Order No. EA-12-050

RS-13-111

February 28, 2013

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
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Dresden Nuclear Power Station, Units 2 and 3
Renewed Facility Operating License Nos. DPR-19 and DPR-25
NRC Docket Nos. 50-237 and 50-249

Subject: Overall Integrated Plan in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Reliable Hardened Containment Vents (Order Number EA-12-050)

References:

1. NRC Order Number EA-12-050, "Issuance of Order to Modify Licenses with Regard to Reliable Hardened Containment Vents," dated March 12, 2012
2. NRC Interim Staff Guidance JLD-ISG-2012-02, "Compliance with Order EA-12-050, Reliable Hardened Containment Vents", Revision 0, dated August 29, 2012
3. Exelon Generation Company, LLC's Initial Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents (Order Number EA-12-050), dated October 25, 2012

On March 12, 2012, 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 BWRs with Mark I and Mark II containments to take certain actions to ensure the operability of reliable hardened containment vent (RHCV) systems to remove decay heat and maintain control of containment pressure following events that result in loss of active containment heat removal capability or prolonged Station Blackout (SBO). Specific requirements are outlined in Attachment 2 of Reference 1.

Reference 1 requires submission of an Overall Integrated Plan by February 28, 2013. The interim staff guidance (Reference 2) was issued August 29, 2012 which provides direction regarding the content of this Overall Integrated Plan. The purpose of this letter is to provide the Overall Integrated Plan pursuant to Section IV, Condition C.1, of Reference 1. This letter confirms EGC has received Reference 2 and has an Overall Integrated Plan complying with the guidance for the purpose of ensuring the functionality of reliable hardened containment vent (RHCV) systems to remove decay heat and maintain control of containment pressure following events that result in loss of active containment heat removal capability or prolonged Station Blackout (SBO) as described in Attachment 2 of Reference 1. Reference 3 provided the EGC initial status report regarding reliable hardened containment vents, as required by Reference 1.

Reference 2, Section 4.0 contains the specific reporting requirements for the Overall Integrated Plan. The information in the enclosure provides the Dresden Nuclear Power Station, Units 2 and 3 Overall Integrated Plan pursuant to Section 4.0 of Reference 2. The enclosed Integrated Plan 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 Integrated Plan updates required by Reference 1.

Dresden Nuclear Power Station, Units 2 and 3, in response to NRC Generic Letter 89-16, installed a hardened vent path that allowed venting from either the torus or the drywell. For the purposes of compliance with NRC Order EA-12-050, Order Modifying Licenses with Regard to Requirements for Reliable Hardened Containment Vents, Dresden Nuclear Power Station, Units 2 and 3 plans to credit the torus vent path. Independent of the requirements of NRC Order EA-12-050, Dresden Nuclear Power Station, Units 2 and 3 is evaluating potential upgrades to the drywell vent path to conform to the requirements of NRC Order EA-12-050.

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 28th day of February 2013.

Respectfully submitted,

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

Enclosure:

1. Dresden Nuclear Power Station, Units 2 and 3 Hardened Containment Vent System (HCVS) Overall Integrated Plan

cc: Director, Office of Nuclear Reactor Regulation
NRC Regional Administrator - Region III
NRC Senior Resident Inspector - Dresden Nuclear Power Station
NRC Project Manager, NRR - Dresden Nuclear Power Station
Mr. Robert J. Fretz, Jr, NRRIJLD/PMB, NRC
Mr. Robert L. Dennig, NRRIDSS/SCVB, NRC
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Enclosure 1

Dresden Nuclear Power Station, Units 2 and 3

Hardened Containment Vent System (HCVS)

Overall Integrated Plan

(26 pages)

Dresden Nuclear Power Station, Units 2 and 3
HCVS Overall Integrated Plan

Table of Contents:

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. JLD-ISG-2012-02, Compliance with Order EA-12-050, Reliable Hardened Containment Vents, dated August 29, 2012
5. 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
6. NEI 12-06, Diverse and Flexible Coping Strategies (FLEX) Implementation Guide, Revision -, dated August 2012.

7. JLD-ISG-2012-01, Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events

8. IEEE Standard 344-2004, IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations

Section 1: System Description

ISG Criteria:

Licensees shall provide a complete description of the system, including important operational characteristics. The level of detail generally considered adequate is consistent with the level of detail contained in the licensee's Final Safety Analysis Report.

Response:

System Overview:

The Hardened Containment Vent System (HCVS) will be designed to mitigate loss-of-decay-heat removal by providing sufficient containment venting capability to limit containment pressurization. The vent will be designed with sufficient capacity to accommodate decay heat input equivalent to 1% of 3016 MWt. The thermal power accounts for a Measurement Uncertainty Recovery (MUR) planned power uprate above the current licensed thermal power (CLTP) of 2957 MWt. Thus, the hardened vent capacity will be adequate to relieve decay heat for a prolonged station blackout (SBO) event. The HCVS is intended for use as one element of core damage prevention strategies. Venting the containment to remove decay heat and limit containment pressurization supports core cooling strategies during a prolonged SBO event.

The HCVS flow path from the containment to an elevated release point above the Reactor Building roof is shown in the simplified piping and instrumentation diagram (P&ID) in Section 8 of this report. The HCVS at each unit will be fully independent of the other unit's HCVS. The upstream portion of the HCVS piping flow path is shared with the Standby Gas Treatment System (SGTS) and the Reactor Building Ventilation System (RBVS), but these interconnected systems are automatically isolated by a containment isolation valve that receives a containment isolation signal. No ductwork will be used in the flow path. This ensures that essentially all the HCVS flow out of the containment is discharged to the outside atmosphere above the unit's Reactor Building.

Equipment and components:

The following equipment and components will be provided:

i. HCVS Mechanical Components –
   a) Containment isolation piping, valves and controls - The HCVS vent piping and supports up to and including the second containment isolation valve (CIV) are designed in accordance with the existing containment penetration design basis. The design of the CIVs will be consistent with the plant's CIV design basis. The in-series CIVs are normally closed, fail closed air-operated valves (AOV). As with existing penetrations open to the containment atmosphere, both CIVs will be located outside the containment.
   b) Other system valves and piping - The HCVS piping and supports downstream of the second CIV, including valve actuator pneumatic supply components, will be designed and analyzed to conform to requirements consistent with the applicable design codes for the plant and to ensure functionality following a design basis earthquake.

c) The HCVS shares part of its flow path with the Standby Gas Treatment System (SGTS) and the Reactor Building Ventilation System (RBVS). These interface systems are automatically isolated by a CIV following any containment isolation signal.
d) The HCVS flow path downstream of the second CIV will have a normally closed, fail-closed, air-operated Pressure Control Valve (PCV). The PCV will control upstream pressure and have an adjustable pressure setpoint to allow either full open operation or controlling pressure near the containment design pressure. The PCV will include a back-up, remote–hydraulic means for PCV operation.

ii. Instrumentation to monitor the status of the HCVS and control the flow path-
a) Instrumentation indications will be available on the HCVS panel. See "System Control" below for discussion of the HCVS panel.
b) HCVS valve position indication, flow path temperature, pressure, effluent radiation instrumentation will monitor the status of the HCVS and aid operator verification of venting conditions. A failure of valve position indication instrumentation would not prevent opening and closing the valve.
c) The effluent radiation monitor will be physically mounted on the outside of the HCVS pipe wall.
d) The available instrumentation will include the HCVS support system pneumatic pressure and DC battery voltage.

iii. Support systems assuming a prolonged SBO –
Paragraphs a) thru c) below apply to all HCVS flow path components except for the normal control circuit on the upstream CIVs described in System Control iii a).

a) DC power valve control and instrumentation is provided from a dedicated permanently installed DC power supply adequate for the first 24 hours of operation. This DC power source will be in an accessible location allowing the power to be sustained after 24 hours. The details will be developed during the detailed design phase.
b) Motive air/gas supply for all HCVS valves and instrumentation will be provided from a dedicated permanently installed source adequate for at least the first 24 hours of operation. It will be designed for 5 open/close cycles under prolonged SBO conditions during the first 24 hours. This motive air/gas source will be in an accessible location allowing the motive air/gas to be sustained after 24 hours. The details will be developed during the detailed design phase including confirmation of the number of open/close cycles.
c) Portable equipment will be provided as required to sustain the dedicated HCVS DC power and motive air/gas after 24 hours. The connections for the portable equipment will provide pre-engineered connections to minimize manpower efforts. The details will be developed during the detailed design phase.

The upstream CIVs as well as the downstream CIV to the SGTS and RBVS are provided with normal Instrument Air (IA) for opening the valves. IA will be lost following a SBO. The dedicated HCVS motive air/gas will be used to allow opening the upstream CIV following a SBO. Refer to System Control iii a) below for discussion on maintaining circuit power.

System control:

i. The HCVS CIVs and PCV will be remote-manually operated in accordance with approved station procedures to control containment pressure following a prolonged SBO. The revised station procedures will address when venting is to be initiated and any imposed limitations on the pressure band.

ii. With the exception of the normal control circuit on the upstream CIV, HCVS controls and indications will be from the "HCVS panel". The HCVS panel will either be part of an existing panel or a new, separate panel. This will be determined early in the detailed design phase. The HCVS panel will be located in the Main Control Room (MCR) or a location readily accessible from the MCR. The location of the panel will also be determined during the detailed design phase.

iii. Valve Control for the upstream Drywell and Torus CIVs:

a) These valves are on a flow path shared with the HCVS, SGTS, and RBVS. They will retain their existing control logic, existing control circuit at their locations, and the existing containment isolation signal. If the valve is open during anticipated modes of operation, the valve will be automatically isolated on a containment isolation signal. Based on the earlier GL 89-16 effort, the current circuit controls already allow over-riding the containment isolation signal to open the hardened vent path. The detailed design effort will determine how to ensure the circuit remains available following a prolonged SBO. This most likely will result in converting the existing circuit power and SOV from AC to DC and using an existing safety-related DC power source for the circuit.

b) A second control circuit dedicated to the HCVS function will be added to these upstream CIVs. This circuit will be located on the HCVS panel. The HCVS circuit will allow opening this upstream CIV using the dedicated HCVS DC power. The HCVS control circuit will be normally de-energized and will have a key-locked control switch to ensure that it is not inadvertently actuated. This circuit will not have an automatic containment isolation signal.

iv. The downstream HCVS CIV control circuit will allow opening the downstream CIV using the dedicated HCVS DC power and pneumatic air/gas support systems. The HCVS control circuit will be normally de-energized and will have a key-locked control switch to ensure that it is not inadvertently actuated. This circuit will not have an automatic containment isolation signal.

v. The downstream CIVs to the SGTS and RBVS are automatically isolated by a containment isolation signal. The design will not be changed.

vi. Periodic CIV testing will be performed in accordance with the current licensing and design basis.

Section 2: A description of how the design objectives contained in Order EA-12-050 Attachment 2, Requirements 1.1.1, 1.1.2, and 1.1.3, are met.

Order EA-12-050 1.1.1 Requirement:

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

ISG 1.1.1 Criteria:

During events that significantly challenge plant operations, individual operators are more prone to human error. In addition, the plant operations staff may be required to implement strategies and/or take many concurrent actions that further places a burden on its personnel. During the prolonged SBO condition at the Fukushima Dai-ichi units, operators faced many significant challenges while attempting to restore numerous plant systems that were necessary to cool the reactor core, including the containment venting systems. The difficulties faced by the operators related to the location of the HCVS valves, ambient temperatures and radiological conditions, loss of all alternating current electrical power, loss of motive force to open the vent valves, and exhausting dc battery power. The NRC staff recognizes that operator actions will be needed to operate the HCVS valves; however, the licensees shall consider design features for the system that will minimize the need and reliance on operator actions to the extent possible during a variety of plant conditions, as further discussed in this ISG.

The HCVS shall be designed to be operated from a control panel located in the main control room or a remote but readily accessible location. The HCVS shall be designed to be fully functional and self sufficient with permanently installed equipment in the plant, without the need for portable equipment or connecting thereto, until such time that additional on-site or off-site personnel and portable equipment become available. The HCVS shall be capable of operating in this mode (i.e., relying on permanently installed equipment) for at least 24 hours during the prolonged SBO, unless a shorter period is justified by the licensee. The HCVS operation in this mode depends on a variety of conditions, such as the cause for the SBO (e.g., seismic event, flood, tornado, high winds), severity of the event, and time required for additional help to reach the plant, move portable equipment into place, and make connections to the HCVS.

When evaluating licensee justification for periods less than 24 hours, the NRC staff will consider the number of actions and the cumulative demand on personnel resources that are needed to maintain HCVS functionality (e.g., installation of portable equipment during the first 24 hours to restore power to the HCVS controls and/or instrumentation) as a result of design limitations. For example, the use of supplemental portable power sources may be acceptable if the supplemental power was readily available, could be quickly and easily moved into place, and installed through the use of pre-engineered quick disconnects, and the necessary human actions were identified along with the time needed to complete those actions. Conversely, supplemental power sources located in an unattended warehouse that require a qualified electrician to temporarily wire into the panel would not be considered acceptable by the staff because its installation requires a series of complex, time-consuming actions in order to achieve a successful outcome. There are similar examples that could apply to mechanical systems, such as pneumatic/compressed air systems.

Response (ref. ISG Item 1.1.1):

The design of the HCVS will minimize the reliance on operator actions in response to hazards identified in JLD-ISG-2012-01, Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events, and NEI 12-06, Diverse and Flexible Coping Strategies (FLEX) Implementation Guide. Immediate operator actions can be completed by Reactor Operators and include remote-manual initiation from the HCVS control panel.

The steps listed below are required to initiate the HCVS flow path. These steps will be confirmed during the detailed design phase.

- Verification that the valves to the interfacing systems (SGTS and RBVS) are shut
- Energizing the DC power to the HCVS components
- Operating a key-locked switch for each of the two torus CIVs

- Opening the PCV and setting the pressure setpoint

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 primary procedural protocol.

The HCVS will be designed to allow initiation and isolation, control, and monitoring at the HCVS panel. The location of the HCVS panel will minimize plant operator's exposure to adverse temperature and radiological conditions and will be reasonably protected from the assumed hazards.

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

After 24 hours, available personnel will be able to connect supplemental motive air/gas to the HCVS support systems. Connections for supplementing electrical power and motive air/gas required for HCVS will be located in accessible areas with reasonable protection from assumed hazards to minimize personnel exposure to adverse conditions following a prolonged SBO and venting. Connections will use pre-engineered quick disconnects to minimize manpower resources.

Order EA-12-050 1.1.2 Requirement:

The HCVS shall be designed to minimize plant operators' exposure to occupational hazards, such as extreme heat stress, while operating the HCVS system.

ISG 1.1.2 Criteria:

During a prolonged SBO, the drywell, wetwell (torus), and nearby areas in the plant where HVCS components are expected to be located will likely experience an excursion in temperatures due to inadequate containment cooling combined with loss of normal and emergency building ventilation systems. In addition, installed normal and emergency lighting in the plant may not be available. Licensees should take into consideration plant conditions expected to be experienced during applicable beyond design basis external events when locating valves, instrument air supplies, and other components that will be required to safely operate the HCVS system. Components required for manual operation should be placed in areas that are readily accessible to plant operators, and not require additional actions, such as the installation of ladders or temporary scaffolding, to operate the system.

When developing a design strategy, the NRC staff expects licensees to analyze potential plant conditions and use its acquired knowledge of these areas, in terms of how temperatures would react to extended SBO conditions and the lighting that would be available during beyond design basis external events. This knowledge also provides an input to system operating procedures, training, the choice of protective clothing, required tools and equipment, and portable lighting.

Response (ref. ISG Item 1.1.2):

The HCVS design allows initiating and then operating and monitoring the HCVS from the HCVS panel. The location of the HCVS panel will minimize plant operators' exposure to adverse temperature and radiological conditions and the panel location is reasonably protected from hazards assumed in JLD-ISG-2012-01, Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events, and NEI 12-06 Diverse and Flexible Coping Strategies (FLEX) Implementation Guide.

In order to minimize operator exposure to temperature excursions due to the impact of the prolonged SBO (i.e., loss of normal and emergency building ventilation systems and/or containment temperature changes) HCVS valve operation will not require access to the suppression pool (torus) area or other plant areas which may pose severe temperature and radiological hazards to personnel.

Similarly, DC power and motive air/gas sources and the connections to these support systems required for sustained operation will be located in accessible areas reasonably protected from severe natural phenomena and which minimize exposure to occupational hazards. Tools required for sustained operation, such as portable lighting and connection specific tooling will be pre-staged in the NEI 12-06 storage locations.

Neither temporary ladders nor scaffold will be required to access these connections or storage locations.

Order EA-12-050 1.1.3 Requirement:

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

ISG 1.1.3 Criteria:

The design of the HCVS should take into consideration the radiological consequences resulting from the event that could negatively impact event response. During the Fukushima event, personnel actions to manually operate the vent valves were impeded due to the location of the valves in the torus rooms. The HCVS shall be designed to be placed in operation by operator actions at a control panel, located in the main control room or in a remote location. The system shall be deigned to function in this mode with permanently installed equipment providing electrical power (e.g., dc power batteries) and valve motive force (e.g., N2/air cylinders). The system shall be designed to function in this mode for a minimum duration of 24 hours with no operator actions required or credited, other than the system initiating actions at the control panel. Durations of less than 24 hours will be considered if justified by adequate supporting information from the licensee. To ensure continued operation of the HCVS beyond 24 hours, licensees may credit manual actions, such as moving portable equipment to supplement electrical power and valve motive power sources.

In response to Generic Letter (GL) 89-16, a number of facilities with Mark I containments installed vent valves in the torus room, near the drywell, or both. Licensees can continue to use these venting locations or select new locations, provided the requirements of this guidance document are satisfied. The HCVS improves the chances of core cooling by removing heat from containment and lowering containment pressure, when core cooling is provided by other systems. If core cooling were to fail and result in the onset core damage, closure of the vent valves may become necessary if the system was not designed for severe accident service. In addition, leakage from the HCVS within the plant and the location of the external release from the HCVS could impact the event response from on-site operators and off-site help arriving at the plant. An adequate strategy to minimize radiological consequences that could impede personnel actions should include the following:

1. Licensees shall provide permanent radiation shielding where necessary to facilitate personnel access to valves and allow manual operation of the valves locally. Licensee may use alternatives such as providing features to facilitate manual operation of valves from remote locations, as discussed further in this guidance under Requirement 1.2.2, or relocate the vent valves to areas that are significantly less challenging to operator access/actions.

2. In accordance with Requirement 1.2.8, the HCVS shall be designed for pressures that are consistent with the higher of the primary containment design pressure and the primary containment pressure limit (PCPL), as well as including dynamic loading resulting from system actuation. In addition, the system shall be leak-tight. As such, ventilation duct work (i.e., sheet metal) shall not be utilized in the design of the HCVS. Licensees should perform appropriate testing, such as hydrostatic or pneumatic testing, to establish the leak-tightness of the HCVS.

3. The HCVS release to outside atmosphere shall be at an elevation higher than adjacent plant structures. Release through existing plant stacks is considered acceptable, provided the guidance under Requirement 1.2.6 is satisfied. If the release from HCVS is through a vent stack different than the plant stack, the elevation of the stack should be higher than the nearest building or structure.

Response (ref. ISG Item 1.1.3):

1. The HCVS will be designed for reliable remote-manual operation from the HCVS panel. HCVS valve operation will not require access to the suppression pool (torus) area or other plant areas which may pose severe temperature and radiological hazards to

personnel. The HCVS will consist of a dedicated flow path for each Dresden unit with no interconnection between the two Dresden units. Within each unit's HCVS, there are interconnected systems but these are automatically isolated by a CIV. This design prevents cross-flow into unintended areas, provides containment isolation, and provides reliable and rugged performance as discussed below for Order requirements 1.2.6.

Although the ISG does not assume core damage, the design of the HCVS is predicated on the possibility of core damage. All HCVS flow path valves that must be operated are power operated valves that can be remote-manually operated without requiring access near the valves or the piping. Localized shielding or other alternatives to facilitate manual actions is not required.

2. As discussed in Section 1.2.8, the HCVS design pressure will be 62 psig. This is the higher of the containment design pressure (62 psig) and the PCPL value (60 psig). The flow path will only use piping components, which excludes the use of any HVAC ducting, and the piping will be evaluated for dynamic loads. Intersystem valve leakage is limited by automatic closure by a CIV on a containment isolation signal. The integrity of the piping will be established as required by the applicable piping standards.
3. As discussed in Section 1.2.6, the release to the outside atmosphere is at an elevation above the Reactor Building which is higher than any adjacent plant structure.

Section 3: Operational characteristics and a description of how each of the Order's technical requirements is being met.

Order EA-12-050 1.2.1 Requirement:

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

ISG 1.2.1 Criteria:

Beyond design basis external events such as a prolonged SBO could result in the loss of active containment heat removal capability. The primary design objective of the HCVS is to provide sufficient venting capacity to prevent a long-term overpressure failure of the containment by keeping the containment pressure below the primary containment design pressure and the PCPL. The PCPL may be dictated by other factors, such as the maximum containment pressure at which the safety relief valves (SRVs) and the HCVS valves can be opened and closed.

The NRC staff has determined that, for a vent sized under conditions of constant heat input at a rate equal to 1 percent of rated thermal power and containment pressure equal to the lower of the primary containment design pressure and the PCPL, the exhaust-flow through the vent would be sufficient to prevent the containment pressure from increasing. This determination is based on studies that have shown that the torus suppression capacity is typically sufficient to absorb the decay heat generated during at least the first three hours following the shutdown of the reactor with suppression pool as the source of injection, that decay heat is typically less than 1 percent of rated thermal power three hours following shutdown of the reactor, and that decay heat continues to decrease to well under 1 percent, thereafter. Licensees shall have an auditable engineering basis for the decay heat absorbing capacity of their suppression pools, selection of venting pressure such that the HCVS will have sufficient venting capacity under such conditions to maintain containment pressure at or below the primary containment design pressure and the PCPL. If required, venting capacity shall be increased to an appropriate level commensurate with the licensee's venting strategy. Licensees may also use a venting capacity sized under conditions of constant heat input at a rate lower than 1 percent of thermal power if it can be justified by analysis that primary containment design pressure and the PCPL would not be exceeded. In cases where plants were granted, have applied, or plan to apply for power uprates, the licensees shall use 1 percent thermal power corresponding to the uprated thermal power. The basis for the venting capacity shall give appropriate consideration of where venting is being performed from (i.e., wetwell or drywell) and the difference in pressure between the drywell and the suppression chamber. Vent sizing for multi-unit sites must take into consideration simultaneous venting from *all the units, and ensure that venting on one unit does not negatively impact the ability to vent on the other units.*

Response (ref. ISG Item 1.2.1):

The HCVS torus path will be designed for venting steam/energy at a nominal capacity of 1% of 3016 MWt power at containment pressure of 60 psig. This pressure is the lower of the containment design pressure (62 psig) and the PCPL value (60 psig). The thermal power accounts for a Measurement Uncertainty Recovery (MUR) planned power uprate above the current licensed thermal power (CLTP) of 2957 MWt.

The 1% value 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 will be confirmed.

Order EA-12-050 1.2.2 Requirement:

The HCVS shall be accessible to plant operators and be capable of remote operation and control, or manual operation, during sustained operations.

ISG 1.2.2 Criteria:

The preferred location for remote operation and control of the HCVS is from the main control room. However, alternate locations to the control room are also acceptable, provided the licensees take into consideration the following:

1. *Sustained operations mean the ability to open/close the valves multiple times during the event. Licensees shall determine the number of open/close cycles necessary during the first 24 hours of operation and provide supporting basis consistent with the plant-specific containment venting strategy.*
2. *An assessment of temperature and radiological conditions that operating personnel may encounter both in transit and locally at the controls. Licensee may use alternatives such as providing features to facilitate manual operation of valves from remote locations or relocating/reorienting the valves.*
3. *All permanently installed HCVS equipment, including any connections required to supplement the HCVS operation during a prolonged SBO (electric power, N2/air) shall be located above the maximum design basis external flood level or protected from the design basis external flood.*
4. *During a prolonged SBO, manual operation/action may become necessary to operate the HCVS. As demonstrated during the Fukushima event, the valves lost motive force including electric power and pneumatic air supply to the valve operators, and control power to solenoid valves. If direct access and local operation of the valves is not feasible due to temperature or radiological hazards, licensees should include design features to facilitate remote manual operation of the HCVS valves by means such as reach rods, chain links, hand wheels, and portable equipment to provide motive force (e.g., air/N2 bottles, diesel powered compressors, and dc batteries). The connections between the valves and portable equipment should be designed for quick deployment. If a portable motive force (e.g., air or N2 bottles, dc power supplies) is used in the design strategy, licensees shall provide reasonable protection of that equipment consistent with the staff's guidance delineated in JLD-ISG-2012-01 for Order EA-12-049.*
5. *The design shall preclude the need for operators to move temporary ladders or operate from atop scaffolding to access the HCVS valves or remote operating locations.*

Response (ref. ISG Item 1.2.2):

The HCVS design will allow initiating and then operating and monitoring the HCVS from the HCVS panel. This location of the panel will be the MCR or a location readily accessible from the MCR. The selected location will be reasonably protected from adverse natural phenomena.

1. The HCVS flow path valves are air-operated valves (AOV) with air-to-open and spring-to-shut. Opening the valves requires energizing a DC powered solenoid operated valve (SOV) and providing motive air/gas. The detailed design will provide a permanently installed DC power source and motive air/gas supply adequate for the first 24 hours. The

initial stored motive air/gas will allow for a minimum of five valve operating cycles; however, the detailed design will determine the number of required valve cycles for the first 24-hours.

2. Although the ISG does not assume core damage, operation of the HCVS is predicated on the possibility of core damage. All HCVS flow path valves that must be operated are power operated valves remote-manually operated from the HCVS panel without requiring access near the valves or the piping.
3. All permanently installed HCVS equipment, including any connections required to supplement the HCVS operation during a prolonged SBO (electric power, N2/air) will be located in areas reasonably protected from assumed hazards.
4. Sustainability of remote operation will be addressed by locating the DC power and pneumatic motive sources at an accessible location. The SOV is the only electrically active component located in an inaccessible area required to open an AOV. For the upstream CIV, two SOVs for each AOV will be arranged such that energizing either SOV from its DC power supply can open the valve. For the downstream HCVS CIV, the SOV will either be located in an accessible location or alternatively two SOVs for each AOV will be arranged such that energizing either SOV from the dedicated DC power supply can open the valve. The AOV PCV will be provided with a hydraulic over-ride at an accessible location in case the air operated controls fail. Any supplemental connections will be pre-engineered to minimize man-power resources and any needed portable equipment will be reasonably protected from assumed hazards.
5. Access to the locations described above will not require temporary ladders or scaffolding.

Order EA-12-050 1.2.3 Requirement:

The HCVS shall include a means to prevent inadvertent actuation.

ISG 1.2.3 Criteria:

The design of the HCVS shall incorporate features, such as control panel key-locked switches, locking systems, rupture discs, or administrative controls to prevent the inadvertent use of the vent valves. The system shall be designed to preclude inadvertent actuation of the HCVS due to any single active failure. The design should consider general guidelines such as single point vulnerability and spurious operations of any plant installed equipment associated with HCVS.

The objective of the HCVS is to provide sufficient venting of containment and prevent long-term overpressure failure of containment following the loss of active containment heat removal capability or prolonged SBO. However, inadvertent actuation of HCVS due to a design error, equipment malfunction, or operator error during a design basis loss-of-coolant accident (DBLOCA) could have an undesirable effect on the containment accident pressure (CAP) to provide adequate net positive suction head to the emergency core cooling system (ECCS) pumps. Therefore, prevention of inadvertent actuation, while important for all plants, is essential for plants relying on CAP. The licensee submittals on HCVS shall specifically include details on how this issue will be addressed on their individual plants for all situations when CAP credit is required.

Response (ref. ISG Item 1.2.3):

The primary design feature that prevents inadvertent HCVS flow path opening is two normally closed, in-series CIVs that are air-to-open and spring-to-close.

The upstream HCVS CIV is on a flow path shared with the SGTS and RBVS flow path. The existing control circuit will control the valve for the HCVS, SGTS and RBVS functions. This circuit will retain the containment isolation signal. Specifically:

- The existing control circuit will be used during all "design basis" operating modes including all design basis transients and accidents. The containment isolation signal will automatically de-energize the AC powered SOV on this circuit causing the AOV to shut. The circuit can be overridden to reopen the CIV if required for venting the containment to atmosphere, but this requires deliberate RO action.
- A second, independent circuit will be used to operate this valve but only following an event that requires operating the HCVS. This circuit will not have any automatic signal. The HCVS control circuit will have a key-locked switch for this valve to address inadvertent operation. In addition, the DC power will normally be isolated.

The downstream CIV, dedicated to the HCVS, must also be opened to establish the flow path. The DC power to this circuit is normally de-energized in addition to requiring a key-lock switch to be operated.

Dresden credits CAP for meeting ECCS pumps' net positive suction head (NPSH) for a DBLOCA. Inadvertent actuation of the HCVS in a DBLOCA (or any other design basis transient or accident) is precluded by separate key-locked switches for the in-series CIVs and by normally maintaining the DC power for the SOVs for these CIV de-energized. In addition, the revised HCVS operating procedures will provide clear guidance that the HCVS is not to be used to defeat containment integrity during any design basis transients and accident.

Order EA-12-050 1.2.4 Requirement:

The HCVS shall include a means to monitor the status of the vent system (e.g., valve position indication) from the control room or other location(s). The monitoring system shall be designed for sustained operation during a prolonged SBO.

ISG 1.2.4 Criteria:

Plant operators must be able to readily monitor the status of the HCVS at all times, including being able to understand whether or not containment pressure/energy is being vented through the HCVS, and whether or not containment integrity has been restored following venting operations. Licensees shall provide a means to allow plant operators to readily determine, or have knowledge of, the following system parameters:

(1) HCVS vent valves' position (open or closed),

(2) system pressure, and

(3) effluent temperature.

Other important information includes the status of supporting systems, such as availability of electrical power and pneumatic supply pressure. Monitoring by means of permanently installed gauges that are at, or nearby, the HCVS control panel is acceptable. The staff will consider alternative approaches for system status instrumentation; however, licensees must provide sufficient information and justification for alternative approaches.

The means to monitor system status shall support sustained operations during a prolonged SBO, and be designed to operate under potentially harsh environmental conditions that would be expected following a loss of containment heat removal capability and SBO. Power supplies to all instruments, controls, and indications shall be from the same power sources supporting the HCVS operation. "Sustained operations" may include the use of portable equipment to provide an alternate source of power to components used to monitor HCVS status. Licensees shall demonstrate instrument reliability via an appropriate combination of design, analyses, operating experience, and/or testing of channel components for the following sets of parameters:

- *radiological conditions that the instruments may encounter under normal plant conditions, and during and after a prolonged SBO event.*
- *temperatures and pressure conditions as described under requirement 1.2.8, including dynamic loading from system operation.*
- *humidity based on instrument location and effluent conditions in the HCVS.*

Response (ref. ISG Item 1.2.4):

The design of the HCVS will have temperature and radiation monitoring downstream of the last isolation valve. Pressure monitoring will be downstream of the CIVs but upstream of the PCV. All flow path valves will have open and closed position indication. These HCVS indications will be on the same panel as the valve control switches. Motive air/gas pressure and DC power source voltage are also monitored at the HCVS panel.

Power for the instrumentation will be from the same source used for the SOVs used to position the AOVs. Refer to the response to 1.2.2 for discussion on the DC power.

The approximate range for the temperature indication will be 50°F to 600°F. The approximate range for the pressure indication will be 0 psig to 120 psig. The upper limits were selected to be approximately twice the required HCVS design temperature and pressure. The ranges will be finalized when the detailed design and equipment specifications are prepared.

The detailed design will address the radiological, temperature, pressure, flow induced vibration (if applicable) and internal piping dynamic forces, humidity/condensation and seismic qualification requirements. Assumed radiological conditions for instrument qualification will bound normal operation followed by a prolonged SBO (without fuel failure).

Order EA-12-050 1.2.5 Requirement:

The HCVS shall include a means to monitor the effluent discharge for radioactivity that may be released from operation of the HCVS. The monitoring system shall provide indication in the control room or other location(s), and shall be designed for sustained operation during a prolonged SBO.

ISG 1.2.5 Criteria:

Licensees shall provide an independent means to monitor overall radioactivity that may be released from the HCVS discharge. The radiation monitor does not need to meet the requirements of NUREG 0737 for monitored releases, nor does it need to be able monitor releases quantitatively to ensure compliance with Title 10 of the Code of Federal Regulations (10 CFR) Part 100 or 10 CFR Section 50.67. A wide-range monitoring system to monitor the overall activity in the release providing indication that effluent from the containment environment that is passing by the monitor is acceptable. The use of other existing radiation monitoring capability in lieu of an independent HCVS radiation monitor is not acceptable because plant operators need accurate information about releases coming from the containment via the HCVS in order to make informed decisions on operation of the reliable hardened venting system.

The monitoring system shall provide indication in the control room or a remote location (i.e., HCVS control panel) for the first 24 hours of an extended SBO with electric power provided by permanent DC battery sources, and supplemented by portable power sources for sustained operations. Monitoring radiation levels is required only during the events that necessitate operation of the HCVS. The reliability of the effluent monitoring system under the applicable environmental conditions shall be demonstrated by methods described under Requirement 1.2.4.

Response (ref. ISG Item 1.2.5):

The HCVS radiation monitoring system (RMS) will be dedicated to the HCVS. The approximate range of the RMS is 0.1 mrem/hr to 1000 mrem/hr. The detailed design will finalize the range. This range is considered adequate to determine core integrity per the NRC Responses to Public Comments document, dated August 29, 2012 (ML12229A477).

The detector will be physically mounted on the outside of the piping, accounting for the pipe wall thickness shielding in order to provide a measurement of the radiation level on the inside of the HCVS piping. The radiation level will be indicated at the HCVS panel. The RMS will be powered from the same source as all other powered HCVS components. Refer to the response to 1.2.2 for discussion on sustainability of the DC power.

Order EA-12-050 1.2.6 Requirement:

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

ISG 1.2.6 Criteria:

At Fukushima, an explosion occurred in Unit 4, which was in a maintenance outage at the time of the event. Although the facts have not been fully established, a likely cause of the explosion in Unit 4 is that hydrogen leaked from Unit 3 to Unit 4 through a common venting system. System cross-connections present a potential for steam, hydrogen, and airborne radioactivity leakage to other areas of the plant and to adjacent units at multi-unit sites if the units are equipped with common vent piping. In this context, a design that is free of physical and control interfaces with other systems eliminates the potential for any cross-flow and is one way to satisfy this requirement. Regardless, system design shall provide design features to prevent the cross flow of vented fluids and migration to other areas within the plant or to adjacent units at multi-unit sites.

The current design of the hardened vent at several plants in the U.S. includes cross connections with the standby gas treatment system, which contains sheet metal ducts and filter and fan housings that are not as leak tight as hard pipes. In addition, dual unit plant sites are often equipped with a common plant stack. Examples of acceptable means for prevention of cross flow is by valves, leak-tight dampers, and check valves, which shall be designed to automatically close upon the initiation of the HCVS and shall remain closed for as long as the HCVS is in operation. Licensee's shall evaluate the environmental conditions (e.g. pressure, temperature) at the damper locations during venting operations to ensure that the dampers will remain functional and sufficiently leak-tight, and if necessary, replace the dampers with other suitable equipment such as valves. If power is required for the interfacing valves to move to isolation position, it shall be from the same power sources as the vent valves. Leak tightness of any such barriers shall be periodically verified by testing as described under Requirement 1.2.7.

Response (ref. ISG Item 1.2.6):

The HCVS for both units are fully independent of each other with separate discharge points. Therefore, the capacity at each unit is independent of the status of the other unit's HCVS.

The HCVS shares the upstream part of its flowpath with SGTS and the RBVS; however, these flow paths are automatically isolated by a CIV on a containment isolation signal. The CIVs on the SGTS and RBVS flow path are AOVs with air-to-open and spring-to-shut. On a containment isolation signal, loss of motive air/N2, or loss of control power, the valves will shut. Any leakage is limited to the leakage rate that could be anticipated for a CIV.

Order EA-12-050 1.2.7 Requirement:

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

ISG 1.2.7 Criteria:

The HCVS piping run shall be designed to eliminate the potential for condensation accumulation, as subsequent water hammer could complicate system operation during intermittent venting or to withstand the potential for water hammer without compromising the functionality of the system. Licensees shall provide a means (e.g., drain valves, pressure and temperature gauge connections) to periodically test system components, including exercising (opening and closing) the vent valve(s). In situations where total elimination of condensation is not feasible, HCVS shall be designed to accommodate condensation, including applicable water hammer loads.

The HCVS outboard of the containment boundary shall be tested to ensure that vent flow is released to the outside with minimal leakage, if any, through the interfacing boundaries with other systems or units. Licensees have the option of individually leak testing interfacing valves or testing the overall leakage of the HCVS volume by conventional leak rate testing methods. The test volume shall envelope the HCVS between the outer primary containment isolation barrier and the vent exiting the plant buildings, including the volume up to the interfacing valves. The test pressure shall be based on the HCVS design pressure. Permissible leakage rates for the interfacing valves shall be within the requirements of American Society of Mechanical Engineers Operation and Maintenance of Nuclear Power Plants Code (ASME OM) – 2009, Subsection ISTC – 3630 (e) (2), or later edition of the ASME OM Code. When testing the HCVS volume, allowed leakage shall not exceed the sum of the interfacing valve leakages as determined from the ASME OM Code. The NRC staff will consider a higher leakage acceptance values if licensees provide acceptable justification. When reviewing such requests, the NRC staff will consider the impact of the leakage on the *habitability of the rooms and areas within the building and operability of equipment in these areas during the event response and subsequent recovery periods. Licensees shall implement the following operation, testing and inspection requirements for the HCVS to ensure reliable operation of the system.*

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 year*
Perform visual inspections and a walkdown of HCVS components	*Once per operating cycle*
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 five years 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*

Response (ref. ISG Item 1.2.7):

The detailed design for the HCVS will address condensation accumulation resulting from intermittent venting. In situations where total elimination of condensation is not feasible, the HCVS will be designed to accommodate condensation, including allowance for applicable water hammer loads.

The CIVs that are part of the HCVS boundary will be tested in accordance with the current licensing and design basis for the plant. Outboard of the containment boundary, there are no interfacing boundaries to other systems. Therefore, the ISG 1.2.7 requirement for intersystem valve leakage testing does not apply.

The test types and frequencies will conform to the ISG 1.2.7 Table "Testing and inspection Requirements" with the clarification that "Leak test the HCVS" applies to intersystem boundary valves. The integrity of the piping will be demonstrated through compliance with the testing requirements of the applicable piping code.

Order EA-12-050 1.2.8 Requirement:

The HCVS shall be designed for pressures that are consistent with maximum containment design pressures, as well as, dynamic loading resulting from system actuation.

ISG 1.2.8 Criteria:

The vent system shall be designed for the higher of the primary containment design pressure or PCPL, and a saturation temperature corresponding to the HCVS design pressure. However, if the venting location is from the drywell, an additional margin of 50 °F shall be added to the design temperature because of the potential for superheated conditions in the drywell. The piping, valves, and the valve actuators shall be designed to withstand the dynamic loading resulting from the actuation of the system, including piping reaction loads from valve opening, concurrent hydrodynamic loads from SRV discharges to the suppression *pool, and potential for water hammer from accumulation of steam condensation during multiple venting cycles.*

Response (ref. ISG Item 1.2.8):

The HCVS piping design pressure will be 62 psig and design temperature is 360°F. The HCVS design pressure is the higher of the containment design pressure (62 psig) and the PCPL value (60 psig). The HCVS design temperature is the saturation temperature corresponding to the design pressure plus 50°F rounded up. This temperature allows for venting from the drywell.

The piping, valves, and valve actuators will be designed to withstand the dynamic loading resulting from the actuation of the HCVS, including piping reaction loads from valve opening, concurrent hydrodynamic loads from SRV/Electromatic Relief Valve (ERV) discharges to the suppression pool, and potential for water hammer from accumulation of condensation during multiple venting cycles.

Order EA-12-050 1.2.9 Requirement:

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

ISG 1.2.9 Criteria:

The HCVS release to outside atmosphere shall be at an elevation higher than adjacent plant structures. Release through existing plant stacks is considered acceptable, provided the guidance under Requirement 1.2.6 is satisfied. If the release from HCVS is through a stack different than the plant stack, the elevation of the stack should be higher than the nearest building or structure. The release point should be situated away from ventilation system intake and exhaust openings, and emergency response facilities. The release stack or structure exposed to outside shall be designed or protected to withstand missiles that could be generated by the external events causing the prolonged SBO (e.g., tornadoes, high winds).

Response (ref. ISG Item 1.2.9):

The HCVS discharge path piping will be routed to a point just above the Reactor Building, which is higher than any adjacent structure. The Station's chimney is an adjacent structure, but it is impractical to raise the HCVS above the chimney. This discharge point location will be determined during the detailed design phase considering ventilation system intake and exhaust openings, main control room location, location of FLEX equipment, access routes required following a prolonged SBO, and emergency response facilities; however, these must be considered in conjunction with other design criteria (e.g., flow capacity) and pipe routing limitations, to the degree practical.

Per NEI 12-06 Section 4.1, all severe natural phenomena that may result in a prolonged SBO must be identified. This includes evaluation if the tornado (including tornado missiles) can cause the failure of the normal, on-site emergency AC power sources, the safety-related AC distribution system, or the heat sinks required to support on-site emergency AC sources. As a minimum, all external HCVS components will be designed for tornado winds. If it is determined that tornado missiles have the potential to cause a prolonged SBO, any external HCVS would also have to be tornado missile protected. This will be determined early in the detailed design effort.

Section 4: Applicable Quality Requirements (Order EA-12-050 requirements 2.1 and 2.2)

Order EA-12-050 2.1 Requirement:

The HCVS system design shall not preclude the containment isolation valves, including the vent valve from performing their intended containment isolation function consistent with the design basis for the plant. These items include piping, piping supports, containment isolation valves, containment isolation valve actuators and containment isolation valve position indication components.

ISG 2.1 Criteria:

The HCVS vent path up to and including the second containment isolation barrier shall be designed consistent with the design basis of the plant. These items include piping, piping supports, containment isolation valves, containment isolation valve actuators and containment isolation valve position indication components. The HCVS design, out to and including the second containment isolation barrier, shall meet safety-related requirements consistent with the design basis of the plant. The staff notes that in response to GL 89-16, in many cases, the HCVS vent line connections were made to existing systems. In some cases, the connection was made in between two existing containment isolation valves and in others to the vacuum breaker line. The HCVS system design shall not preclude the containment isolation valves, including the vent valve from performing their intended containment isolation function consistent with the design basis for the plant. The design shall include all necessary overrides of containment isolation signals and other interface system signals to enable the vent valves to open upon initiation of the HCVS from its control panel.

Response (ref. ISG Item 2.1):

The HCVS through the first CIV shares a common path with the SGTS and RBVS. Downstream of the second CIV the HCVS has a dedicated flow path.

The HCVS vent path piping and supports up to and including the second containment isolation valve will be designed in accordance with existing design basis. As with all other Dresden mechanical penetrations open to the containment atmosphere (i.e., Generic Design Criteria 56 penetrations), both HCVS CIVs will be located outside containment. Associated actuators, position indication, and power supplies are also designed consistent with the requirements to meet the design basis for containment isolation.

In order to maintain containment isolation when required by the plant's design basis, both CIVs in the flow path will be normally closed, fail-closed AOVs. As discussed in Section 1.2.3, the existing control circuit for the first CIV will not be changed, but a second control circuit will be added for the HCVS function. Opening the HCVS flow path valves will be controlled procedurally and the design will address inadvertent operation to ensure that the HCVS flow path remains isolated anytime the design basis requires containment integrity. Due to the above, automatic containment isolation signal will not be provided to the HCVS CIV control circuits.

The HCVS system design will not preclude any existing CIVs and the new HCVS CIV from performing their intended containment isolation. The control circuit for the HCVS CIVs will allow operation of the valves from its control panel when required following containment pressurization and a containment isolation signal.

Order EA-12-050 2.2 Requirement:

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

ISG 2.2 Criteria:

All components of the HCVS beyond the second containment isolation barrier shall be designed to ensure HCVS functionality following the plant's design basis seismic event. These components include, in addition to the hardened vent pipe, electric power supply, pneumatic supply and instrumentation. The design of power and pneumatic supply lines between the HCVS valves and remote locations (if portable sources were to be employed) shall also be designed to ensure HCVS functionality. Licensees shall ensure that the HCVS will not impact other safety-related structures and components and that the HCVS will not be impacted by non-seismic components. The staff prefers that the HCVS components, including the piping run, be located in seismically qualified structures. However, short runs of HCVS piping in non-seismic structures are acceptable if the licensee provides adequate justification on the seismic ruggedness of these structures. The hardened vent shall be designed to conform to the requirements consistent with the applicable design codes *for the plant, such as the American Society of Mechanical Engineers Boiler and Pressure Vessel Code and the applicable Specifications, Codes and Standards of the American Institute of Steel Construction.*

To ensure the functionality of instruments following a seismic event, the NRC staff considers any of the following as acceptable methods:

- *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 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.*

Response (ref. ISG Item 2.2):

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

The HCVS downstream of the second containment isolation valve, including piping and supports, electrical power supply, valve actuator pneumatic supply, and instrumentation (local and remote) components, will be designed/analyzed to ensure functionality following a design basis earthquake and to conform to the applicable plant requirements/design codes except as the HCVS ISG allows or directs other criteria.

The ISG definition for "seismically rugged design" allows the use of commercial grade components and materials beyond the second containment isolation barrier including exclusion from compliance with Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants."

Per ISG Item 2.2 direction, the HCVS instruments, including valve position indication, process instrumentation, radiation monitoring, and support system monitoring, will be qualified using one 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.

Instrument	**Qualification Method***
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.

Section 5: Procedures and Training (Order EA-12-050 requirements 3.1 and 3.2)

Order EA-12-050 3.1 Requirement:

Licensees shall develop, implement, and maintain procedures necessary for the safe operation of the HCVS. Procedures shall be established for system operations when normal and backup power is available, and during SBO conditions.

ISG 3.1 Criteria:

Procedures shall be developed describing 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 equipment. The procedures shall identify appropriate conditions and criteria for use of the HCVS. The procedures shall clearly state the nexus between CAP and ECCS pumps during a DBLOCA and how an inadvertent opening of the vent valve could have an adverse impact on this nexus. The HCVS procedures shall be developed and implemented in the same manner as other plant procedures necessary to support the execution of the Emergency Operating Procedures (EOPs).

Licensees shall establish provisions for out-of-service requirements of the HCVS and compensatory measures. These provisions shall be documented in the Technical Requirements Manual (TRM) or similar document. The allowed unavailability time for the HCVS shall not exceed 30 days during modes 1, 2, and 3. If the unavailability time exceeds 30 days, the TRM shall direct licensees to perform a cause assessment and take the necessary actions to restore HCVS availability in a timely manner, consistent with plant procedures and prevent future unavailability for similar causes.

Response (ref. ISG Item 3.1):

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

The HCVS procedures will be developed and implemented following the plant's process for initiating or revising procedures and will 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 (reference NEI 12-06), including the storage location of portable equipment,
- training on operating the portable equipment, and
- testing of portable equipment

Dresden credits CAP for ECCS pump NPSH during a DBLOCA. The procedures will emphasize the need for immediate isolation if the HCVS is inadvertently opened.

Dresden Nuclear Power Station will establish provisions for out-of-service requirements of the HCVS and compensatory measures. The following provisions will be documented in the Technical Requirements Manual (TRM) document:

- The allowed unavailability time for the HCVS shall not exceed 30 days during modes 1, 2, and 3.
- If the unavailability time exceeds 30 days
    - The condition will be entered into the corrective action system,
    - The HCVS availability will be restored in a manner consistent with plant procedures,
    - A cause assessment will be performed to prevent future unavailability for similar causes.

Order EA-12-050 3.2 Requirement:

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

ISG 3.2 Criteria:

All personnel expected to operate the HVCS shall receive training in the use of plant procedures developed for system operations when normal and backup power is available, and during SBO conditions consistent with the plants systematic approach to training. The training shall be refreshed on a periodic basis and as any changes occur to the HCVS.

Response (ref. ISG Item 3.2):

Training materials will be developed for the staff involved in operating the HCVS in all modes of HCVS operation. For accredited training programs, the Systematic Approach to Training (SAT) will be used to determine training needs. Assignments to personnel responsible for implementing the SAT process at Dresden will include direction to ensure compliance with training requirements of NRC Order EA-12-050 Requirement 3.2 and ISG Criteria 3.2.

Section 6: Implementation Schedule Milestones

The following milestone schedule is provided. The dates are planning dates subject to change as design and implementation details are developed. Any changes to the following target dates will be reflected in the subsequent 6 month status reports.

Original Target Date	Activity	Status
October 2012	Conceptual design meeting	Complete
October 2012	Submit 60 Day Status Report	Complete
February 2013	Submit Overall Integrated Implementation Plan	Completed with this submittal
August 2013	Submit 6 Month Status Report	
February 2014	Submit 6 Month Status Report	
August 2014	Submit 6 Month Status Report	
November 2014	U2 Design Change Package Issued	
February 2015	Submit 6 Month Status Report	
June 2015	U2 Design Major Material On-site[1]	
June 2015	Procedure Changes and Training Material Complete	
August 2015	Submit 6 Month Status Report	
D2R24 outage Fall 2015	U2 Design Change Implemented	
D2R24 outage Fall 2015	Procedure Changes Active	
D2R24 outage Fall 2015	U2 Demonstration/ Functional Test prior to rod withdrawal; Full compliance.	
November 2015	U3 Design Change Package Issued	
February 2016	Submit 6 Month Status Report	
June 2016	U3 Design Major Material On-site[1]	
August 2016	Submit 6 Month Status Report	
D3R24 outage Fall 2016	U3 Design Change Implemented	
D3R24 outage Fall 2016	U3 Demonstration/Functional Test prior to rod withdrawal; Full compliance.	
December 2016	Submit Completion Report	

Section 7: Changes/Updates to this Overall Integrated Implementation Plan

Significant changes to this plan and added design details will be communicated to the NRC in the 6 month Status Reports.

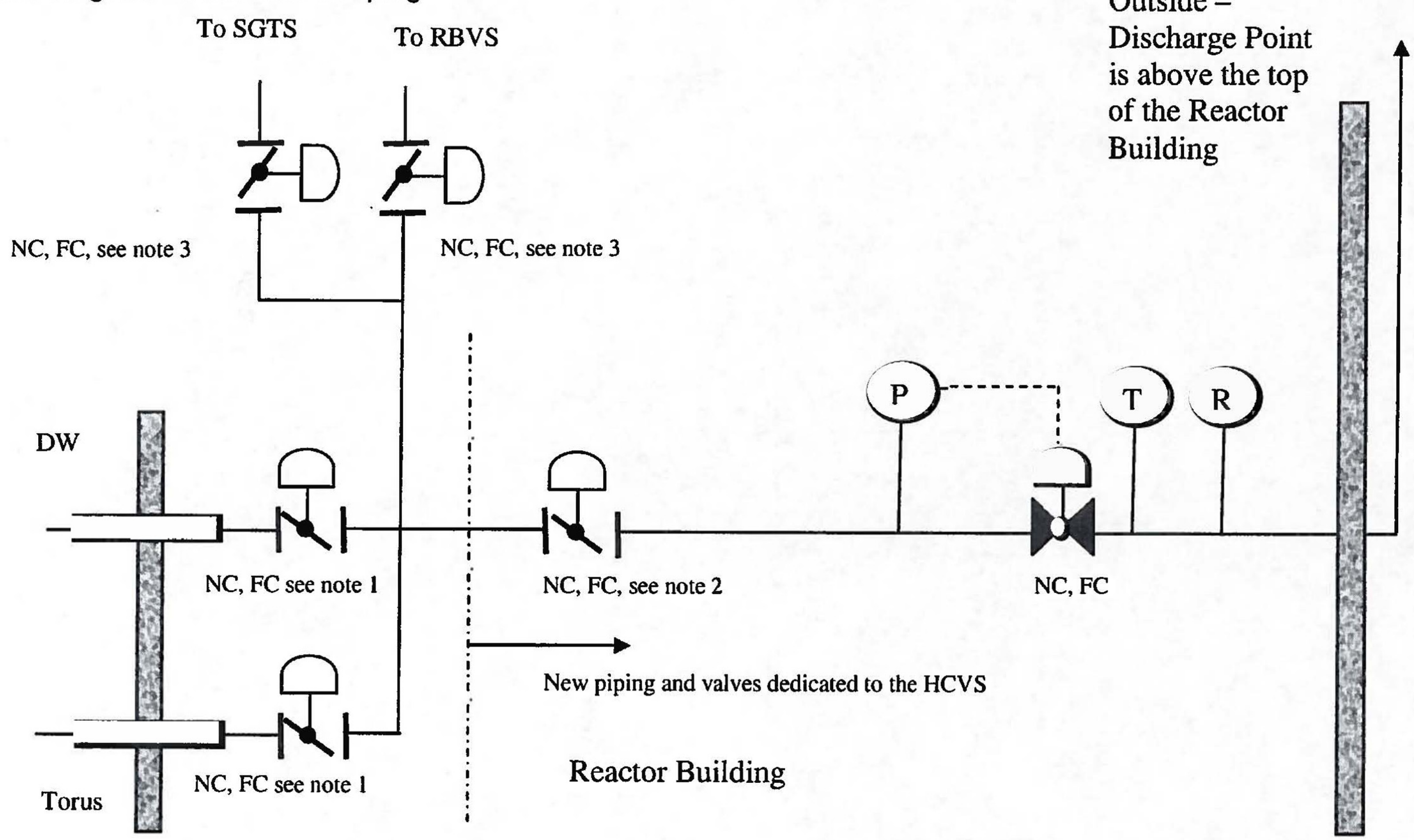
[1] Major Equipment - Piping, valves and components greater than 3", Instrumentation pick-ups and indicators.

Section 8: Figures/Diagrams

ISG IV.C. 1. Reporting Requirements:

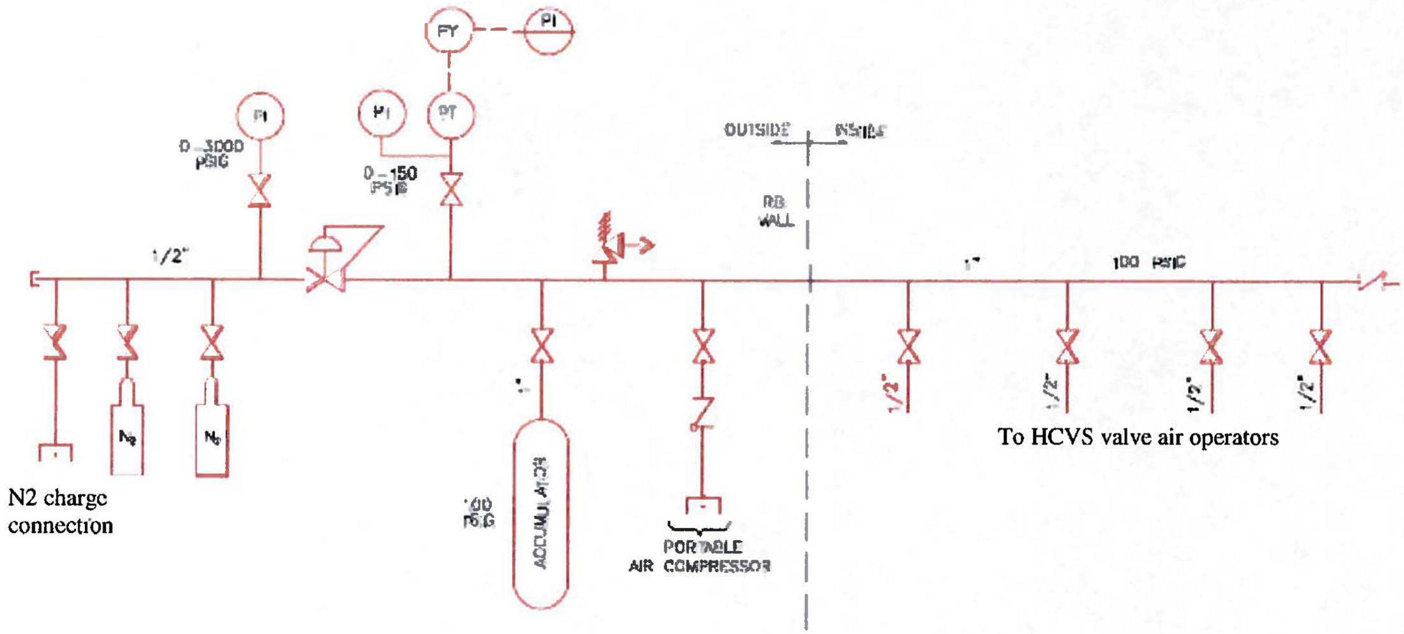
A piping and instrumentation diagram or a similar diagram that shows system components and interfaces with plant systems and structures is acceptable.

Conceptual One-Line Diagram for the HCVS Piping

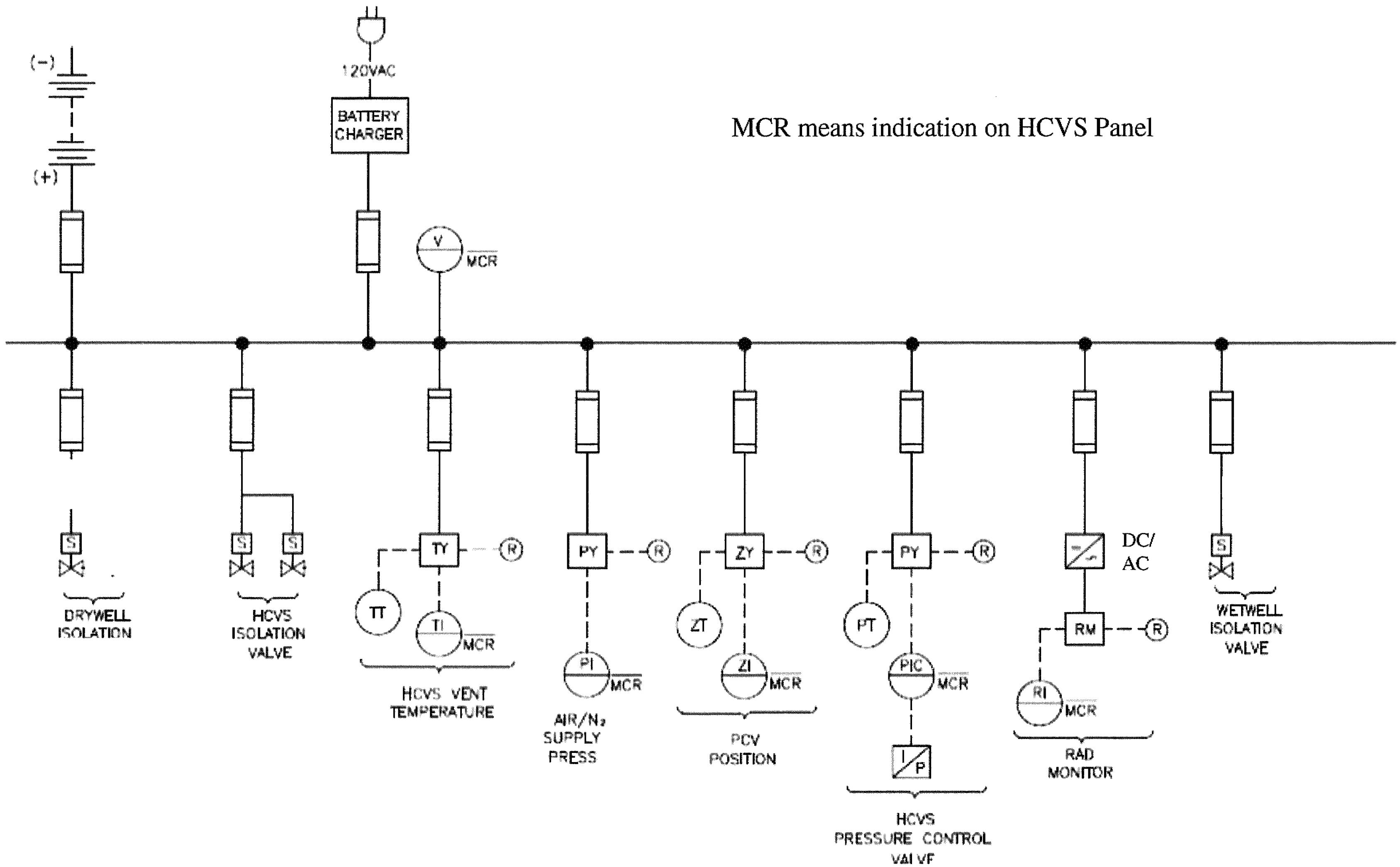


Note 1: These CIVs have a circuit for "design basis" operation and a second circuit for HCVS operation. The "design basis" circuit can be overridden to open for the HCVS function.
Note 2: The downstream CIV only has a circuit for HCVS operation.
Note 3: The downstream CIV to the RBVS and SGTS only have a "design basis" circuit that is automatically isolated by containment isolation signal.

Conceptual One Line Diagram for Dedicated N2/Air for the HCVS



Conceptual One Line Diagram for Dedicated DC power for the HCVS



Section 9: Table – HCVS Failure Modes

The following table summarizes the Integrated Plan response to specific HCVS valve circuit, valve power and valve motive air ISG requirements for reliability and sustainability.

HCVS Failure Modes	Potential Cause	How Addressed	Containment Venting Fails?
CIV fails to Vent (Open) on demand or fail shut after opening	Solenoid Valve (SV) failure	The design will prevent a failure of a SV from disabling the HCVS flow path. The Integrated Plan discusses (a) providing redundant SVs such that energizing either SV would allow opening the CIV or (b) locating a single SV in an accessible location. The accessible SV location would allow access to locally open the SV to the motive air source.	No
	loss of power to the SV(s)	If redundant inaccessible SVs are used, one of the SVs will be powered from the dedicated DC power supply in an accessible location sized for 24 hours with provisions for sustaining the charge after 24 hours. The other SV will be energized from an alternate source (Exelon is reviewing the options, which include converting the existing AC circuit and SV to an existing DC source which will be maintained energized by FLEX, or other means to energize that SV following a prolonged SBO). If the single accessible SV option is selected, it will be powered from the dedicated DC source and it will allow access to locally open the SV to the motive air source. The accessible DC power location would allow corrective actions (e.g., battery change-out) if required.	No
	loss of pneumatic air supply	HCVS valves will not rely on normal pneumatic air supply; they will be supplied from an accessible dedicated motive air supply which is sufficient for a 24 hour period with provisions for sustaining the motive air pressure after 24 hours (e.g., recharge dedicated motive air supply using portable air compressors and/or replace N2 bottles.	No

HCVS Failure Modes	Potential Cause	How Addressed	Containment Venting Fails?
PCV fails to Vent (Open) on demand or fails shut after opening	loss of power or motive air	PCV will use dedicated DC power source and motive air source being added for the CIVs. The DC power and motive air source will be accessible.	No
	loss of a PCV control circuit component	The detailed design will provide a back-up capability for opening. Under consideration are providing: (a) a hydraulic system with hand-pump, located at an accessible location, to over-ride the spring-to-shut function and (b) an over-ride circuit that will bypass the control circuit and provide motive air to PCV air-operator that fully opens the valve. Containment pressure control would then revert to PCIV cycling.	No
Fail to stop venting (Close) on demand	Not credible as there is not a common mode failure that would prevent the closure of at least 1 of the 3 valves needed for venting.	N/A	No
Spurious Opening	Not credible as key locked switch on both CIV's and other actions require at least three discrete steps to open the flow path.	N/A	No
CIV closure due to an automatic signal	Upstream CIV closes on a containment isolation signal. Not credible for the downstream CIV since it does not have containment isolation signal. The valve control is simple open or shut.	The upstream CIV with containment isolation signal has a containment isolation signal over-ride. In addition, the second SV will have a separate circuit without automatic closure logic. N/A for downstream CIV.	No