

Calculation of Oxygen Deficiency Hazard Classes for RHIC

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RHIC PROJECT

Brookhaven National Laboratory

**Calculation of Oxygen Deficiency
Hazard Classes for RHIC**

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INTRODUCTION

The calculation of Oxygen Deficiency Hazard (ODH) Classifications was completed for the Magnet Enclosure Building which encloses equipment that may release cryogen or pressurized gas to the building internal volume¹. Calculation of ODH Classifications was also completed for any other buildings enclosing equipment that may release cryogen or pressurized gas to the building internal volume². This sudden release³ could then expose personnel in that building to an oxygen deficient atmosphere.

The criteria, guidelines, and methods for the calculation of ODH classifications, are defined in the Rhic Project Document "Oxygen Deficiency Hazards (ODH)⁴." The classifications are quantified from "0" to "4", for no hazard to the most severe hazard respectively, by calculating the ODH fatality rate (per hour) as defined by:

$$\Phi = \sum N_i P_i F_i \quad (1)$$

where N_i = number of i-type components

P_i = probability of the i-th component failure per hour

F_i = fatality factor or $O_2\%$.

The value of the ODH fatality rate is used to determine the ODH classification.

Table I ODH Classes

ODH Class	Fatality Rate Φ (1/hr.)
Unclassified	$\Phi < 10^{-9}$
0	$10^{-9} \leq \Phi < 10^{-7}$
1	$10^{-7} \leq \Phi < 10^{-5}$
2	$10^{-5} \leq \Phi < 10^{-3}$
3	$10^{-3} \leq \Phi < 10^{-1}$
4	$\Phi \geq 10^{-1}$

DISCUSSION

To prepare for a specific ODH calculation the following data and calculations are required:

- 1- The quantity of each different type of component, contained in the building volume, that could fail and cause a spill. N_1, N_2, N_3 , etc.
- 2- The probability of the i -th component failure and human error rate estimates (per hour) shown in Reference 3 tables B-IV, B-V, B-VI, and B-VII. P_1, P_2, P_3 , etc.
- 3- The building volume in ft^3 (V), from Reference 1 and calculations of building volumes from architectural drawings, Reference 2.
- 4- The fan ventilation rate in CFM (Q).
- 5- The spill rate in SCFM (R), from Reference 2 and/or manufacturer's data.
- 6- Spill time in minutes (t).
- 7- Atmospheric pressure in Torr (p)
- 8- The fatality factor (F) per hour as defined by:

$$F_i = 10^{(6.5 - P_{O_2i}/10)} \quad (2)$$

where

$$P_{O_{2i}} = cr_i * p / 100 \quad \text{Partial pressure } O_2 \text{ (mmHg)} \quad (3)$$

and

$$cr_i = 0.21 * [1 - R/Q * (1 - e^{(-Q*t/V)})] * 100 \quad O_2\% \text{ (volumetric) during release} \quad (4)$$

CALCULATIONS

The building volumes requiring ODH classifications were numerous and calculations to arrive at the most optimum ventilation rates were repetitive. In addition a parametric study, with variable fan rates, was performed to assure the optimal number of fan(s) were selected for a given enclosure. For each building volume three sets of calculations were made as follows: 1- full fans, 2- one fan off, and 3- no fan. To expedite the calculations a Mathcad program was developed (see Appendix I). The equations from Reference 4 were utilized, in this program, to conduct the parametric study and calculate all ODH classifications.

RESULTS

The results of the ODH calculations, for full fan operation, can be found in Appendix II.

REFERENCES

1. D.P. Brown, ", RHIC Project Technical Note AD/RHIC/RD-78, Nov. 1994.
2. RHIC Cryogenic System Safety Analysis Report, Introduction; Table 4, calculated from P.E. Architectural Drawings.
3. K.C. Wu, "Estimation of Helium Discharge Rates for RHIC ODH Calculations", RHIC Project Technical Note AD/RHIC/RD-79, Nov. 1994.
4. Oxygen Deficiency Hazards (ODH), RHIC Project Document.

APPENDIX 1

This mathcad program calculates the ODH class when the ventilation fans are drawing from the the confined volume at a rate greater than the spill rate. The methodology followed is described in the RHIC ODH standard.

D := READPRN(v100r) Reads data input file "vXXXX.prn"

v0 := D^{<0>}

AREACODE := D₂₈

Area in Question= AREACODE = 100

DATA

DATA : R...,V,Q,P1...,N1....

DATA

Gas Spill Rate (R) [f(t)]

Confined Volume (V) V := D₀ (CF)

Fan Vent Rate (Q) Q := D₁ (CFM)

Note: failure rates below obtained from the ODH standard. If the variety of equipment numbers less than 6, enter "0" for N....

DATA

Equip. #1 failure rate (P1) P1 := D₁₆ (per hr.)

Quantity of Equip. #1 (N1) N1 := D₁₇ (ea.)

Equip. #2 failure rate (P2) P2 := D₁₈ (per hr.)

Quantity of Equip. #2 (N2) N2 := D₁₉ (ea.)

Equip. #3 failure rate (P3) P3 := D₂₀ (per hr.)

Quantity of Equip. #3 (N3) N3 := D₂₁ (ea.)

Equip. #4 failure rate (P4) P4 := D₂₂ (per hr.)

Quantity of Equip. #4 (N4) N4 := D₂₃ (ea.)

Equip. #5 failure rate (P5) P5 := D₂₄ (per hr.)

Quantity of Equip. #5 (N5) N5 := D₂₅ (ea.)(FANS)

Equip. #6 failure rate (P6) P6 := D₂₆ (per hr.)

Quantity of Equip. #6 (N6) N6 := D₂₇ (ea.)

Note: R - R13 above are time (t in min.) dependant spill rates as follows:

R: 0 ≤ t ≤ .5

R1: .5 < t ≤ 1.0

R2: 1.0 < t ≤ 1.5

R3: 1.5 < t ≤ 2.0

R4: 2.0 < t ≤ 2.5

R5: 2.5 < t ≤ 3.0 ETC.

i := 0, 1.. 14

t_i := $\frac{i}{2}$

R_i := R·1 R1_i := R1·1 R2_i := R2·1 R6_i := R6·1 R7_i := R7·1 R8_i := R8·1 R12_i := R12·1

R3_i := R3·1 R4_i := R4·1 R5_i := R5·1 R9_i := R9·1 R10_i := R10·1 R11_i := R11·1 R13_i := R13·1

R_i := if(t_i ≤ .5, R_i, if(t_i ≤ 1.0, R1_i, if(t_i ≤ 1.5, R2_i, if(t_i ≤ 2.0, R3_i, if(t_i ≤ 2.5, R4_i, if(t_i ≤ 3.0, R5_i, if(t_i ≤ 3.5, R6_i, if(t_i ≤ 4.0, R7_i, if(t_i ≤ 4.5, R8_i, if(t_i ≤ 5.0, R9_i, if(t_i ≤ 5.5, R10_i, if(t_i ≤ 6.0, R11_i, if(t_i ≤ 6.5, R12_i, if(t_i ≤ 7.0, R13_i, if(t_i ≤ 7.5, R14_i, if(t_i ≤ 8.0, R15_i, if(t_i ≤ 8.5, R16_i, if(t_i ≤ 9.0, R17_i, if(t_i ≤ 9.5, R18_i, if(t_i ≤ 10.0, R19_i, if(t_i ≤ 10.5, R20_i, if(t_i ≤ 11.0, R21_i, if(t_i ≤ 11.5, R22_i, if(t_i ≤ 12.0, R23_i, if(t_i ≤ 12.5, R24_i, if(t_i ≤ 13.0, R25_i, if(t_i ≤ 13.5, R26_i, if(t_i ≤ 14.0, R27_i, if(t_i ≤ 14.5, R28_i, if(t_i ≤ 15.0, R29_i, if(t_i ≤ 15.5, R30_i, if(t_i ≤ 16.0, R31_i, if(t_i ≤ 16.5, R32_i, if(t_i ≤ 17.0, R33_i, if(t_i ≤ 17.5, R34_i, if(t_i ≤ 18.0, R35_i, if(t_i ≤ 18.5, R36_i, if(t_i ≤ 19.0, R37_i, if(t_i ≤ 19.5, R38_i, if(t_i ≤ 20.0, R39_i, if(t_i ≤ 20.5, R40_i, if(t_i ≤ 21.0, R41_i, if(t_i ≤ 21.5, R42_i, if(t_i ≤ 22.0, R43_i, if(t_i ≤ 22.5, R44_i, if(t_i ≤ 23.0, R45_i, if(t_i ≤ 23.5, R46_i, if(t_i ≤ 24.0, R47_i, if(t_i ≤ 24.5, R48_i, if(t_i ≤ 25.0, R49_i, if(t_i ≤ 25.5, R50_i, if(t_i ≤ 26.0, R51_i, if(t_i ≤ 26.5, R52_i, if(t_i ≤ 27.0, R53_i, if(t_i ≤ 27.5, R54_i, if(t_i ≤ 28.0, R55_i, if(t_i ≤ 28.5, R56_i, if(t_i ≤ 29.0, R57_i, if(t_i ≤ 29.5, R58_i, if(t_i ≤ 30.0, R59_i, if(t_i ≤ 30.5, R60_i, if(t_i ≤ 31.0, R61_i, if(t_i ≤ 31.5, R62_i, if(t_i ≤ 32.0, R63_i, if(t_i ≤ 32.5, R64_i, if(t_i ≤ 33.0, R65_i, if(t_i ≤ 33.5, R66_i, if(t_i ≤ 34.0, R67_i, if(t_i ≤ 34.5, R68_i, if(t_i ≤ 35.0, R69_i, if(t_i ≤ 35.5, R70_i, if(t_i ≤ 36.0, R71_i, if(t_i ≤ 36.5, R72_i, if(t_i ≤ 37.0, R73_i, if(t_i ≤ 37.5, R74_i, if(t_i ≤ 38.0, R75_i, if(t_i ≤ 38.5, R76_i, if(t_i ≤ 39.0, R77_i, if(t_i ≤ 39.5, R78_i, if(t_i ≤ 40.0, R79_i, if(t_i ≤ 40.5, R80_i, if(t_i ≤ 41.0, R81_i, if(t_i ≤ 41.5, R82_i, if(t_i ≤ 42.0, R83_i, if(t_i ≤ 42.5, R84_i, if(t_i ≤ 43.0, R85_i, if(t_i ≤ 43.5, R86_i, if(t_i ≤ 44.0, R87_i, if(t_i ≤ 44.5, R88_i, if(t_i ≤ 45.0, R89_i, if(t_i ≤ 45.5, R90_i, if(t_i ≤ 46.0, R91_i, if(t_i ≤ 46.5, R92_i, if(t_i ≤ 47.0, R93_i, if(t_i ≤ 47.5, R94_i, if(t_i ≤ 48.0, R95_i, if(t_i ≤ 48.5, R96_i, if(t_i ≤ 49.0, R97_i, if(t_i ≤ 49.5, R98_i, if(t_i ≤ 50.0, R99_i, if(t_i ≤ 50.5, R100_i, if(t_i ≤ 51.0, R101_i, if(t_i ≤ 51.5, R102_i, if(t_i ≤ 52.0, R103_i, if(t_i ≤ 52.5, R104_i, if(t_i ≤ 53.0, R105_i, if(t_i ≤ 53.5, R106_i, if(t_i ≤ 54.0, R107_i, if(t_i ≤ 54.5, R108_i, if(t_i ≤ 55.0, R109_i, if(t_i ≤ 55.5, R110_i, if(t_i ≤ 56.0, R111_i, if(t_i ≤ 56.5, R112_i, if(t_i ≤ 57.0, R113_i, if(t_i ≤ 57.5, R114_i, if(t_i ≤ 58.0, R115_i, if(t_i ≤ 58.5, R116_i, if(t_i ≤ 59.0, R117_i, if(t_i ≤ 59.5, R118_i, if(t_i ≤ 60.0, R119_i, if(t_i ≤ 60.5, R120_i, if(t_i ≤ 61.0, R121_i, if(t_i ≤ 61.5, R122_i, if(t_i ≤ 62.0, R123_i, if(t_i ≤ 62.5, R124_i, if(t_i ≤ 63.0, R125_i, if(t_i ≤ 63.5, R126_i, if(t_i ≤ 64.0, R127_i, if(t_i ≤ 64.5, R128_i, if(t_i ≤ 65.0, R129_i, if(t_i ≤ 65.5, R130_i, if(t_i ≤ 66.0, R131_i, if(t_i ≤ 66.5, R132_i, if(t_i ≤ 67.0, R133_i, if(t_i ≤ 67.5, R134_i, if(t_i ≤ 68.0, R135_i, if(t_i ≤ 68.5, R136_i, if(t_i ≤ 69.0, R137_i, if(t_i ≤ 69.5, R138_i, if(t_i ≤ 70.0, R139_i, if(t_i ≤ 70.5, R140_i, if(t_i ≤ 71.0, R141_i, if(t_i ≤ 71.5, R142_i, if(t_i ≤ 72.0, R143_i, if(t_i ≤ 72.5, R144_i, if(t_i ≤ 73.0, R145_i, if(t_i ≤ 73.5, R146_i, if(t_i ≤ 74.0, R147_i, if(t_i ≤ 74.5, R148_i, if(t_i ≤ 75.0, R149_i, if(t_i ≤ 75.5, R150_i, if(t_i ≤ 76.0, R151_i, if(t_i ≤ 76.5, R152_i, if(t_i ≤ 77.0, R153_i, if(t_i ≤ 77.5, R154_i, if(t_i ≤ 78.0, R155_i, if(t_i ≤ 78.5, R156_i, if(t_i ≤ 79.0, R157_i, if(t_i ≤ 79.5, R158_i, if(t_i ≤ 80.0, R159_i, if(t_i ≤ 80.5, R160_i, if(t_i ≤ 81.0, R161_i, if(t_i ≤ 81.5, R162_i, if(t_i ≤ 82.0, R163_i, if(t_i ≤ 82.5, R164_i, if(t_i ≤ 83.0, R165_i, if(t_i ≤ 83.5, R166_i, if(t_i ≤ 84.0, R167_i, if(t_i ≤ 84.5, R168_i, if(t_i ≤ 85.0, R169_i, if(t_i ≤ 85.5, R170_i, if(t_i ≤ 86.0, R171_i, if(t_i ≤ 86.5, R172_i, if(t_i ≤ 87.0, R173_i, if(t_i ≤ 87.5, R174_i, if(t_i ≤ 88.0, R175_i, if(t_i ≤ 88.5, R176_i, if(t_i ≤ 89.0, R177_i, if(t_i ≤ 89.5, 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152.5, R304_i, if(t_i ≤ 153.0, R305_i, if(t_i ≤ 153.5, R306_i, if(t_i ≤ 154.0, R307_i, if(t_i ≤ 154.5, R308_i, if(t_i ≤ 155.0, R309_i, if(t_i ≤ 155.5, R310_i, if(t_i ≤ 156.0, R311_i, if(t_i ≤ 156.5, R312_i, if(t_i ≤ 157.0, R313_i, if(t_i ≤ 157.5, R314_i, if(t_i ≤ 158.0, R315_i, if(t_i ≤ 158.5, R316_i, if(t_i ≤ 159.0, R317_i, if(t_i ≤ 159.5, R318_i, if(t_i ≤ 160.0, R319_i, if(t_i ≤ 160.5, R320_i, if(t_i ≤ 161.0, R321_i, if(t_i ≤ 161.5, R322_i, if(t_i ≤ 162.0, R323_i, if(t_i ≤ 162.5, R324_i, if(t_i ≤ 163.0, R325_i, if(t_i ≤ 163.5, R326_i, if(t_i ≤ 164.0, R327_i, if(t_i ≤ 164.5, R328_i, if(t_i ≤ 165.0, R329_i, if(t_i ≤ 165.5, R330_i, if(t_i ≤ 166.0, R331_i, if(t_i ≤ 166.5, R332_i, if(t_i ≤ 167.0, R333_i, if(t_i ≤ 167.5, R334_i, if(t_i ≤ 168.0, R335_i, if(t_i ≤ 168.5, R336_i, if(t_i ≤ 169.0, R337_i, if(t_i ≤ 169.5, R338_i, if(t_i ≤ 170.0, R339_i, if(t_i ≤ 170.5, R340_i, if(t_i ≤ 171.0, R341_i, if(t_i ≤ 171.5, R342_i, if(t_i ≤ 172.0, R343_i, if(t_i ≤ 172.5, R344_i, if(t_i ≤ 173.0, R345_i, if(t_i ≤ 173.5, R346_i, if(t_i ≤ 174.0, R347_i, if(t_i ≤ 174.5, R348_i, if(t_i ≤ 175.0, R349_i, if(t_i ≤ 175.5, R350_i, if(t_i ≤ 176.0, R351_i, if(t_i ≤ 176.5, R352_i, if(t_i ≤ 177.0, R353_i, if(t_i ≤ 177.5, R354_i, if(t_i ≤ 178.0, R355_i, if(t_i ≤ 178.5, R356_i, if(t_i ≤ 179.0, R357_i, if(t_i ≤ 179.5, R358_i, if(t_i ≤ 180.0, R359_i, if(t_i ≤ 180.5, R360_i, if(t_i ≤ 181.0, R361_i, if(t_i ≤ 181.5, R362_i, if(t_i ≤ 182.0, R363_i, if(t_i ≤ 182.5, R364_i, if(t_i ≤ 183.0, R365_i, if(t_i ≤ 183.5, R366_i, if(t_i ≤ 184.0, R367_i, if(t_i ≤ 184.5, R368_i, if(t_i ≤ 185.0, R369_i, if(t_i ≤ 185.5, R370_i, if(t_i ≤ 186.0, R371_i, if(t_i ≤ 186.5, R372_i, if(t_i ≤ 187.0, R373_i, if(t_i ≤ 187.5, R374_i, if(t_i ≤ 188.0, R375_i, if(t_i ≤ 188.5, R376_i, if(t_i ≤ 189.0, R377_i, if(t_i ≤ 189.5, R378_i, if(t_i ≤ 190.0, R379_i, if(t_i ≤ 190.5, R380_i, if(t_i ≤ 191.0, R381_i, if(t_i ≤ 191.5, R382_i, if(t_i ≤ 192.0, R383_i, if(t_i ≤ 192.5, R384_i, if(t_i ≤ 193.0, R385_i, if(t_i ≤ 193.5, R386_i, if(t_i ≤ 194.0, R387_i, if(t_i ≤ 194.5, R388_i, if(t_i ≤ 195.0, R389_i, if(t_i ≤ 195.5, R390_i, if(t_i ≤ 196.0, R391_i, if(t_i ≤ 196.5, R392_i, if(t_i ≤ 197.0, R393_i, if(t_i ≤ 197.5, R394_i, if(t_i ≤ 198.0, R395_i, if(t_i ≤ 198.5, R396_i, if(t_i ≤ 199.0, R397_i, if(t_i ≤ 199.5, R398_i, if(t_i ≤ 200.0, R399_i, if(t_i ≤ 200.5, R400_i, if(t_i ≤ 201.0, R401_i, if(t_i ≤ 201.5, R402_i, if(t_i ≤ 202.0, R403_i, if(t_i ≤ 202.5, R404_i, if(t_i ≤ 203.0, R405_i, if(t_i

$$P11 := N1 \cdot P1 \quad P44 := N4 \cdot P4 \quad P22 := N2 \cdot P2 \quad P33 := N3 \cdot P3 \quad P55 := N5 \cdot P5 \quad P66 := N6 \cdot P6$$

$$cr_i := 21 \cdot \left[1 - \frac{R_i + A_i}{2 \cdot Q} \cdot \left(1 - e^{-Q \frac{t_i}{V}} \right) \right] \quad Cr_i := \text{if}(cr_i \geq 0, cr_i, 0) \quad \text{eqs. calculate O2 \% by vol. and constrain to } > 0\%$$

$$Cr_1 := \text{if} \left(Cr_1 \geq 2 \cdot Cr_0, \frac{\sqrt{Cr_0 + Cr_1}}{2}, Cr_1 \right) \quad Cr_2 := \text{if} \left(Cr_2 \geq 2 \cdot Cr_1, \frac{\sqrt{Cr_1 + Cr_2}}{2}, Cr_2 \right)$$

$$Cr_3 := \text{if} \left(Cr_3 \geq 2 \cdot Cr_2, \frac{\sqrt{Cr_2 + Cr_3}}{2}, Cr_3 \right) \quad Cr_4 := \text{if} \left(Cr_4 \geq 2 \cdot Cr_3, \frac{\sqrt{Cr_3 + Cr_4}}{2}, Cr_4 \right)$$

$$Cr_5 := \text{if} \left(Cr_5 \geq 2 \cdot Cr_4, \frac{\sqrt{Cr_4 + Cr_5}}{2}, Cr_5 \right) \quad Cr_6 := \text{if} \left(Cr_6 \geq 2 \cdot Cr_5, \frac{\sqrt{Cr_5 + Cr_6}}{2}, Cr_6 \right)$$

$$Cr_7 := \text{if} \left(Cr_7 \geq 2 \cdot Cr_6, \frac{\sqrt{Cr_6 + Cr_7}}{2}, Cr_7 \right)$$

$$Cr_8 := \text{if} \left(Cr_8 \geq 2 \cdot Cr_7, \frac{\sqrt{Cr_7 + Cr_8}}{2}, Cr_8 \right)$$

$$Cr_9 := \text{if} \left(Cr_9 \geq 2 \cdot Cr_8, \frac{\sqrt{Cr_8 + Cr_9}}{2}, Cr_9 \right) \quad Cr_{10} := \text{if} \left(Cr_{10} \geq 2 \cdot Cr_9, \frac{\sqrt{Cr_9 + Cr_{10}}}{2}, Cr_{10} \right)$$

$$Cr_{11} := \text{if} \left(Cr_{11} \geq 2 \cdot Cr_{10}, \frac{\sqrt{Cr_{10} + Cr_{11}}}{2}, Cr_{11} \right) \quad Cr_{12} := \text{if} \left(Cr_{12} \geq 2 \cdot Cr_{11}, \frac{\sqrt{Cr_{11} + Cr_{12}}}{2}, Cr_{12} \right)$$

$$Cr_{13} := \text{if} \left(Cr_{13} \geq 2 \cdot Cr_{12}, \frac{\sqrt{Cr_{12} + Cr_{13}}}{2}, Cr_{13} \right)$$

$$PO2_i := Cr_i \cdot \frac{760}{100} \quad PP \text{ O2}$$

$$G_i := 10 \left(6.5 - \frac{PO2_i}{10} \right)$$

$$F_i := \text{if}(G_i \geq 1, 1, \text{if}(G_i \leq 1 \cdot 10^{-7}, 0.0, \text{if}(G_i > 1 \cdot 10^{-7}, G_i, 1)))$$

Eq. at left calculates fatality factor
and sets limits between 0 and 1.
Nested "if" statement.

$$\phi_i := P11 \cdot F_i + P22 \cdot F_i + P33 \cdot F_i + P44 \cdot F_i + P55 \cdot F_i + P66 \cdot F_i$$

$$P_i := (P11 + P22 + P33 + P44 + P55 + P66) \cdot 1$$

ODH fatality Rate.

$$P_i := P_i \cdot 1 \cdot 10^6 \quad F_i := F_i \cdot 1 \cdot 10^7$$

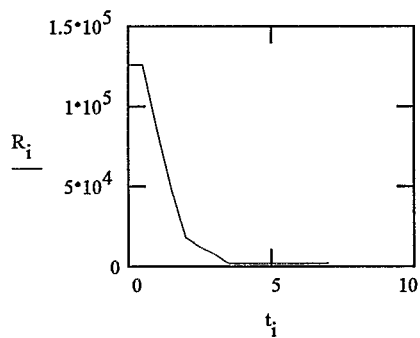
$$\text{ODH}_i := \text{if}(\phi_i \leq 1 \cdot 10^{-7}, 0, \text{if}(\phi_i \leq 1 \cdot 10^{-5}, 1, \text{if}(\phi_i \leq 1 \cdot 10^{-3}, 2, \text{if}(\phi_i \leq 1 \cdot 10^{-1}, 3, 4))))$$

$$\phi_i := \phi_i \cdot 1 \cdot 10^7$$

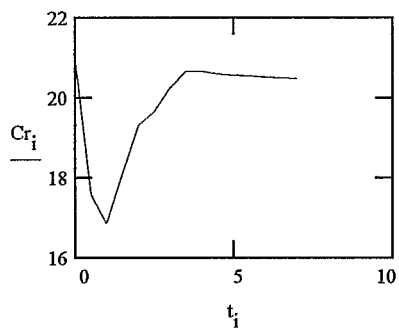
The eq. above calculates the ODH class. Nested "if" statement.

Spill Rate (SCFM)	T (min)	O2 (%)	PP (mmHg)	Fatality Factor Fi (10E-7)	Event Rate Pi (10E-6) (per hr.)	ODH Fatality Rate phi (10E-7) (per hr.)	ODH Class
R_i	t_i	Cr_i	$PO2_i$	F_i	P_i	ϕ_i	ODH_i
126000	0	21	159.6	0	7919.15	0	0
126000	0.5	17.6	133.5	1.422	7919.15	0.011	0
87000	1	16.8	128	5.007	7919.15	0.04	0
48000	1.5	18.1	137.5	0	7919.15	0	0
18000	2	19.3	146.8	0	7919.15	0	0
12000	2.5	19.7	149.5	0	7919.15	0	0
7800	3	20.2	153.9	0	7919.15	0	0
2000	3.5	20.7	157	0	7919.15	0	0
2000	4	20.7	157	0	7919.15	0	0
2000	4.5	20.6	156.5	0	7919.15	0	0
2000	5	20.6	156.3	0	7919.15	0	0
2000	5.5	20.5	156.1	0	7919.15	0	0
2000	6	20.5	155.9	0	7919.15	0	0
2000	6.5	20.5	155.8	0	7919.15	0	0
2000	7	20.5	155.7	0	7919.15	0	0

Spill rate (CFM) vs. Time
(min.)



O2 (%) vs. Time (min.)



$$\text{ODHCLASS} := \text{if}(\text{ODH}_2 < \text{ODH}_1, \text{ODH}_1, \text{if}(\text{ODH}_3 < \text{ODH}_2, \text{ODH}_2, \text{if}(\text{ODH}_4 < \text{ODH}_3, \text{ODH}_3, \text{if}(\text{ODH}_5 < \text{ODH}_4, \text{ODH}_4, \text{if}(\text{ODH}_6 < \text{ODH}_5,$$

The equation above selects the highest ODH class.

For: AREACODE = 100 ,the ODHCLASS = 0

O := ODHCLASS

APPEND(output) := O

Writes output to file "output.dat"

**OXYGEN DEFICIENCY HAZARD CLASS FOR RHIC BUILDINGS DURING
NORMAL OPERATIONS**

BLDG NO	BUILDING NAME	ODH CLASS
1005H	Compressor Bldg.	0
1005R	Cryogenic Bldg.	1
1001	RME-1:00	0
1003	RME-3:00	0
1005	RME-5:00	0
1007	RME-7:00	0
1009	RME-9:00	0
1011	RME-11:00	0
1002B	2:00 Service Bldg	0
1004B	4:00 Service Bldg	0
1006B	6:00 Service Bldg	0
1008B	8:00 Service Bldg	0
1010A	10:00 Service Bldg	0
1012A	12:00 Service Bldg	0

odh.tck 8/94