Matt et al,

I have initially reviewed the Oxygen Deficient Hazards with the Ultimate Injector Test Facility in Bldg 58 that utilizes the existing Injector Test Cave and a new extension, made from large shield blocks and T-shaped roof members that is currently under construction. I used the layout prints and dimensions you provided.

Other presumptions/data:
No effective air exchanges or ex-filtration of any gaps for extension area.
There is an existing exhaust system in the current Test Cave but that exhaust was not considered for this calculation.
However, previous ODH calculations for the existing Cave were sufficient for to achieve ODH 0 and this exhaust system would have to remain operational.
The information regarding which gas to be use in a particular location was provided by your organization and only those configurations were calculated below.

As a reference, I used the following conversions/expansions in the calculations:

Liquid liters to gaseous liters:
Helium: 780
Nitrogen: 710

Conversion of gaseous materials in liters into cubic feet uses a multiplier of 0.0353.

From a pipe table of standard gas flows:
3/8 inch diameter pipe at 80 psi provides 22 cubic feet per minute = 1320 cubic feet per hour

From the provided information for three helium Dewars, i.e 1000L, 500L, 50L = 1,550L to gas as
1,550 L x 780 = 1,209,000 gas liters then converted using liters to cubic feet using the multiplier of 0.0353 equates to 42,678 cubic feet

Injector spaces (volumes provided):
Existing test cave: 9,140 cubic feet
New HDIce extension: 16,564 cubic feet
Total: 25,704 cubic feet
Note that the solid end wall between the existing Test Cave and the expansion will be removed.

Using the ODH Safety Review Form calculations (using cubic feet):

$$\frac{21(\text{Vol of room x volume of gas})}{\text{Volume of room}} = \text{Oxygen \%}$$

or can substitute cubic feet per hour as volume of gas from outside sources from a gas generator system (e.g. nitrogen).

The resulting calculations are:

HDIce extension only for nitrogen: $\frac{21(16{,}545 - 1320)}{16545} = 19.3\%$

HDIce extension only for Helium: $\frac{21(16{,}545 - 28{,}240)}{16{,}545} = -14.8\%$ (cannot have a negative concentration, therefore Zero %)

Existing Test Cave only for nitrogen: $\frac{21(9140 - 1320)}{9140} = 17.9\%$ (hence has ventilation system not considered at this point)

Total of new and existing spaces, since they will be open to each other (for helium only):

$\frac{21(25{,}704 - 42{,}678)}{25{,}704} = -13\%$ (cannot have a negative concentration, therefore Zero %)

Total of new and existing spaces, since they will be open to each other (for nitrogen only):

$\frac{21(25{,}704 - 1320)}{25{,}704} = 19.9\%$

From the above calculations, the projected new UITF will require an ODH Risk assessment, which is conducted by the Cryo organization within the Engineering Division. If known ventilation systems are planned for this facility, that information will need to be provided for the Risk Assessment.

As the above calculation indicates, these spaces must have some type of mechanical ventilation with connection to emergency power. It is my understanding that an ODH monitoring system is planned for these spaces and this system must continue to be implemented. Any valves or system connections should be minimized since those contribute to system failures (leaks).

If you have any questions regarding the above information, please feel free to contact me.

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And another version:

Matt,

My draft on this has disappeared. So here is the summary of the various areas. While the new function (UITF) is all of one name, there are several areas that make it easier to calculate and address and consider. Initial dataused for this review are:

Injector volumes in cubic feet (rounded/nominal) and assuming tight joints:
Existing cave: 9140
HDIce addition: 16,564
Total: 25,704
Presumption is one air change per hour.

Helium dewars: 1,000 liters, 500 liters, 50 liters = 1,550 liters. Using liquid to gas expansion ratio for helium of 780
Nitrogen line at 80 psi thru a 3/8 inch pipe = 22 cfm or 1,320 cubic feet per hour

Since I'm a little behind and wanted to get you the oxygen concentration numbers quicker, I'll provide the results and assemble the calculations later.

HDIce area for nitrogen only: 19.3%

HDIce area for helium only : Zero %

Existing Test Cave for nitrogen (assuming all walls intact): 17.9%

Existing Test Cave for Sulfur hexafluoride (144 cubic feet): 20.7%

Total volume (25,704) for helium only: Zero %

Total volume (25,704) for nitrogen only: 19.9%

As you can see, the helium is the gas of concern (well the 19.3% for the HDIce and nitrogen is just under the 19.5% criteria) and the existing Test cave with nitrogen (with the end wall in place gets us to 17.9% but this wall will be removed.

My concern is though, if the Test Cave has a nitrogen leak, it will "fill" or have a greater concentration before the gas migrates to the HDIce section, so we should continue to address the Test Cave as a place of concern.

Since the HDIce and Total volume for the helium case takes the concentration to Zero (actually it is less than that but we cannot have a negative concentration) and the existing Test Cave is less than 19.5% (even less than the 18% used for hazard analysis), then each of these area should either
1) be provided with an oxygen monitoring system
2) have supplemental air supply on emergency power
3) be part of the ODH Risk Assessment calculations (conducted by the Cryo group in Engineering Division).

I hope this information is sufficient to allow your design and other work to progress.

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