

CDF Oxygen Deficiency Hazard (ODH) Alarm Procedure

(This is a Safety Procedure)

This procedure outlines the steps to be taken by the CDF Alarm Coordinator in the event of a ODH Alarm within the CDF Complex.

Approvals:

(CDF Department Head)

(Date)

(Research Division Head)

(Date)

(Acclerator Division Head)

(Date)

1.0 Controlled Copies of this procedure.

Four controlled copies of this procedure will exist in the following locations:

1. CDF Control Room in the CDF Assembly Building
2. RD / CDF Department Office
3. Research Division Office
4. Accelerator Division Office

In addition, one copy of section 2.0 of this document will be in the CDF Control Room in an operator's aid called " CDF Alarms Response Handbook ".

All other copies will be marked, " INFORMATIONAL COPY ONLY "

2.0 The Procedure.

The CDF Alarm Coordinator defined in the current version of the CDF Conduct of Operation Outline will execute the procedures O-1 through O-4 as required.

Definitions and General Information:

ODH Class rankings are given to areas at Fermilab via conditions listed in the Fermilab ES&H Manual following engineering calculations and review procedures. The CDF Assembly Hall is an ODH Class 0 area, the CDF Collision Hall floor level is an ODH Class 0 area, **the CDF Collision Hall Catwalks are treated as ODH Class 1** areas.

The CDF Ventilation system is an integral part of the ODH system. There are four fans: AC2, AC3, BF1, and PF1 (AC = Air Conditioning, BF = Booster Fan, PF = Purge Fan). Each fan is monitored for flow via Pitot tubes and a lack of flow triggers a "Ventilation Trouble" light on the status panels (including the one in the CDF Control Room).

Fresh outside air is used as make up air and the dampers on the intake of AC2 cannot be closed to less than 10% of full open -- the actuator is positioned so that the dampers remain partially open even when the full actuator stroke is applied by the control lines. (note this damper open condition may be assured via software control in the near future).

Normally, BF1 and PF1 act together to keep the air pressure in the Collision Hall equal to the outside air pressure for the benefit of the CDF Detector -- i.e., no large ΔP is allowed.

Only PF1 operation is required for the ODH 0 classification of the Collision Hall.

PF1 is capable of 34,000 cfm in full purge mode with all the dampers full open, but it normally runs at lower cfm in a differential pressure range of 3.5 - 5.0 inches of water. If the PF1 differential pressure drops below 1 inch of water (20-30% of its normal flow), it is assumed that PF1 is not operating, and an ODH evacuation alarm is triggered for the Collision Hall.

The CDF Oxygen Deficiency Hazard (ODH) alarm system consists of the standard Fermilab Experimental Areas Oxygen Monitor System with a set of 12 ODH sensors (see reference 1). The sensors are Oxygen concentration monitors based on an electrochemical cell. The Monitor System issues an alarm condition if the Oxygen concentration falls below 18%. The system issues a trouble alarm if the concentration rises above 23% (this is system fault signal at CDF as there is no source of excess Oxygen). The readouts for the CDF ODH sensors are located in the CDF Cryo Control area on the first floor of the CDF Assembly Building in electronics rack RR1. The sensors latch an alarm condition but continue to provide a real time monitor of the Oxygen concentration detected.

The alarm can be silenced with a key in the possession of the CDF Alarm Coordinator. Only the CDF Alarm Coordinator can order the use of the key to silence the alarm.

The CDF ODH sensors are located as follows:

- 2 are in the Assembly Hall ceiling
- 2 are in the Assembly Hall deep pit area
- 2 are in the Collision Hall ceiling on the catwalk
- 2 are at the extreme East and West ends of the Collision Hall under the low β quads
- 2 are under the CDF Forward Hadron detector (also under the low β quads) in the Collision Hall
- 2 are in the deep pit area of the Collision Hall under the Central Detector

Accidents leading to **ODH conditions in the Assembly Hall** can only be due to Helium or Nitrogen spills associated with the CDF Solenoid. Helium gas rises, Nitrogen gas flows downward if cold or mixes readily if warm. Due to the volume of the Assembly Hall, no calculable Helium accident scenario leads to an Oxygen concentration below 18%. However, due to the smaller volume of the Assembly Pit, calculable accident scenarios from a liquid nitrogen spill can lead to less than 18% Oxygen if the ventilation system is not operating. The Assembly Pit purge fan operates only if an ODH alarm occurs and there is no ODH alarm caused by lack of this purge fan operation (the fan is tested once per week by the RD / Cryo Department).

Credible accidents leading to **ODH conditions in the Collision Hall** are calculated to be due to Helium or Nitrogen associated with the CDF Solenoid or with the Tevatron low β quads located in the hall. Calculable accident scenarios leading to an Oxygen concentration below 18% are possible if the ventilation system is not operating.

CDF also uses Argon-Ethane in a 50/50 mixture in many detectors. Ethane is flammable and Flammable Gas alarms are covered in CDF PROCEDURE #2. The volumes of room temperature Argon-Ethane gas at CDF are small (only about 100 cubic meters), while the Helium and Nitrogen systems contain liquids and are potentially much larger. Argon-Ethane can contribute to an ODH condition but cannot be the primary cause.

The **MX-241 Dual Function Gas Monitor** is a small 3' x 4" x 1" unit which can be hand carried or put on a belt loop. The unit has a LCD readout of Oxygen concentration and can be toggled to read out the % LEL. In addition this unit emits a warning tone if the Oxygen level goes below 18% or if the unit detects 20% of LEL.

The **TIF-8800 (red) Flammable gas detector** is a hand held unit sensitive to concentrations as low as 50 parts per million. The unit emits a "geiger counter" ticking signal which increased in frequency as the detected concentration increases. The unit has no numerical readout.

The **Lumidor Safety Products Model COM-26 Portable Oxygen Monitor** has a readout of oxygen concentration in the range 17 - 22 % and sounds an alarm if the concentration is below 18%.

SCBA stands for Self-Contained Breathing Apparatus. Special training and a medical exam are required for personnel using this equipment. In addition, Fermilab Fire Department supervision is required.

CDF ODH ALARM PROCEDURE

IN THE EVENT OF AN ODH ALARM IN THE CDF COMPLEX, THE CDF ALARM COORDINATOR SHALL:

1. SILENCE THE LOCAL CONTROL ROOM AUDIBLE ALARM

**2. DETERMINE THE ZONE IN ALARM
AND REMAIN IN THE CONTROL ROOM**

Utilize the display on the North Wall of the Control Room.

3. ASSESS THE DANGER OF ODH EXPOSURE TO PEOPLE.

Quickly evaluate the access status with respect to the zone in alarm.

(For example, if it is a Collision Hall alarm and no access is in progress, then no personnel can be in danger)

If appropriate:

Assign one crew member to count the Controlled and / or Supervised Access Keys.

4. IF THE ACCESS STATUS INDICATES POSSIBLE DANGER TO PERSONNEL, IMMEDIATELY DIAL 3131

report the ODH Alarm condition and

**REQUEST THE THE FIRE DEPARTMENT RESPOND TO A
"CDF OXYGEN DEFICIENCY HAZARD STANDBY
WITH SCBA GEAR".**

Request that the **"Fire Department Officer in charge report to the CDF Alarm Coordinator, GIVE YOUR NAME, in the CDF Control Room".**

Be ready to inform the emergency response team of the access and key status.

5. FOLLOW THE APPROPRIATE ODH PROCEDURE:

Record the sequence of events in the SOD Logbook.

O-1 ASSEMBLY BUILDING ALARM

O-2 COLLISION HALL ALARM

O-3 ALARM WHEN THE 1200 TON SHIELD DOOR IS OPEN

BETWEEN THE ASSEMBLY BUILDING AND THE COLLISION HALL

CDF ODH ALARM PROCEDURE O-1

Assembly Building Alarm

1. THE FOLLOWING AUTOMATIC ACTIONS OCCUR:

- (1) The Assembly Building Evacuate Alarm is sounded.
- (2) The Assembly Building Evacuate Strobe Lights are activated.
- (3) The Assembly Pit ventilation purge fan is activated.
- (4) The Control Room and Entry Status Panels display "ODH, ALARM, ASSEMBLY PIT".

IN ADDITION, DO THE FOLLOWING:

2. IF A COLLISION HALL ACCESS IS IN PROGRESS, INITIATE EVACUATION WITHOUT EXPOSING PERSONNEL TO THE HAZARD.

Using the phone paging system, instruct the access group(s) to "Exit via the labyrinth door next to the elevator (do NOT use the 50 Ton door passage leading into Assembly pit), proceed up the stairwell, and exit via the South door on the first floor".

Assign one crew member to meet the access group(s) at the South Door exit, verify that all personnel are accounted for, and report back to the Control Room.

3. WARNING: DO NOT GO INTO THE DEEP PIT.

INSPECT DEEP PIT AND GAS PLATFORM AREAS FOR AFFECTED PERSONNEL AND EVIDENCE OF A VALID ALARM.

Assign two crew members to walk along the west and north pit edge railings, check the pit and gas platform areas visually, and return to the Control Room to report to you.

An alarm is valid if a vapor cloud, vent plume, or broken line can be seen.

An alarm is valid if injured personnel can be seen.

4. IF INJURED PERSONNEL ARE SEEN, DIAL 3131 AND REQUEST FIRE DEPARTMENT RESPONSE TO A "CDF OXYGEN DEFICIENCY HAZARD EMERGENCY WITH SCBA GEAR".

Request that the "Fire Department Officer in charge report to the CDF Alarm Coordinator, GIVE YOUR NAME, in the CDF Control Room".

5. HAVE QUALIFIED PERSONNEL (CRYO OPERATOR OR GAS TECH) INVESTIGATE THE ALARM FROM RACK #1 IN THE CRYO AREA.

An alarm is valid if two or more sensors indicate a latched ODH alarm.

An alarm is valid if a latched sensor continues to read an Oxygen concentration out of the normal range -- i.e., a yellow or red bar remains on.

6. AN ALARM IS VALID IF YOU CANNOT PROPERLY ACCOUNT FOR ALL THE ACCESS KEYS.

If the Assembly Hall Pit is not part of the Supervised Access Area,

then the access key count doesn't matter.

IF THE ALARM IS VALID, GO TO PROCEDURE O-4.

(If the alarm is NOT valid, it is a false alarm)

CDF ODH ALARM PROCEDURE O-2

Collision Hall Alarm

1. THE FOLLOWING AUTOMATIC ACTIONS OCCUR:

- (1) The Collision Hall Evacuate Alarms are sounded.
- (2) The Collision Hall Evacuate Strobe Lights are activated.
- (3) The Collision Hall ventilation is changed to purge mode.
- (4) The Control Room and Entry Status Panels display "ODH, ALARM, COLLISION HALL".

IN ADDITION, DO THE FOLLOWING:

2. CALL THE ACCELERATOR MAIN CONTROL ROOM (3721) TO INFORM THEM OF THE CDF COLLISION HALL ODH ALARM.

Ask the Main Control Room to investigate if the Tevatron could be the source of the CDF ODH condition.

Assign one crew member to keep the line open to the MCR.

3. WARNING: DO NOT GO INTO THE COLLISION HALL.

INSPECT THE COLLISION HALL FOR AFFECTED PERSONNEL AND EVIDENCE OF A VALID ALARM.

Assign one crew member to use the surveillance cameras.

An alarm is valid if a vapor cloud, vent plume, or broken line can be seen.

An alarm is valid if injured personnel can be seen.

4. IF INJURED PERSONNEL ARE SEEN, DIAL 3131 AND REQUEST FIRE DEPARTMENT RESPONSE TO A "CDF OXYGEN DEFICIENCY HAZARD EMERGENCY WITH SCBA GEAR".

Request that the "Fire Department Officer in charge report to the CDF Alarm Coordinator, GIVE YOUR NAME, in the CDF Control Room".

5. HAVE QUALIFIED PERSONNEL (CRYO OPERATOR OR GAS TECH) INVESTIGATE THE ALARM FROM RACK #1 IN THE CRYO AREA.

An alarm is valid if two or more sensors indicate a latched ODH alarm.

An alarm is valid if one sensor continues to read an Oxygen concentration out of the normal range -- i.e., a yellow or red bar remains on.

An alarm is valid if Purge Fan PF1 is not operating.

6. AN ALARM IS VALID IF YOU CANNOT PROPERLY ACCOUNT FOR ALL ACCESS KEYS .

IF THE ALARM IS VALID, GO TO PROCEDURE O-4

(If the alarm is NOT valid, it is a false alarm)

CDF ODH ALARM PROCEDURE O-3

Alarm when the 1200 Ton Shield Door is Open

1. THE FOLLOWING AUTOMATIC ACTIONS OCCUR:

- (1) The Collision Hall and Assembly Building Evacuate Alarms are sounded.
- (2) The Collision Hall and Assembly Building Evacuate Strobe Lights are activated.
- (3) The ventilation is changed to purge mode in the area in alarm.
- (4) The Control Room and Entry Status Panels display "ODH", "ALARM", "COLLISION HALL", or "ASSEMBLY PIT" depending on zone in alarm.

IN ADDITION, DO THE FOLLOWING:

2. CALL THE ACCELERATOR MAIN CONTROL ROOM (3721) TO INFORM THEM OF THE ODH ALARM AT CDF

Ask to Main Control Room to investigate if the Tevatron could be the source of the CDF ODH condition.

Assign one crew member to keep the line open to the MCR.

3. WARNING: DO NOT GO INTO THE DEEP PIT OR COLLISION HALL.

INSPECT THE DEEP ASSEMBLY HALL PIT AND THE COLLISION HALL FOR AFFECTED PERSONNEL AND EVIDENCE OF A VALID ALARM

Assign one crew member to use the surveillance cameras to look for people still in the Collision Hall.

Assign two crew members to walk along the west and north Assembly pit edge railings, check the pit and gas platform areas visually, and return to the Control Room to report to you.

An alarm is valid if a vapor cloud, vent plume, or broken line can be seen.

An alarm is valid if injured personnel can be seen.

4. IF INJURED PERSONNEL ARE SEEN, DIAL 3131 AND REQUEST FIRE DEPARTMENT RESPONSE TO A "CDF OXYGEN DEFICIENCY HAZARD EMERGENCY WITH SCBA GEAR".

Request that the "Fire Department Officer in charge report to the CDF Alarm Coordinator, GIVE YOUR NAME, in the CDF Control Room".

5. HAVE QUALIFIED PERSONNEL (CRYO OPERATOR OR GAS TECH) INVESTIGATE THE ALARM FROM RACK #1 IN THE CRYO AREA.

An alarm is valid if two or more sensors indicate a latched ODH alarm.

An alarm is valid if one sensor continues to read an Oxygen concentration out of the normal range -- i.e., a yellow or red bar remains on.

An alarm is valid if Purge Fan PF1 is not operating.

6. AN ALARM IS VALID IF YOU CANNOT PROPERLY ACCOUNT FOR ALL ACCESS KEYS .

IF THE ALARM IS VALID, GO TO PROCEDURE O-4

(If the alarm is NOT valid, then it is a false alarm)

CDF ODH ALARM PROCEDURE O-4

VALID ALARM RESPONSE

1. TO REACH THIS PART OF THE PROCEDURE YOU MUST HAVE A "VALID ALARM" DEFINED AS ANY OF THE FOLLOWING:

- (1) Visual observation of injured personnel.
- (2) Inability to account for all access keys properly.
- (2) Visual observation of a vapor cloud, vent plume, or broken line.
- (3) Two or more sensors in Cryo Rack #1 indicating a latched ODH alarm.
- (4) One sensor in Cryo Rack #1 continuing to read an Oxygen concentration out of the normal range -- i.e., a yellow or red bar remains on.
- (5) Purge Fan PF1 not operating.

REMAIN IN THE CDF CONTROL ROOM & DO THE FOLLOWING:

2. COORDINATE WITH THE FIRE DEPARTMENT.

The Fire Department will assume command if personnel are missing or known to be injured.

3. TAKE ADDITIONAL INVESTIGATIVE ACTIONS:

Verify that the ODH alarm is the only emergency -- check the status panel.

Determine if recent changes in the cryo or gas systems may be the cause.

Have the CDF Gas Tech investigate PF1 if appropriate.

Have the Cryo Operator examine the solenoid control readbacks.

For Collision Hall alarms, double check the Tevatron status with the MCR (3721).

If the valid alarm is due to only one sensor in Cryo Rack #1 continuing to read out of the normal range and no other confirming evidence can be found, the alarm is declared false.

(WARNING: Only Experts should be the first to enter the Assembly Hall Pit or Collision Hall following such "single sensor false alarms", and the expert should enter only with MX-241 or COM-26 Oxygen monitors and a 5 minute escape pack.

Call the CDF Operations Manager who may call experts to initiate single sensor repair.)

IF THE ALARM REMAINS VALID, DO THE FOLLOWING:

4. NOTIFY PERSONNEL ON THE CDF NOTIFICATION CALL LIST.

5. DEVELOP A CORRECTIVE ACTION PLAN.

Consult with experts on call before taking any action.

Further actions for consideration are:

- (1) Fix PF1.
- (2) Close the LN2 supply valve, MV-1914-N for dewar #32 and / or valve MV-1730-N for dewar #18, both located near the southeast exit.
- (3) Full CDF flammable gas shutdown
- (4) Solenoid slow dump.
- (5) Call the Fire Department Officer in charge to aid in a sweep of the area in alarm
If SCBA trained, the CDF Cryo Operator is a good candidate to accompany the Fire Department on a sweep of the

pit area.

A pit sweep could determine the validity of the alarm with portable monitors

(MX-241 Dual Function Gas Monitor, Lumidor Safety Products Model
COM-26 Portable Oxygen Monitor, TIF-8800 Flammable gas detector).

- (6) If all personnel are properly accounted for, use the Hazardous Atmosphere Alarm System key to silence the building alarm and ask the Fire Department to help keep off-shift people out of the building.

Record status and shutdown actions taken.

3.0 Checklist

No "Procedure Execution Form" is required for this safety procedure. Instead the CDF Alarm Coordinator should record the steps taken in the CDF SOD logbook in the CDF Control Room.

4.0 Deviations from the Procedure

None are allowed.

5.0 Required Training and Authorized Training Personnel.

Prerequisite training is required for this procedure as follows:

- (1) current valid training in the CDF Fire Alarm Procedure
 - (2) current valid training the the CDF Flammable Gas Alarm Procedure
- (These prerequisites insure a general familiarity with the CDF complex and alarm systems).

Additional special training in this procedure is also required.

Authorized training personnel are listed below:

John Elias, ID# 2306

John Pawlak, ID# 9381

qualified by experience in the design / implementation
of the CDF ODH Alarm systems.

6.0 Training Materials.

No written materials exist.

A lecture must be given by one of the authorized training personnel.

This lecture must include a tour with stops and instruction at:

1. CDF Control Room display used to determine the zone in alarm.
2. Relay Rack #1 in the Cryogenic control area, with a discussion of the specific sensors which can trip.
3. Monitor for PF1.

7.0 List of Trained People for this procedure.

The list of trained people for this procedure should exist in written form in the CDF Department copy of this procedure.

The list may eventually reside in a Lab-wide database as well.

8.0 References and Supporting Documentation.

1. Operation of the CDF Hazardous Atmosphere Safety System, December 4, 1991,
by Robert D. Gatze