

## PMLevyCOLPEm Resource

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**From:** Habib, Donald  
**Sent:** Thursday, September 03, 2015 9:19 AM  
**To:** PMLevyCOLPEm Resource  
**Subject:** FW: Question about Moisture in VES Air

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**From:** Habib, Donald  
**Sent:** Wednesday, September 02, 2015 9:31 AM  
**To:** Kitchen, Robert (Robert.Kitchen@duke-energy.com) <Robert.Kitchen@duke-energy.com>  
**Subject:** Question about Moisture in VES Air

Bob –

Below is a question from the staff I mentioned to you yesterday and discussed at last week's public teleconference. The staff expects to send this out as an RAI.

Don Habib  
Levy COL Review, Lead Project Manager  
NRO/DNRL, Licensing Branch 4  
301-415-1035

The design basis for the AP1000 main control room emergency habitability system (VES) is to provide emergency ventilation and pressurization for the main control room. The AP1000 VES air storage tanks, which contain high pressure breathable air, are sized to deliver the required air flow to the main control room and induce sufficient air flow through the passive filtration line to meet the ventilation and pressurization requirements for 72 hours based on the performance requirements specified in the AP1000 DCD, Tier 2, Chapter 6.

VES compressed air quality is specified in the AP1000 DCD, Tier 2, Chapter 9 as Quality Verification Level E air as defined in ANSI/CGA G-&.1. Level E does not specify a limiting characteristic for the moisture content in the air. Although the applicant states that the air will be supplied from instrument air, which is dry, there are no provisions to this effect in the DCD. Therefore, the potential exists for the air in the VES bottles to vary in moisture content.

Levy incorporates by reference the AP1000 DCD related to VES. Levy submitted a departure and exemption request dated March 26, 2015, to address issues related to main control room heat up. Analysis<sup>[1]</sup> performed by the applicant associated with the departure and exemption request assumes a very low moisture content for VES air in order to demonstrate compliance with requirements related to the control room habitability. No assessment was provided assuming a high moisture content. A high moisture content in VES air would appear to be conservative when assessing bounding high control room humidity levels. In contrast, assuming a very low moisture limit is potentially non-conservative with respect to bounding high humidity levels based on the air quality specified in the DCD, i.e., the DCD does not specify a VES moisture content nor does it indicate that VES moisture is important to achieving emergency habitability for the main control room, as an input to the effective temperature of the control room for the first 72 hours.

In addition, the expansion of air tends to result in a decrease in temperature related to the reduction in pressure. Air expanding from high pressure (under the conditions projected to occur at the pressure regulator in the VES system) may cool down by as much as 90 degrees F due to the Joule-Thomson effect. If there is sufficient moisture present in the air (relatively high pressure-dew-point) the moisture in the air may freeze as the air cools down below the freezing point

during gas expansion. The ice (freezing moisture) that forms may block the VES flow paths at restrictions such as valves, pressure regulators, or orifices. Levy analysis<sup>[2]</sup> associated with the departure and exemption request predicts potentially below freezing temperatures during VES operation. The AP1000 DCD Tier 2, Chapter 6 also specifies that there is no source that could create line blockage in the VES line from the air bottles to the eductor.

The staff requests that Levy assess the VES air quality requirements related to moisture in the air. If the supporting safety analyses require a VES moisture content that is more restrictive than the specification provided in the referenced AP1000 design basis, then include this requirement in the Levy licensing basis, including consideration of Technical Specification surveillances for air quality testing, and specify the basis for the limit (e.g., assessing humidity in the control room, preventing line blockage, or other).

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<sup>[1]</sup> APP-VES-M3C-107

<sup>2</sup> APP-VES-M8-001

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<sup>[2]</sup> APP-VES-M8-001

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