HCVS Guidance Inquiry Form

A. TOPIC: HCVS Release Point Inq. No.: HCVS - 04

Source document: NEI 13-02 Sections: Order EA-13-109, Element 1.2.2, NEI 13-02 Section 4.1.5

B. DESCRIPTION:

What is the meaning of "release point above main plant structures" in order element 1.2., "**Order Reference: 1.2.2** – The HCVS shall discharge the effluent to a release point above main plant structures."?

To be more specific, how high should the vent release point be above the building that it is based upon/emanates from and what considerations apply with respect to adjacent buildings/structures?

C. PROPOSED ANSWER (Include additional pages if necessary. Total pages: 3)

First, it is understood that the existing Plant Stack provides an acceptable release point. This is considered valid so long as it is the highest release point existing at the site. It is also understood that, if the Plant Stack is used for this purpose, measures to prevent combustible gas cross-flow between plant units must be adequately evaluated and all corrective measures must be in place (if shared with another unit's HCVS).

This response is written to address plants that have a single independent release pipe/vent per unit. This would be typically mounted onto (or emanating from) the Reactor Building, the Turbine Building, or other adjacent building convenient for the HCVS routing.

Guidance for HCVS elevated release points is separated out into a series of topics which are presented below. A synopsis of the bases for each recommendation is presented with each topic. The individual sites are encouraged to utilize this guidance as seen fit but also understand that they may take exception to any such guidance they choose with reasonable basis. This is also applicable to site specific conditions which are outside the bounds of this guidance. Note that in the case of multi-unit sites with single vents for each unit, adjacent unit emergency intakes should also be considered relative to each of these 3 topics separately.

1. Release Point Height –
   The elevated release point should be at least 3' above the roof and related structures of the building that it emanates from. Related structures, in this case, is intended to be any appurtenances associated with the building proper (e.g., parapet walls, etc.). This value agrees with accepted industry practice for roof vents. This is also considered as reasonable based on the minimal frequency at which this system is considered to be used along with the relative buoyancy, relative temperature and potentially high flowrate of the released effluent (would tend to be minimally affected by building and structure effects).
   - As per 1995 ASHRAE HVAC Applications Handbook Chapter 26, an effluent release velocity of 8000 fpm will assure that the roof recirculation zone of a given building will not affect the effluent plume. In consideration of the design conditions and intended function of an HCVS, the predominant release velocity of these vents will be above this value.
   - An evaluation based on several references (e.g., "Turbulent Jets and Plumes: A Lagrangian Approach," Lee & Chu, 2003, "Evaluation of the Effects and Consequences of Major Accidents in Industrial Plants," Casal, 2008) provides further basis that the momentum driven flow from a vent will neither be appreciably affected by the roof recirculation zone nor will the effluent be effectively exchanged with air in the recirculation zone.
   - It should be noted at this point that strict adherence to all available guidance is not considered practical or reasonable for this application. Venting a nuclear containment volume at accident pressures considered will be predominately a high relative Mach evolution. Effluent will not simply waft across a building roof as if released by a predominantly buoyancy driven exhaust stack but will be jetted upward from the vent due to momentum. Although ASHRAE references are used to emphasize some general rules for release point placement in this FAQ, the behavior of such vented effluent is better characterized as a rapidly rising jet (due to high release velocity) driven well above building and equipment influences.

2. Release Point Structural Requirements -
   The pipe above the building is required to be seismically rugged but not missile protected if the building is at an elevation over 30' from the nominal ground elevation. This value (30' from ground elevation) must be used with reasonable engineering judgment. If there is an obvious source of tornado missiles which could potentially strike the piping higher than the stated 30', the vent should be protected accordingly.

3. Distance from Release Point to Nearest Structure -
   Typical points of vent exit from the power block are the reactor building or turbine building. As such, this topic is intended to address distances from adjacent buildings and/or structures associated with building the vent is emanating from (e.g., equipment housings such as for elevator equipment, tanks, etc.). The distance from the vent release point to such a structure should be at least 25' (horizontal distance). This value is based on the ability of the effluent stream to overcome wind effects above the roof (and cited appurtenances) elevation and agrees with accepted industry practice for roof vents. The same additional basis as stated above (for Topic 1), relative to effluent release, are considered to apply in this case.

4. Potential for Damage due to Deflagration/Detonation in Effluent Plume –
   Although momentum and buoyancy will work to drive the vented effluent upward once it has exited the release point, there is the possibility that any vented hydrogen may deflagrate or possibly detonate if an ignition source is available. Based on the guidance and philosophy presented in Topics 1 and 2, there is reasonable assurance that such an event would occur well away from building equipment. However, flammable or heat sensitive equipment should not be located in the general vicinity of the release point.

5. Distance and Elevation Relative to Emergency Filtration Intakes -
   This topic is written relative to intakes for systems which may be powered up from emergency power associated with facilities used in accident mitigation (e.g., EOF/TSC filter trains, CBEAF). It should not be considered applicable to normal building (such as reactor building HVAC) intakes. A general "rule of thumb" of 1:5 zone of influence (5' of horizontal travel versus 1' of vertical drop) of the effluent from the release point to the potential downwind vortices/ recirculation zones is a reasonable method of release point configuration determination (2011 ASHRAE HVAC Applications Handbook, Cpt. 45). Although this approach is more conservative than the vent/jet philosophy established in topic 1, it does provide a reasonable set of guidelines that the industry can use in siting their release points. This "rule of thumb" should be applied to such intakes associated with the power block. For example, if a subject intake is 100' away from the release point, it should be situated such that it is at least 20' below the tip of the release point. As is stated, this is considered as conservative guidance which may be used with no further engineering justification. Based on Topic 1, there is reasonable leeway such that plants may deviate from this guidance with adequate engineering justification.

   Good engineering judgment should be applied (relative to this ratio) for such intakes located away from the power block. There is reasonable assurance (considering good engineering judgment) that no appreciable intake of HCVS effluent will occur for intakes outside 100' of the vent release point that are 20' below the tip of the release point. It must be noted that this information should also be applied to changes made (such as open doors) to facilitate Control Room ventilation. The considerations listed above relative to the buoyancy, temperature, and flowrate of the effluent should be included in associated basis. It should be considered, along with this, that such systems are qualified to remove the vast majority of radionuclides associated with such releases.

Notes relative to this guidance –

- Buildings outside of the site's main power block should not be considered relative to the above. Administrative buildings, warehouses, and other support buildings would typically not be staffed during a BDBE unless they house an accident mitigation type emergency facility (in which case the aforementioned information should be used as stated).
- Cooling towers, by nature of their location requirements, are situated well away from the power block such that they are not able to detrimentally affect HCVS effluent flow.

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D. RESOLUTION: (Include additional pages if necessary. Total pages: _____)

Revision: 0 Date: _____

E. NRC Review:

Not Necessary_____ Interpretation X Agency Position_____
Explanation: _____

F. Industry Approval:

Documentation Method: _____FAQ_____ Date: _____