that "The release point should be situated away from ventilation system intake and exhaust openings or other openings that may be used as natural circulation ventilation intake flow paths during a BDBEE." There is an existing Reactor Building HVAC exhaust duct on the northeast end of the Reactor Building roof as well as the refuel floor hatch. These are potential natural circulation discharge points during a BDBEE. Although the zone of influence criteria do not apply in this case, both points are situated approximately 170' away from the HCVS release point.

The vent pipe extends approximately 3' above the parapet wall of the Reactor Building roof. This satisfies the guidance for height from HCVS-FAQ-04.

HCVS-WP-04 provides criteria that demonstrate robustness of the HCVS pipe. CNS meets the requirements of this white paper. No further protection of the HCVS pipe is required as this evaluation documents that the HCVS pipe is adequately protected from applicable external events.

CNS 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. No portion of the HCVS vent piping is exposed below 30' above grade. The HCVS vent piping exits the Reactor Building at EL 1049' (146' above grade). The SAWA connection points are located in the Control Building. It has been evaluated to provide wind-borne missile protection as part of the plant's design basis.
2. The exposed piping greater than 30' above grade has the following characteristics:
   a. The total vent pipe exposed strike area is less than 10 square feet which is less than the 300 square feet.
   b. The pipe is made of schedule 40 carbon steel and is not plastic and the pipe components have no small tubing susceptible to missiles.
   c. There are no obvious sources of missiles located in the proximity of the exposed HCVS components.
3. Per the BWROG guidance found in BWROG-TP-15-005, (Reference 68), HCVS pipe is required to be seismically rugged but not missile protected if the exposed piping is at an elevation over 30' from the nominal ground elevation.

The section of pipe above the Reactor Building roof has been evaluated using the guidance in NEI 12-06, Section 7.3.1 (Reference 31), to determine if reasonable protection is provided against high winds and wind generated missiles. By its nature, it is not practical to locate the HCVS vent pipe in diverse locations (as there is only one); however, based on the location of the pipe within the Reactor Building, the Reactor Building will provide reasonable protection from any wind generated missiles originating from the ground up to the roof line of the Reactor Building. Due to the elevation of the Reactor Building roof in relation to the other structures onsite, it is much less likely that a wind generated missile will be originated above the elevation of the Reactor Building. Since the HCVS piping above the Reactor Building roof is more than 30' above nominal ground elevation and there is no obvious source of tornado missiles that could potentially strike the HCVS piping on top of the Reactor Building roof, it is concluded that no additional missile shielding or a cutting tool are required.

4. CNS is not screened in for hurricanes.

Based on the above description of the vent pipe design, the CNS 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 wetwell vent utilizes PC system valves PC-MOV-233AV and PC-AOV-237AV for containment isolation. PC system boundary valves PC-AOV-235AV and PC-AOV-239AV are the only functional boundary valves between the HCVS and the downstream vent and purge system. These valves do not have a safety-related function during a design basis accident but are tested per the guidance of CNS' 10CFR50 Appendix J Program. The inboard containment isolation valve (PC-MOV-233MV) is a MOV and the outboard containment isolation valve is an AOV. The outboard AOV and the PC system boundary valves are air-to-open and spring-to-shut. An SOV must be energized to allow the motive air to open the valve from the MCR location. Although these valves are shared between the PC and the HCVS, separate control circuits are provided to each valve. Specifically, the PC control circuit will be used during all "design basis" operating modes including all design basis transients and accidents. The downstream PC valves serve the function of isolating the HCVS flow path from the SGT. These valves are tested, and will continue to be tested, for leakage under the guidance of CNS' 10CFR50 Appendix J Program as part of the containment boundary in accordance with HCVS-FAQ-05.

Based on the above description, the CNS design meets the requirements to minimize unintended cross-flow of vented fluids.

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

Evaluation:

After switching the power supply for PC-MOV-233MV at the Reactor Building EL 958', the wetwell vent will allow initiating and then operating and monitoring from a control panel located in the MCR. Operators access Reactor Building EL 958' to align alternate power to valve PC-MOV-233MV. This is performed in the first hour.

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, a readily accessible alternate location, called the MROS was added. The MROS 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 MROS is located on the exterior south wall of the Reactor Building, and is several feet to the east of the current standby nitrogen injection station (and its barricaded door) just inside the security fence entrance to the Main Power Transformer yard area. The MROS is a missile shielded structure. An entry door has been installed to allow operator access and to move additional nitrogen bottles into the MROS to supply pneumatic motive force beyond the initial 24 hours of the event. The exterior and interior walls forming the door entrance have been constructed in order to protect the equipment in the MROS from tornado missiles. Therefore, the door does not need to be designed for missile protection itself. Refer to the sketch provided in Attachment 8 for the HCVS site layout. The controls available at the MROS location are accessible and functional under a range of plant conditions, including severe accident conditions with due consideration to source term and dose impact on operator exposure, ELAP, inadequate containment cooling, and loss of Reactor Building ventilation. Table 1 contains an evaluation of the required controls and instruments that are required for severe accident response and demonstrates that 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 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. These evaluations demonstrate that the design meets the requirement to be manually operated from a remote but readily accessible location during sustained operation.

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 a dedicated 24 VDC HCVS battery and charger. The HCVS battery and charger are permanently installed in the Control Building EL 903' where they are protected from screened-in hazards and have sufficient capacity to provide this power without recharging. Calculation NEDC 15-030 (Reference 57) demonstrated that the 24 VDC battery capacity is sufficient to supply HCVS torus venting components for a minimum of 24 hours.

At 24 hours, FLEX generators can be credited to repower the station instrument buses and/or the battery charger to supply HCVS loads while recharging the 24 VDC batteries per the response to Order EA-12-049. The HCVS battery charger provided requires a 120 VAC supply. The battery charger is repowered via portable cables from a FLEX portable generator as part of the response to Order EA-12-049. Engineering Change CED 6037041 (Reference 65) confirms that the battery charger is capable of supplying the continuous HCVS loads while recharging the batteries.

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

Pneumatic power for the HCVS valve actuators is normally provided by the accumulators via instrument air system with backup nitrogen provided from installed nitrogen supply tanks. Following an ELAP event, the station air system is lost, and normal backup from installed nitrogen supply tanks is isolated. Therefore, for the first 24 hours, pneumatic force will be supplied from existing and newly installed air accumulator tanks. These accumulators will supply the required motive force to those HCVS valves needed to maintain flow through the HCVS effluent piping. Calculation NEDC 92-073 (Reference 70) demonstrates that the installed accumulators have the capacity to supply the required motive force to those HCVS valves needed to maintain flow through the HCVS effluent piping for 24 hours without replenishment. This analysis sizes the accumulators to open valve PC-AOV-237AV once and to perform up to 8 open and close cycles of HCVS isolation valve PC-AOV-AO32 over the course of a 24-hour period.

Per NEDC 15-026 (Reference 55), the back-up nitrogen system has been sized to open valve PC-AOV-237AV six times and to perform up to 48 open and close cycles of HCVS isolation valve PC-AOV-AO32 for assumed days 2 through 7 of the ELAP. Note that only valve PC-AOV-AO32 is cycled for venting operation while PC-AOV-237AV will remain open once venting process is initiated.

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

Evaluation:

EOPs provide clear guidance that the HCVS is not to be used to defeat containment integrity during any design basis transients and accidents. In addition, the HCVS was designed to provide features to prevent inadvertent actuation due to equipment malfunction or operator error. Also, these protections are designed such that any credited CAP that would provide net positive suction head to the 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. CNS credits CAP to maintain sufficient NPSH for ECCS pumps (CS and RHR). Therefore, it is essential to prevent inadvertent actuation of the HCVS to ensure that the CAP can be maintained.

At CNS, the features that prevent inadvertent actuation are two containment isolation valves in series powered from different divisions and key-lock switches. With respect to the containment isolation valves, the inboard valve (PC-MOV-233MV) is an AC motor-driven MOV fed from a Division I AC power source, and the outboard valve (PC-AOV-237AV) is an AOV with an AC powered SOV fed from a Division II AC power source. Hence, the containment isolation valves meet the requirements for redundant and diverse power sources. Furthermore, these valves can be operated from key-locked switches in the MCR. Although these valves are shared between the Containment Purge System and the HCVS, key-locked override switches are provided for each valve to allow operators to override the containment isolation signal.

Specifically:

- The Containment Purge System control circuit is used during all "design basis" operating modes including all design basis transients and accidents. The containment isolation signal will cause the valves to shut.
- The HCVS control circuit has a key-locked switch for each of the two in-series valves to address inadvertent operation. Turning the switch to "open" will energize the control circuit opening the valve. Both valves will use AC power for opening for the HCVS function. Also, separate control circuits including switches will be used for the two redundant valves to address single point vulnerabilities that may cause the flow path to inadvertently open.

Procedures also provide clear guidance to not circumvent containment integrity by simultaneously opening torus and drywell vent valves during any design basis transient or accident.

The containment isolation valves must be open to permit vent flow. The physical features that prevent inadvertent actuation are the key lock switches for PC-MOV-233MV and PC-AOV-237AV at the primary control station and locked closed valves at the MROS.

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.

This monitoring instrumentation provides the indication from the MCR per Order requirement 1.2.4. During the event, the wetwell HCVS and required containment instrumentation will be supplied by the HCVS UPS. The HCVS UPS has a 24-hour capacity. Beyond that time, a battery charger powered by the FLEX 60kW generator will maintain the UPS charged (Reference 36).

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, vent pipe pressure, radiation monitoring, and support system monitoring, are seismically qualified as indicated on Table 1 and they include the ability to handle harsh environmental conditions (although they may not be considered part of the site EQ program).

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

Evaluation:

The HCVS radiation monitoring system consists of an ion chamber detector coupled to a process and control module. The process and control module is mounted in the Reactor Building EL 931'. The MCR has radiation indication on recorder PC-R-520 on Panel

P2 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 mild environment in the Reactor Building EL 931'. 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 valves PC-AOV-235AV and PC-AOV-239AV are designed to 62.7 psig at 310 °F. Wetwell vent piping and components installed downstream of the containment isolation boundary are designed for BDB conditions.

HCVS piping and components have been analyzed and shown to perform under severe accident conditions using the guidance provided in HCVS-FAQ-08 and HCVS-WP-02. The site-specific radiological conditions for the HCVS are evaluated in NEDC 15-024 (Reference 49) based on the bounding CNS specific in-containment source term during the first 7 days following an ELAP (Reference 71).

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 check valve is installed near the top of the pipe in accordance with HCVS-WP-03. This valve will open on venting, but will close to prevent air from migrating back into the pipe after a period of venting. The check valve is installed to ensure that it limits back-leakage to preclude a detonable mixture from occurring in the case venting is stopped prior to the establishment of alternate reliable containment heat removal. The use of a check valve meets the requirement to ensure the flammability limits of gases passing through the vent pipe will not be reached.

Furthermore, HCVS-WP-03, (Reference 10) states that soft seated versions of relevant check valves (capable of operating at wetwell venting design temperatures) can be expected to have an effective leakage of approximately 2 cc/hr/inch of seat. HCVS-WP-03 states that for a 14" valve, this would equate to an in-leakage of 0.001 ft^3/hr of oxygen. For CNS, the HCVS check valve is a 12" valve, so a conservative in-leakage of 0.001 ft^3/hr of oxygen can be assumed. Between the control valve PC-AOV-AO32 and the check valve PC-CV-37CV, it is conservatively assumed that there is a 100' run of 12" pipe (volume = π*r2*h = 3.14 * (0.5 ft)2 * 100 ft = 78 ft^3). The actual HCVS pipe has a conservatively longer run of pipe (i.e., more than 100') between PC-AOV-AO32 and PC-CV-37CV, where the pipe travels from the torus area to the refueling floor. In order to reach an oxygen concentration of 5% (which would only support a low flame – no detonation potential, per HCVS-WP-03), it would take more than 162.5 days, approximately. This is calculated by taking 5% of the pipe volume and dividing by the in-leakage rate of 0.001 ft^3/hr of oxygen (In-leakage time = 0.05 * 78 ft^3 / (0.001 ft^3/hr) = 3,900 hours = 162.5 days). For the HCVS scenario, the vent is designed to vent multiple times in a 24-hour period and over a duration of 7 days if needed. Since the venting scenario is only 7 days, there is not enough time between vent cycles (and over the duration of the HCVS scenario) for in-leakage of oxygen to reach a concentration of 5%. Therefore, the function of the check valve PC-CV-37CV to prevent air/oxygen backflow into the HCVS discharge piping is sufficient.

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.

CNS has implemented the following operation, testing and inspection requirements in Table 3-3 for the HCVS to ensure reliable operation of the system. 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.
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.
Cycle the HCVS valves[1] and the interfacing system valves not used to maintain containment integrity during operations.	Once per every[2] operating cycle.

---

[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.

[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.

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 (PC-AOV-237AV) 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 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 structure(s).

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, controls 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 EA-13-109 requirements, Attachment 2, Section B for Phase 2

Licensees with BWR 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.

B.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 for the wetwell venting system shall also apply to the drywell venting system.

B.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 of the Order. NEI 13-02, Revision 1, provides SAWA in conjunction with 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.

CNS has implemented containment venting strategy, as the compliance method for Phase 2 of the Order and conforms to the associated guidance in NEI 13-02, Revision 1, for this compliance method.

Section IV.B HCVS Existing System

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

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

The HCVS Phase 2 SAWA system and SAWM strategy utilize the FLEX mitigation equipment and strategies to the extent practical. This approach is reasonable because the external hazards and the event initiator (ELAP) are the same for both FLEX mitigation strategies and HCVS. For SAWA, it is assumed that the initial FLEX response actions are unsuccessful in providing core cooling such that core damage contributes to significant radiological impacts that may impede the deployment, connection, and use of FLEX equipment. These radiological impacts, including dose from containment and HCVS vent line shine, were evaluated and modifications made as necessary to mitigate the radiological impacts such that the actions needed to implement SAWA and SAWM are feasible in the timeframes necessary to protect the containment from overpressure related failure. To the extent practical, the SAWA equipment, connection points, deployment locations and access routes are the same as the FLEX alternate 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.

CNS has implemented the containment venting strategy utilizing SAWA and SAWM. The SAWA system consists of a FLEX (SAWA) pump injecting into the 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 a revision to the SAMGs. This strategy has been shown via MAAP and MACCS analysis to protect containment without requiring a drywell vent for at least 7 days which is the guidance from NEI 13-02 for the period of sustained operation.

Section IV.C.1 Detailed SAWA Flow Path Description

The SAWA flow path is the same as the FLEX alternate injection flow paths (Reference 36). The SAWA flow path's primary source is from the Missouri River with a backup suction source from the unit's Condensate Storage Tank (CST 1A), if available (Reference 45). Both flow paths utilize the FLEX pump and include a SAWA flow indicator. The primary SAWA flow path hose routing is from the FLEX pump to SW-V-1531, RHRSW FLEX Connection Isolation, in the Control Building (Reference 37). This connection then passes injection flow via the normal RHRSW crosstie to the Division 1 RHR injection flow path. RPV pressure is below the shutoff head of the FLEX pump. The RHRSW to RHR flow path is established by opening valve SW-120 (Reference 37) to allow flow into the 24" line to the LPCI valves, RHR-MO-27A and RHR-MO-25A (Reference 38). This provides the flow path into the RPV. The basic pictorial overview of the SAWA flow path(s) is shown in Attachment 6, Figure 6.

Drywell pressure and suppression pool level are monitored and flow rate can be adjusted by use of the FLEX pump speed control at the Missouri River or CST 1A. Communication is established between the MCR and the FLEX pump location. (Reference 56)

Based upon timed validations, the hose connections and valve lineups will be completed and injection will commence within 4.13 hours of starting the evolution (loss of injection). Note that the generic industry guidance for core damage is 1 hour. Thus, all evaluations used 1.0 hours to core damage.

The FLEX pump is capable of meeting water makeup requirements for CNS. As discussed in Combined OIP (Reference 23), the total amount of water added will not completely fill up the wetwell to render torus venting inoperable.

BWROG generic assessment, BWROG-TP-15-008, provides the principles of SAWA to ensure protection of containment. This SAWA injection path is qualified for the the screened-in hazards (Section III) in addition to severe accident conditions.

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

The actions inside the Reactor Building, where there could be a high radiation field due to a severe accident, will be to open PC-MOV-233MV and open the Reactor Building alternate ventilation path. These actions inside the Reactor Building can be performed before the dose is unacceptable, under the worst-case scenario within the first hour, after the loss of RPV injection. These times were validated as part of the Time Sensitive Action validation for Order EA-12-049.

Procedure 5.3SBO directs accomplishment of actions that must be done early in the severe accident event where there is a loss of AC power and a loss of all high-pressure injection to the core. In this event, core damage is not expected for at least 1 hour so that there will be no excessive radiation levels or heat related concerns in the Reactor Building when the valve is operated. The other actions take place outside the Reactor Building at the MCR, Missouri River or CST 1A, FSB, and the deployment pathways to the Control Building. Since these locations are outside the Reactor Building, they are shielded from the severe accident radiation by the thick concrete walls of the Reactor Building.

The SAWA injection path is the FLEX alternate injection pathway, and is actually patterned by the B.5.b primary injection path; therefore, the most significant portion of the pathway is a practiced evolution. But, as it was not time-critical in the FLEX evaluation, a time validation of the injection pathway was developed for this Order. This was time-critical validated to be no more than 4.13 hours from loss of injection to recommencing injection into the RPV, well within the 8 hours required by the Order.

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 or downcomer 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

CNS 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 freeboard between +12'-11" and 28'-9" elevation in the wetwell provides approximately 813,820 gallons of water volume before the water level reaches the bottom of the vent pipe (Reference 50). BWROG generic assessment BWROG-TP-15-011 (Reference 74) provides the principles of SAWM to preserve the wetwell vent for a minimum of 7 days. After containment parameters are stabilized with SAWA flow, SAWA flow will be reduced to a point where containment pressure will remain low while wetwell level is stable or very slowly rising. As shown in Engineering Study ER 1252, the wetwell level will not reach the wetwell vent for at least 7 days. A diagram of the available freeboard is shown on Attachment 1 (Reference 50).

Section IV.C.5 Upper Range of Torus Level Indication

The upper range of torus level indication provided for SAWA/SAWM is +30 foot elevation. The torus level indication spans the entire volume of the suppression chamber and exceeds the upper limit of torus 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 (Reference 72), Engineering Study ER 1252 (Reference 50), and BWROG-TP-15-011 (Reference 74), all 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 7 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 CNS is developed from the BWROG EPG/SAGs. As such, the SAWA/SAWM implementing procedures are integrated into the CNS SAMGs. In particular, EPG/SAG Revision 3, when implemented with Emergency Procedures Committee Generic Issue 1314 (Reference 73), 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, CNS has validated that the FLEX pump can be deployed and injection commenced 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 344 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.

Engineering Study ER 1252 (Reference 50) demonstrated that, SAWA flow could be reduced to 69 gpm after 4 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

CNS will accomplish SAWA flow control by the use of speed control on the FLEX pump. The operators at the FLEX pump will be in communication with the MCR via radios 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 FLEX pump location are the same as that evaluated and found acceptable for FLEX strategies. (Reference 56) The communications capabilities have been tested to ensure functionality at the SAWA flow control and monitoring locations (Reference 56).

Section IV.C.9 SAWA/SAWM Element Assessment

Section IV.C.9.1 SAWA Pump

CNS uses one portable diesel-driven pump for both FLEX and SAWA. The pump is capable of 925 gpm at the pressures required for RPV injection during an ELAP. This pump has been shown to be capable of supplying the required flow rate to the RPV and Fuel Pool for SAWA scenarios. The pump(s) are stored in the FSB(s) where they are protected from all screened-in hazards and are rugged, over the road, trailer-mounted units, and therefore will be available to function after a seismic event.

Section IV.C.9.2 SAWA Analysis of Flow Rates and Timing

CNS SAWA flow is 344 gpm which is the site-specific flow rate when the site's RTP 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 power level is 3514 MWth, equivalent to the reference plant RTP level used in NUREG-1935, State of the Art Reactor Consequence Analysis (SOARCA). NUREG 1935 is Reference 9 of NEI 13-02, Revision 1.

Section IV.C.9.3 SAWA Pump Hydraulic Analysis

Calculation NEDC 15-002 (Reference 51) analyzed the FLEX pumps and the lineup for RPV injection that would be used for SAWA. This calculation showed that the pumps have adequate capacity to meet the SAWA flow rate required to protect containment.

Section IV.C.9.4 SAWA Method of Backflow Prevention

The CNS SAWA flow path from the SAWA pump to the RPV includes check valves RHR-CV-20CV and RHR-CV-26CV inside the Reactor Building as shown on Attachment 6. These valves will prevent any backflow to the SAWA pump.

Check Valve RHR-CV-26CV is also a PCIV whose integrity of check function (open and closed) is demonstrated by other plant testing requirements (Reference 66) such that additional testing per the NEI 13-02, Revision 1, Section 6.2, is not required for this valve per NEI 13-02, Revision 1, Table 6-1, Note 3. Thus, backflow is prevented by check valves in the SAWA flow path inside the Reactor Building.

Section IV.C.9.5 SAWA Water Source

The initial source of water for SAWA is the UHS (Missouri River) (alternately CST 1A). The Missouri River is an inexhaustible supply; CST 1A can provide approximately 52 hours of water injection without makeup based on the FLEX analysis. Before CST 1A's initial supply of water is depleted, the N+1 FLEX pump or the NSRC-supplied pump will be deployed to either directly inject into the RPV or re-fill the CST from the Missouri River. This long-term strategy of water supply was qualified for Order EA-12-049 response and is available during a severe accident. Therefore, there will be sufficient water for injection to protect containment during the period of sustained operation.

Section IV.C.9.6 SAWA/SAWM Motive Force

Section IV.C.9.6.1 SAWA Pump Power Source

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

Section IV.C.9.6.2 Electrical Loading Calculation for SAWA/SAWM Equipment

Table 1 shows the electrical power source for the SAWA/SAWM instruments. These loads were evaluated as part of Order EA-12-049. For the instruments powered by the HCVS UPS, calculation NEDC 15-030 demonstrates that they can provide power until the FLEX generator restores power to the battery charger (Reference 57).

Section IV.C.10 SAWA/SAWM Instrumentation

1) Credited SAWA/SAWM instruments.
    a. SAWA/SAWM Pump flow meter - capable of measuring flow in 70 - 800 gpm range
    b. Drywell Pressure
    c. Suppression Pool Level
2) Describe the instruments used to monitor SAWA pump flow.
    a. The SAWA/SAWM flow meter is required to determine the flow of water going to the RPV 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) Qualifications of instrumentation (temperature/radiation/seismic).

    a. The flow meter is capable of withstanding pressure up to ~260 psi which exceeds the maximum discharge pressure of the SAWM pump. The flow meter has a rated operating temperature range of 0°F to 150°F. While this temperature range does not encompass the minimum cold temperature at CNS, the vendor has stated that the flow meter will function at the low temperature of -5°F. (References 26 & 28) Two flow meters have been procured and stored with each SAWA pump in the FSB, such that one flow meter will be available following a seismic event. Radiation exposure will be kept minimal based on the storage location and use.

4) Describe the means to provide power (e.g., skid mounted diesel engine/alternator, batteries or small portable AC generators) to these instruments for the sustained operation period.

    a. The unit is powered by an internal lead acid battery which will power the flow meter for 5-7 years.

5) Describe how containment pressure and wetwell level instrumentation will be repowered through the sustained operation period.

    a. Containment pressure and wetwell level instrumentation will be repowered through their respected electrical buses by the use of the FLEX generator or the HCVS UPS unit.

Section IV.C.10.1 SAWA/SAWM Instruments

Table 1 contains a listing of 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 SAGs 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 of the FLEX/SAWA pump 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 to provide confirmation for adjusting 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 33), which is the CNS committed version per Technical Specifications Basis B3.3.3.1 (Reference 41) as post-accident instruments and are therefore qualified for Order EA-13-109 events.

The SAWA flow meter is rated for continuous use under the expected ambient conditions and so will be available for the entire period of sustained operation. Furthermore, since the pump is deployed outside the Reactor Building, and on the opposite end of the Reactor Building from the vent pipe, there is no concern for any effects of radiation exposure to the flow instrument.

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

CNS 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. Calculation NEDC 15-024 analyzed dose at different locations and times where operator actions will take place during FLEX/SAWA/SAWM activities. Table 6 of NEDC 15-024 provides this dose information. Key locations are MCR, MROS, travel paths for hose routing, and FLEX/SAWA pump location. FSGs 5.10FLEX.18 and 5.10FLEX.19 (References 53 and 52) provide guidance for ventilation strategies at various locations to mitigate high temperature conditions.

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

Since the FLEX pump is stored in the FSB and will be operated from outside the Reactor Building, near CST 1A or the Missouri River there will be no issues with radiation dose rates at the FLEX pump control location and there will be no significant dose to the FLEX pump.

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 actions inside the Reactor Building, where there could be a high radiation field due to a severe accident. These actions occur within the first hour of a loss of injection per Procedure 5.3SBO. They are the opening of PC-MOV-233MV and the opening of the Reactor Building alternate ventilation path. These actions inside the Reactor Building can be performed before the dose is unacceptable under the worst-case scenario within the first hour, after the loss of RPV injection per HCVS-FAQ-12. These times were validated as part of the Time Sensitive Action validation for Order EA-12-49. The remaining actions 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, CNS performed GOTHIC calculations of the temperature response of the Reactor and Control Buildings during the ELAP event (Reference 51). Since, in the severe accident, the core materials are contained inside the primary containment, the temperature response of the Reactor Building and Control Building is driven by the loss of ventilation and ambient conditions and therefore will not change. Thus, the FLEX GOTHIC calculations are 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.

The operators make all hose connections and control the FLEX pump to perform SAWA/SAWM as well as observe the necessary instruments from outside the Reactor Building. The thick concrete Reactor Building walls as well as the distance to the core materials mean that there is not significant radiological concern with any actions outside the Reactor Building. Therefore, all SAWA controls and indications are accessible during severe accident conditions.

The FLEX pump and monitoring equipment can all be operated from the MCR or from outside the Reactor Building at ground level. The CNS FLEX response ensures that the FLEX pump, FLEX air compressors, FLEX generators and other equipment can all be run for a sustained period by refueling. All the refueling locations are located in shielded or yard areas so that there is no radiation hazard from core material during a severe accident. The monitoring instrumentation includes SAWA flow at the pump, and 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 CNS' 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 CNS relies on CAP to achieve NPSH for the ECCS pumps, the procedures include precautions that use of the vent may impact NPSH (CAP) available to the ECCS pumps.

CNS has implemented the BWROG Emergency Procedures Committee Issue 1314 that implements the SAWM strategy in the 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 ELAP conditions with significant core damage including exvessel core debris.

CNS has incorporated the following quotes into the SAMGs and SAMG implementing documents as shown below under each subheading as bulleted items. The document reference will be shortened using following method (Reference #, Additional Information - if required; e.g. [48,TSG 3.30]):

Cautions

- Reducing PC pressure will reduce available NPSH for pumps taking suction from suppression pool. [42,SAG 1] [43,SAG 2B]
- Adding water to hot core debris may result in rapid steam generation challenging primary containment limits. [42,SAG 1] [43,SAG 2B]
- Raising suppression pool water level above 28.63' will result in loss of the suppression chamber vent path. [42,SAG 1] [43,SAG 2B]

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

- If core debris breaches RPV, SAGs prioritize primary containment integrity while limiting radioactivity release. Water addition is managed to stabilize core debris while preserving suppression chamber vent path, thereby retaining benefits of suppression pool scrubbing and minimizing likelihood of radioactivity and hydrogen release into secondary containment. [44,5.9SAMG]
- Stabilize core debris in the PC (TSG 3.30) [43,SAG 2B]
- Commence RPV injection flow of < 400 gpm (~344 gpm) to stabilize core debris. [43,SAG 2B]
- Inject to RPV at a rate of ≥ 344 gpm but < 400 gpm until at least one indication that core debris has been stabilized per Step 3.1.8 is obtained. WHEN indication that core debris has been stabilized, THEN enter Attachment 8. [44,5.9SAMG]
- Once core debris stabilized, commence RPV injection flow of < 100 gpm (~69 gpm) to cool core debris and preserve PC integrity. [43,SAG 2B]
- IF drywell pressure cannot be maintained PCPL-B (GRAPH 11), THEN emergency vent PC, EOP 5.8.18, to control drywell pressure below PCPL-B (GRAPH 11) (use manual PC vent if necessary, 5.3ALT-STRATEGY). [43,SAG 2B]

- When water addition is initiated, the steaming rate will increase due to the heat transfer from the RPV, internal components, containment structures, and core debris, further pressurizing the containment. The pressure increase can be controlled by containment venting through the torus vent. [46,TSG 3.30]
- IF necessary to add water to RPV or PC THEN emergency vent PC, EOP 5.8.18 (use manual PC vent if necessary, 5.3ALT-STRATEGY). [43,SAG 2B]
- IF torus water level cannot be maintained below 28.5', THEN stop injection into RPV and PC from sources external to PC not required for core debris cooling. [43,SAG 2B]

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

- Stabilize Debris, Slowly increase injection to stabilize core debris (TSG-3.30) using Water Addition Systems (TABLE 19) with injection into the RPV if possible. [43,SAG 2B]
- WHEN core debris is stabilized (TSG-3.30), THEN operate Water Addition Systems (TABLE 19) to cool core debris and preserve primary containment integrity:
    - Operate CS
    - Inject into the RPV if possible
    - Maintain total injection from sources external to the primary containment as low as practicable
    - Confirm SAWA capability [43,SAG 2B]
- Inject into the RPV, if possible, from any available sources to cool the core debris and maintain it in a stabilized condition. [44,5.9SAMG]
- IF necessary to add water to RPV or PC THEN emergency vent PC, EOP 5.8.18 (use manual PC vent if necessary, 5.3ALT-STRATEGY). [43,SAG 2B]
- By maintaining torus vent path, all releases should be scrubbed by passing through suppression pool. [44,5.9SAMG]

Section V.B HCVS Out of Service Requirements

Provisions for out-of-service requirements of the HCVS and compensatory measures have been added to the CNS TRM, Section 3.12, Beyond Design Basis Components (Reference 67).

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

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

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

- If for up to 90 consecutive days, primary control and monitoring elements or alternate valve control elements of HCVS operation are non-functional, no compensatory actions are necessary.
- If up for to 30 days, primary control and monitoring elements and alternate valve control elements of HCVS 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 to 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 HCVS operation are functional.

The system functionality basis is for coping with BDB events and therefore plant shutdown to address non-functional conditions is not warranted. However, such conditions shall 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 BDB 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 ELAP.

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 Systematic Approach to Training 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

CNS 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 Order EA-12-049: Hardened containment vent operation on backup power and from primary or

alternate locations during conditions of ELAP/loss of UHS with no core damage). System use is for containment heat removal AND containment pressure control.

3. HCVS operation on backup power and from primary or alternate location during conditions of ELAP/loss of UHS with core damage. System use is for containment heat removal AND containment pressure control with potential for combustible gases.

Evaluation:

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

The use of the HCVS and SAWA capabilities will be demonstrated during drills, tabletops or exercises consistent with NEI 13-06 and on a frequency consistent with 10 CFR 50.155(e)(4). CNS will perform the first drill demonstrating at least one of the above capabilities by November 14, 2022, which is within 4 years of the first unit compliance with Phase 2 of Order EA-13-109, or consistent with the next FLEX strategy drill or exercise. Subsequent drills, tabletops or exercises will be performed to demonstrate the capabilities of different elements of Items 1, 2, and 3 above that is applicable to CNS in subsequent 8-year intervals.

Section VI: References

1. GL 89-16, Revision 0, Installation of a Hardened Wetwell Vent, September 1,1989, ML031140220
2. SECY-12-0157, Revision 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, Revision 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, Revision 0, Order to Modify Licenses with Regard to Reliable Hardened Containment Vents, ML12054A694
5. EA-13-109, Revision 0, Order to Modify Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions, ML13143A321
6. NEI 13-02, Revision 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[6], Revision 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, Revision 0, Hardened Containment Vent System Dedicated and Permanently Installed Motive Force, Revision 0, April 14, 2014, ML14120A295 / ML14126A374
9. HCVS-WP-02, Revision 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, Revision 1, Hydrogen/Carbon Monoxide Control Measures Revision 1, October 2014, ML14302A066 / ML15040A038
11. HCVS-WP-04, Revision 0, Missile Evaluation for HCVS Components 30 Feet Above Grade, ML15244A923 / ML15240A072
12. JLD-ISG-2013-02, Revision 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

---

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

13. JLD-ISG-2015-01, Revision 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, Revision 1, Severe Accident Multiple Unit Response, ML15273A141 / ML15271A148
15. HCVS-FAQ-11, Revision 0, Plant Response During a Severe Accident, ML15273A141 / ML15271A148
16. HCVS-FAQ-12, Revision 0, Radiological Evaluations on Plant Actions Prior to HCVS Initial Use, ML15273A141 / ML15271A148
17. HCVS-FAQ-13, Revision 0, Severe Accident Venting Actions Validation, ML15273A141 / ML15271A148
18. Phase 1 OIP, Revision 0, NPPD Correspondence NLS2014057, ML14189A415
19. HCVS Phase 1 NRC ISE, ML15006A234
20. HCVS Phase 2 NRC ISE, ML16266A066
21. First Six-Month Status Report, (Phase 1 OIP, Revision 1, also provided as part of this update), NPPD Correspondence NLS2014101, ML14364A154
22. Second Six-Month Status Report, NPPD Correspondence NLS2015079, ML15189A047
23. Phase 1 and Phase 2 Overall Integrated Plan (Third six-month update included in combined OIP), NPPD Correspondence NLS2015137, ML15364A011
24. Fourth Six-Month Status Report, NPPD Correspondence NLS2016040, ML16196A058
25. Fifth Six-Month Status Report, NPPD Correspondence NLS2016068, ML17006A005
26. Sixth Six-Month Status Report, NPPD Correspondence NLS2017055, ML17177A091
27. Seventh Six-Month Status Report, NPPD Correspondence NLS2017093, ML17362A037
28. Eighth Six-Month Status Report, NPPD Correspondence NLS2018020, ML18190A181
29. Ninth Six-Month Status Report, NPPD Correspondence NLS2018058, ML18351A090

30. Compliance Letter, Completion of Required Action for NRC Order EA-13-109, NPPD Correspondence NLS2019001
31. NEI 12-06, Revision 2, Diverse and Flexible Coping Strategies (FLEX) Implementation Guide, ML16005A625
32. EA-12-049, Issuance of Order to Modify Licenses With Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events, dated March 12, 2012, ML12054A735
33. RG 1.97, Revision 2, Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Conditions During and Following an Accident, ML060750525.
34. TR-1026539, Revision 0, EPRI Investigation of Strategies for Mitigating Radiological Releases in Severe Accidents BWR, Mark I and Mark II Studies, October 2012
35. NEDC 14-026, Review or ERIN Calculation C122140001-11622, "MAPP Analysis to support Cooper FLEX Strategy"
36. FLEX FIP, Revision 1, February 14, 2018
37. B&R Drawing 2006 (Sh 4), Circulating, Screen Wash and Service Water Systems
38. B&R Drawing 2040 (Sh 1), Residual Heat Removal System Div 1
39. B&R Drawing 2040 (Sh 2), Residual Heat Removal System Div 2
40. Emergency Operating Procedure 5.8, Emergency Operating Procedures (EOPs)
41. CNS Technical Specifications & Bases
42. SAG 1, RPV, Containment and Radioactivity Release Control
43. SAG 2B, Core Debris has Breached RPV, SAG 2A/B Chart
44. Procedure 5.9SAMG, Severe Accident Management Guidance
45. FSG 5.10FLEX.25, Alternate RPV Injection From CST1A, FLEX Well, or Missouri River
46. AMP-TBD02, TSG Technical Basis Document
47. FSG 5.10FLEX.31, FLEX Equipment Refueling Operations
48. Emergency Procedure 5.3SBO, Station Blackout
49. NEDC 15-024, Owner Acceptance of TetraTech Calculation CNS001-194-4933-

005 "Radiological Conditions Resulting from the Operation of the HCVS"

50. Engineering Report 1252, NRC Order EA-13-109 Phase 2 Reliable Hardened Containment Vent Engineering Study, Revision 1, May 19, 2016
51. NEDC 15-002, Review of Tetra Tech Portable Equipment Calculations in Support of CNS FLEX Strategy
52. FSG 5.10FLEX.19, Alternate Ventilation FLEX Operations
53. FSG 5.10FLEX.18, Alternate Reactor Building Ventilation FLEX Operations
54. FLEX Validation Report, Attached to FLEX Program Document
55. NEDC 15-026, Owner Acceptance of TetraTech Calculation CNS001-194-4933-007 "Mechanical ROS Nitrogen Calculation"
56. Response to NRC Technical Issues for Resolution Regarding Licensee Communication Submittals Associated with Near-Term Task Force Recommendation 9.3 (TAC No ME7951), NPPD Correspondence NLS2013028, ML13057A028
57. NEDC 15-030, HCVS UPS Sizing Analysis
58. NEDC 15-025, Mechanical ROS Civil/Structural Design for the Hardened Containment Vent System Project
59. CNS Drawing CNS-PC-80, Sheet 1
60. B&R Drawing 2206, H&V Plan and Sections Drywell & Reactor Bldg, FL, ELEV 931'6"
61. B&R Drawing 2210, Heating & Ventilation Drywell & Reactor Sections & Details
62. B&R Drawing, 4506, Roof Plan and Details
63. NEDC 15-023, Owner Acceptance of TetraTech Calculation CNS001-194-4933-004 "Calculation of the Pressure Gradient Across the HCVS Line and HCVS Maximum Operational Temperature"
64. NEDC 92-054, Analysis of 24" Torus Purge-Vent Duct for Hard Pipe Vent Locations
65. CED 6037041, FLEX Electrical Connections, December 21, 2015
66. Procedure 6.1RHR.402, RHR-MOV-MO25A, RHR-MOV-MO274A, and RHR-CV-26CV Pressure Isolation Valve Leak Rate Test (IST)

67. Technical Requirements Manual, Section 3.12, Beyond Design Basis Components

68. BWROG-TP-15-005 BWROG FRC Missile Strike on HCVS Piping (BWROG-15021), Revision 0, May 2015

69. NEDC 15-020, Owner Acceptance of TetraTech Calculation CNS001-194-4933-001 "Calculation of HCVS Flow Rate and Vent Size"

70. NEDC 92-073, Accumulator Sizing and Recharge Time for PC-237AV and PC-AO32

71. NEDC 15-047, Owner Acceptance of TetraTech Calculation CNS001-194-4933-028 "HCVS Radiological Source Term"

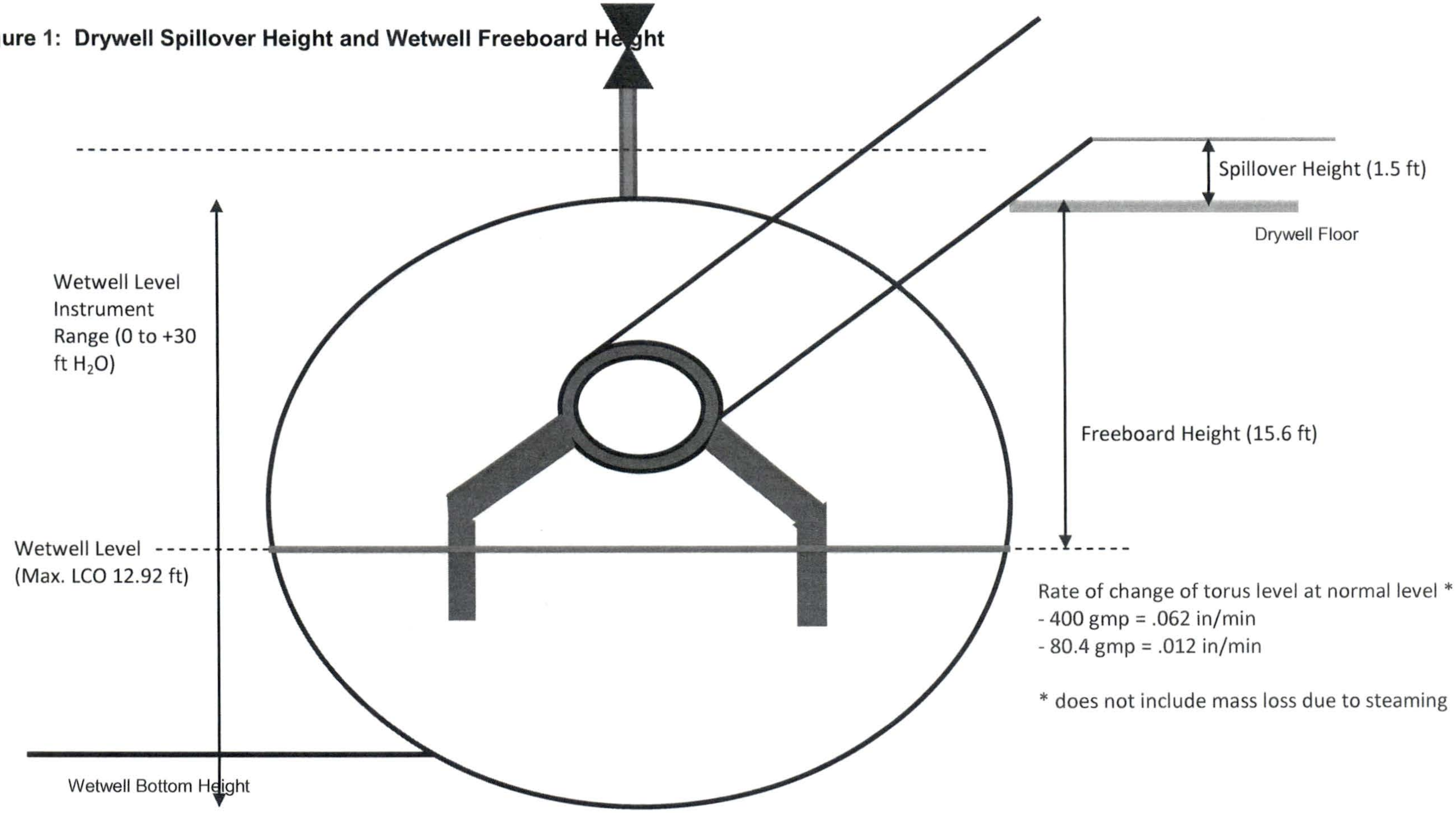
72. EPRI Technical Basis for Severe Accident Mitigating Strategies: Volume 1, Product Id: 3002003301.

73. BWROG EPG Issue 13-14, Implementation of SAWA/SAWM Strategies.

74. BWROG-TP-15-011, Severe Accident Water Management Supporting Evaluations

Attachment 1: Phase 2 Freeboard Diagram

Figure 1: Drywell Spillover Height and Wetwell Freeboard Height



Rate of change of torus level at normal level *
- 400 gmp = .062 in/min
- 80.4 gmp = .012 in/min

* does not include mass loss due to steaming

Attachment 2: One Line Diagram of HCVS Vent Path

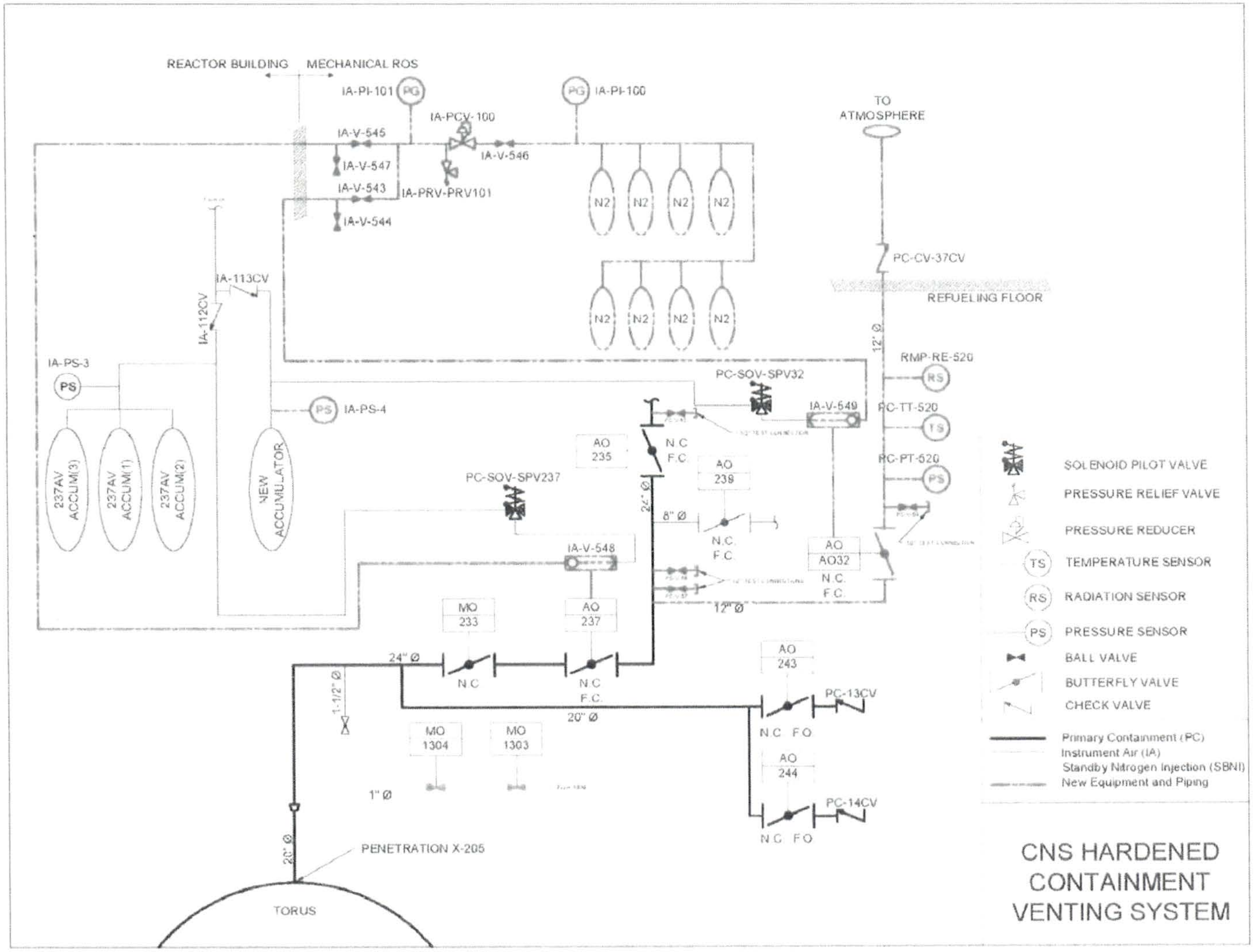


Figure 2: One Line Diagram of HCVS Vent Path

Attachment 3: One Line Diagram of HCVS Electrical Power Supply

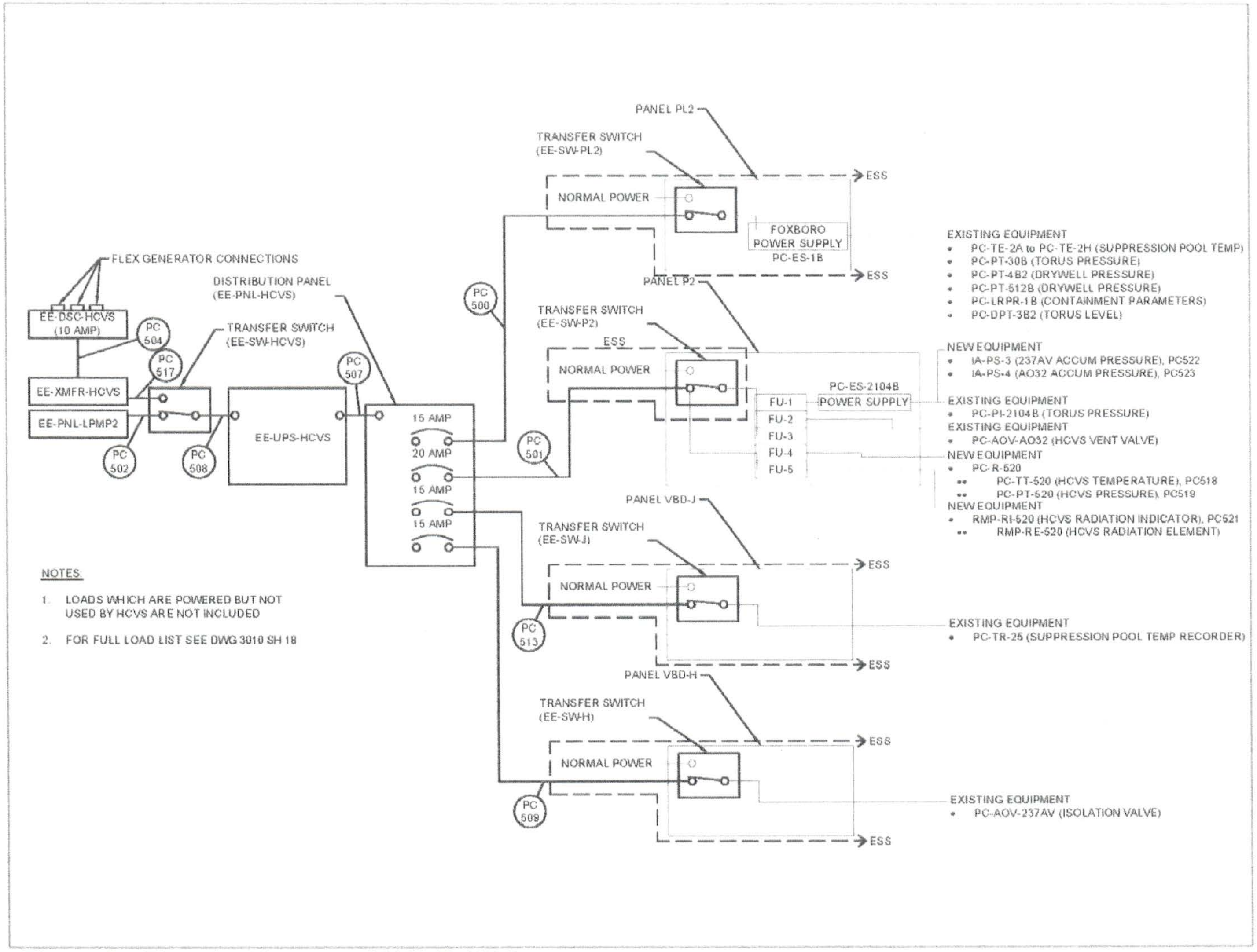


Figure 3: Electrical Layout of HCVS UPS

Attachment 4: Control Building UPS Location

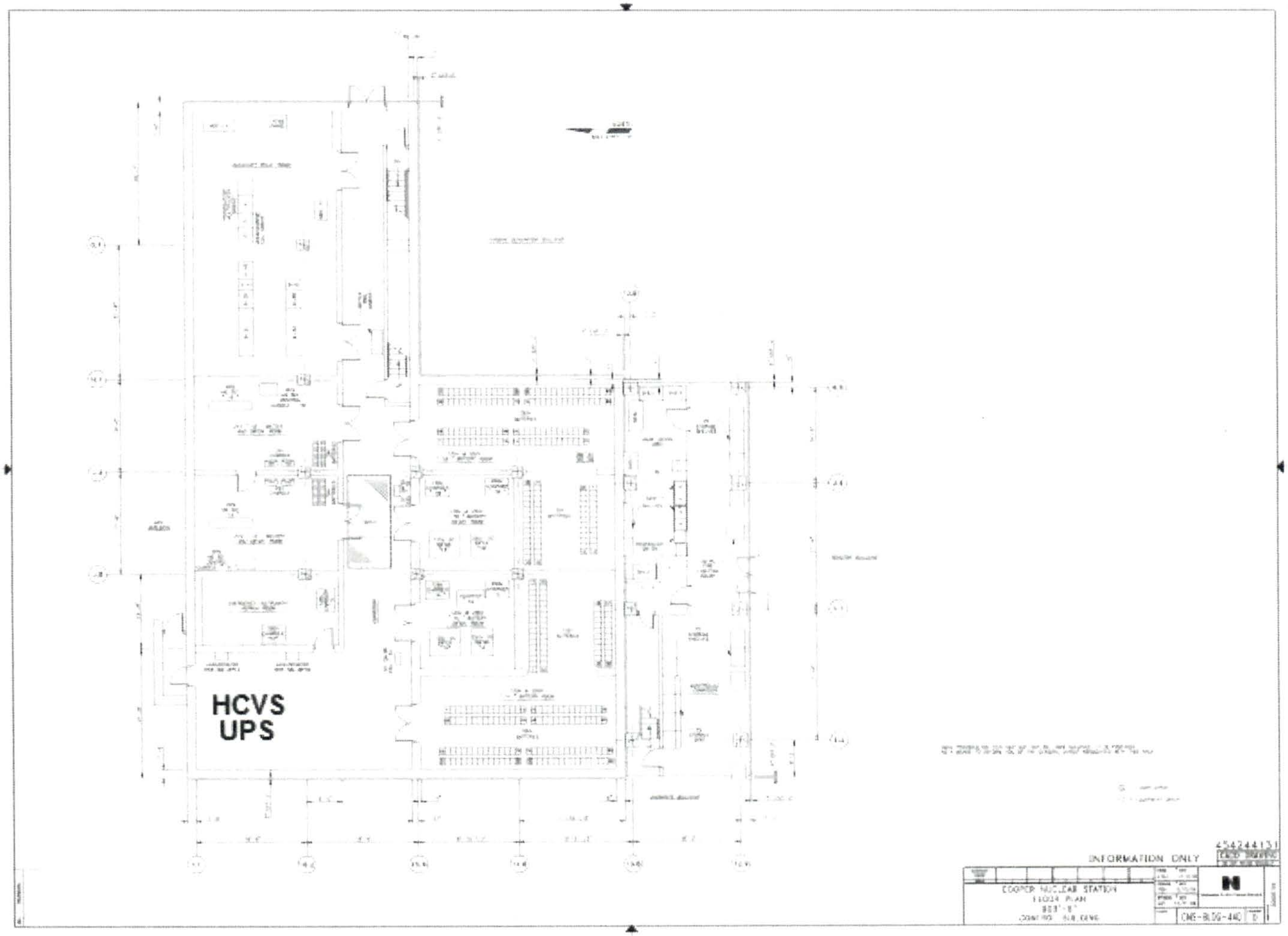
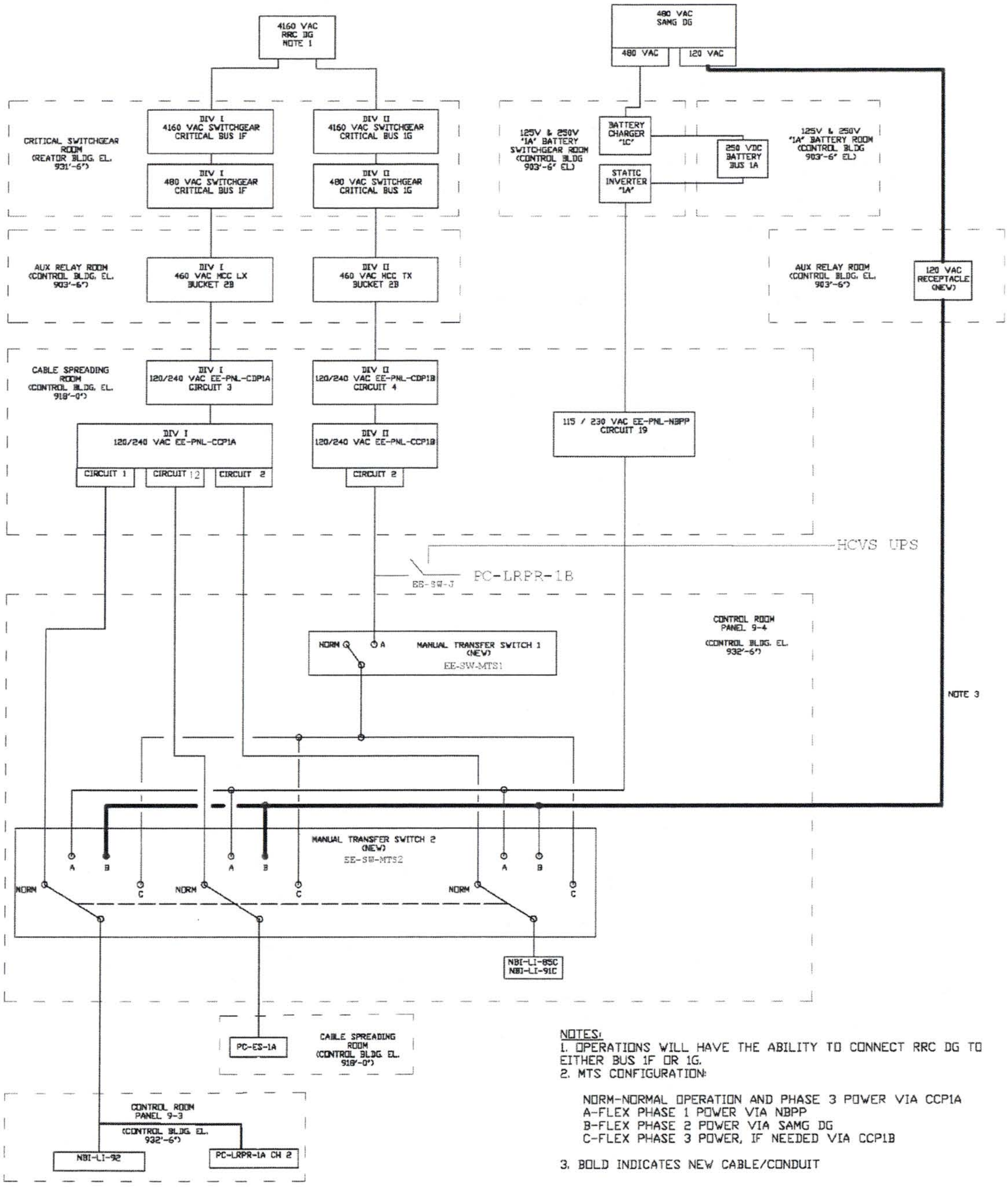


Figure 4: Control Building UPS Location

Attachment 5: Control Room Vital Instrument Power



NOTES:

1. OPERATIONS WILL HAVE THE ABILITY TO CONNECT RRC DG TO EITHER BUS 1F OR 1G.
2. MTS CONFIGURATION:

   NORM-NORMAL OPERATION AND PHASE 3 POWER VIA CCP1A
   A-FLEX PHASE 1 POWER VIA NBPP
   B-FLEX PHASE 2 POWER VIA SAMG DG
   C-FLEX PHASE 3 POWER, IF NEEDED VIA CCP1B

3. BOLD INDICATES NEW CABLE/CONDUIT

Figure 5: Control Room Vital Instrument Power

Attachment 6: One Line Diagram of SAWA Flow Path

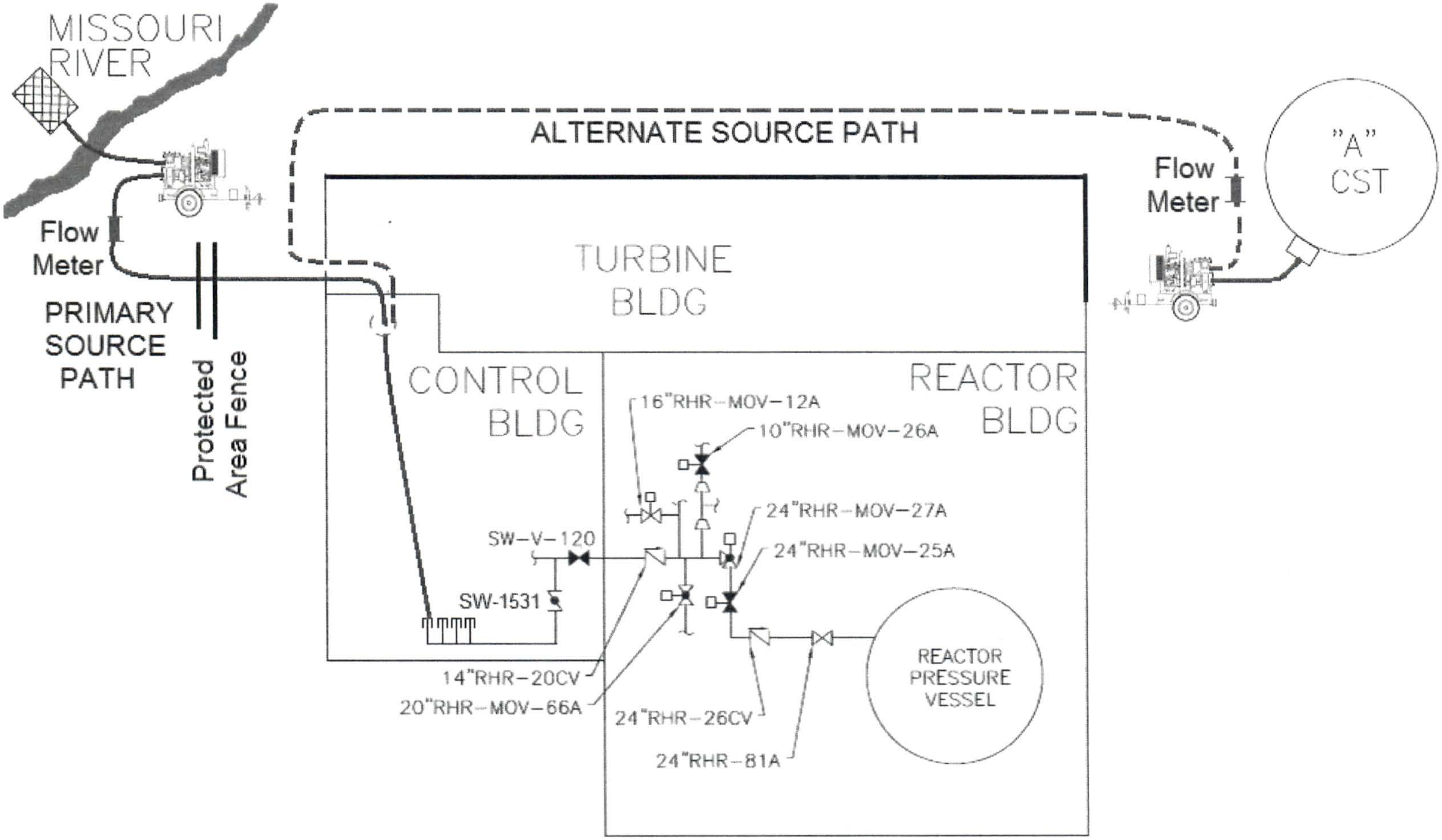


Figure 6: SAWA Flow Path with Both Suction Sources

Attachment 7: 125 & 250 VDC Electrical Distribution with FLEX Connections

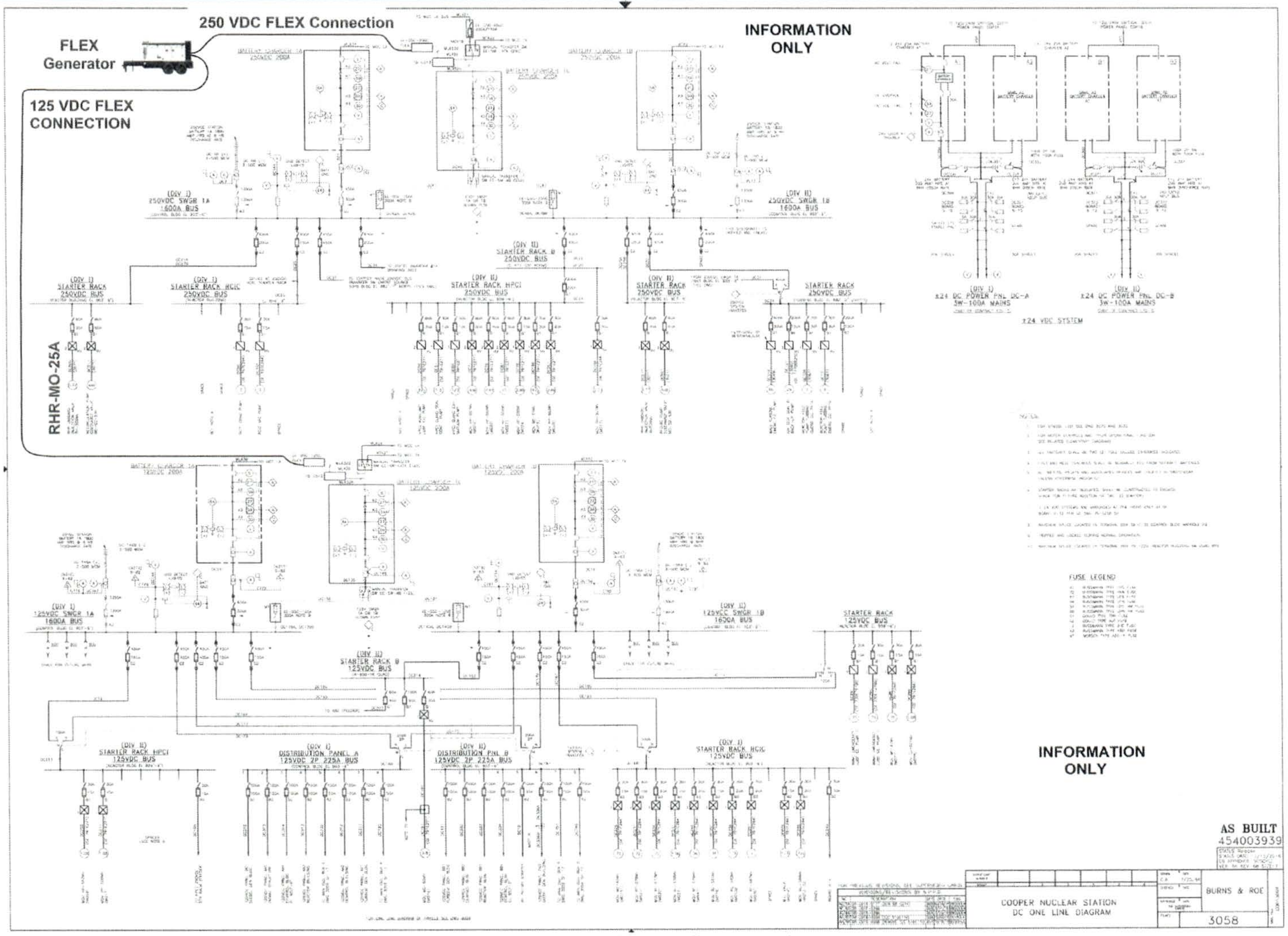


Figure 7: 125 & 250 VDC Electrical Distribution with FLEX Connections

Attachment 8: Operator Action Locations

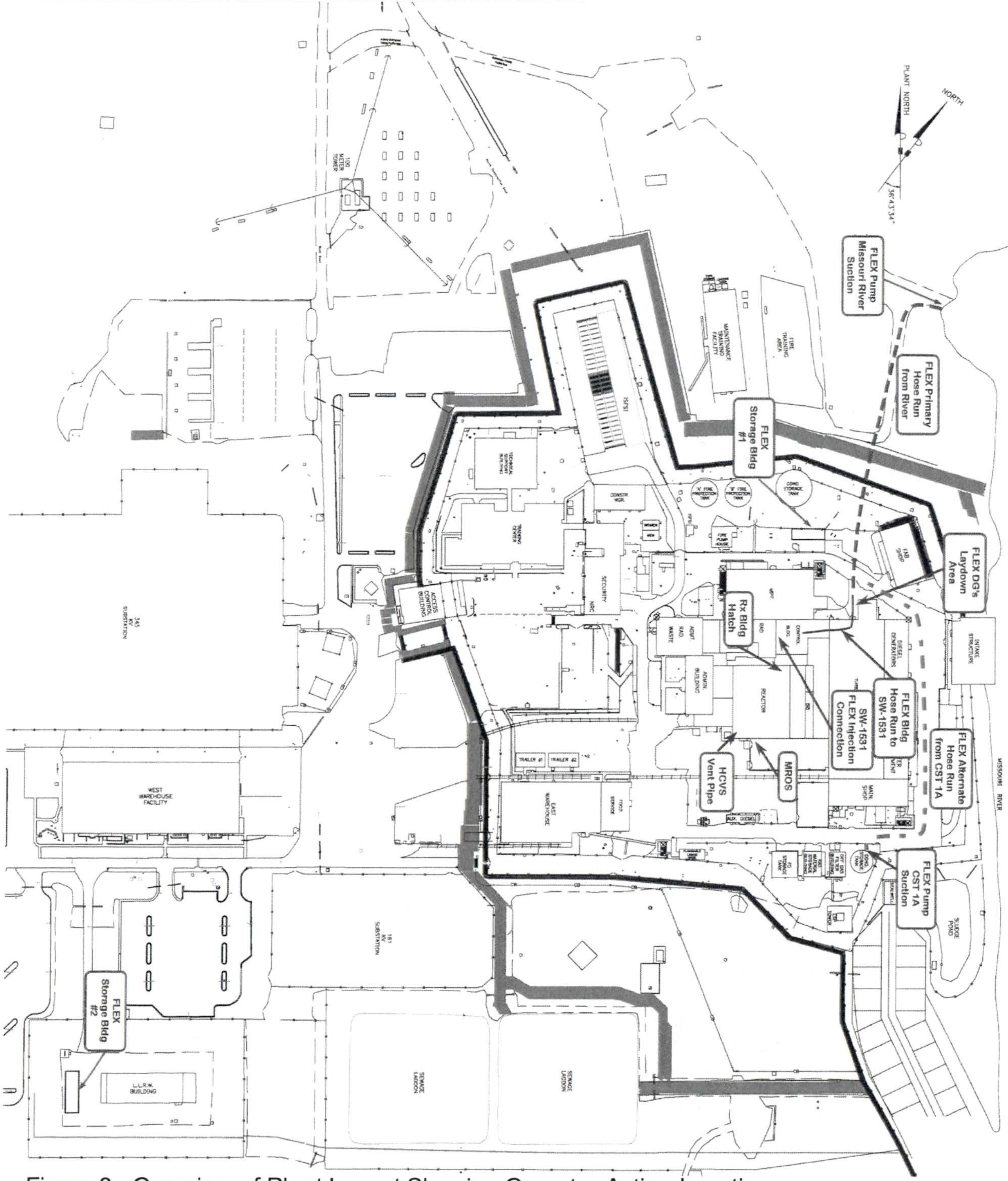
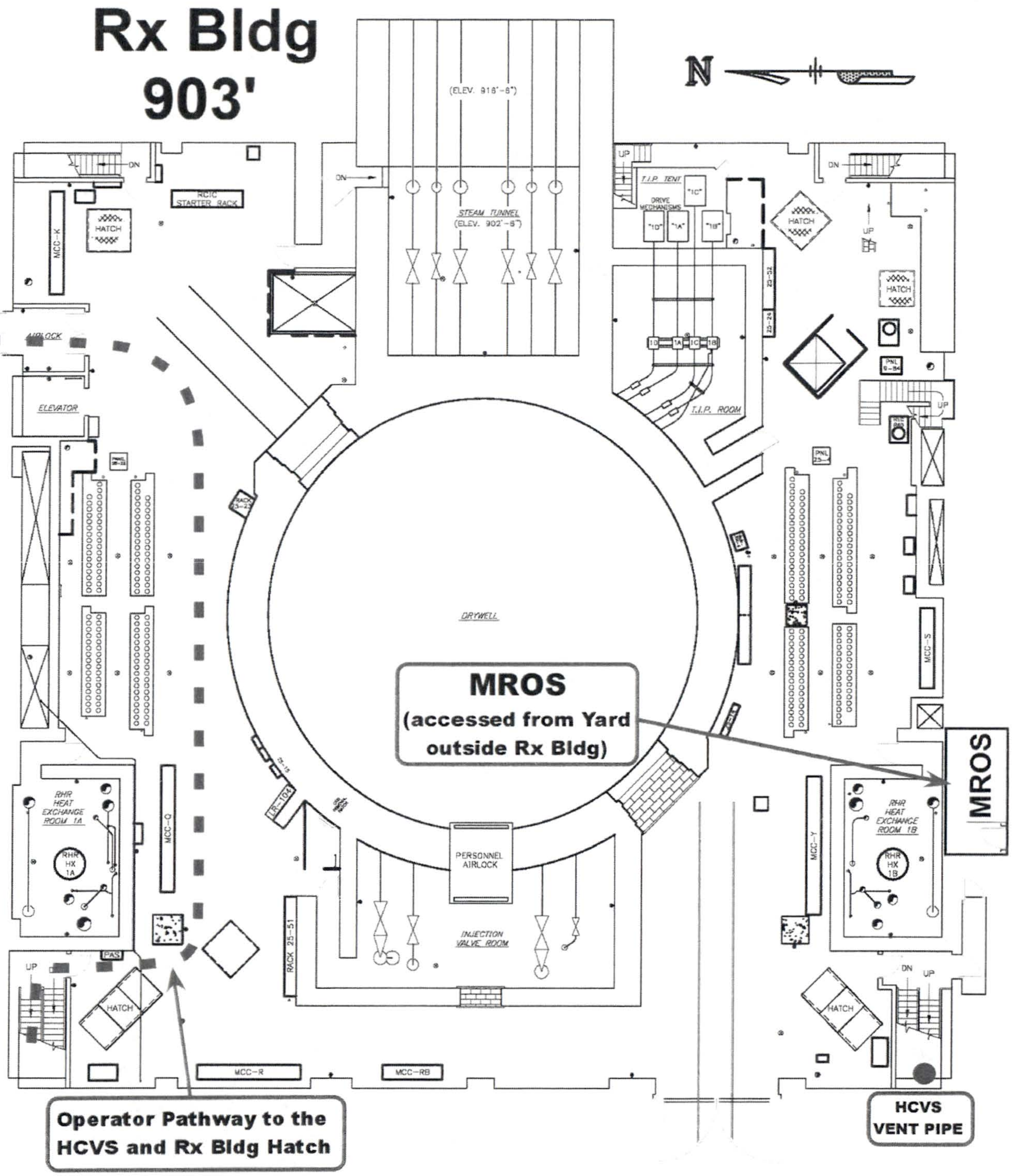


Figure 8: Overview of Plant Layout Showing Operator Action Locations


Rx Bldg 903'

MROS (accessed from Yard outside Rx Bldg)

Operator Pathway to the HCVS and Rx Bldg Hatch

HCVS VENT PIPE

Figure 9: Reactor Building 903 Operator Pathway

Rx Bldg 958'

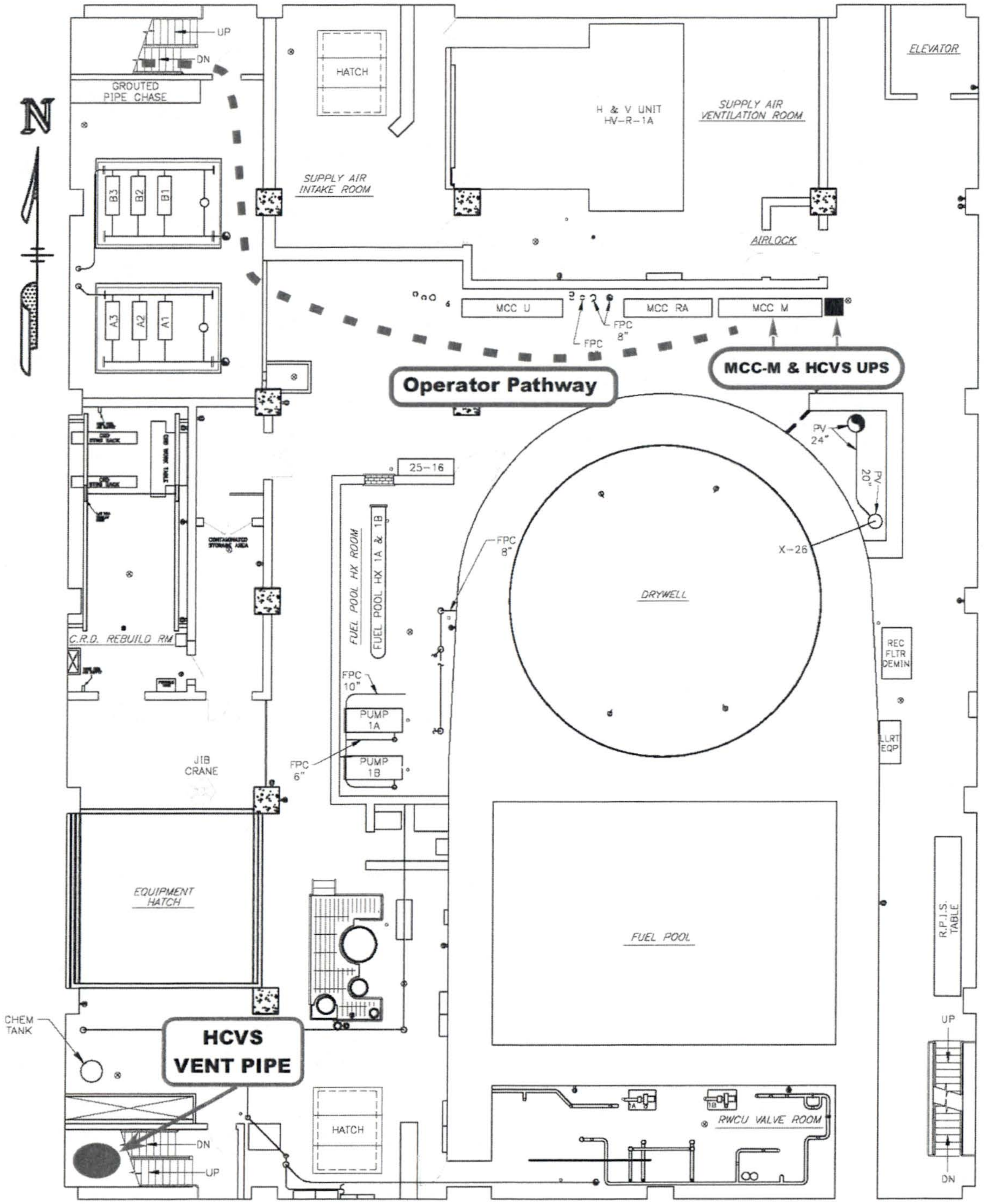


Figure 10: Reactor Building 958 Operator Pathway

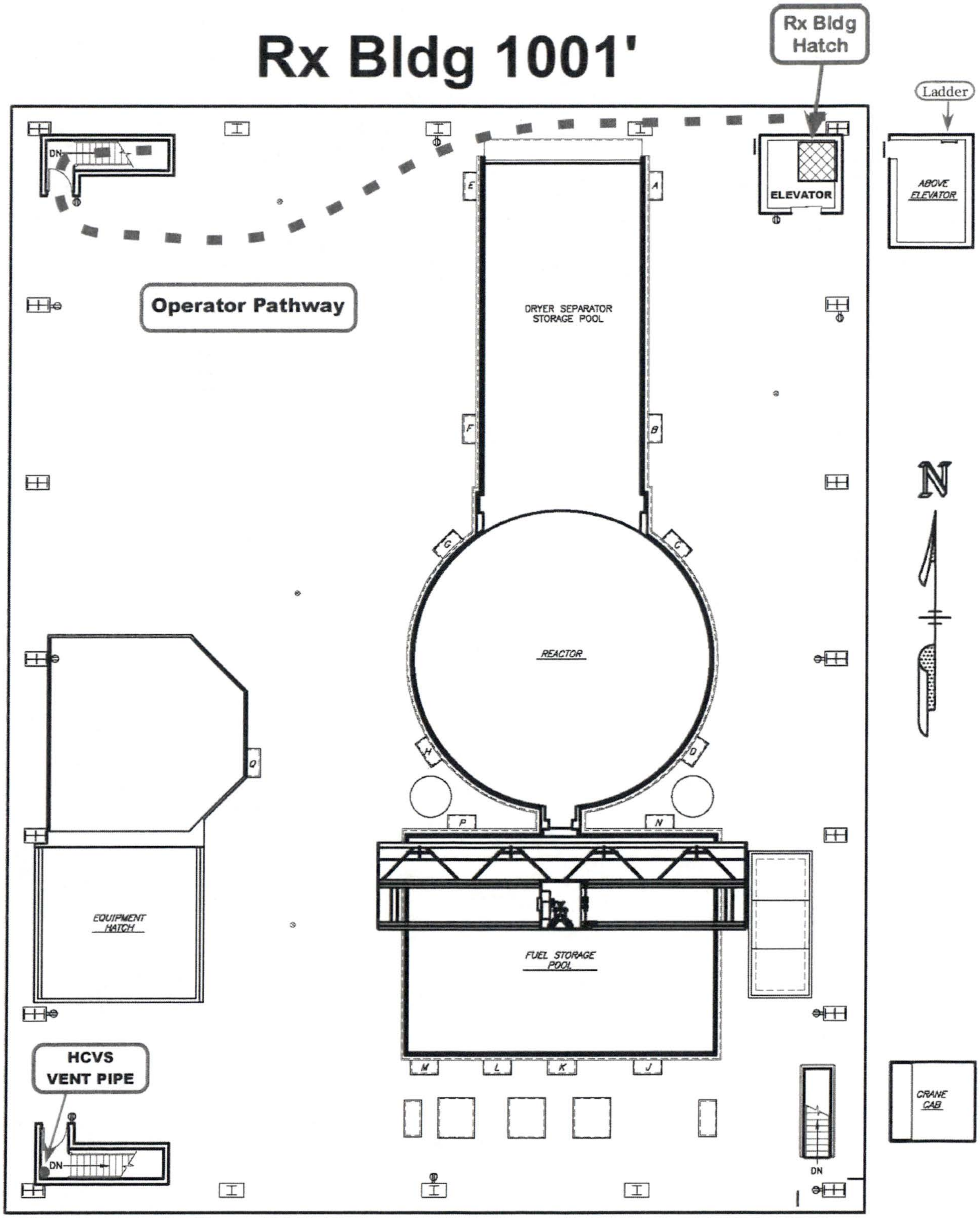


Figure 11: Reactor Building 1001 Operator Pathway

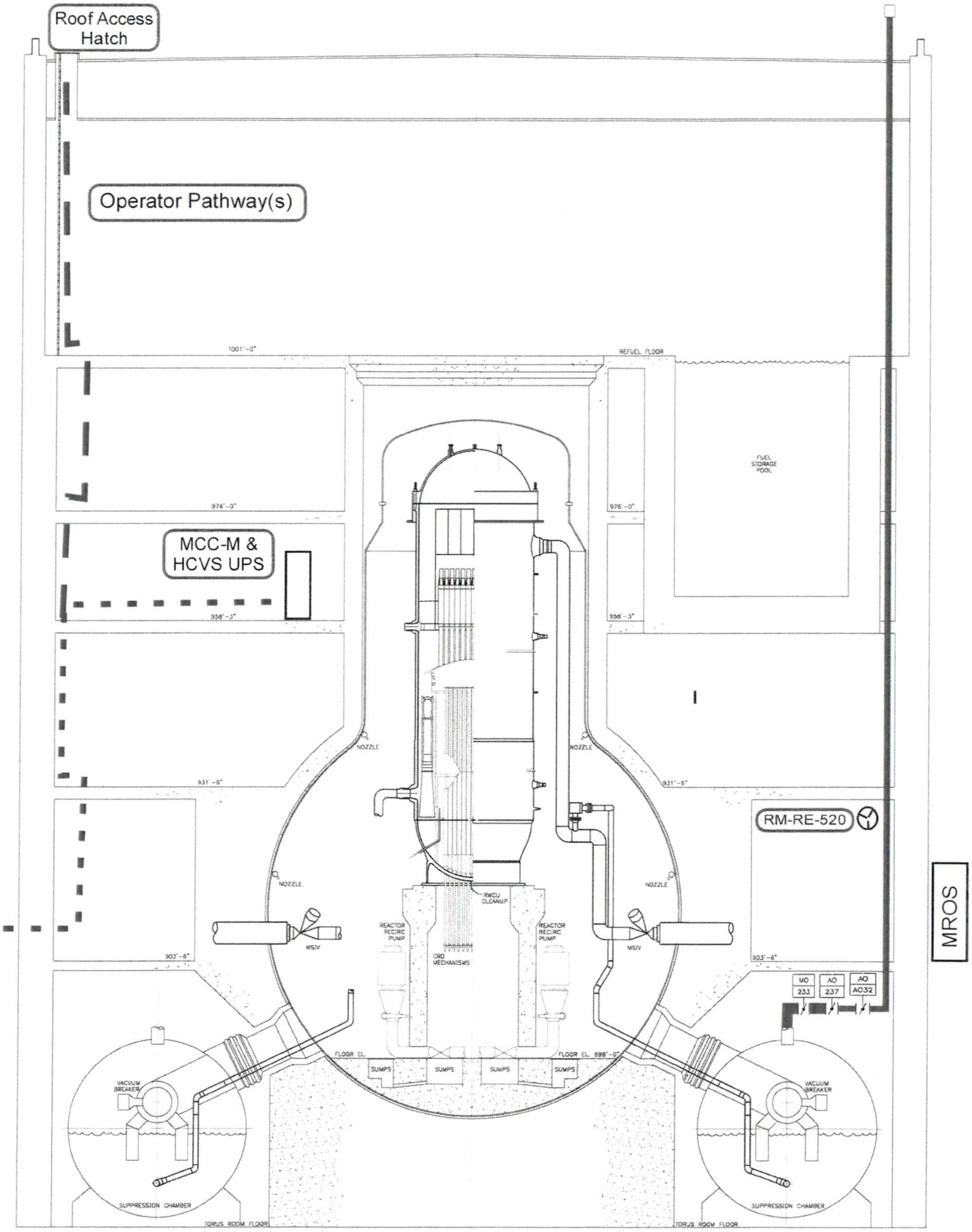


Figure 12: Reactor Building Cut-Away

Attachment 9: Reactor Building Parapet vs HCVS Pipe Sketch

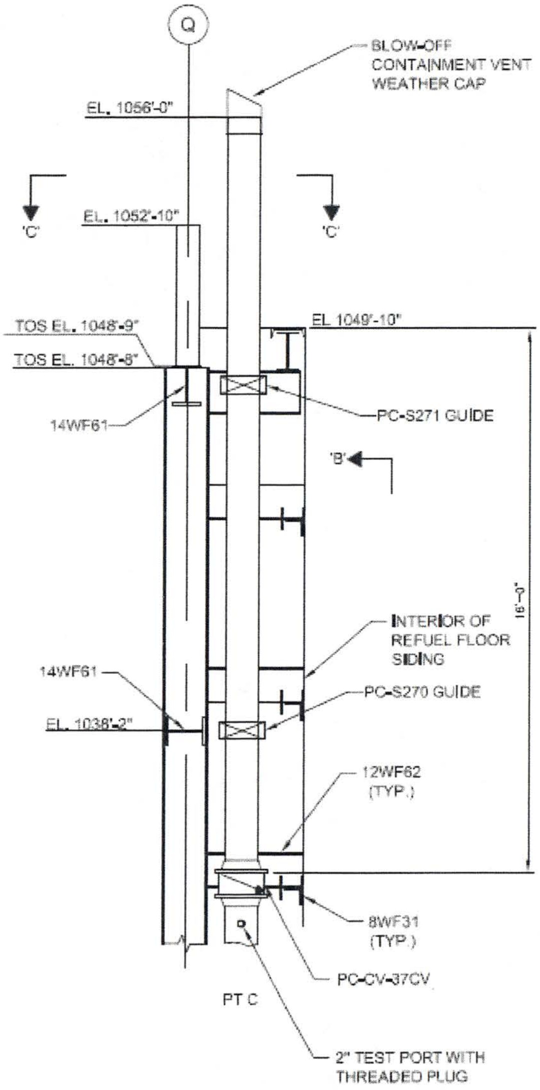


Figure 13: Reactor Building Parapet vs HCVS Pipe Sketch (Reference 59)

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

Component Name	Equipment ID	Range	Location	Local Event Temp	Local Event Humidity	Local Radiation Level	Qualification[7]	Qualification Temp	Qualification Humidity	Qualification Radiation	Power Supply
Wetwell Vent Instruments and Components											
HCVS effluent temperature sensor	PC-TT-520	0 to +400°F	925' RB Stairwell, on 12" pipe	137°F	N/A	1E+6 Rad	IEEE 344-1975/1987 IEEE 323-1974/1983/2003	0-750°F	No electronics, not susceptible	3.00E+08 Rem	N/A
HCVS effluent temperature transmitter	PC-TT-520	0 to +400°F	925' RB Stairwell	137°F	N/A	3E+05 Rad	IEEE 344-1975/1987 IEEE 323-1974/1983	-15 to +185°F	N/A	1E+06 Rem	HCVS UPS
HCVS effluent pressure sensor	PC-PT-520	N/A	925' RB Stairwell, on 12" pipe	137°F	N/A	1E+06 Rad	IEEE 344-1975/1987/2004 IEEE 323-1974/1983/2003	435°F	100%	1.12E+08 Rem	N/A
HCVS effluent pressure transmitter	PC-PT-520	N/A	925' RB Stairwell	137°F	N/A	3E+05 Rad	IEEE 344-1975/1987/2004 IEEE 323-1974/1983/2003	333°F	100%	3.6E+07 Rem	HCVS UPS
* Power transfer switches	EE-SW-H EE-SW-J EE-SW-P2	N/A	MCR	120°F	N/A	**CB	IEEE-323-1974, IEEE 344-1975	N/A	N/A	N/A	N/A
* Power transfer switches	EE-SW-PL2	N/A	CB-918	120°F	N/A	**CB	IEEE-323-1974, IEEE 344-1975	N/A	N/A	N/A	N/A
* Power transfer switches	EE-SW-233MV	N/A	RB-958	138°F	N/A	2E+01 Rad	Nutherm Report NPP-13990R (CNS EQDP.2-160)	239°F	100%	5.21E+05	N/A

---

[7] See USAR Appendix C Section 3.3.4 for qualification code of record IEEE-344-1975. Where later code years are referenced, this was reconciled in the design process.

Component Name	Equipment ID	Range	Location	Local Event Temp	Local Event Humidity	Local Radiation Level	Qualification[7]	Qualification Temp	Qualification Humidity	Qualification Radiation	Power Supply
* Power transfer switches	EE-SW-HCVS	N/A	CB-903	115°F	N/A	**CB	N/A	N/A	N/A	N/A	N/A
HCVS UPS	EE-UPS-HCVS	N/A	CB-903	120°F	N/A	**CB	N/A	N/A	N/A	N/A	Self for 24 hours, then FLEX generator powers charger
PC-MOV-233MV UPS	EE-UPS-233MV	N/A	RB-958	138°F	N/A	2E+01 Rad	N/A	N/A	N/A	N/A	Self for 24 hours, only required within 1st hour of declared ELAP
Wetwell Vent line rad. Detector	RMP-RE-520	1E-03 to 1E+06 Rad/hr	925' RB Stairwell	123°F	N/A	3E+05Rad	IEEE-323-1974, IEEE 344-1975	350°F	100%	2.00E+08 Rad/Hr	HCVS UPS
Wetwell vent radiation monitor/ processor	RMP-RM-520	1E-03 to 1E+06 Rad/hr	RB-931	126°F	N/A	4E+02 Rad	IEEE-323-1974, IEEE 344-1975	131°F	95%	2.5E+03 Rad	HCVS UPS
* Pneumatic valves (limit switches)	PC-AOV-AO32	N/A	RB-881 Torus Area	178°F	N/A	2E+06 Rem	IEEE-323-1974, IEEE 344-1975	200°F	N/A	2.4E+08 Rad	Nitrogen backup bottles
* MROS valves	IA-V-543 IA-V-544 IA-V-545 IA-V-546 IA-V-547 IA-V-550 IA-V-551	N/A	MROS	117°F	N/A	Low dose area	N/A	N/A	No electronics, not susceptible	N/A	Manual
* MROS N_2 Backup pressure indicators	IA-PI-100 / IA-PI-101	0-3000 psig / 0-160 psig	MROS	117°F	N/A	Low dose area	N/A	-20 to 200°F	No electronics, not susceptible	N/A	N/A

Component Name	Equipment ID	Range	Location	Local Event Temp	Local Event Humidity	Local Radiation Level	Qualification[7]	Qualification Temp	Qualification Humidity	Qualification Radiation	Power Supply
IA-ACC-237AV Accumulator Pressure Switch	IA-PS-3	+12 to +100 psi	RB-881 Torus Area	178°F	N/A	2E+06 Rad	EPRI Research Project 1707-3 (NP-2129)	-65 to 200°F	N/A	4.4E+06 Rem	HCVS UPS
IA-ACC-AO32 Accumulator Pressure Switch	IA-PS-4	+12 to +100 psi	RB-881 Torus Area	178°F	N/A	2E+06 Rad	EPRI Research Project 1707-3 (NP-2129)	-65 to 200°F	N/A	4.4E+06 Rem	HCVS UPS
HCVS effluent temperature/pressure/radiation indicator	PC-R-520	N/A	MCR	120°F	N/A	**CB	N/A	N/A	N/A	N/A	HCVS UPS
PC-233MV Position Indication	N/A	N/A	MCR	120°F	N/A	**CB	N/A	N/A	N/A	N/A	HCVS UPS
PC-237AV Position Indication	N/A	N/A	MCR	120°F	N/A	**CB	N/A	N/A	N/A	N/A	HCVS UPS
PC-AO32 Position Indication	N/A	N/A	MCR	120°F	N/A	**CB	N/A	N/A	N/A	N/A	HCVS UPS

Component Name	Equipment ID	Range	Location	Local Accident Temp	Local Accident Humidity	Local Radiation Level	Qualification[7]	Qualification Temp	Qualification Humidity	Qualification Radiation	Power Supply
SAWA/SAWM Instruments											
Drywell pressure sensor/ transmitter / indicator	PC-PT-4B2 / PC-LRPR-1B Ch 3	0 to +250 psig	RB-958-NE	138°F	N/A	2E+01 Rad	IEEE 323-1974, IEEE 344-1975	RG 1.97	RG 1.97	RG 1.97	Station batteries via FLEX generator, HCVS UPS
Drywell pressure sensor/ transmitter / indicator	PC-PT-5B2 / PC-LRPR-1B Ch 4	-5 to +5 psig	RB-958-NE / MCR	138°F	N/A	2E+01 Rad	IEEE 323-1974, IEEE 344-1975	RG 1.97	RG 1.97	RG 1.97	Station batteries via FLEX generator, HCVS UPS
Wetwell level sensor/ transmitter / indicator	PC-DPT-3B2 / PC-LRPR-1B Ch 2	0 to +30 Feet H2O	RB-859-SE QUAD / MCR	285°F / 120°F	N/A	2.72E+06 Rad	IEEE 323-1974, IEEE 344-1975	RG 1.97	RG 1.97	RG 1.97	Station batteries via FLEX generator, HCVS UPS
***Drywell Water Level sensor/ transmitter / indicator	PC-PT-1B2, PC-PT-2B2 / PC-LRPR-1B Ch 1	0 to +100 Feet H2O	RB-958-NE / MCR	N/A	N/A	N/A	IEEE 323-1974, IEEE 344-1975	RG 1.97	RG 1.97	RG 1.97	HCVS UPS
***Wetwell Pressure sensor/ transmitter / indicator	PC-PT-30B / PC-LRPR-1B Ch 5	-5 to +70 psig	RB-903-SE / MCR	N/A	N/A	N/A	IEEE 323-1974, IEEE 344-1975	RG 1.97	RG 1.97	RG 1.97	HCVS UPS
***Drywell Pressure sensor/ transmitter / indicator	PC-PT-512B / PC-LRPR-1B Ch 6	-5 to +70 psig	RB-931-SE / MCR	N/A	N/A	N/A	IEEE 323-1974, IEEE 344-1975	RG 1.97	RG 1.97	RG 1.97	HCVS UPS
***Wetwell Pressure sensor/ transmitter / indicator	PC-PT-2104B / PC-PI-2104B	0 to +70 psi	RB-931-SE / MCR	N/A	N/A	N/A	IEEE 323-1974, IEEE 344-1975	RG 1.97	RG 1.97	RG 1.97	HCVS UPS

***Wetwell Temperature sensor/ transmitter / indicator	PC-TE-2A to PC-TE-2H / PC-TR-25	0 to +250°F	RB-859-TORUS AREA / MCR	N/A	N/A	N/A	IEEE 323-1974, IEEE 344-1975	RG 1.97	RG 1.97	RG 1.97	HCVS UPS
SAWA flow instrument and readout	N/A	+70 to +800 gpm	Outside, mounted on the FLEX pump	97°F	N/A (outside)	Outside, radiation not a concern	Commercial instrument qualified for over the road use, therefore qualified per NEI 12-06	120°F	100%	N/A	Self-contained battery

* Denotes non-required item, added for site-specific design.
** Denotes Control Building where local radiation levels are not applicable. Building has no significant radiation sources.
*** Denotes instruments that will be re-powered via HCVS UPS, so the instruments will be available (but not credited) to support monitoring activities associated with SAWA/SAWM.

Table 2: Operator Actions Evaluation

Operator Action		Evaluation Time[8]	Validation Time[9]	Location	Thermal conditions	Radiological Conditions	Evaluation
1	Operating PC-MO-233 during ELAP	0-1 hour	10.5 min	RB-958	Done in the first hour, so no concerns.	Done in the first hour, so no concerns.	Acceptable
2	Open RB roof hatch for ventilation	0-1 hour	54 min	RB-1001 refueling floor	Done in the first hour, so no concerns.	Done in the first hour, so no concerns.	Acceptable
3	Begin torus venting	≤ 7 hours (venting start)	9 min	MCR	<107°F Per GOTHIC[10] calculations performed for FLEX actions	Actions in MCR are acceptable.	Acceptable MCR is a preferred location based on HCVS-FAQ-1.
4	Backup HCVS valve operation (if primary method fails)	≤ 7 hours (approximate venting start)	15 min	Yd-903-SW at MROS	Temp is basically ambient conditions	Actions acceptable. (Reference 51)	Acceptable

---

[8] Evaluation timing is from NEI 13-02 to support radiological evaluations.
[9] Validation Report (Reference 54)
[10] Calculation NEDC 15-002, Portable Equipment Calculations in support of CNS FLEX Strategy

Operator Action		Evaluation Time[8]	Validation Time[9]	Location	Thermal conditions	Radiological Conditions	Evaluation
5	SAWA pump staging hose connection and injection starting	≤ 5 hours	4.14 hours	Pump at Missouri River, hose ending CB at SW-V-1531	Outside (ambient conditions) TB-903 and CB-903 and CB-877 (no temp extremes)	Well shielded by structure and distance	Acceptable
6	SAWA pump operation and refueling	> T+4 hours then continuous operation. Refueling reoccurring at >3.5 hour intervals	Operation continuous Refueling actions 72 mins	Missouri River (alternate at CST 1A)	Outside, so ambient conditions	Both positions are well shielded by structure and distance	Acceptable
7	FLEX Generator connection (supporting 125/250 VDC Batteries)	≤ 6 hours then continuous operation. Refueling reoccurring at >24 hours	Operation continuous (113 min)[11]	Outside TB-903-N, connection in CB-903 C Charger Room	Outside (ambient conditions) TB-903 and CB-903 and CB-877 (no temp extremes)	Well shielded by structure and distance	Acceptable

---

[11] Validation see FLEX Validation Report (Reference 54)

Operator Action		Evaluation Time[8]	Validation Time[9]	Location	Thermal conditions	Radiological Conditions	Evaluation
8	FLEX Generator connection and alignment (supporting FLEX UPS)	>24 hours	N/A - >24 hours	DG building	No heat sources in either structure during this event, so no thermal concern	Concrete structure on the opposite side of the RB from the vent pipes, so no radiological concern	Acceptable
9	FLEX Generator operation and refueling (supporting FLEX UPS)	>24 hours	N/A - >24 hours	FLEX generator enclosure	Outside, vented enclosure, so near ambient conditions	Opposite side of the RB from the vent pipes, well shielded by structure and distance, no radiological concern.	Acceptable
10	Start/ operate and refuel FLEX air compressor	>24 hours	N/A - >24 hours	Outside RB, east of the seismic isolation space	Outside, so ambient conditions.	Shielded from containment and vent pipe by RB concrete walls, so no dose concern.	Acceptable No thermal or radiological concerns.