1. Where does HDice vent under normal operations and under upset conditions

2. What is the HDice helium inventory both in operation and under fill conditions

Maximum LHe volume = 50L in the target, 500L buffer dewar, 1000L fill dewar

3. Does HDice have any other ODH gases being used?

No

4. How are fills done for HDice and are there any other "unusual" evolutions where we should be concern about creating an ODH situation?

5. What is the 1/4 CM He inventory?

Per literature, 400L

6. Where do the 2 reliefs for the 1/4 CM vent to?

7. What is the source term for He when CTF is in operation - how does it respond to a CM vent?

8. There is N2 in the room - how is its flow controlled/restricted?

9. I think there is SF6 in the room - how much?

From John Hansknecht: the volume of the SF6 tank will be ~25 cubic feet (707 liters).  The SF6 charge will be 70 psi.  This is 53.7 pounds of SF6….how to convert to cubic feet of gas…?

Dick Owen calculated that in the existing Test Cave with 9140 cubic feet of volume,

the 144 cubic feet of SF6, if uniformly mixed would reduce the oxygen content to 20.7%. But it will not be uniformly mixed, it will accumulate at the floor, which should further reduce the problem in terms of ODH

10. Are there transition periods where conditions might be changing or folks are taking accesses that we need to be worried about?

We imagined entering cave when it was cold….

11. What are the dimensions of the cave?

Injector spaces (volumes provided):

Existing test cave: 9,140 cubic feet

New HDIce extension: 16,564 cubic feet

Total: 25,704 cubic feet

No “door”, rather there will be a gate

12. What is ventilation like/controlled - are there fans?

Yes, two exhaust fans, one to outside and one to high bay. 30” diameter ports approx. 7’ above floor.

13 Are there open penetrations on the ceiling of the cave and if so how many in2 are they?

Yes, in Cave 1 there are six 10” diameter penetrations. Cables will pass through some. There are also three rectangular penetrations, one will house waveguides.

14 Are there racks on the roof of the cave that will have open penetrations leading into them during normal operations?  or during shutdowns but with the CM cold?

The racks are displaced from the penetrations. Racks do not sit directly above penetrations

From Ed Daly:

Hi Matt,

I'm at SLAC and will return to work Friday but that day is booked solid.

There are two circuits in the CM - the primary and the shield circuits. You'll need to take both systems into account.

There are reliefs on both circuits. There may be reliefs on transfer lines or connection boxes that might be inside the UITF.

In addition to reliefs venting, you'd need to consider a rupture of the internal piping that would cause the insulating vacuum relief plate to open on the 1/4 CM or on transfer lines that might be in the UITF cave.

The strategy for these cases would be to show that a certain number of air exchanges occur in the UITF volume. The 1/4 CM has about 400 liters of liquid helium when operating at 2K. When expanded to room temp, a factor of ~700 can be applied. This is a lot of liters so you probably won't be able to show that the O2 level remains above 19.5%. I'm not sure of the cave volume.

You may know this but I want to make sure. Note that ODH 1 only happens when the u-tubes are installed a CM that is being tested. Otherwise the cave is ODH 0. When the cave door is closed and u-tubes are installed, the cave becomes ODH 2. I guess you are thinking that you'll want to enter the UITF cave with the door closed and the u-tubes installed, correct?

Can we meet on Monday?

Cheers,

Ed

From Dick Owen:

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):

21(Vol of room x volume of gas)

----------------------------------------  = Oxygen %

             Volume of room

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:  21(16,545 - 1320)

                                                       ----------------------   =  19.3%

                                                               16545

HDIce extension only for Helium:  21(16,545 - 28,240)

                                                     ------------------------   = - 14.8% (cannot have a negative concentration, therefore Zero %)

                                                                16,545

Existing Test Cave only for nitrogen:  21(9140- 1320)

                                                          --------------------   =  17.9%  (hence has ventilation system not considered at this point)

                                                                 9140

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

  21(25,704 - 42,678)

 ------------------------   = - 13%  (cannot have a negative concentration, therefore Zero %)

          25,704

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

  21(25,704 - 1320)

 ------------------------   = 19.9%

          25,704

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.

Richard J. Owen CIH, CSP

EHS&Q

Ext 6381

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 data used 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.

Richard J. Owen CIH, CSP

EHS&Q

Ext 6381