

CDF Procedure for Hazardous Atmosphere Alarm System Maintenance

This procedure outlines the steps needed to maintain and operate the CDF Hazardous Atmosphere alarm systems. The original document was written in 1993. The flammable gas portions are substantially revised in the March, 2000 edition.

Editorial Hand-Processed Changes Other than Spelling
Require Co-Project Manager Approval

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HPC Number	Date	Section Number	Initials
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Approvals:

(CDF Department Head)

(Date)

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1.0 Controlled Copies of this procedure

There is one controlled copy of this procedure.

It is in the CDF Department Office

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

2.0 The Procedure

This procedure covers regular maintenance of the ODH or Flammable Gas Alarm sub-systems. Any work done on this system must be logged into the CDF electronic log.

Caution: If any problems arise which are questionable, or not covered by this procedure, STOP and call the safety system expert. A call list is included in section 4.0.

2.1 ODH Sub-system

2.1.1 Oxygen Sensor Replacement

A checklist exists for this procedure. It is a list of all the sensor locations. Use this checklist when performing the yearly maintenance. See section 3.1.

This procedure requires two people.

NOTE: Routine replacement of oxygen sensors should only be replaced when open access or supervised access exists in the area of the sensors to be replaced.

1. Obtain authorization from the CDF Operations Manager. Explain where all of the locations are that require sensor replacement.
2. Notify the RD/OD Operator of the sensor replacement.
3. Obtain the *CDF Hazardous Atmosphere Alarm System silence/bypass* keys with the bypass connector from the RD/OD operator.
4. Obtain the replacement oxygen sensor(s).

NOTE: Use only one key for this procedure. When repeating step 5, it is OK to remove the bypass key from one monitor to use it for another. A trouble does not cause any actions or evacuate alarms to occur. The Sonalert on the alarm/summary electronics may need to be silenced.

5. Insert the bypass key into the *maintenance bypass* key-switch of the oxygen monitor which pertains to the oxygen sensor that needs replaced.
6. Turn the key and verify that the monitor is in bypass mode by observing the indicator on the front panel.
7. Unplug the sensor to be replaced on the rear panel, and replace it with a bypass connector.
8. Return the monitor to normal operation.

WARNING: You must have received authorization from the CDF Scientific Coordinator or the CDF flammable gas engineer if using a 120 VAC solder iron in any of the locations of oxygen sensors while flammable gas is flowing. A solder iron is considered an ignition source.

9. Remove the old oxygen sensor with a solder iron (a battery powered solder iron is preferred, since no authorization is needed to use it).
10. Record the location and sensor serial number of the old sensor on the checklist.
11. Replace old sensor with new one, and record the location and serial number on the checklist.
12. Put the oxygen monitor back into bypass and replace the bypass connector with the normal oxygen sensor plug.

NOTE: New sensors may drop below the normal level and even drop so far as to cause an alarm. If the new sensor is reading well below the normal level (green bars of the channel's LED display) then an adjustment to the pot on the back panel is needed to bring the reading back in the normal range.

13. Verify that the new sensor is operational by observing the front panel reading. The reading should start at full scale showing an oxygen sensor trouble. If the display of the replaced sensor is off, check that both sides of the cable are plugged in.
14. Repeat steps 5 through 11 until all oxygen sensors that need replaced are replaced.
15. Return the oxygen monitor back to normal.
16. Clear any trouble alarms on the front panels of the oxygen monitors by pushing the *DISPLAY RESET* button.
17. Verify that all replaced oxygen sensor(s) read in the normal green area of the LED bar graph. It takes about fifteen minutes from the time the sensor was replaced for the reading to drop to that level.
18. At least fifteen minutes after the last oxygen sensor is replaced, calibrate the sensor(s). See section 2.1.2 (next section) for the procedure on how to calibrate oxygen sensors.
19. Return the keys and the bypass connector to the RD/OD Operator.
20. Notify the CDF Scientific Coordinator that you are finished replacing oxygen sensors.
21. Log the new sensor(s) in the maintenance database and put a copy of the data in the *CDF Hazardous Atmosphere Alarm System Log* book.

2.1.2 ODH Sensor Calibration

Following this procedure will not cause any alarms.

1. Connect a digital voltmeter to the channel's *O₂ LEVEL* connector on the back of the monitor.
2. Adjust the gain control for a reading of +2.08 volts ± 0.01 volt.
3. Repeat steps 1 through 2 for the other channel(s) that need it.
4. Verify that all graph displays are in the green region.
5. If referral to this section was made by section 2.1.1 step 18, then return now to step 19 of section 2.1.1.

6. Log the calibration in the maintenance database and put a print out of the data in the *CDF Hazardous Atmosphere Alarm System Log* book.

2.1.3 Alarm Set-point and Level Display Verification

Following this procedure will not cause any alarms.

This section covers the verification procedure of the ODH monitor level display, and the upper and lower alarm trip settings.

A checklist exists for this section. See section 3.2.

WARNING: When people exist in the area that is being bypassed, another person must watch the ODH display and remove the bypass if an alarm condition appears.

1. Notify the RD/OD operator of the test.
2. Obtain the bypass keys for the Hazardous Atmosphere Alarm System from RD/OD.
3. Bypass the monitor to be tested.
4. Connect the ALTEK loop calibrator to the input of channel one using the special connector labeled *ODH Test Connector*. Connect positive to the red wire and negative to the black wire. Switch the ALTEK to SOURCE and mA.
5. Connect a digital voltmeter to the O₂ LEVEL connector on the back for channel one. Set the current source to obtain a reading of 2.08 volts on the meter.

NOTE: No alarms or trouble indications should be active other than the ALARMS BYPASSED OR DISCONNECTED indicator.

6. The level indication for the channel being tested should be either or both of the green bars at the center of the display.
7. Slowly lower the current and watch the meter reading.
8. Verify that the tested channel's ALARM light comes on before reaching a value of 1.80 volts on the meter. Check off on the checklist for this channel.
9. Verify that the bar display for the channel being tested has the lowest red bar lit at 1.80 volts. Check off on the checklist for this channel.
10. Slowly raise the current.
11. Verify that the tested channel's ALARM resets at about 1.90 volts. Check off on the checklist for this channel.
12. Continue to raise the current.
13. Verify that the O₂ OVER 23% trouble indication comes on before reaching 2.30 volts. Check off on the checklist for this channel.
14. Verify that the bar display has the highest red bar lit at 2.30 volts. Check off on the checklist for this channel.
15. Lower the current and verify that the O₂ OVER 23% trouble indication clears below about 2.2 volts. Check off on the checklist for this channel.

16. Bypass the channel being tested with a bypass connector and repeat the tests starting at step five for the rest of the channels. Once a box is completed, replace the bypass connectors with the normal sensor plugs. Then un-bypass the box.
17. Repeat step 3 through 16 until all channels are tested.
18. Log all results in the *CDF Hazardous Atmosphere Alarm System Log* book.

2.1.4 Trouble Status Verification

Following this procedure will not cause any serious alarms.

This section covers the verification procedure for the trouble indications of the ODH monitor.

A checklist exists for this procedure. See section 3.3.

1. Notify the RD/OD operator of the test.
2. Obtain the bypass keys for the Hazardous Atmosphere Alarm System.
3. Bypass the monitor to be tested.
4. Verify that the ALARMS BYPASSED OR DISCONNECTED status light comes on. Check off on the checklist for this box.
5. Verify that the trouble light on the CDF Control Room status sign is flashing, and that the front panel of the *Hazardous Atmosphere Main Control Chassis* indicates the trouble. Check off on the checklist for this box.
6. Remove the bypass key, and reset the display.
7. Verify that no trouble lights are on.
8. Bypass the monitor being tested.
9. Remove channel one's sensor plug. Connect the ALTEK loop calibrator to the input of channel one using the special connector labeled *ODH Test Connector*. Connect positive to the red wire and negative to the black wire. Switch the ALTEK to SOURCE and mA.
10. Adjust the source upward until the bar graph for that channel reads in the green region.
11. Remove the bypass key, and reset the display.
12. Adjust the ALTEK until the O₂ OVER 23% indication comes on.
13. Verify that the trouble light on the CDF Control Room status sign is flashing, and that the front panel of the *Hazardous Atmosphere Main Control Chassis* indicates the trouble. Check off on the checklist for this box.
14. Bypass the monitor.
15. Replace the ODH sensor for channel one.
16. Wait for reading to stabilize (about 15 minutes).
17. Remove bypass key, and reset display.
18. Verify that no trouble lights are on.
19. Log all results in the *CDF Hazardous Atmosphere Alarm System Log* book.

2.1.5 Jumper Out an ODH Sensor Head

This procedure is only carried out when the CDF Operations Manager deems it necessary to jumper an ODH sensor head out of service.

1. Obtain the Hazardous Atmosphere Alarm System bypass keys from the RD/OD operator.
2. Bypass the monitor corresponding to the sensor to be jumpered.
3. Unplug the sensor to be jumpered.
4. Replace the sensor plug with a jumper plug from the bypass key ring.
5. Press the front panel *Display Reset* push button, and verify that no alarms exist in that box.
6. Un-bypass the monitor box and return the keys to the RD/OD operator.
7. If necessary, inform the CDF Operations Manager that the sensor head is now bypassed.
8. Inform the RD/OD operator that the head is now bypassed.
9. Log the bypassed sensor in the *CDF Hazardous Atmosphere Alarm System Log* book.

2.2. Flammable Gas Sub-system, Astro Sensors

2.2.1 Sensor Calibration

Calibration should be performed quarterly. This procedure may be done without bypassing the alarm system. Calibrate mode bypasses the sensor locally and a trouble indication will be received by the Interlock System. A checklist exists to track calibration dates. See CDF procedure 13.

1. Obtain authorization from the CDF Flammable Gas Engineer and the CDF Operations Manager.
2. Obtain the appropriate gas bottle. It should contain a 50% LEL concentration of ethane in air, or 1.5% ethane. A blue case labeled ASTRO contains the bottle.
3. Locate the sensor to calibrate. Use a hand held flammable gas monitor to make sure the area is at zero LEL.
4. Remove the cover of the junction box connected to the sensor.
NOTE: A sensor trouble alarm will occur during the calibration.
WARNING: Be careful not to jar the board internal to the junction box. Doing so may cause a high level ethane alarm.
5. Set the calibration/run switch to CALIBRATE.
6. Connect a voltmeter to the plus (+) and minus (-) of the calibrator board.
7. Verify that the voltmeter reads approximately 40 mV. If not, adjust the ZERO pot. If 40 mV cannot be reached, then calibrate the IR sensor head following the procedure in section 2.2.7.
8. Connect the tube of the calibration gas bottle to the sensor head.
9. Place the cover (should be in the calibration gas kit) over the sensor head.
10. Turn on the calibration gas.

11. Verify that the voltmeter reads 120 mV. If not, adjust the SPAN pot.
12. Disconnect the calibration gas, and remove the cover.
13. Ensure that the gas has been removed from the cell. If necessary, purge with air or nitrogen.
14. Allow the reading on the voltmeter to return to 40 mV. Repeat calibration if it doesn't return within +/- 1mV.
15. Switch the Calibration/Run switch to RUN.
16. Replace the cover(s) on the sensor head.
17. Log the, calibration date and your initials.
18. Enter the results in the CDF electronic log.

2.2.2 Sensor Replacement

This procedure is not a regular maintenance item. However, if a sensor head is malfunctioning, and attempts to fix it in place were unsuccessful, this covers the replacement of a sensor head.

To get to this step authorization must have been obtained from the CDF Flammable Gas Engineer or the CDF Operations Manager.

1. Bypass the alarms with either the storage shed or hall bypass switch.
2. Pull the fuse in the system junction box which pertains to the head being replaced (apparent in system documentation)
2. Remove cover to the electronics of the sensor head (this is the smaller of the two covers).
3. Pull the top electronics board out of its socket connector (center post is used to grasp the board).
4. Disconnect the gray cable from the sensor head (make note of wire colors).
5. Connect cable to new head.
6. Replace the electronics board, and place it in CALIBRATION mode via the toggle switch on the board.
7. Replace the fuse in the system junction box.
8. Verify power to the head by observing the red fault light. It will be on.
8. Calibrate the head, if necessary using section 2.2.2.1.
9. Notify the CDF Operations Manager, is necessary, that the head is replaced
- 10.

2.2.3 Calibrating the IR Detector of the Sensor Head.

This procedure is carried out only by referral from section 2.2.2.1.

1. Loosen the allen screw on the cover of the large enclosure (IR Detector), and remove the cover.
2. Connect the red lead of other meter to TP5 test point (AGC), and connect the black lead to TP1 test point (Common).

3. Record the value of the reading on the meter.
4. Adjust the AGC pot until the reading is 2.000 volts ± 0.1 volt.
5. Move the red lead of the meter to TP4 test point (0-5v).
6. Record the value of the reading on the meter.
7. Adjust the ZERO pot of the IR Detector until the reading is around 30 mV. The reading will usually fluctuate, so just average it out.
8. Adjust the ZERO pot of the small enclosure (calibrator board) until that meter reads 40 mV.
9. Connect the tube of the calibration gas bottle to the sensor head.
10. Place the cover (should be in the calibration gas kit) over the sensor head.
11. Turn on the calibration gas.
12. When the readings on the meters stabilize, record the reading of the meter connected to TP4.
13. Adjust the SPAN pot of the IR Detector until the reading of TP4 is 3.500 volts.
14. Adjust the SPAN pot of the calibrator board until the reading is 120 mV.
15. Return to step 13 of section 2.2.2.1.

2.3 Flammable Gas Sub-system, Dettronics Sensors

1. Reserved for later use.

2.4 Alarms and Actions

This procedure shall be carried out on an annual basis.

Note: This procedure will actually cause the alarms and actions as described in the system documentation. Therefore careful consideration must be made regarding when it is carried out.

Caution: To ensure coordination with other activities you must get authorization from the CDF Operations Manager and the CDF Flammable Gas Engineer before carrying out any part of this procedure.

2.4.1 Assembly Hall Ventilation Purge

The purge can be tested without causing evacuate alarms however the temperature and humidity control of the assembly hall will be disrupted.

1. Notify the CDF Scientific Coordinator that purging will be activated.
2. Follow the checklist in section 3.6.
3. Enter results in the CDF electronic log.

2.4.2 Collision Hall Ventilation Purge

The purge can be tested without causing evacuate alarms however the temperature, humidity and pressure control of the collision hall will be disrupted.

1. Notify the CDF Scientific Coordinator that purging will be activated.
2. Follow the checklist in section 3.7.
3. Enter results in the CDF electronic log.

2.4.3 Electric Power Shutoff to Central Detector

The power shutoff can be tested without causing evacuate alarms but power to the central detector will be turned off.

1. Notify the CDF Scientific Coordinator or Operations Manager of the test.
CAUTION: The following step will shutdown detector power as described in the system documentation. If this cannot be done, then wait for an appropriate time.
3. On the FIX display for Gas alarm testing, press the button for Electric Power Shutoff. The output is pulsed and does not require reset.
4. Follow the checklist in CDF Procedure 13.
3. Enter the results in the CDF electronic log.

2.4.4 Gas Shutoff Valves

This procedure tests both the Assembly hall supply valves and the Storage Shed supply valve. The valves can be tested without disrupting operations if the not closed over three minutes.

1. Notify the CDF Scientific Coordinator of the test.
2. Obtain authorization from the CDF Flammable Gas Engineer.
3. Follow the checklist in section 3.9
4. Enter the results in the CDF electronic log.

2.4.5 Evacuate Alarm Test

This test will sound evacuation alarms in the assembly and collision halls. A checklist exists for this procedure..

1. Notify the CDF Scientific Coordinator of the test.
2. Announce to the building that alarms will be tested.
3. Inform the Lab dispatcher at X3414 that the alarms will be tested.
4. Follow the checklist in section 3.5.
5. Log the results in the CDF electronic logbook.

2.5 UPS Maintenance

Perform battery maintenance every eighteen months per ES&H chapter 5047.

3.0 Checklists

Blank checklists can be found later in this document.

3.1 Oxygen Sensor Replacement Checklist

Use this checklist to complete 2.1.1.

This checklist is a catalog of ODH sensor heads in the experiment. When all sensor heads are being replaced, this checklist is used to ensure that all sensors are replaced.

3.2 ODH Alarm Set-point and Level Display Checklist

Use this checklist to complete 2.1.3.

This checklist includes areas to check off which correspond to actual steps in the procedure. These steps reference this checklist to check off on.

3.3 ODH Trouble Status Checklist

Use this checklist to complete 2.1.4.

This checklist includes both trouble indications used at CDF to test for each monitor box.

3.4 Evacuate Alarm Test Checklist

Assembly Hall

- _____ Gas Platform horn
- _____ Gas Platform strobe
- _____ Cable Carrier horn
- _____ Cable Carrier strobe

Collision Hall

- _____ West Wall horn
- _____ West wall strobe
- _____ South center wall strobe
- _____ Southwest ceiling horn
- _____ East wall horn
- _____ East wall strobe
- _____ North wall East side strobe
- _____ Northeast ceiling horn

Completed by: _____

Date: _____

3.5 Assembly Hall Purge Checklist

- _____ Set AH-1 and AH-2 to "summer" mode via the Johnson Controls PC.
- _____ On the FIX display for Gas alarm testing, press the Assembly Hall purge test button
- _____ Verify that the pit purge fan starts.
- _____ Verify that all of the ceiling louvers open.
- _____ Verify that AH-1 changed from summer mode to winter mode.
- _____ Verify that AH-1 outside air louvers fully open.
- _____ Verify that AH-1 recirculating damper is fully closed and outside air damper is fully open.
- _____ Verify that AH-2 changed from summer mode to winter mode.
- _____ Verify that AH-2 outside air louvers fully open.
- _____ Verify that AH-2 recirculating damper is fully closed and outside air damper is fully open.
- _____ On the FIX display turn off the test purge..

Completed by: _____

Date: _____

3.6 Collision Hall Purge Test Checklist

- _____ On the FIX display for Gas alarm testing, press the Collision Hall purge test button.
- _____ Verify that PF1 and BF1 are running.
- _____ Verify that AC-2 and AC-3 outside air dampers are fully open.
- _____ Verify that PF-1 exhaust damper is fully open.
- _____ Verify that AC-2 and AC-3 return air dampers are fully closed.
- _____ On the FIX display turn off the test purge.

Completed by: _____

Date: _____

3.7 Gas Valve Shutoff Test

- _____ Verify that the storage shed supply valve is open.
- _____ On the FIX display for gas alarm testing, press the button to test the Storage Shed Supply valves.
- _____ Verify that the valve closed as expected.
- _____ On the FIX display press the button to end the test.
- _____ Verify that both assembly hall supply valves are open.
- _____ On the FIX display press the button to test the A.H. supply valves.
- _____ Verify that both valves closed as expected.
- _____ On the FIX display press the button to end the test.

Completed by: _____

Date: _____

4.0 Deviations from the Procedure

If there are any failures in completing this procedure, contact the safety system expert to determine if the failure(s) can be readily fixed. If the failure(s) cannot be readily fixed, the safety system expert must contact the CDF Operations Manager to determine the appropriate action to take.

CALL LIST FOR THIS PROCEDURE:

<u>NAME</u>	<u>PHONE</u>
Richard Schmitt.	4849
Del Allspach	3493

5.0 Required Training and Authorized Training Personnel

In order to execute this procedure in its entirety, personnel must have the safety training required for access into the CDF Collision Hall. Also, training is required on this system in order to do any work on it.

LIST OF AUTHORIZED INSTRUCTORS FOR THIS PROCEDURE:

NAME

Richard Schmitt

Del Allspach

Michael Starr

Bill Noe

6.0 Training Materials

Training materials include the reference materials in section 8.0.

7.0 List of Trained People for this procedure.

The list of trained people for this procedure will exist in written form in the CDF Department copy of this procedure. Only CDF technicians will be trained in the procedure.

Name	Date	Instructor Signature	Comments
Bruce Lambin			
Dean Beckner			
Bruce Vollmer			
Dave Haynie			
Cutchlow Cahill			
George Wyatt			

A list of trained personnel for this procedure is located at the end of this document. It will be kept up to date and maintained with each controlled copy of the procedure.

8.0 References and Supporting Documentation

Supporting documentation for this procedure include:

The CDF Hazardous Atmosphere Alarm System manual revised 6/94 (for ODH)

CDF Procedure 13, Sign-off Procedure Required before Flowing Flammable Gas to or Turning on High Voltage on the CDF Detector Subsystems.

CDF Engineering Note 139 'CDF Flammable Gas Safety Interlock System'

CDF Engineering Note 140 'CDF Flammable Gas Safety Interlock System Commissioning

ASTRO operating manual

CDF Flammable Gas Safety Interlock System Description

PPD Emergency Procedures ERP 3.1 through 3.4

APACS Hardware and Software Manuals

APACS Configuration documentation.