NEI 13-02

Section 4.1, DESIGN ONSIDERATIONS

BWR OWNERS' GROUP

NUCLEAR ENERGY INSTITUTE

Section 4.1 HCVS Design Criteria

- 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 PCPL and to ensure capability to depressurize the RPV to permit injection of low head injection systems

Section 4.1 HCVS Design Criteria

- Key issues to be addressed in the Vent Thermal Design and Capacity requirements
  - containment venting to support mitigation strategies
  - A wetwell HCVS flowpath sized under conditions of constant heat input at a rate equal to 1 percent of rated thermal power and containment pressure equal to the PCPL
    - justification for less than 1 percent rated thermal power decay heat generation requires an auditable engineering basis to be developed
    - HCVS capacity sized lower than 1 percent of thermal power can be justified by analysis provided that the primary containment design pressure and the PCPL would not be exceeded

Section 4.1 HCVS Design Criteria

- HCVS 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.
- Multi-purpose penetration use
  - Most, if not all, HCVS designs will use existing containment penetrations
  - Each HCVS containment penetration must have two in-series Primary Containment Isolation Valves (PCIVs) as required by GDC 56
  - both PCIVs on each HCVS containment penetration may be installed outside containment and as close as reasonably possible to the penetration

Section 4.1 HCVS Design Criteria

- GDC 56 stipulates that the PCIVs must be either locked-closed or have automatic closure
  - Automatic isolation of the HCVS valves on a containment isolation signal is possible, but it would be redundant since these valves are required to be closed during all anticipated modes of operation that could require containment isolation
  - New PCIVs are to be normally-closed valves that have a fail-closed mode (e.g., AOVs)

Section 4.1 HCVS Design Criteria

- As required by GDC 54, these penetrations "shall be designed with a capability to test periodically the operability of the isolation valves and associated apparatus and to determine if valve leakage is within acceptable limits."
  - The periodic PCIV testing frequency is dictated by the unit's Technical Specifications
  - The HCVS flow path can be credited for being closed and remaining closed during all design basis transients and accidents

Section 4.1 HCVS Design Criteria

- Routing Considerations
  - Severe accident conditions within the containment require consideration of accessibility and stay time using the methodologies in Appendix F (Calculation of Operator Doses) and Appendix G (Calculation of Source Term for the HCVS)

Section 4.1 HCVS Design Criteria

- Multi-Unit Interfaces
  - System cross-connections or shared Unit HCVS exhaust flowpaths 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 HCVS flowpaths share common vent piping
    - A design that is free of physical and control interfaces with other systems eliminates the potential for any cross-flow is one way to satisfy this requirement
    - Examples of acceptable means for minimizing cross flow are the use of valves, leak-tight dampers, and check valves
    - environmental conditions (e.g., pressure, temperature) at the flowpath interface locations during venting operations should be evaluated to ensure that the interface will remain sufficiently leak-tight

Section 4.1 HCVS Design Criteria

- Release Point
  - The HCVS release to outside atmosphere should be at an elevation higher than adjacent plant structures
    - Release through existing plant meteorological stack(s) is acceptable
  - If the release from HCVS is through a stack different than the plant meteorological stack, the elevation of the stack should meet the following criteria
    - Be higher than the nearest power block building or structure
    - The release point should be situated away from ventilation system intake and exhaust openings
    - The release stack or structure exposed to outside should be designed or protected to withstand hazards that could be generated by the external events (Reference NEI 12-06)

Section 4.1 HCVS Design Criteria

- Leakage Criteria
  - The HCVS up to the second containment isolation valve should be either nitrogen inerted or be “steam inerted” such that any hydrogen gases within the containment or vent pipe remain below the hydrogen gas flammability limit
  - The HCVS pipe beyond the PCIVs used to initiate/cease venting should be designed for deflagration/detonation due to potential for oxygen intrusion resulting from steam condensation following HCVS vent closure or have the capability of being purged prior to the vent drawing in oxygen.

Section 4.1 HCVS Design Criteria

- Leakage Criteria
  - The exclusion of oxygen as an acceptable alternative to either inerting with steam or nitrogen or making the piping detonation/deflagration proof
- Protection from Flammable Gas Ignition
  - The evaluation of gas ignition is to document the capability of the HCVS piping to maintain integrity should deflagration or detonation occur. Deformation of the pipe is acceptable given the integrity of the pipe is shown to be maintained.

Section 4.1 HCVS Design Criteria

- Protection from Flammable Gas Ignition
  - Methods of designing the HCVS piping/components against flammable gas detonation/deflagration are discussed in Appendix H. Susceptible portions of the piping should be determined based on where oxygen can be drawn into the piping/interfacing piping
  - Use of a purge system in sections of pipe susceptible to air intrusion from intermittent HCVS operation can also be used to minimize detonation/deflagration potential
  - Design of the HVCS may include features that prevent air/oxygen backflow into the discharge piping
- Combined Drywell/Wetwell HCVS Design Considerations