



Fermilab

**Particle Physics Division
Mechanical Department Engineering Note**

Number: MD-ENG-471

Date: 1 May 2013

Project Internal Reference: PPD docdb: NOvA docdb:

Project: NOvA Near Detector Cavern

Title: ODH analysis for NOvA Near Cavern Fire Protection.

Author(s): Dave Pushka

Reviewer(s):

Key Words: ODH

Applicable Codes: FESHM 5064

Abstract Summary:

Calculations and correspondences are attached below:

Fermilab Engineering Manual Requirements:

- Chapter 1: The specification given by Russ Albers is the verbal request to prepare the FESHM 5064 ODH analysis.
- Chapter 2: Risk analysis has not been formally prepared. ODH calculations are prepared to quantify the risk of an oxygen deficiency hazard.
- Chapter 3: Requirements and specification reviews by the project have not been formally prepared.
- Chapter 4: This engineering note has been specifically prepared to address chapter 4 of the engineering manual.
- Chapter 5: The 'reviewed by' signature on the cover page of this document addresses Chapter 5 of engineering manual.
- Chapter 6: No materials were purchased as part of the preparation of this document.
- Chapter 7: This is a document and no testing is required.
- Chapter 8: This is a document and no release to operations is required
- Chapter 9: Unless there are lessons learned from this effort, this engineering note and the other material posted in NOvA docdb will be considered the final written Project Report as described in Chapter 9. This note will be placed in the PPD and NOvA document data bases as a means of Archiving and Control.

Data and Calculations:

- The NOvA near detector hall has a gross volume of 40,400 cubic feet.
- The detector has a gross volume of 7700 cubic feet
- Four 50 liter cylinders are included and presumed to discharge simultaneously and instantly.
- Ventilation rate in the NOvA near detector hall is presumed to be zero cubic feet per minute when the fire protection discharges
- Cylinders are assumed to be pressurized to 150 bar per section 3.2.2 of the MAU operating manual. 150 bar is approximately 2200 psi.
- Each Cylinder has a volume of 50 liters (1.76 cubic feet).
- When expanded to atmospheric pressure, 1.76 cubic feet of gas at 2200 psig yields 265 cubic feet of gas:

$$P_1 * V_1 = P_2 * V_2$$

$$V_1 = (P_2 * V_2) / P_1$$

$$V_1 = (2200 \text{ psig} + 14.7 \text{ psia}) * 1.76 \text{ cubic feet} / 14.7 \text{ psig}$$

$$V_1 = 265 \text{ cubic feet}$$

For Four cylinders, the volume of nitrogen released is:

$$V_{\text{released}} = 4 * 265 \text{ cubic feet} = 1060 \text{ cubic feet}$$

Net air volume of the facility is 40,400 – 7700 cubic feet

Net air volume of the facility is 32,700 cubic feet

Oxygen concentration at time = 0 (before discharge) is 20.9 % oxygen

Oxygen concentration after discharge is:

$$\%O_2 = ((32700 * 0.209) / (32700 + 1060)) * 100\%$$

$$\%O_2 = 20.24 \text{ percent oxygen concentration.}$$

Since the oxygen concentration never falls below 19.5%, the ODH classification is 0 per FESHM 5064

From: [Russell J Alber](#)
To: [David B. Pushka](#)
Cc: [Jonathan W. Hunt](#)
Subject: FW: NNDH Acceptance testing for Water Mist System
Date: Wednesday, May 01, 2013 1:22:02 PM
Attachments: [MINOS-NOVA-Cavern.pdf](#)
[MAU manual.pdf](#)

Thanks Dave,
The volume of the detector hall is 40,400 cu-ft or 1,500 cu-yds.
The volume of Nitrogen is 200 liters (4 tanks of 50 liters). All expected to be released as a propellant simultaneously.
Russ

-----Original Message-----

From: James H Niehoff
Sent: Wednesday, May 01, 2013 7:40 AM
To: Russell J Alber
Cc: Jonathan W. Hunt
Subject: RE: NNDH Acceptance testing for Water Mist System

Documents attached:

1. MINOS NOVA Cavern is the Life Safety/Fire Protection Analysis, bottom of page 4 and top of page 5 reference the requirement for a fire suppression system.
2. Water Mist MAU skid unit. Assume (4) MAU-150 installed each has 50 liters of nitrogen gas cylinder for a total of 200 liters. The nitrogen is the propellant (pump) to push the water through the water mist piping network.
3. My understanding is the Marioff water mist is a Class I (NFPA 750) water mist which is accepted by the U.S. EPA as being environmentally benign and suitable for use in occupied spaces.
<http://www.epa.gov/ozone/snap/fire/lists/flood.html>

Should you have any additional questions or comments, please do not hesitate to call or email me.

Thanks, Jim
630.840.3856
Niehoff@fnal.gov

-----Original Message-----

From: Russell J Alber
Sent: Tuesday, April 30, 2013 4:04 PM
To: James H Niehoff
Cc: Jonathan W. Hunt
Subject: FW: NNDH Acceptance testing for Water Mist System

Jim,
I have no record of an ODH analysis for the 4 bottles of nitrogen.
Who can we get this from before the test? Del?
Russ

-----Original Message-----

From: Timothy L Trout
Sent: Tuesday, April 30, 2013 4:00 PM
To: Russell J Alber; Jonathan W. Hunt; James H Niehoff; Brian K. Petersohn; Charles E. Kuhn
Cc: Steven J Dixon; Timothy L Trout; Michael P Andrews; Michael P Michalak; William M Lee
Subject: NNDH Acceptance testing for Water Mist System

All,
Kiewit and their sub ORR will be performing a functional acceptance test for the water mist system