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April 25, 2019

L-MT-19-020
10 CFR 2.202
EA-13-109

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

Monticello Nuclear Generating Plant
Docket No. 50-263
Renewed Facility Operating License No. DPR-22

Monticello Nuclear Generating Plant: 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), Phases 1 and 2 (CAC No. MF4376)

References:
1) NRC Order Number EA-13-109, "Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions," dated June 6, 2013. (ADAMS Accession No. ML13143A334)
2) NRC Interim Staff Guidance JLD-ISG-2013-02, "Compliance with Order EA-13-109, Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation under Severe Accident Conditions," Revision 0, dated November 14, 2013. (ADAMS Accession No. ML13304B836)
3) Letter from D. Skeen (NRC) to J. Pollock (NEI), Endorsement of Hardened Containment Venting System (HCVS) Phase 1 Overall Integrated Plan Template (EA-13-109) Rev 0, dated May 14, 2014. (ADAMS Accession No. ML14128A219)
4) NEI 13-02, "Industry Guidance for Compliance with Order EA-13-109," Revision 0, dated November 2013. (ADAMS Accession No. ML13316A853)

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5) Letter from K. Fili (NSPM) to Document Control Desk (NRC), "MNGP's Phase 1 Overall Integrated Plan in Response to June 6, 2013 Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109)," L-MT-14-052, dated June 30, 2014. (ADAMS Accession No. ML14183A412).
6) Letter from K. Fili (NSPM) to Document Control Desk (NRC), "Monticello Nuclear Generating Plant: First Six-Month Status Report in Response to June 6, 2013 Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109)," L-MT-14-092, dated December 16, 2014. (ADAMS Accession No. ML14353A215)
7) Letter from P. Gardner (NSPM) to Document Control Desk (NRC), "Monticello Nuclear Generating Plant: Second Six-Month Status Report in Response to June 6, 2013 Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109), Phase 1," L-MT-15-031, dated June 22, 2015. (ADAMS Accession No. ML15173A176)
8) NEI 13-02, "Industry Guidance for Compliance with Order EA-13-109," Revision 1, dated April 2015. (ADAMS Accession No. ML15113B318)
9) NRC Interim Staff Guidance JLD-ISG-2015-01, "Compliance with Phase 2 of Order EA-13-109, Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation under Severe Accident Conditions," Revision 0, dated April 2015. (ADAMS Accession No. ML15104A118)
10) Letter from P. Gardner (NSPM) to Document Control Desk (NRC), "Monticello Nuclear Generating Plant's 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) including Phase 1 Status Report," L-MT-15-090, dated December 17, 2015. (ADAMS Accession No. ML15356A120)

11) Letter from P. Gardner (NSPM) to Document Control Desk (NRC), "Monticello Nuclear Generating Plant: Fourth Six-Month Status Report in Response to June 6, 2013 Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109), Phases 1 and 2," L-MT-16-034, dated June 17, 2016. (ADAMS Accession No. ML16169A309)
12) Letter from M. Halter (NRC) to P. Gardner (NSPM), "Subject: Monticello Nuclear Generating Plant – Interim Staff Evaluation Relating to Overall Integrated Plan in Response to Phase One of Order EA-13-109 (Severe Accident Capable Hardened Vents) (TAC No. MF4376),"dated April 2, 2015. (ADAMS Accession No. ML15082A167)
13) Letter from J. Quichocho (NRC) to P. Gardner (NSPM), "Subject: Monticello Nuclear Generating Plant – Interim Staff Evaluation Relating to Overall Integrated Plan in Response to Phase 2 of Order EA-13-109 (Severe Accident Capable Hardened Vents) (CAC No. MF4376),"dated September 6, 2016. (ADAMS Accession No. ML16244A120)
14) Letter from P. Gardner (NSPM) to Document Control Desk (NRC), "Monticello Nuclear Generating Plant: Fifth Six-Month Status Report in Response to June 6, 2013 Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109), Phases 1 and 2," L-MT-16-072, dated December 19, 2016. (ADAMS Accession No. ML16354A666)
15) Letter from P. Gardner (NSPM) to Document Control Desk (NRC), "Monticello Nuclear Generating Plant: Sixth Six-Month Status Report in Response to June 6, 2013 Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109), Phases 1 and 2," L-MT-17-042, dated June 14, 2017. (ADAMS Accession No. ML17166A051)
16) Letter from C. Church (NSPM) to Document Control Desk (NRC), "Monticello Nuclear Generating Plant: Seventh Six-Month Status Report in Response to June 6, 2013 Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109), Phases 1 and 2," L-MT-17-081, dated December 21, 2017. (ADAMS Accession No. ML17355A508)
17) Letter from R. Auluck (NRC) to C. Church (NSPM), "Subject: Monticello Nuclear Generating Plant – Report for the Audit of Licensee Responses to Interim Staff Evaluations Open Items Related to NRC Order EA-13-109 to Modify Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe

Accident Conditions (CAC NO. MF3476; EPID L-2014-JLD-0052)," dated April 10, 2018. (ADAMS Accession No. ML18094A804)

18) Letter from R. Auluck (NRC) to C. Church (NSPM), "Subject: Monticello Nuclear Generating Plant – Correction to the Audit Report for the Audit of Licensee Responses to Interim Staff Evaluations Open Items Related to NRC Order EA-13-109 to Modify Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (CAC NO. MF3476; EPID L-2014-JLD-0052)," dated May 14, 2018. (ADAMS Accession No. ML18130A921)

19) Letter from C. Church (NSPM) to Document Control Desk (NRC), "Monticello Nuclear Generating Plant: Eighth Six-Month Status Report in Response to June 6, 2013 Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109), Phases 1 and 2," L-MT-18-035, dated June 26, 2018. (ADAMS Accession No. ML18177A422)

20) Letter from C. Church (NSPM) to Document Control Desk (NRC), "Monticello Nuclear Generating Plant: Ninth Six-Month Status Report in Response to June 6, 2013 Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109), Phases 1 and 2," L-MT-18-079, dated December 17, 2018. (ADAMS Accession No. ML18352A254)

On June 6, 2013, the Nuclear Regulatory Commission (NRC) issued Order EA-13-109 (Reference 1) to Northern States Power Company, a Minnesota corporation (NSPM), doing business as Xcel Energy. Reference 1 was effective immediately and directs NSPM to install a reliable hardened venting capability for pre-core damage and under severe accident conditions, including those involving a breach of the reactor vessel by molten core debris, for Monticello Nuclear Generating Plant (MNGP). Specific requirements are outlined in Attachment 2 of Reference 1.

Reference 1 required submission of a Phase 1 Overall Integrated Plan (OIP) pursuant to Section IV, Condition D. References 2 and 3 endorse industry guidance document, NEI 13-02, Revision 0 (Reference 4) with clarifications and exceptions. Reference 5 provided the MNGP Phase 1 OIP.

Reference 1 requires submission of a status report at six-month intervals following submittal of the Phase 1 OIP. References 2 and 4 provide direction regarding the content of the status reports. References 6 and 7 provided the first and second six-month status reports for Phase 1 of the order.

In Reference 9, the NRC endorsed industry guidance document NEI 13-02, Revision 1 (Reference 8) with clarifications and exceptions identified in Reference 9. NEI 13-02, Revision 1 provides guidance for implementing Phase 2 of Order EA-13-109. Reference 10 provided a combined Phase 1 and 2 OIP and provided an updated status of Phase 1 of the order. Reference 11 provided the fourth status report which included both Phase 1 and Phase 2 status updates. In References 12 and 13, the NRC provided interim staff evaluations (ISEs) for HCVS Order Phase 1 and 2 OIPs, respectively. In References 14, 15, 16, 19, and 20 NSPM provided the fifth, sixth, seventh, eighth, and ninth HCVS Order status reports.

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 Monticello Nuclear Generating Plant (MNGP).

MNGP 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. MNGP has implemented a reliable containment venting strategy that makes it unlikely that the plant would need to vent from the containment drywell before alternative reliable containment heat removal and pressure control is reestablished in response to Phase 2 of NRC Order EA-13-109. The information provided herein documents full compliance for MNGP with NRC Order EA-13-109.

MNGP Phases 1 and 2 OIP Open Items and ISE Open Items have been addressed and reviewed by the NRC as documented in Reference 18 and as provided below, and are considered complete.

OIP Phase 1 Open Items	Status
1. Follow industry guidance on missile protection for HCVS.	Closed - see ISE Phase 1 Open Item 5
2. Identify the 24 hour power supply for the HCVS.	Closed – see ISE Phase 1 Open Item 1
3. Determine radiological conditions for the FLEX portable equipment staging areas.	Closed – see ISE Phase 1 Open Item 3

4. Evaluate the Alternate Shutdown System (ASDS) panel and Backup HCVS Operation Station locations for accessibility, habitability, staffing sufficiency, associated pathways from the control room and communication capability with vent-use decision makers.	Closed – see ISE Phase 1 Open Items 3 and 7
5. Determine approach or combination of approaches to control hydrogen.	Closed – see ISE Phase 1 Open Items 8 and 9
6. Determine the Qualification Method for HCVS instrumentation.	Closed – see ISE Phase 1 Open Item 10
7. Evaluate the effects of radiological and temperature constraints on the deployment of nitrogen bottles after 24 hours.	Closed – see ISE Phase 1 Open Item 3
8. Evaluate HCVS battery charger location for accessibility, habitability, staffing sufficiency, associated pathways from control room and communication capability with vent-use decision makers.	Closed – see ISE Phase 1 Open Items 3 and 7
OIP Phase 2 Open Items	**Status**
1. Determine approach to repower Low Pressure Coolant Injection (LPCI) swing bus from FLEX PDG.	Complete See Reference 16

ISE Phase 1 Open Items	Status
1. Make available for NRC staff audit the final sizing evaluation for HCVS batteries/battery charger including incorporation into FLEX Diesel Generator (DG) loading calculation.	Closed See Reference 18
2. Make available for NRC staff audit documentation of the HCVS nitrogen pneumatic system design including sizing and location.	Closed See Reference 18
3. Make available for NRC staff audit an evaluation of temperature and radiological conditions to ensure that operating personnel can safely access and operate controls and support equipment.	Closed See Reference 18

ISE Phase 1 Open Items	Status
4. Make available for NRC staff audit analyses demonstrating that HCVS has the capacity to vent the steam/energy equivalent of one percent of licensed/rated thermal power (unless a lower value is justified), and that the suppression pool and the HCVS together are able to absorb and reject decay heat, such that following a reactor shutdown from full power containment pressure is restored and then maintained below the primary containment design pressure and the primary containment pressure limit.	Closed See Reference 18
5. Make available for NRC staff audit the seismic and tornado missile final design criteria for the HCVS stack.	Closed See Reference 18 and Additional Information in Enclosure 2 of Reference 20
6. Make available for NRC staff audit the descriptions of local conditions (temperature, radiation and humidity) anticipated during Extended Loss of AC Power (ELAP) and severe accident for the components (valves, instrumentation, sensors, transmitters, indicators, electronics, control devices, etc.) required for HCVS venting including confirmation that the components are capable of performing their functions during ELAP and severe accident conditions.	Closed See Reference 18
7. Make available for NRC staff audit documentation that demonstrates adequate communication between the remote HCVS operation locations and HCVS decision makers during ELAP and severe accident conditions.	Closed See Reference 18
8. Provide a description of the final design of the HCVS to address hydrogen detonation and deflagration.	Closed See Reference 18
9. 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 See Reference 18
10. Make available for NRC staff audit descriptions of all instrumentation and controls (existing and planned) necessary to implement this order including qualification methods.	Closed See Reference 18

ISE Phase 1 Open Items	Status
11. Make available for NRC staff audit documentation of an evaluation verifying the existing containment isolation valves, relied upon for the HCVS, will open under the maximum expected differential pressure during Beyond Design Basis External Event (BDBEE) and severe accident wetwell venting.	Closed See Reference 18

ISE Phase 2 Open Items	Status
1. Licensee to provide the plant specific justification for SAWA [Severe Accident Water Addition] flow capacity less than specified in the guidance in NEI 13-02, Section 4.1.1.2.	Closed See Reference 18
2. 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 See Reference 18
3. 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 See Reference 18
4. Licensee to demonstrate that containment failure as a result of overpressure can be prevented without a drywell vent during severe accident conditions.	Closed See Reference 18
5. Licensee to demonstrate how the plant is bounded by the reference plant analysis that shows the SAWM [Severe Accident Water Management] strategy is successful in making it unlikely that a drywell vent is needed.	Closed See Reference 18
6. Licensee to demonstrate that there is adequate communication between the MCR [Main Control Room] and the Intake Structure operator at the FLEX manual valve during severe accident conditions.	Closed See Reference 18
7. Licensee to demonstrate the SAWM flow instrumentation qualification for the expected environmental conditions.	Closed See Reference 18

Milestone Schedule – Items Complete

Milestone	Completion Date
Phase 1 and 2 HCVS Milestone Table	
Submit Phase 1 OIP	June 2014
Submit 6 Month Updates:	
Update 1	December 2014
Update 2	June 2015
Update 3 (with Phase 2 OIP)	December 2015
Update 4	June 2016
Update 5	December 2016
Update 6	June 2017
Update 7	December 2017
Update 8	June 2018
Update 9	December 2018
Phase 1 Specific Milestones	
Phase 1 Modifications:	
Hold preliminary/conceptual design meeting	June 2014
Design Engineering On-site/Complete	November 2016
Implementation Outage	May 2017
Walk Through Demonstration/Functional Test	May 2017
Phase 1 Procedure Changes Active:	
Operations Procedure Changes Developed	May 2017
Site Specific Maintenance Procedure Developed	May 2017

Milestone	Completion Date
Procedure Changes Active	May 2017
Phase 1 Training:	
Training Complete	May 2017
Phase 1 Completion:	
HCVS Implementation	May 2017
Phase 2 Specific Milestones	
Phase 2 Modifications:	
Hold preliminary/conceptual design meeting	October 2015
Design Engineering On-site/Complete	June 2018
Implementation Outage	Not Needed
Walk Through Demonstration/Functional Test	December 2018
Phase 2 Procedure Changes Active:	
Operations Procedure Changes Developed	December 2018
Site Specific Maintenance Procedure Developed	March 2019
Procedure Changes Active	February 2019
Phase 2 Training:	
Training Complete	May 2018
Phase 2 Completion:	
HCVS Implementation	April 2019
Submit Completion Report	April 2019, completed with this submittal

Order EA-13-109 Compliance Elements Summary

The elements identified below for MNGP as well as the Phase 1 (Updated) and Phase 2 OIP response submittal (Reference 10), and the 6-Month Status Reports (References 6, 7, 11, 14, 15, 16, 19, and 20), demonstrate compliance with NRC Order EA-13-109. The MNGP 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 MNGP 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 MNGP 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 MNGP 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 MNGP Phase 1 and Phase 2 HCVS strategies are in compliance with Order EA-13-109. The modifications required to support the HCVS strategies for MNGP 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 MNGP comply 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 MNGP 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 MNGP 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 MNGP 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.

MNGP 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 10).

MNGP 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.

Please contact Stephen Sollom, Senior Regulatory Affairs Engineer, at 612-342-8982, if additional information or clarification is required.

Summary of Commitments

This letter makes no new commitments and no revisions to existing commitments.

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

Executed on April 25, 2019.

Christopher R. Church
Site Vice President, Monticello Nuclear Generating Plant
Northern States Power Company - Minnesota

Enclosure (1)

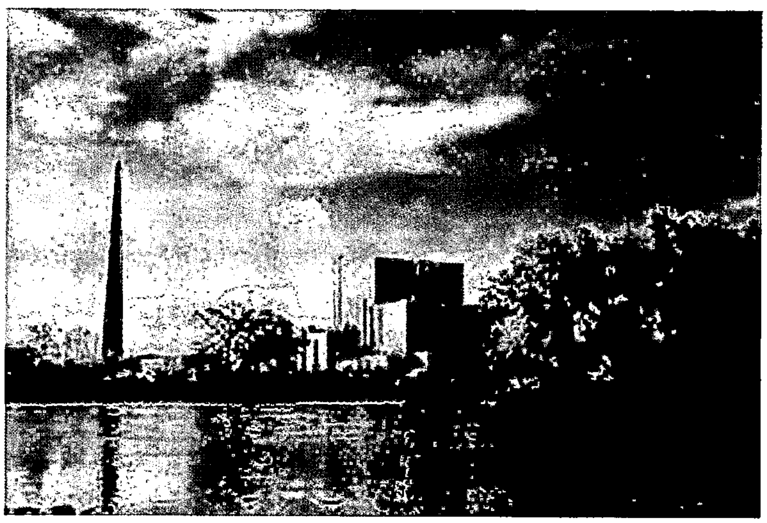
cc: Administrator, Region III, USNRC
Project Manager, Monticello Nuclear Generating Plant, USNRC
Resident Inspector, Monticello Nuclear Generating Plant, USNRC

Final Integrated Plan

HCVS Order EA-13-109

for

Monticello Nuclear Generating Plant



April, 2019

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) – hereinafter referred to as "the Order". The Order requires that licensees of BWR facilities with Mark I and Mark II containment designs ensure that these facilities have a reliable hardened vent to remove decay heat from the containment, and to maintain control of containment pressure within acceptable limits following events that result in the loss of active containment heat removal capability while maintaining the capability to operate under severe accident (SA) conditions resulting from an Extended Loss of AC Power (ELAP).

The Monticello Nuclear Generating Plant (MNGP) is required by NRC Order EA-13-109 to have a reliable, severe accident capable hardened containment venting system (HCVS). The Order 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. MNGP achieved Phase 1 compliance on May 11, 2017.

- Phase 2 provided additional protections for severe accident conditions through the development of a reliable containment venting strategy that makes it unlikely that MNGP would need to vent from the containment drywell during severe accident conditions. MNGP achieved Phase 2 compliance on April 24, 2019.

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 the Order 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 the Order.

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

The NRC performed a review of each OIP submittal and provided MNGP 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 the Order. These status reports were used to close 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 had been addressed.

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

Section III contains the MNGP 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 Phase 1 of the Order, severe accident capable venting scenario, can be summarized by the following:

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

- The vent utilizes containment parameters of pressure and level from the Alternate Shutdown System panel 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 replacing nitrogen bottles 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 MNGP are seismic, external flooding, high winds, extreme high temperature, and extreme cold. Initial operator actions are completed by plant personnel and include the capability for remote-manual initiation from the HCVS control station. Attachment 2 contains a one-line diagram of the HCVS vent flow path.

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

The Phase 2 actions can be summarized as follows:

- Utilization of Severe Accident Water Addition (SAWA) to initially inject water into the Reactor Pressure Vessel (RPV).

- Utilization of Severe Accident Water Management (SAWM) to control injection and Suppression Pool level to ensure the HCVS Phase 1 wetwell vent will remain functional for the removal of heat from the containment.

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

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

- Parameters measured are Drywell pressure, Suppression Pool level, SAWA flowrate and the HCVS Phase 1 vent path parameters as described in section I.A.1.

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

The SAWA flow path is the same as the FLEX primary injection flow. The flow path is from the discharge canal through the FLEX pump. The SAWA flow passes through the FLEX pump discharge hose, to the Turbine Building where it is connected via a flow indicator to the Residual Heat Removal Service Water (RHRSW) system. The flow path then proceeds through a crosstie to the Residual Heat Removal (RHR) system and into the reactor via the Low Pressure Coolant Injection (LPCI) injection line. Cross flow into other portions of the RHR system is prevented by check valves or normally closed valves. Drywell pressure and Suppression Pool level are monitored and flow rate is adjusted by use of the manual valve at the RHRSW connection point. Communication is maintained between the ASDS Panel, the MCR, and the FLEX pump location. Attachment 4 contains a one-line diagram of the SAWA flow path.

The SAWA electrical loads are included in the FLEX DG loading calculation for EA-12-049 compliance. The FLEX DGs are located east or south of the Plant Administration Building and are a significant distance and on the opposite side of the RB from the discharge of the HCVS on the west side of the RB. See Attachment 6 for applicable locations. Refueling of the FLEX DG is accomplished from the EDG fuel oil day tanks as described in the EA-12-049 FIP.

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

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

Section II: List of Acronyms

AC	Alternating Current
AOV	Air-Operated Valve
ASDS	Alternate Shutdown System
BDBEE	Beyond Design Basis External Event
BWROG	Boiling Water Reactor Owners Group
CAP	Containment Accident Pressure
CST	Condensate Storage Tank
DC	Direct Current
ECCS	Emergency Core Cooling System
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 – one of two FLEX storage locations at MNGP. The other is Warehouse 6.
GPM	Gallons per minute
HCVS	Hardened Containment Vent System
ISE	Interim Staff Evaluation

ISG	Interim Staff Guidance
JLD	Japan Lessons Learned Project Directorate
MAAP	Modular Accident Analysis Program
MCR	Main Control Room
MNGP	Monticello Nuclear Generating Plant
N_2	Nitrogen
NEI	Nuclear Energy Institute
NPSH	Net Positive Suction Head
NRC	Nuclear Regulatory Commission
OIP	Overall Integrated Plan
PCPL	Primary Containment Pressure Limit
RCIC	Reactor Core Isolation Cooling System
RHR	Residual Heat Removal
RHRSW	Residual Heat Removal Service Water
RM	Radiation Monitor
ROS	Remote Operating Station
RPV	Reactor Pressure Vessel
RWCU	Reactor Water Cleanup
SA	Severe Accident
SAMG	Severe Accident Management Guidelines
SAWA	Severe Accident Water Addition
SAWM	Severe Accident Water Management
SBGT	Standby Gas Treatment

SFP	Spent Fuel Pool
SRV	Safety-Relief Valve
UFSAR	Updated Final Safety Analysis Report
VAC	Voltage AC
VDC	Voltage DC
WH6	Warehouse 6 – one of two FLEX storage locations at MNGP
WW	Wetwell

Section III: Phase 1 Final Integrated Plan Details

Section III.A: HCVS Phase 1 Compliance Overview

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

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

MNGP installed a hardened wetwell vent in response to NRC Generic Letter 89-16, under modification 92Q925. The hardened wetwell vent system allows venting of the wetwell via piping connected to penetration X-240. Two air-operated containment isolation valves (AO-4539 and AO-4540) and a rupture disk prevent inadvertent venting of the containment atmosphere. The vent line exits the building via the roof of the High Pressure Coolant Injection pump room and, supported from the Reactor Building wall, runs along the exterior of the building to a release point slightly above the roof. The vent line was equipped with a rupture disk (PSD-4543) with a burst pressure of 44-50 psig, downstream of the isolation valve AO-4540 to preclude inadvertent opening of the vent line in the event of a design basis event and a T-cap at its end to avoid entry of debris and precipitation. The burst pressure for the rupture disk was selected as being above the maximum Loss of Coolant Accident wetwell pressure of 32.7 psig, yet below the containment design pressure of 56 psig. The existing wetwell vent system and components are designed for 62 psig at 309°F, corresponding to saturated steam conditions at the Primary Containment Pressure Limit (PCPL) of 62 psig. The vent line is equipped with a radiation monitor adjacent to the line for alerting the operators of a release through the vent line.

Wetwell vent valves AO-4539 and AO-4540 are equipped with keylock switches at the ASDS control panel. Another keylock switch controls solenoid valves SV-4541 and SV-4542 which can be used to pressurize the piping between AO-4540 and the rupture disk to blow open the rupture disk to allow venting when the containment pressure is below the rupture disk setpoint. Motive force for all valves was provided by the Train B Alternate Nitrogen system and control power was provided by Division

2 250 volt batteries.

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

MNGP made several changes to the existing GL-89-16 wetwell vent system to achieve compliance with the Order.

- The vent piping exterior to the reactor building was rerouted to provide a wind-resistant, seismically robust support.
- The T-cap was replaced with a weather cap that performs the same function.
- A check valve was installed near the top of the vent to prevent air entering the line and possibly reacting with residual hydrogen in the line following venting.
- A dedicated nitrogen system has been installed in the Turbine Building to provide pneumatic pressure to blow the rupture disk and operate the valves.
- A new radiation and temperature monitoring system replaced the old radiation monitor.
- A dedicated battery system was installed to provide control power to the HCVS.
- A ROS has been installed in a readily accessible location of the Turbine Building to provide a means to manually operate the wetwell vent independent of AC or DC power.

The controls available at the ROS are accessible and functional under a range of plant conditions, including severe accident conditions. The ROS location is in the TB 931' elevation. Table 2 contains the evaluation of the acceptability of the ROS location with respect to severe accident conditions.

The ROS opens the valves directly with compressed nitrogen so that no electrical controls are needed.

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

At the ASDS location, the operators can operate the HCVS isolation valves, monitor HCVS vent valve position, drywell pressure, torus level, HCVS RM, vent pipe temperature, HCVS battery voltage. The ROS consists of manual valves that directly port nitrogen to the actuators of the HCVS isolation valves. There is no instrumentation provided at the ROS. Table 1 contains a complete list of instruments available to the operators for operating and monitoring the HCVS.

A radiation monitor and a radiation recorder installed in panel C-289B adjacent to the

ASDS panel provides a display of the radiation levels at the vent pipe. The radiation monitor provides an indication of radiation in the pipe to provide additional knowledge of the vent pipe operation. The radiation element is housed in lead shielding to prevent other radiation from impacting the radiation reading of the vent pipe. The element is mounted outdoors and is qualified for operation in the extreme temperatures possible at the site.

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

The wetwell vent up to, and including, the second containment isolation barrier is designed consistent with the design basis of the plant. These items include piping, piping supports, containment isolation valves, containment isolation valve actuators and containment isolation valve position indication components. The hardened vent piping, between the wetwell and the Reactor Building roof is designed to 62 psig at 309°F.

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. Since 309°F corresponds to the saturation temperature for the MNGP PCPL of 62 psig, it will be retained as the pipe design temperature. Per NEI 13-02, it is acceptable to assume saturation conditions in containment (2.4.3.1) so that these design parameters are acceptable.

The design of the HCVS with a dedicated pipe from the containment to the release point prevents leakage of vented effluent to other parts of the Reactor Building or other systems. A check valve protects the small tubing that provides nitrogen to blow the rupture disk, which is the only piping that interfaces with the HCVS.

HCVS features to prevent inadvertent actuation include keylock switches at the primary control station. Motive force is applied only when the isolation valves on nitrogen bottles in the Turbine Building are manually opened. Since these valves are in a different location from both the POS and the ROS, inadvertent operation would require two separate actions in two different locations.

As required by the Order, Section 1.2.11, the wetwell vent is designed to prevent air/oxygen backflow into the discharge piping to ensure the flammability limits of hydrogen, and other non-condensable gases, are not reached. The MNGP design includes a check valve near the end of the vent pipe. Guidance for this design is contained in Reference 10. The relevant design specification ensured that the check valve will preclude a flammable mixture from occurring in the vent pipe.

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 reliable and rugged and include the ability to handle harsh environmental conditions (although they are not considered part of the site Environmental Qualification (EQ) program).

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

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

1. HCVS Functional Requirements

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

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

<u>Evaluation:</u>

The operation of the HCVS was designed to minimize the reliance on operator actions in response to hazards identified in NEI 12-06, *Diverse and Flexible Coping Strategies (FLEX) Implementation Guide* (Reference 31), which are applicable to the plant site. Operator actions to initiate the HCVS vent path can be completed by plant personnel and include the capability for remote-manual initiation from the HCVS control station. A list of the remote manual actions performed by plant personnel to open the HCVS vent path is in the following table

Table 3-1: HCVS Operator Actions

Primary Action	Primary Location/ Component	Notes
1. OPEN manual isolation valve to connect HCVS to dedicated HCVS nitrogen supply	HCVS Nitrogen Rack, Turbine Building 931' East / HPV-125.	An independent, dedicated nitrogen supply was installed to meet Phase 1 of EA-13-109.
2. OPEN manual isolation valve to connect rupture disk to dedicated rupture disk nitrogen supply	HCVS Nitrogen Rack, Turbine Building 931' East / HPV-400.	An independent, dedicated nitrogen supply for the rupture disk was installed to meet Phase 1 of EA-13-109.
3. Breach the rupture disk by opening solenoid valve	ASDS Panel / Key-locked switch HS-4541.	If required - Rupture disk will burst between 44 – 50 psig. Alternate method by using manual valve at the ROS.
4. Open air operated suppression pool Primary Containment Isolation Valves (PCIVs) AO-4539 and AO-4540	ASDS panel / Key-locked switches HS-4539 and HS-4540.	Alternate method by using manual valves at the ROS.

Primary Action	Primary Location/ Component	Notes
5. Transfer HCVS power to uninterruptable power supply (UPS) Y80, powered from EA-12-049 FLEX portable diesel generator (PDG)	Transfer switch D85 located near the ASDS panel.	Transfer occurs prior to depletion of dedicated HCVS battery, minimally 24 hours.
6. Replenish pneumatics with replaceable N2 bottles	HCVS Nitrogen Rack, Turbine Building 931' East / HPV-125. Spares stored at FLEX storage locations.	Prior to depletion of the pneumatic sources, nitrogen bottles will be replaced, sustaining operation past 24 hours.

Permanently installed electrical power and pneumatic supplies are available to support operation and monitoring of the HCVS for a minimum of 24 hours.

After 24 hours, available personnel will be able to exchange depleted nitrogen bottles for full ones, and transfer the HCVS control power to a DC panel (D100) backed up by a FLEX Generator. This provides electric controls and motive power for sustained operation of the HCVS for a minimum of 7 days. A supply of full nitrogen bottles is stored in each of the FSBs.

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

Table 3-2: Failure Evaluation

Functional Failure Mode	Failure Cause	Alternate Action	Failure with Alternate Action Impact on Containment Venting?
Failure of Vent to Open on Demand	Valves fail to open/close due to loss of normal power	No action needed. A 24-hour battery has been provided.	No
Failure of Vent to Open on Demand	Valves fail to open/close due to loss of alternate power (long term)	No action needed. A 24-hour battery has been provided.	No

Functional Failure Mode	Failure Cause	Alternate Action	Failure with Alternate Action Impact on Containment Venting?
Failure of Vent to Open on Demand	Valves fail to open/close due to complete loss off batteries (long term)	Manual valves at the Remote Operating Station will be used to open the HCVS.	No
Failure of Vent to Open on Demand	Valves fail to open/close due to loss of normal pneumatic air supply	Replace nitrogen bottles with spares from the FSBs.	No
Failure of Vent to Open on Demand	Valves fail to open/close due to SOV issue	Manual valves at the Remote Operating Station will be used to open the HCVS.	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 POS at the ASDS Panel on the third floor of the EFT Building. Alternate control of the HCVS is accomplished from the ROS at the 931' elevation (ground floor) of the Turbine Building. The POS location will remain habitable under ELAP conditions based on an evaluation of the environmental conditions.

Actions that will maintain the POS and ROS habitable include:

1. Providing fans or heaters as needed to maintain the EFT habitable for equipment and personnel. This equipment was included as a load in the 120V FLEX generator sizing calculations and is acceptable per Engineering Evaluation 28584.

2. Opening EFT doors to the outside (if required).

Table 2 contains a thermal evaluation of all the operator actions that may be required to support HCVS operation. The relevant GOTHIC analysis calculation (Reference 30) demonstrates that the final design meets the order requirements to minimize the plant operators' exposure to occupational hazards.

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

Evaluation:

Primary control of the HCVS is accomplished from the POS at the ASDS Panel in the EFT Building. Under the postulated scenarios of the Order the POS is adequately protected from excessive radiation dose as demonstrated by dose calculations in Reference 31.

Alternate control of the HCVS is accomplished from the ROS in the Turbine Building 931' East area. The ROS was evaluated for radiation effects due to a severe accident with containment venting and determined to be acceptable.

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

The HCVS vent is routed away from the MCR, the POS, and the ROS such that building structures provide shielding. If venting operations create the potential for airborne contamination, the ERO will initiate protective actions to minimize any operator exposure.

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

Evaluation:

Primary control of the HCVS is accomplished from the POS at the ASDS Panel in the EFT Building. Under the postulated scenarios of the Order the POS is adequately protected from excessive radiation dose as demonstrated by dose calculations in Reference 31.

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

For ELAP with injection, the HCVS wetwell vent will be opened to protect the containment from overpressure. The operator actions and timing of those actions to perform this function under ELAP conditions were evaluated as part of Monticello's response to NRC Order EA-12- 049 as stated in Reference 34.

Table 2 contains a thermal and radiological evaluation of all the operator actions at the POS or alternate locations that may be required to support HCVS operation during a severe accident. The relevant GOTHIC analysis calculation (Reference 30) demonstrates that the final design meets the order requirements to minimize the plant operators' exposure to occupational and radiological hazards.

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

1.2 The HCVS shall include the following design features:

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

Evaluation:

Calculation 16-019 contains the verification of 1% power flow capacity at design pressure (56 psig in the Drywell). This calculation models all the piping elbows, valves and other components using a nodalized series of piping components. Since the piping consists of 8" and 10" sections, both are modeled. The model is input to RELAP5 which is used to simulate transient two-phase flow conditions in piping systems. The code also looks for flow choking effects. The minimum flow at design pressure to pass 1% RTP is 75,718 lbm/hr. Calculation 16-019 verifies that the piping can pass greater than 1% flow. Additional assumptions and modeling details are described in the calculation.

The decay heat absorbing capacity of the suppression pool and the selection of venting pressure were made such that the HCVS will have sufficient capacity to maintain containment pressure at or below the lower of the containment design pressure (56 psig) or the PCPL (62 psig). This calculation of containment response is contained in Calculation 16-019 that was provided to the NRC along with Reference 25, and which shows that containment is maintained below the design pressure once the vent is opened, even if it is not opened until PCPL.

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

Evaluation

The wetwell vent exits the Primary Containment through penetration X-240 at the top of the torus airspace via containment isolation valves AO-4539 and AO-4540 and rupture disk PSD-4543. Downstream of the isolation valves, the vent piping exits the Reactor Building through the HPCI Room roof. The vent traverses up the exterior of the building, rises along the west side where it discharges above the Reactor Building roof. The discharge point is approximately five feet above the Reactor Building parapet wall such that the release point will vent away from emergency ventilation system intake and exhaust openings, main control room location, location of HCVS portable equipment, access routes required following an ELAP and BDBEE, and emergency response. This satisfies the guidance for height from HCVS-FAQ-04.

HCVS-WP-04 provides criteria that demonstrate robustness of the HCVS pipe. MNGP 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.

MNGP 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 portion of exposed piping has been protected to an elevation of 30 feet above grade by the erection of a tornado missile barrier.

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

   a. The total vent pipe exposed area is approximately 143 square feet which is less than 300 square feet.

   b. The exposed portion of the pipe is made of welded steel, designed to ASME B31.1, and contains no small tubing susceptible to missiles.

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

3. The Hardened Containment Vent System at MNGP is designed to withstand the external events applicable to the site. Therefore, there is no need to provide for repairing or bypassing a damaged section of the vent piping.

4. MNGP was screened out for hurricanes due to its location near the center of the North American continent.

Based on the above description of the vent pipe design, the MNGP

HCVS vent pipe design meets the order requirement to be robust with respect to all external hazards including wind-borne missiles.

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

Evaluation

A check valve at the rupture disc pneumatic supply connection to the HCVS piping prevents backflow to the remote operating station. In addition, the rupture disc pneumatic supply line is normally isolated with manual and solenoid valves when not in use. With exception to the rupture disc supply, the HCVS piping is designed to have no interfaces with other plant systems, and all valves that open external to the system are designed to the system operating conditions. MNGP is a single unit site, so cross flow between units is not a concern.

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

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

Evaluation

The existing wetwell vent will allow initiating and then operating and monitoring from the ASDS panel on the third floor of the EFT Building. Environmental and radiation dose analyses show that this area is readily accessed during an ELAP or Severe Accident and remains accessible during the sustained operating period.

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

Evaluation

To meet the requirement for an alternate means of operation, a readily accessible alternate location, called the ROS was added. The ROS contains manually operated valves that supply pneumatics to the HCVS flow path valve actuators and rupture disk so that the HCVS may be opened without power to the valve actuator solenoids and regardless of any containment isolation signals that may be actuated. This provides a diverse method of valve operation improving system reliability.

The location for the ROS is on a concrete wall just south of the B Alternate Nitrogen bottle station, accessed through DOOR-26 (931' Turbine Building East). The ROS is shielded from the HCVS vent pipe by intervening structures, including the path to the MCR. 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 ventilation. Table 1 contains an evaluation of the 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 the operator actions that may be required to support HCVS operation during a loss of AC power and severe accident and demonstrates that these actions will be possible without undue hazard to the operators. Attachment 6 contains a site layout showing the location of these HCVS actions.

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

<u>Evaluation</u>

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

The dedicated HCVS battery has sufficient capacity to carry all HCVS electrical loads for at least 24 hours, thus there will be no need to use other power sources for HCVS wetwell venting components during the first 24 hours. These batteries are permanently installed in the EFT Building 3rd floor near the POS where they are protected from screened in hazards, and have sufficient capacity to provide this power without recharging. At 24 hours, operators transfer the power feed to a circuit supported by battery D6, which would be energized by its battery chargers powered by a FLEX Portable Diesel Generator. Specification MPS-2173 included the D6 battery chargers D70 and D80 in the FLEX PDG loading calculation, so there is no additional load on the FLEX PDG and they are capable of carrying HCVS wetwell venting components electrical. D6 battery voltage status is indicated on panel D82 at the transfer switch, so that operators will be able to monitor the status of the D6 battery. Attachment 3 contains a diagram of the HCVS electrical distribution system.

Pneumatic power for the HCVS valve actuators is normally provided by the dedicated nitrogen system installed for the HCVS. The nitrogen bottles contain enough nitrogen to operate the system for the first 24 hours following an ELAP. Nitrogen pressure is indicated locally, near the bottles on 931' East turbine Building.

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

Evaluation

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

The containment isolation valves must be open to permit vent flow. The physical features that prevent inadvertent actuation are the key lock switches for the vent valves at the primary control station and the design that requires multiple actions in at least two different locations to actuate the vent. These design features meet the requirement to prevent inadvertent actuation of HCVS.

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

Evaluation

The HCVS includes indications for HCVS valve position, vent pipe temperature and effluent radiation levels at the POS. These indications are powered from the dedicated HCVS battery, D8, which has sufficient power for all these loads for 24 hours, and the capability to transfer to a backup source for sustained operation as described in section 1.2.6.

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 coupled to a process and control module. The process and control module is mounted in panel C289B adjacent to the POS in the EFT Building. The RM detector is fully qualified for the expected environment at the vent pipe during accident conditions, and the process and control module is qualified for the environment in the EFT. Both components are qualified for the seismic requirements. Table 1 includes a description and qualification information on the radiation monitor.

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

Evaluation

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

The hardened vent piping, between the wetwell and the discharge point above the Reactor Building roof, including valves AO-4539 and AO-4540 is designed to 62 psig and 309 °F. Wetwell vent piping and components installed downstream of the containment isolation boundary are designed for beyond design basis conditions.

HCVS piping and components have been analyzed and shown to perform under severe accident conditions using the guidance provided in HCVS-FAQ-08 and HCVS-WP-02. Reference 26 contains the response to ISE open item 6 regarding the evaluation of HCVS components for severe accident conditions.

Refer to requirement 1.2.11 of the Order 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 check valve is installed near the top of the pipe in accordance with HCVS-WP-03. This valve will open on venting, but will close to prevent air from migrating back into the pipe after a period of venting. The check valve is installed and tested to ensure that it limits back-leakage to preclude a detonable mixture from occurring in the case venting is stopped prior to the establishment of alternate reliable containment heat removal. The use of a check valve meets the requirement to ensure the flammability limits of gases passing through the vent pipe will not be reached.

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 foroperation, 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 of 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.

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

Table 3-3: Testing and Inspection Requirements

Description	Frequency
Cycle the HCVS valves[1] and the interfacing system valves not used to maintain containment integrity during operations.	Once per every[2] operating cycle
Cycle the HCVS check valves not used to maintain containment integrity during unit operations.[3]	Once per every other[4] operating cycle.
Perform visual inspections and a walk down of HCVS and installed SAWA components	Once per operating cycle
Functionally test the HCVS radiation monitors.	Once per two years
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.	N/A. MNGP has no such valves.

[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] 4 After two consecutive successful performances, the test frequency may be reduced by one operating cycle to a maximum of once per every fourth operating cycle.
[5] Interfacing system boundary valves that are normally closed and fail closed under ELAP conditions (loss of power and/or air) do not require control function testing under this section. Performing existing plant design basis function testing or system operation that reposition the valve(s) to the HCVS required position will meet this requirement without the need for additional testing.

2. HCVS Quality Standards:

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

Evaluation:

The HCVS upstream of and including the second containment isolation valve (AO-4540) and penetrations are not being modified for order compliance so that they continue to be designed consistent with the design basis of primary containment including pressure, temperature, radiation, and seismic loads.

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

Evaluation:

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

The HCVS downstream of the outboard containment isolation valve, including piping and supports, electrical power supply, valve actuator pneumaticsupply, 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 wetwell vent in service until alternate reliable containment heat removal and pressure control are established, as the means for compliance with part B of the order.

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

Section IV.B: HCVS Existing System

There previously was neither a hardened drywell vent nor a strategy at MNGP 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.

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

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

The SAWA flow path is the same as the FLEX primary injection path. The SAWA system, shown on Attachment 4, consists of a FLEX pump injecting into the Reactor Pressure Vessel (RPV) and SAWM consists of flow control at manual valve RHRSW-14 along with wetwell level indication to ensure that the wetwell vent is not submerged (SAWM). The SAWA injection path, starts at the Discharge Canal, goes to the FLEX pump via suction hoses, goes through the FLEX pump to a flexible discharge hose, then to the connection point at valve RHRSW-68 in the Turbine Building 931' East area via a flow meter. The hoses and pumps are stored in the FLEX Storage Building (FSB) and Warehouse 6 (WH6) which assures that a set of FLEX equipment is protected from all hazards.

The RHRSW-68 connection ties to the Residual Heat Removal (RHR) system, then to the Reactor Pressure Vessel (RPV) via the Low Pressure Coolant Injection (LPCI) line. BWROG generic assessment, BWROG-TP-15-008 provides the principles of Severe Accident Water Addition to ensure protection of containment. This SAWA injection path is qualified for the all the screened in hazards (Section III) in addition to severe accident conditions.

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

SAWA can be implemented at MNGP without entry to the Reactor Building.

SAWA actions take place outside the RB at the Office and Control Building, Turbine Building, discharge canal area, FSBs, 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 and POS to determine that venting and SAWA are operating satisfactorily, maintaining containment pressure low to avoid containment failure. Stable or slowly rising trend in wetwell level with SAWA at the minimum flow rate indicates water on the drywell floor up to the vent pipe or downcomer openings. After some period of time, as decay heat levels decrease, the operators will be able to reduce SAWA flow to keep the core debris cool while avoiding overfilling the torus to the point where the wetwell vent is submerged.

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

MNGP 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, detailed in Reference 34.

Section IV.C.4: Available Freeboard Use

The freeboard between normal wetwell level of 910' and 925' elevation provides approximately 728,812 gallons of water volume before the wetwell level instrument would be off scale high. BWROG generic assessment BWROG-TP-15-011 provides the principles of Severe Accident Water Management to preserve the wetwell vent for a minimum of seven days. After containment parameters are stabilized with SAWA flow, SAWA flow will be reduced to a point where containment pressure will remain low while wetwell level is stable or very slowly rising. As shown in evaluation 608000000102, the wetwell level will not reach the wetwell vent for at least seven days. A diagram of the available freeboard is shown on Attachment 1.

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

The upper range of wetwell level indication provided for SAWA/SAWM is +15 feet elevation. This defines the upper limit of wetwell volume that will preserve the wetwell vent function as shown in Attachment 1.

Section IV.C.6: Wetwell vent service time

MNGP Evaluation 608000000102 and BWROG-TP-15-011, demonstrate that throttling SAWA flow after containment parameters have stabilized, in conjunction with venting containment through the wetwell vent will result in a stable or slowly rising wetwell level. The references demonstrate that, for the scenario analyzed, wetwell level will remain below the upper range of the wetwell level instrument, and below the wetwell vent pipe for greater than the seven days of sustained operation allowing significant time for restoration of alternate containment pressure control and heat removal.

Section IV.C.7: Strategy time line

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

Using NEI 12-06 Appendix E, MNGP has validated that the SAWA pump can be deployed and commence injection in less than 8 hours. The studies referenced in NEI 13-02 demonstrated that establishing flow within 8 hours will protect containment. The initial SAWA flow rate will be at least 285 gpm. After 4 hours, in which the SAWA flow rate is maintained, the RPV injection flow will be reduced. Evaluation 608000000102 demonstrated that RPV injection flow could be reduced to 57 gpm after four hours of initial SAWA flow rate and containment would be protected.

Section IV.C.8: SAWA Flow Control

MNGP will accomplish SAWA flow control by the use of manual throttle valve RHRSW-14. The operators at the valve will be in communication with the MCR via hand-held radios, PBX phones, or runners and the exact time to throttle flow is not critical since there is a large margin between normal wetwell level and the level at which the wetwell vent will be submerged. The communications capabilities that will be used for communication between the MCR and the SAWA flow control location are the same as that evaluated and found acceptable for FLEX strategies.

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

Section IV.C.9.1: SAWA Pump

MNGP uses a portable diesel-driven pump for FLEX and SAWA. Two pumps are maintained for this purpose, each of which is capable of 300 gpm at the pressures required for RPV injection during an ELAP. Each of these pumps has been shown to be capable of supplying the required flow rate to the RPV and the SFP for FLEX and for SAWA scenarios. The pumps are stored in the FSB and WH6 where they are protected from screened-in hazards and are rugged, over the road, trailer-mounted units, and therefore will be available to function after a seismic event.

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

MNGP's SAWA flow is 285 gpm which is the site-specific flow rate when the site's rated thermal power is compared to the reference power level of NEI 13-02. The initial SAWA flow will be injecting to the RPV within 8 hours of the loss of injection. The reference 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 15-004 analyzed the FLEX pumps and the lineup for RPV injection that would be used for SAWA, which is the same as used for FLEX. This calculation showed that the pumps have adequate capacity to meet the SAWA flow rate required to protect containment.

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

The MNGP SAWA flow path injects to the RPV via two check valves in series (RHRSW-17 and AO-10-46A). The check function of LPCI testable check valve AO-10-46A (open and closed) is demonstrated under other testing requirements such that additional testing per NEI 13-02 Revision 1 Section 6.2 is not required. The function of RHRSW-17 is maintained under the Preventive Maintenance Program. Thus, backflow is prevented by check valves in the SAWA flow path.

Section IV.C.9.5: SAWA Water Source

The source of water for SAWA is the Mississippi River, either via the intake structure or the discharge canal. After the National SAFER Response Center responds by delivering equipment to the site, a water treatment system will be available to treat this water before it is injected. 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 stored in the FSB and WH6, which provides reasonable protection from all screened-in hazards per the guidance of NEI 12-06. The SAWA pumps are commercial diesel-driven pumps rated for long- term outdoor use in emergency scenarios. The pumps are diesel-driven by an engine mounted on the skid with the pump. The pumps will be refueled by the FLEX refueling equipment that has been qualified for long-term refueling operations per EA-12-049. The action to refuel the SAWA pumps was evaluated under severe accident conditions in Table 2, and demonstrated to be acceptable. Since the pumps are reasonably protected from all screened-in hazards, are qualified for the environment in which they will be used, and will be refueled by a qualified refueling strategy, they will perform their function to maintain SAWA flow needed to protect primary containment per EA-13-109.

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

Table 1 shows the electrical power source for the SAWA/SAWM instruments. For the instruments powered by the HCVS battery D8, calculation 16-006 demonstrates that the battery can provide power for 24 hours, at which time the power supply can be transferred to a source supported by the FLEX generator. The instruments powered by the 125V station batteries were included in the original battery coping analysis for NRC Order EA-12-049.

The FLEX load on the FLEX DG per EA-12-049 was evaluated in Engineering Evaluation 23964, attached to Specification MPS-2173. This calculation demonstrated 83 kW of margin to full load. The additional loads on the FLEX DGs for SAWA and SAWM consist of motor control center MCC-143B/133B (the LPCI Swing Bus), which will be powered temporarily to establish the SAWA injection path. The LPCI Swing Bus load on the FLEX DG was evaluated in EC 6MOD00026921. The method to repower the LPCI Swing Bus uses a cable and FLEX DG output that would otherwise be used to power a battery charger. The load to establish the SAWA injection pathway is smaller than a battery charger, so the SAWA load is bounded by the FLEX load.

Section IV.C.10: SAWA/SAWM Instrumentation

Section IV.C.10.1: SAWA/SAWM instruments

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

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

The drywell pressure and wetwell level instruments used to monitor the condition of containment are pressure and differential pressure detectors that are safety-related and qualified for post-accident use. These instruments are referenced in site procedures for control of SAWA flow to maintain the wetwell vent in service while maintaining containment protection. These instruments are powered by batteries for at least 12 hours and will be re-powered by FLEX generator systems for the sustained operating period. These instruments are powered by distribution panel Y80, which gets its power from the Division 2 250VDC battery, D6. The chargers required to sustain this battery are included in the FLEX generator loading for EA-12-049. Note that other indications of these parameters may be available depending on the exact scenario.

The SAWA flow meter is an in-line flow meter powered by its own batteries and installed as part of setting up the SAWA connection.

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

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

The drywell pressure and wetwell level instruments are pressure and differential pressure detectors that are safety-related and qualified for post-accident use. These instruments are qualified per RG-1.97 Revision 2 (Reference 32) 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 flow instrument is deployed inside the Turbine Building 931' East area near the connection point, it is protected from weather and high radiation near the vent pipe.

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

MNGP FLEX strategies will maintain functional the containment instruments, containment pressure and wetwell level, necessary to successfully implement SAWA. The strategy will be to use the FLEX generator to re-power battery chargers before the batteries supplying the instruments are depleted. Since the FLEX generators are refueled 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

Environmental conditions within the plant structures were evaluated for the period of sustained operations in Calculation 16-055. The calculation credited FLEX actions to provide supplemental ventilation or heating. Taking account for these actions, the equipment required for SAWA/SAWM will be in an environment that permits it to perform its desired functions.

Radiological conditions in the locations of equipment and controls utilized for SAWA/SAWM were evaluated for the period of sustained operations in Calculation

16-054. This equipment will not experience radiological conditions that would prevent it from performing its desired function.

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

Since the SAWA pumps are stored in the FSB and WH6 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. Therefore, the SAWA flow path will not be affected by radiation or temperature effects due to a severe accident.

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

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

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

To implement SAWA, personnel must deploy a portable diesel generator and connect it to the LPCI Swing Bus. They must also deploy and connect a portable diesel pump to the FLEX connection at RHRSW-68 in the TB. They would then use the reenergized swing bus to align the LPCI injection MOV in the RB and operate the PDP to inject water. Table 2 describes the 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.

MNGP performed GOTHIC calculations of the temperature response of the locations of instruments, control elements, and personnel actions during the ELAP event. These calculations determined that the equipment will function and the areas to be occupied by personnel will remain habitable for the period of sustained operations.

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

After the SAWA flow path is aligned inside the RB, the operators can control SAWA/SAWM in the TB and observe the necessary instruments from the POS and the TB. The thick concrete RB walls (below the refuel floor level) as well as the distance to the core materials mean that there is no radiological concern with any actions outside the RB until the wetwell vent is first used at ~7 hours. A radiological analysis of site conditions during severe accident venting has shown that operators can safely access the equipment and controls to operate and sustain venting and SAWA/SAWM throughout the seven-day period of sustained operations.

The SAWA pump and monitoring equipment can all be operated from the POS, the TB or from outside at ground level. The MNGP 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 areas where the radiation hazard from a severe accident would be acceptable. The monitoring instrumentation includes SAWA flow in the Turbine Building, and wetwell level and containment pressure at the POS.

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 HCVS and SAWA procedures have been developed and implemented following MNGP's process for creating and revising procedures and contain the following details:

- appropriate conditions and criteria for use of the system,
- when and how to place the system in operation,
- the location of system components,
- instrumentation available,
- normal and backup power supplies,
- directions for sustained operation, including the storage location of portable equipment,
- training on operating the portable equipment, and
- testing portable equipment.

- Since MNGP relies on Containment Accident Pressure (CAP) to achieve net positive suction head (NPSH) for the Emergency Core Cooling System (ECCS) pumps, the procedures include precautions that use of the vent may impact NPSH (CAP) available to the ECCS pumps.

MNGP 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.

Actual language that is incorporated into site SAMGs:

Cautions

- "Adding water to hot core debris may pressurize the primary containment by rapid steam generation." This addresses the possible plant response associated with adding water to hot core debris and the resulting pressurization of the primary containment by rapid steam generation.

- "Raising torus level above 15 ft will result in loss of the hard pipe vent." This addresses the plant impact that raising suppression pool water level above the elevation of the suppression chamber vent opening elevation will flood the suppression chamber vent path.

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

- "Stabilize core debris in primary containment." Core debris in the primary containment is stabilized by water addition (SAWA).

- "To control DW pressure below Fig D, DW Pressure Limit …Vent the torus." Primary containment pressure is controlled below the Primary Containment Pressure Limit.

- "After core debris is stabilized … Maintain injection from outside the primary containment as low as possible." Water addition is managed to preserve the Mark I/II suppression chamber vent paths, thereby retaining the benefits of suppression pool scrubbing and minimizing the likelihood of radioactivity and hydrogen release into the secondary containment (SAWM)

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

- "Increase injection slowly." Use controlled injection if possible
- "Inject into the RPV if possible."
- "Maintain injection from outside the primary containment as low as possible." This helps to preserve the suppression chamber vent capability.

Section V.B: HCVS Out of Service Requirements

Provisions for out-of-service requirements of the HCVS and compensatory measures have been added to FP-BDB-EQP-01 so that it is with the FLEX out-of-service program.

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

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

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

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

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

Section V.D: Demonstration with other Post Fukushima Measures

MNGP 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.

It is NSPM's intention to comply with drill/exercise performance requirements consistent with the final 10 CFR 50.155 language. NSPM will utilize the guidance of NEI 13-06 and NEI 14-01 insofar as it is consistent with the regulatory requirements promulgated in the final rulemaking.

Section VI: References

Number	Rev	Title	Location[6]
1. GL-89-16	0	Installation of a Hardened Wetwell Vent (Generic Letter 89-16), dated September 1, 1989.	ML031140220
2. SECY-12-0157	0	Consideration of Additional Requirements for Containment Venting Systems for Boiling Water Reactors with Mark I and Mark II Containments	ML12345A030
3. SRM-SECY-12-0157	0	Staff Requirements – SECY-12-0157 – Consideration of Additional Requirements for Containment Venting Systems for Boiling Water Reactors with Mark I and Mark II Containments	ML13078A017
4. EA-12-050	0	Order to Modify Licenses with Regard to Reliable Hardened Containment Vents	ML12054A694
5. EA-13-109	0	Order to Modify Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions	ML13143A321
6. NEI 13-02	0	Industry Guidance for Compliance with Order EA-13-109, BWR Mark I & II Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions	ML13316A853
7. NEI 13-02[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

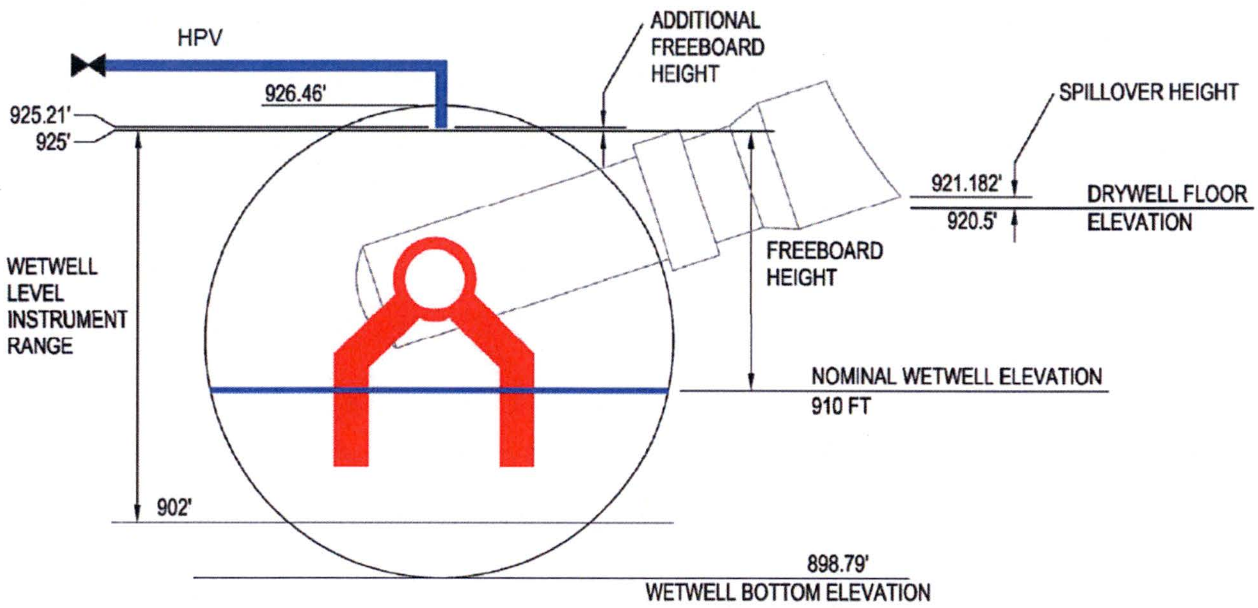
[6] Where two ADAMS accession numbers are listed, the first is the reference document and the second is the NRC endorsement of that document.

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

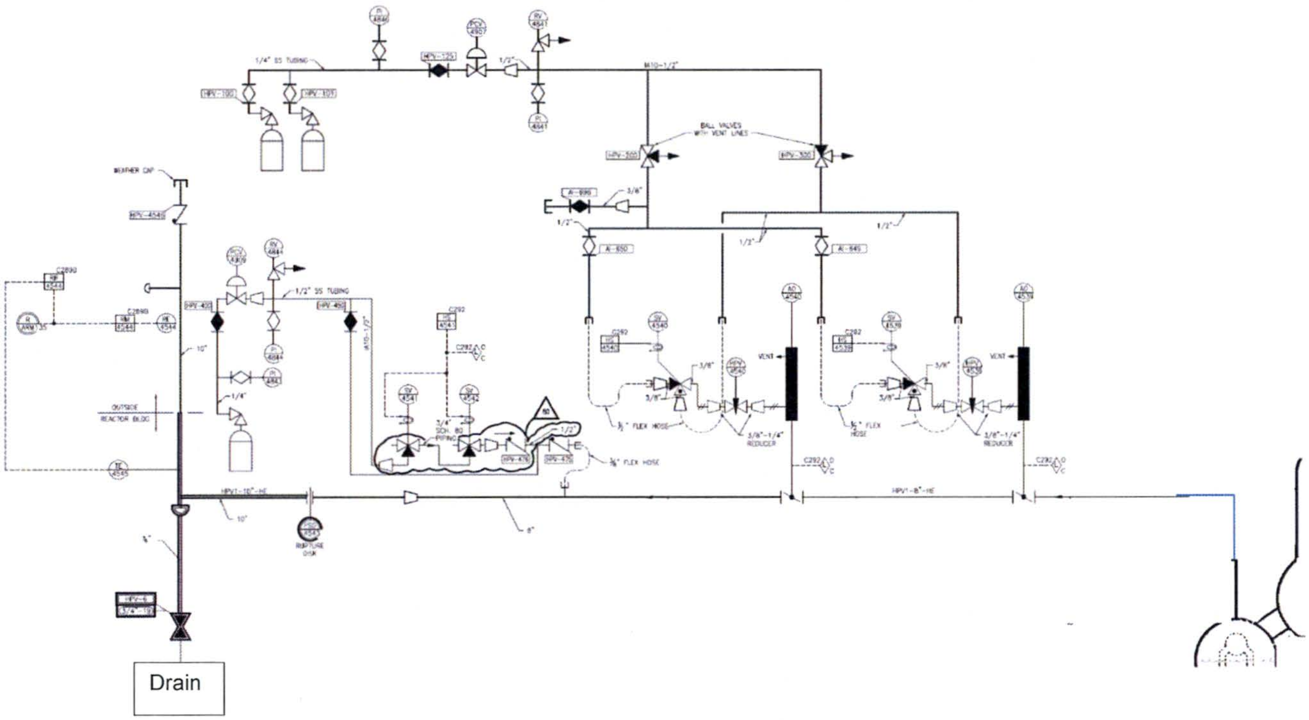
Number	Rev	Title	Location[6]
12. JLD-ISG-2013-02	0	Compliance with Order EA-13-109, Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation under Severe Accident Conditions	ML13304B836
13. JLD-ISG-2015-01	0	Compliance with Phase 2 of Order EA-13-109, Order Modifying 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 onPlant 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	L-MT-14-052 HCVS Phase 1 Overall Integrated Plan (OIP) 6/30/14	ML14183A412
19. Combined OIP / 3rd Update	0	L-MT-15-090 Combined HCVS Phase 1 and 2 Overall Integrated Plan (OIP), Includes third six-month update 12/17/15	ML15356A120
20. Phase 1 ISE	0	HCVS Phase 1 Interim Staff Evaluation (ISE) 4/2/15	ML15082A167
21. Phase 2 ISE	0	HCVS Phase 2 Interim Staff Evaluation (ISE) 9/6/16	ML16244A120
22. 1st Update	0	L-MT-14-092, First Six Month Update 12/16/14	ML14353A215
23. 2nd Update	0	L-MT-15-031 Second Six Month Update 6/22/15	ML15173A176
24. 4th Update	0	L-MT-16-034 Fourth Six Month Update 6/17/16	ML16169A309
25. 5th Update	0	L-MT-16-072 Fifth Six Month Update 12/19/16	ML16354A666
26. 6th Update	0	L-MT-17-042 Sixth Six Month Update 6/14/17	ML17166A051
27. 7th Update	0	L-MT-17-081 Seventh Six Month Update 12/21/17	ML17355A508
28. 8th Update		L-MT-18-035 Eighth Six Month Update 6/26/18	ML18177A422
29. 9th Update	0	L-MT-18-079 Ninth Six Month Update 12/17/18	ML18352A254
30. Calculation 16-055	0	GOTHIC Analysis for the Hardened Containment Vent Project	N/A

Number	Rev	Title	Location[6]
31. Calculation 16-054	0A	MNGP HCVS Radiological Assessment	N/A
32. NEI 12-06	0	Diverse and Flexible Coping Strategies (FLEX) Implementation Guide	ML12221A205
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. FLEX FIP	0	L-MT-17-047 MNGP FLEX Final Compliance 7/6/17	ML17187A153
34. RG 1.97	3	Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Conditions During and Following an Accident	ML003740282
35. TR-1026539	0	EPRI Investigation of Strategies for Mitigating Radiological Releases in Severe Accidents BWR, Mark I and Mark II Studies, September 2012	N/A

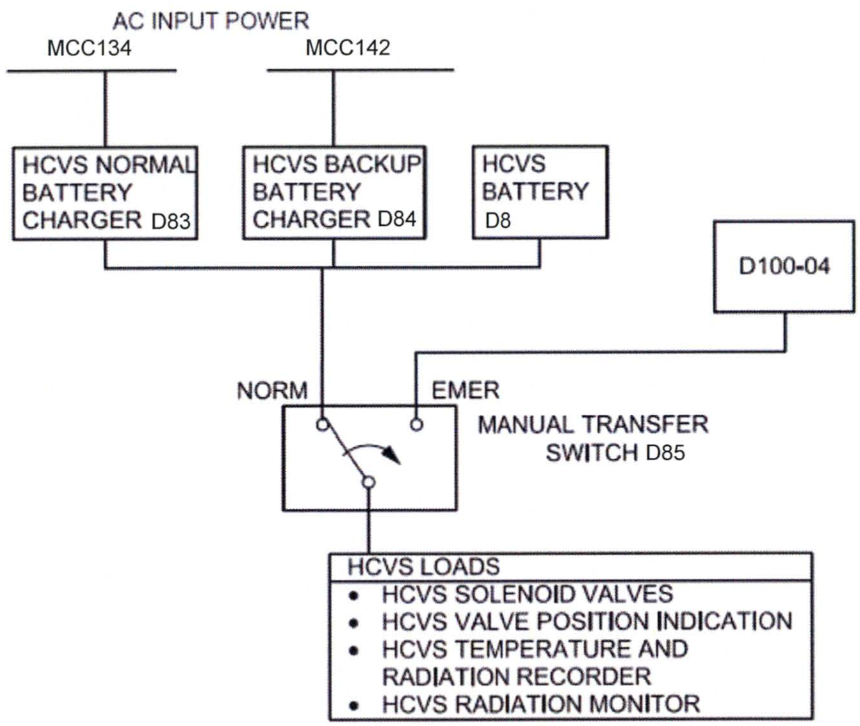
Attachment 1: Phase 2 Freeboard diagram



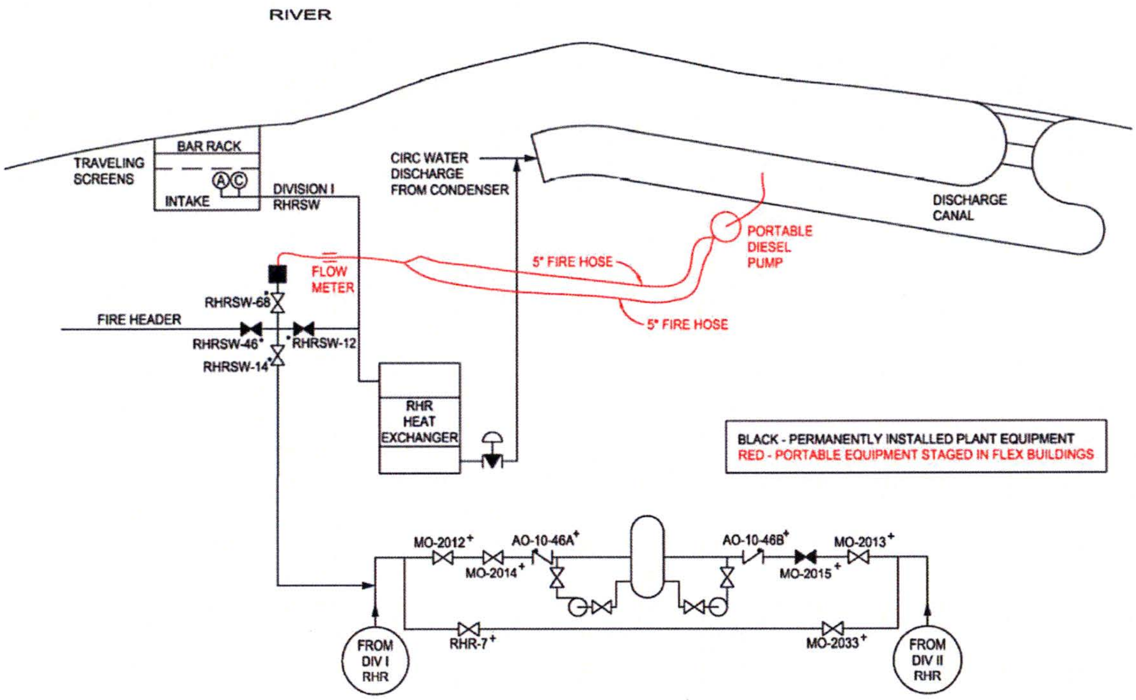
Attachment 2: One Line Diagram of HCVS Vent Path



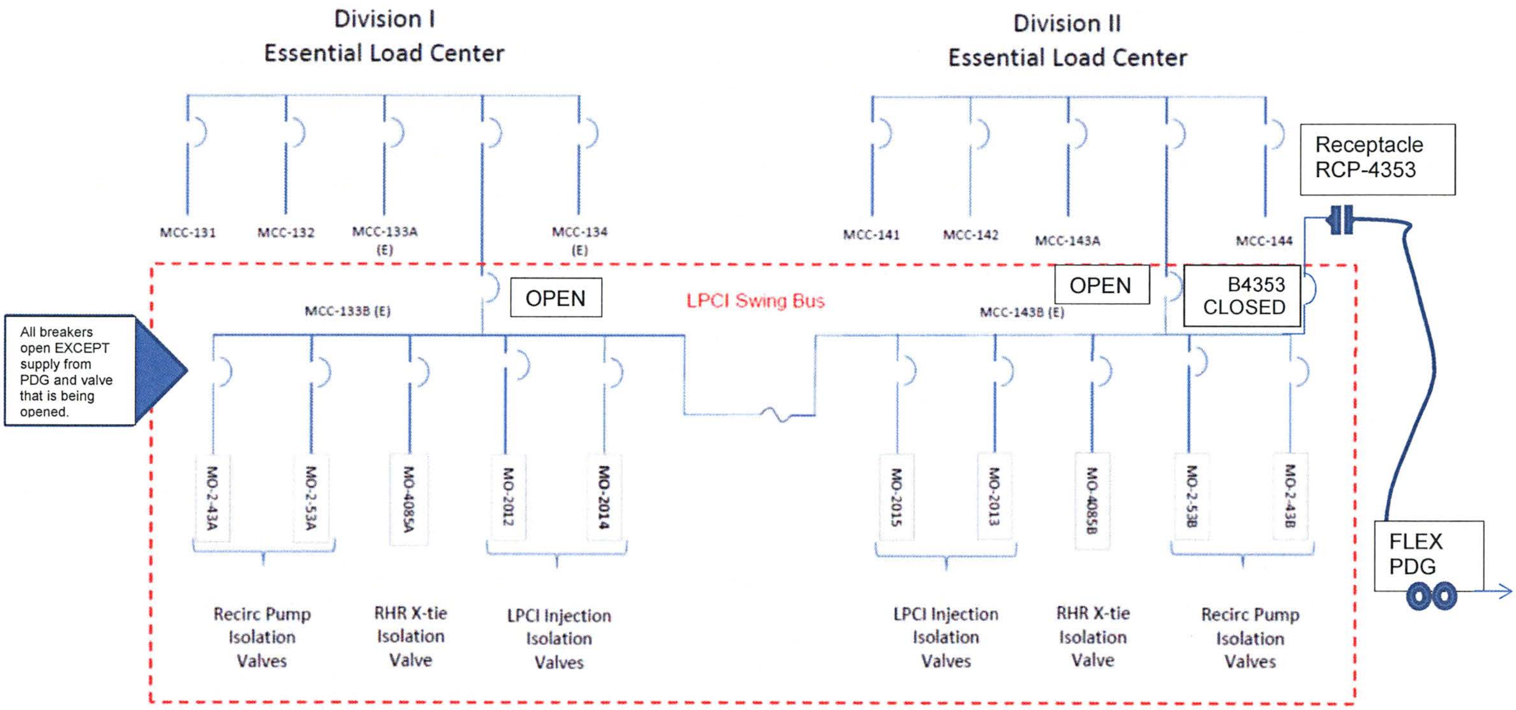
Attachment 3: One Line Diagram of HCVS Electrical Power Supply



Attachment 4: One Line Diagram of SAWA Flow Path



Attachment 5: One Line Diagram of SAWA Electrical Power Supply



Attachment 6: Plant Layout Showing Operator Action Locations

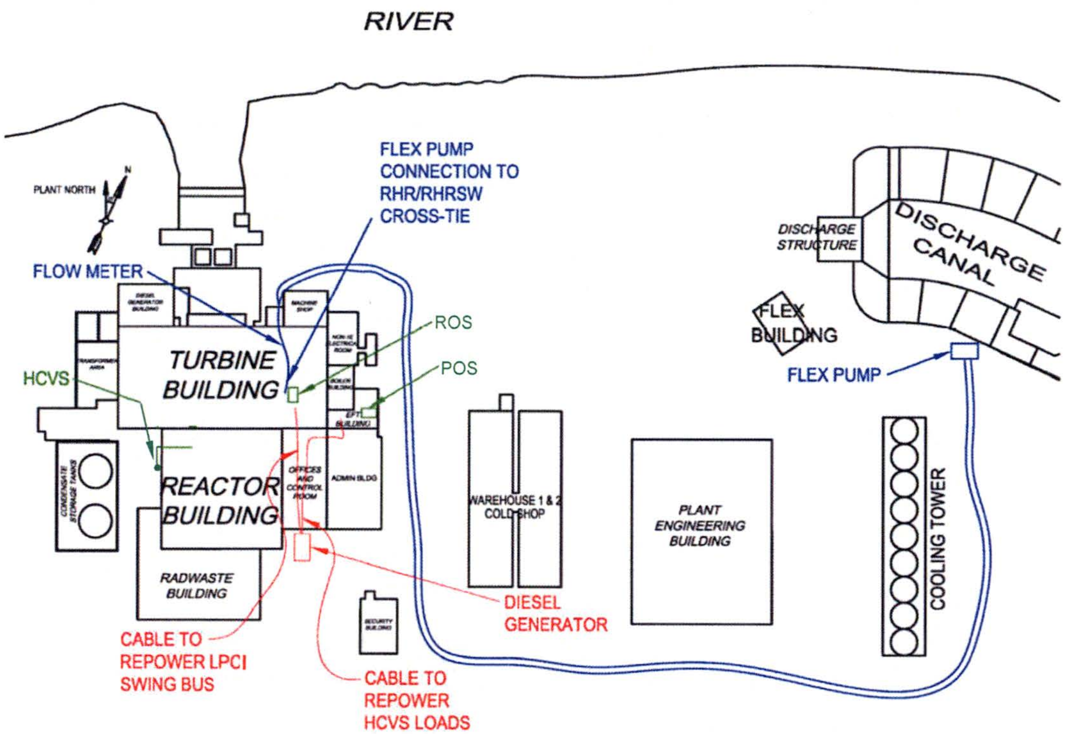


Table 1: List of HCVS Component, Control and Instrument Qualifications

Component Name	Equipment ID	Range	Location	Local Accident Temp	Local Accident Humidity	Local Radiation Level	Qualification	Qualification Temp	Qualification Humidity	Qualification Radiation	Power Supply
Wetwell Vent Instruments and Components											
HCVS Effluent Temperature Element	TE-4545	0-500F	HPCI Room	218 F	80%	3.51E+4 R/hr, 2.90E+6 R integrated dose	IEEE-323-1974 & 1983, IEEE-344-1975 & 1987, and NUREG 0588	500F	No electronics, not susceptible	3E+8 R	D85
HCVS Effluent temperature / radiation indicator	RR-4544	0-500F 0.01-10,000 R/hr	3rd Floor EFT	40F-135F,	Low – no sources of moisture	1.75 mR/hr, 145mR total	Test Report TR90725-06N, Rev 2	32F-138.2F	NA – low humidity	NA – negligible radiation	D85
HCVS Battery Voltage Indicator	D82	0-200 VDC	3rd Floor EFT	40F-135F	Low – no sources of moisture	1.75 mR/hr, 145mR total	Similarity	Not temperature sensitive	NA – low humidity	Not radiation sensitive	D8 or D100, ckt 4, depending on D85 position
Power Transfer Switch	D85	N/A	3rd Floor EFT	40F-135F	Low – no sources of moisture	1.75 mR/hr, 145mR total	EPRI NP-5223-SLR1, Table 3.1	Not temperature sensitive	No electronics, not susceptible	Not radiation sensitive	D8 or D100, ckt 4, depending on D85 position
HCVS Battery	D8	125VDC nominal	3rd Floor EFT	40F-135F	Low – no sources of moisture	1.75 mR/hr, 145mR total	Qualified by design	>25F	No electronics, not susceptible	NA – negligible radiation	Battery charger D83 or D84 (lost upon ELAP)
HCVS Rad Element	RE-4544	0.01-10,000 R/hr	Outdoors, near ground level	ambient	ambient	1.05E+4 R/hr, 8.366E+5 R integrated dose	General Atomics Report 04518900-QSR	-40F to +350F	Designed for outdoors	2.0E+8 R	D85
HCVS Rad Monitor / Processor	RM-4544	0.01-10,000 R/hr	3rd Floor EFT	40F-135F	Low – no sources of moisture	1.75 mR/hr, 145mR total	General Atomics Report 04518900-QSR	40-131F	NA – low humidity	NA – negligible radiation	D85
Pneumatic Supply Valves	HPV-125, HPV-400	Open-closed	TB 931' East	>0F	Not determined	0.186R/hr peak, 15.5R total for 7 days	IEEE-344-2004	Not temperature sensitive	No electronics, not susceptible	Not radiation sensitive	Manual

Component Name	Equipment ID	Range	Location	Local Accident Temp.	Local Accident Humidity	Local Radiation Level	Qualification	Qualification Temp	Qualification Humidity	Qualification Radiation	Power Supply
ROS Valves	HPV-200, HPV-300, HPV-450	Open-closed	ROS on TB 931' East	>0F	Not determined	0.186R/hr peak, 15.5R total for 7 days	Qualified by design – specification MPS-1107	Not temperature sensitive	No electronics, not susceptible	Not radiation sensitive	Manual
HCVS Valves (Primary Containment Isolation Valves)	AO-4539, AO-4540,	Open-Closed	Torus Room	260F	35%	3.24E+5 R/hr, 1.37E+7 R	Design Report 86133.	260F	Safety-Related	5E+7 R	Nitrogen bottles (motive force) and D85 (control)
N2 Pressure Gages	PI-4840, PI-4841, PI-4843, PI-4844	0-5000 psig 0-200 psig 0-5000 psig 0-300 psig	TB 931' East	>0F	Not determined	0.186R/hr peak, 15.5R total for 7 days	IEEE-344-2004	Not temperature sensitive	No electronics, not susceptible	Not radiation sensitive	N/A – needle moved by system pressure.
SAWA/SAWM Instruments											
Drywell Pressure Sensor / Transmitter	PT-7251B	-5 psig – +250 psig	Reactor Bldg 985' South Wall	212F	35%	Bounded by Torus Room: 3.24E+5 R/hr, 1.37E+7 R	Qualified by design	360F peak, 220F for > 7 days	Reg Guide 1.97	4.4E+7 R	Y80, ckt 2
Drywell Pressure Indicator	PI-7251B	-5 psig – +250 psig	3rd Floor EFT	40F-135F		1.75 mR/hr, 145mR total	IEEE-344-1987 & IEEE-323-1983	32F – 140F	Reg Guide 1.97	NA – negligible radiation dose	Y80, ckt 2
Wetwell Level Sensor / Transmitter	LT-7338B	-8 ft – +15 ft Corresponding to 902' – 925' MSL	Torus Room	260F	35%	3.24E+5 R/hr, 1.37E+7 R	Qualified by design	450F	Reg Guide 1.97	5.55E+7	Y80, ckt 2
Wetwell Level Indicator	LI-7338B	-8 ft – +15 ft Corresponding to 902' – 925' MSL	3rd Floor EFT	40F-135F	Low – no sources of moisture	1.75 mR/hr, 145mR total	IEEE-344-1975	-4F – +150F	Reg Guide 1.97	NA – negligible radiation dose	Y80, ckt 2
SAWA Flow Instrument and Readout	None. The flow meter is not permanently-installed plant equipment	50-2000 gpm or 38-1914 gpm, depending which one is deployed	TB 931' East	>0F	Not determined	0.186R/hr peak, 15.5R total for 7 days	Commercial instrument robust per HCVS-OGP-011	-4F – +140F or -40F – +176F, depending on which one is deployed	Industrial grade	~ 50 Sv (5E+3 R)	Self-powered by its own battery

Table 2: Operator Actions Evaluation

	Operator Action	Evaluation Time	Validation Time	Location	Thermal conditions	Radiological Conditions	Evaluation
1	Operating crew recognizes event, takes actions directed by C.4-B.09.02.A and declares ELAP.	0-1 hour	<38 min	Control Room, Cable Spreading Room, 3rd Floor EFT Building, Reactor Building	Done in the first hour, so no concerns.	Done in the first hour, so no concerns.	Acceptable
2	Complete deep load shed per C.5-4401	<2 hour	<24 min	Battery Panels, in Plant Admin Building and EFT Building	< 125F	Action will be complete prior to venting start so no radiological concern.	Acceptable
3	Complete site assessment per C.5-4101	≤ 8 hours*	< 5 hr*	Outdoors	Outside, so ambient conditions	Action will be complete prior to venting start so no radiological concern.	Acceptable
4	Clear debris and open gate per C.5-4102	≤ 8 hours*	< 5 hr*	FSB and Outdoors	Outside, so ambient conditions	Action will be complete prior to venting start so no radiological concern.	Acceptable

	Operator Action	Evaluation Time	Validation Time	Location	Thermal conditions	Radiological Conditions	Evaluation
5	Stage and prepare PDG per C.5-4051	≤ 8 hours*	< 5 hr*	FSB and Outdoors	Outside, so ambient conditions	Action will be complete prior to venting start so no radiological concern.	Acceptable
6	Route cable from PDG to LPCI swing bus per C.5-4051	≤ 8 hours*	< 5 hr*	Outdoors, Plant Admin Building, and Turbine Building	Outside, so ambient conditions, PAB < 110F Turbine Building >40F	Action will be complete prior to venting start so no radiological concern.	Acceptable
7	Trip all feeds and breakers for LPCI swing bus per C.5-4051	≤ 8 hours*	< 5 hr*	Turbine Building 911' and 931' East	>40F	Action will be complete prior to venting start so no radiological concern.	Acceptable
8	Connect cable previously routed to LPCI swing bus and PDG per C.5-4051	≤ 8 hours*	< 5 hr*	Outside and Turbine Building 931' East	Outside, so ambient conditions Turbine Building >40F	Action will be complete prior to venting start so no radiological concern.	Acceptable

	Operator Action	Evaluation Time	Validation Time	Location	Thermal conditions	Radiological Conditions	Evaluation
9	Operate PDG per C.5-4403 and close B4353 (C.5-4051)	≤ 8 hours*	< 5 hr*	Outdoors and TB 931' East	Outside, so ambient conditions	Action will be complete prior to venting start so no radiological concern.	Acceptable
10	Open LPCI Injection valve per C.5-4051 – including placing and removing jumper.	≤ 8 hours*	< 5 hr*	Cable Spreading Room, Main Control Room	<110F	Action will be complete prior to venting start so no radiological concern.	Acceptable
11	Stage and connect a PDP per C.5-4051.	≤ 8 hours*	< 5 hr*	Outdoors and Turbine Building	Outside, so ambient conditions Turbine Building >40F	Action will be complete prior to venting start so no radiological concern.	Acceptable
12	Inject to RPV at SAWA flow rate using C.5-3203.	≤ 8 hours*	< 5 hr* continues until 9 hours	Outdoors and Turbine Building East 931'	Outside at ambient conditions. Turbine Building >40F	<186 mR/hr in TB East 931' and <3.13R/hr at PDP Location. North location was limiting. Continuous presence at PDP is not needed.	Acceptable

	Operator Action	Evaluation Time	Validation Time	Location	Thermal conditions	Radiological Conditions	Evaluation
13	Lower injection flow to SAWM Value	< 9 hr	NA not a Time-sensitive action	Turbine Building East 931'	>40F	<186 mR/hr	Acceptable
14	Open B4353, and disconnect cable from LPCI swing bus per C.5-4051	< 12 hr	< 24 min	Turbine Building East, 931'	>35F	<186 mR/hr	Acceptable
15	Connect cables to battery chargers per C.5-4402	< 12 hr	< 24 min	Plant Admin Building Basement	<113F	Negligible	Acceptable
16	Operate the PDG to charge batteries per C.5-4050	< 12 hr	< 39 min	Outdoors, East or South of the Plant Admin Building	Outside, so ambient conditions	Negligible	Acceptable

	Operator Action	Evaluation Time	Validation Time	Location	Thermal conditions	Radiological Conditions	Evaluation
17	Energize HPV from batteries supported by PDG per C.5-4453	24 hr	NA not time sensitive	EFT 3rd Floor	<110F	<2mR/hr	Acceptable
18	Open valves to provide motive force (nitrogen) to HCVS system	< 7 hr	14 min	Turbine Building 931' East	>40F	Action will be complete prior to venting start so no radiological concern.	Acceptable
19	Operate HS-4541 OR HPV-450 to blow rupture disk	< 7 hr	14 min	POS or ROS	>40F at ROS >40F and <130F at POS	Action will be complete prior to venting start so no radiological concern.	Acceptable
20	Operate and Monitor HCVS	< 7 hr, continuing intermittent operation for duration of event	14 min	POS or ROS	>0F at ROS >40F and <135F at POS Ventilation or heaters will maintain the POS either >40F or <110F for the long term.	POS: 145 mR integrated dose if continuously occupied for 7 days. ROS: 15.5 R integrated dose if continuously occupied for 7 days.	Acceptable

	Operator Action	Evaluation Time	Validation Time	Location	Thermal conditions	Radiological Conditions	Evaluation
21	Replace HCVS nitrogen bottles	24 hours. Task repeated daily	NA not time sensitive	TB 931' East Area and FSB	>0F in TB 931' East. Ambient conditions at FSB	negligible at bottle rack in TB 931' East.<368mR/hr at FSB	Acceptable

* Tasks 3-12 must all be completed within 8 hours. Validation showed these tasks could be completed with available staff within 5 hours.