Tennessee Valley Authority, 1101 Market Street, Chattanooga, Tennessee 37402

CNL-18-084

June 27, 2018

10 CFR 2.202
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Attn: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Browns Ferry Nuclear Plant, Units 1, 2, and 3
Renewed Facility Operating License Nos. DPR-33, DPR-52, and DPR-68
NRC Docket Nos. 50-259, 50-260, and 50-296

Subject: **Tennessee Valley Authority Browns Ferry Nuclear Plant's Eighth Six-Month Status Report in Response to 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)**

References:

1. NRC Order Number EA-13-109, "Issuance of Order to Modify Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions," dated June 6, 2013 (ML13143A321)
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 (ML13304B836)
3. NEI 13-02, "Industry Guidance for Compliance with Order EA-13-109, BWR Mark I & II Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions," Revision 1, dated April 23, 2015 (ML15113B318)
4. Letter from TVA to NRC, "Tennessee Valley Authority'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 (Order Number EA-13-109)," dated June 30, 2014 (ML14181B169)
5. Letter from TVA to NRC, "Tennessee Valley Authority's Browns Ferry Nuclear Plant First Six-Month Status Report in Response to 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)," dated December 19, 2014 (ML14353A428)

6. Letter from NRC to TVA, “Browns Ferry Nuclear Plant, Units 1, 2, and 3 - Interim Staff Evaluation Relating to Overall Integrated Plan in Response to Phase 1 of Order EA-13-109 (Severe Accident Capable Hardened Vents) (TAC Nos. MF4540, MF4541 and MF4542),” dated February 11, 2015 (ML14356A362)
7. 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 29, 2015 (ML15104A118)
8. Letter from TVA to NRC, “Tennessee Valley Authority's Browns Ferry Nuclear Plant Second Six-Month Status Report in Response to 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),” dated June 29, 2015 (ML15181A338)
9. Letter from TVA to NRC, “Tennessee Valley Authority's Browns Ferry Nuclear Plant Third Six-Month Status Report and Phase 1 and Phase 2 Overall Integrated Plan in Response to 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),” dated December 29, 2015 (ML15365A554)
10. Letter from TVA to NRC, “Tennessee Valley Authority’s Browns Ferry Nuclear Plant Fourth Six-Month Status Report in Response to 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),” dated June 30, 2016 (ML16182A517)
11. Letter from TVA to NRC, “Tennessee Valley Authority Browns Ferry Nuclear Plant’s Fifth Six-Month Status Report in Response to 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),” dated December 22, 2016 (ML16357A577)
12. Letter from TVA to NRC, “Tennessee Valley Authority Browns Ferry Nuclear Plant’s Sixth Six-Month Status Report in Response to 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),” dated June 30, 2017 (ML17181A333)
13. Letter from TVA to NRC, “Tennessee Valley Authority Browns Ferry Nuclear Plant’s Seventh Six-Month Status Report in Response to 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),” dated December 20, 2017 (ML17354A250)

14. Letter from TVA to NRC, "Tennessee Valley Authority, Browns Ferry Nuclear Plant, Unit 3, Completion of Required Action for NRC Order EA-13-109, Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (CAC No. MF4542)," dated May 31, 2018 (ML18169A178)

On June 6, 2013, the Nuclear Regulatory Commission (NRC) issued an Order (Reference 1) to Tennessee Valley Authority (TVA). Reference 1 was immediately effective and directed TVA to install a reliable hardened venting capability for instances of pre-core damage and under severe accident conditions, including those involving a breach of the reactor vessel by molten core debris. Specific requirements are outlined in Attachment 2 of Reference 1.

Reference 1 required submission of a Phase 1 and Phase 2 Overall Integrated Plan (OIP) pursuant to Section IV, Condition D for Browns Ferry Nuclear Plant (BFN), Units 1, 2, and 3. References 2 and 7 endorsed industry guidance document Nuclear Energy Institute (NEI) 13-02, Revision 1 (Reference 3) with clarifications and exceptions identified in References 2 and 7. Reference 3 provides direction regarding the content of the Phase 1 and Phase 2 OIPs and includes guidance for combining the OIPs.

Reference 4 provided TVA's Phase 1 OIP. The NRC issued its Interim Staff Evaluation relating to the BFN Phase 1 OIP on February 11, 2015 (Reference 6).

Reference 1 also requires submission of status reports at six-month intervals following submittal of the OIP. Reference 3 provides direction regarding the content of the status reports. TVA submitted the first six-month status report on December 19, 2014 (Reference 5) and has provided subsequent six-month status reports in References 8 through 13. Reference 14 provided notification of Order EA-13-109 compliance for Unit 3.

The purpose of this letter is to provide the combined Phase 1 and Phase 2 OIP six-month status report pursuant to Section IV, Condition D of Reference 1, which delineates progress made in implementing the requirements of Reference 1. The Enclosure provides an update of milestone accomplishments since submittal of the seventh six-month status report, including any changes to the compliance method or schedule.

There are no new regulatory commitments resulting from this submittal. If you have any question regarding this submittal, please contact Mike Oliver at (256) 729-7874.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 27th day of June 2018.

Respectfully,

E. K. Henderson
Director, Nuclear Regulatory Affairs

Enclosure: Tennessee Valley Authority Browns Ferry Nuclear Plant's Eighth Six-Month Status Report for the Implementation of Order EA-13-109, "Issuance of Order to Modify Licenses With Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions"

cc (w/Enclosure):

NRR Director - NRC Headquarters
NRO Director - NRC Headquarters
NRC Regional Administrator - Region II
NRR Project Manager - Browns Ferry Nuclear Plant
NRC Senior Resident Inspector - Browns Ferry Nuclear Plant

ENCLOSURE

Tennessee Valley Authority Browns Ferry Nuclear Plant's Eighth Six-Month Status Report for the Implementation of Order EA-13-109, "Issuance of Order to Modify Licenses With Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions"

1 Introduction

On June 6, 2013, the Nuclear Regulatory Commission (NRC) issued Order EA-13-109, Order Modifying Licenses with Regard to Requirements for Reliable Hardened Containment Vents (HCVS) Capable of Operation Under Severe Accident Conditions (Reference 1 in Section 8), to Tennessee Valley Authority (TVA). This Order was immediately effective and directs the Browns Ferry Nuclear Plant (BFN), Units 1, 2, and 3, 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 in response to Order EA-13-109.

BFN developed an Overall Integrated Plan (OIP) to provide HCVS. (Phase 1 was provided in Reference 2.)

BFN developed an updated and combined Phase 1 and 2 OIP (Reference 5) documenting:

1. The installation of a HCVS that provides a reliable hardened venting capability for instances of pre-core damage and under severe accident conditions, including those involving a breach of the reactor vessel by molten core debris, in response to Reference 1.
2. An alternative venting strategy that makes it unlikely that a drywell vent is needed to protect the containment from overpressure related failure under severe accident conditions, including those that involve a breach of the reactor vessel by molten core debris, in response to Reference 1.

This enclosure provides an update of milestone accomplishments since submittal of the combined Phase 1 and 2 OIP and previous update (Reference 9) including any changes to the compliance method, schedule, or need for relief/relaxation and the basis, if any.

2 Milestone Accomplishments

The following milestone(s) have been completed since the previous update (Reference 9). The status is current as of June 1, 2018.

Unit 3 Phase 1 Implementation Outage
Unit 3 Phase 1 Walk Through Demonstration/Functional Test
Unit 3 Phase 1 HCVS Implementation
Phase 1 Full Site HCVS Implementation
Unit 3 Phase 2 Implementation Outage
Unit 3 Phase 2 Walk Through Demonstration/Functional Test
Unit 1 Phase 2 Design Engineering On-site/Complete
Unit 2 Phase 2 Design Engineering On-site/Complete
Phase 2 Operations Procedure Changes Developed
Phase 2 Site Specific Maintenance Procedures Developed
Phase 2 Procedure Changes Active
Phase 2 Training Complete
Unit 3 Phase 2 HCVS Implementation

3 Milestone Schedule Status

The following provides an update to Part 5 of the combined Phase 1 and 2 OIP. It provides the activity status of each item and whether the expected completion date has changed. These dates are planning dates subject to change as design and implementation details are developed.

The revised milestone target completion dates do not impact the order implementation date.

Milestone	Target Completion Date	Activity Status	Comments
Phase 1 and 2 HCVS Milestone Table			
Submit Overall Integrated Plan	June 2014	Complete	
Submit 6 Month Updates:			
Update 1	December 2014	Complete	
Update 2	June 2015	Complete	
Update 3 [Simultaneous with Phase 2 OIP]	December 2015	Complete	
Update 4	June 2016	Complete	
Update 5	December 2016	Complete	
Update 6	June 2017	Complete	
Update 7	December 2017	Complete	
Update 8	June 2018	**Complete with this submittal**	
Update 9	December 2018	Not Started	

Phase 1 Specific Milestones			
Phase 1 Modifications:			
Hold preliminary/conceptual design meeting	November 2014	Complete	
Modifications Evaluation	November 2015	Complete	
Unit 1 Design Engineering On-site/Complete	April 2016	Complete	June 2016
Unit 1 Implementation Outage	November 2016	Complete	
Unit 1 Walk Through Demonstration/Functional Test	November 2016	Complete	
Unit 2 Design Engineering On-site/Complete	June 2016	Complete	December 2016
Unit 2 Implementation Outage	March 2017	Complete	
Unit 2 Walk Through Demonstration/Functional Test	April 2017	Complete	
Unit 3 Design Engineering On-site/Complete	July 2017	Complete	
Unit 3 Implementation Outage	March 2018	**Complete**	
Unit 3 Walk Through Demonstration/Functional Test	April 2018	**Complete**	
Phase 1 Procedure Changes Active			
Operations Procedure Changes Developed	July 2016	Complete	
Site Specific Maintenance Procedure Developed	July 2016	Complete	
Procedure Changes Active	November 2016	Complete	
Phase 1 Training:			
Training Complete	September 2016	Complete	
Phase 1 Completion			
Unit 1 HCVS Implementation	December 2016	Complete	
Unit 2 HCVS Implementation	April 2017	Complete	
Unit 3 HCVS Implementation	March 2018	**Complete**	
Full Site HCVS Implementation	March 2018	**Complete**	

Phase 2 Specific Milestones			
Phase 2 Modifications:			
Hold preliminary/conceptual design meeting	January 2017	Complete	
Modifications Evaluation	April 2017	Complete	
Unit 3 Design Engineering On-site/Complete	May 2017	Complete	September 2017
Unit 3 Implementation Outage	March 2018	**Complete**	
Unit 3 Walk Through Demonstration/Functional Test	March 2018	**Complete**	
Unit 1 Design Engineering On-site/Complete	December 2017	**Complete**	**May 2018**
Unit 1 Implementation Outage	October 2018	Not Started	
Unit 1 Walk Through Demonstration/Functional Test	October 2018	Not Started	
Unit 2 Design Engineering On-site/Complete	May 2018	**Complete**	
Unit 2 Implementation Outage	March 2019	Not Started	
Unit 2 Walk Through Demonstration/Functional Test	March 2019	Not Started	
Phase 2 Procedure Changes Active			
Operations Procedure Changes Developed	September 2017	**Complete**	March 2018
Site Specific Maintenance Procedures Developed	December 2017	**Complete**	**March 2018**
Procedure Changes Active	March 2018	**Complete**	
Phase 2 Training:			
Training Complete	December 2017	**Complete**	**March 2018**
Phase 2 Completion			
Unit 3 HCVS Implementation	March 2018	**Complete**	
Unit 1 HCVS Implementation	October 2018	Not Started	
Unit 2 HCVS Implementation	March 2019	Not Started	
Full Site HCVS Implementation	March 2019	Not Started	
Submit Completion Report [60 days after full site compliance]	May 2019	Not Started	

4 Changes to Compliance Method

The following is a list of changes made to the information provided in the Combined Phase 1 and 2 OIP (Reference 5). These changes were made to clarify the OIP and provide more specific information because the design process is further along than previously anticipated. These changes meet the NEI 13-02 compliance method.

- Revised Part 2: Boundary Conditions for Wet Well Vent, Key Venting Parameters, Component Identifiers to include Unit 3 component unique identifiers (UNIDs).
- Updated Part 5: Implementation Schedule Milestones, Phase 1 and Phase 2 Milestone Schedule.
- Revised Attachment 3, Conceptual Sketches, Figure 7 to show correct locations of Remote Operating Station (ROS).
- Revised Attachment 7, List of Overall Integrated Plan and Interim Staff Evaluation (ISE) Open Items, OIP Phase 1 Open Item 4 to include update of Unit 3 EOI Appendix 13.
- Revised Attachment 7, List of Overall Integrated Plan and Interim Staff Evaluation (ISE) Open Items, ISE Phase 1 Open Item 2 to include update of Unit 3 EOI Appendix 13.
- Included statement on all Attachment 7, List of Overall Integrated Plan and Interim Staff Evaluation (ISE) Open Items, ISE Phase 1 and Phase 2 Open Items that "This ISE Open Item was closed during NRC audit and documented in ML18038B606." (Reference 12).

There are no changes to the compliance method as documented in the combined Phase 1 and 2 OIP (Reference 5).

5 Need for Relief/Relaxation and Basis for the Relief/Relaxation

BFN expects to comply with the order implementation date, and no relief/relaxation is required at this time.

6 Open Items from Combined Phase 1 and 2 OIP and ISE

The following tables provide a summary of the open items documented in the combined Phase 1 and 2 OIP or the ISE and the status of each item.

Combined Phase 1 and 2 OIP Open Item	Status
Phase 1 Open Items	
1. Perform an assessment of temperature and radiological conditions to ensure that operating personnel can safely access and operate controls at the Remote Operating Station based on time constraints listed in Attachment 2.	Closed - An assessment was completed and documented in the Design Change Technical Evaluation of Design Change Notice (DCN) 71389 for Unit 1, DCN 71390 for Unit 2, DCN 71391 for Unit 3, calculation MDQ0000642015000351, HCVS Operator (Mission) Dose Calculation, and calculation MDQ0009992014000291, Temperature Response of the Reactor Building Following an Extended Loss of AC Power. calculation MDQ0009992014000291 also evaluates the temperature response in the Unit 1/2 and Unit 3 Diesel Building during an Extended Loss of AC Power (ELAP) event.
2. Perform an evaluation for HCVS ability to operate from the MCR and has the ability to be supplied adequate amounts of pneumatic pressure for 24 hour actions.	Closed - An evaluation was performed and documented in calculation MDQ0000322015000347 Revision 0, HCVS Nitrogen System Sizing Analysis, and DCN 71389.

Combined Phase 1 and 2 OIP Open Item	Status
3. Perform an evaluation for FLEX portable generators and nitrogen cylinders use past 24 hour actions.	Closed - An evaluation was performed for Mitigation Strategies for Beyond-Design-Basis External Events (FLEX) portable generators and documented in a White Paper reviewed during the FLEX audit and documented in Browns Ferry Nuclear Plant, Units 1, 2, and 3 - Report for the Onsite Audit Regarding Implementation of Mitigating Strategies and Reliable Spent Fuel Instrumentation Related to Orders EA-12-049 and EA-12-051 (ML15069A358). A nitrogen cylinder use evaluation was performed and documented in DCN 71389 for Unit 1, DCN 71390 for Unit 2, DCN 71391 for Unit 3, and calculation MDQ0000322015000347. A combination of installed and dedicated nitrogen cylinder carts will be used to provide a seven-day supply of nitrogen.
4. Revise 1/2/3-EOI Appendix-13 to include venting for loss of DC power.	Closed for Unit 1 - 1-EOI Appendix-13 Revision 3, Emergency Venting Primary Containment, was revised to include venting for loss of direct current (DC) power. Closed for Unit 2 - 2-EOI Appendix-13 Revision 9 was revised to include venting for loss of DC power. Closed for Unit 3 - 3-EOI Appendix-13 Revision 6 was revised to include venting for loss of DC power.
5. Perform an evaluation for FLEX portable generators use for post 24 hour actions in Severe Accident conditions.	Closed - An evaluation for FLEX portable generator use for post 24-hour actions was performed and documented in Engineering Information Record from AREVA document 51-9262174-003, Projected Dose Rate Contour Map of Shine from the HCVS Vent Line Extending Above Refueling Floor (BFN).
6. Electrical load shedding will be performed in 1 hour of the event.	Closed - Calculation EDQ0009992013000202 Revision 3, 250V DC Unit Batteries, 1, 2, & 3 Evaluation for the Beyond Design Basis External Event (BDBEE) ELAP, has been issued to determine load shedding impact on the unit batteries.
7. The implementation of the HCVS DCNs will be staged so that there is no effect on the operating units.	Closed - A conceptual meeting was held in November 2014, and a staging plan was used to separate the existing Hardened Wet Well Vent (HWWV) from the HCVS.
8. The wetwell vent will be designed to remove 1% of rated thermal power at EPU conditions.	Closed - The existing wetwell vent and the HCVS have been designed for 1 percent of rated thermal power at Extended Power Uprate (EPU) conditions.
9. Implement the Harris Radio System for communication between the MCR and the ROS.	Closed - A communication system has been implemented that uses hand held radios for communication between the main control room and the ROS (DCN 70852).

Combined Phase 1 and 2 OIP Open Item	Status
Phase 2 Open Items	
1. Perform an evaluation for the locations of the SAWA equipment and controls, as well as ingress and egress paths for the expected Severe Accident conditions (temperature, humidity, radiation) for the sustained operating period.	Closed - <u>Equipment and Controls</u> Plant instrumentation for Severe Accident Water Management (SAWM) that is qualified to NRC Regulatory Guide (RG) 1.97 or equivalent is considered qualified for the sustained operating period without further evaluation. The following plant instruments are qualified to RG 1.97: • Drywell (DW) Pressure Indicators, 1,2,3-PI-64-67B • Suppression Pool Level Indicators, 1,2,3-LI-64-159A. Passive components that do not need to change state after initially establishing Severe Accident Water Addition (SAWA) flow do not require evaluation beyond the first 8 hours, at which time they are expected to be installed and ready for use to support SAWA/SAWM. The following additional equipment performing an active SAWA/SAWM function is considered: • SAWA/SAWM flow instrument, • SAWA/SAWM pump, • FLEX generator, and • SAWA throttle valve. These components will be used at a remote location (outside Reactor Building) and have been evaluated for the environmental conditions applicable at those locations. <u>Ingress and Egress</u> A quantitative evaluation of expected dose rates, AREVA document 51-9262174-003, has been performed per NEI HCVS-WP-02, Sequences for HCVS Design and Method for Determining Radiological Dose from HCVS Piping, and found the dose rates at deployment locations including ingress/egress paths are acceptable.
2. Perform a hydraulic evaluation to ensure flow adequacy can be met for all 3 units using 1 FLEX pump to support SAWA flow requirement	Closed - Hydraulic Analysis calculation MDN0003602014000233, Hydraulic Analysis for Fukushima FLEX Connection Modifications, was revised to include a bounding case that concluded that a single FLEX pump (with booster pump) can provide 500 gallons per minute (gpm) to the Unit 1 Reactor Pressure Vessel (RPV), 500 gpm to the Unit 2 RPV, and 500 gpm to Unit 3 RPV at an RPV pressure of 106 pounds per square inch gage (psig) in response to a SAWA event.

Phase 1 Interim Staff Evaluation Open Item	Status
1. 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.	An evaluation of temperature and radiological conditions was performed to ensure that Operating personnel can safely access and operate controls at the ROS located in the Diesel Buildings and in the Reactor Building. This evaluation is documented in Unit 1 DCN 71389 Design Change Technical Evaluation (Pages 70-73 of 81), Unit 2 DCN 71390 Design Change Technical Evaluation (Pages 65-68 of 75), and Unit 3 DCN 71391 Design Change Technical Evaluation (Pages 60-63 of 69). Calculations MDQ0000642015000351 and MDQ0009992014000291 were used to validate the evaluation. This ISE Open Item was closed during NRC audit and documented in ML18038B606 (Letter from NRC to TVA, dated February 21, 2018) (Reference 12).
2. Make available for NRC audit documentation that procedure 1/2/3-EOI Appendix-13 has been revised to include venting for loss of dc power.	1-EOI Appendix-13 Revision 3 was revised to include venting for loss of DC power. 2-EOI Appendix-13 Revision 9 was revised to include venting for loss of DC power. 3-EOI Appendix-13 Revision 6 was revised to include venting for loss of DC power. This ISE Open Item was closed during NRC audit and documented in ML18038B606 (Reference 12).
3. Make available for NRC staff audit documentation demonstrating that all load sheds will be accomplished within one hour of event initiation and will occur in an area not impacted by a possible radiological event.	Calculation EDQ0009992013000202, 250V DC Unit Batteries, 1, 2, & 3 Evaluation for the Beyond Design Basis External Event (BDBEE) Extended Loss of AC Power (ELAP), has been issued to determine load shedding impact on the unit batteries. The performance of the load shed is directed by 0-FSI-1, FLEX Support Instruction, and performed in accordance with 0-FSI-3F, Load Shed of 250V Main Bank Battery 1, 2, 3. The load shed is performed in the Control Bay and Electrical Board rooms only and will not require entry into areas that are impacted by a possible radiological event. This ISE Open Item was closed during NRC audit and documented in ML18038B606 (Reference 12).
4. Make available for NRC staff audit documentation that demonstrates that operating units that have not implemented the order will be able to vent through the existing vent system unaffected by the implementation of HCVS on other units.	A conceptual meeting was held in November 2014, and a staging plan was used to separate the existing HWWV from the HCVS. The HCVS has been implemented on all three units. This ISE Open Item was closed during NRC audit and documented in ML18038B606 (Reference 12).

5. 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.	The existing wetwell vent and the HCVS have been designed for 1 percent of rated thermal power at EPU (3952 MWt) conditions. This analysis is available and documented in Calculation NDQ0000642015000341, HCVS MAAP Analysis. This ISE Open Item was closed during NRC audit and documented in ML18038B606 (Reference 12).

6. 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.	A communication system has been implemented (DCN 70852) that uses hand held radios for communication between the main control room (MCR) and the remote operating station. This Radio System consists of a Ultra High Frequency (UHF)/Very High Frequency (VHF) trunked system and an independent VHF channel (F4). The In-plant Radio System is accessed by handheld radios and has normal and emergency diesel generator-backed power supply. The radio system is powered from two Class 1E redundant power sources, the 480V DG Auxiliary Boards A and B. Primary power source will be from the 480V DG Auxiliary Board A via a second 480-208V/120V transformer/distribution center. In the event of loss of primary power source, power to radio equipment will be automatically transferred to backup source via transfer switches located in each cabinet, with exception of cabinet 4, which receives power via cabinet 1 transfer switch. Backup power source includes Uninterrupted Power Supply (UPS) with battery capacity to supply four UHF channels for three hours. Therefore, in this configuration, capacity is reduced from five simultaneous conversations to three. The loads supplied via UPS can be alternatively supplied from a portable generator via a transfer switch (0-FSI-4B). UPS conservation can be accomplished by switching off one of the two UPSs until such time the active UPS reaches “low level.” Then, the UPS previously switched off can be returned to service extending the overall time the radio system can remain operable without portable generator power to approximately 6 hours. BFN maintains a large number of handheld radios, batteries, and charging units. The FLEX program does not maintain dedicated handheld radios. These units, spare batteries, and chargers will be gathered if not readily available in the control rooms. Handheld Radios can additionally be operated in “Radio-to-Radio” mode enabling communications not affected by shielding or distance. This ISE Open Item was closed during NRC audit and documented in ML18038B606 (Reference 12).
7. Make available for NRC staff audit documentation of an evaluation verifying the existing containment isolation valves, relied upon for the HCVS, will open under the maximum expected differential pressure during BDBEE and severe accident wetwell venting.	An evaluation was performed and concluded that the containment isolation valves will open under the maximum expected differential pressure and is documented in Flowserve Report RAL-70181, Design Review Report of Size 14 Class 150 Wafer Butterfly Valve with Pneumatic Actuator, Revision 1. This ISE Open Item was closed as documented in ML18038B606 (Reference 12).

8. Make available for NRC staff audit documentation of a seismic qualification evaluation of HCVS components.	Electrical and instrument and control components were procured as seismically qualified or as Seismic Class I to ensure their functionality following a seismic event. Seismic qualification reports of HCVS components are available for audit. This ISE Open Item was closed during NRC audit and documented in ML18038B606 (Reference 12).
9. Make available for NRC staff audit descriptions of all instrumentation and controls (existing and planned) necessary to implement this order including qualification methods.	Instrumentation and controls necessary to implement this order including equipment description, location, and qualifications are available for audit. This ISE Open Item was closed during NRC audit and documented in ML18038B606 (Reference 12).
10. Make available for NRC staff audit the descriptions of local conditions (temperature, radiation and humidity) anticipated during ELAP and severe accident for the components (valves, instrumentation, sensors, transmitters, indicators, electronics, control devices, and etc.) required for HCVS venting including confirmation that the components are capable of performing their functions during ELAP and severe accident conditions.	Descriptions of local conditions (temperature, radiation and humidity) anticipated during ELAP and severe accident for the components (valves, instrumentation, sensors, transmitters, indicators, electronics, control devices, and etc.) required for HCVS venting including confirmation that the components are capable of performing their functions during ELAP and severe accident conditions are available for audit. This ISE Open Item was closed during NRC audit and documented in ML18038B606 (Reference 12).
11. Make available for NRC staff audit the final sizing evaluation for HCVS batteries/battery charger including incorporation into FLEX DG loading calculation.	HCVS batteries/battery charger final sizing evaluation was performed and documented in the Design Change Technical Evaluation of DCN 71389 for Unit 1, DCN 71390 for Unit 2, and DCN 71391 for Unit 3. There is no incorporation of the HCVS battery/battery charger required into the FLEX DG loading calculation due to no plans or requirements to recharge the HCVS battery after depletion. The HCVS electrical loads will be aligned back to their normal power supply which is the Unit Battery. The recharging of the Unit Battery is incorporated into the FLEX DG loading calculations. Calculation EDQ0003602014000281 Revision 3, Electrical Evaluation for Portable Power Supply for Unit Battery Chargers, and calculation EDQ0003602015000325 Revision 1, Electrical Evaluation for 4KV Spare FLEX Turbine Generators, were used to validate the evaluation. This ISE Open Item was closed during NRC audit and documented in ML18038B606 (Reference 12).

12. Make available for NRC staff audit documentation of the HCVS nitrogen pneumatic system design including sizing and location.	The HCVS evaluation has been completed and documented in DCN 71389 for Unit 1, DCN 71390 for Unit 2, DCN 71391 for Unit 3, and calculation MDQ00003220150000347, HCVS Nitrogen System Sizing Analysis. As documented in DCN 71389 Design Change Technical Evaluation (Page 29 of 81), there are 9 Nitrogen Cylinders required for Unit 1 for 7 days of Hardened Vent operation. There are 5 Nitrogen Cylinders installed to support Hardened Vent operation for Unit 1. As documented in DCN 71390 Design Change Technical Evaluation (Page 28 of 75), there are 10 Nitrogen Cylinders required for Unit 2 for 7 days of Hardened Vent operation. As documented in DCN 71391 Design Change Technical Evaluation (Page 26 of 69), there are 9 Nitrogen Cylinders required for Unit 3 for 7 days of Hardened Vent operation. 24 Nitrogen Cylinders are required for Units 2 and 3 for 7 days simultaneous operation. There are 5 Nitrogen Cylinders installed to support Hardened Vent operation for Units 2 and 3. There are 6 Nitrogen Cylinder carts with 6 Nitrogen Cylinders on each cart available in the FLEX Storage building with no other committed use of them. This ISE Open Item was closed during NRC audit and documented in ML18038B606 (Reference 12).
13. Make available for NRC staff audit the seismic and tornado missile final design criteria for the HCVS stack.	Tornado and seismic missile criteria are located in the Primary Containment System (64A) Design Criteria Document (DCD). As part of DCN 71389 for Unit 1, DCN 71390 for Unit 2, and DCN 71391 for Unit 3, a markup reflecting these changes has been generated and will be incorporated in the next revision of the DCD per TVA process. This ISE Open Item was closed during NRC audit and documented in ML18038B606 (Reference 12).
14. Provide a description of the final design of the HCVS to address hydrogen detonation and deflagration.	The final design of HCVS at BFN to address hydrogen detonation and deflagration is the installation of a check valve near the vent discharge release point. A description of this design is contained in the Technical Evaluation for DCN 71389 for Unit 1, DCN 71390 for Unit 2, and DCN 71391 for Unit 3. This ISE Open Item was closed during NRC audit and documented in ML18038B606 (Reference 12).

15. 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.	The HCVS provides a direct vent path from the wetwell to an exhaust point above the Reactor Building roof in accordance with NEI 13-02, Section 4.1.5. This is a leak tight system with no boundary valves outside the primary containment isolation valves (PCIVs) that would allow hydrogen gas migration and ingress into the Reactor Building or other buildings. Per NEI 13-02 Frequently Asked Question FAQ-04, an effluent release velocity of 8000 feet per minute will assure that the effluent plume will not be entrained into the roof recirculation zone of a given building. A description of this design is contained in the Technical Evaluation for DCN 71389 for Unit 1, DCN 71390 for Unit 2, and DCN 71391 for Unit 3. This ISE Open Item was closed during NRC audit and documented in ML18038B606 (Reference 12).
16. Provide design details that minimize unintended cross flow of vented fluids within a unit and between units on the site.	The BFN design includes a separate HCVS stack for each unit as well as meeting the testing criteria and valve requirements for PCIVs and control and boundary valves. A description of this design is contained in the Technical Evaluation for DCN 71389 for Unit 1, DCN 71390 for Unit 2, and DCN 71391 for Unit 3. This ISE Open Item was closed during NRC audit and documented in ML18038B606 (Reference 12).

Phase 2 Interim Staff Evaluation Open Item	**Status**
1. Licensee to perform a hydraulic evaluation to ensure flow adequacy can be met for all 3 units using 1 FLEX pump to support SAWA flow requirement.	Calculation MDN0003602014000233 was revised to include a bounding case that concluded that a single FLEX pump (with booster pump) can provide 500 gpm) to the Unit 1 RPV, 500 gpm to the Unit 2 RPV, and 500 gpm to the Unit 3 RPV, each at RPV pressure of 106 psig in response to a SAWA event. This ISE Open Item was closed during NRC audit and documented in ML18038B606 (Reference 12).

Phase 2 Interim Staff Evaluation Open Item	Status
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.	Equipment and Controls Plant instrumentation for SAWM is qualified to NRC Regulatory Guide (RG) 1.97 or equivalent and is considered qualified for the sustained operating period without further evaluation. The following plant instruments are qualified to RG 1.97: • DW Pressure Indicators, 1,2,3-PI-64-67B, and • Suppression Pool Level Indicators, 1,2,3-LI-64-159A. Passive components that do not need to change state after initially establishing SAWA flow do not require evaluation beyond the first 8 hours, at which time they are expected to be installed and ready for use to support SAWA/SAWM. The following additional equipment performing an active SAWA/SAWM function is considered: • SAWA/SAWM flow instrument, • SAWA/SAWM pump, • FLEX generator, and • SAWA throttle valve. These components will be used at a remote location (outside Reactor Building) and have been evaluated for the environmental conditions applicable at those locations. Ingress and Egress For locations outside the Reactor Building between 7 hours and 7 days when SAWA is being utilized, BFN performed a qualitative evaluation of equipment and deployment locations and confirmed they are protected by distance and/or buildings with substantial shielding to minimize dose rates. A quantitative evaluation of expected dose rates, AREVA document 51-9262174-003, has been performed per NEI HCVS-WP-02 and found the dose rates at deployment locations including ingress/egress paths are acceptable. This ISE Open Item was closed during NRC audit and documented in ML18038B606 (Reference 12).

Phase 2 Interim Staff Evaluation Open Item	Status
3. Licensee to demonstrate how SAWA flow is capable to perform its intended function for the sustained operating period under the expected temperature and radiological conditions.	Equipment and Controls Plant instrumentation for SAWA that is qualified to RG 1.97 or equivalent is considered qualified for the sustained operating period without further evaluation. The following plant instruments are qualified to RG 1.97: • DW Pressure Indicators, 1,2,3-PI-64-67B, and • Suppression Pool Level Indicators, 1,2,3-LI-64-159A. Passive components that do not need to change state after initially establishing SAWA flow do not require evaluation beyond the first 8 hours, at which time they are expected to be installed and ready for use to support SAWA/SAWM. The following additional equipment performing an active SAWA/SAWM function is considered for temperature and radiation effects: • SAWA/SAWM flow instrument, • FLEX/SAWA pump, • FLEX generator, and • SAWA throttle valve. Temperature The location of SAWA equipment and controls that are the same or similar as FLEX will be bounded by the FLEX evaluations for temperature. Radiation For equipment locations outside the Reactor Building between 7 hours and 7 days when SAWA is being utilized, BFN performed a qualitative evaluation of equipment and deployment locations and confirmed they are protected by distance and/or buildings with substantial shielding to minimize dose rates. A quantitative evaluation of expected dose rates, AREVA document 51-9262174-003, has been performed per NEI HCVS-WP-02 and found the dose rates at deployment locations including ingress/egress paths are acceptable. This ISE Open Item was closed during NRC audit and documented in ML18038B606 (Reference 12).

<table>
<tr><th>Phase 2 Interim Staff Evaluation Open Item</th><th>Status</th></tr>
<tr><td>4. Licensee to demonstrate that containment failure as a result of overpressure can be prevented without a drywell vent during severe accident conditions.</td><td>The wetwell vent has been designed and installed to meet NEI 13-02 Revision 1 guidance which will ensure that it is adequately sized to prevent containment overpressure under severe accident conditions.
The SAWM strategy will ensure that the wetwell vent remains functional for the period of sustained operation. BFN will follow the guidance (flow rate and timing) for SAWA/SAWM described in BWROG-TP-15-008, SAWA Timing, and BWROG-TP-15-011, SAWM Supporting Evaluations. The wetwell vent will be opened prior to exceeding the Primary Containment Pressure Limit value of 62 psig. Therefore, containment over pressurization is prevented without the need for a drywell vent.

This ISE Open Item was closed during NRC audit and documented in ML18038B606 (Reference 12).</td></tr>
<tr><td>5. Licensee to demonstrate how the plant is bounded by the reference plant analysis that shows the SAWM strategy is successful in making it unlikely that a drywell vent is needed.</td><td>Using Figure 2.1.C from the combined Phase 1 and 2 OIP, compare the reference plant parameters to the plant specific parameters.
<table>
<tr><th>Reference Plant</th><th>Browns Ferry Nuclear Plant</th></tr>
<tr><td>Torus freeboard volume is 525,000 gallons</td><td>Torus freeboard volume is 757,544 gallons</td></tr>
<tr><td>SAWA flow is 500 gpm at 8 hours followed by 100 gpm from 12 hours to 168 hours</td><td>SAWA flow is 500 gpm at 8 hours followed by 100 gpm from 12 hours to 168 hours</td></tr>
<tr><td colspan="2">The above parameters for BFN compared to the reference plant that determine success of the SAWM strategy demonstrate that the reference plant values are bounding. Therefore, the SAWM strategy implemented at BFN makes it unlikely that a DW vent is needed to prevent containment overpressure related failure.</td></tr>
</table>
This ISE Open Item was closed during NRC audit and documented in ML18038B606 (Reference 12).</td></tr>
</table>

Phase 2 Interim Staff Evaluation Open Item	Status
6. Licensee to demonstrate that there is adequate communication between the MCR and the operator at the FLEX pump during severe accident conditions.	BFN utilizes the Harris Radio System to communicate between the MCR and the operator at the FLEX pump. This communication method is the same as accepted in Order EA-12-049. These items will be powered and remained powered using the same methods as evaluated under EA-12-049 and continued for the period of sustained operation. This ISE Open Item was closed during NRC audit and documented in ML18038B606 (Reference 12).

7 Interim Staff Evaluation Impacts

There are no potential impacts to the Interim Staff Evaluation(s) identified at this time.

8 References

The following references support the updates to the combined Phase 1 and 2 Overall Integrated Plan described in this enclosure.

1. NRC Order Number EA-13-109, “Issuance of Order to Modify Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions,” dated June 6, 2013 (ML13143A321).

2. Letter from TVA to NRC, “Tennessee Valley Authority’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 (Order Number EA-13-109),” dated June 30, 2014 (ML14181B169)

3. Letter from TVA to NRC, “Tennessee Valley Authority's Browns Ferry Nuclear Plant First Six-Month Status Report in Response to 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),” dated December 19, 2014 (ML14353A428)

4. Letter from TVA to NRC, “Tennessee Valley Authority's Browns Ferry Nuclear Plant Second Six-Month Status Report in Response to 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),” dated June 29, 2015 (ML15181A338)

5. Letter from TVA to NRC, “Tennessee Valley Authority's Browns Ferry Nuclear Plant Third Six-Month Status Report and Phase 1 and Phase 2 Overall Integrated Plan in Response to 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),” dated December 29, 2015 (ML15365A554)

6. Letter from TVA to NRC "Tennessee Valley Authority's Browns Ferry Nuclear Plant Fourth Six-Month Status Report in Response to 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)," dated June 30, 2016 (ML16182A517)

7. Letter from TVA to NRC "Tennessee Valley Authority Browns Ferry Nuclear Plant's Fifth Six-Month Status Report in Response to 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),"dated December 22, 2016 (ML16357A577).

8. Letter from TVA to NRC "Tennessee Valley Authority Browns Ferry Nuclear Plant's Sixth Six-Month Status Report in Response to 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)," dated June 30, 2017 (ML17181A333).

9. Letter from TVA to NRC "Tennessee Valley Authority Browns Ferry Nuclear Plant's Seventh Six-Month Status Report in Response to 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)," dated December 20, 2017 (ML17354A250).

10. Letter from NRC to TVA, "Browns Ferry Nuclear Plant, Units 1, 2, and 3 - Interim Staff Evaluation Relating to Overall Integrated Plan in Response to Phase 1 of Order EA-13-109 (Severe Accident Capable Hardened Vents) (TAC Nos. MF4540, MF4541, and MF4542)", dated February 11, 2015 (ML14356A362)

11. Letter from NRC to TVA, "Browns Ferry Nuclear Plant, Units 1, 2, and 3 - Interim Staff Evaluation Relating to Overall Integrated Plan in Response to Phase 2 of Order EA-13-109 (Severe Accident Capable Hardened Vents) (CAC Nos. MF4540, MF4541, and MF4542)," dated September 6, 2016 (ML16244A762)

12. Letter from NRC to TVA, "Browns Ferry Nuclear Plant, Units 1, 2, and 3 - Report for the Audit of Licensee Responses to Interim Staff Evaluations Open Items Related to NRC Order EA-13-109 To Modify Licenses With Regard To Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (CAC Nos. MF4540, MF4541, and MF4542; EPID L-2014-JLD-0044)," dated February 21, 2018 (ML18038B606)

13. Letter from TVA to NRC, "Tennessee Valley Authority, Browns Ferry Nuclear Plant, Unit 3, Completion of Required Action for NRC Order EA-13-109, Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (CAC No. MF4542)," dated May 31, 2018 (ML18169A178)