DØ DETECTOR ASSEMBLY HALL PLATFORM OXYGEN DEFICIENCY HAZARD ANALYSIS

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ABSTRACT

Liquid cryogens, released and warming to atmosphere conditions, expand to, on average, seven hundred times their liquid volume, and displace vital atmospheric oxygen. An oxygen deficiency hazard analysis assesses the increased risk to personnel in areas containing cryogenic systems. The DØ detector platform area ODH analysis has been approached four different ways using established methods. In each case, the analysis shows the platform area to be ODH class 0 as equipped (with ventilation fans) and requiring no special safety provisions. System designers have provided for a reduced oxygen level detection and warning system as well as emergency procedures to address fault conditions.

INTRODUCTION

The Oxygen Deficiency Hazard of any particular area is defined by these parameters: the nature of the accidental supply of inert gas (probability of occurrence and quantity then released), the area's volume, the area's ventilation rate, and to a small degree the elevation of the area. Once this information is assembled, the ODH classification can be determined through standardized calculations.[1]

The platform area under the D0 detector contains much of the cryogenic and gas system piping necessary for the D0 experiment. Prior to moving the detector into the Collision Hall, the liquid argon calorimeters are cooled down and operated in the Assembly Hall. The first phase of this operation involved the cooldown of the Central Calorimeter, which was done in February 1991. This engineering note assesses the increased risk to personnel in the platform level to a reduced oxygen atmosphere during the cool down and subsequent operation of the calorimeters in the Assembly Hall. In addition, it outlines the steps taken to warn personnel of an emergency and to direct the subsequent evacuation. This note analyses only the Assembly Hall area. A similar engineering note, EN-332, covers the analysis of the Collision Hall area.

[1] DØ Engineering Note 3740.510-EN-229, General ODH Analysis Methods and Conclusions, Sept. 19, 1989, Rev. B.

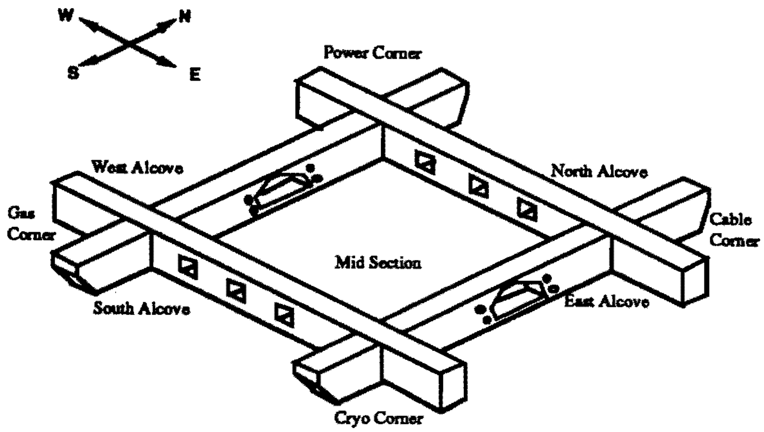


FIG. 1 D0 DETECTOR PLATFORM SUPPORT BEAMS

ODH ANALYSIS

The platform area can be divided into nine sections separated by the support beams (see fig. 1). Of the nine sections of the platform, none are completely isolated from either another section or the Assembly Hall. In the case of the east and west alcoves, there is a considerable distance between the platform and the nearest wall[2] (>4 ft). The mid section is potentially the most isolated volume, and yet it too is connected via two large openings and 16 ventilation fans to both the east and west alcoves (see Platform Ventilation).

Each of these sections contains some cryogenic and/or gas system piping in addition to being encased by the B (above) and C (below) layer muon gas chamber planes. The following is a list with estimated quantities of all the components involved in the platform area and above, broken down into sections.

ODH COMPONENT LISTING 160 muon gas chambers

ABOVE PLATFORM:
- 351 pipe sections
- 121 elbows
- 41 tees
- 562 welds
- 112 screw connectors
- 16 plastic manifolds
- 112 plastic/flex lines
- 30 rotary bayonets

CRYOCORNER:
- 94 pipe sections
- 57 elbows
- 3 tees
- 11 valves
- 168 welds
- 12 connectors
- 2 brass flex hoses
- 10 bayonets

[2] DØ Detector Parameter Layout, Plan View, Drawing Number 3740.000 MC 222134 rev. A

GAS CORNER:
- 122 pipe sections
- 29 elbows
- 58 tees
- 56 valves
- 267 welds
- 7 connectors

SOUTH ALCOVE:
- 113 pipe sections
- 7 elbows
- 17 valves
- 147 welds
- 17 swagelok hose connectors

ALONG HALL WALL:
- 145 pipe sections
- 41 elbows
- 28 tees
- 26 valves
- 273 welds
- 23 hose connections
- 23 swagelok flexible hoses

NE CORNER:
- 25 pipe sections
- 26 elbows
- 4 valves
- 52 welds
- 2 screw connections
- 2 plastic/flex lines

MID SECTION:
- 4 pipe sections
- 4 welds

WEST/EAST ALCOVE (EACH):
- 51 pipe sections
- 49 elbows
- 8 tees
- 2 valves
- 116 welds
- 28 connectors
- 2 plastic manifolds
- 26 plastic/flex lines

All of the cryogenic and gas system lines have restrictions which would limit their failure leak rates to under 1 scfm (except for the LAr, LN2, & GAr line bayonet jumpers[3]). The 2" SAMUS supply line has a maximum flow rate of 140 lpm, or about 5 scfm, which is the highest flow rate of any of the detector gas supply/exhaust lines.[4] As a conservative estimate, the estimated leak rates actually used in the analysis are 10 scfm. None of the vacuum jacketed lines, except the GN2 purge line, have restricting orifices. The 1" line 488GN does have a restricting orifice for each cryostat, tag numbers RO136N, RO236N, and RO336N. Note that vacuum jacketed lines have a significantly lower probability of failure in comparison to the rest of the piping components. From an external viewpoint, two pipes would have to fail to cause a cryogen leak, making the probability of a leak the product of two high quality pipe failure rates of $1x10^{-10}$/hr, or $1x10^{-20}$/hr. This rate has a negligible contribution to the ODH classification. However, there still exists the possibility of an internal failure. An internal leak would have an easy task of finding a way to atmosphere through the vacuum jacket pump outs. The leak would be restricted, though,

[3] For bayonet leak rate estimate see DØ EN-231, Leak Analysis, Bayonet + Flange.

[4] reference Kelly Dixon, 12/91.

due to the warming effect of the outside jacket, vaporizing and expanding the leaking cryogens before they vent to the air. The failure in the internal line would also be restricted by the size of the crack and the PO opening as well. The internal pipe in the vacuum jacketed lines used at DØ is not only high quality, but it is 100% analyzed for potential stress problems (see e.g. EN-162). There is also the possibility of a line rupture to consider. In the case of a heavy object being dropped accidentally onto a vacuum jacketed pipe, it is possible that both the internal pipe and the vacuum jacket could rupture. Most of the pipe sections are protected by the sidewalk, platform, cryobridge, or end irons. When the detector is closed, it is virtually impossible to drop something directly onto a pipe, but the possibility is included in the analysis. A single high quality pipe has a rupture failure rate of $1x10^{-10}$/hr,[5] so two independent pipes would have a rupture failure rate of $1x10^{-20}$/hr. Vacuum jacketed pipes should have a failure rate somewhere in between, so as a conservative measure, a failure rate of $1x10^{-11}$/hr is used in the spreadsheet. The leak rate is calculated from the largest expected flowrate in any of the pipes, which at this time would be 100 gpm, the maximum flow of liquid nitrogen from the dewar to the ECN cryostat.[6] Note that an internal leak would be a better case, with a much lower leak rate. The resulting ODH classification is 0 because of the low probability of failure. Also note that the high flow rate results in an oxygen concentration of 0% at infinity, however, if a line were to rupture, a flow switch would prompt the PLC to automatically shut a valve, limiting the total volume of escaped cryogens.[7]

The insulating vacuum line was not counted, as that line cannot create an ODH situation. The same is true of the instrument air lines. The utility vacuum line, however, can contain gases during backfill, so it was included in the analysis.

The CC to EC extension piping includes a system of rotary bayonets which allow the EC's to open and close without the removal of hard piping on top of the cryostats. There are three rotary bayonets in each assembly, and each of the six lines (LAr Fill/Drain, LN2, Gar, Ar/N2 Vent, UV, and IV) contains a rotary bayonet assembly for both the ECS and the ECN. This makes a total of 36 rotary bayonets, however, since the insulating vacuum line does not contribute to an ODH hazard, only 30 of these bayonets are considered in this

[5] Fermilab Safety Manual section 5064TA-7 rev. 6/86, Table III, NRC Equipment Failure Rate Estimates.

[6] reference Kelly Dixon, 12/91.

[7] see DØ Engineering Note 3740.000-EN-147, Cryogen Spills Due to Line Rupture, March 31, 1988.

analysis. The leak rate chosen was from EN-231 for a bayonet and flange. Although the volume used was of the area under the platform level, the rotary bayonets extend out into the surrounding space, so the volume used in the calculation is actually smaller and more conservative. The rotary bayonet analysis resulted in an ODH classification of 0.

PLATFORM VENTILATION

The ventilation for the platform level is provided primarily by the D0 building ventilation system. The building system nominally provides the platform with 1500 scfm fresh air which flows from the west side of the platform to the east side. In addition, there are several fans embedded in the platform which maintain uniform ventilation throughout.[8] The ventilation diagram included in the appendix shows the exact location and size of the fans located in the platform as well as the supply of air the building provides. Note that the total circulation provided nominally by the embedded fans is much greater than the amount of fresh air nominally provided by the building's system (4440 scfm vs. 1500 scfm). Thus, the fresh air make up rate for ODH calculation purposes is conservatively estimated to be 1500 scfm.

NOTES ON THE DIAGRAM:

While the detector is in the Assembly Hall, the platform relies mostly on the pull of the return air duct assembly located along the entire length of the east side of the pit area. However, much of the platform area is exposed to the Assembly Hall volume, and the surrounding air easily serves as the fresh air supply.

CALCULATION

For the ODH analysis of the area, there were four considerations involved. The first was simply to sum all the components throughout the platform with their appropriate estimated failure rates, and use the ODH calculations as per EN-229. This approach seems logical since none of the volumes are in fact isolated. Each volume is related to the others by the ventilation scheme and by

[8] "D0 Detector Platform With Electronic Cabinets," Drawing Number 3740.522-ME-222433 rev. C

the fact that much of the piping runs through more than one section. The total live volume under the platform is 8095 cf, and the normal ventilation rate is 1500 scfm. The first spreadsheet in the appendix (page A-2) shows the calculation, resulting in an ODH classification of 0.

The second consideration is the cryostat/trough system. If the cryostats leak, any leakage will flow through a trough system, designed to bypass the platform completely. In the unlikely event that the trough system fails, there could be leakage into the platform area. In order to estimate the chance for this occurrence, the highest component failure rate of $3x10^{-6}$/hr was multiplied by the failure rate for the trough system. Since there are no reference numbers for the failure rate of the trough system, it was calculated by assuming that the trough would only leak through one of its 12 flanges,[9] (4 of which are welded) where the failure rate per flange is $3x10^{-7}$/hr (the same for all of the flanges). The leak rate for the trough was estimated by analyzing the largest flange, a 24" diameter flange,[10] and scaling the leak rate calculated from EN-231 for a flange to adjust for the larger size. A 1/16" gap in the gasket was used for the calculation. Since a liquid cryogen spill flows through the spill trough by gravity, ΔP was arbitrarily chosen to be 5 psid. Using Equation 3 in EN-231, where r_h = 12", S = (1/16")(2)(π)(12") = 4.712 in^2, and ΔL = 3". The mass flow leak rate, M, is then 7.56 lbm/s, or 106 scfm. The first spreadsheet shows the fatality rate calculation, resulting in an ODH classification of 0.

The third consideration would be the failure of the muon chamber supply line, which could result in the release of the gas (90% argon, 5% carbon dioxide, 5% tetraflouromethane) in up to 5 full muon chambers (the associated spill from the supply side has already been accounted for in the first consideration). The muon chamber spill can be dealt with here:

Volume of gas released (90% Ar, 5% CO_2, 5% CF_4):

The chambers operate at a pressure of 4"Hg, and atmospheric pressure here is approximately 28"Hg.

$$5 \text{ chambers} \times \frac{2{,}000\ \text{L}}{\text{chamber}} \times \frac{0.0353\ \text{ft}^3}{\text{L}} \times \frac{4\text{"Hg}}{28\text{"Hg}} = 50.43 \text{ scf total}$$

This release would be essentially instantaneous. The smallest volume of

[9] reference Gary Trotter, 12/91.

[10] DØ Detector Liquid Argon Spill Duct System, Drawing number 3740.512-ME-278820 rev. A.

air into which one can release this amount of gas and not cause an ODH problem (i.e., the fraction of oxygen remains above 18%) is:

$$\text{volume} = \frac{(21\%)(50.43\ \text{cf})}{(21\% - 18\%)} = 353\ \text{cf}$$

Since the smallest volume we could possibly consider in the platform would be one of the corners, and each of the corners are 386 cf in volume, this could not cause an ODH problem.

In the first spreadsheet, it was assumed that the ventilation system was operating and maintaining the normal ventilation of 1500 scfm. The fourth and final calculation considers the case in which the ventilation system fails to operate properly. In this case, virtually any leak or rupture can result in an ODH condition. Essentially, the ratio of the leak rate to the exhaust rate would approach infinity, so the fatality factor would be equal to 1.0. However, even though this reduces the final oxygen level to 0%, it does not change the ODH class when the failure rates are accounted for. As with the spill trough, the maximum component failure rate of $3\text{x}10^{-6}$/hr is multiplied by the failure rate of the ventilation, which is this case is taken to be $1.3\text{x}10^{-5}$/hr, derived from the failure of an electric motor to run.[11] This results in an ODH classification of 0. Note that for an ODH class 0, the maximum failure rate for just the ventilation alone can be up to $3.33\text{x}10^{-2}$/hr, determined by dividing the maximum fatality rate of $1\text{x}10^{-7}$/hr by the component failure rate of $3\text{x}10^{-6}$/hr.

The spreadsheet in the appendix (page A-2) assumes a normal operating ventilation of 1500 scfm. The four analyses cover the cryogenic piping components, muon gas chamber lines, vacuum jacketed lines, utility vacuum line, rotary bayonet assemblies, spill trough system, and the ventilation system. In each case it is clear that with the nominal ventilation of 1500 scfm, the <u>ODH classification of the DØ Collision Hall is zero</u>. The normal ventilation will be monitored by a fixed flowmeter in the argon sump line. An alarm setting at 1000 scfm has been determined through discussion. If the measured flow drops below the alarm setting, EF-6 will turn on, providing up to 13,000 cfm of additional ventilation. If EF-6 fails, or does not increase the flow above the alarm setting, the control system will activate the ODH alarm, and the Assembly Hall will be evacuated. With the normal ventilation of 1500 scfm,

[11] <u>CDF Oxygen Deficiency Hazard Analysis,</u> Craig Drennan, 5/13/92.

there are only two scenarios which can lower the oxygen level below the safe 18%. The first is a complete rupture of a vacuum jacketed pipe, coupled with a failure in the control system to close the supply valve, resulting in the maximum flow of liquid cryogen. The probability of this double failure has a negligible contribution to the ODH classification. The second scenario is a failure in ventilation, in which the exhaust rate drops to 0 scfm, and any significant leak or rupture can lower the oxygen level. As with the vacuum jacketed pipes, however, the probability of this double failure has a negligible contribution to the ODH classification.

ODH ALARM PROVISIONS

Areas defined to be ODH class 0 do not require the installation of any special hardware or the posting of any signs. However, in order to foresee and safeguard against any possible accident in and around the detector, it is necessary to design and install a detection and warning system. Therefore the DØ Cryogenics group has implemented the Research Division ODH monitoring system consisting of oxygen sensing cells and horn/strobe alarms. Included in the appendix is a diagram showing the placement and number of ODH heads and the placement of horn strobe alarms (see ODH Alarm Provisions) within the platform area.

The heads and alarms are all controlled from the ODH chassis in the ODH chassis rack platform located near the south stairway above the building sump. The ODH chassis are in turn connected to a programmable logic controller (PLC) accessed through two user interface computers in the cryogenic control room. A control system page much like the Alarm Provisions diagram can be accessed on these computers showing which ODH heads, if any, are in alarm. A summation of the status of the ODH heads—OK, trouble or alarm—is sent (independently from the PLC) to FIRUS, which activates a call-in list in the event of an emergency. The control system will also turn on EF-6, providing an additional 13,000 cfm of exhaust ventilation. The system designers have also installed an autodialer as part of the control system hardware. Any alarm, including any ODH alarm, will trigger a call-in list on the autodialer to specified cryoexperts.

NOTES ON THE DIAGRAM:

The placement of the ODH heads covers all areas of the platform where personnel can enter. The power corner (NW) and the cable corner (NE) are full of equipment and did not require heads.

The platform ODH system protects the localized area under the calorimeters. If all design measures to preclude ODH problems fail, the monitoring system will alarm warning workers to exit the area. The system has been tested and operated successfully.[12] The horns are audible throughout the platform area and are uncomfortable enough to prevent anyone from ignoring them and continuing work in the area.

ODH EMERGENCY PROCEDURES

In the event of an oxygen deficiency hazard in the platform level (detected by the ODH heads), the alarms will sound, warning personnel in the area of the impending danger. Signs posted adjacent to the alarms will instruct personnel to exit the lower Assembly Hall area surrounding the detector as quickly as possible. Personnel should then congregate in the high bay area near the large overhead door where senior personnel may account for each individual.

In addition to activating the horns and strobes in the platform level (see alarm provisions), the ODH system sends an alarm to FIRUS which will activate a call in list as well as notify the Fire Department of the impending emergency. The signal is also sent to a cryosystems autodialer which will attempt to contact individuals on a call list and inform them of the emergency. The autodialer will continue to phone the people on the call list until it receives an acknowledgement that the message was received.

Once the Fire Department and/or cryoexpert has arrived, an area status panel mounted near each of the main entrances to the D0 assembly building as well as the main control room will help determine the nature of the emergency. This panel includes a summation of ODH alarms and flammable gas alarms. From there, emergency responders can access the ODH control page in either the cryo control room or the main control room in order to

[12] Urbin, John, " DØ ODH System (Southside DAB) Test Procedure," D0 Cryogenic Operating Procedures Manual, 4/05/90.

determine the location of the alarm. A plan of action will then be coordinated by Fire Department and system experts.

Included in the appendix are two documents which contain the procedures to be followed in an ODH emergency. The first is the sign which will be posted adjacent to the horns/strobes in the platform level informing them to evacuate the Assembly Hall. The second is a more general procedure. It describes in detail the proper sequence of events during an emergency.

GENERAL NOTES ON ODH

Virtually every ODH analysis currently in use makes certain assumptions to simplify the analysis. These include assuming a defined volume, and uniform mixing and exhaust throughout the volume. In reality, helium will tend to rise, while argon and nitrogen will tend to fall because of the difference in the density of air and of the leaking cryogen. In the DØ Assembly Hall, only argon and nitrogen are present in significant quantities, therefore this analysis uses only the volume under the platform of 8,095 cf.

Some of the failure rates are referenced from Tables II and III in the Fermilab Safety Manual, section 5064, rev. 6/86. These tables are often subject to interpretation, as currently no details are available on the specific failure modes and item specifications. Other failure rates are derived from combinations of single failure rates. Leak rates are either conservatively estimated, calculated, measured, or referenced from previous engineering notes.

This analysis does not take into account any failure rate in the ODH detection system, including failure in the ODH heads, the control system, or the building purge ventilation. The analysis relies only on the normal operating ventilation provided by EF-7, an exhaust fan independent of the building ventilation and controlled by cryoexperts. The analysis does consider the possibility of a failure in EF-7, in which case the ventilation rate would drop to 0 scfm (assuming no fresh air from the building ventilation), and any leak would result in an ODH condition. To guard against this possibility, the ventilation flow is continuously monitored, and if the flow drops below an alarm setting of 1000 scfm and EF-6 is not able to restore the required flow, an ODH alarm is initiated, and the Assembly Hall is evacuated.

There are a number of factors which have been conservatively estimated or assumed to simplify the analysis. First, it is assumed that all leak rates exist indefinitely, so that the oxygen level is determined at infinity. In reality, rupture flows would be sensed by a flow switch and the supply would be shut off at the source. Second, the vacuum jacketed lines are assumed to undergo a catastrophic rupture, but in such a way that the pipes remain completely open, allowing the maximum liquid flow of 100 gpm of nitrogen (11,000 scfm) to release into the atmosphere.

In general, a wide variety of assumptions are necessary for any practical ODH analysis. The assumptions outlined above may be modified at a later date, but under the current methodology, the DØ Assembly Hall is an ODH class 0.

APPENDIX

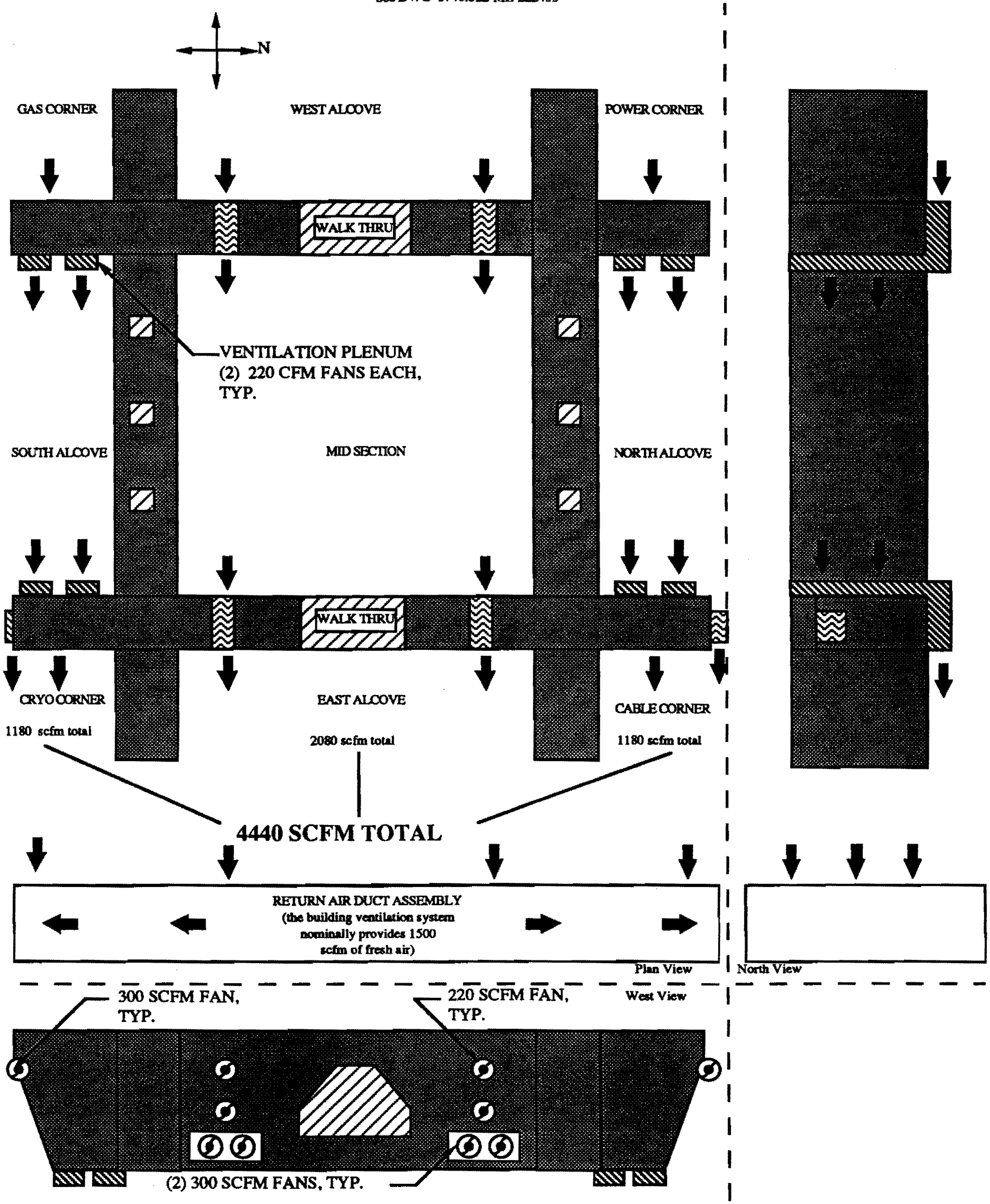
DØ ENGINEERING NOTE 258
DØ PLATFORM ASSEMBLY HALL ODH ANALYSIS

CONTENTS:

PLATFORM VENTILATION DIAGRAM

D. Clark 9/90 rev. J. Wu 6/92

See DWG 3740.522-ME-222433



DØ ASSEMBLY HALL PLATFORM ODH ANALYSIS
NORMAL VENTILATION RATE

Exhaust E	TC, min. V/E	
1,500	5.40	
Volume V	**Elevation**	**Pressure**
8,095	701 ft	742 mmHG

ITEM	TYPE	N	P FAIL RATE	GROUP FAIL RATE	L leak rate	L/E LEAK/EXH	fO2{∞} FRACT O2	F Fatal. Factor	Ø Fatal. Rate	ODH Class
Pipes <3"	Sections	520	3.00E-06	1.56E-03	10	0.006667	20.86%	1.06E-09	1.66E-12	0
Elbows		255	3.00E-07	7.65E-05	10	0.006667	20.86%	1.06E-09	8.13E-14	0
Tees		110	3.00E-07	3.30E-05	10	0.006667	20.86%	1.06E-09	3.51E-14	0
Pipes***	vac jacketed	436	1.00E-11	4.36E-09	11000	7.333333	0.00%	1.00E+00	4.36E-09	0
Elbows	vac jacketed	124	1.00E-11	1.24E-09	11000	7.333333	0.00%	1.00E+00	1.24E-09	0
Tees	vac jacketed	36	1.00E-11	3.60E-10	11000	7.333333	0.00%	1.00E+00	3.60E-10	0
Valves**		59	1.00E-08	5.90E-07	33	0.022000	20.54%	1.84E-09	1.09E-15	0
Bayonets*	cryocorner	10	3.00E-06	3.00E-05	10	0.006667	20.86%	1.06E-09	3.19E-14	0
Bayonets	rotary, EC	30	3.00E-06	9.00E-05	10	0.006667	20.86%	1.06E-09	9.57E-14	0
Joints	welded/brazed	1705	3.00E-09	5.12E-06	10	0.006667	20.86%	1.06E-09	5.44E-15	0
Connectors	screw	229	3.00E-06	6.87E-04	10	0.006667	20.86%	1.06E-09	7.30E-13	0
Manifolds	plastic	20	3.00E-06	6.00E-05	10	0.006667	20.86%	1.06E-09	6.38E-14	0
Hose	plastic/flex	191	3.00E-06	5.73E-04	10	0.006667	20.86%	1.06E-09	6.09E-13	0
TOTAL									5.96E-09	0

Trough (Failure of a component and concurrent trough failure)

leak/catastrophic overflow	12	9.00E-13	1.00E-11	106	0.023556	20.51%	1.95E-09	2.10E-20	0

Ventilation (Failure of a component and concurrent ventilation failure)

leak/catastrophic overflow	1	3.90E-11	3.90E-11	any	infinite	0.00%	1.00E+00	3.90E-11	0

* Leak taken from EN-231, using the highest value for a likely leak in each case.
** Leak taken from EN-192, using the highest value (80°K N2, ΔP = 3 atms, annular gap 0.01')
*** Leak derived from 100 gpm maximum N2 flow (reference Kelly Dixon 12/91).

Explanation of Table Columns and Special Notes

ITEM and TYPE: component description.

N: number of components of item.

FAIL RATE(**P**): probability of failure, one item, in units of hr^{-1}.

LEAK RATE(**L**): maximum leakage upon failure of component, in units of scfm.

L/E: ratio of leak rate to exhaust ventilation rate.

FRACTION OF OXYGEN(fO_2):

IF L/E > 1, THEN $fO_2\{\infty\} = 0$, ELSE

$fO_2\{\infty\} = 0.21\ (1 - L/E)$

p: pressure, in mmHG.

FATALITY FACTOR(**F**) (truncates with if-then):

IF $10^\wedge(6.5 - (p/10)(fO2)) \geq 1$, THEN **F** = 1, ELSE

$\mathbf{F} = 10^\wedge(6.5 - (p/10)(fO2))$

FATALITY RATE(**Ø**): N(P)(F)

ODH CLASS (uses if-then-else logical operators):

IF $Ø \leq 10^{-7}$, THEN ODH class = 0, ELSE
IF $Ø \leq 10^{-5}$, THEN ODH class = 1, ELSE
IF $Ø \leq 10^{-3}$, THEN ODH class = 2, ELSE
IF $Ø \leq 10^{-1}$, THEN ODH class = 3, ELSE
ODH class = 4.

SPECIAL NOTES: Volume, V, is in ft^3, and time constant, TC, is in minutes. On the first table, for normal ventilation, trough failure rate was derived from the highest component failure rate (3×10^{-6}/hr) multiplied by the failure rate for a leak or rupture of a flange (3×10^{-7}/hr, see text). Note that the leak and exhaust rates are not critical in the vacuum jacketed lines or the ventilation failure, because the maximum fatality factor is 1.00 for any oxygen level under 8.553% (see EN-229). Ventilation failure rate was derived from the highest component failure rate (3×10^{-6}/hr) multiplied by the failure of an electric motor to run (1.3×10^{-5}/hr, see text). For an ODH class 0, the failure rate of the ventilation itself can be as high as 3.33×10^{-2}/hr (see text).

ODH ALARM PROVISIONS

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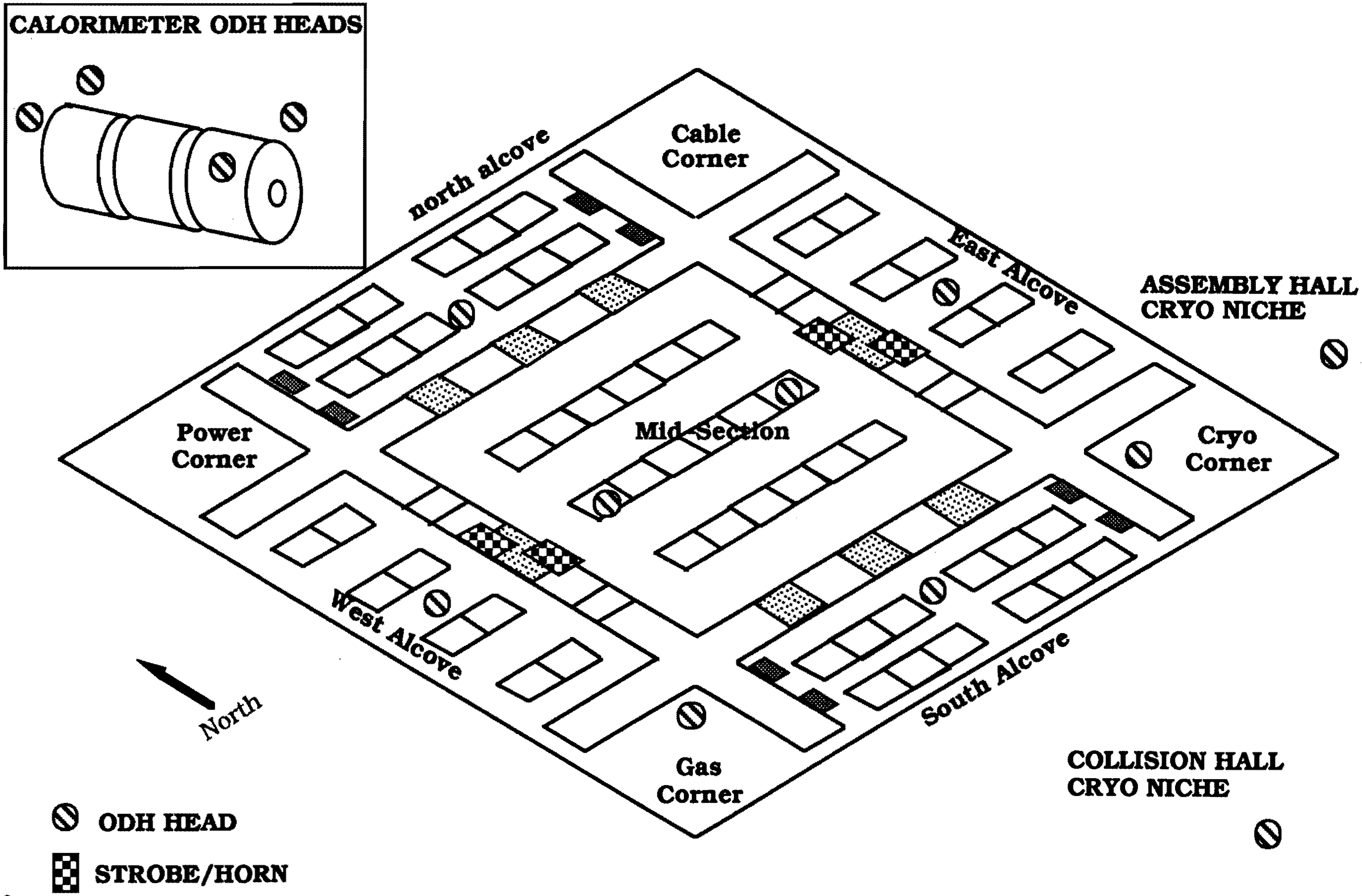
11/07/90



Orig. JM

1/29/91

ODH ALARM

EVACUATE DØ DETECTOR AREA

DØ Detector Platform ODH Alarm Response

An ODH monitoring system has been installed in the platform level below the DØ detector. This procedure addresses the proper response to alarms from the ODH monitoring system.

1. HORNS AND STROBES WILL BE ACTIVATED IF AN ODH CONDITION IS SENSED BY THE MONITOR SYSTEM.

2. ALL PERSONNEL IN THE PLATFORM AREA AND THE LOWER ASSEMBLY HALL AREA MUST EVACUATE TO THE HIGH BAY AREA NEAR THE LARGE OVERHEAD DOOR.

3. INFORMATION FROM THE ODH STATUS PANEL MOUNTED IN THE MAIN CONTROL ROOM AND NEAR THE NORTH ENTRANCE AND REPORTS FROM THE PERSONNEL EXITING WILL HELP DETERMINE IF THERE IS A REAL ODH EMERGENCY. IF THERE IS ANY UNCERTAINTY, ASSUME A REAL EVENT AND CALL X3131 FOR FIRE DEPARTMENT ASSISTANCE. DO NOT RE-ENTER THE BUILDING DURING A REAL EVENT WITHOUT FIRE DEPARTMENT SUPPORT AND SCBA EQUIPMENT.

4. IF THE ODH HEAD IN THE CRYO CONTROL ROOM AND/OR MAIN CONTROL ROOM IS NOT IN ALARM, CRYO OPERATORS MAY ACCESS THE ROOM THROUGH THE DOUBLE DOORS AND CHECK THE CRYO CONTROL SYSTEM TO HELP ANALYZE THE SITUATION.

5. THE ODH MONITORING SYSTEM IS TIED TO THE FIRUS SYSTEM AND THE CRYO SYSTEM'S AUTODIALER, WHICH WILL ALERT THE COMMUNICATIONS CENTER AND ACTIVATE A CALL-IN LIST FOR EXPERT ASSISTANCE IN CRYO OR GAS SYSTEM PROBLEMS.

6. IN THE EVENT OF A REAL ODH INCIDENT, A PLAN OF ACTION WILL BE COORDINATED BY THE EMERGENCY RESPONSE TEAM AND THE SYSTEM EXPERTS.

7. IN THE EVENT OF A FALSE ALARM, THE SYSTEM EXPERTS WITH ASSISTANCE FROM THE ODH MONITOR EXPERTS WILL TAKE CORRECTIVE ACTION TO RESTORE THE ODH MONITORING SYSTEM TO NORMAL OPERATING CONDITION.