Operation of the COT Endplate Cooling System

This procedure outlines the steps needed to commission and operate the CDF COT Endplate Cooling system.

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

==========

HPC Number	Date	Section Number	Initials
1.	_____	_____	_____
2.	_____	_____	_____
3.	_____	_____	_____
4.	_____	_____	_____
5.	_____	_____	_____
6.	_____	_____	_____
7.	_____	_____	_____

==========

Approvals:

_____ _____
(CDF Department Head) (Date)

1.0 Controlled Copies of this procedure.

Only one controlled copy of this procedure will exist.

It will be held in the CDF Department Office.
The others will be on the CDF web page at
http://www-cdf.fnal.gov/cdfsafe/cdfproclist.html
and at ADMIN.CDF/ES&H/PROCEDURES

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

2.0 The Procedure.

2.1 Prerequisites

(a) Technicians following these procedures must have experience handling pressurized fluids and with vacuum equipment.
(b) Technicians following these procedures must be familiar with bubble leak testing procedures, pipe and tubing connections, cylinder handling, and the fluid properties before performing the mechanical tasks.
(c) Familiarization with FIX control operations is needed to perform the operational tasks.
(d) Operators and technicians should have a copy of P&ID 2563.457-ME-339147 sheet 3.
(e) Safety glasses should be worn when connecting or disconnecting tubing. Work gloves should be readily available when transferring refrigerant to and from cylinders in case leaks should occur and the tubing gets cold.

2.2 Pressure and leak testing.

(a) Newly fabricated portions of the system must be pneumatic tested per ES&H Chapter 5034 to 438 psig.
(b) A test is successful when no leaks are found with either bubble testing or static pressure drop for ten minutes.
(c) New mechanical connections must be bubble leak checked after pressurizing with refrigerant.

2.3 Filling the Storage Vessel

(a) **Caution:** Refrigerant is under pressure.
(b) Suva pumps P7 and P8 must be off.
(c) Evacuate storage vessel to below 100 microns with a roughing pump. Measure the vacuum either with the pump valved off or away from the pump.
(d) **Caution:** Remove all vacuum gauges from the piping before pressurization.
(e) Invert a Suva 9100 supply cylinder so liquid is transferred to storage. The cylinder holds 100 lb. of refrigerant so a proper stand is needed.
(f) Chilled water supply valve MV-1001 and return valve MV-1002 must be open.
(g) Connect a stainless or copper tube or flex line to the fill port near the west pit railing. Flex line rating must be at least 350 psig.
(h) Put the storage pressure control in manual and fully open chilled water control valve COT_PCV_STOR. Chilled water flow should exceed 1.5 GPM.
(i) Open the cylinder valve and fill valve MV-1027 and completely empty the supply cylinder.
(j) Close the cylinder valve and fill valve MV-1027 before disconnecting hose.
(k) Initially add nine cylinders of refrigerant.

(l) When filling is complete close the chilled water supply valve MV-1001 or COT_PCV_STOR.

2.4 Emptying the Storage Vessel

(a) Contact the I&I group leaders or deputies before performing this procedure.
(b) On the FIX display, put the temperature control loop in manual and close water valve COT_PCV_STOR.
(c) Obtain cylinders or vessels with a working pressure of at least 350 psig. The total system charge is about 1100 lbs which has a liquid volume of about 17 cubic feet.
(d) Close the instrument valves around PDT-P7 and disconnect the instrument tubing. Connect cylinder to the drain connection under the storage tank with stainless or copper tubing or flex line. The flex line rating must be at least 350 psig.
(e) Open valves MV-1003, MV-1005 and the instrument valve.
(f) Do not fill cylinders over 95% using a scale or storage level.
(g) If there is difficulty transferring due to vapor displacement, cool the receiving cylinder with cool water.

2.5 Fill Entire Piping System from Storage

(a) Close valves MV-1003, MV-1024 and MV-1025.
(b) Open valves MV-1022, MV-1023, MV-1021, MV-1020, MV-1019, MV-1017, MV-1018, MV-1011, MV-1008 or MV-1009, MV-1003, MV-1004, MV-1005, MV-1006, MV-1007
(c) Evacuate the piping to below 100 microns with a roughing pump. Measure the vacuum either with the pump valved off or measured away from the pump.
(d) **Caution:** Remove all vacuum gauges from the piping before pressurization and disconnect the vacuum pump.
(e) Open block valves MV-1024 first to avoid spinning the pumps.
(f) Open block valve MV-1003.

2.6 Move Liquid from Piping System into Storage

(a) Stop the Suva circulation pumps P7 and P8 from the FIX display.
(b) Put the storage pressure control in manual and fully open chilled water valve COT_PCV_STOR. This will lower the pressure in the storage vessel.
(c) Open block valves to all parts of the system to be emptied. If the entire system is to be emptied open the valves in section 2.5(a).
(d) Open storage tank inlet valve MV-1024. Close storage tank outlet valve MV-1003.
(e) Depending on the specific conditions, the refrigerant may need to boil out of the piping, which could take hours. The piping will be dry when level in the storage tank stops rising and none of the piping is cold.
(f) Close the storage vessel inlet and outlet block valves, MV-1003, MV-1025 and MV-1024.
(g) Put chilled water control valve COT_PCV_STOR in automatic.

(h) **Caution:** At the end of this procedure the piping will be dry but it is still under pressure.

2.7 Moving the Central Detector

(a) Move the liquid refrigerant back to storage as described in section 2.6.
(b) Close the block valves isolating the assembly and collision hall piping, MV-1008, MV-1009, MV-1011, MV-1021, MV-1022, MV-1023.
(c) Close the storage vessel Suva inlet and outlet valves MV-1003, MV-1025 and MV-1024. There must be two valves closed between the storage tank and the notch area in both supply and return.
(d) **Caution:** There should be no liquid present but the notch piping is still under pressure.
(e) Connect a tube to the notch phase separator pumpout port to vent refrigerant out of the upper notch and slowly blow down the refrigerant vapor to atmospheric pressure with valve MV-1012.
(f) Disconnect the supply and return flex lines and cap all openings.
(g) In the collision hall disconnect the relief valve vent line.
(h) When the detector is in the new position reconnect flex lines. If the flex connection offset exceeds one inch, do not connect.
(i) In the collision hall connect the relief valve vent line.
(j) After connections are made, evacuate the notch phase separator and adjacent piping to below 100 microns.
(k) Open the relevant block valves and fill with refrigerant. See section 2.5(b) and (c).
(l) Bubble leak check all new connections and tighten if necessary.

2.8 Endplate Temperature Control Description

(a) The only operator action needed is to put the control loop in automatic on the FIX display. The rest of this section is a description only.
(b) Normal operation is cascade control. The primary loop controls the COT end plate temperature. The initial setting will be 69F. The primary loop determines the set point of the secondary loop, which controls pressure in the storage tank by regulating chilled water valve COT_PCV_STOR.
(c) When the pumps are off the storage tank will operate on pressure control alone with a higher set point. There should be little need for operator intervention.

2.9 Endplate Pressure Drop Control Description

(a) During normal operation all vapor and some liquid exit the top of the notch phase separator and return to the storage tank. The balance flows through the end plates. The ratio is adjusted by changing the differential pressure across the end plates. The setting will be adjusted experimentally after commissioning.

2.10 Pump Control

(a) **Caution:** Do not start circulation to the Endplates if storage vessel temperature is below 60F. If it is notify the system engineer.
(b) Normal operation is with one pump running and the other in standby.
(c) Both pump starters should normally be set to auto.
(d) A lead pump is selected from the control screen CDF/COT. This may be changed any time, whether running or not.
(e) **Caution:** Do not run the pumps unless there is a flow path for the fluid to return to the storage tank, either through the Endplates or through recycle valve MV-1025 in the west alcove
(f) Requesting the system to run will start the lead pump. If it should fail the backup pump will start.

2.11 If a leak occurs

(a) A leak may be indicated by a loss of level in the storage vessel or a cold spot in the piping.
(b) Close the nearest manual supply and return valves around the leak.
(c) Consider pulling the liquid refrigerant back to storage per section 2.6.
(d) If the location is uncertain shut down the pumps and close the main valves around the storage.

2.12 Refrigerant Properties

(a) The refrigerant is SUVA 9100, a.k.a. R-410A
(b) The chemical formula is CH_2F_2/CHF_2CF_3, 50/50 by weight.
(c) The molecular weight is 72.58.
(d) The normal boiling point is –60.8F.
(e) The saturation pressure at 69F is 198 psig.

3.0 Checklist

No additional "Procedure Execution Form" is required for this procedure. Any unusual events should be recorded in the CDF electronic logbook.

4.0 Deviations from the Procedure

All deviations from the above procedure must be approved by the ECW system manager, the ECW system engineer, the head of the I&I group or their deputies.

5.0 Required Training and Authorized Training Personnel

There is no prerequisite training for this procedure other than the prerequisites listed in section 2.1.

Authorized training personnel are listed below:

Bill Noe, ID# 2132
Mike Starr, ID# 6919
Rich Schmitt, ID# 6918

The tasks involving refrigerant transfers require the skills and knowledge listed in section 2.1. The normal operating tasks require less training and can be done by personnel familiar with Fix displays.

6.0 Training Materials

No written materials exist.

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	ECW Systems Engineer o Manager Signature	Comments
Bruce Lambin			
Dean Beckner			
Bruce Vollmer			
Dave Haynie			
Cutchlow Cahill			
Craig Olson			
John Voirin			
Steve Gordon			

8.0 References and Supporting Documentation.

(a) MSDS for Suva 9100
(b) Thermodynamic properties of Suva 9100 by Dupont
(c) Transport properties of Suva 9100 by Dupont