



Order No. EA-13-109

RS-14-063

June 30, 2014

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

Quad Cities Nuclear Power Station, Units 1 and 2
Renewed Facility Operating License Nos. DPR-29 and DPR-30
NRC Docket Nos. 50-254 and 50-265

Subject: 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)

References:

1. NRC Order Number EA-13-109, "Issuance of Order to Modify Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions," dated June 6, 2013
2. NRC Interim Staff Guidance JLD-ISG-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
3. Exelon Generation Company, LLC's Answer to June 6, 2013, Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109), dated June 26, 2013
4. NEI 13-02, "Industry Guidance for Compliance With Order EA-13-109, BWR Mark I & II Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions", Revision 0, dated November 2013
5. NRC Generic Letter 89-16, Installation of a Hardened Wetwell Vent, dated September 1, 1989

On June 6, 2013, the Nuclear Regulatory Commission ("NRC" or "Commission") issued an order (Reference 1) to Exelon Generation Company, LLC (EGC). Reference 1 was immediately effective and directs EGC to require their BWRs with Mark I and Mark II containments to take certain actions to ensure that these facilities have a hardened containment vent system (HCVS) to remove decay heat from the containment, and maintain control of containment pressure within acceptable limits following events that result in loss of active containment heat removal capability while maintaining the capability to operate under severe accident (SA) conditions resulting from an Extended Loss of AC Power (ELAP). Specific requirements are outlined in Attachment 2 of Reference 1.

Reference 1 requires submission of an Overall Integrated Plan (OIP) by June 30, 2014 for Phase 1 of the Order. The interim staff guidance (Reference 2) was issued November 14, 2013, which

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provides direction regarding the content of this OIP. Reference 3 provided the EGC initial status report regarding reliable hardened containment vents capable of operation under severe accident conditions. The purpose of this letter is to provide the OIP for Phase 1 of the Order pursuant to Section IV, Condition D.1, of Reference 1. This letter confirms EGC has received Reference 2 and has a Phase 1 OIP complying with the guidance for the purpose of ensuring the functionality of a HCVS to remove decay heat from the containment, and 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 SA conditions resulting from an ELAP as described in Attachment 2 of Reference 1.

Reference 4, Section 7.0 contains the specific reporting requirements for the OIP. The information in the Enclosure provides the Quad Cities Nuclear Power Station, Units 1 and 2 Phase 1 OIP pursuant to Reference 2. The enclosed OIP is based on conceptual design information. Final design details and associated procedure guidance, as well as any revisions to the information contained in the Enclosure, will be provided in the 6-month OIP updates required by Section IV, Condition D.3, of Reference 1.

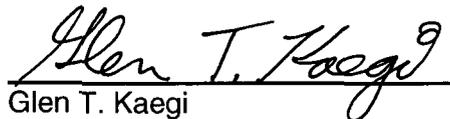
For the purposes of compliance with Phase 1 of Order EA-13-109, Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions, Quad Cities Nuclear Power Station, Units 1 and 2 plans to install a severe accident capable wetwell vent.

Compliance with the requirements of Reference 1 will supersede any and all actions or commitments associated with Reference 5. Any actions or commitments made relative to Reference 5 are rescinded and not binding by submittal of the Reference 1 Phase 1 OIP via this letter.

This letter contains no new regulatory commitments. If you have any questions regarding this report, please contact David P. Helker at 610-765-5525.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 30th day of June 2014.

Respectfully submitted,



Glen T. Kaegi
Director - Licensing & Regulatory Affairs
Exelon Generation Company, LLC

Enclosure:

1. Quad Cities Nuclear Power Station, Units 1 and 2, Overall Integrated Plan for Phase 1 Requirements for Reliable Hardened Containment Vent System (HCVS) Capable of Operation Under Severe Accident Conditions

cc: Director, Office of Nuclear Reactor Regulation
NRC Regional Administrator - Region III
NRC Senior Resident Inspector – Quad Cities Nuclear Power Station
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Enclosure 1

Quad Cities Nuclear Power Station, Units 1 and 2

Overall Integrated Plan for Phase 1 Requirements for Reliable Hardened Containment Vent System (HCVS) Capable of Operation Under Severe Accident Conditions

(43 pages)

Quad Cities Nuclear Power Station, Units 1 and 2 Overall Integrated Plan for Phase 1 Requirements for
Reliable Hardened Containment Vent System (HCVS) Capable of Operation Under Severe Accident
Conditions

Table of Contents:

Introduction:

Part 1: General Integrated Plan Elements and Assumptions

Part 2: Boundary Conditions for Wet Well Vent

Part 3: Boundary Conditions for Dry Well Vent

Part 4: Programmatic Controls, Training, Drills and Maintenance

Part 5: Milestones Schedule

Attachment 1: HCVS Portable Equipment

Attachment 2: Sequence of Events Timeline

Attachment 3: Conceptual Sketches

Attachment 4: Failure Evaluation Table

Attachment 5: References

Attachment 6: Changes/Updates to this Overall Integrated Implementation Plan

Attachment 7: List of Overall Integrated Plan Open Items

Quad Cities Nuclear Power Station, Units 1 and 2 Overall Integrated Plan for Phase 1 Requirements for Reliable Hardened Containment Vent System (HCVS) Capable of Operation Under Severe Accident Conditions

Introduction

In 1989, the NRC issued Generic Letter 89-16, "Installation of a Hardened Wetwell Vent," 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 to require licensees with Mark I and Mark II containments to "upgrade or replace the reliable hardened vents required by Order EA-12-050 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 Modify Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accidents*, June 6, 2013. The Order (EA-13-109) requires that licensees of BWR facilities with Mark I and Mark II containment designs ensure that these facilities have a reliable hardened vent to remove decay heat from the containment, and 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 Order requirements are applied in a phased approach where:

- "Phase 1 involves upgrading the venting capabilities from the containment wetwell to provide reliable, severe accident capable hardened vents to assist in preventing core damage and, if necessary, to provide venting capability during severe accident conditions." (Completed "no later than startup from the second refueling outage that begins after June 30, 2014, or June 30, 2018, whichever comes first.")
- "Phase 2 involves providing additional protections for severe accident conditions through installation of a reliable, severe accident capable drywell vent system or the development of a reliable containment venting strategy that makes it unlikely that a licensee would need to vent from the containment drywell during severe accident conditions." (Completed "no later than startup from the first refueling outage that begins after June 30, 2017, or June 30, 2019, whichever comes first.")

The NRC provided an acceptable approach for complying with Order EA-13-109 through Interim Staff Guidance (JLD-ISG-2013-02) issued in November 2013. The ISG endorses the compliance approach presented in NEI 13-02 Revision 0, *Compliance with Order EA-13-109, Severe Accident Reliable Hardened Containment Vents*, with clarifications. Except in those cases in which a licensee proposes an acceptable alternative method for complying with Order EA-13-109, the NRC staff will use the methods described in this ISG (NEI 13-02) to evaluate licensee compliance as presented in submittals required in Order EA-13-109.

The Order also requires submittal of an overall integrated plan that will provide a description of how the requirements of the Order will be achieved. This document provides the Overall

Quad Cities Nuclear Power Station, Units 1 and 2 Overall Integrated Plan for Phase 1 Requirements for Reliable Hardened Containment Vent System (HCVS) Capable of Operation Under Severe Accident Conditions

Integrated Plan (OIP) for complying with Order EA-13-109 using the methods described in NEI 13-02 and endorsed by NRC JLD-ISG-2013-02. Six-month progress reports will be provided consistent with the requirements of Order EA-13-109.

Quad Cities venting actions for the EA-13-109 severe accident capable venting scenario can be summarized by the following:

- The HCVS will be initiated via manual action from the Main Control Room (MCR) or Remote Operating Station (ROS) at the appropriate time based on procedural guidance in response to plant conditions from observed or derived symptoms.
- The vent will utilize Containment Parameters of Pressure and Wetwell Water Level from the MCR instrumentation to monitor effectiveness of the venting actions.
- The vent operation will be monitored by HCVS valve position, temperature, pressure and effluent radiation levels.
- The HCVS motive force will be monitored and have the capacity to operate for 24 hours with installed equipment. Replenishment of the motive force will be by use of portable equipment once the installed motive force is exhausted.
- Venting actions will be capable of being maintained for a sustained period of up to 7 days or a shorter time if justified.

Quad Cities Nuclear Power Station, Units 1 and 2 Overall Integrated Plan for Phase 1 Requirements for Reliable Hardened Containment Vent System (HCVS) Capable of Operation Under Severe Accident Conditions

Part 1: General Integrated Plan Elements and Assumptions

Extent to which the guidance, JLD-ISG-2013-02 and NEI 13-02, are being followed. Identify any deviations.

Include a description of any alternatives to the guidance. A technical justification and basis for the alternative needs to be provided. This will likely require a pre-meeting with the NRC to review the alternative.

Ref: JLD-ISG-2013-02

Compliance will be attained for Quad Cities with no known deviations to the guidelines in JLD-ISG-2013-02 and NEI 13-02 for each phase as follows:

- Unit 1 Phase 1 (wetwell): by the startup from the second refueling outage that begins after June 30, 2014, or June 30, 2018, whichever comes first. Currently scheduled for 1st Qtr 2017.
- Unit 2 Phase 1 (wetwell): by the startup from the second refueling outage that begins after June 30, 2014, or June 30, 2018, whichever comes first. Currently scheduled for 2nd Qtr 2018.
- Unit 2 Phase 2 (drywell): by the startup from the first refueling outage that begins after June 30, 2017, or June 30, 2019, whichever comes first. Currently scheduled for 2nd Qtr 2018.
- Unit 1 Phase 2: (drywell): by the startup from the first refueling outage that begins after June 30, 2017, or June 30, 2019, whichever comes first. Currently scheduled for 1st Qtr 2019.

If deviations are identified at a later date, then the deviations will be communicated in a future 6 month update following identification.

State Applicable Extreme External Hazard from NEI 12-06, Section 4.0-9.0

List resultant determination of screened in hazards from the EA-12-049 Compliance.

Ref: NEI 13-02 Section 5.2.3 and D.1.2

The following extreme external hazards screen-in for Quad Cities

- Seismic, External Flooding, Extreme Cold, High Wind, Extreme High Temperature

The following extreme external hazards screen out for Quad Cities

- None

Quad Cities Nuclear Power Station, Units 1 and 2 Overall Integrated Plan for Phase 1 Requirements for Reliable Hardened Containment Vent System (HCVS) Capable of Operation Under Severe Accident Conditions

Part 1: General Integrated Plan Elements and Assumptions

Key Site assumptions to implement NEI 13-02 HCVS Actions.

Provide key assumptions associated with implementation of HCVS Phase 1 Actions.

Ref: NEI 13-02 Section 1

Mark I/II Generic HCVS Related Assumptions:

Applicable EA-12-049 assumptions:

- 049-1. Assumed initial plant conditions are as identified in NEI 12-06 section 3.2.1.2 items 1 and 2
- 049-2. Assumed initial conditions are as identified in NEI 12-06 section 3.2.1.3 items 1, 2, 4, 5, 6 and 8
- 049-3. Assumed reactor transient boundary conditions are as identified in NEI 12-06 section 3.2.1.4 items 1, 2, 3 and 4
- 049-4. No additional events or failures are assumed to occur immediately prior to or during the event, including security events, except for failure of RCIC or HPCI.
- 049-5. At Time=0 the event is initiated and all rods insert and no other event beyond a common site ELAP is occurring at any or all of the units. (NEI 12-06, section 3.2.1.3 item 9 and 3.2.1.4 item 1-4)
- 049-6. At 1 hour (time critical at a time greater than 1 hour) an ELAP is declared and actions begin as defined in EA-12-049 compliance
- 049-7. DC power and distribution can be credited for the duration determined per the EA-12-049 (FLEX) methodology for battery usage: (Equal or greater than 8 hours.)

Open Item 8 - Confirm 125 VDC Station Battery Life

- 049-8. Deployment resources are assumed to begin arriving at hour 6 and fully staffed by 24 hours
- 049-9. All activities associated with plant specific EA-12-049 FLEX strategies that are not specific to implementation of the HCVS, including such items as debris removal, communication, notifications, SFP level and makeup, security response, opening doors for cooling, and initiating conditions for the event, can be credited as previously evaluated for FLEX.

Applicable EA-13-109 generic assumptions:

- 109-1. Site response activities associated with EA-13-109 actions are considered to have no access limitations associated with radiological impacts while RPV level is above 2/3 core height (core damage is not expected).
- 109-2. Portable equipment can supplement the installed equipment after 24 hours provided the portable equipment credited meets the criteria applicable to the HCVS. The portable equipment (e.g., compressor, generator) used to replenish HCVS components must be demonstrated to meet the "SA Capable" criteria that are defined in NEI 13-02 Section 4.2.4.2 and Appendix D Section D.1.3.
- 109-3. SFP Level is maintained with either on-site or off-site resources such that the SFP does not contribute to the analyzed source term.
- 109-4. Existing containment components design and testing values are governed by existing plant containment criteria (e.g., Appendix J) and are not subject to the testing criteria from NEI 13-02.
- 109-5. Classical design basis evaluations and assumptions are not required when assessing the operation of the HCVS. The reason this is not required is that the order postulates an unsuccessful mitigation of an event such that an ELAP progresses to a severe accident with ex-vessel core debris that classical

Quad Cities Nuclear Power Station, Units 1 and 2 Overall Integrated Plan for Phase 1 Requirements for Reliable Hardened Containment Vent System (HCVS) Capable of Operation Under Severe Accident Conditions

Part 1: General Integrated Plan Elements and Assumptions

- design basis evaluations are intended to prevent.
- 109-6. HCVS manual actions that require minimal operator steps and can be performed in the postulated thermal and radiological environment at the location of the step(s) (e.g., load stripping, control switch manipulation, valving-in nitrogen bottles) are acceptable to obtain HCVS venting dedicated functionality.
 - 109-7. HCVS dedicated equipment is defined as vent process elements that are required for the HCVS to function in an ELAP event that progresses to core melt ex-vessel.
 - 109-8. Use of MAAP Version 4 or higher provides adequate assurance of the plant conditions (e.g., RPV water level, temperatures, etc.) assumed for Order EA-13-109 BDBEE and SA HCVS operation. Additional analysis using RELAP5/MOD 3, GOTHIC, PCFLUD, LOCADOSE and SHIELD are acceptable methods for evaluating environmental conditions in areas of the plant provided the specific version utilized is documented in the analysis.
 - 109-9. Utilization of NRC Published Accident evaluations (e.g., SOARCA, SECY-12-0157, and NUREG 1465) as related to Order EA-13-109 conditions are acceptable as references.
 - 109-10. Permanent modifications installed per EA-12-049 are assumed implemented and may be credited for use in EA-13-109 Order response.
 - 109-11. This Overall Integrated Plan is based on Emergency Operating Procedure changes consistent with EPG/SAGs Revision 3 as incorporated per the sites EOP/SAMG procedure change process.
 - 109-12. Under the postulated scenarios of order EA-13-109 the Control Room is adequately protected from excessive radiation dose per General Design Criterion (GDC) 19 in 10CFR50 Appendix A and no further evaluation of its use as the preferred HCVS control location is required. In addition, adequate protective clothing and respiratory protection is available if required to address contamination issues.

Plant Specific HCVS Related Assumptions/Characteristics:

Quad Cities 1 – EA-12-049 (FLEX) actions to restore power are sufficient to ensure continuous operation of non-dedicated containment instrumentation.

Quad Cities 2 – Although Quad Cities screens in for the Combined Maximum River Flood, HCVS will not be required due to the Station's response to this event. The Station will have advance warning of the River Flood, and will be in cold shutdown via normal procedures, with the two Reactor Vessels disassembled and flooded up to the refueling cavity and combined with the Spent Fuel Pool, prior to water going above plant grade. Therefore, since Primary Containment will no longer be intact during this event, the HCVS will not be required.

Part 2: Boundary Conditions for Wetwell (WW) Vent

Provide a sequence of events and identify any time or environmental constraint required for success including the basis for the constraint.

HCVS Actions that have a time constraint to be successful should be identified with a technical basis and a justification provided that the time can reasonably be met (for example, action to open vent valves).

HCVS Actions that have an environmental constraint (e.g. actions in areas of High Thermal stress or High Dose areas) should be evaluated per guidance.

Describe in detail in this section the technical basis for the constraints identified on the sequence of events timeline attachment.

See attached sequence of events timeline (Attachment 2).

Ref: EA-13-109 Section 1.1.1, 1.1.2, 1.1.3/ NEI 13-02 Section 4.2.5, 4.2.6. 6.1.1

The containment vent exhaust at each Quad Cities unit consists of a WW primary containment isolation valve (PCIV), a Drywell (DW) PCIV, and common downstream PCIVs. The HCVS flow path will utilize portions of this system. The HCVS will connect upstream of the existing downstream PCIVs. Consequently, the HCVS flow path will share the upstream PCIVs with the containment vent system, but it will have a downstream PCIV dedicated to the HCVS flow path. The new HCVS flow path will have a dedicated secondary containment isolation valve (SCIV), which will also supply HCVS flow control. Each unit will have piping that is totally separate from the other unit and with no interconnected systems downstream of the new downstream PCIV. The piping from each unit is routed separately and discharges above the Reactor Building roof.

Each unit will have dedicated motive power (Pressurized N₂/air) for HCVS valves and dedicated DC power for HCVS components that are not shared with any other function and do not rely on FLEX, with the clarification that existing containment instrumentation (pressure and WW level) are not considered HCVS components and power will be maintained through the actions for EA-12-049.

The operation of the HCVS will be designed to minimize the reliance on operator actions in response to hazards listed in Part 1. Immediate operator actions will be completed by plant personnel and will 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 can be found in the following table (2-1). A HCVS Extended Loss of AC Power (ELAP) Failure Evaluation table, which shows alternate actions that can be performed, is included in Attachment 4.

Table 2-1 HCVS Remote Manual Actions

Primary Action	Primary Location / Component	Notes
1. Energize the HCVS power supply to the HCVS components	Main Control Room (MCR)	This action is not required for operation at the Remote Operating Station (ROS) (Open Item 1 – Determine Motive Power)
2. Enable the N ₂ /air motive air for the HCVS valves	MCR	Alternate control via manual valves at the ROS (Open Item 1 – Determine Motive Power)

Quad Cities Nuclear Power Station, Units 1 and 2 Overall Integrated Plan for Phase 1 Requirements for Reliable Hardened Containment Vent System (HCVS) Capable of Operation Under Severe Accident Conditions

Part 2: Boundary Conditions for Wetwell (WW) Vent

3. Check shut the DW PCIV and the downstream PCIV on the containment vent	MCR	Precautionary steps; these valves are normally shut and fail shut.
4. Open WW PCIV [1(2)-1601-60]	Override the containment isolation signal and open the PCIV in the MCR	Alternate control via manual valves at the ROS
5. Open the PCIV on the common HCVS line [EPN TBD]	Key locked hand switch located in the MCR	Alternate control via manual valves at the ROS
6. Open HCVS SCIV [EPN TBD]	Key locked hand switch located in the MCR	Alternate control via manual valves at the ROS
7. Align portable generator to HCVS battery charger.	At ROS	Prior to depletion of the HCVS battery supply, actions will be required to recharge the battery.
8. Replace N ₂ /air motive power bottles or align portable compressor	Replacement Nitrogen bottles and/or compressor will be located at the ROS.	Prior to depletion of the pneumatic sources, actions will be required to connect back-up sources at a time greater than 24 hours.

Open Item 1 - Determine how HCVS DC Power and/or Motive Power will be disabled during normal operation to provide assurances against inadvertent operation, but to also minimize actions to enable operation following an ELAP.

A timeline was developed to identify required operator response times and potential environmental constraints. This timeline is based upon the following three cases:

1. Case 1 is based upon the action response times developed for FLEX when utilizing anticipatory venting in a BDBEE without core damage.
2. Case 2 is based on a SECY-12-0157 long-term station blackout (LTSBO) (or ELAP) with failure of RCIC after a black start where failure occurs because of subjectively assuming over injection.
3. Case 3 is based on NUREG-1935 (SOARCA) results for a prolonged SBO (or ELAP) with the loss of RCIC case without black start.

Discussion of time constraints identified in Attachment 2 for the 3 timeline cases identified above

- At 8.3 hours, initiate use of Hardened Containment Vent System (HCVS) per site procedures to maintain containment parameters below design limits and within the limits that allow continued use of RCIC - Reliable operation of HCVS will be met because HCVS meets the seismic requirements identified in NEI 13-02, will be powered by DC power from a dedicated power source, and HCVS valves are supplied with motive force from portable nitrogen bottles. HCVS controls and instrumentation will be DC powered. Valves will be operable from the HCVS control panel in the MCR, or at the ROS. DC power and motive air will be available for 24 hours from permanent sources. Containment pressure and WW level indication will be initially powered from existing 1E Station battery and maintained by FLEX generators.

Part 2: Boundary Conditions for Wetwell (WW) Vent

Thus, initiation of the HCVS from the MCR or the Remote Operating Station within 8.3 hours is acceptable because the actions can be performed any time after declaration of an ELAP until the venting is needed for BDBEE venting. This action can also be performed for SA HCVS operation which occur at a time further removed from an ELAP declaration as shown in Attachment 2.

- “Anticipatory Venting” refers to the action of venting Primary Containment before a containment limit *requiring* venting is reached (i.e. Primary Containment Pressure Limit) in *anticipation* of a future need to vent containment. EPG Revision 3 permits “Anticipatory Venting” when primary containment pressure cannot be maintained below the drywell pressure scram setpoint, if the action is needed either to “maintain adequate core cooling” OR to “reduce the total offsite radiation dose.” As discussed in the BWROG Appendix B “Technical Bases”, venting below the Primary Containment Pressure Limit may be appropriate to restore and maintain adequate core cooling if:
 - 1) Pressure must be reduced to permit RPV injection.
 - 2) The suppression pool approaches saturation conditions and can no longer effectively condense steam discharged from RCIC.
- The response for a Local Intense Precipitation (LIP) event will delay the deployment of the FLEX equipment from the storage building due to the water levels surrounding the Turbine, Reactor, and FLEX buildings. As the water levels drop, operators will be dispatched to perform the necessary actions to connect the FLEX support equipment. Based on the LIP studies it is anticipated that the connections of the FLEX equipment will be completed at T= 10 hours.
- Within 24 hours, the permanently installed nitrogen bottles at the ROS will be replaced, as required, to maintain sustained operation or alternatively a portable compressor will be connect at the ROS. This can be performed at any time prior to 24 hours to ensure adequate capacity is maintained; therefore, this time constraint is not limiting.
- Within 24 hours, a portable generator will be installed and connected to recharge the dedicated HCVS power supply to maintain sustained operation. This can be performed any time prior to 24 hours; therefore, this time constraint is not limiting. Modifications will be implemented to facilitate the connections and operational actions required to supply power any time after declaration of an ELAP until the repowering is needed at greater than 24 hours.
- Current Quad Cities’ 1E battery durations are calculated to last at least 8 hours. FLEX DG will be staged beginning at approximately 4 hours. Thus, the FLEX DGs will be available to be placed in service at any point after 4 hours as required to supply power to containment parameters (containment pressure and WW level). A FLEX DG will be maintained in on-site FLEX storage buildings. DG will be transferred and staged via haul routes and staging areas evaluated for impact from external hazards.

Discussion of radiological and temperature constraints identified in Attachment 2

- Actions to initiate HCVS operation are taken from the MCR or from the ROS in the Turbine Building. Both locations have significant shielding and/or physical separation from radiological sources. Non-radiological habitability for the MCR is being addressed as part of the Quad Cities FLEX response.
- Before the end of the initial 24-hour period, replenishment of the HCVS dedicated DC power and motive power (pressurized gas) will occur at the ROS. The selection of the ROS location will take into account the SA temperature and radiation condition to ensure access to the ROS. The design will allow

Part 2: Boundary Conditions for Wetwell (WW) Vent

replenishment with minimal actions.

Open Item 2 – Confirm that the ROS will be in an accessible area following a SA.

Provide Details on the Vent characteristics

Vent Size and Basis (EA-13-109 Section 1.2.1 / NEI 13-02 Section 4.1.1)

What is the plants licensed power? Discuss any plans for possible increases in licensed power (e.g. MUR, EPU).

What is the nominal diameter of the vent pipe in inches/ Is the basis determined by venting at containment design pressure, Primary Containment Pressure Limit (PCPL), or some other criteria (e.g. anticipatory venting)?

Vent Capacity (EA-13-109 Section 1.2.1 / NEI 13-02 Section 4.1.1)

Indicate any exceptions to the 1% decay heat removal criteria, including reasons for the exception. Provide the heat capacity of the suppression pool in terms of time versus pressurization capacity, assuming suppression pool is the injection source.

Vent Path and Discharge (EA-13-109 Section 1.1.4, 1.2.2/ NEI 13-02 Section 4.1.3, 4.1.5 and Appendix F/G)

Provides a description of Vent path, release path, and impact of vent path on other vent element items.

Power and Pneumatic Supply Sources (EA-13-109 Section 1.2.5 & 1.2.6 / NEI 13-02 Section 4.2.3, 2.5, 4.2.2, 4.2.6, 6.1)

Provide a discussion of electrical power requirements, including a description of dedicated 24-hour power supply from permanently installed sources. Include a similar discussion as above for the valve motive force requirements. Indicate the area in the plant from where the installed/dedicated power and pneumatic supply sources are coming.

Indicate the areas where portable equipment will be staged after the 24-hour period, the dose fields in the area, and any shielding that would be necessary in that area. Any shielding that would be provided in those areas.

Location of Control Panels (EA-13-109 Section 1.1.1, 1.1.2, 1.1.3, 1.1.4, 1.2.4, 1.2.5 / NEI 13-02 Section 4.1.3, 4.2.2, 4.2.3, 4.2.5, 4.2.6, 6.1.1 and Appendix F/G)

Indicate the location of the panels, and the dose fields in the area during severe accidents and any shielding that would be required in the area. This can be a qualitative assessment based on criteria in NEI 13-02.

Hydrogen (EA-13-109 Section 1.2.10, 1.2.11, 1.2.12 / NEI 13-02 Section 2.3,2.4, 4.1.1, 4.1.6, 4.1.7, 5.1, & Appendix H)

Part 2: Boundary Conditions for Wetwell (WW) Vent

State which approach or combination of approaches the plant will take to address the control of flammable gases, clearly demarcating the segments of vent system to which an approach applies.

Unintended Cross Flow of Vented Fluids (EA-13-109 Section 1.2.3, 1.2.12 / NEI 13-02 Section 4.1.2, 4.1.4, 4.1.6 and Appendix H)

Provide a description to eliminate/minimize unintended cross flow of vented fluids with emphasis on interfacing ventilation systems (e.g. SGTS). What design features are being included to limit leakage through interfacing valves or Appendix J type testing features?

Prevention of Inadvertent Actuation (EA-13-109 Section 1.2.7/NEI 13-02 Section 4.2.1)

The HCVS shall include means to prevent inadvertent actuation.

Component Qualifications (EA-13-109 Section 2.1 / NEI 13-02 Section 5.1, 5.3)

State qualification criteria based on use of a combination of safety related and augmented quality dependent on the location, function and interconnected system requirements.

Monitoring of HCVS (Order Elements 1.1.4, 1.2.8, 1.2.9/NEI 13-02 4.1.3, 4.2.2, 4.2.4, and Appendix F/G)

Provides a description of instruments used to monitor HCVS operation and effluent. Power for an instrument will require the intrinsically safe equipment installed as part of the power sourcing.

Component reliable and rugged performance (EA-13-109 Section 2.2 / NEI 13-02 Section 5.2, 5.3)

HCVS components including instrumentation should be designed, as a minimum, to meet the seismic design requirements of the plant.

Components including instrumentation that are not required to be seismically designed by the design basis of the plant should be designed for reliable and rugged performance that is capable of ensuring HCVS functionality following a seismic event. (reference ISG-JLD-2012-01 and ISG-JLD-2012-03 for seismic details.)

The components including instrumentation external to a seismic category 1 (or equivalent building or enclosure should be designed to meet the external hazards that screen-in for the plant as defined in guidance NEI 12-06 as endorsed by JLD-ISG-12-01 for Order EA-12-049.

Use of instruments and supporting components with known operating principles that are supplied by manufacturers with commercial quality assurance programs, such as ISO9001. The procurement specifications shall include the seismic requirements and/or instrument design requirements, and specify the need for commercial design standards and testing under seismic loadings consistent with design basis values at the instrument locations.

Demonstration of the seismic reliability of the instrumentation through methods that predict performance by analysis, qualification testing under simulated seismic conditions, a combination of testing and analysis, or the use of experience data. Guidance for these is based on sections 7, 8, 9, and 10 of IEEE Standard 344-2004, "IEEE Recommended Practice for Seismic Qualification of Class

Part 2: Boundary Conditions for Wetwell (WW) Vent

1E Equipment for Nuclear Power Generating Stations," or a substantially similar industrial standard could be used.

Demonstration that the instrumentation is substantially similar in design to instrumentation that has been previously tested to seismic loading levels in accordance with the plant design basis at the location where the instrument is to be installed (g-levels and frequency ranges). Such testing and analysis should be similar to that performed for the plant licensing basis.

Vent Size and Basis

The HCVS WW path is designed for venting steam/energy at a nominal capacity of 1% of 2957 MWt thermal power at a pressure of 56 psig. This pressure is the lower of the containment design pressure and the PCPL value.

The nominal diameter of the upstream HCVS piping, which is part of the containment penetration boundary, is 18 inches, which provides adequate capacity to meet or exceed the Order criteria. The new downstream piping, which is dedicated to the HCVS venting function, is estimated to be between 12 to 14 inches in diameter

Open Item 3 – Confirm diameter on new common HCVS piping.

Vent Capacity

The 1% value at Quad Cities assumes that the suppression pool pressure suppression capacity is sufficient to absorb the decay heat generated during the first 3 hours. The vent would then be able to prevent containment pressure from increasing above the containment design pressure. As part of the detailed design, the duration of suppression pool decay heat absorption capability will be confirmed.

Open Item 4 – Confirm suppression pool heat capacity.

Vent Path and Discharge

The WW HCVS path at Quad Cities will use the existing upstream primary containment isolation Valve (PCIV) that is common with the WW exhaust to the Standby Gas Treatment System (SGTS) and the normal containment ventilation system. The HCVS WW ventilation path will add a line starting upstream of the existing downstream PCIV. It will include a new, dedicated downstream PCIV and Secondary Containment Isolation Valve (SCIV). The new line will route horizontally through the Reactor Building wall, and then rise vertically on the outside of the Reactor Building to a point above the top of the Reactor Building. There are no interconnected systems downstream of the second, dedicated PCIV and there is no sharing of any flow path between the two units.

The HCVS discharge path will be routed to a point above any adjacent structure. This discharge point is just above that unit's Reactor Building, and will follow the guidance of FAQ- HCVS-04 (Reference 16) such that the release point will vent away from contingency ventilation system intake and exhaust openings, main control room location, location of HCVS portable equipment, access routes required following a ELAP and BDBEE, and emergency response facilities to the extent reasonably possible; however, these must be considered in conjunction with other design criteria (e.g., flow capacity) and pipe routing limitations.

The detailed design will address missile protection to a maximum height of 30 feet from ground elevation, from external events as defined by NEI 12-06 for the outside portions of the selected release pipe.

Part 2: Boundary Conditions for Wetwell (WW) Vent

Power and Pneumatic Supply Sources

All electrical power required for operation of HCVS components will be from a dedicated HCVS DC battery source with permanently installed capacity for the first 24 hours and design provisions for recharging to maintain sustained operation.

Motive (pneumatic) power to the HCVS valves is provided by a dedicated bank of N₂/air gas bottles with permanently installed capacity for the first 24 hours and design provisions for replacing bottles and/or connecting a portable compressor to maintain sustained operation. The initial stored motive air/gas will allow for a minimum of 12 vent cycles for the HCVS valves for the first 24 hours. The 12 vent cycles is defined as initially opening all valves in the WW flow path, and then shutting and reopening one of the valves in the flow path 11 times.

1. The HCVS flow path valves are air-operated valves (AOV) with air-to-open and spring-to-shut. Opening the valves from the HCVS control panel located in the MCR requires energizing a DC powered solenoid operated valve (SOV) and providing motive air/gas.
2. An assessment of temperature and radiological conditions will be performed to ensure that operating personnel can safely access and operate controls at the ROS based on time constraints listed in Attachment 2.
3. All permanently installed HCVS equipment, including any connections required to supplement the HCVS operation during an ELAP (i.e., DC power and motive force [pressurized N₂/air]) will be located in areas reasonably protected from defined hazards listed in Part 1 of this report.
4. All valves required to open the flow path will be designed for remote manual operation following an ELAP, such that the primary means of valve manipulation does not rely on use of a handwheel, reach-rod or similar means that requires close proximity to the valve. The preferred method is opening from the MCR through the control switch that energizes the AOVs SOV. The back-up method is from the ROS by repositioning valves on the pneumatic air line; this allows opening and closing of a valve from the ROS without reliance on any electrical power or control circuit. Accessibility to the ROS will be verified during the detailed design phase.

Open Item 2 – Confirm the ROS will be accessible following a SA.

5. Any supplemental connections will be pre-engineered to minimize manpower resources and address environmental concerns. Required portable equipment will be reasonably protected from screened in hazards listed in Part 1 of this OIP.
6. Access to the locations described above will not require temporary ladders or scaffolding.

Proposed Location of Control Panels

The HCVS design allows initiating and then operating and monitoring the HCVS from the Main Control Room (MCR) and in addition, opening valve(s) from the ROS in case of a DC circuit failure. The tentative location for the ROS is the Turbine Building Main Floor along the Turbine/Reactor Building wall. The MCR location is protected from adverse natural phenomena and the normal control point for Plant Emergency Response actions. The ROS location will be evaluated to ensure acceptable temperature and dose consequences.

Part 2: Boundary Conditions for Wetwell (WW) Vent

Open Item 2 – Confirm the ROS will be accessible following a SA.

Hydrogen

As is required by EA-13-109, Section 1.2.11, the HCVS must be designed such that it is able to either provide assurance that oxygen cannot enter and mix with flammable gas in the HCVS (so as to form a combustible gas mixture), or it must be able to accommodate the dynamic loading resulting from a combustible gas detonation. Several configurations are available which will support the former (e.g., purge, mechanical isolation from outside air, etc.) or the latter (design of potentially affected portions of the system to withstand a detonation relative to pipe stress and support structures). Quad Cities will determine the approach or combination of approaches the plant will take to address the combustible gas mixture. Quad Cities intends to follow the guidance in HCVS-WP-03, Hydrogen/CO Control Measures.

Open Item 5 – Determine the approach for combustible gases.

Unintended Cross Flow of Vented Fluids

The HCVS uses dedicated PCIVs for containment isolation and a dedicated flow path that has neither any interconnected-systems nor sharing with the opposite unit's HCVS. These containment isolation valves are AOVs that are air-to-open and spring-to-shut.

Prevention of Inadvertent Actuation

EOP/ERG operating procedures provide clear guidance that the HCVS will not be used to defeat containment integrity during any design basis transients and accident. In addition, the HCVS will be designed to provide features to prevent inadvertent actuation due to an equipment malfunction or operator error 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 (DBLOCA)). However, the ECCS pumps will not have normal power available because of the starting boundary conditions of an ELAP. Note that Quad Cities does credit CAP for its DBLOCA. However, preventing inadvertent operation is addressed.

The features that prevent inadvertent actuation are two PCIVs in series. These valves are fail-shut AOVs. They are air to open, spring to shut AOVs that require energizing a SOV to allow the motive air to open the valve. Emergency operation of each PCIV will require dedicated operation of a key-locked switch. In addition, the DC power to the SOVs will normally be disabled to prevent inadvertent operation.

Component Qualifications

The HCVS components and components that interface with the HCVS are routed in seismically qualified structures.

HCVS components that are part of the containment pressure boundary will be safety-related. The containment system limits the leakage or release of radioactive materials to the environment to prevent offsite exposures from exceeding the guidelines of 10CFR100. During normal or design basis operations, this means serving as a pressure boundary to prevent release of radioactive material. HCVS components downstream of the containment pressure boundary (i.e., downstream of the downstream PCIV) will not be safety-related.

The HCVS components (SOVs and instrumentation) will be powered from a normally de-energized, dedicated power supply. HCVS electrical or control components that interface with Class 1E power sources will be considered safety related up to and including appropriate isolation devices such as fuses or breakers, as their failure could adversely impact containment isolation and/or a safety-related power source. The installation of

Quad Cities Nuclear Power Station, Units 1 and 2 Overall Integrated Plan for Phase 1 Requirements for Reliable Hardened Containment Vent System (HCVS) Capable of Operation Under Severe Accident Conditions

Part 2: Boundary Conditions for Wetwell (WW) Vent

the remaining equipment will be considered Augmented Quality. Newly installed piping and valves will be seismically qualified to handle the forces associated with the Safe Shutdown Earthquake (SSE) back to their isolation boundaries. Electrical and controls components will be seismically qualified and will include the ability to handle harsh environmental conditions (although they will not be considered part of the site Environmental Qualification (EQ) program).

HCVS instrumentation performance (e.g., accuracy and precision) need not exceed that of similar plant installed equipment. Additionally, radiation monitoring instrumentation accuracy and range will be sufficient to confirm flow of radionuclides through the HCVS. The HCVS instruments, including valve position indication, process instrumentation, radiation monitoring, and support system monitoring, will be qualified by using one or more of the three methods described in the ISG, which includes:

1. Purchase of instruments and supporting components with known operating principles from manufacturers with commercial quality assurance programs (e.g., ISO9001) where the procurement specifications include the applicable seismic requirements, design requirements, and applicable testing.
2. Demonstration of seismic reliability via methods that predict performance described in IEEE 344-2004
3. Demonstration that instrumentation is substantially similar to the design of instrumentation previously qualified.

<u>Instrument</u>	<u>Qualification Method*</u>
HCVS Process Temperature	ISO9001 / IEEE 344-2004 / Demonstration
HCVS Process Pressure	ISO9001 / IEEE 344-2004 / Demonstration
HCVS Process Radiation Monitor	ISO9001 / IEEE 344-2004 / Demonstration
HCVS Process Valve Position	ISO9001 / IEEE 344-2004 / Demonstration
HCVS Pneumatic Supply Pressure	ISO9001 / IEEE 344-2004 / Demonstration
HCVS Electrical Power Supply Availability	ISO9001 / IEEE 344-2004 / Demonstration

* The specific qualification method used for each required HCVS instrument will be reported in future 6 month status reports.

Monitoring of HCVS

The Quad Cities WW HCVS will be capable of being remote-manually operated during sustained operations from a control panel located in the main control room (MCR) and will meet the requirements of Order element 1.2.4. The MCR is a readily accessible location with no further evaluation required. (Generic Assumption 109-12) Additionally, to meet the intent for a secondary control location of section 1.2.5 of the Order, a readily accessible Remote Operating Station (ROS) will also be incorporated into the HCVS design as described in NEI 13-02 section 4.2.2.1.2.1. The controls and indications at the ROS location will be 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), and inadequate containment cooling. An evaluation will be performed to determine accessibility to the ROS location, habitability, staffing sufficiency, and communication capability with Vent-use decision makers.

Part 2: Boundary Conditions for Wetwell (WW) Vent

The WW HCVS will include means to monitor the status of the vent system in the MCR and to monitor DC power and N₂/air pressure at the ROS. The proposed design for the HCVS includes control switches in the MCR with valve position indication. The HCVS controls will meet the environmental and seismic requirements of the Order for the plant severe accident with an ELAP. The ability to open/close these valves multiple times during the event's first 24 hours will be provided by dedicated motive air and DC power. Beyond the first 24 hours, the ability to maintain these valves open or closed will be maintained by sustaining the motive air and DC power.

The WW HCVS will include indications for vent pipe pressure, temperature, valve position, and effluent radiation levels in the MCR. Other important information on the status of supporting systems (i.e., DC power source status and pneumatic supply pressure) will also be included in the design and located to support HCVS operation.

Other instrumentation that supports HCVS function is provided in the MCR. This includes existing DW vent pressure and containment level indication. This instrumentation is not required to validate HCVS function and is therefore not powered from the dedicated HCVS batteries. However, these instruments are expected to be available since the FLEX DG supplies the station battery charger for these instruments and will be installed prior to depletion of the station batteries.

Component Reliable And Rugged Performance

Unless otherwise required to be safety-related, Augmented Quality requirements will be applied to the components installed in response to this Order.

Non-safety related piping, electrical power supply, valve actuator pneumatic supply, and instrumentation (local and remote) components, would be designed/analyzed to conform to the requirements consistent with the applicable design codes (e.g., Non-safety, Seismic Category 1, B31.1) for the plant and to ensure functionality following a design basis earthquake.

Additional modifications required to meet the Order will provide reliability at the postulated vent pipe conditions (temperature, pressure, and radiation levels). The instrumentation/power supplies/cables/connections (components) will be qualified for temperature, pressure, radiation level, total integrated radiation dose appropriate for that location (e.g., near the effluent vent pipe or at the HCVS ROS location).

Conduit design and/or cable trays will be installed to Seismic Class 1 criteria.

Both existing and new barriers will be used to provide a level of protection from externally generated missiles below 30 feet above ground level when equipment is located outside of seismically qualified structures.

If the instruments are purchased as commercial-grade equipment, they will be qualified to operate under severe accident environment as required by NRC Order EA-13-109 and the guidance of NEI 13-02. These qualifications will be bounding conditions for Quad Cities.

For the HCVS instruments required after a potential seismic event, the following methods will be used to verify

Part 2: Boundary Conditions for Wetwell (WW) Vent

that the design and installation is reliable / rugged and thus capable of ensuring HCVS functionality following a seismic event. Applicable instruments are rated by the manufacturer (or otherwise tested) for seismic impact at levels commensurate with those of postulated severe accident event conditions in the area of instrument component use using one or more of the following methods:

- demonstration of seismic motion will be consistent with that of existing design basis loads at the installed location;
- substantial history of operational reliability in environments with significant vibration with a design envelope inclusive of the effects of seismic motion imparted to the instruments proposed at the location;
- adequacy of seismic design and installation is demonstrated based on the guidance in Sections 7, 8, 9, and 10 of IEEE Standard 344-2004, *IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations*, (Reference 27) or a substantially similar industrial standard;
- demonstration that proposed devices are substantially similar in design to models that have been previously tested for seismic effects in excess of the plant design basis at the location where the instrument is to be installed (g-levels and frequency ranges); or
- seismic qualification using seismic motion consistent with that of existing design basis loading at the installation location.

Part 2 Boundary Conditions for WW Vent: BDBEE Venting

Determine venting capability for BDBEE Venting, such as may be used in an ELAP scenario to mitigate core damage.

Ref: EA-13-109 Section 1.1.4/NEI 13-02 Section 2.2

First 24-Hour Coping Detail

Provide a general description of the venting actions for first 24 hours using installed equipment including station modifications that are proposed.

Ref: EA-13-109 Section 1.2.6 / NEI 13-02 Section 2.5, 4.2.2

The operation of the HCVS will be designed to minimize the reliance on operator actions for response to a ELAP and BDBEE hazards identified in Part 1 of this OIP. Immediate operator actions can be completed by Operators from the HCVS control station and include remote-manual initiation. The operator actions required to open a vent path are as described in Table 2-1.

Remote-manual is defined in this report as a non-automatic power operation of a component that does not require the operator to be at or in close proximity to the component. No other operator actions are required to initiate venting under the guiding procedural protocol.

The HCVS will be designed to allow initiation, control, and monitoring of venting from the Main Control Room (MCR). This location minimizes plant operators' exposure to adverse temperature and radiological conditions and is protected from hazards assumed in Part 1 of this report.

Permanently installed and dedicated power and motive air/gas capability will be available to support operation and monitoring of the HCVS for the first 24 hours.

System control:

- i. Active: The PCIV and the SCIV will be operated in accordance with EOPs/SOPs to control containment pressure. The HCVS will be designed for 12 vent cycles under ELAP conditions over the first 24 hours following an ELAP. Controlled venting will be permitted in the revised EPGs and associated implementing EOPs.
- ii. Passive: Inadvertent actuation protection is provided by:
 - A key locked switch for the dedicated downstream PCIV located in the Main Control Room and controlled by procedures
 - AND
 - Disabling the HCVS DC power to the SOV and disabling the motive power (pressurized N₂/air) for the dedicated PCIV except when required by procedures to initiate containment venting

Quad Cities Nuclear Power Station, Units 1 and 2 Overall Integrated Plan for Phase 1 Requirements for Reliable Hardened Containment Vent System (HCVS) Capable of Operation Under Severe Accident Conditions

Part 2 Boundary Conditions for WW Vent: BDBEE Venting

Greater Than 24-Hour Coping Detail

Provide a general description of the venting actions for greater than 24 hours using portable and installed equipment including station modifications that are proposed.

Ref: EA-13-109 Section 1.2.4, 1.2.8 / NEI 13-02 Section 4.2.2

Before the end of the 24 hours initial phase, available personnel will be able to connect supplemental motive air/gas to the HCVS. Connections for supplementing electrical power and motive air/gas required for HCVS will be located in accessible areas with reasonable protection per NEI 12-06 that minimize personnel exposure to adverse conditions for HCVS initiation and operation. Connections will be pre-engineered to minimize manpower resources.

FLEX is credited solely to sustain power for a BDBEE ELAP to containment instruments used to monitor the containment (e.g., pressure and WW level). The response to NRC Order EA-12-049 will demonstrate the capability for FLEX efforts to maintain the power source.

These actions provide long-term support for HCVS operation for the period beyond 24 hours to 7 days (sustained operation time period) because on-site and off-site personnel and resources will have access to the unit(s) to provide needed action and supplies.

Details:

Provide a brief description of Procedures / Guidelines:

Confirm that procedure/guidance exists or will be developed to support implementation.

Primary Containment Control Flowchart will be provided to direct operations in protection and control of containment integrity, including use of the existing Hardened Containment Vent System.

Open Item 7 – Provide procedures for HCVS Operation.

Identify modifications:

List modifications and describe how they support the HCVS Actions.

EA-12-049 Modifications

- No additional EA-12-049 modifications are required to support HCVS.

EA-13-109 Modifications

- A modification will be required to install the new common piping including the new downstream PCIV. Since this line goes outside of the Reactor Building, it will include a SCIV and provisions to control primary containment leakage during a design basis LOCA. The new valves will include valve position

Quad Cities Nuclear Power Station, Units 1 and 2 Overall Integrated Plan for Phase 1 Requirements for
Reliable Hardened Containment Vent System (HCVS) Capable of Operation Under Severe Accident
Conditions

Part 2 Boundary Conditions for WW Vent: BDBEE Venting

indication and remote-manual control only. There is no sharing of any flow paths with the opposite unit.

- A modification will be required to allow operation of the existing upstream WW PCIV . This includes the capability to override a containment isolation signal. Reopening the valves following a BDBE will be remote-manual.
- A modification will be required to install the dedicated batteries needed to supply power to HCVS for the first 24 hours including capability for recharging from a portable charger at or before 24 hours. The battery will be located near the ROS.
- A modification will be required to install the dedicated motive power (Pressurized N₂/air) needed to open the HCVS valves for the first 24 hours including capability for replacing N₂/air bottles or connection a portable compressor after 24 hours. The N₂/air bottles will be located near the ROS.
- A modification will be required to add (a) HCVS flow path instrumentation consisting of pressure, temperature, and effluent radiation in the MCR, and (b) Motive power and DC battery indication in the MCR and the ROS.

Key Venting Parameters:

List instrumentation credited for this venting actions. Clearly indicate which of those already exist in the plant and what others will be newly installed (to comply with the vent order)

Initiation, operation and monitoring of the HCVS venting will rely on the following key parameters and indicators which will be added as part of the HCVS modification:

Key Parameter	Component Identifier	Indication Location
HCVS Effluent temperature	TBD	MCR
HCVS Effluent radiation	TBD	MCR
HCVS pressure indication	TBD	MCR
HCVS valve position indication	TBD	MCR
HCVS DC Power Voltage/Conditions	TBD	MCR/ROS
HCVS Pneumatic supply pressure	TBD	MCR/ROS

Initiation, operation and monitoring of the HCVS system will rely on several existing Main Control Room key parameters and indicators which are qualified or evaluated to Regulatory Guide 1.97 per the existing plant design:

Key Parameter	Component Identifier	Indication Location
Drywell vent pressure	PI 1(2)-1640-19	MCR
Containment (Wetwell) level	LI 1(2)-1640-21	MCR

Notes:

Part 2 Boundary Conditions for WW Vent: Severe Accident Venting

Determine venting capability for Severe Accident Venting, such as may be used in an ELAP scenario to mitigate core damage.

Ref: EA-13-109 Section 1.2.10 / NEI 13-02 Section 2.3

First 24-Hour Coping Detail

Provide a general description of the venting actions for first 24 hours using installed equipment including station modifications that are proposed.

Ref: EA-13-109 Section 1.2.6 / NEI 13-02 Section 2.5, 4.2.2

The operation of the HCVS will be designed to minimize the reliance on operator actions for response to an ELAP and severe accident events. Severe accident event assumes that specific core cooling actions from the FLEX strategies identified in the response to Order EA-12-049 were not successfully initiated. Access to the reactor building will be restricted as determined by the RPV water level and core damage conditions. Immediate actions will be completed by Operators in the Main Control Room (MCR) and will include remote-manual actions. The ROS provides back-up capability to open HCVS valve(s) in case of a valve circuit or SOV failure. The operator actions required to open a vent path were previously listed in the BDBEE Venting Part 2 section of this report (Table 2-1).

Permanently installed power and motive air/gas capability will be available to support operation and monitoring of the HCVS for 24 hours. Specifics are the same as for Part 2 BDBEE Venting.

System control:

- i. Active: Same as for Part 2 BDBEE Venting.
- ii. Passive: Same as for Part 2 BDBEE Venting

Greater Than 24-Hour Coping Detail

Provide a general description of the venting actions for greater than 24 hours using portable and installed equipment including station modifications that are proposed.

Ref: EA-13-109 Section 1.2.4, 1.2.8 / NEI 13-02 Section 4.2.2

Specifics are the same as for Part 2 BDBEE Venting.

These actions provide long-term support for HCVS operation for the period beyond 24 hours to 7 days (sustained operation time period) because on-site and off-site personnel and resources will have access to the unit(s) to provide needed action and supplies.

Quad Cities Nuclear Power Station, Units 1 and 2 Overall Integrated Plan for Phase 1 Requirements for
 Reliable Hardened Containment Vent System (HCVS) Capable of Operation Under Severe Accident
 Conditions

Part 2 Boundary Conditions for WW Vent: Severe Accident Venting
Details:
Provide a brief description of Procedures / Guidelines: <i>Confirm that procedure/guidance exists or will be developed to support implementation.</i>
The operation of the HCVS will be governed the same for SA conditions as for BDBEE conditions. Existing guidance in the SAMGs directs the plant staff to consider changing radiological conditions in a severe accident.
Identify modifications: <i>List modifications and describe how they support the HCVS Actions.</i>
The same as for Part 2 BDBEE Venting.
Key Venting Parameters: <i>List instrumentation credited for the HCVS Actions. Clearly indicate which of those already exist in the plant and what others will be newly installed (to comply with the vent order).</i>
The same as for Part 2 BDBEE Venting.
Notes:

Quad Cities Nuclear Power Station, Units 1 and 2 Overall Integrated Plan for Phase 1 Requirements for Reliable Hardened Containment Vent System (HCVS) Capable of Operation Under Severe Accident Conditions

<p>Part 2 Boundary Conditions for WW Vent: HCVS Support Equipment Functions</p>
<p>Determine venting capability support functions needed</p>
<p>Ref: EA-13-109 Section 1.2.8, 1.2.9/NEI 13-02 Section 2.5, 4.2.4, 6.1.2</p>
<p>BDBEE Venting</p>
<p><i>Provide a general description of the BDBEE Venting actions support functions. Identify methods and strategy(ies) utilized to achieve venting results.</i></p>
<p>Ref: EA-13-109 Section 1.2.9 / NEI 13-02 Section 2.5, 4.2.2, 4.2.4, 6.1.2</p>
<p>All containment venting functions will be performed from the MCR or ROS.</p> <p>Venting to prevent containment overpressurization will be maintained by permanently installed equipment. The HCVS dedicated DC power source and dedicated motive force is adequate for the first 24 hours, but it can be replenished to support sustained operation.</p> <p>Existing safety related station batteries will provide sufficient electrical power for MCR containment instrumentation for greater than 8 hours. Before station batteries are depleted, the response detailed in Order EA-12-049 will be credited to maintain DC bus voltage.</p>
<p>Severe Accident Venting</p>
<p><i>Provide a general description of the Severe Accident Venting actions support functions. Identify methods and strategy(ies) utilized to achieve venting results.</i></p>
<p>Ref: EA-13-109 Section 1.2.8, 1.2.9 / NEI 13-02 Section 2.5, 4.2.2, 4.2.4, 6.1.2</p>
<p>The same support functions that are used in the BDBEE scenario would be used for severe accident venting. The ROS location (the location of the HCVS DC power source and motive force) will be evaluated to confirm accessibility under severe accident conditions.</p>
<p>Details:</p>
<p>Provide a brief description of Procedures / Guidelines:</p> <p><i>Confirm that procedure/guidance exists or will be developed to support implementation.</i></p>
<p>All the HCVS equipment for the first 24 hours is permanently installed. The key portable HCVS items are the HCVS portable generator, and either a portable compressor or added N₂/air bottles needed to sustain operation after 24 hours. Also, the FLEX DGs will be credited to maintain existing containment instrumentation. This portable equipment will be staged in position for the duration of the event.</p>
<p>Identify modifications:</p> <p><i>List modifications and describe how they support the HCVS Actions.</i></p>
<p>Flex modifications applicable to HCVS operation: None</p> <p>HCVS modification: Provide a ROS location for the HCVS DC power supply and motive power that will be protected from all applicable screened-in hazards and located such that operator exposure to radiation and occupational hazards will be minimized. The DC power and motive power support systems will include connection points for replenishment for sustained operation.</p>

Quad Cities Nuclear Power Station, Units 1 and 2 Overall Integrated Plan for Phase 1 Requirements for
Reliable Hardened Containment Vent System (HCVS) Capable of Operation Under Severe Accident
Conditions

Part 2 Boundary Conditions for WW Vent: HCVS Support Equipment Functions
Key Support Equipment Parameters: <i>List instrumentation credited for the support equipment utilized in the venting operation. Clearly indicate which of those already exist in the plant and what others will be newly installed (to comply with the vent order).</i>
The HCVS support systems, including its instrumentation, will be new and installed to comply with the order. The instrumentation will consist of (a) motive gas supply pressure indication in the MCR and local pressure indication at the ROS, and (b) DC voltage in the MCR and local indication at the ROS.
Notes:

Quad Cities Nuclear Power Station, Units 1 and 2 Overall Integrated Plan for Phase 1 Requirements for
 Reliable Hardened Containment Vent System (HCVS) Capable of Operation Under Severe Accident
 Conditions

Part 2 Boundary Conditions for WW Vent: HCVS Venting Portable Equipment Deployment		
<p><i>Provide a general description of the venting actions using portable equipment including modifications that are proposed to maintain and/or support safety functions.</i></p> <p>Ref: EA-13-109 Section 3.1 / NEI 13-02 Section 6.1.2, D.1.3.1</p>		
<p>Deployment pathways for compliance with Order EA-12-049 are acceptable without further evaluation needed except in areas around the Reactor Building or in the vicinity of the HCVS piping.</p> <p>Before the end of the initial 24-hour period, replenishment of the HCVS dedicated DC power and motive power (pressurized gas) will occur at the ROS. The selection of the ROS location will take into account the SA temperature and radiation condition to ensure access to the ROS is maintained. The design will allow replenishment with minimal actions.</p>		
Details:		
<p>Provide a brief description of Procedures / Guidelines: <i>Confirm that procedure/guidance exists or will be developed to support implementation.</i></p>		
<p>Operation of the portable equipment is the same as for compliance with Order EA-12-049; thus, they are acceptable without further evaluation.</p> <p>Open Item 2 – Confirm the ROS will be accessible following a SA.</p>		
HCVS Actions	Modifications	Protection of connections
<i>Identify Actions including how the equipment will be deployed to the point of use.</i>	<i>Identify modifications</i>	<i>Identify how the connection is protected</i>
Per compliance with Order EA-12-049 (FLEX)	N/A	Per compliance with Order EA-12-049 (FLEX)
Notes:		

Part 3: Boundary Conditions for Drywell Vent

Provide a sequence of events and identify any time constraint required for success including the basis for the time constraint.

HCVS Actions that have a time constraint to be successful should be identified with a technical basis and a justification provided that the time could reasonably be met (for example, a walk-through of deployment).

Describe in detail in this section the technical basis for the time constraint identified on the sequence of events timeline Attachment 2B.

See attached sequence of events timeline (Attachment 2B).

Ref: EA-13-109 Section X.X.X / NEI 13-02 Section X.X.x

This section will be completed with the Phase 2 OIP submittal by December 31, 2015.

Severe Accident Venting

Determine venting capability for Severe Accident Venting, such as may be used in an ELAP scenario to mitigate core damage.

Ref: EA-13-109 Section X.X.X / NEI 13-02 Section X.X.x

First 24-Hour Coping Detail

Provide a general description of the venting actions for first 24 hours using installed equipment including station modifications that are proposed.

Ref: EA-13-109 Section X.X.X / NEI 13-02 Section X.X.x

This section will be completed with the Phase 2 OIP submittal by December 31, 2015.

Greater Than 24-Hour Coping Detail

Provide a general description of the venting actions for greater than 24 hours using portable and installed equipment including station modifications that are proposed.

Ref: EA-13-109 Section X.X.X / NEI 13-02 Section X.X.x

This section will be completed with the Phase 2 OIP submittal by December 31, 2015.

Quad Cities Nuclear Power Station, Units 1 and 2 Overall Integrated Plan for Phase 1 Requirements for
Reliable Hardened Containment Vent System (HCVS) Capable of Operation Under Severe Accident
Conditions

Part 3: Boundary Conditions for Drywell Vent

Details:

Provide a brief description of Procedures / Guidelines:

Confirm that procedure/guidance exists or will be developed to support implementation.

This section will be completed with the Phase 2 OIP submittal by December 31, 2015.

Identify modifications:

List modifications and describe how they support the HCVS Actions.

This section will be completed with the Phase 2 OIP submittal by December 31, 2015.

Key Venting Parameters:

List instrumentation credited for the venting HCVS Actions.

This section will be completed with the Phase 2 OIP submittal by December 31, 2015.

Notes:

Open Item 9 – Supply Part 3 Drywell Boundary Conditions.

Part 4: Programmatic Controls, Training, Drills and Maintenance

Identify how the programmatic controls will be met.

Provide a description of the programmatic controls equipment protection, storage and deployment and equipment quality addressing the impact of temperature and environment

Ref: EA-13-109 Section 3.1, 3.2 / NEI 13-02 Section 6.1.2, 6.1.3, 6.2

Program Controls:

The HCVS venting actions will include:

- Site procedures and programs are being developed in accordance with NEI 13-02 to address use and storage of portable equipment relative to the Severe Accident defined in NRC Order EA-13-109 and the hazards applicable to the site per Part 1 of this OIP.
- Routes for transporting portable equipment from storage location(s) to deployment areas will be developed as the response details are identified and finalized. The identified paths and deployment areas will be accessible following all modes of operation and during Severe Accidents.

Procedures:

Procedures will be established for system operations when normal and backup power is available, and during ELAP conditions.

The HCVS procedures will be developed and implemented following the plant's process for initiating or revising procedures and contain the following details:

- appropriate conditions and criteria for use of the HCVS
- when and how to place the HCVS 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 of portable equipment

Quad Cities relies on CAP for ECCS pump NPSH. The procedures will state that the use of the HCVS vent path would impact NPSH.

Quad Cities will establish provisions for out-of-service requirements of the HCVS and compensatory measures. A procedure will document the following provisions, the development of which is tracked in the Corrective Action Process.

Open Item 6 – Develop a procedure for HCVS out-of-service requirements and compensatory measures.

The provisions for out-of-service requirements for HCVS functionality are applicable in Modes 1, 2 and 3.

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

Quad Cities Nuclear Power Station, Units 1 and 2 Overall Integrated Plan for Phase 1 Requirements for Reliable Hardened Containment Vent System (HCVS) Capable of Operation Under Severe Accident Conditions

Part 4: Programmatic Controls, Training, Drills and Maintenance

compensatory actions are necessary.

- If the out of service times exceed 30 or 90 days as described above, the following actions will be performed:
 - The condition will entered into the corrective action system,
 - The HCVS functionality will be restored in a manner consistent with plant procedures,
 - A cause assessment will be performed to prevent future loss of function for similar causes.
 - Initiate action to implement appropriate compensatory actions

Describe training plan

List training plans for affected organizations or describe the plan for training development.

Ref: EA-13-109 Section 3.2 / NEI 13-02 Section 6.1.3

Personnel expected to perform direct execution of the HVCS will receive necessary training in the use of plant procedures for system operations when normal and backup power is available and during ELAP conditions. The training will be refreshed on a periodic basis and as any changes occur to the HCVS. Training content and frequency will be established using the Systematic Approach to Training (SAT) process.

In addition, personnel on-site will be available to supplement trained personnel.

Identify how the drills and exercise parameters will be met.

Alignment with NEI 13-06 and 14-01 as codified in NTF Recommendation 8 and 9 rulemaking

The Licensee should demonstrate use of the HCVS system in drills, tabletops, or exercises as follows:

- *Hardened containment vent operation on normal power sources (no ELAP).*
- *During FLEX demonstrations (as required by EA-12-049: Hardened containment vent operation on backup power and from primary or alternate location during conditions of ELAP/loss of UHS with no core damage. System use is for containment heat removal AND containment pressure control.*
- *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 (Demonstration may be in conjunction with SAG change).*

Ref: EA-13-109 Section 3.1 / NEI 13-02 Section 6.1.3

Quad Cities will utilize the guidance provided in NEI 13-06 and 14-01 for guidance related to drills, tabletops, or exercises for HCVS operation. In addition, Quad Cities will integrate these requirements with compliance to any rulemaking resulting from the NTF Recommendations 8 and 9.

Part 4: Programmatic Controls, Training, Drills and Maintenance

Describe maintenance plan:

- *The HCVS maintenance program should ensure that the HCVS equipment reliability is being achieved in a manner similar to that required for FLEX equipment. Standard industry templates (e.g., EPRI) and associated bases may be developed to define specific maintenance and testing.*
 - *Periodic testing and frequency should be determined based on equipment type, expected use and manufacturer's recommendations (further details are provided in Section 6 of this document).*
 - *Testing should be done to verify design requirements and/or basis. The basis should be documented and deviations from vendor recommendations and applicable standards should be justified.*
 - *Preventive maintenance should be determined based on equipment type and expected use. The basis should be documented and deviations from vendor recommendations and applicable standards should be justified.*
 - *Existing work control processes may be used to control maintenance and testing.*
- *HCVS permanent installed equipment should be maintained in a manner that is consistent with assuring that it performs its function when required.*
 - *HCVS permanently installed equipment should be subject to maintenance and testing guidance provided to verify proper function.*
- *HCVS non-installed equipment should be stored and maintained in a manner that is consistent with assuring that it does not degrade over long periods of storage and that it is accessible for periodic maintenance and testing.*

Ref: EA-13-109 Section 1.2.13 / NEI 13-02 Section 5.4, 6.2

Quad Cities will utilize the standard EPRI industry PM process (similar to the Preventive Maintenance Basis Database) for establishing the maintenance calibration and testing actions for HCVS components. The control program will include maintenance guidance, testing procedures and frequencies established based on type of equipment and considerations made within the EPRI guidelines.

Quad Cities will implement the following operation, testing and inspection requirements for the HCVS to ensure reliable operation of the system.

Table 4-1: Testing and Inspection Requirements

Description	Frequency
Cycle the HCVS valves and the interfacing system valves not used to maintain containment integrity during operations.	Once per operating cycle
Perform visual inspections and a walk down of HCVS components	Once per operating cycle

Quad Cities Nuclear Power Station, Units 1 and 2 Overall Integrated Plan for Phase 1 Requirements for
 Reliable Hardened Containment Vent System (HCVS) Capable of Operation Under Severe Accident
 Conditions

Part 4: Programmatic Controls, Training, Drills and Maintenance

Test and calibrate the HCVS radiation monitors.	Once per operating cycle
Leak test the HCVS.	(1) Prior to first declaring the system functional; (2) Once every three operating cycles thereafter; and (3) After restoration of any breach of system boundary within the buildings
Validate the HCVS operating procedures by conducting an open/close test of the HCVS control logic from its control panel and ensuring that all interfacing system valves move to their proper (intended) positions.	Once per every other operating cycle
Perform Battery Service/Performance Tests.	5 years for performance/18 months for services

Notes:

Quad Cities Nuclear Power Station, Units 1 and 2 Overall Integrated Plan for Phase 1 Requirements for
Reliable Hardened Containment Vent System (HCVS) Capable of Operation Under Severe Accident
Conditions

Part 5: Milestone Schedule

Provide a milestone schedule.

This schedule should include:

- *Modifications timeline*
- *Procedure guidance development complete*
 - *HCVS Actions*
 - *Maintenance*
- *Storage plan (reasonable protection)*
- *Staffing analysis completion*
- *Long term use equipment acquisition timeline*
- *Training completion for the HCVS Actions*

The dates specifically required by the order are obligated or committed dates. Other dates are planned dates subject to change. Updates will be provided in the periodic (six-month) status reports.

Ref: EA-13-109 Section D.1, D.3 / NEI 13-02 Section 7.2.1

Quad Cities provides the following milestone schedule. The dates are for planning purposes, and are subject to change as design and implementation details are developed. The subsequent 6-month status reports will reflect any changes to the following target dates.

Milestone	Target Completion Date	Activity Status	Comments <i>{Include date changes in this column}</i>
Hold preliminary/conceptual design meeting	Jun, 2014	Complete	
Submit Overall Integrated Implementation Plan	Jun 2014	Complete	
Submit 6 Month Status Report	Dec. 2014		
Submit 6 Month Status Report	Jun. 2015		
Submit 6 Month Status Report	Dec. 2015		Simultaneous with Phase 2 OIP
U1 HCVS Design Approved (WW)	Mar, 2016		
Submit 6 Month Status Report	Jun. 2016		
Operations Procedure Changes Developed	Dec, 2016		
Site Specific Maintenance Procedure Developed	Dec, 2016		
Submit 6 Month Status Report	Dec. 2016		
Training Complete	Dec, 2016		
U2 HCVS Design Approved (WW and DW)	Mar, 2017		
U1 Implementation Outage (WW)	Apr, 2017		
U1 Procedure Changes Active (WW)	Apr, 2017		
U1 Walk Through Demonstration/Functional Test (WW)	Apr, 2017		
Submit 6 Month Status Report	Jun. 2017		
Submit 6 Month Status Report	Dec. 2017		

Quad Cities Nuclear Power Station, Units 1 and 2 Overall Integrated Plan for Phase 1 Requirements for
 Reliable Hardened Containment Vent System (HCVS) Capable of Operation Under Severe Accident
 Conditions

Part 5: Milestone Schedule

U1 HCVS Design Approved (DW)	Feb, 2018		
U2 Implementation Outage (WW and DW)	Apr, 2018		
U2 Procedure Changes Active (WW and DW)	Apr, 2018		
U2 Walk Through Demonstration/Functional Test (WW and DW)	Apr, 2018		
U1 Implementation Outage (DW)	Apr, 2019		
U1 Procedure Changes Active (DW)	Apr, 2019		
U1 Walk Through Demonstration/Functional Test (DW)	Apr, 2019		
Submit Completion Report	May, 2019		

DW milestones are preliminary and are based on the Phase 2 schedule. DW milestones are subject to revision with the December 2015 OIP submission.

Quad Cities Nuclear Power Station, Units 1 and 2 Overall Integrated Plan for Phase 1 Requirements for Reliable Hardened Containment Vent System (HCVS) Capable of Operation Under Severe Accident Conditions

Attachment 1: HCVS Portable Equipment				
<i>List portable equipment</i>	<i>BDBEE Venting</i>	<i>Severe Accident Venting</i>	<i>Performance Criteria</i>	<i>Maintenance / PM requirements</i>
Nitrogen / air Cylinders	X	X	TBD	Check periodically for pressure, replace or replenish as needed
Portable compressor	X	X	TBD	Test periodically for performance
Portable HCVS battery charger	X	X	TBD	Test periodically for performance

Attachment 2: Sequence of Events Timeline

Quad Cities Venting Timelines

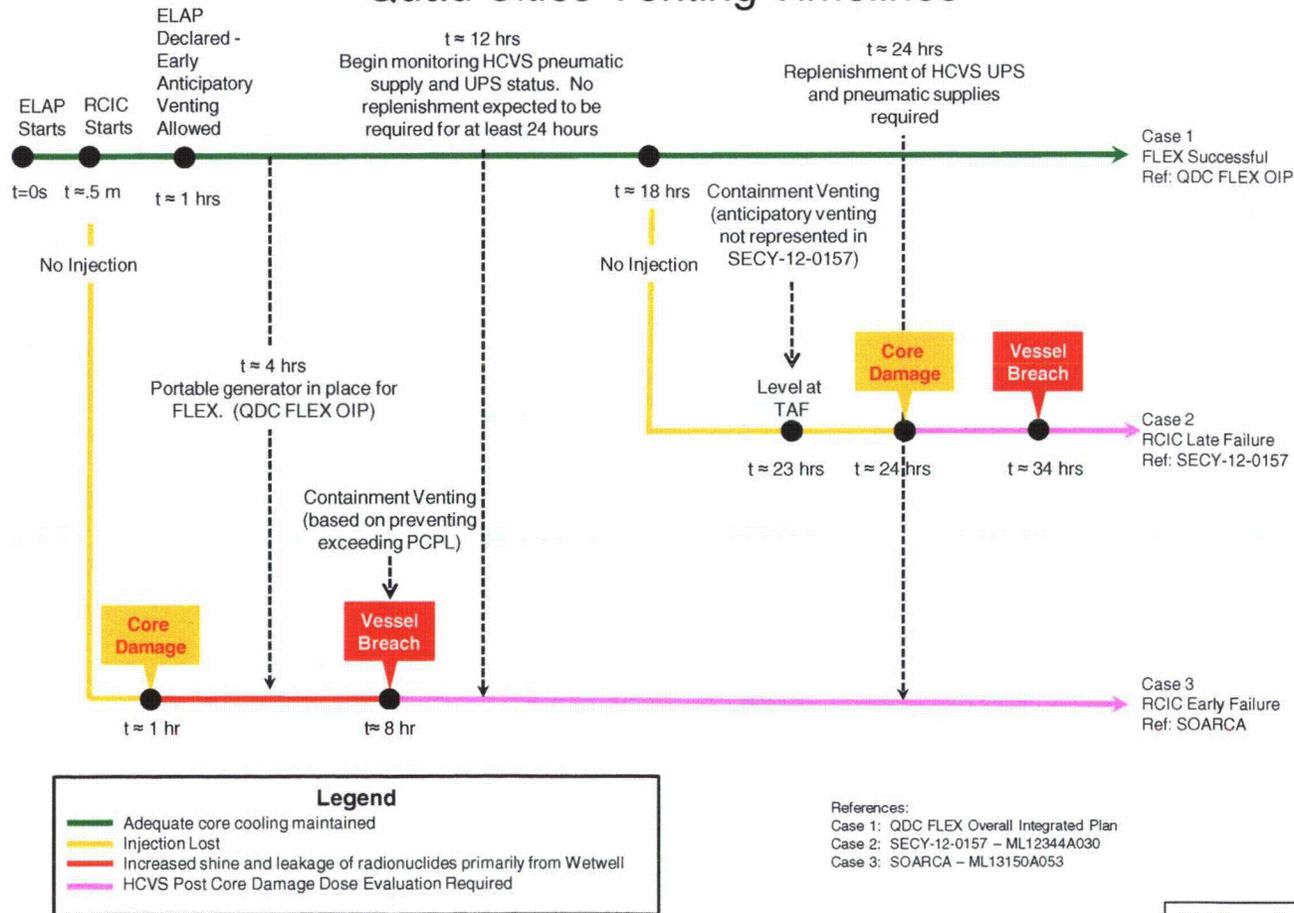
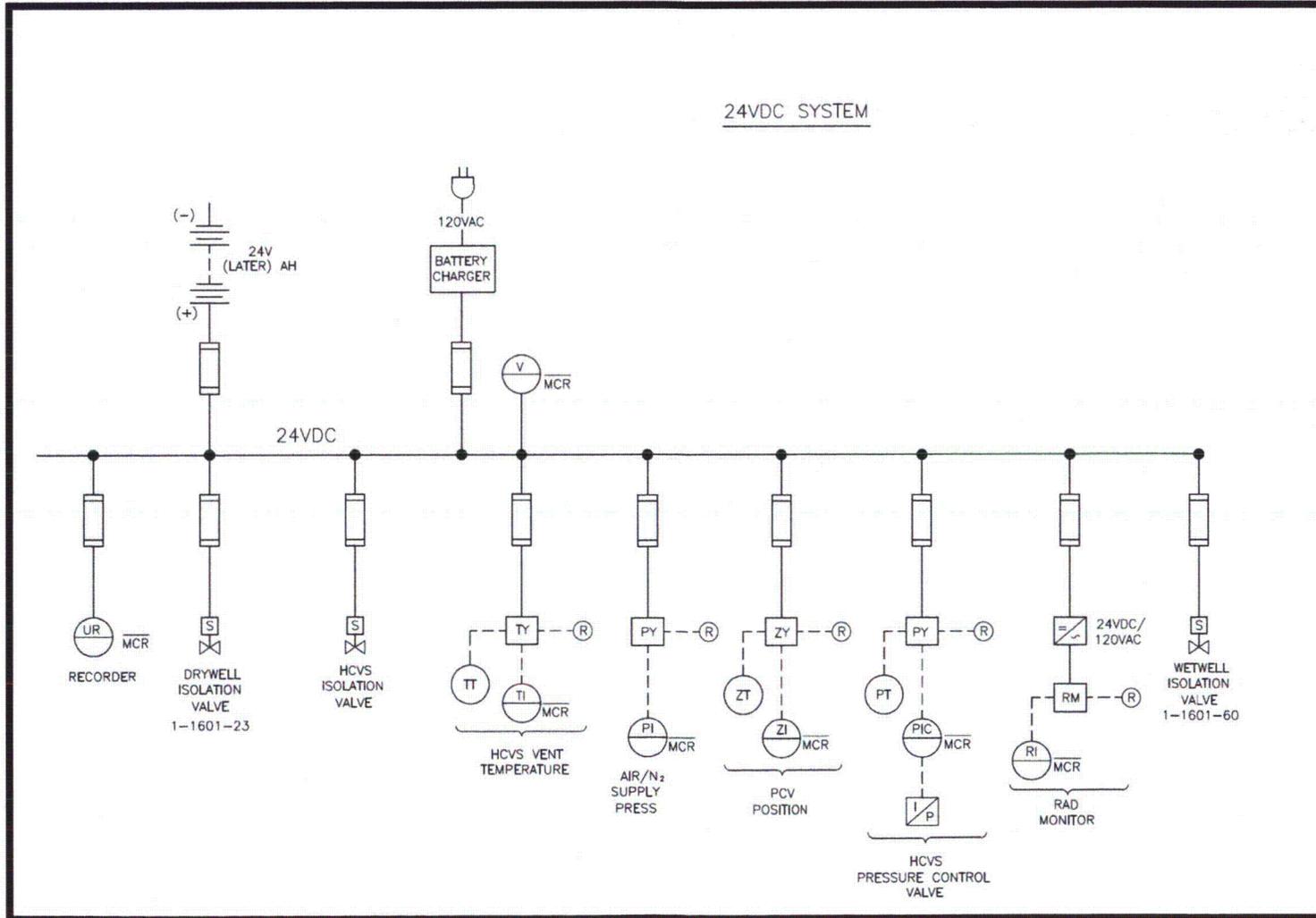


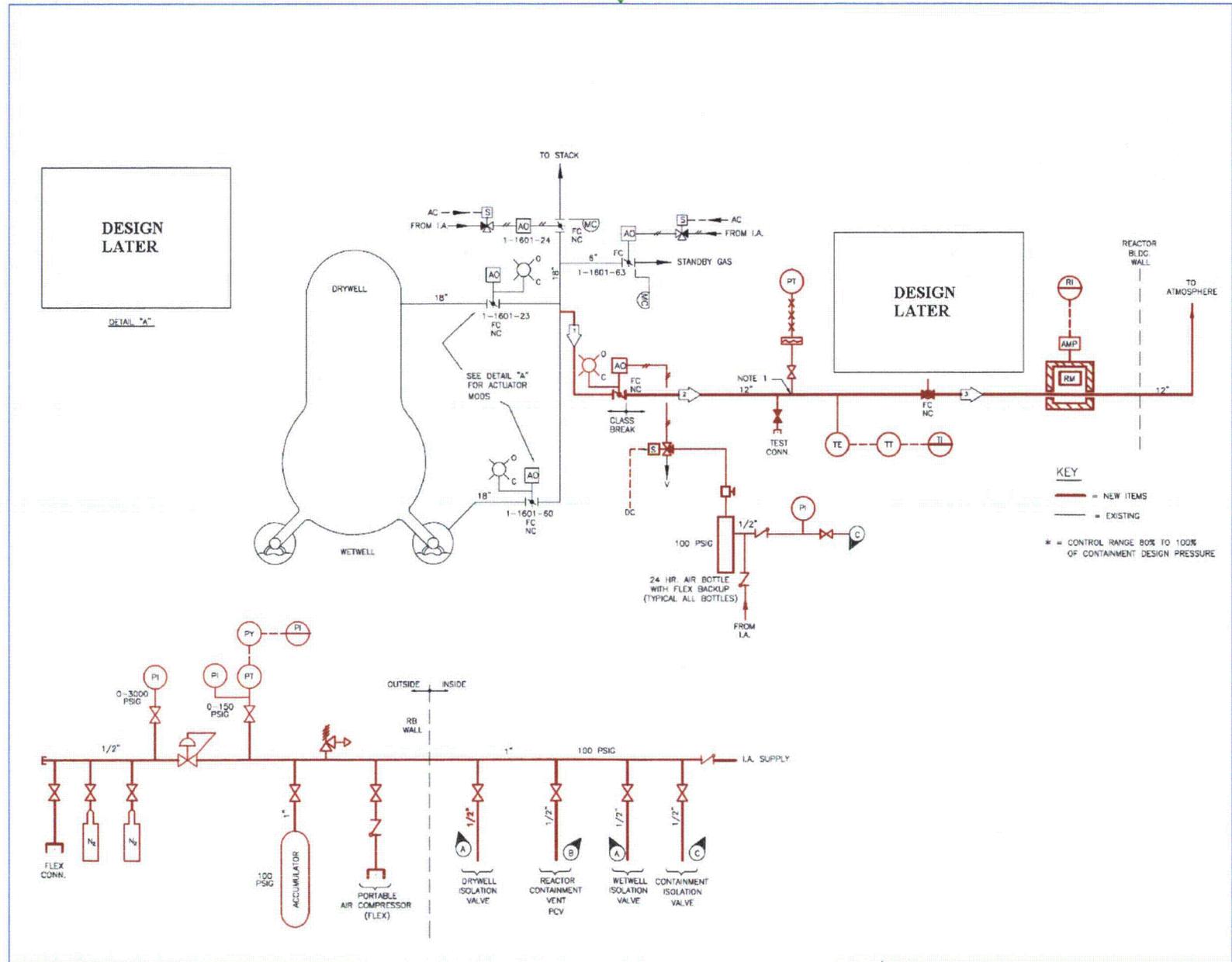
Table 2A: Wetwell HCVS Timeline

Attachment 3: Conceptual Sketches

Sketch 1: Electrical Layout of HCVS System, Unit 1 (Similar for Unit 2)



Sketch 2: Layout of Proposed HCVS, Unit 1 (Similar for Unit 2)



Sketch 3: Plant Layout (*later*)

- **Egress and Ingress Pathways to ROS, Battery Transfer Switch, DG Connections and Deployment location**
- **Site layout sketch to show location/routing of HCVS piping and associated components. This should include relative locations both horizontally and vertically**

Attachment 4: Failure Evaluation Table

Table 4A: Wetwell HCVS Failure Evaluation Table

Functional Failure Mode	Failure Cause	Alternate Action	Failure with Alternate Action Impact on Containment Venting?
Failure of Vent to Open on Demand	ELAP event (loss of all AC)	No action needed, DC power and motive force is supplied from dedicated HCVS supply.	No
Failure of Vent to Open on Demand	Valves fail to open/close due to complete loss of HCVS batteries (long term)	Recharge HCVS batteries with portable provided generator, considering severe accident conditions.	No
Failure of Vent to Open on Demand	Valves fail to open/close due to loss of pneumatic air supply (long term)	Replace bottles as needed or connect portable compressor.	No
Failure of Vent to Open on Demand	Valves fail to open/close due to SOV failure and/or circuit failure	Open the affected valve at the ROS which is independent of the electrical circuit.	No

Attachment 5: References

1. Generic Letter 89-16, Installation of a Hardened Wetwell Vent, dated September 1, 1989
2. Order EA-12-049, Mitigation Strategies for Beyond-Design-Basis External Events, dated March 12, 2012
3. Order EA-12-050, Reliable Hardened Containment Vents, dated March 12, 2012
4. Order EA-12-051, Reliable SFP Level Instrumentation, dated March 12, 2012
5. Order EA-13-109, Severe Accident Reliable Hardened Containment Vents, dated June 6, 2013
6. JLD-ISG-2012-01, Compliance with Order EA-12-049, Mitigation Strategies for Beyond-Design-Basis External Events, dated August 29, 2012
7. JLD-ISG-2012-02, Compliance with Order EA-12-050, Reliable Hardened Containment Vents, dated August 29, 2012
8. JLD-ISG-2013-02, Compliance with Order EA-13-109, Severe Accident Reliable Hardened Containment Vents, dated November 14, 2013
9. NRC Responses to Public Comments, Japan Lessons-Learned Project Directorate Interim Staff Guidance JLD-ISG-2012-02: Compliance with Order EA-12-050, Order Modifying Licenses with Regard to Reliable Hardened Containment Vents, ADAMS Accession No. ML12229A477, dated August 29, 2012
10. NEI 12-06, Diverse and Flexible Coping Strategies (FLEX) Implementation Guide, Revision 1, dated August 2012
11. NEI 13-02, Industry Guidance for Compliance with Order EA-13-109, Revision 0, Dated November 2013
12. NEI 13-06, Enhancements to Emergency Response Capabilities for Beyond Design Basis Accidents and Events, Revision 0, dated March 2014
13. NEI 14-01, Emergency Response Procedures and Guidelines for Extreme Events and Severe Accidents, Revision 0, dated March 2014
14. NEI FAQ HCVS-01, HCVS Primary Controls and Alternate Controls and Monitoring Locations
15. NEI FAQ HCVS-02, HCVS Dedicated Equipment
16. NEI FAQ HCVS-03, HCVS Alternate Control Operating Mechanisms
17. NEI FAQ HCVS-04, HCVS Release Point
18. NEI FAQ HCVS-05, HCVS Control and 'Boundary Valves'
19. NEI FAQ HCVS-06, FLEX Assumptions/HCVS Generic Assumptions
20. NEI FAQ HCVS-07, Consideration of Release from Spent Fuel Pool Anomalies
21. NEI FAQ HCVS-08, HCVS Instrument Qualifications
22. NEI FAQ HCVS-09, Use of Toolbox Actions for Personnel
23. NEI White Paper HCVS-WP-01, HCVS Dedicated Power and Motive Force
24. NEI White Paper HCVS-WP-02, HCVS Cyclic Operations Approach
25. NEI White Paper HCVS-WP-03, Hydrogen/CO Control Measures
26. NEI White Paper HCVS-WP-04, FLEX/HCVS Interactions
27. IEEE Standard 344-2004, IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power *Generating Stations*,
28. Quad Cities EA-12-049 (FLEX) Overall Integrated Implementation Plan, Rev 0, February 2013
29. Quad Cities EA-12-050 (HCVS) Overall Integrated Implementation Plan, Rev 0, February 2013

Quad Cities Nuclear Power Station, Units 1 and 2 Overall Integrated Plan for Phase 1 Requirements for Reliable Hardened Containment Vent System (HCVS) Capable of Operation Under Severe Accident Conditions

30. Quad Cities EA-12-051 (SFP LI) Overall Integrated Implementation Plan, Rev 0, February 2013
31. Memorandum to R.W. Borchardt , dated May 19, 2013, Subject "Staff Requirements – SECY-12-0157- Consideration of Additional Requirements for Containment Venting systems for Boiling Water Reactors with Mark I and Mark II Containments"

Attachment 6: Changes/Updates to this Overall Integrated Implementation Plan

Any significant changes to this plan will be communicated to the NRC staff in the 6-Month Status Reports

Quad Cities Nuclear Power Station, Units 1 and 2 Overall Integrated Plan for Phase 1 Requirements for Reliable Hardened Containment Vent System (HCVS) Capable of Operation Under Severe Accident Conditions

Attachment 7: List of Overall Integrated Plan Open Items

Open Item	Action	Comment
1	Determine how Motive Power and/or HCVS Battery Power will be disabled during normal operation	Design approach
2	Confirm that the ROS will be in an accessible area following a SA	Confirmatory action
3	Confirm diameter on new common HCVS Piping	Design effort
4	Confirm suppression pool heat capacity	Confirmatory action
5	Determine the approach for combustible gases	Design approach
6	Develop a procedure for HCVS out-of-service requirements and compensatory measures.	Procedure development
7	Provide procedures for HCVS Operation.	Procedure development
8	Confirm 125 VDC DC Station Battery Life	Design Effort
9	Supply Part 3 Drywell Boundary Condition	Dec 2015