Exelon Generation

JAFP-18-0050
RS-18-066

Order No. EA-13-109

August 28, 2018

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

James A. FitzPatrick Nuclear Power Plant
Renewed Facility Operating License No. DPR-59
NRC Docket No. 50-333

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

References:

1. NRC Order Number EA-13-109, "Issuance of Order to Modify Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions," dated June 6, 2013
2. NRC Interim Staff Guidance JLD-ISG-2015-01, "Compliance with Order EA-13-109, Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions," Revision 0, dated April 2015
3. NEI 13-02, "Industry Guidance for Compliance With Order EA-13-109, BWR Mark I & II Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions", Revision 1, dated April 2015
4. James A. FitzPatrick Nuclear Power Plant Phase 1 Overall Integrated Plan per Order EA-13-109 Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions, dated June 30, 2014 (JAFP-14-0075)
5. James A. FitzPatrick Nuclear Power Plant First Six-Month Status Report Phase 1 Overall Integrated Plan in Response to June 6, 2013 Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109), dated December 19, 2014 (JAFP-14-0146)
6. James A. FitzPatrick Nuclear Power Plant Second Six-Month Status Report Phase 1 Overall Integrated Plan in Response to June 6, 2013 Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109), dated June 30, 2015 (JAFP-15-0080)

7. James A. FitzPatrick Nuclear Power Plant Third Six-Month Status Report Phase 1 (Updated) and Phase 2 Overall Integrated Plan in Response to June 6, 2013 Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109), dated December 15, 2015 (JAFP-15-0148)
8. James A. FitzPatrick Nuclear Power Plant Fourth Six-Month Status Report For Phases 1 and 2 Overall Integrated Plan in Response to June 6, 2013 Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109), dated June 30, 2016 (JAFP-16-0111)
9. James A. FitzPatrick Nuclear Power Plant Fifth Six-Month Status Report For Phases 1 and 2 Overall Integrated Plan in Response to June 6, 2013 Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109), dated December 22, 2016 (JAFP-16-0192)
10. James A. FitzPatrick Nuclear Power Plant Sixth Six-Month Status Report For Phases 1 and 2 Overall Integrated Plan in Response to June 6, 2013 Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109), dated June 29, 2017 (JAFP-17-0063)
11. James A. FitzPatrick Nuclear Power Plant Seventh Six-Month Status Report For Phases 1 and 2 Overall Integrated Plan in Response to June 6, 2013 Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109), dated December 15, 2017 (JAFP-17-0116)
12. NRC letter to James A. FitzPatrick Nuclear Power Plant – Interim Staff Evaluation Relating to Overall Integrated Plan in Response to Phase 1 of Order EA-13-109 (Severe Accident Capable Hardened Vents), dated February 12, 2015
13. NRC letter to James A. FitzPatrick Nuclear Power Plant – Interim Staff Evaluation Relating to Overall Integrated Plan in Response to Phase 2 of Order EA-13-109 (Severe Accident Capable Hardened Vents), dated December 16, 2016
14. NRC letter to Exelon Generation Company, LLC, James A. FitzPatrick Nuclear Power Plant – Report for the Audit of Licensee Responses to Interim Staff Evaluation Open Items Related to NRC Order EA-13-109 to Modify Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions, dated June 21, 2018

On June 6, 2013, the Nuclear Regulatory Commission ("NRC" or "Commission") issued Order EA-13-109, "Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions," (Reference 1) to James A. FitzPatrick Nuclear Power Plant (JAF). Reference 1 was immediately effective and directs JAF to take certain actions to ensure that JAF has a hardened containment vent system (HCVS) to remove decay heat from the containment, and maintain control of containment pressure within acceptable limits following events that result in loss of active containment heat removal capability while maintaining the capability to operate under severe accident (SA) conditions resulting from an Extended Loss of AC Power (ELAP). Specific requirements are outlined in Attachment 2 of Reference 1.

Reference 2 provided the NRC interim staff guidance on methodologies for compliance with Phases 1 and 2 of Reference 1 and endorsed industry guidance document NEI 13-02, Revision 1 (Reference 3) with clarifications and exceptions. Reference 4 provided the JAF Phase 1 Overall Integrated Plan (OIP), which was replaced with the Phase 1 (Updated) and Phase 2 OIP (Reference 7). References 12 and 13 provided the NRC review of the Phase 1 and Phase 2 OIP, respectively, in an Interim Staff Evaluation (ISE).

Reference 1 required submission of a status report at six-month intervals following submittal of the OIP. References 5, 6, 7, 8, 9, 10, and 11 provided the first, second, third, fourth, fifth, sixth, and seventh six-month status reports, respectively, pursuant to Section IV, Condition D.3, of Reference 1 for JAF.

The purpose of this letter is to provide the report of full compliance with Phase 1 and Phase 2 of the June 6, 2013 Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109) (Reference 1) pursuant to Section IV, Condition D.4 of the Order for JAF.

JAF has designed and installed a venting system that provides venting capability from the wetwell during severe accident conditions in response to Phase 1 of NRC Order EA-13-109. JAF has implemented a reliable containment venting strategy that makes it unlikely that the plant would need to vent from the containment drywell before alternative reliable containment heat removal and pressure control is reestablished in response to Phase 2 of NRC Order EA-13-109.

JAF Phase 2 OIP Open Items have been addressed and closed as documented in Reference 11 and are considered complete per Reference 14. There were no Phase 1 OIP Open Items. The information provided herein documents full compliance for JAF with NRC Order EA-13-109.

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

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

ISE Phase 1 Open Item No. 1 Make available for NRC staff audit analyses demonstrating that HCVS has the capacity to vent the steam/energy equivalent of one (1) percent of licensed/rated thermal power (unless a lower value is justified), and that the suppression pool and the HCVS together are able to absorb and reject decay heat, such that following a reactor shutdown from full power containment pressure is restored and then maintained below the primary containment	Closed per Reference 11

design pressure and the primary containment pressure limit.	
ISE Phase 1 Open Item No. 2 Make available for NRC staff audit the seismic and tornado missile final design criteria for the HCVS stack.	Closed per Reference 11
ISE Phase 1 Open Item No. 3 Make available for NRC staff audit the final sizing evaluation for HCVS batteries/battery charger including incorporation into FLEX DG loading calculation.	Closed per Reference 11
ISE Phase 1 Open Item No. 4 Make available for NRC staff audit documentation of the HCVS nitrogen pneumatic system design including sizing and location.	Closed per Reference 11
ISE Phase 1 Open Item No. 5 Provide a description of the final design of the HCVS to address hydrogen detonation and deflagration.	Closed per Reference 11
ISE Phase 1 Open Item No. 6 Provide a description of the strategies for hydrogen control that minimizes the potential for hydrogen gas migration and ingress into the reactor building or other buildings.	Closed per Reference 11
ISE Phase 1 Open Item No. 7 Make available for NRC staff audit descriptions of all instrumentation and controls (existing and planned) necessary to implement this order including qualification methods.	The required instrumentation and controls (existing and new) are identified as part of the JAF OIP, Part 2. Plant instrumentation for HCVS that is qualified to RG 1.97 or equivalent is considered qualified for the sustained operating period without further evaluation. The following plant instruments and controls are qualified to RG 1.97: • Drywell Pressure: 27PI-115A2 • Torus Water Level: 23LI-202A • Torus Valve Limit Switches: 27PNS-117-1, 27PNS-117-2, 27PNS-118-1, 27PNS-118-2 The following additional

	instrumentation and controls performing a HCVS function is considered for temperature and radiation effects: • HCVS Control Valve Limit Switches • HCVS Temperature Instrument • HCVS Radiation Instrument • HCVS Batteries • HCVS Battery Charger • HCVS Indicators The environmental qualification of the existing and new HCVS specific equipment has been summarized in Attachment 6.009 to EC 52721 along with the referenced reports and Topic Notes sections. <u>Temperature</u> Temperatures within the Reactor Building are calculated in JAF-CALC-15-00025. Temperatures within the Administration Building and Battery Room are evaluated in Topic Notes Section 3.1.11.2 based on FLEX heatup calculation JAF-CALC-15-000025. <u>Radiation</u> Specific HCVS dose values are calculated in calculation JAF-CALC-14-00029. These documents have been provided in the eportal.
ISE Phase 1 Open Item No. 8 Make available for NRC staff audit documentation of a seismic qualification evaluation of HCVS components.	The existing equipment supporting HCVS is seismically qualified. The new HCVS equipment is seismically robust as discussed in Topic Notes Sections 3.1.5.1 and 3.1.6.2, which is supported by the following reports / calculations: • JAF-RPT-17-00029 "Hardened Containment Vent System Equipment Seismic Evaluations" • JAF-CALC-17-00046 "HCVS

	Control Valve, 27AOV-142, 10" 150 Tricentric with Bettis Op Design / Seismic Report, Weak Link Analysis, Maximum Torque Calculation" • JAF-RPT-17-00011 "HCVS Isolation Valve (27AOV-142) Actuator/Limit Switch Qualification Reports" • JAF-CALC-14-00016 "Hardened Containment Vent System: Process Piping Stress Analysis" • JAF-RPT-18-00002, "Hardened Containment Vent System (HCVS) Instrumentation and Battery System Seismic Qualification" These documents have been provided in the eportal.
ISE Phase 1 Open Item No. 9 Make available for NRC staff audit the descriptions of local conditions (temperature, radiation and humidity) anticipated during ELAP and severe accident for the components (valves, instrumentation, sensors, transmitters, indicators, electronics, control devices, etc.) required for HCVS venting including confirmation that the components are capable of performing their functions during ELAP and severe accident conditions.	The required instrumentation and controls (existing and new) are identified as part of the JAF OIP, Part 2. The environmental qualification of the existing and new HCVS specific equipment has been summarized in Attachment 6.009 to EC 52721 along with the referenced reports and Topic Notes sections. See additional discussion in ISE Open Item 7. These documents have been provided in the eportal.
ISE Phase 1 Open Item No. 10 Make available for NRC staff audit documentation of an evaluation verifying the existing containment isolation valves, relied upon for the HCVS, will open under the maximum expected differential pressure during BDBEE and severe accident wetwell venting.	Closed per Reference 11
ISE Phase 1 Open Item No. 11 Make available for NRC staff audit documentation that demonstrates adequate communication between the remote HCVS operation locations and HCVS decision makers during ELAP and severe accident conditions.	Closed per Reference 11

ISE Phase 1 Open Item No. 12 Make available for NRC staff audit an evaluation of temperature and radiological conditions to ensure that operating personnel can safely access and operate controls and support equipment.	Closed per Reference 11

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

OIP Phase 2 Open Item No. 1 Complete hydraulic analysis of diesel fire pump for SAWA / SAWM flowrates.	Closed per Reference 11
OIP Phase 2 Open Item No. 2 Identify and evaluate severe accident conditions for Phase 2 manual actions.	Closed per Reference 11
OIP Phase 2 Open Item No. 3 The FLEX Engineering Change (EC 52736) has not been completed; therefore, any reference to this information is considered unverified.	Closed per Reference 11
ISE Phase 2 Open Item No. 1 Licensee to evaluate the SAWA equipment and controls, as well as the ingress and egress paths for the expected severe accident conditions (temperature, humidity, radiation) for the sustained operating period.	Closed per Reference 11 utilizing BWROG generic response template.
ISE Phase 2 Open Item No. 2 Licensee to demonstrate how instrumentation and equipment being used for SAWA and supporting equipment is capable to perform for the sustained operating period under the expected temperature and radiological conditions.	Closed per Reference 11 utilizing BWROG generic response template.
ISE Phase 2 Open Item No. 3 Licensee to demonstrate that containment failure as a result of overpressure can be prevented without a drywell vent during severe accident conditions.	Closed per Reference 11 utilizing BWROG generic response template.

ISE Phase 2 Open Item No. 4 Licensee to demonstrate that there is adequate communication between the primary HCVS operating station and the operator at the FLEX supply hose splitter valve during severe accident conditions.	Closed per Reference 11 utilizing BWROG generic response template.
ISE Phase 2 Open Item No. 5 Licensee to demonstrate the SAWA/SAWM flow instrumentation qualification for the expected environmental conditions.	Closed per Reference 11 utilizing BWROG generic response template.

MILESTONE SCHEDULE – ITEMS COMPLETE

JAF - Phase 1 Specific Milestone Schedule

Milestone	Completion Date
Hold preliminary/conceptual design meeting	January 2014
Submit Overall Integrated Implementation Plan	June 2014
Submit 6 Month Status Report	December 2014
Submit 6 Month Status Report	June 2015
Submit 6 Month Status Report	December 2015
Design Engineering Complete	December 2015
Submit 6 Month Status Report	June 2016
Submit 6 Month Status Report	December 2016
Submit 6 Month Status Report	June 2017
Submit 6 Month Status Report	December 2017
Operations and Maintenance Procedure Changes Developed, Training Complete	June 2018
Walk-Through Demonstration/Functional Test	June 2018
HCVS Phase 1 Complete	June 29, 2018
Submit Completion Report	Complete with this submittal

JAF - Phase 2 Specific Milestone Schedule

Milestone	Completion Date
Hold preliminary/conceptual design meeting	October 2015
Submit Overall Integrated Implementation Plan	December 2015
Submit 6 Month Status Report	June 2016
Submit 6 Month Status Report	December 2016
Submit 6 Month Status Report	June 2017
Design Engineering Complete	October 2017
Submit 6 Month Status Report	December 2017
Maintenance and Operations Procedure Changes Developed, Training Complete	June 2018
Implementation	June 2018
Walk-Through Demonstration/Functional Test	June 2018
HCVS Phase 2 Complete	June 29, 2018
Submit Completion Report	Complete with this submittal

ORDER EA-13-109 COMPLIANCE ELEMENTS SUMMARY

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

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

The JAF 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 JAF 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 JAF Phase 2 HCVS strategies implement Severe Accident Water Addition (SAWA) with Severe Accident Water Management (SAWM) as an alternative venting strategy. This strategy consists of the use of the Phase 1 wetwell vent and SAWA hardware to implement a water management strategy that will preserve the wetwell vent path until alternate reliable containment heat removal can be established.

The JAF Phase 1 and Phase 2 HCVS strategies are in compliance with Order EA-13-109. The modifications required to support the HCVS strategies for JAF 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 JAF complies with the requirements specified in the Order and described in NEI 13-02, Revision 1, "Industry Guidance for Compliance with Order EA-13-109". The Phase 1 and Phase 2 HCVS has been installed in accordance with the station design control process.

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

HCVS PHASE 1 AND PHASE 2 PROGRAMMATIC FEATURES - COMPLETE

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

Training in the use of the Phase 1 and Phase 2 HCVS for JAF 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 JAF 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.

JAF has completed validation in accordance with industry developed guidance to assure required tasks, manual actions and decisions for HCVS strategies are feasible and may be executed within the constraints identified in the HCVS Phases 1 and 2 OIP for Order EA-13-109 (Reference 7).

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

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

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 28th day of August 2018.

Respectfully submitted,

James Barstow
Director - Licensing & Regulatory Affairs
Exelon Generation Company, LLC

Enclosure: James A. FitzPatrick Nuclear Power Plant Final Integrated Plan Document – Hardened Containment Vent System NRC Order EA-13-109

cc: Director, Office of Nuclear Reactor Regulation
NRC Regional Administrator - Region I
NRC Senior Resident Inspector – James A. FitzPatrick Nuclear Power Plant
NRC Project Manager, NRR – James A. FitzPatrick Nuclear Power Plant
Mr. Peter J. Bamford, NRR/JLD/JOMB, NRC
Mr. Brian E. Lee, NRR/JLD/JCBB, NRC
Mr. Rajender Auluck, NRR/JLD/JCBB, NRC
NYSPSC
NYSERDA

Enclosure

James A. FitzPatrick Nuclear Power Plant

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

(62 pages)

Final Integrated Plan

HCVS Order EA-13-109

for

James A. FitzPatrick Nuclear Power Plant

August 28, 2018

Table of Contents

Section I: Introduction

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

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

James A. FitzPatrick Nuclear Power Plant (JAF) is required by NRC Order EA-13-109 to have a reliable, severe accident capable hardened containment venting system (HCVS). Order EA-13-109 allows implementation of the HCVS Order in two phases.

- Phase 1 upgraded the venting capabilities from the containment wetwell to provide reliable, severe accident capable hardened vent to assist in preventing core damage and, if necessary, to provide venting capability during severe accident conditions. JAF achieved Phase 1 compliance in June 2018.

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

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

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

As required by the order, JAF submitted a phase 1 Overall Integrated Plan (OIP) in June of 2014 (Reference 18) and subsequently submitted a Phase 2 OIP in December 2015 (Reference 19). These OIPs followed the guidance NEI 13-02 Revision 0 and 1 respectively, Compliance with Order EA-13-109, Severe Accident Reliable Hardened Containment Vents. The NRC staff used the methods described in the ISGs to evaluate licensee compliance as presented in the Order EA-13-109 OIPs. While the Phase 1 and combined Phase 1 and 2 OIPs where written to different revisions of NEI 13-02, JAF conformed 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 JAF with Interim Staff Evaluations (ISEs) (References 20 and 21) assessing the site's compliance methods. In the ISEs the NRC identified open items which the site needed to address before that phase of compliance was reached. Six-month progress reports (References 22 through 28) 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 JAF has addressed all the elements of NRC Order EA-13-109 utilizing the endorsed guidance in NEI 13-02, Revision 1 and the related HCVS-FAQs and HCVS-WPs documents. In addition, the site has addressed the NRC Phase 1 and Phase 2 ISE Open Items as documented in previous six-month updates.

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

Section I.A: Summary of Compliance

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

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

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

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

The operation of the HCVS is designed to minimize the reliance on operator actions in response to external hazards. The screened in external hazards for JAF are seismic, external flooding, high winds, extreme high temperature, and extreme cold (including ice and snow). Initial operator actions are completed by plant personnel and include the capability for remote-manual initiation from the HCVS control station. Depending on the plant status at the time of the accident, actions may be required within the Reactor Building to align specific valves to the closed position. Monitoring of the containment is from the Main Control Room (MCR). The ROS at JAF is the only location for operation and monitoring of the HCVS System with communication to the MCR. Attachment 2 contains a one-line diagram of the HCVS vent flowpath.

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

The Phase 2 actions can be summarized as follows:

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

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

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

- Parameters measured are drywell pressure, Torus level, SAWA flowrate and the HCVS Phase 1 vent path parameters.

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

The FLEX primary and secondary injection flow paths were switched as the secondary pathway offered the advantage of reduced operator dose exposure and burden. As a result, the primary FLEX pathway and SAWA injection pathway are the same. To support this change, (a) new permanent plant piping connections were installed for ease of connection, (b) permanent platforms installed for operation of manual isolation valves in the Screenwell / Reactor Building, and (c) portable throttling valve manifolds installed (including the FLEX/SAWA flow meter) were provided to support the range of FLEX and SAWA flow rates. The new carts are located within the basement of the Screenwell local to the Fire Protection and Residual Heat Removal Service Water (RHRSW) pipeline connections. This modified flow path has been evaluated and found to be acceptable in calculation JAF-CALC-17-00104 (Reference 36).

The FLEX primary (SAWA) pump is the permanently installed Diesel Driven Fire Pump (DDFP) 76P-4 which takes suction from Lake Ontario. A new permanent plant hose quick connection at the discharge of pump 76P-4 is connected via portable hose and quick connections to the new throttling valve cart where SAWA flow indication and control is provided. The outlet of the new throttling valve cart is connected via portable hose to new permanent fire hose quick connections downstream of the RHRSW pump strainer. To complete the flowpath, valves are then modulated as follows:

- 76FPS-807 (Manually closed via permanent platform)
- 76FPS-780 (Manually open)
- 10RHR-460 (Manually open)
- 10MOV-148B (Manually open via permanent platform)
- 10MOV-149B (Manually open via permanent platform)
- 10MOV-25B (Open using MCR Switch with LPCI Batteries)
  (Note: 10MOV-27B is normally open)

Backflow prevention is provided by installed containment isolation check valve 10AOV-68B. Cross flow into other portions of the RHR system is prevented using normally closed valves. Communication will be established between the MCR and the SAWA flow control location in the Screenwell. Attachment 4 contains a one-line diagram of the SAWA flowpath.

The SAWA electrical loads are included in the FLEX DG loading calculation reviewed for EA-12-049 compliance. The Screenwell is located north of the RB and the FLEX DGs are located north of the Screenwell. The FLEX DG location is a significant distance and on the opposite side of the RB from the HCVS discharge. See Attachment 6 for applicable locations. Refueling of the FLEX DG is accomplished from the EDG fuel oil storage tanks located to the West of the Screenwell as described in the EA-12-049 FIP (Reference 37).

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

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

<u>Section II</u>: List of Acronyms

AC	Alternating Current
AOV	Air Operated Valve
BDBEE	Beyond Design Basis External Event
BWROG	Boiling Water Reactor Owners' Group
CAD	Containment Atmosphere Dilution
CAP	Containment Accident Pressure
DC	Direct Current
ECCS	Emergency Core Cooling Systems
ELAP	Extended Loss of AC Power
EOP	Emergency Operating Procedure
EPG/SAG	Emergency Procedure and Severe Accident Guidelines

EPRI	Electric Power Research Institute
ERO	Emergency Response Organization
FAQ	Frequently Asked Question
FIP	Final Integrated Plan
FLEX	Diverse & Flexible Coping Strategy
FSB	FLEX Storage Building
GPM	Gallons per minute
HCVS	Hardened Containment Vent System
ISE	Interim Staff Evaluation
ISG	Interim Staff Guidance
JAF	James A. FitzPatrick Nuclear Power Plant
JLD	Japan Lessons Learned Project Directorate
MCR	Main Control Room
N_2	Nitrogen
NEI	Nuclear Energy Institute
NPSH	Net Positive Suction Head
NRC	Nuclear Regulatory Commission
NSRC	National SAFER Response Center
OIP	Overall Integrated Plan
PCIV	Primary Containment Isolation Valve
PCPL	Primary Containment Pressure Limit
RM	Radiation Monitor
ROS	Remote Operating Station

RPV	Reactor Pressure Vessel
SA	Severe Accident
SAMG	Severe Accident Management Guidelines
SAOG	Severe Accident Operating Guidelines
SAWA	Severe Accident Water Addition
SAWM	Severe Accident Water Management
SGTS	Standby Gas Treatment System
SRV	Safety-Relief Valve
UFSAR	Updated Final Safety Analysis Report
VAC	Voltage AC
VDC	Voltage DC

Section III: Phase 1 Final Integrated Plan Details

Section III.A: HCVS Phase 1 Compliance Overview

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

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

JAF, in response to GL 89-16, successfully justified to the NRC that the existing vent pathway to the Standby Gas Treatment System (SGTS) meets the required criterion (or the intent) for a hardened vent (Reference 38). The existing JAF Torus (wetwell) vent path originates at Torus Penetration X-205 and terminates at the inlet to SGTS. The pathway consists of large bore piping (12”+) inboard and outboard Torus Primary Containment Isolation Valves (PCIVs) (27AOV-117 and 27AOV-118), parallel SGTS motor operated isolation valves (27MOV-120 and 27MOV-121), and SGTS filter isolation valves (01-125MOV-14A / B). The hardened vent terminates in the SGTS room, located adjacent to the Reactor Building, which contains sheet metal ductwork and filters. The ductwork and filters are only rated for a few pounds and are presumed to fail under most venting scenarios. After ductwork failure, high pressure venting will pressurize the SGTS room until failure of the access doors to the outside. These are double doors that normally open to the environment thereby providing a large release path for the steam mixture.

Inadvertent actuation of the existing system is prevented through emergency operating procedures, physical separation of the valve controls from the MCR, and the likely requirement for manual operation of some venting valves due to a loss of power. Radiation monitoring is provided using existing containment high range monitor (CHRM) and post-accident sampling system (PASS).

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

The EA-13-109 compliant HCVS system utilizes portions of the GL-89-16 wetwell vent system. Similar to the existing GL 89-16 hardened vent, the EA-13-109 vent path originates at the Torus Penetration X-205, passes through existing Containment Atmosphere Dilution (CAD) inboard and outboard PCIVs (27AOV-117 and -118) and combines with the Drywell piping into a common 30” header. Installed between the PCIVs and the Standby Gas Treatment System intermediate isolation valves (27MOV-120 and 27MOV-121) is a new 8” / 10” branch pipeline (10”-N-152-108, 8”-N-152-109, 10”-N-152-110) with a HCVS air-operated control valve (27AOV-142) to bypass the SGTS. The new HCVS pipeline and HCVS isolation valve starts above RB elevation of 344’, routes through a stairwell, and up the inside the Southwest side of the Refuel Floor to discharge a minimum of 3 feet above the RB parapet. The HCVS control valve and piping is designed and fabricated as a secondary containment barrier and for anticipated severe accident conditions. The pipeline above the Refuel Floor meets the reasonable protection requirements of HCVS-WP-04 for tornado missiles. Attachment 2 shows the HCVS vent flow path

Valves 27MOV-120 and 27MOV-121 serve to isolate the HCVS from the SGTS. 27MOV-121 is the only valve that could be procedurally opened prior to a severe accident event; therefore, a permanent platform is provided for manual operation of this valve.

Monitoring of existing plant instrumentation is within the MCR. Operation and additional monitoring and operation of the HCVS is from a dedicated HCVS Remote Operating Station located two floors below the MCR in the Administration Building Corridor (El. 272'). Both locations are protected from adverse natural phenomena and are sufficiently shielded. Table 2 contains the evaluation of the acceptability of the ROS with respect to severe accident conditions.

The HCVS requires electrical power only for monitoring of HCVS parameters. All electrical power required for monitoring of HCVS components is provided by a dedicated HCVS battery charger and battery located in the DC 'A' Equipment Room (Administration Building El. 272'). The HCVS battery has a minimum capacity capable of providing power for 24 hours without recharging. The HCVS battery charger provided requires a 120 VAC supply. The battery charger is repowered via portable cables from 71ACUPS-2 that will be repowered by a diesel generator as part of the FLEX response. Actions to replenish the electrical supply include refueling the DG.

For the first 24 hours following the event, the motive supply for the AOVs will be nitrogen gas bottles that have been pre-installed at the ROS. Calculation JAF-CALC-15-00013 (Reference 45) determined the required amount of nitrogen needed for the required number of vent cycles in a 24-hour period. These bottles were sized such that they can provide motive force for at least 8 cycles of a vent path, which includes two (2) openings for each of the two PCIVs (27AOV-117 and 27AOV-118) and at least eight (8) openings of the HCVS control valve, 27AOV-142.

The HCVS design includes a nitrogen purge system connected just downstream of the HCVS isolation valve 27AOV-142. It is designed to prevent hydrogen detonation downstream of that valve. However, the nitrogen purge system is required to be used only if the ELAP progresses to severe accident conditions which result in the creation of combustible gases. The nitrogen purge system has a manual supply control valve at the ROS to allow opening the purge for the designated time. Calculation JAF-CALC-15-00038 (Reference 46) determined the required amount of nitrogen for 8 purges within the first 24 hours of the ELAP. The design allows for nitrogen bottle replacement for continued operation past 24 hours.

The following table describes the existing drywell pressure and Torus level indication and associated transmitters/switches that are used for supporting decision making for operation of the HCVS. Operation of the HCVS will be based on guidance in the EOPs and SAOGs and will follow the primary containment pressure limit (PCPL) curves contained in these procedures. The PCPL curve uses Torus pressure vs. primary containment water level parameters to determine when to vent containment. Since Torus Pressure instrumentation is not repowered for use during this event, EPC Issue 1614 is implemented for evaluating Primary Containment Pressure Limit (PCPL) using existing Drywell Pressure instrumentation.

Table 3-1: Existing Containment Instrumentation

Indicating Component	Assoc. Component	Indication Location	Classification
Drywell Pressure 27PI-115A2* 27PI-115B2	 27PT-115A2 27PT-115B2	 MCR / Relay Room	Safety Related / Environmentally Qualified
Torus Water Level 23LI-202A* 23LI-202B	 23LT-202A 23LT-202B	 MCR / Relay Room	Safety Related / Environmentally Qualified

*Credited via backup from the Primary FLEX Diesel Generator; others defense-in-depth

Torus level indication is needed to determine that the Torus vent path is preserved. Both of the instruments interface with the Torus up to elevation 257’-6” (27.5 ft). The inlet to the HCVS vent pipe is at elevation 260’-6”. Therefore, water level will have to be maintained below 257’-6” in order to ensure that the vent inlet does not get covered with water (see Attachment 1). Engineering Change 620605 Attachment 6.004 demonstrates that the Torus water level will remain below the maximum indicated level of 257’-6” with approximately 50,000 gallons of margin.

The pressure and level indicators and related transmitters are all Safety Related, Regulatory Guide 1.97 compliant components (Reference 34). They are also environmentally qualified for accident conditions. Division A (125 VDC Battery Bus 71BCB-2A) is the primary FLEX Phase 2 diesel power backed loop, and Division 2 (125 VDC Battery Bus 71BCB-2B) can be powered as an alternate strategy.

The Remote Operating Station displays the following parameters:

- HCVS Control Valve Position Indication
- HCVS PCIV Position Indication
- HCVS Vent Pipe Temperature
- HCVS Vent Pipe Radiation
- HCVS Valve Motive Force and Purge System Supply Pressure
- HCVS Battery Voltage
- HCVS Battery Current

Table 1 contains a complete list of instruments available to the operators for operating and monitoring the HCVS.

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

The Torus 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 Torus vent downstream of the second containment isolation barrier is designed for the containment design pressure of 56 psig and ambient temperature (100°F). The design conditions of the existing and new portions of the HCVS System (downstream of the second containment isolation barrier) remain consistent with these conditions. However, the EA-13-109 Order requires this portion of the system to be capable of operation at the higher of the PCPL or containment design pressure. NEI 13-02 suggests a 350°F value for HCVS design temperature based on the highest Primary Containment Pressure Limit (PCPL) among the Mark I and II plants but it is also acceptable to assume saturation conditions in containment (2.4.3.1). Therefore, the existing and new HCVS downstream of the second containment isolation barrier downstream of the containment boundary is evaluated for a pressure consistent with the containment design pressure of 62 psig and a corresponding saturation temperature of 309°F. The system is acceptable for these conditions as shown in pipe stress analyses JAF-CALC-14-00016 (Reference 39) and the associated support calculations.

There is one interfacing mechanical system on the HCVS flow path (in the Standby Gas Treatment System). The boundary valves between the two systems are 27MOV-120 and 27MOV-121. Valve 27MOV-120 remains closed for plant modes 1-3; therefore, it could not be in the open position prior to a BDBEE when the HCVS is required to be functional. A new permanent access platform is used to access 27MOV-121 should it be open prior to the BDBEE. Per the guidance given in NEI 13-02, leak rate testing is suggested for the HCVS system boundary valves (27MOV-120 and 27MOV-121). Per FAQ-05, "HCVS Control and Boundary Valves" the allowable leakage was set equal to the allowable leakage for the PCIV of the valve pair associated with the HCVS containment penetrations which exhibits the highest accepted leakage rate during a 10CFR50, Appendix J testing cycle. In this way, expectations set for boundary valves will not be set higher than those for the existing safety related PCIVs.

HCVS features to prevent inadvertent actuation include locked closed manual valves and a normally open vent valve at the ROS which is an acceptable method of preventing inadvertent actuation per NEI 13-02.

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

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 JAF 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 32), 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 3-2: HCVS Operator Actions

Primary Action	Primary Location/ Component	Notes
1. Open RB doors / exhaust duct and the Track Bay door	Reactor Building RB-369-1 RB-369-2 RB-272-1 RB-272-2	Complete in less than 5 hours.
2. Close SGTS Isolation Valve, 27MOV-121	Reactor Building	Complete in less than 7 hours. Valve may be closed at start of event; use permanent access platform, if needed
3. Prepare nitrogen supply system valves for use	Remote Operating Station in Admin Building Corridor 27CAD-314 – Unlock and close 27CAD-309 – Unlock and open 27CAD-310 – Unlock 27CAD-311 – Unlock 27CAD-313 – Unlock 27CAD-317 – Open	

Primary Action	Primary Location/ Component	Notes
4. Open Torus Inboard Primary Containment Isolation Valve (27AOV-117)	Remote Operating Station in Admin Building Corridor 27CAD-310 – Change Position to supply nitrogen	
5. Open Torus Outboard Primary Containment Isolation Valve (27AOV-118)	Remote Operating Station in Admin Building Corridor 27CAD-311 – Change Position to supply nitrogen	
6. Open HCVS Control Valve (27AOV-142)	Remote Operating Station in Admin Building Corridor 27CAD-313 – Change Position to supply nitrogen	After closing, initiate purge system by opening valve 27CAD-319.
7. Connect back-up power to HCVS battery charger using the extension cord from 71ACUPS-2	Administration Building (Battery Charger located in DC 'A' Equipment Room)	Prior to depletion of the dedicated HCVS power supply batteries (connect prior to 24 hours from initiation of ELAP).
8. Replenish Nitrogen bottles (stored in FSBs) and/or portable air compressor stored in FSB.	Administration Building Corridor	Prior to depletion of the pneumatic/purge supply (no less than 24 hours from initiation of ELAP).

Permanently installed electrical power and pneumatic supplies are available to support operation and monitoring of the HCVS for a minimum of 24 hours. No portable equipment is required 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, spare nitrogen bottles provide this operation and monitoring. In all likelihood, these actions will be completed in less than 24 hours. However, the HCVS can be operated for at least 24 hours without any supplementation.

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

Table 3-3 below provides a list of functional failure modes and the corresponding mitigating actions.

Table 3-3: Failure Evaluation

Functional Failure Mode	Failure Cause	Alternate Action	Failure with Alternate Action Impact on Containment Venting?
Fail to Vent (Open) on Demand	Valves fail to open/close due to loss of normal AC power	Open valves from Remote Operating Station (dedicated nitrogen supply)	No
Fail to Vent (Open) on Demand / Spurious Closure	Valves fail to open/close due to loss of normal pneumatic air supply	Open valves from Remote Operating Station (dedicated nitrogen supply)	No
Fail to Vent (Open) on Demand / Spurious Closure	Valves fail to open/close due to loss of backup pneumatic air supply (long term)	Replace bottles as needed and/or recharge with portable air compressors.	No
Fail to stop venting (Close) on demand	Not credible as there is not a common mode failure that would prevent the closure of at least 1 of the 3 valves needed for venting.	N/A	No
Spurious Opening	Not credible - two locked closed nitrogen isolation valves and a locked open nitrogen vent valve in series prevent pneumatic supply to the PCIVs.	N/A	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 Remote Operating Station two floors below the Control Room in the Administration Building (located adjacent to the Reactor Building). FLEX actions that will maintain the MCR and ROS habitable were implemented in response to NRC Order EA-12-049 (Reference 33). These include:

1. Restoring MCR ventilation via the NSRC DG, if required. Temperatures may increase beyond 110°F late in the mission time of 168 hours requiring this action. Without action to restore MCR ventilation, MCR temperature will remain <120°F for the duration of the 7 days of Sustained Operation.

2. While not specifically credited, opening of the MCR doors can also be implemented to reduce the MCR temperature.

3. Opening doors in the RB to establish natural circulation air flow in the RB (Reference 30).

Table 2 contains a thermal evaluation of all the operator actions that may be required to support HCVS operation. The relevant ventilation calculations / evaluations (References 30, 31, 43, 50, 51, 52) 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:

Monitoring of the drywell pressure and Torus level is accomplished from the Main Control Room. Under the postulated scenarios of order EA-13-109 the control room is adequately protected from excessive radiation dose and no further evaluation of its use is required. (Ref. 7)

HCVS control and monitoring is accomplished from the ROS (primary). 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 HCVS PCIVs (27AOV-117 and 27AOV-118) are located within the Reactor Building adjacent to the Administration Building Corridor; however, shielding from the Reactor Building (secondary containment) exterior concrete wall as well as interior Administration Building walls provides shielding from the HCVS. Peak maximum dose rates and a 7-day total integrated dose have been calculated for the ROS in Calculation JAF-CALC-14-00029 (Reference 40). The radiation dose to personnel occupying this location is predicted to be 5 rem whole body over a period of 7 hours (using a conservative drywell source term). Since action times at the ROS are short during the 7 days of sustained operation for BDBEE, the predicted radiological conditions will be acceptable for the operators to gain access to the ROS for HCVS operation.

If venting operations create the potential for airborne contamination in the

MCR or at the ROS, 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:

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

HCVS control and monitoring is accomplished from the ROS (primary). 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 HCVS PCIVs (27AOV-117 and 27AOV-118) are located within the Reactor Building adjacent to the Administration Building Corridor; however, shielding from the Reactor Building (secondary containment) exterior concrete wall as well as interior Administration Building walls provides shielding from the HCVS. Peak maximum dose rates and a 7-day total integrated dose have been calculated for the ROS in Calculation JAF-CALC-14-00029 (Reference 40). The radiation dose to personnel occupying this location is predicted to be 5 rem whole body over a period of 7 hours (using a conservative drywell source term). Since action times at the ROS are short during the 7 days of sustained operation for BDBEE, the predicted radiological conditions will be acceptable for the operators to gain access to the ROS for HCVS operation.

For ELAP with injection, the HCVS Torus 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 JAFs response to NRC Order EA-12-049 as stated in the FLEX SER (Reference 37).

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.

Table 2 contains a thermal and radiological evaluation of all the operator actions that may be required to support HCVS operation during a severe accident. The relevant ventilation evaluations (Reference 43) demonstrate that the final design meets the order requirements to minimize the plant operators' exposure to occupational and radiological hazards.

1.2 The HCVS shall include the following design features:

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

Evaluation

Calculation JAF-CALC-14-00015 (Reference 41) contains the verification of 1% power flow capacity at the lesser of the containment design pressure and PCPL (56 psig). This is a flow rate of approximately 95,500 lbm/hr. The analysis was performed by a RELAP5 model created for the HCVS piping and fittings. The current design has been evaluated considering pipe diameter, length, and geometry as well as vendor provided valve Cv's. Calculation JAF-CALC-14-00015 concludes that the design provides margin to the minimum required flow rate; therefore, the vent is capable of preventing containment pressure from increasing above the containment design pressure. Calculation JAF-CALC-15-00026 (Reference 42) contains the verification that the Torus is sufficient to absorb the decay heat generated during at least the first 3 hours.

The decay heat absorbing capacity of the Torus 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 psig).

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

Evaluation

The HCVS vent pipe release point to the outside atmosphere is at an elevation that is higher than the adjacent power block structures. The vent exits the Torus through the existing Containment Atmosphere Dilution piping (penetration X-205), through the Torus inboard and outboard PCIVs (27AOV-117 and 27AOV-118), and finally the HCVS Control Valve (27AOV-142). Downstream of the HCVS Control Valve, the vent pipe is routed through the southwest Refuel Floor stairwell and up the interior of the Reactor Building before penetrating the roof. The discharge point was extended approximately three feet above the Reactor Building parapet wall (435'-0"). The release point is on the far southwest side of the RB and a minimum of 25' from the Reactor Building and Turbine Building HVAC exhaust ductwork. Since the effluent release velocity of the vent exceeds 8000 fpm, it is assured that the effluent plume will not be entrained into the recirculation zone of the Turbine Building, Reactor Building, emergency response facilities or ventilation system intakes, and open doors used for natural circulation in the BDBEE response.

Part of the HCVS-FAQ-04 guidance is designed to ensure that vented fluids are not drawn immediately back into any emergency ventilation intakes. Such ventilation intakes should be below a level of the pipe by 1 foot for every 5 horizontal feet. The MCR emergency intake in the ELAP event is at the 322 ft. elevation which is approximately 113 feet below the HVCS pipe outlet. This intake is approximately 180 feet from the vent pipe which would require the intake to be approximately 36 feet below the vent pipe. Therefore, the vent pipe is appropriately placed relative to this air intake.

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

EC 9000052721 Topic Notes (Reference 43) was provided for EA-13-109 compliance and contains an evaluation of vent pipe for protection from external events based on HCVS-WP-04 criteria to demonstrate robustness of the HCVS pipe. JAF meets all the requirements of this white paper. This evaluation documents that the HCVS pipe is adequately protected from all external events and no further protection is required.

JAF 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. The JAF HCVS piping is contained within the RB and first exits a tornado missile protected area at elevation 369’-6” (Refuel Floor). This is nearly 100 feet above the site grade at 272’-0”; there is no HCVS piping at JAF exposed to wind missile hazards below 30 feet above grade that is applicable to this assumption.

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

    a. The total vent pipe exposed area is 255 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 potential missiles or unrestrained material lay down areas in close proximity to the HCVS components because all components, except upper portions of the HCVS large bore piping and the radiation monitor, are located within the protected structure below the Refuel Floor. The radiation monitor, located adjacent to the vent pipe on El. 369'-6", is qualified seismically and is enclosed with a robust vendor supplied lead shield. Under the unlikely occurrence that a tornado missile strikes this component, the device within the lead shield may not remain functional; however, alternate, protected devices are available to serve the function of the radiation monitor, which is to provide an indication of vent line status (i.e., vent line open or isolated). Alternate indicators include HCVS vent line temperature and valve position indication. In addition, temporary storage of material in the area is controlled through work management procedures.

3. JAF will maintain the existing GL 89-16 Torus vent capability as a contingency vent path should the HCVS vent path above 30 feet become damaged such that it restricts flow to an unacceptable level.

4. Hurricanes are not screened for JAF.

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

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

<u>Evaluation</u>

There is one interfacing mechanical system on the HCVS flow path for which there could be unintended cross flow of vented fluids:

- Standby Gas Treatment System - the boundary valves between the two systems are 27MOV-120 and 27MOV-121. Valve 27MOV-120 remains closed for plant modes 1-3; therefore, it could not be in the open position prior to a BDBEE when the HCVS is required to be functional. A new permanent access platform is used to access 27MOV-121 should it be open prior to the BDBEE. Per the guidance given in NEI 13-02, leak rate testing is suggested for the HCVS system boundary valves (27MOV-120 and 27MOV-121). Per HCVS-FAQ-05, "HCVS Control and Boundary Valves" the allowable leakage was set equal to the allowable leakage for the PCIV of the valve pair associated with the HCVS containment penetrations which exhibits the highest accepted leakage rate during a 10CFR50, Appendix J testing cycle. In this way, expectations set for boundary valves will not be set higher than those for the existing safety related PCIVs.

The miscellaneous vent, drain, and test connections have a normally closed valve and are end-capped. The process instrumentation lines are isolated by a manual valve or the instrument. These pathways adequately minimize the potential for cross flow or combustible migration into the RB or other systems.

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

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

Evaluation

Monitoring of the containment parameters is within the MCR. Operation and monitoring of the HCVS is from a control panel located in the Administration Building Corridor. This location is two floors below the Main Control Room and accessible via a local stairway making the Remote Operating Station readily accessible. The ROS location has a direct travel path to the MCR and is protected by intervening structures. Table 2 contains a list and evaluation of the HCVS required actions ensuring access during a severe accident. Attachment 6 shows the location relative to the Main Control Room.

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

1.2.5 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

Manual operation of the HCVS is completed at the Remote Operating Station as described in Order Item 1.2.4 above. The ROS contains manually operated valves that supply pneumatics to the HCVS flow path valve actuators so that these valves may be opened without power to the valve actuator solenoids and regardless of any containment isolation signals that may be actuated.

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 (Reference 8) 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 DC 'A' Equipment Room in the Administration Building where they are protected from screened in hazards and have sufficient capacity to provide this power without recharging. Engineering Change 9000052721 Attachment 6.003 (Reference 43) 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 24VDC batteries per the response to EA-12-049. The HCVS battery charger provided requires a 120 VAC supply. The battery charger is repowered via portable cables from 71ACUPS-2 that will be repowered by a portable diesel generator as part of the response to EA-12-049. Engineering Change 9000052721 Topic Notes Section 3.1.4 (Reference 43) confirms that the battery charger is capable of supplying the continuous HCVS loads while recharging the batteries within 12 hours.

Calculation JAF-CALC-15-00031 (Reference 44) included the 24VDC battery charger in the FLEX DG loading calculation, so there is no additional load on the FLEX DG and they are capable of carrying HCVS Torus venting components electrical loads. 24 VDC battery voltage and current status will be indicated on panel 27CAD-PNL-1 so that operators will be able to monitor the status of the 24 VDC batteries. Attachment 3 contains a diagram of the HCVS electrical distribution system.

A permanent access platform is available to access the valve 27MOV-121 handwheel should it require closure prior to operation of the HCVS. This eliminates the need for portable equipment such as ladders, portable platforms, scaffolding, etc.

The pneumatic motive force is provided by two nitrogen bottles in the Administration Building Corridor. The designed capacity of the pneumatic system is required to perform a minimum of 8 vent cycles. Valve 27AOV-142 is cycled for venting operation while valves 27AOV-117 and 27AOV-118 will remain open once venting process is initiated. Per JAF-CALC-15-00013 (Reference 45), the nitrogen system is sized to open Torus PCIVs 27AOV-117 and 27AOV-118 twice and to perform up to twelve (12) open and close cycles of HCVS Control Valve 27AOV-142 over a 24-hour period.

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

Evaluation

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

The Torus PCIVs must be open to permit vent flow. The physical features that prevent inadvertent actuation are locked close manual nitrogen supply valves and normally open vent valves at the Remote Operating Station. This design feature meets 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 at the ROS, as well as information on the status of supporting systems which are 24 VDC battery voltage, battery current and backup nitrogen pressure.

This monitoring instrumentation provides the indication from a remote but readily accessible location per Requirement 1.2.4. Containment instrumentation will be supplied by emergency busses repowered by the FLEX DGs. The Torus HCVS will be supplied by the HCVS 24VDC batteries and designed for sustained operation during an ELAP event using the FLEX equipment.

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

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

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

Evaluation

The HCVS radiation monitoring system consists of an ion chamber detector (27RE-106) which is coupled to a process and control module and located adjacent to the HCVS pipeline on the Refuel Floor (RB El. 369'-6"). The process and control module is mounted in panel 27CAD-PNL-2 in the Administration Building Corridor. 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 Administration Building Corridor. 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 Torus 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 Torus and the containment isolation boundary is designed to 56 psig at 220ºF. The existing Torus PCIVs, 27AOV-117 and 27AOV-118, meet these design conditions for the containment boundary. Torus vent piping and components installed downstream of the containment isolation boundary are designed or have been reevaluated for beyond design basis 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. Refer to EA-13-109, requirement 1.2.11 for a discussion on designing for combustible gas.

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

Evaluation

In order to prevent a detonable mixture from developing in the pipe, a purge system is installed to purge hydrogen from the pipe with nitrogen after a period of venting. The nitrogen purge system is charged by opening manual valve 27CAD-317 and initiated by opening manual valve 27CAD-319 to inject into the HCVS pipeline downstream of the HCVS Control Valve 27AOV-142. Calculation JAF-CALC-15-00038 (Reference 46) has determined that a 31-second purge time is required to purge the combustibles after a vent cycle. The use of this purge system meets the requirement to ensure the flammability limits of gases passing through the vent pipe will not be reached.

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

Evaluation

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

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

Evaluation:

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

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

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

Table 3-4: 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

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

[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.

valve actuators, and containment isolation valve position indication components.

Evaluation:

The HCVS upstream of and including the second containment isolation valve 27AOV-118 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 a seismically qualified structure.

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

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

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

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

1. HCVS Drywell Vent Functional Requirements

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

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

2. Containment Venting Strategy Requirements

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

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

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

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

Because the order contains just three requirements for the containment venting strategy, the compliance elements are in NEI 13-02, Revision 1. NEI 13-02, Revision 1, endorsed by NRC in JLD-ISG-2015-01, provides the guidance for the containment venting strategy (B.2) of the order. NEI 13-02, Revision 1, provides SAWA in conjunction with Severe Accident Water Management (SAWM), which is designed to maintain the Torus 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.

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

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

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

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

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

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

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

As part of implementing SAWA, the FLEX primary and secondary injection flow paths were switched as the secondary pathway offered the advantage of reduced operator dose exposure and burden. As a result of this change, the primary FLEX pathway and SAWA injection pathway are the same. To support this change, (a) new permanent plant piping connections were installed for ease of connection, (b) platforms installed for operation of manual isolation valves in the Screenwell / Reactor Building, and (c) portable throttling valve manifolds installed (including the FLEX/SAWA flow meter) were provided to support the range of FLEX and SAWA flow rates. The new carts are located within the basement of the Screenwell local to the Fire Protection and Residual Heat Removal Service Water (RHRSW) pipeline connections. This modified flow path has been evaluated and found to be acceptable in calculation JAF-CALC-17-00104 (Reference 36). The SAWA system, shown on Attachment 4, consists of a FLEX pump (existing Diesel Driven Fire Pump) injecting into the Reactor Pressure Vessel (RPV) and SAWM consists of flow control at the valve manifold cart along with Torus level indication to ensure that the Torus vent is not submerged. The FLEX primary (SAWA) pump is the permanently installed Diesel Driven Fire Pump (DDFP) 76P-4 which takes suction from Lake Ontario. A new permanent plant hose quick connection at the discharge of pump 76P-4 is connected via portable hose and quick connections to the new throttling valve cart where SAWA flow indication and control is provided. The outlet of the new throttling valve cart is connected via portable hose to new permanent fire hose quick connections downstream of the RHRSW 'B' strainer. This connection to RHRSW provides a hard pipe connection to the Reactor Pressure Vessel (RPV). To complete the flowpath, valves are then modulated as follows:

- 76FPS-807 (Manually closed via permanent platform)
- 76FPS-780 (Manually open)
- 10RHR-460 (Manually open)
- 10MOV-148B (Manually open via permanent platform)
- 10MOV-149B (Manually open via permanent platform)
- 10MOV-25B (Open using MCR Switch with LPCI Batteries)
  (Note: 10MOV-27B is normally open)

Backflow prevention is provided by installed containment isolation check valve 10AOV-68V. Cross flow into other portions of the RHR system is prevented using normally closed valves. Communication will be established between the MCR and the SAWA flow control location in the Screenwell.

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

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

The actions inside the RB where there could be a high radiation field due to a severe accident will be to open valves 10MOV-148B and 10MOV-149B. The action to open valves inside the RB can be performed before the dose is unacceptable (7 hours) after the loss of RPV injection. This time was validated as part of the Time Sensitive Action validation for EA-13-109. The FSGs direct early accomplishment of actions that must be done early in the severe accident event where there is a loss of all AC power and a loss of all high-pressure injection to the core. In this event, core damage is not expected for at least one hour so that there will be no excessive radiation levels or heat related concerns in the RB when the valves are operated. The other SAWA actions all take place outside the RB at the MCR, Screenwell (and adjacent outdoor locations), FSB, and the deployment pathways. Since these locations are outside the RB, they are shielded from the severe accident radiation by the thick concrete walls of the RB. Once SAWA is initiated, the operators will monitor the response of containment from the MCR to determine that venting and SAWA are operating satisfactorily, maintaining containment pressure low to avoid containment failure. Stable or slowly rising trend in Torus 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 of the Torus to the point where the Torus vent is submerged.

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

JAF 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 243’-9” and 257’-6” (27.5’ above the bottom of the Torus) elevation in the Torus provides approximately 813,012 gallons of water volume before the level instrument would be off scale high. An additional 51,586 gallons is available prior to reaching the elevation of the Torus vent penetration. BWROG generic assessment BWROG-TP-15-011, provides the principles of Severe Accident Water Management to preserve the Torus vent for a minimum of seven days. After containment parameters are stabilized with SAWA flow, SAWA flow will be reduced to a point where containment pressure will remain low while Torus level is stable or very slowly rising. As shown in EC 620605 Attachment 6.004 (Reference 47), the Torus level will not reach the Torus vent for at least seven days. A diagram of the available freeboard is shown on Attachment 1.

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

The upper range of Torus level indication provided for SAWA/SAWM is 257’-6” elevation. This defines the upper limit of Torus volume that will preserve the Torus vent function as shown in Attachment 1.

Section IV.C.6: Torus vent service time

Reference 27 in NEI 13-02, Revision 1 (Reference 7) and BWROG-TP-15-011 demonstrates that throttling SAWA flow after containment parameters have stabilized, in conjunction with venting containment through the Torus vent will result in a stable or slowly rising Torus level. The references demonstrate that, for the scenario analyzed, Torus level will remain below the Torus vent pipe for greater than the seven days of sustained operation allowing significant time for restoration of alternate containment pressure control and heat removal.

Section IV.C.7: Strategy time line

The overall accident management plan for JAF is developed from the BWR Owner's Group Emergency Procedure Guidelines and Severe Accident Guidelines (EPG/SAG). As such, the SAWA/SAWM implementing procedures are integrated into the JAF SAOGs. In particular, EPG/SAG Revision 3, when implemented with Emergency Procedures Committee Generic Issue 1314, allows throttling of SAWA in order to protect containment while maintaining the Torus vent in service. The SAOG 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, JAF has validated that the SAWA pump can be deployed and commence injection in less than 8 hours. The studies referenced in NEI 13-02 demonstrated that establishing flow within 8 hours will protect containment. The initial SAWA flow rate will be about 361 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 Torus level.

NEI 13-02 generic analysis per Reference 27 of NEI 13-02 demonstrated that, SAWA flow could be reduced to 71 gpm after four hours of initial SAWA flow rate and containment would be protected. At some point Torus 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 SAOGs are symptom-based guidelines.

Section IV.C.8: SAWA Flow Control

JAF will accomplish SAWA flow control by the use of throttle valves on the FLEX / SAWA valve cart. The operators at the FLEX / SAWA valve cart will be in communication with the MCR via radios or runners and the exact time to throttle flow is not critical since there is a large margin between normal Torus level and the level at which the Torus vent will be submerged. The communications capabilities that will be used for communication between the MCR and the SAWA flow control location are the same as that evaluated and found acceptable for FLEX strategies. The communications capabilities have been tested to ensure functionality at the SAWA flow control and monitoring locations.

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

Section IV.C.9.1: SAWA Pump

JAF uses one primary and one alternate Diesel Driven Fire Pump pump for FLEX and SAWA (existing and permanently installed). Each pump is capable of a minimum of 361 gpm at the pressures required for RPV injection during an ELAP.

Each of these pumps has been shown to be capable of supplying the required pressure and flow rate to the RPV for FLEX and for SAWA scenarios (Reference 36). The pumps are permanently installed in the Screenwell where they are protected from all screened-in hazards and will be available to function after a seismic event.

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

The JAF SAWA flow rate is 361 gpm which is the site-specific flow rate when the site's rated thermal power (2536 MWth) 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 rated thermal power level used in NUREG-1935, State of the Art Reactor Consequence Analysis (SOARCA). NUREG 1935 is Reference 9 of NEI 13-02 Revision 1.

Section IV.C.9.3: SAWA Pump Hydraulic Analysis

Calculation JAF-CALC-17-00104 (Reference 36) analyzed the FLEX pumps and the lineup for RPV injection that would be used for SAWA. This calculation showed that the pumps have adequate capacity to meet the SAWA flow rate required to protect containment.

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

NEI 13-02, Rev. 1 (Reference 7), Section 4.1.4.2 requires a means of backflow prevention for the SAWA/SAWM flow path into containment in order to prevent unintended cross flow and migration from containment into other areas within the plant. Existing safety related check valve 10AOV-68B provides a means of backflow prevention. Therefore, this order requirement is satisfied. These valves are tested as a part of the Inservice Testing (IST) program; therefore, additional testing is not required in accordance with HCVS-FAQ-05 and NEI 13-02 Section 6.2.3.3.

Section IV.C.9.5: SAWA Water Source

JAF is located on the southeastern shore of Lake Ontario, which is the ultimate heat sink for the plant and the normal supply to the permanently installed Diesel Driven Fire Pump. This provides an unlimited water source throughout the ELAP/Severe Accident event. 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 SAWA pumps are permanently installed in the Screenwell where they are protected from all screened-in hazards. The SAWA pumps are commercial fire pumps rated for long-term use in emergency scenarios. The pumps are diesel-driven by an engine mounted on the skid with the pump. The pumps will be refueled by the FLEX refueling equipment that has been qualified for long-term refueling operations per EA-12-049. The action to refuel the SAWA pumps was evaluated under severe accident conditions in Table 2 and demonstrated to be acceptable. Since the pumps are stored in a protected structure, are qualified for the environment in which they will be used, and will be refueled by a qualified refueling strategy, they will perform their function to maintain SAWA flow needed to protect primary containment per EA-13-109.

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

Table 1 shows the electrical power source for the SAWA/SAWM instruments. For the HCVS instruments powered by the HCVS 24 VDC batteries, EC 9000052721 Attachment 6.003 demonstrates that the HCVS batteries can provide power until the FLEX generator restores power to the battery charger.

The FLEX load on the FLEX DG per EA-12-049 was evaluated in calculation JAF-CALC-15-00031 (Reference 44). This calculation demonstrated 29 kW of margin to full load. There are no additional loads on the FLEX DGs for SAWA and SAWM. The FLEX generator is qualified to carry the rest of the FLEX loads as part of Order EA-12-049 compliance.

The existing safety-related (seismic) Low Pressure Coolant Injection inverter battery (71BAT-3B) is capable of opening RHR injection valve 10MOV-25B as evaluated in EC 620605 Attachment 6.002 (Reference 47); therefore, opening the LPCI injection valve 10MOV-25B does not require support from the FLEX DG.

Section IV.C.10: SAWA/SAWM Instrumentation

1) Section III.A.2 provides a complete listing of the specific instruments credited for SAWA.

2) The FLEX electromagnetic flow meter is used to provide a means of confirming the desired flow rate. The flow meter is installed on the FLEX (SAWA) valve cart stored in the Screenwell RHRSW Pump Room ‘B’. Since the flow meter is installed on the same cart that will be used for FLEX an N+1 FLEX cart with a flow meter is also stored in the Screenwell RHRSW Pump Room ‘A’ although a backup flow meter is not required by EA-13-109.

3) The flow meter is designed for the expected flow rate, temperature, pressure and radiation for SAWA over the period of sustained operation. The flow range for the model selected for JAF is approximately 12 to 1000 GPM. This model is acceptable, because it bounds the JAF SAWA/SAWM flow rates of 71 to 361 gpm. The flow meter is rated for 150 psi which exceeds the 148 psi maximum expected pressure. The 10 to 130°F rated temperature range bounds the 11 to 110°F expected ambient/fluid temperature the meter will be exposed to (Reference 47 Topic Notes Section 3.1.9.5). The dose rate at the operating location of the flow meter cart (inside the Screenwell RHRSW Pump Room 'B') is <1 mR/hr (Reference 40). The total dose over the 7-day period is less than 1 rem, which is well below the generally accepted maximum for digital equipment, 1000 rem. The flow meter is commercial equipment and does not have a published radiation dose limit. The flow meter is generally rugged, is stored within a Class I Structure in an area protected from non-seismic equipment that could fall on the cart and the cart has its wheels chocked to prevent movement. These measures are consistent with HCVS-OGP-011 to ensure availability following a seismic event (Reference 48).

4) The flow meter is self-powered from internal batteries with a life of 2.5 years.

5) Containment pressure and Torus level instrumentation will be repowered through their respective electrical buses using the FLEX diesel generator.

Section IV.C.10.1: SAWA/SAWM instruments

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

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

The drywell pressure and Torus level instruments, used to monitor the condition of containment, are pressure and differential pressure detectors that are safety-related and qualified for post-accident use. These instruments are referenced in Severe Accident Guidelines for control of SAWA flow to maintain the Torus vent in service while maintaining containment protection. These instruments are powered by batteries for at least 9 hours (Ref. 53) and will be re-powered by FLEX generator systems for the sustained operating period. These instruments are on buses included in the FLEX generator loading calculations for EA-12-049 (Reference 44). Note that other indications of these parameters may be available depending on the exact scenario.

The SAWA flow meter is a portable digital based electromagnetic flow meter installed on the FLEX (SAWA) valve manifold cart and self-powered by internal batteries.

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. SAOG 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 Torus 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 34) which is the JAF committed version per UFSAR Table 7.19-1 as post-accident instruments and are therefore qualified for 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 valve cart is located in the basement of the Screenwell, and on the opposite side of the RB from the vent pipe, there is no concern for any effects of radiation exposure to the flow instrument.

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

JAF FLEX strategies will restore the containment instruments, containment pressure and Torus 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

Thermal and radiological impacts will not impact equipment (installed and portable), instrument functionality, or operators performing necessary actions for the SAWA/SAWM strategy. Key locations are MCR, ROS, Screenwell, and FLEX DG refueling locations. The most important Severe Accident consideration is the radiological dose as a result of the accident and operation of the HCVS. JAF-CALC-14-00029 (Reference 40) analyzed dose at different locations and times where operator actions will take place during FLEX/SAWA/SAWM activities. FSG-001 and FSG-ELAP provide guidance for ventilation strategies at various locations to mitigate high temperature conditions. JAF-CALC-17-00105 (Reference 49) determines the minimum temperature expected in the RHRSW Pump Rooms during an ELAP to ensure equipment remains operational. The other locations for personnel occupancy or equipment operation including the Reactor Building, Diesel Fire Pump Rooms, Switchgear Rooms, Battery Rooms, and MCR were evaluated as part of FLEX and those evaluations remain bounding for SAWA.

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

Since the SAWA pump is permanently installed in the Screenwell and will be operated from outside the RB, on the opposite side of the RB from the vent pipe, there will be no issues with radiation dose rates at the SAWA pump control location and there will be no significant dose to the SAWA pump.

Inside the RB, the SAWA flow path consists of steel pipe which will remain unaffected by the radiation or elevated temperatures inside the RB. All SAWA hoses are contained within the Screenwell and, as noted for the SAWA pump, there will be no significant dose. Therefore, the SAWA flow path will not be affected by radiation or temperature effects due to a severe accident.

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

The SAWA/SAWM instruments are described in section IV.C.9.3, that section provides severe accident effects

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

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

As part of the response to Order EA-12-049, JAF performed or referenced existing calculations of the temperature response of the Reactor and Control Buildings during the ELAP event. Since, in the severe accident, the core materials are contained inside the primary containment, the temperature response of the RB and Control Building (CB) is driven by the loss of ventilation and ambient conditions and therefore will not change. Thus, the FLEX 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.

After the SAWA pipe is aligned inside the RB, the operators can control SAWA/SAWM as well as observe the necessary instruments from outside the RB. Up to the first 7 hours (prior to the HCVS venting), the thick concrete RB walls as well as the distance to the core materials mean that there is no radiological concern with any actions outside the RB. Therefore, all SAWA controls and indications are accessible during severe accident conditions.

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

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

Cautions

JAF Specific Caution wordings in SAOG-1:

- Adding water to hot core debris may pressurize the primary containment by rapid steam generation
- Raising Torus water level above 29.5 ft will result in loss of Torus vent capability

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

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

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

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

<u>Section V.B</u>: HCVS Out of Service Requirements

Provisions for out-of-service requirements of the HCVS and compensatory measures have been added to CC-JF-118 so that it is with the FLEX out-of-service program.

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

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

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

- If for up to 90 consecutive days, the primary or alternate means of HCVS operation are non-functional, no compensatory actions are necessary.
- If for up to 30 days, the primary and alternate means of HCVS operation or SAWA are non-functional, no compensatory actions are necessary.
- If the out of service times projected to exceed 30 or 90 days as described above, the following actions will be performed through the corrective action system 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 system operation are functional.

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

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

<u>Section V.C</u>: HCVS Training Requirements

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

<u>Evaluation:</u>

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

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

<u>Section V.D</u>: Demonstration with other Post Fukushima Measures

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

1. Hardened containment vent operation on normal power sources (no ELAP)

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

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

Evaluation

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

The use of the HCVS and SAWA capabilities will be demonstrated during drills, tabletops or exercises consistent with NEI 13-06 and on a frequency consistent with 10 CFR 50.155(e)(4). JAF will perform the first drill demonstrating at least one of the above capabilities by June 30, 2022 which is within four years of compliance with Phase 2 of Order EA-13-109, or consistent with the next FLEX strategy drill or exercise. Subsequent drills, tabletops or exercises will be performed to demonstrate the capabilities of different elements of Items 1, 2 and/or 3 above that is applicable to JAF in subsequent eight year intervals.

<u>Section VI</u>: References

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

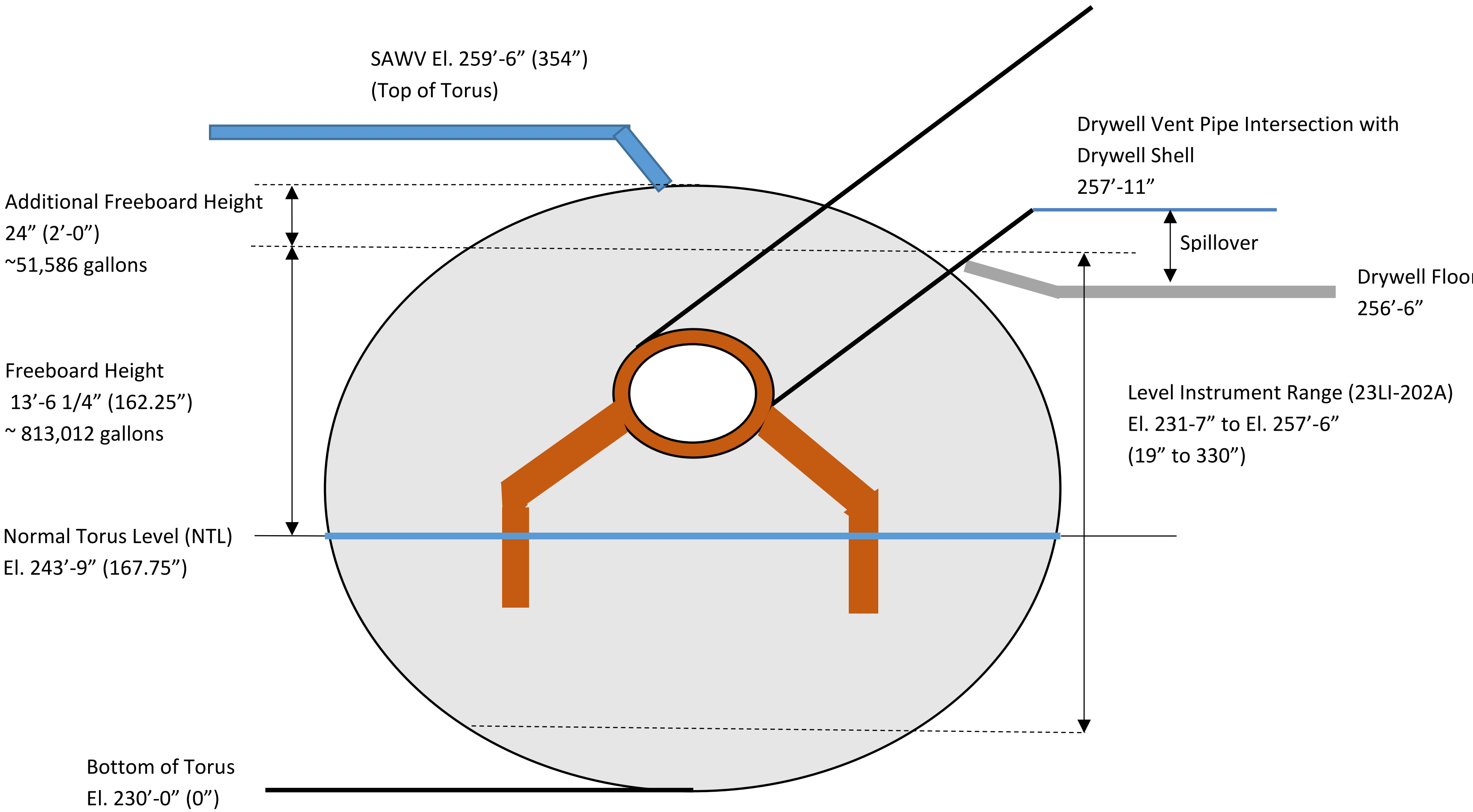
[6] Where two ADAMS accession numbers are listed, the first is the reference document and the second is the NRC endorsement of that document.
[7] NEI 13-02 Revision 1 Appendix J contains HCVS-FAQ-01 through HCVS-FAQ-09.

Number	Rev	Title	Location[6]
12. JLD-ISG-2013-02	0	Compliance with Order EA-13-109, Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation under Severe Accident Conditions	ML13304B836
13. JLD-ISG-2015-01	0	Compliance with Order EA-13-109, Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation under Severe Accident Conditions	ML15104A118
14. HCVS-FAQ-10	1	Severe Accident Multiple Unit Response	ML15273A141 ML15271A148
15. HCVS-FAQ-11	0	Plant Response During a Severe Accident	ML15273A141 ML15271A148
16. HCVS-FAQ-12	0	Radiological Evaluations on Plant Actions Prior to HCVS Initial Use	ML15273A141 ML15271A148
17. HCVS-FAQ-13	0	Severe Accident Venting Actions Validation	ML15273A141 ML15271A148
18. Phase 1 OIP	0	HCVS Phase 1 Overall Integrated Plan (OIP)	ML14181B117
19. Phase 2 OIP	0	HCVS Phase 2 Overall Integrated Plan (OIP)	ML15365A593
20. Phase 1 ISE	0	HCVS Phase 1 Interim Staff Evaluation (ISE)	ML15007A090
21. Phase 2 ISE	0	HCVS Phase 2 Interim Staff Evaluation (ISE)	ML16343B030
22. 1st Update	0	First Six Month Update	ML14353A359
23. 2nd Update	0	Second Six Month Update	ML15181A261
24. 3rd Update	0	Third Six Month Update	ML15363A412
25. 4th Update	0	Fourth Six Month Update	ML16182A377
26. 5th Update	0	Fifth Six Month Update	ML16357A787
27. 6th Update	0	Sixth Six Month Update	ML17180A951
28. 7th Update	0	Seventh Six Month Update	ML16238A522
29. Compliance Letter	0	HCVS Phase 1 and Phase 2 Compliance Letter	N/A
30. JAF-CALC-15-00025	0	Reactor Building Heat Up During Extended Loss of AC Power (ELAP)	N/A
31. JAF-CALC-MISC-04509	0	Main Control Room Heat-Up During Extended Loss of Offsite Power	N/A
32. NEI 12-06	4	Diverse and Flexible Coping Strategies (FLEX) Implementation Guide	ML16354B421

Number	Rev	Title	Location[6]
33. EA-12-049	0	Issuance of Order to Modify Licenses With Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events, dated March 12, 2012.	ML12054A735
34. JAF-RPT-MULTI-03366	0	Updated Regulatory Guide 1.97 Assessment for New York Power Authority JAF Nuclear Power Plant	N/A
35. TR-1026539	0	EPRI Investigation of Strategies for Mitigating Radiological Releases in Severe Accidents BWR, Mark I and Mark II Studies, October 2012	N/A
36. JAF-CALC-17-00104	0	HCVS Phase 2 SAWA Hydraulic Analysis	N/A
37. FLEX/SFPI SER	0	James A. Fitzpatrick Nuclear Power Plant - Safety Evaluation Regarding Implementation Of Mitigating Strategies And Reliable Spent Fuel Pool Instrumentation Related To Orders EA-12-049 and EA-12-051	ML17342A006
38. September 28, 1992 Letter		Hardened Wetwell Vent Capability at the James A. FitzPatrick Nuclear Power Plant	ML13015A634
39. JAF-CALC-14-00016	0	Hardened Containment Vent System: Process Piping Stress Analysis	N/A
40. JAF-CALC-14-00029	0	Hardened Containment Vent System: Dose Assessment	N/A
41. JAF-CALC-14-00015	0	Hardened Containment Vent Capacity	N/A
42. JAF-CALC-15-00026	0	Containment Heat Up Without Water Addition	N/A
43. EC 9000052721	0	Phase 1 Hardened Containment Vent System (Parent EC)	N/A
44. JAF-CALC-15-00031	0	FLEX Strategy – Portable Generator System Sizing	N/A
45. JAF-CALC-15-00013	0	Hardened Containment Vent System: N_2 Bottle and Venting Capacity	N/A
46. JAF-CALC-15-00038	0	Hardened Containment Vent System: Purge Bottle Sizing and PCV Setpoint	N/A

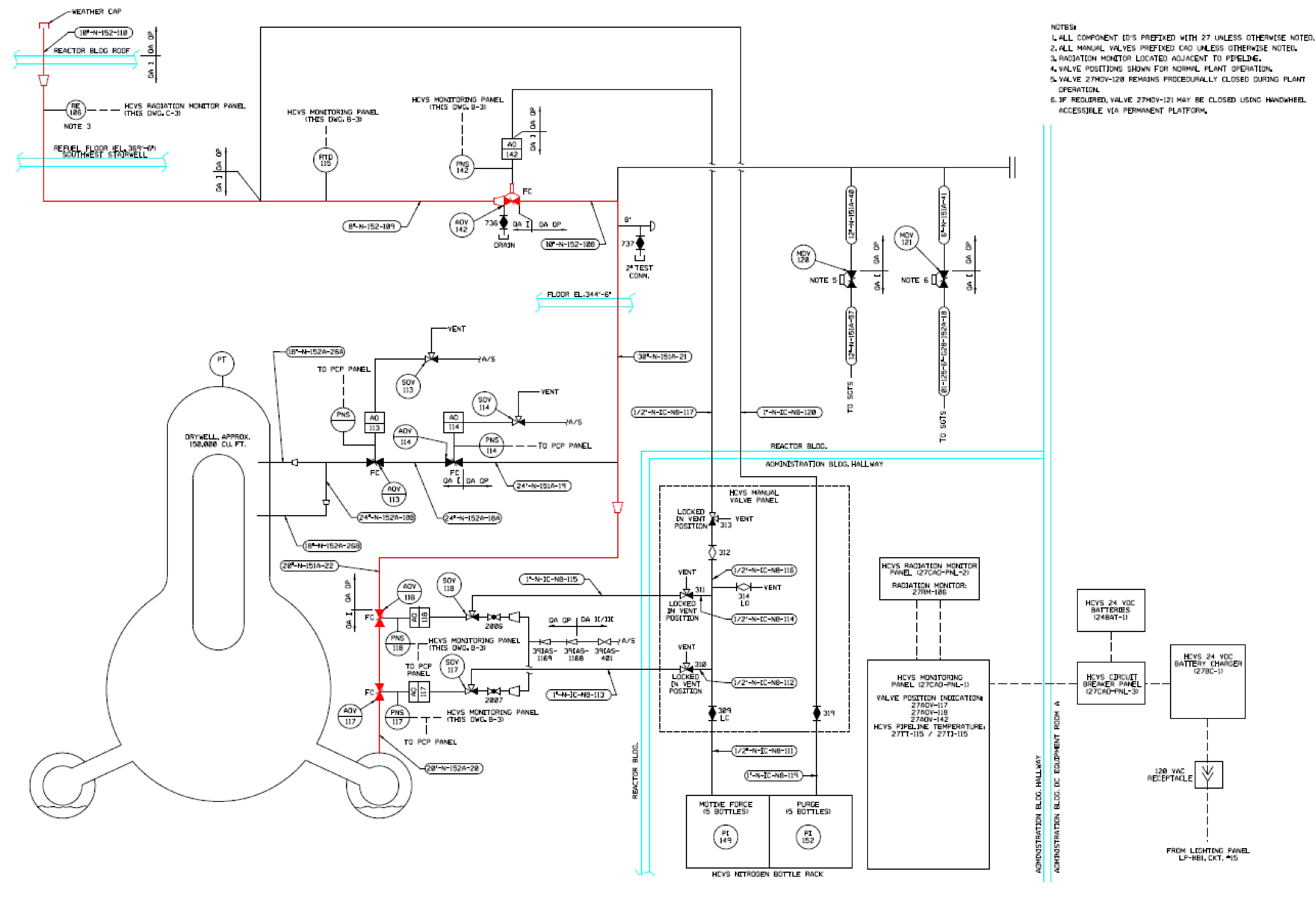
Number	Rev	Title	Location[6]
47. EC 620605	0	Hardened Containment Vent (HCVS) System Phase 2	N/A
48. HCVS-HG-011	0	SAWA Potable Equipment Qualification	N/A
49. JAF-CALC-15-00105	0	Evaluation of JAF RHRSW Pump Rooms Minimum Temperature during the Extended Loss of AC Power (ELAP)	N/A
50. JAF-CALC-14-00027	0	Temperature Evaluation of Battery Room and DC Equipment Room During Extended Loss of Offsite Power (FLEX)	N/A
51. JAF-CALC-15-00006	0	Diesel Fire Pump Room Heatup for Extended Loss of Offsite Power (FLEX)	N/A
52. JAF-CALC-15-00020	0	Steady-State Temperature in El. 272' Electrical Bays and EL. 272' EDG Switchgear Rooms During Phase 2 of Response to BDBEE	N/A
53. JAF-CALC-15-00045	0	Station Service Batteries A and B Discharge Capacity during Extended Loss of AC Power	N/A

<u>Attachment 1</u>: Phase 2 Freeboard diagram

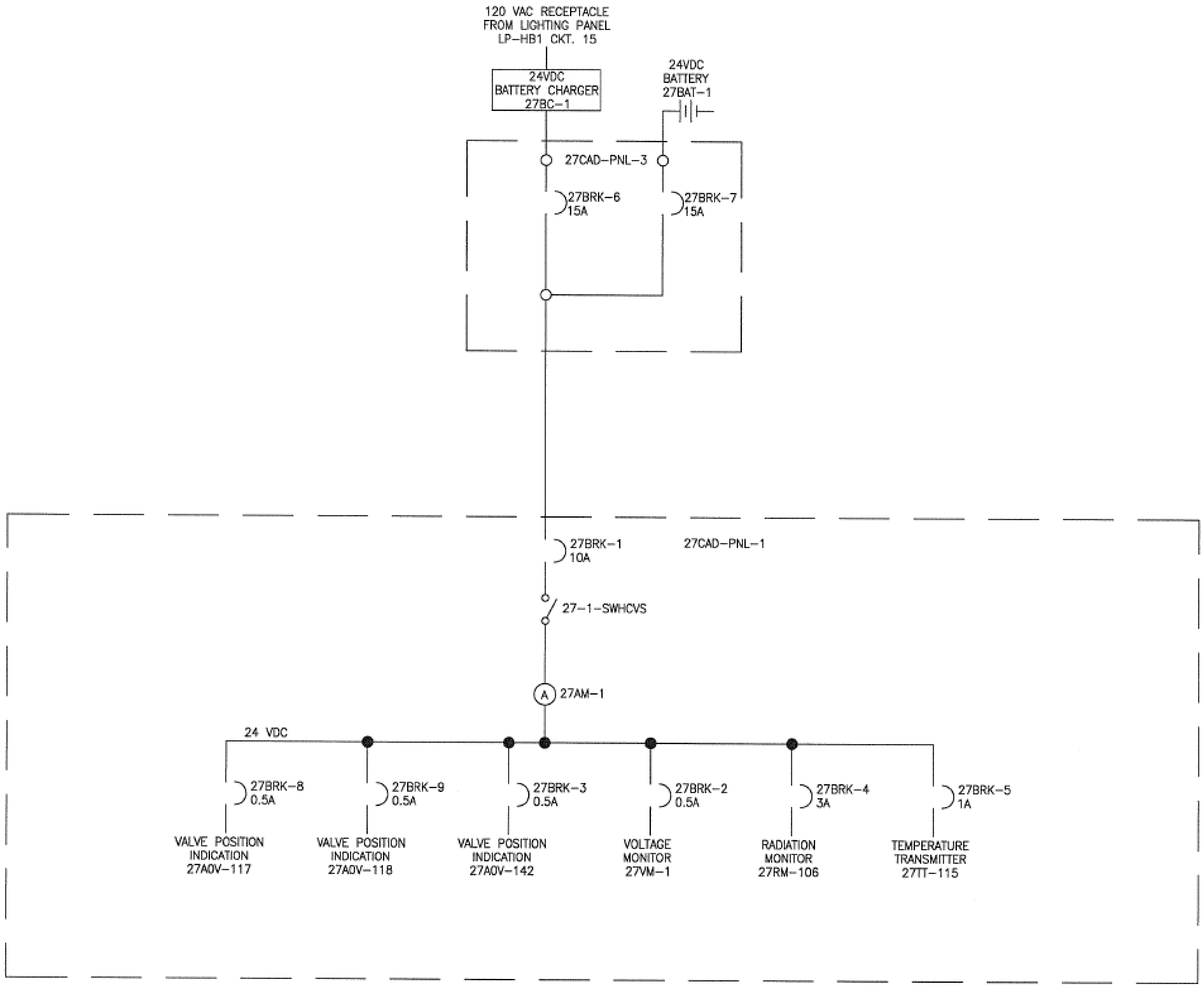


EC 620605 Attachment 6.004 (Reference 47)

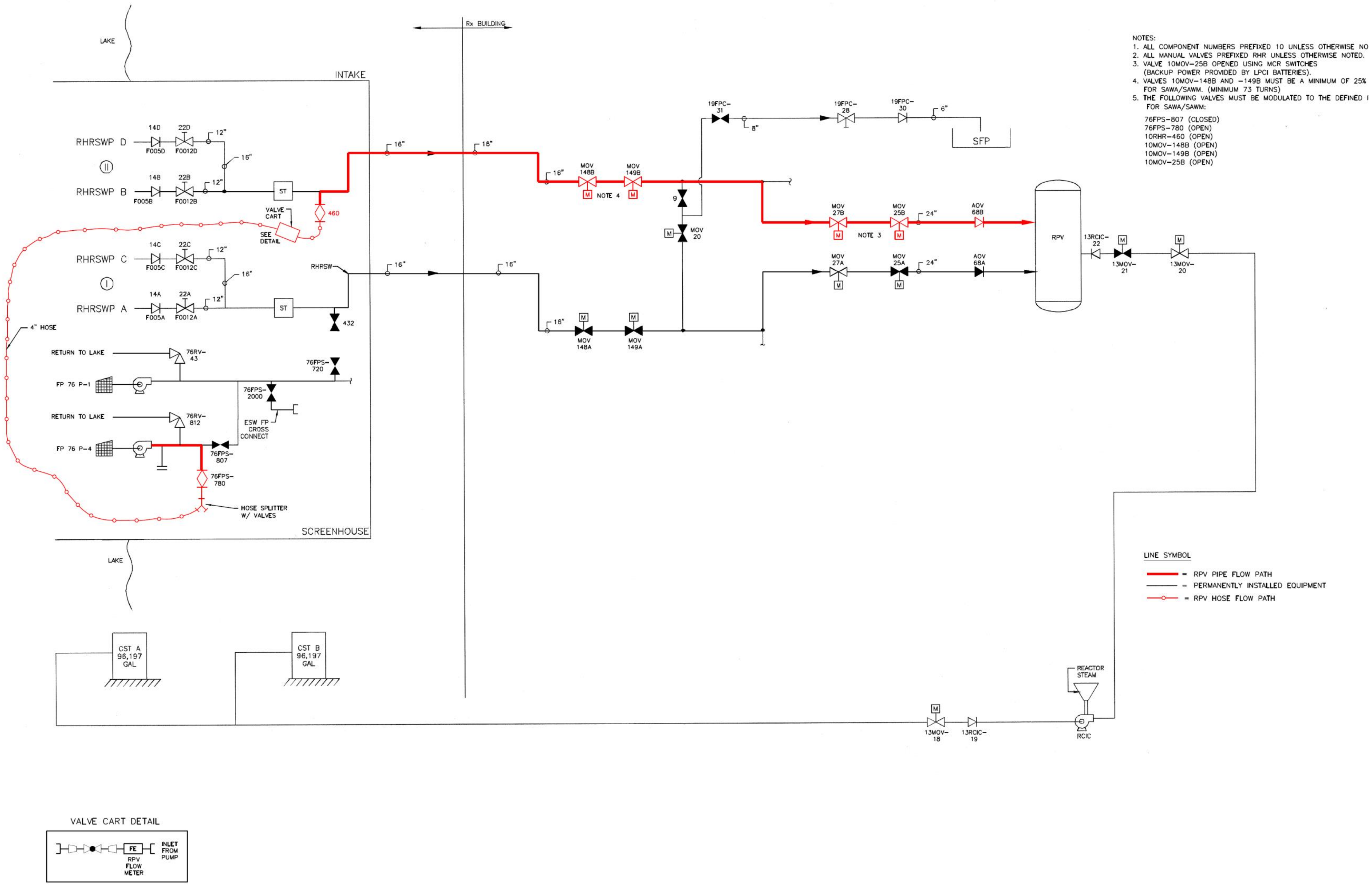
Attachment 2: One Line Diagram of HCVS Vent Path



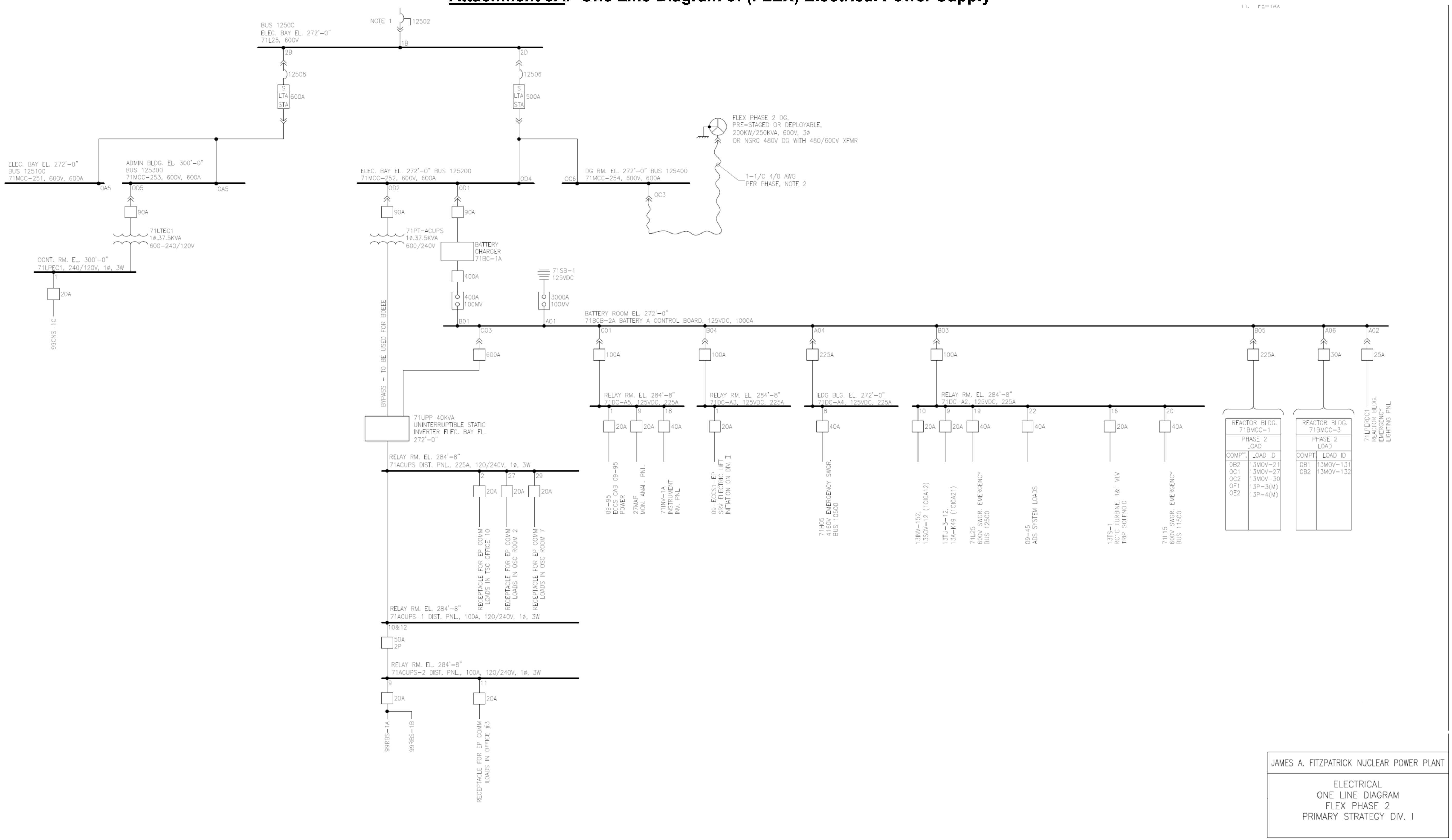
<u>Attachment 3</u>: One Line Diagram of HCVS Electrical Power Supply



Attachment 4: One Line Diagram of SAWA Flow Path



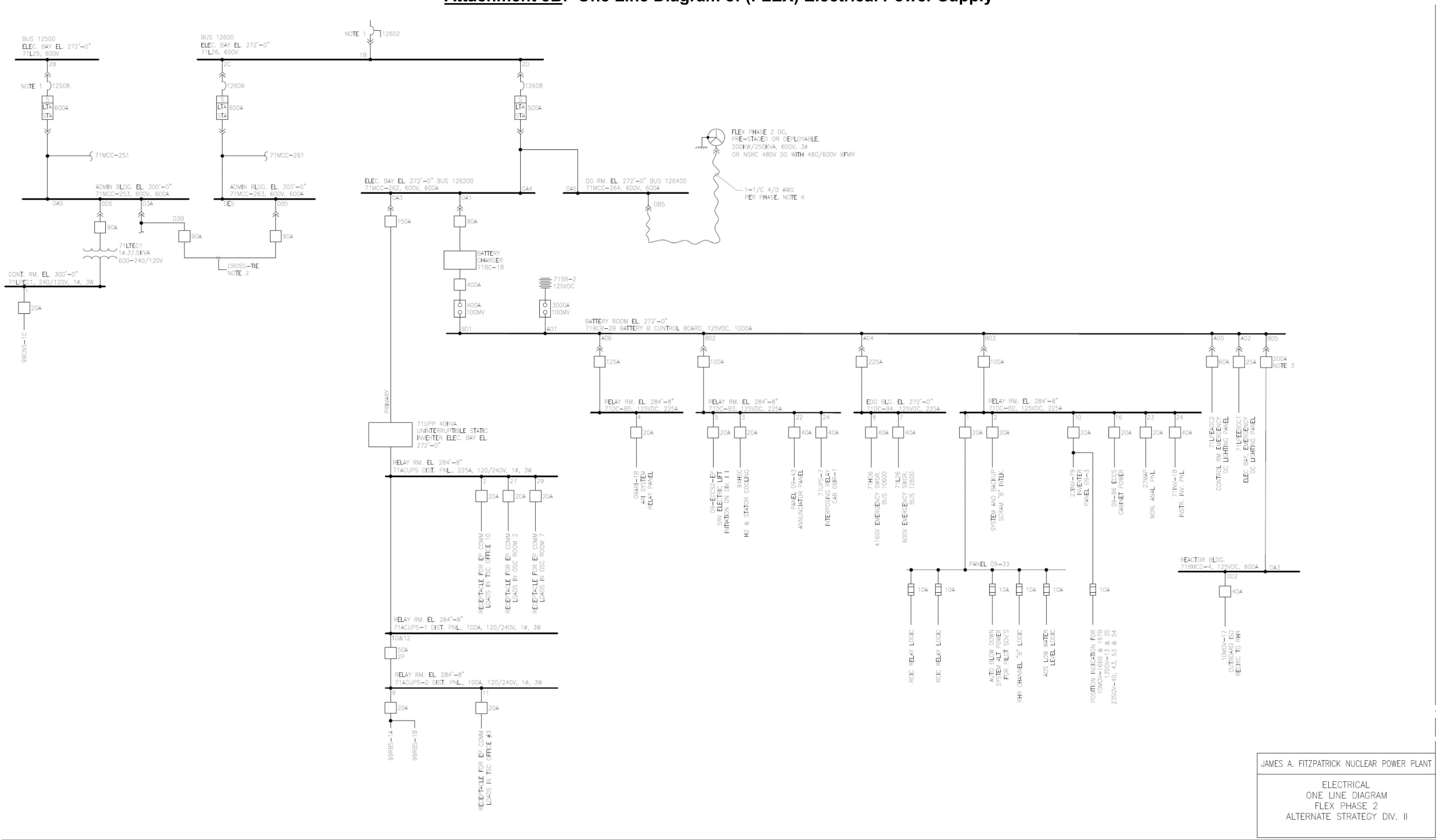
Attachment 5A: One Line Diagram of (FLEX) Electrical Power Supply



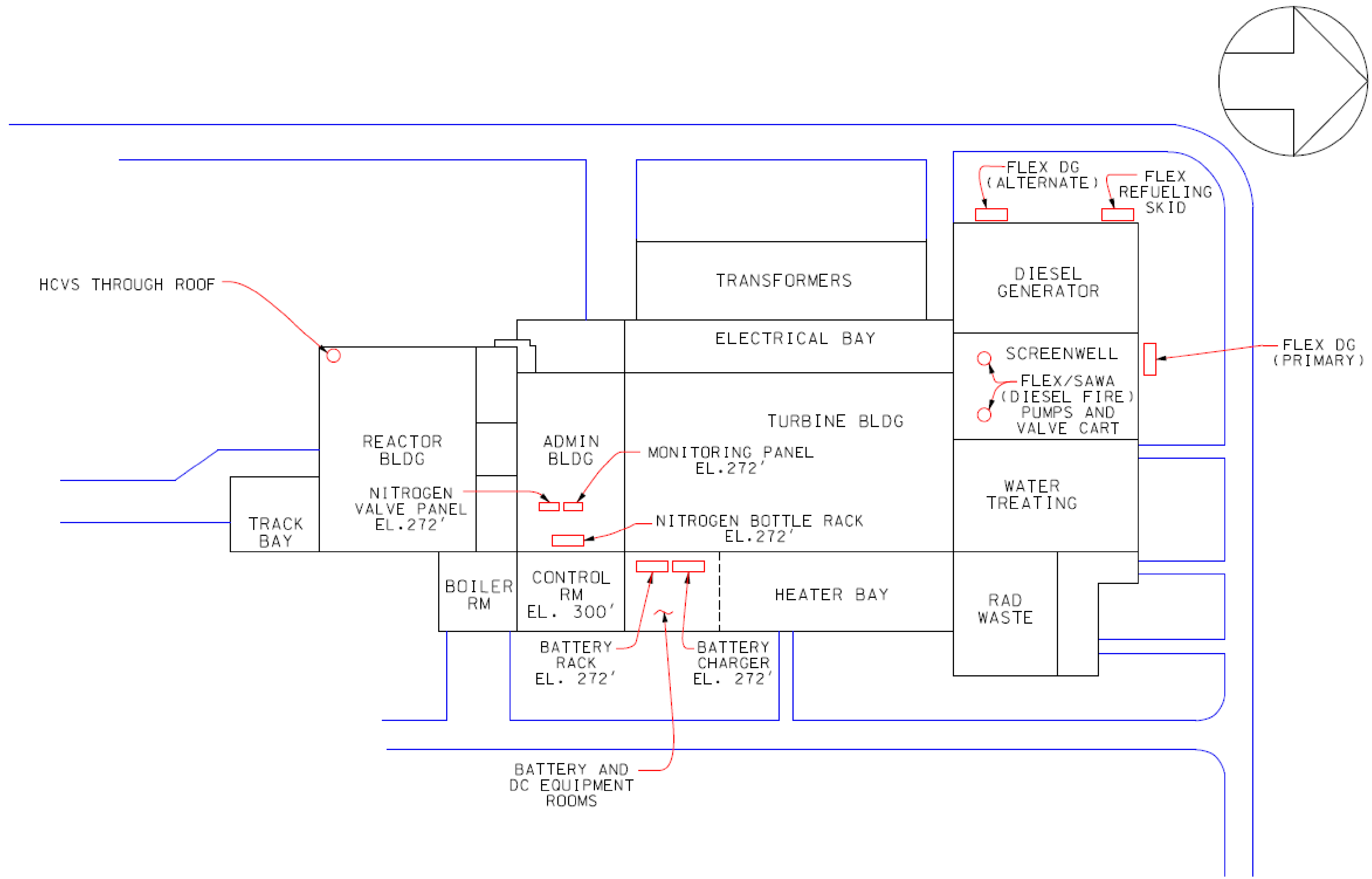
COMPT.	LOAD ID
0B2	13MOV-21
0C1	13MOV-27
0C2	13MOV-30
0E1	13P-3(M)
0E2	13P-4(M)

COMPT.	LOAD ID
0B1	13MOV-131
0B2	13MOV-132

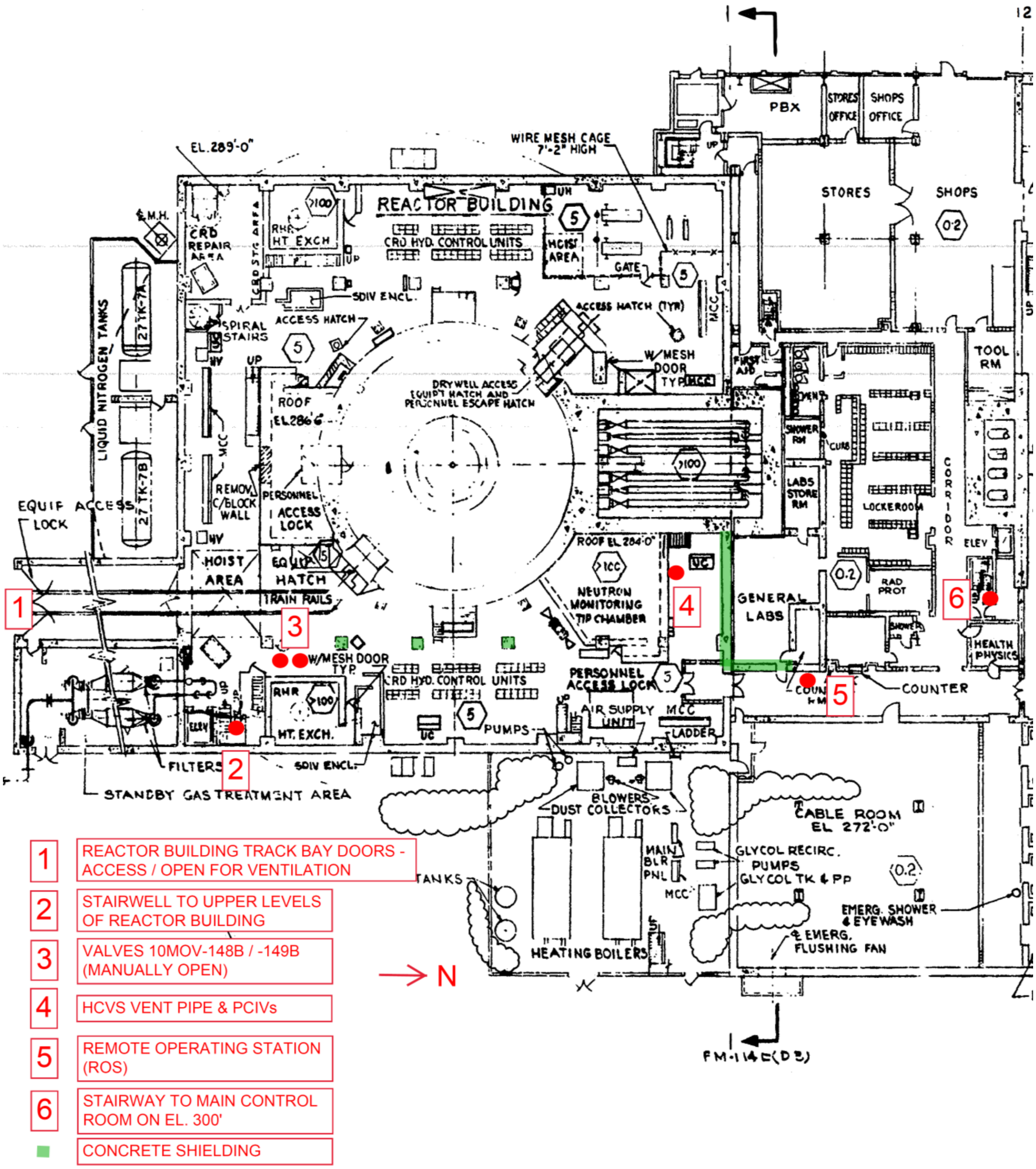
Attachment 5B: One Line Diagram of (FLEX) Electrical Power Supply



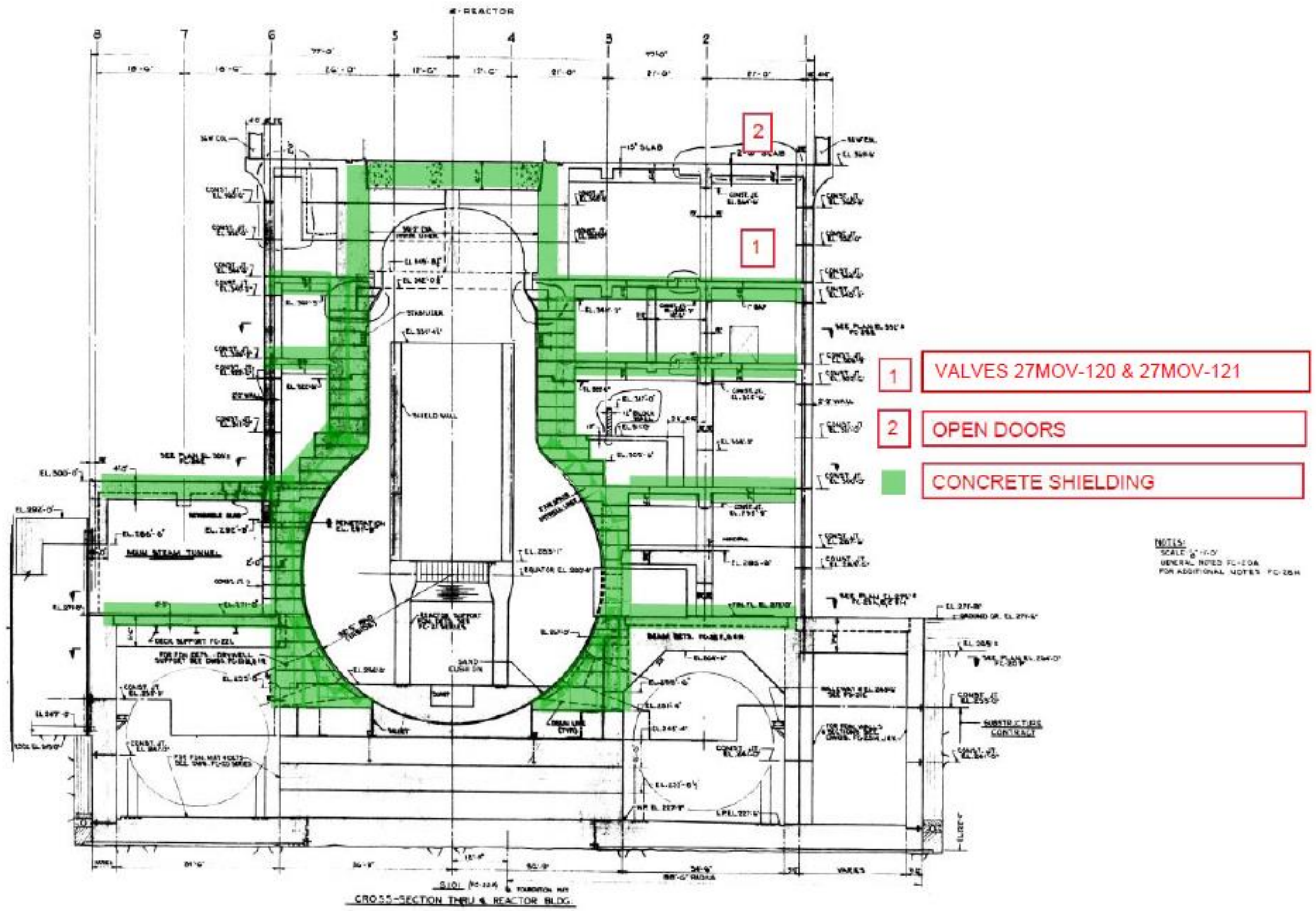
Attachment 6: Plant Layout Showing Operator Action Locations



<u>Attachment 6A</u>: Reactor Building Elevation 272' Manual Action Locations



<u>Attachment 6B</u>: Reactor Building Elevation 344' / 369'-6" HCVS / FLEX Manual Actions



Attachment 6C: FLEX Hose Connection for RPV Injection (Screenwell Elevation 260')

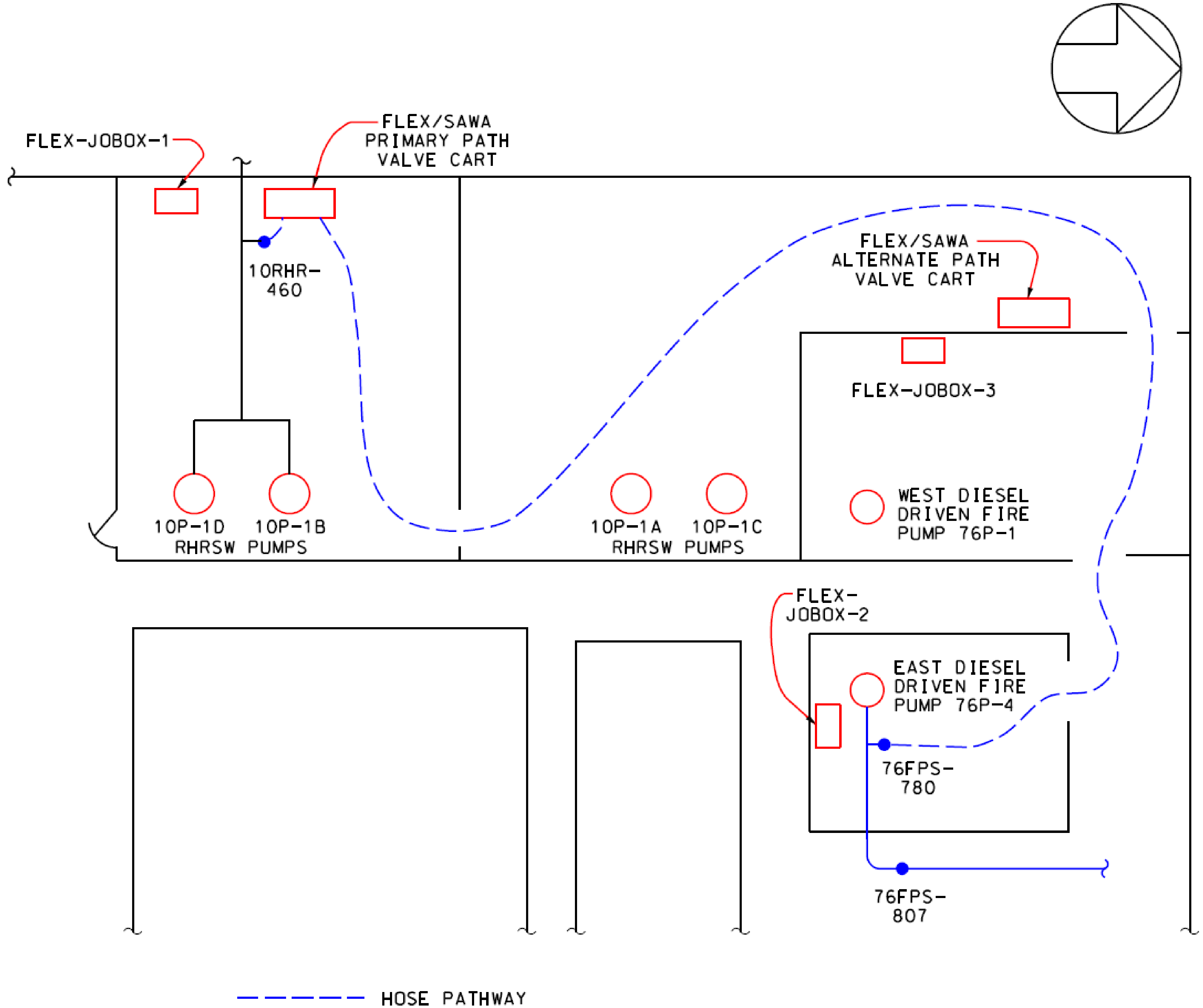


Table 1: List of HCVS Component, Control and Instrument Qualifications

Component Name	Equipment ID	Range	Location	Local BDBEE Temp	Local BDBEE Humidity	Local BDBEE Radiation (TID)	Qualification	Qualification Temp	Qualification Humidity	Qualification Radiation (TID)	Power Supply
Torus Vent Instruments and Components											
HCVS Effluent Temperature Sensor	27RTD-115	50-700°F	Above 344' RB Floor, on 8" pipe	309°F	100%	5.3E7 Rad	IEEE 323-1974 IEEE 344-1975	485°F	95% plus Chemical Spray	3.0E8 Rad	HCVS 24 VDC Batt & Batt Charger
HCVS Effluent Radiation Detector	27RE-106	10E-2 to 10E4 R/hr	369'-6" RB Floor, adjacent to pipe	309°F	100%	2.1E6 Rad	IEEE-323-1974 IEEE 344-1975	350°F (max normal operating)	100%	2.0E8 Rad	HCVS 24 VDC Batt & Batt Charger
HCVS Effluent Radiation Monitor	27RM-106	10E-2 to 10E+4 Rad/hr	27CAD-PNL-2 Remote Operating Station (AB Corridor, El. 272')	55-109°F	20-90%	1.2E2 Rad	IEEE-323-1974 IEEE 344-1975	39-131°F	95%	1E3 Rad	HCVS 24 VDC Batt & Batt Charger
HCVS Effluent Temperature Transmitter	27TT-115	N/A	27CAD-PNL-1 Remote Operating Station (AB Corridor, El. 272')	55-109°F	20-90%	1.2E2 Rad	IEEE 323-1974 IEEE 344-1974 / -1987	-13-185°F	Sealed unit and coated circuit board – high level of humidity	1E3 Rad	HCVS 24 VDC Batt & Batt Charger
Circuit Breaker (instruments) Nitrogen Pressure Gauges Circuit Breaker (Power Supply) Power Switch Valve Position Indicator Lights Current / Voltage / Temperature Indicator	27BRK-2 27BRK-3 27BRK-4 27BRK-5 27BRK -8 27BRK -9 27PI-152 27PI-149 27BRK-1 27-1-SWHCVS 27DC-117A / -117B 27DC-118A / -118B 28DC-142A / -142B 27AM-1 27VM-1 27TI-115	Various	27CAD-PNL-1 Remote Operating Station (AB Corridor, El. 272')	55-109°F (Mild)	20-90% (Mild)	1.2E2 Rad (Mild)	UL489 IEEE 344-Various IEEE 323-1974 UL 489 IEC 947.5.1 IEEE C37.90-1989	55-109°F (Minimum**)	20-90% (Minimum**)	1E3 Rad	N/A
Battery Battery Charger Circuit Breaker (Power Supply)	27BAT-1 27BC-1 27BRK-6 27BRK-7	N/A	DC Equipment Room 'A', (AB El. 272')	55-120°F (Mild)	20-90% (Mild)	3.3E-2 Rad (Mild)	IEEE 344-1975 UL 1012	55-120°F (Minimum**)	20-90% (Minimum**)	1E3 Rad	N/A

Component Name	Equipment ID	Range	Location	Local BDBEE Temp	Local BDBEE Humidity	Local BDBEE Radiation (TID)	Qualification	Qualification Temp	Qualification Humidity	Qualification Radiation (TID)	Power Supply
HCVS Control Valve (27AOV-142) Limit Switches	27PNS-142-1 27PNS-142-2	N/A	Reactor Building El. 344'	309°F	100%	8.1E6 Rad	IEEE 323-1974 IEEE 344-1975	> 309°F (Ref. EC 9000052721 Topic Notes Section 3.1.5.1)	100%	2.16E8 Rad	HCVS 24 VDC Batt & Batt Charger
HCVS Valve Actuators	27AOV-142 (OP)	N/A	Reactor Building El. 344'	309°F	100%	8.1E6 Rad	IEEE 323-1974 IEEE 344-1987	> 309°F (Ref. EC 9000052721 Topic Notes Section 3.1.6.2)	100%	7.8E7 Rad	N/A
Torus Level Indicator	23LI-202A	1.7'–27.5'	MCR*	N/A	N/A	N/A	IEEE 323-1974 IEEE 344-1975	RG 1.97	RG 1.97	RG 1.97	Backed by FLEX DG
Torus Level Transmitter	23LT-202A	1.7'–27.5'	RB El. 227'	N/A	N/A	N/A	IEEE 323-1974 IEEE 344-1975	RG 1.97	RG 1.97	RG 1.97	Backed by FLEX DG
Drywell Pressure Indicator	27PI-115A2	0-250 psig	MCR*	N/A	N/A	N/A	IEEE 323-1974 IEEE 344-1975	RG 1.97	RG 1.97	RG 1.97	Backed by FLEX DG
Drywell Pressure Transmitter	27PT-115A2	0-250 psig	RB El. 344'	N/A	N/A	N/A	IEEE 323-1974 IEEE 344-1975	RG 1.97	RG 1.97	RG 1.97	Backed by FLEX DG
SAWA Flow Meter	N/A	12-1,000 gpm	RHR Pump Room 'B' (Screenwell El. 260')	11-110°F	90%	< 1 R	N/A	10 - 130°F	N/A	1E3 TID	Internal Batteries

* Denotes Control Building where local radiation levels are not applicable. Building has no significant radiation sources.
**Denotes components with least margin to the expected temperature and humidity conditions

Table 2: Operator Actions Evaluation

Operator Action		Evaluation Time[8]	Validation Time	Location	Thermal conditions	Radiological Conditions	Evaluation
1	Open Reactor Building Doors (Ventilation)	≤ 5 hours (Goal ≤ 1 hour)	47 minutes	Reactor Building El. 272' (Track Bay) and 369'-6"	< 110°F	1.258E-01 rem/hr	Acceptable JAF-VP-011 from original FLEX validation
2	Close Valve 27MOV-121, if required (HCVS)	≤ 7 hours (Goal ≤ 1 hour)	15 minutes 30 seconds	Reactor Building El. 344'	< 110°F	1.258E-01 rem/hr	Acceptable JAF-VP-012 revised for HCVS modifications
3	Open Valves 10MOV-148B / -149B (SAWA)	≤ 7 hours (Goal ≤ 1 hour)	2 hours 26 minutes	Reactor Building El. 272'	< 110°F	7.04E+03 mrem/hr (42 minute stay time; validation timing shows task completed in less than 15 minutes)	Acceptable JAF-VP-018 revised for HCVS modifications
4	Close Valve 76FPS-807 Open Valves 76FPS-780 / 10RHR-460 (SAWA)	≤ 7 hours	2 hours 26 minutes	Screenwell El. 260'	< 110°F	Outside Reactor Building, shielded by intervening structures and concrete, low to no dose.	Acceptable JAF-VP-018 revised for HCVS modifications

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

Operator Action		Evaluation Time[8]	Validation Time	Location	Thermal conditions	Radiological Conditions	Evaluation
5	Electrical Load Shed	≤ 7 hours	30 minutes	(None in RB) West Elec Bay (272') South Emer SWG Room (272') Relay Room (284') Battery Room (272') Fan Room (300')	< 110°F	Outside Reactor Building and shielded by intervening structures and concrete, low to no dose.	Acceptable Combination of: 1) Most limiting AOP-49 load shed individual actions documented in JAF-VP-001 from original FLEX validation (16 min 21 seconds) 2) Most limiting FSG-002 deep load shed individual actions documented in JAF-VP-008 from original FLEX validation (12 minutes 23 seconds)
6	Stage and Start FLEX DG	≤ 7 hours	4 hours 5 minutes	North of Screenwell	Outdoors (Ambient)	4.86E+01 mrem/hr Outside Reactor Building, shielded by intervening structures and concrete 102 hour stay time after the start of venting.	Acceptable JAF-VP-015 from original FLEX validation (using N+1 equipment)
7	Stage SAWA pump / hoses / cart	≤ 7 hours	2 hours 26 minutes	Screenwell El. 260’	< 110°F	Outside Reactor Building, shielded by intervening structures and concrete, no radiological concern.	Acceptable JAF-VP-018 revised for HCVS modifications
8	Open Fire Pump Room Doors (as required) 76FDR-SP-255-5 76FDR-SP-255-6 76FDR-SP-255-7	≤ 7 hours	2 hours 26 minutes	Screenwell El. 260’	< 110°F	Outside Reactor Building, shielded by intervening structures and concrete, no radiological concern	Acceptable JAF-VP-018 revised for HCVS modifications

Operator Action		Evaluation Time[8]	Validation Time	Location	Thermal conditions	Radiological Conditions	Evaluation
9	Open Valve 27MOV-25B (SAWA)	≤ 4 hours (Goal ≤ 1 hour)	2 hours 26 minutes	Main Control Room (Switch using LPCI Batteries)	<120°F	MCR is removed from the vent pipes and RP actions will provide protection from any airborne activity	Acceptable MCR is a preferred location based on HCVS-FAQ-1. JAF-VP-018 revised for HCVS modifications
10	Open HCVS Vent Valves 27AOV-117 / -118 / -142	≤ 7 hours (approximate venting start)	15 minutes 30 seconds	Remote Operating Station (AB Corridor El. 272')	< 110°F	6.634E-01 rem/hr Protected by intervening structures 7 hour stay time	Acceptable JAF-VP-012 revised for HCVS modifications
11	Monitor Containment Pressure and Torus Level	≤ 7 hours (approximate venting start)	15 minutes 30 seconds	Main Control Room	<120°F	MCR is removed from the vent pipes and RP actions will provide protection from any airborne activity	Acceptable MCR is a preferred location based on HCVS-FAQ-1. JAF-VP-012 revised for HCVS modifications
12	Start SAWA Pump and inject at 361 gpm	≤ 8 hours to 12 hours	2 hours 26 minutes	Screenwell El. 260'	< 110°F	Shielded by intervening structures and concrete, no radiological concern.	Acceptable JAF-VP-018 revised for HCVS modifications
13	Reduce SAWA Pump injection to 73 gpm	≤ 12 hours to 168 hours	2 hours 26 minutes	Screenwell El. 260'	< 110°F	Shielded by intervening structures and concrete, no radiological concern.	Acceptable JAF-VP-018 revised for HCVS modifications
14	Open Fire Doors (as required in Summer) 76FDR-HB-272-2 76FDR-HB-272-3 76FDR-HB-272-4 76FDR-HB-272-5 76FDR-HD-272-6	≤ 10 hours	6 minutes	DC Equipment and Battery Charger Rooms (AB El. 272')	< 110°F	Protected by intervening structures	Acceptable JAF-VP-016 from original FLEX validation

Operator Action		Evaluation Time[8]	Validation Time	Location	Thermal conditions	Radiological Conditions	Evaluation
15	Refuel Diesel Driven Fire Pump	≤ 17 hours (1 hour refuel time required)	14.64 hours	West of Screenwell	Outdoors (Ambient)	< 1 mr/hr – At DDFP 7.80E+01 mr/hr – At Refuel Skid Shielded by intervening structures and concrete. 102 hour stay time at Refuel Skid after the start of venting.	Acceptable New JAF-VP-HCVS-001 validation
16	Refuel FLEX Diesel Generator	≤ 15.4 hours (0.8 hour refuel time required)	13.55 hours	West of Screenwell	Outdoors (Ambient)	4.86E+01– At DG 7.80E+01 mr/hr – At Refuel Skid Shielded by intervening structures and concrete. 102 hour stay time at DG and 64 hours at Refuel Skid after the start of venting.	Acceptable New JAF-VP-HCVS-001 validation
17	Repower HCVS Battery Charger	≤ 24 hours	12 hours 14 minutes	Administration Building DC Equipment Room ‘A’ (Extension Cord to Administration	< 110°F	Protected by intervening structures	Acceptable New JAF-VP-HCVS-002 validation
18	Replenish Nitrogen Bottles	≤ 24 hours	12 hours 20 minutes	Remote Operating Station (AB Corridor El. 272’)	< 110°F	6.634E-01 rem/hr Protected by intervening structures 7 hour stay time after the start of venting.	Acceptable New JAF-VP-HCVS-003 validation