NEXTera ENERGY
DUANE ARNOLD

February 28, 2013

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

Duane Arnold Energy Center
Docket No. 50-331
Renewed Op. License No. DPR-49

NextEra Energy-Duane Arnold, LLC's 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, Order Modifying Licenses with Regard to Requirements for Reliable Hardened Containment Vents, dated March 12, 2012, Accession No. ML12054A694
2. NRC Interim Staff Guidance JLD-ISG-2012-02, Compliance with Order EA-12-050, Order Modifying Licenses with Regard to Requirements for Reliable Hardened Containment Vents, Revision 0, dated August 29, 2012, Accession No. ML12229A475
3. Letter, R. Anderson (NextEra Energy Duane Arnold, LLC) to U.S. NRC, "NextEra Energy Duane Arnold, 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)," NG-12-0427, dated October 29, 2012, Accession No. ML12305A375

On March 12, 2012, the Nuclear Regulatory Commission ("NRC" or "Commission") issued an Order (Reference 1) to NextEra Energy Duane Arnold, LLC (hereafter, NextEra Energy Duane Arnold). Reference 1 was immediately effective and directs NextEra Energy Duane Arnold to have a reliable hardened vent (RHV) installed at its Boiling Water Reactor (BWR) with a Mark I Containment to remove decay heat and maintain control of containment pressure within acceptable limits following events that result in the 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 NRC Interim Staff Guidance (Reference 2) was issued August 29, 2012, which provides direction regarding the content of this Overall Integrated Plan.

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Reference 3 acknowledged NextEra Energy Duane Arnold's receipt of Reference 2 and provided the initial status report regarding the RHV, as required by Reference 1.

The purpose of this letter is to provide the Overall Integrated Plan pursuant to Section IV, Condition C.1, of Reference 1. Reference 2, Section 4.0 contains the specific reporting requirements for the Overall Integrated Plan. The Enclosure to this letter provides NextEra Energy Duane Arnold's Overall Integrated Plan in accordance with Section 4.0 of Reference 2.

For the purposes of compliance with Order EA-12-050 (Reference 1), NextEra Energy Duane Arnold plans to use a wetwell vent system. The potential addition of a hardened drywell vent system will not be determined until additional review of industry studies of severe accidents is completed.

The Enclosure contains the current design information as of the writing of this letter, much of which is still preliminary, pending completion of on-going evaluations and analyses. Due to the synergy between the design of the RHV system and the equipment to be utilized in the Mitigating Strategies (so called FLEX) required by Order EA-12-049, some of the design details, in particular those regarding backup DC power and pneumatic supplies for the RHV, are still being developed. As further design details and associated procedure guidance are finalized, that additional information, as well as any revisions to the information contained in the Enclosure, will be communicated to the Staff in the 6-month updates required by the Orders.

This letter contains no new regulatory commitments. If you have any questions regarding this report, please contact Ken Putnam at 319-851-7238.

I declare under penalty of perjury that the foregoing is true and correct.
Executed on February 28, 2013

Richard L. Anderson
Vice President, Duane Arnold Energy Center
NextEra Energy Duane Arnold, LLC

Enclosure: Duane Arnold Energy Center Overall Integrated Plan for the Reliable Hardened Vent System

cc: NRC Regional Administrator (Region III)
NRC Resident Inspector (DAEC)
NRC Licensing Project Manager (DAEC)

Duane Arnold Energy Center
Overall Integrated Plan for
the Reliable Hardened Vent System

25 Pages to Follow

Duane Arnold Energy Center
Overall Integrated Plan for
the Reliable Hardened Vent System

Table of Contents:

References:

1 Generic Letter 89-16, Installation of a Hardened Wetwell Vent, dated September 1, 1989

2 Order EA-049, Mitigation Strategies for Beyond-Design-Basis External Events, dated March 12, 2012

3 Order EA-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, dated August 29, 2012, ADAMS Accession No. ML12229A477

6 NEI 12-06, Diverse and Flexible Coping Strategies (FLEX) Implementation Guide, Revision 0, dated August 2012

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.

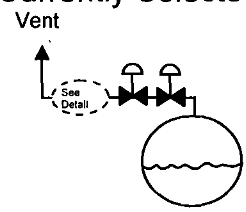
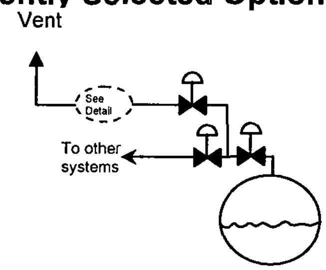
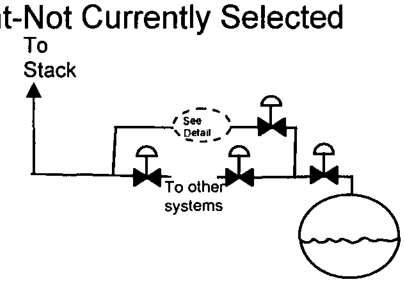
Response:

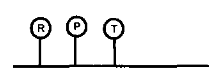
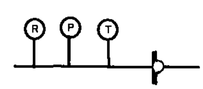
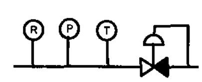
System Overview:

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 and maintain core cooling capability. The vent will be designed with sufficient capacity to accommodate decay heat input equivalent to approximately 1% of current licensed thermal power and will be capable of venting greater than the decay heat present when venting must be initiated to ensure the containment does not exceed design pressure. And 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

The HCVS flow path from the containment to an elevated release point is shown in the simplified diagram below. No ductwork will be used in the flow path.

Figure 1
Simplified Vent Line Connections to Wetwell and Other Systems

System Connection Options
Option 1 - Dedicated wetwell vent-Not Currently Selected Option 
Option 2 - Wetwell vent interfacing with another wetwell-connected system, dedicated release point-**Currently Selected Option** 
Option 3 - Wetwell vent interfacing with another wetwell-connected system and with an existing release point-Not Currently Selected Option 

Detail Options	
Option A - No control valve or rupture disk (Not Currently Selected Option)	
Option B - Rupture disk (**Currently Selected Option**)	
Option C – Control valve (Not Currently Selected Option)	

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 are designed in accordance with existing design basis. Containment isolation valves (CIVs) are provided consistent with the plants primary containment isolation valve design basis. The valves are air-operated valves (AOV) operated by a DC powered solenoid valve (SOV), and can be operated from switches in the Main Control Room.

b) Other system valves and piping - The HCVS piping and supports downstream of the second containment isolation valve, including valve actuator pneumatic supply components, will be designed/analyzed to conform to the requirements consistent with the applicable design codes for the plant and to ensure functionality following a design basis earthquake.

c) The interface valves provide isolation to the interconnected system. The HCVS shares part of its flow path with the Standby Gas Treatment System (SGTS). Prior to initiating the HCVS, the valve to the SGTS must be isolated. However, since SGTS isolation valves are fail-close AOV(s), with air-to-open and spring to shut, the containment isolation signal will automatically isolate the valve(s) upon any abnormal containment pressure.

d) A rupture disk is currently provided in the vent line downstream of the CIVs. It is anticipated that this rupture disk will be retained following the modifications to improve the reliability of the hardened vent. Provisions will be made to pressurize the disk from Main Control Room as directed by applicable procedures to allow venting earlier in the event if desired. The final design may elect to remove the rupture disk or replace it with a rupture disk with a different pressure set.

ii. Instrumentation to monitor the status of the HCVS –

a) Instrumentation indications will be available in the Main Control Room

b) Effluent radiation monitor will be located external to the vent piping.

c) HCVS vent flow path valves position indication, temperature and pressure instrumentation will monitor the status of the HCVS to aid the operator to ensure verification of proper venting operation. A failure of the position indication instrumentation would not prevent opening and closing the valves.

iii. Support systems –

a) Existing power for the HCVS DC valve solenoids is provided from the 125 Volt Essential DC Batteries.

b) Motive air/gas supply for HCVS operation under the current plant design are adequate for at least three strokes of the valves during the first 24 hours during operation under prolonged SBO conditions is provided from an accumulator in the Atmosphere Control System (1T429). If the final containment analysis

supporting the HCVS determines that additional valve cycles are needed, the accumulator capacity will be upgraded to match the required number of cycles.

c) Under DAEC implementation of NRC Order EA-12-049 for Mitigation of Strategies for Beyond –Design-Bases External Events, FLEX equipment will have the capability to provide back-up support equipment for reliable HCVS operation. Power will be supplied from a portable 480 volt generator connected to the applicable battery chargers. Motive air/gas for HCVS operation can be supplied from a portable cylinder if needed. Power for instrumentation will be supplied from the same batteries as the solenoids. In addition, alternate means to power critical indicators of containment parameters will be provided under the FLEX program.

System control:

i. Active: Control Valves are operated in accordance with EOPs to control containment pressure. The CIVs are currently designed for 3 open / close cycles. Current procedures call for operation of the valves to maintain a containment pressure band between 45 PSIG and 53 PSIG (PCPL) unless otherwise directed by the Technical Support Center.

ii. Passive: Inadvertent actuation protection will be provided by key lock switches for the CIV's that must be opened to permit flow.

Section 2: Design Objectives

Order EA-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 operation of the HCVS will be designed to minimize the reliance on operator actions in response to hazards identified in NEI 12-06, Diverse and Flexible Coping Strategies (FLEX) Implementation Guide. The design will allow immediate operator actions to be completed by reactor operators in the Main Control Room (MCR) or other accessible location. The operator actions that will be required to open a vent path are:

Operator Actions Necessary to Vent the Containment during a Prolonged SBO	
Task	Location
Close interfacing system valves (new)	MCR or Other Accessible Location
Override containment isolation signal for CV4300	MCR

Open Containment Isolation Valve CV4300	MCR
Open HCVS control valve CV4357	MCR

Isolation or cycling of the vent path can be directly performed from the MCR by operating either of the containment isolation valves (CV4300 or CV4357).

The HCVS will be designed to allow initiation, control, and monitoring of venting from the MCR or other accessible location. The location minimizes plant operators' exposure to adverse temperature and radiological conditions and is protected from hazards consistent with the existing plant design. In addition, an alternate capability to open the valves from a location outside the main control room in the essential switchgear room or another accessible location will be provided that allows applying portable pneumatic supply to directly actuate the HCVS valves in the event normal operation from the MCR is not available.

Permanently installed power and motive gas capability will be available to support operation and monitoring of the HCVS in the modified design. The current motive gas accumulator is sized for three cycles of the HCVS valves. In the event final containment analysis and procedure concludes addition cycle capacity is needed the accumulator will be upgraded accordingly. DC power will be maintained throughout the event using portable generators under the FLEX program and NEI 12-06. If for any reason, DC power or installed motive gas is unavailable, a back up capability will be provided to open the HCVS remotely from the essential switchgear room or other accessible location using a portable pneumatic supply.

Order EA-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 HCVS 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 will allow operating the HCVS from the MCR or other accessible location which minimizes plant operators' exposure to adverse temperature and radiological conditions. The MCR is protected from hazards consistent with the existing plant design and will be evaluated for acceptable temperature and radiological conditions.

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) procedures will not require access to suppression pool

(wetwell) area and exposure to extreme occupational hazards for normal and backup operation of electrical and pneumatic systems.

Connections for supplemental equipment needed for sustained operation will be located in accessible areas protected from severe natural phenomena and minimize exposure to occupational hazards. Tools required for sustained operation, such as portable lights and connection specific tooling will be pre-staged in the NEI 12-06 storage locations or the control room.

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

Order EA-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):

The HCVS will be designed for reliable remote-manual operation. Operators will not be required to access the suppression pool area. The HCVS will be designed to minimize system cross flow, prevent steam flow into unintended areas, provide containment isolation, and provide reliable and rugged performance as discussed below for Order requirements 1.2.6.

Dose rates will be evaluated consistent with the assumption that the HCVS is to be used for the prevention of significant core damage. Shielding or other alternatives to facilitate manual actions are not required for operation of the vent under these conditions since no core damage has occurred and operator actions can be completed in the MCR or other accessible location.

Section 3: Operational Characteristics

Order EA-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 current HCVS wetwell path is designed for venting steam/energy at a nominal capacity of slightly less than 1% of 1912 MWt thermal power at pressure of 53 psig. During the design and licensing of the extended power uprate of the DAEC this capacity of slightly less than 1% was evaluated and found acceptable for the anticipated decay heat level that would be present at the time venting is required for the assumed loss of decay heat removal event per GL 89-16. This pressure is the Primary Containment Pressure Limit (PCPL) which is the lower of the containment design pressure and the PCPL value.

The design assumes that the pressure suppression capacity of the suppression pool is sufficient to absorb the decay heat generated during initial plant response. The vent would then be able to prevent containment pressure from increasing above the containment design pressure. As part of the final detailed design, the duration of suppression pool decay heat absorption will be confirmed.

Order EA-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 MCR or other accessible location. Alternate capability for operation from the essential switch gear room or other accessible location will be provided. These locations are protected from adverse natural phenomena.

1. The HCVS flow path valves are air-operated valves 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 ensure a permanently installed DC power source and motive air/gas supply. The response to NRC EA-12-049 will demonstrate the capability under the FLEX effort to maintain the DC source throughout the period. The initial stored motive gas will allow for a minimum of three valve operating cycles; however, the final detailed design will determine the number of required valve cycles for the first 24-hours. If required, the stored motive gas will be upgraded to be consistent with the required number of valve cycles.
2. All primary controls can be operated from the MCR or other accessible location therefore temperature and radiological conditions that operating personnel may encounter at the controls are acceptable. No transit through inaccessible areas to local controls will be required.
3. All permanently installed HCVS equipment, including any connections required to supplement the HCVS operation during a prolonged SBO (electric power, Nitrogen/air) will be located in areas reasonably protected from defined hazards from NEI 12-06.
4. All valves required to open the flow path will be designed for remote manual operation following a prolonged SBO, i.e., no valve operation via hand wheel, reach–rod or similar

means that requires close proximity to the valve. Alternate means for operation of the HCVS valves will be provided in the essential switchgear room, or other accessible location, which will also be accessible for operations personnel. Any supplemental connections will be pre-engineered to minimize man-power resources and any needed portable gas supply will be reasonably protected from defined hazards as noted in NEI 12-06.

5. Access to the locations described above will not require temporary ladders or scaffolding.

Order EA-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 features that prevent inadvertent actuation are two normally closed CIV's in series with keylock switches controlled administratively. The currently installed rupture disc may be retained but the final design may elect to either remove this disk or modify it to a different pressure setting.

EOP/ERG operating procedures provide clear guidance that the HCVS is not to 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 a design error, equipment malfunction, or operator error such that any credited containment accident pressure (CAP) that would provide net positive suction head (NPSH) to the emergency core cooling system (ECCS) pumps will be available (inclusive of a design basis loss-of-coolant accident (DBLOCA)). UFSAR Section 5.4.7 discusses credit for containment over pressure to assist in maintaining NPSH and applicable values are displayed in Figure 5.4-15.

Order EA-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 pressure monitoring downstream of the last isolation valve / rupture disc. All flow path valves will have open and closed position indication. These HCVS indications will be at or near the same location as the valve control switches (CV4300 and CV4357), which are in the MCR. 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 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 are approximately twice the required containment 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 will be those expected after a prolonged SBO (without significant fuel failure), and will bound normal plant conditions.

Order EA-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 to 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) will be 0.1 mRem/hr to 1000 mRem/hr. This range is considered adequate to determine core integrity per the NRC Responses to Public Comments on the draft ISG (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 MCR or other accessible location. The RMS will be powered from the same source as other electrically powered HCVS components. Refer to the response to 1.2.2 for discussion on sustainability of the power.

Order EA-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):

DAEC is a single unit site.

The HCVS shares part of its flow path with the Standby Gas Treatment System (SGTS). Prior to initiating the HCVS, the valve to the SGTS must be isolated. However, since SGTS isolation valves are AOV(s) that fail closed and receive containment isolation signals that will automatically isolate the valve(s) upon an abnormal containment pressure or loss of power, no

operator action is required. The detailed design phase will review the valve(s) to determine if the inter-system valves can meet the required leakage criteria under the limiting HCVS design conditions. If required, the valve(s) will be replaced or upgraded. The current hardened vent flow path downstream of the rupture disc includes valves that must isolate the flow stream from interfacing equipment. These valves would not close automatically with a loss of AC power and currently need to be closed by local manual operator action. To improve reliability, these interfacing valves will be upgrade to ensure they can be remotely closed from the MCR or other accessible location and meet required leakage testing criteria.

Order EA-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 HCVS Containment Isolation Valves will be tested in accordance with the licensing and design basis for the plant. The HCVS past the outboard Containment Isolation Valve will be tested in conformance to the ISG methods. The test pressure shall be based on the HCVS design pressure. Permissible leakage rates for the interfacing valves will be within the requirements of American Society of Mechanical Engineers Operation and Maintenance of Nuclear Power Plants Code (ASME OM) – 2009, Subsection ISTC – 3630, or later edition of the ASME OM Code. When testing the HCVS volume, the allowed leakage will not exceed the sum of the interfacing valve leakages as determined from the ASME OM Code unless a higher leakage acceptance value is justified to the NRC.

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 the HCVS boundary valves. Rupture disks (if retained in the final design) will be replaced at manufacturer's recommendations not to exceed 10 years. Interfacing system valves that cannot be cycled on line without challenging plant operation will be on an operating cycle frequency rather than once per year.

Order EA-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 design pressure will be 56 psig and design temperature is 281°F. The HCVS design pressure is the higher of the containment design pressure and the PCPL value. The HCVS design temperature is the saturation temperature corresponding to the design pressure.

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 discharges to the suppression pool, and potential for water hammer from accumulation of condensation during multiple venting cycles.

Order EA-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 will use the existing path through the plant off gas stack whose release point is elevated above other plant structures. As noted above upgrades to interfacing valves in the flow path are needed to ensure requirements in 1.2.6 above are satisfied.

The detailed design will address missile protection from external events as defined by the existing plant design requirements for the off gas stack.

Section 4: Applicable Quality Requirements

Order EA-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 vent path up to and including the second containment isolation barrier piping and supports will be designed in accordance with existing design basis. The HCVS system design will 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 control circuit will allow manual overrides of containment isolation signals or if applicable interface system signal to enable the vent valves to open upon initiation of the HCVS from the MCR or other accessible location.

Order EA-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 seismically qualified structures or reviewed for seismic ruggedness to ensure that any potential failure would not adversely impact the function of the HCVS or other safety related structures or components (i.e. seismic category II over category I criteria).

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 conform to the requirements consistent with the applicable design codes for the plant and to ensure functionality following a design basis earthquake.

The HCVS instruments, including valve position indication, process instrumentation, radiation monitoring, and support system monitoring, will be qualified by 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

Section 5: Procedures and Training

Order EA-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 plants 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(reference NEI 12-06), including the storage location of portable equipment,
- training on operating the portable equipment, and
- testing of portable equipment.

The procedures will ensure adequate containment over-pressure is maintained for ECCS pump net positive suction head during a DBA LOCA.

The following provisions for out-of-service restrictions for the HCVS and associated compensatory measures will be documented in the Technical Requirements Manual (TRM):

The allowed out of service time for the HCVS shall not exceed 30 days during Modes 1, 2, and 3.

- If the out of service time exceeds 30 days:
  - The condition will be entered into the corrective action system,
  - Action will be initiated to restore functionality of the HCVS
  - A cause assessment will be performed to prevent future unavailability for similar causes.

Order EA-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 HCVS 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):

Personnel expected to operate the HCVS will receive necessary training in the use of plant procedures for system operations when normal and backup power is available and during prolonged SBO conditions. The training will be performed on a periodic basis and as any changes occur to the HCVS. The training will utilize the systematic approach to training.

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
Oct. 2012	Submit 60 Day Status Report	Complete
Feb. 2013	Submit Overall Integrated Implementation Plan	Complete
Aug 2013	Submit 6 Month Status Report	
Feb. 2014	Submit 6 Month Status Report	
Aug. 2014	Submit 6 Month Status Report	
Feb. 2015	Submit 6 Month Status Report	
Aug. 2015	Submit 6 Month Status Report	
Dec. 2015	Completed Design Change Package issued for construction	
Feb. 2016	Submit 6 Month Status Report	
June 2016	Procedure Changes Training Material Complete	
July 2016	Design Change Major Material On-site	
Aug. 2016	Submit 6 Month Status Report	
RFO 25 Fall 2016	Design Change Construction Completed	
RFO 25 Fall 2016	Procedure Changes Active	
RFO 25 Fall 2016	Demonstration/Functional Test	
Dec. 2016	Submit Completion Report	

Section 7: 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.

Duane Arnold Energy Center
Overall Integrated Plan for
the Reliable Hardened Vent System

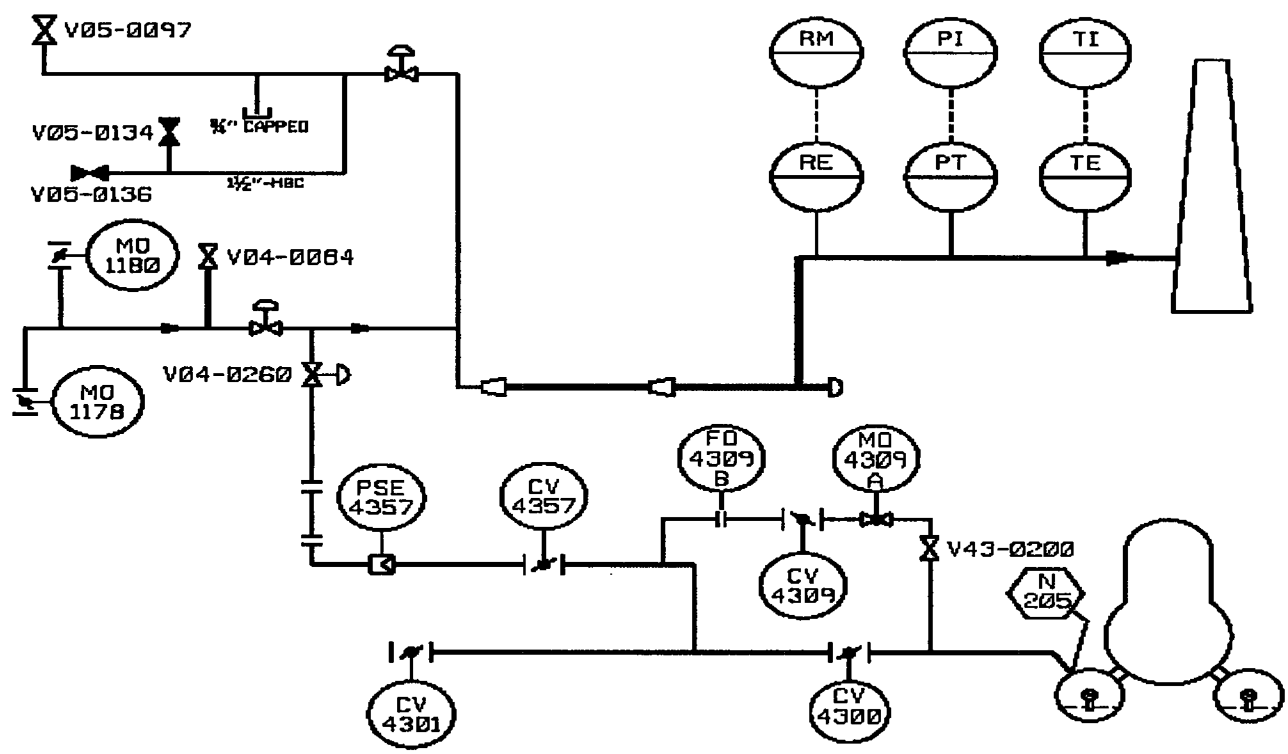
Section 8: Figures/Diagrams

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.*

Response (ref. ISG Item 3.2):

In addition, per Staff request, a Table has been included to discuss various potential failure modes in the proposed design.



Potential Failure Evaluation Table (Proposed Design)

Functional Failure Mode	Failure Cause	Alternate Action	Alternate Action Corrects Failure
One or Both Containment Isolation Valve Fails to Open on Demand	Loss of Normal AC power to solenoid valve supplying nitrogen gas,	DC power solenoid supplying nitrogen gas	Yes
	Loss of AC and DC power	Recharge DC batteries with FLEX diesel generator or portable pneumatic supply via manual connection (future installation)	Yes
	Loss of safety related Alternate Nitrogen	Portable pneumatic supply via manual connection (future installation)	Yes
	Solenoid valve fails to open	Portable pneumatic supply via manual connection (future installation)	Yes
	Mechanical valve problem	None	No
One Containment Isolation Valve Fails to Close on Demand	Any failure	Close alternate valve	Yes
Both Containment Isolation valves Fail to Close and Rupture Disc Open	Both solenoid valves fail to close for any reason	De-pressurize Alternate Nitrogen supply to solenoid	Yes
	Mechanical problems in both valves	None	No
Spurious Containment Isolation Valve Opening	Not credible as key locked switches prevent miss-positioning and two valves are normally closed	NA	NA
Automatic Containment Isolation Closure from other signals	High containment pressure	Over ride containment isolation signal or portable pneumatic supply via manual connection (future installation)	Yes
Failure to be able to open rupture disc if rupture disk is retained	Loss of safety related Alternate Nitrogen	Portable pneumatic supply via manual connection (future installation)	Yes
	Solenoid valve fails to open	Portable pneumatic supply via manual connection (future installation)	Yes
	Rupture disk does not open as designed at available pressure	None.	No