

HCVS-WP-01: Hardened Containment Vent System Dedicated and Permanently Installed Motive Force

Revision B, March 11, 2014

Purpose

The purpose of this paper is to provide an interpretation of NRC Order EA 13-109 element 1.2.6 regarding the requirement that the Hardened Containment Vent System (HCVS) be able to operate for 24 hours with dedicated and permanently installed equipment. Specifically, this paper addresses HCVS components related to motive force such as electrical power and pneumatic supply. See related FAQ HCVS-02 for discussion of other HCVS equipment that may be shared with other plant systems.

Relevant Order EA 13-109 Requirement

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

Relevant NEI 13-02 Guidance Sections

2.5 – Guidance that the vent must be capable of operation during an extended loss of AC power (ELAP) and under conditions that may exist during a severe accident.

4.2.2 – Guidance for primary and alternate control locations, as well as system monitoring requirements.

4.2.6 – Guidance for minimizing operator actions to maximize the probability of successful operator action to operate the vents when required.



6.1 - Further guidance for operator actions, including the requirement that “at least one method of operation of the HCVS should be capable of operating with permanently installed equipment for at least 24 hours during the extended loss of AC power. The system should be designed to function in this mode with permanently installed equipment providing electrical power (e.g., DC power batteries or electrical or pneumatic operation) valve motive force (e.g., N₂/air cylinders).”

Background

Contributing to the accident progression at Fukushima Dai-ichi was the inability of the operators to successfully operate the installed Hardened Containment Vent Systems (HCVS) in a timely manner. This inability was primarily due to the loss of control power for the valve solenoids, the loss of compressed gas for actuating valve pistons, and the fact there was no installed backup means to operate these valves during a sustained loss of AC power event. The operators were eventually able to operate the vents only with great difficulty, by locally connecting power and portable gas supplies. The actions were performed at the valves under extreme circumstances of radiation, heat, and stress. The purpose of element 1.2.6 of EA 13-109 is to ensure that the HCVS can be operated as needed for containment protection without undue risk to the operators and without significant actions to supply the necessary electrical and pneumatic power for at least 24 hours.

Evaluation/Discussion

The standard definition of “dedicated” is “used for one particular purpose.” Strictly using this definition would mean that all equipment associated with the HCVS would be permanently installed and dedicated only to the HCVS. This interpretation, however, would conflict with other elements of order EA 13-109 that permit shared component functions. This also would conflict with the current installed hardened vents at some plants.

FAQ  VS-02 describes non-motive force HCVS components that may be shared with other plant systems. In addition, some components in the HCVS system are powered electrically or pneumatically by non-dedicated sources as described in the plant  current Licensing Basis documents. These same sources may provide the motive power for HCVS functions provided certain conditions are met as described below. Examples include:

- Inverters that supply AC power to solenoids for Primary Containment Isolation Valves may be the same power source used for HCVS solenoids,
- Station batteries that supply DC power to HCVS solenoids may also supply other containment isolation valves,
- Station batteries that supply DC power to instrumentation in the main control room may also be used to indicate the need for HCVS operation and the status of the HCVS,
- Plant safety-related air or nitrogen systems used to operate isolation valves or safety-relief valves may be the same pneumatic supply used to operate HCVS valves.

Therefore, it is clear that some portions of HCVS and HCVS supporting systems may be shared with other plant systems. However, the purpose of element 1.2.6 will be met if, for the first 24 hours of an event, no *significant* (emphasis added) action or portable equipment is required to maintain HCVS fully functional. This requirement is defined in NEI 13-02 Section 6.1 “Actions should be simple and easily accomplished with direct feedback to indicate when the action is successfully accomplished”.

Examples of non-simple/easily accomplished electrical operator action would include:

- Connecting portable generators to re-power station switchgear,
- Connecting portable battery chargers to charge batteries,
- Connecting portable batteries or power supplies directly to valve solenoids,
- Connecting portable batteries or power supplies directly to needed instrumentation.

Examples of non- simple/easily accomplished pneumatic operator action would include:

- Connecting portable air compressors to maintain HCVS or station compressed air pressurized,
- Replacing compressed gas cylinders to replenish pneumatic supplies,
- Connecting portable gas bottles or air compressors directly to HCVS components, such as valve actuator tubing.

Operator actions are considered simple/easily accomplished if they can be performed using installed (not portable) plant equipment in readily accessible locations under the conditions expected at the time the action is performed. Examples of operator actions that are considered simple/easily accomplished and may be used during the first 24 hours of the sustained operational period include:

- Operation of permanently installed switches or disconnects to re-align power supplies when located near the Main Control Room or Remote Operating Station,
- Operation of breakers or switches to shed loads as part of battery life extension actions,
- Operation of valves to align installed backup pneumatic supplies.

Electrical and pneumatic supplies that support the HCVS function may support non-HCVS functions provided the following conditions are met:

- The electrical and/or pneumatic supplies can be shown to support the first 24 hours of HCVS sustained operation without the need for significant operator action as described above.
- The electrical and/or pneumatic supplies can be shown to support the HCVS function for the remainder of the sustained operational period after 24 hours, but

for this time period, actions to replenish power and compressed gas supplies are acceptable.



te for the first 24 hours of an event, simple and easily accomplished operator action guidance need only apply to either the primary OR alternate operating station per NEI 13-02, section 6.1.

In all cases, ensure the operator actions to support HCVS initiation can be performed under the plant conditions that could exist at the time they would need to be performed, up to and including a severe accident. This includes consideration for pathways through the plant that the operator would take to perform this action. For example:

- If load shedding is planned as an acceptable FLEX action to extend station battery life, the pathways to/from and the location of the load shedding action must be evaluated to verify that they will be safe for the operator when the load shedding would occur. Since the purpose of load shedding is to prolong the availability of station batteries, these actions are typically performed early in the event sequence even before the declaration of the ELAP condition. As such, these actions will be completed before core damage impedes the ability to perform these actions.
- If backup nitrogen bottles are to be used to maintain 24-hour functionality, the pathway, location and timing of the operation of the valves to align them for use must be evaluated similarly to the load shedding action evaluation.

Conclusion

The purpose and intent of NRC Order EA 13-109 element 1.2.6 will be met if the station can provide 24 hours of reliable HCVS motive force without the need for significant operator action, provided the action can be performed safely and reliably. The use of components shared with other plant systems to supply HCVS electrical and pneumatic power is acceptable provided the guidance described in this paper for using shared components supplying motive force to HCVS are met. This guidance only applies to the first 24 hours of the sustained operational period. The Order and NEI 13-02 guidance apply for the use of portable equipment after 24 hours.