

CDF Flammable Gas 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 Flammable Gas 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 G-1 through G-7 as required.

Definitions and General Information:

LEL means "Lower Explosive Limit"

The flammable gas used in CDF is Ethane in a 50/50 mix with Argon. Ethane is flammable in the concentrations of 3% to 12.5% in air.

7 % LEL =	0.21 % concentration in air =	2,100 parts per million (PPM)
20 % LEL =	0.60 % concentration in air =	6,000 PPM
100% LEL =	3.00 % concentration in air =	30,000 PPM

When the complete CDF Detector is in the Collision Hall, the ambient level of ethane from small leaks in all the chambers amounts to 100 - 300 PPM.

The sensor readouts in Relay Rack #1 in the CDF Cryo area are for a set of 63 flammable gas sensors in the CDF Complex. Most sensors are the "Astro" infrared type read out by a Model 310 Controller. These devices have LCD readout and show % LEL in real time. The units have a red light ("LOW") which comes on at 7 % LEL and another red light ("HIGH") which comes on at 20 % LEL. Both lights latch once that concentration is detected even though the unit continues to show actual detected % LEL in real time.

A few of the CDF flammable gas sensors are still the older type General Model 610 Combustible Gas Monitors which require the presence of oxygen for operation. These sensors remain installed on the Forward Calorimeters only. The General Model 610 devices also have LED readout and show % LEL in real time. The units have a yellow light (instead of red) which comes on at 7 % LEL and a red light which comes on at 20 % LEL. Only the 20% LEL red light latches once that concentration is detected. The unit continues to show actual detected % LEL in real time just like the "Astro" model.

Note two of the flammable gas sensors are in the Inerting jug located on the main floor of CDF Assembly in the Gas Rack Area (See CDF PROC - 5, "CDF Inerting Alarm Procedure"). These two sensors are set for a "LOW" level pre-alarm at 30% LEL and for a "HIGH" level alarm at 50% LEL since they are in an inerted area where approximately 18% LEL is normal. Since they are different, these two sensor readouts are clearly marked and their trip levels are prominently displayed.

Note that the Inerting Alarm Panel in the CDF Control Room registers alarms for both oxygen levels and Ethane levels, so a dual alarm condition can occur.

The Nitrogen purge system for the inerted CTC area is monitored by pressure transducers. Normal operating pressure is 12.7 psig = 1450 SCFH. Trip levels for the Nitrogen purge are set at 5.9 psig = 1000 SCFH for low flow and at 19.0 psig for restricted flow. **Both trips cause the same automatic actions as a high level Flammable Gas Alarm.** See CDF PROC-5 "CDF Inerting Alarm Procedure" for additional inerting system information.

The CH(x) PPM alarm sensor panel is located in the CDF Control Room. There are 12 sensors and a map showing their locations in the Collision Hall. The CH(x) alarm has a yellow (low level) light which flashes if 400 PPM is detected and a red (high level) light which flashes if 440 PPM is detected. These alarm levels may change throughout the run to accommodate the ambient ethane levels in the hall. The current alarm levels are posted on the panel. In any case it is possible to obtain the real time reading of any one of the 12 sensors via a separate LED readout on the panel.

The **TIF-8800 (red) Flammable gas detector** is a hand held unit sensitive to concentrations as low as 50 parts per million (= 0.17 % of LEL). The unit emits a "geiger counter" ticking signal which increases in frequency as the detected concentration increases. The unit can be decreased in sensitivity to make to low end of the detectable concentration 1000 PPM (= 3.3 % of LEL = 0.1% concentration). The unit has no numerical readout.

The **Gas-Trac Model NGX-6 (yellow) Flammable gas detector** is a hand held unit sometimes used at CDF and has three different alarm light / audible warning tone levels:

"Slight" = approximately 0.1 % concentration = 3.3 % of LEL = 1,000 PPM

"Medium" = approximately 1.0 % concentration = 33 % of LEL = 10,000 PPM

"Alarm" = approximately 2.0 % concentration = 67% of LEL = 20,000 PPM

The unit "ticks" at low concentrations, ticks faster at higher concentrations, and emits a warbling tone when in "Alarm" status. The unit has no numerical readout.

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.

CDF PROCEDURE - 301 " Guide to Gas System Repairs" is expected to be completed by about May 15, 1992. This procedure will codify existing practice -- i.e. it will detail the general steps to be taken with ignition sources, inerting systems, flow rates, gas mixtures (e.g. P-10 vs. Argon-Ethane 50/50) in various situations before a CDF Gas Tech repairs or modifies any part an existing gas system. It will also indicate the latitude given to the CDF Gas Tech in such repairs, so the the tech will know when to call in his supervisor before proceeding. It will also indicate the latitude given to the Gas Tech Supervisor, so the supervisor will know when he must confer with the CDF Gas System Engineer before proceeding.

CDF FLAMMABLE GAS PROCEDURE

IN THE EVENT OF A FLAMMABLE GAS ALARM IN THE CDF COMPLEX, THE CDF ALARM COORDINATOR SHALL:

1. SILENCE THE CONTROL ROOM LOCAL ALARM

The sonalert silence switch is located directly beneath the flammable gas section of the CDF control room alarm display panels.

2. DETERMINE ZONE AND SENSOR IN ALARM

Utilize the display on the North Wall of the Control Room to determine the zone in alarm.

Check for a dual alarm from the Inerting System panel in the southwest corner of the CDF Control Room.

Dispatch a person to Relay Rack #1 in the Cryogenic control area to determine which specific sensor has tripped.

The Relay Rack #1 data has the most important information available from the alarm system and the information may be transitory.

Record the sequence of events.

3. FOLLOW THE APPROPRIATE FLAMMABLE GAS PROCEDURE:

If the Alarm status changes during the response, switch to the appropriate NEW procedure

IF YOU LEAVE THE CDF CONTROL ROOM TO HELP INVESTIGATE THE ALARM, TAKE THIS COMPLETE SET OF PROCEDURES WITH YOU

G-1 ASSEMBLY BUILDING LOW LEVEL ALARM, >7%LEL

G-2 ASSEMBLY BUILDING HIGH LEVEL ALARM, >20%LEL

G-3 COLLISION HALL LOW LEVEL ALARM, >7% LEL

G-4 COLLISION HALL HIGH LEVEL ALARM, >20% LEL

G-5 GAS SHED LOW LEVEL ALARM, >7% LEL

(this refers to the Gas Storage area next to the CDF
Assembly Building, not to the Gas Mixing area inside
the berm)

G-6 GAS SHED HIGH LEVEL ALARM, >20% LEL

CDF FLAMMABLE GAS PROCEDURE G-1 ASSEMBLY BUILDING LOW LEVEL ALARM, >7%LEL

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

An alarm is valid if the sensor has a stable reading near or above 7 % LEL.

(note exception: valid if stable near or above 30% for the inerting jug sensor)

Report to the CDF Alarm Coordinator if the alarm is valid.

IF THE LOW LEVEL ALARM IS VALID, THEN:

2. TAKE SHUTDOWN AND PROTECTIVE ACTIONS

Determine if recent changes in the gas system may be the cause of the alarm.

If appropriate for the situation, execute

- individual detector system power and gas shutdown
- full CDF flammable gas shutdown
- full CDF detector power shutdown
- Solenoid power shutdown
- none of the above

Record shutdown actions executed.

3. GO TO PROCEDURE G-7

CDF FLAMMABLE GAS PROCEDURE G-2 ASSEMBLY BUILDING HIGH LEVEL ALARM, >20%LEL

1. THE FOLLOWING AUTOMATIC ACTIONS OCCUR:

- (1) The evacuate alarm for the building is sounded.
- (2) An emergency message is issued on FIRUS.
- (3) The flammable gas supply to the building is shut off.
- (4) All high voltage to the detector is shut off.
- (5) The 400 Hz MG#1 and #2 power is shut off.
- (6) The toroid power supply is shut off.
- (7) All 60 Hz detector power is shut off.

IN ADDITION, DO THE FOLLOWING:

2. DIAL 3131 TO CONFIRM THE ALARM CONDITION AND TO REQUEST THAT THE FIRE DEPARTMENT RESPOND TO A "CDF FLAMMABLE GAS STANDBY".

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

(or in the CDF Cryo Area depending on your location).

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

An alarm is valid if the latched sensor has a non-zero reading or if the
latched sensor had previously indicated a low-level 7% LEL alarm.

(note exception: non-zero of about 18% is normal for the inerting jug sensors)

Report to the CDF Alarm Coordinator if the alarm is valid.

4. HAVE THE GAS TECH INVESTIGATE THE INERTING NITROGEN FLOW ON THE 730' GAS PLATFORM.

An alarm is valid if the CTC flow is less than 1200 SCFH
or if the CDT flow is less than 250 SCFH.

IF THE ALARM IS VALID, THEN:

5. CONFIRM SHUTDOWNS LISTED IN STEP 1 ABOVE AND CLOSE THE MANUAL GAS SUPPLY VALVE.

6. TAKE ADDITIONAL SHUTDOWN AND PROTECTIVE ACTIONS

Determine if recent changes in the gas system may be the cause of the alarm.

If appropriate for the situation, execute

- Solenoid power shutdown

Record shutdown actions confirmed and executed.

7. GO TO PROCEDURE G-7

CDF FLAMMABLE GAS PROCEDURE G-3 COLLISION HALL LOW LEVEL ALARM, >7% LEL

1. THE FOLLOWING AUTOMATIC ACTIONS OCCUR:

- (1) The Collision Hall evacuate alarm whooper is sounded if the interlocks are in the "Access Permitted" status.

IN ADDITION, DO THE FOLLOWING:

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

An alarm is valid if the sensor has a stable reading near or above 7% LEL.
(note exception: valid if stable near or above 30% for the inerting jug sensor)

Report to the CDF Alarm Coordinator if the alarm is valid.

From the Control Room, use the surveillance cameras and any specific area information from the CH(x) PPM alarm sensor panel to aid the investigation.

IF THE LOW LEVEL ALARM IS VALID, THEN:

3. SUMMARIZE ACCESS STATUS

Count the Controlled or Supervised Access Keys.
If appropriate assign one person to use the surveillance cameras to look for people still in the Collision Hall.

4. TAKE SHUTDOWN AND PROTECTIVE ACTIONS

Determine if recent changes in the gas system may be the cause of the alarm.

As appropriate for the situation, execute

- individual detector system power and gas shutdown
- full CDF flammable gas shutdown
- full CDF detector power shutdown
- Toroid power shutdown
- Solenoid power shutdown

Record Shutdown actions executed.

5. GO TO PROCEDURE G-7.

CDF FLAMMABLE GAS PROCEDURE G-4 COLLISION HALL HIGH LEVEL ALARM, >20% LEL

1. THE FOLLOWING AUTOMATIC ACTIONS OCCUR:

- (1) The Collision Hall evacuate alarm whooper is sounded.
- (2) An emergency message is issued on FIRUS.
- (3) The flammable gas supply to the building is shut off.
- (4) All High Voltage to the detector is shut off.
- (5) The 400 Hz MG#1 and #2 power is shut off.
- (6) The Toroid power is shut off.
- (7) All 60 Hz detector power is shut off.

IN ADDITION, DO THE FOLLOWING:

2. DIAL 3131 TO CONFIRM THE ALARM CONDITION AND TO REQUEST THAT THE FIRE DEPARTMENT RESPOND TO A "CDF FLAMMABLE GAS STANDBY".

Request that the "Fire Department Officer in charge report to the CDF Alarm Coordinator, GIVE YOUR NAME, in the CDF Control Room" (or in the CDF Cryo Area depending on your location).

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

An alarm is valid if the latched sensor has a non-zero reading or if the latched sensor had previously indicated a low-level 7% LEL alarm.

(note exception: non-zero of about 18% is normal for the inerting jug sensors)

Report to the CDF Alarm Coordinator if the alarm is valid.

From the Control Room, use the surveillance cameras and any specific area information from the CH(x) PPM fire sensor panel to aid the investigation.

4. HAVE THE GAS TECH INVESTIGATE THE INERTING NITROGEN FLOW ON THE 730' GAS PLATFORM.

An alarm is valid if the CTC flow is less than 1200 SCFH
or if the CDT flow is less than 250 SCFH.

IF THE ALARM IS VALID, THEN:

5. CONFIRM SHUTDOWNS LISTED IN STEP 1 ABOVE AND CLOSE THE MANUAL GAS SUPPLY VALVE.

6. SUMMARIZE ACCESS STATUS

Count the Controlled or Supervised Access Keys.

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

If appropriate assign one person to use the surveillance cameras to look for people still in the Collision Hall.

7. TAKE ADDITIONAL SHUTDOWN AND PROTECTIVE ACTIONS

Determine if recent changes in the gas system may be the cause of the alarm.

As appropriate for the situation, execute

- Solenoid power shutdown

Record Shutdown actions confirmed and executed.

8. GO TO PROCEDURE G-7

CDF FLAMMABLE GAS PROCEDURE G-5 GAS SHED LOW LEVEL ALARM, >7%LEL

1. HAVE QUALIFIED PERSONNEL INVESTIGATE THE ALARM FROM RACK #1 IN THE CRYO AREA

An alarm is valid if the sensor has a stable reading near or above 7 % LEL.
Report to the CDF Alarm Coordinator if the alarm is valid.

IF THE LOW LEVEL ALARM IS VALID, THEN:

2. TAKE SHUTDOWN AND PROTECTIVE ACTIONS

Determine if recent changes in the gas system may be the cause of the alarm.

As appropriate for the situation, execute:

- gas system compressor shutdown

Record Shutdown actions executed.

3. GO TO PROCEDURE G-7

CDF FLAMMABLE GAS PROCEDURE G-6 GAS SHED HIGH LEVEL ALARM, >20%LEL

1. THE FOLLOWING AUTOMATIC ACTIONS OCCUR:

- (1) The flammable gas supply to the building is shut off.
- (2) An emergency message is issued on FIRUS.

IN ADDITION, DO THE FOLLOWING:

**2. DIAL 3131 TO CONFIRM THE ALARM CONDITION AND TO
REQUEST THAT THE FIRE DEPARTMENT RESPOND TO A
"CDF FLAMMABLE GAS STANDBY".**

Request that the "Fire Department Officer in charge report to the CDF Alarm Coordinator, GIVE YOUR NAME, in the CDF Control Room" (or in the CDF Cryo Area depending on your location).

**3. HAVE QUALIFIED PERSONNEL INVESTIGATE THE ALARM
FROM RACK #1 IN THE CRYO AREA**

An alarm is valid if the latched sensor has a non-zero reading or if the latched sensor had previously indicated a low-level 7% LEL alarm.

Report to the CDF Alarm Coordinator if the alarm is valid.

IF THE ALARM IS VALID, THEN:

**4. CONFIRM SHUTDOWNS LISTED IN STEP 1 ABOVE
AND CLOSE THE MANUAL GAS SUPPLY VALVE.**

5 TAKE ADDITIONAL SHUTDOWN AND PROTECTIVE ACTIONS

Determine if recent changes in the gas system may be the cause of the alarm.

As appropriate for the situation, execute:
- gas system compressor shutdown

Record Shutdowns confirmed and executed.

6. GO TO PROCEDURE G-7

CDF FLAMMABLE GAS PROCEDURE G-7 INVESTIGATION AND REPAIR RESPONSE TO A VALID ALARM

To reach this part of the procedure you must have a "valid" alarm confirmed by a stable sensor reading in Rack #1 in the Cryo Area or by an off-normal inerting Nitrogen purge flow observed on the 730' Gas Platform.

1. **BE READY TO BACKTRACK TO AN EARLIER PROCEDURE IF THE ALARM STATUS CHANGES FROM 7% LEL TO 20% LEL.**

NOW DO THE FOLLOWING:

2. **IF THE ALARM IS NOT IN THE COLLISION HALL ZONE, PROCEED TO STEP 3.**

Dial 3721 and advise the Accelerator Main Control Room of the Collision Hall alarm condition and that an access may be required.

- IF THE COLLISION HALL IS ALREADY OPEN AND IN "ACCESS PERMITTED" STATUS, PROCEED TO STEP 3.**

Contact the CDF Operations Manager for CDF authorization to access the Collision Hall and investigate the leak.

3. **THE CDF ALARM COORDINATOR AND THE CDF GAS TECH REVIEW THE STATUS OF DETECTOR POWER AND GAS SUPPLY AS RECORDED IN THE PRECEDING INVESTIGATIONS**

4. **INVESTIGATE THE ALARM IN MORE DETAIL WITHOUT EXPOSING PERSONNEL TO HAZARDS**

WARNING: Investigating Personnel must all wear Dual Function Gas Monitors and leave the area if the monitor alarms.

WARNING: The two man rule is in force.

There are two possible investigation paths:

(a) Using a TIF-8800 (red) flammable gas detector, the CDF Gas Tech plus one or more qualified personnel shall proceed to zone indicated to determine leak validity and severity.

(b) The CDF Gas Tech & Cryo Operator investigate the Nitrogen purge system.

Report to the CDF Alarm Coordinator if a leak is confirmed by the TIF-8800 flammable gas detector or if Nitrogen purge problems are observed.

5. **REPAIR**

The CDF Gas Tech may repair the problem following the repair procedures in CDF PROCEDURE - 301 **only as long as all personal Dual Function Gas monitors signal no alarm.**

6. NOTIFY PERSONNEL ON THE CDF NOTIFICATION CALL LIST

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.

There is no prerequisite training for this procedure.

Authorized training personnel are listed below:

Don Mizicko, ID# 704
John Pawlak, ID# 9381

Both are qualified by experience in the design / implementation of the CDF Gas 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 local gas alarm
2. CDF Control Room display used to determine the zone in alarm.
3. Relay Rack #1 in the Cryogenic control area, with a discussion of the specific sensors which can trip.
4. Discussion of the term "LEL"
5. Hands on instruction using a hand held flammable gas detector, including instructions on where to find the monitor.
6. the point where the alarm coordinator can execute individual detector system power and gas shutdowns.
7. The point where the full CDF flammable gas shutdown can be done
8. The point where the full CDF detector power shutdown can be done
9. The point where the Solenoid power shutdown can be done.
10. The point where the CDF Notification Call List can be found.
11. The point where the automatic flammable gas supply shutdown is done.
12. The FIRUS panel.
13. The point where the automatic high voltage shutdown is done
14. The point where the automatic 400 Hz MG #1 and #2 power shutdown is done.
15. The point where the automatic 60 Hz detector power shutdown is done.
16. Discussion of where the Controlled Access Keys and Supervised Access Keys reside.
17. The surveillance cameras in the CDF Control Room.
18. The CH(x) PPM fire sensor panel in the CDF Control Room.
19. The point where the gas system compressor shutdown can be done.

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.

None.