Cryogenic Operations of MicroBooNE

Microboone-doc-db-4319

2016

Geynisman - Zuckerbrot - Schwartz

While this activity is called "operations", de-facto it includes the following tasks, some of which are on 24/7 basis:

- Plan and conduct operations, i.e. commissioning, including cooldown and fill, **normal operations**, response to alarms, tuning for stability, monitoring contamination and purity and arranging for purchasing and filling of argon and nitrogen.
- Plan and coordinate for maintenance, repair and installation activities for existing cryogenic equipment and directing technicians in field.
- Coordinate activities of ND/LAr group with ND collaboration, non-Fermi experimenters, PPD technical support, FESS for operating issues.

There is a certain core knowledge required for these activities, including knowledge for systems and components, processes, controls, procedures, etc.

Primary Objective:

- Provide 24/7 support for operations of the MicroBooNE cryogenic systems to allow non-interrupted running of the scientific program.

Secondary Objectives:

- Provide expertise and resources for minor modifications and upgrades for the cryogenic system in order to satisfy safety requirements and to increase reliability.
- Provide expertise and resources for minor upgrades and improvements of the equipment per collaboration request.

Approach to Operations:

Maintain status quo for the systems (cold or warm configuration) with minimal effort for tuning or investigations unless for the following:

Initiation of Change in Operations (typically done by a cryo engineer):

New operations, or change in operations, are initiated based on the following:

- Request from collaboration, i.e. cooldown, warmup or change of cryostat parameters. Such request is typically directed from collaboration to the MicroBooNE Coordinator
- Need for preventive or corrective maintenance, typically based on safety, trending or reliability issues

Initiation of Investigations (typically done by a cryo engineer or ROC shifter):

Investigation of the status or performance of a cryogenic system or its components can be initiated based on the following:

- Deviation of the parameters from the baseline, typically due to alarm
- Deviation of performance from the baseline, typically as noted through datalogger or field inspections

- Equipment failure

Response to a power outage:

Scheduled power outages should be coordinated and recovered by LAr group engineers. The response to the unscheduled power outages should include notifications of the responsible personnel shown in the list below. There is no presently any mechanism for automatic notification for power outage, except alarming via cryo controls, and the facility may stay on emergency power generator without proper recovery and control until cryo, or other parameters will alarm. As a minimum, the Facility Manager, Run Coordinator and Cryo engineer should be notified.

During power outage, the ODH controls, ODH ventilation equipment, sump pump, cryo controls, contaminations monitors, and Win911 will stay on UPS power. The emergency generator will be started automatically to power selected equipment and UPSes. The network crate is on UPS now, so it will not be lost. Still, Cryo engineers will have an option to log in to local machines in the pit to control equipment if necessary. FIRUS exists in the building and alarms ODH to Fermi Com Center, but is not configured to alarm power outage. That can and should be fixed to allow alarming loss of power through FIRUS with the list of people to be notified. But FIRUS will be configured to alarm loss of cryo equipment (as explained in the next sections).

Response to ODH event:

ODH alarm will shut down a number of valves supplying cryogens to the pit: PV290, PV300, PV310, PV270, PV1058, Lar Pump1 and 2. Response to ODH should be done per procedure shown in Attachment 1. Additionally, while FESHM4240 does not require multiple personnel in communications for ODH1 areas, LArTF safety requires two-person rule to access ODH-1 areas. Loss of ODH fan EF-1 is alarmed via cryo controls notifying cryo personnel thus allowing to request maintenance within next 6-12 hours and devise the action plan for the building ODH under EF-1 off conditions.

Response to alarms:

Cryogenic alarms are configured in iFix and Win911 as 01 through 85, where even-numbered alarms are either equipment status alarms or low (LO) alarms, and odd-numbered alarms are high (HI) alarms. See Attachment 1 for list of critical and non-critical alarms and Fig.6 through 8 in this text for the list of alarms. Alarms can be either enabled or disabled by anybody who logs in to iFix.

There is division on critical versus non-critical alarms.

Alarm response:

- Schwartz, Zuckerbrot, Geynisman are the “operations team” (in the order of typical call sequence and response). The contacts are listed here: https://docs.google.com/spreadsheets/d/1Ma34SkbcIN4xaVYSqasFZ9OmXO8Bt1Qx9cfRDOq2SC4/edit?usp=sharing

- Cryo engineers responding to critical alarms must notify the MicroBooNE shifter 937-582-6663 within 15 min. If not notified, shifter is encouraged to contact cryo engineers.

- If any change of operations (for example maintenance) is requested, it will be cleared between a run coordinator or experimenters and cryo person listed first on the list. If no response within 1 hr, then the next person can/should be contacted.
- Emergency call (if necessary) should be directed to cryo person listed first on the list as well. If no response within 5 min, the next person can/should be contacted.
- Automated notification will be handled in the following way via texting to personal smart phones (Cryo pager will be retained for another year in case it's needed for commissioning of SBN):
    - For non-critical alarms -> Win911 will initiate a single text within 8:00 – 22:00 time window (if alarm occurs between 22:00 and 8:00, the text is delayed) to the first three people on the list.
    - For critical cryo alarms -> Win911 will immediately initiate a text (via email) for each alarming variable to the ALL people on the list. That is 24/7 coverage.
    - For critical cryo alarms, additionally, Sarychev will configure PLC to generate a single alarm bit. That bit will be connected via FIRUS to Com Center. Com Center will call cryo personnel on same list. Joe Flores will need to configure FIRUS.
    - As before, all cryo alarms are routinely emailed to uboonecryo@gmail.com

- Additionally, MicroBooNE may continue watching and alarming parameters that are not in the primary list of cryo alarms, but additional to the operations of the detector systems.
- Additionally, ND technicians will attempt to walk LarTF once a week. Technician must run the predefined plots on Proficy to observe trends.

Therefore, Michael Zuckerbrot, Fritz Schwartz and Michael Geynisman are presently the primary responders to MicroBooNE alarms. More pages, phone numbers or emails can be added to the notification list, though a user can either receive all alarms or none of them.

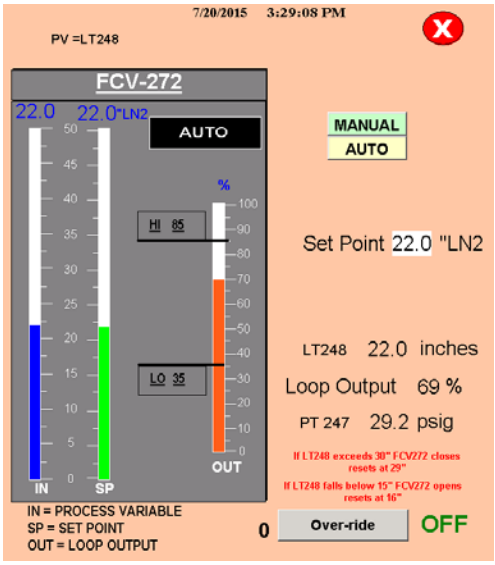
This document also serves as the training manual and guide for the cryogenic technician and ROC shifters.

• Section 1 below describes the "normal" operations and controls.
• Section 2 below describes alarms and response to alarms
• Attachment 1 shows present list of alarms configured for alarming via Win911
• Attachment 2 shows Pit Emergency Procedure
• Attachment 3 shows P&ID for the system showing "normal" flow path

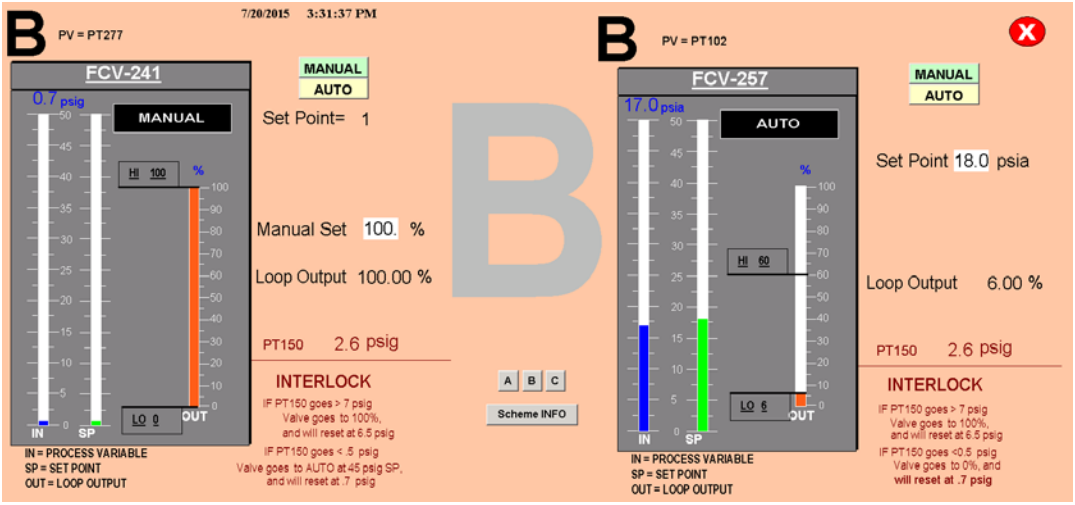
Section 1 "Normal" Operations

LN2 supply and controls:

1. LN2 is supplied from LN2 11,000 gal dewar #49 (typically at 30 psig as regulated with pressure building loop via vaporizer and blow-down pressure regulator). Call Air Products if alarm #34 alarms below 2,000 gal. Air Products # 800-224-2724 (option 9) and **customer # 689-976**.
2. LN2 is routed to the phase separator, where its level is controlled with FCV272. If the level goes up, the vent valve FCV272 closes, thus building the pressure in phase separator, thus decreasing the flow from the dewar (at constant pressure) to the phase separator.

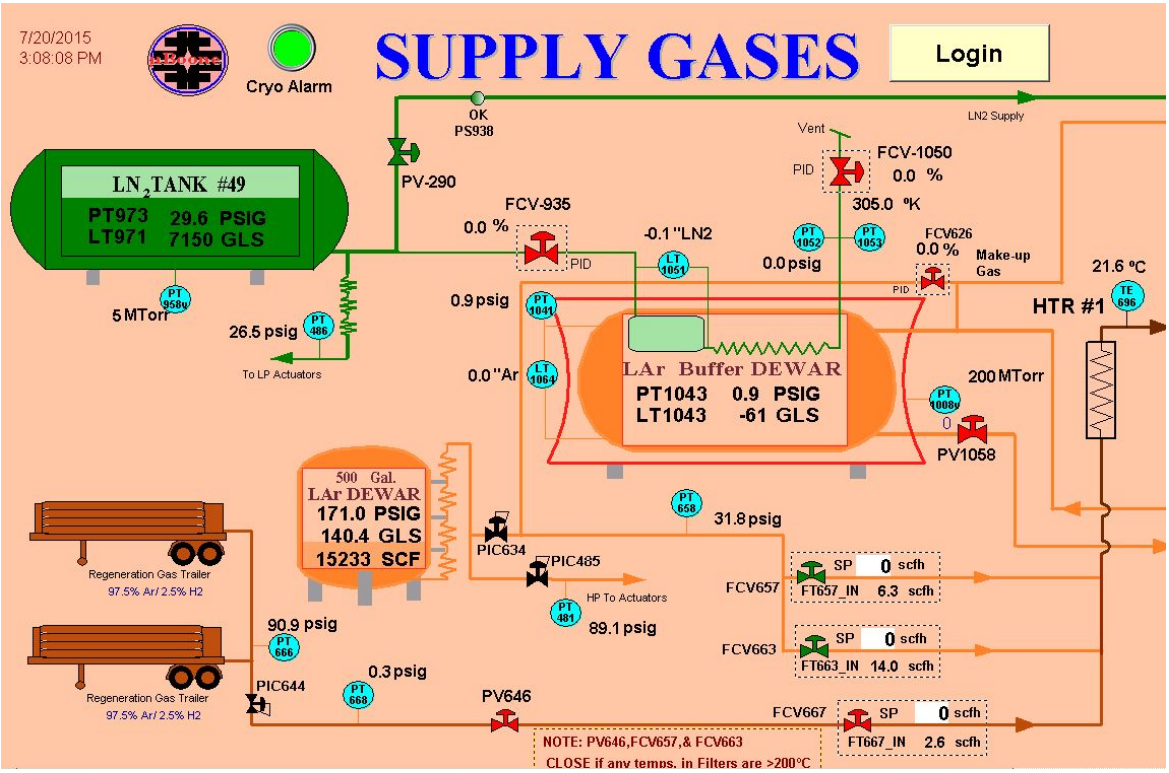


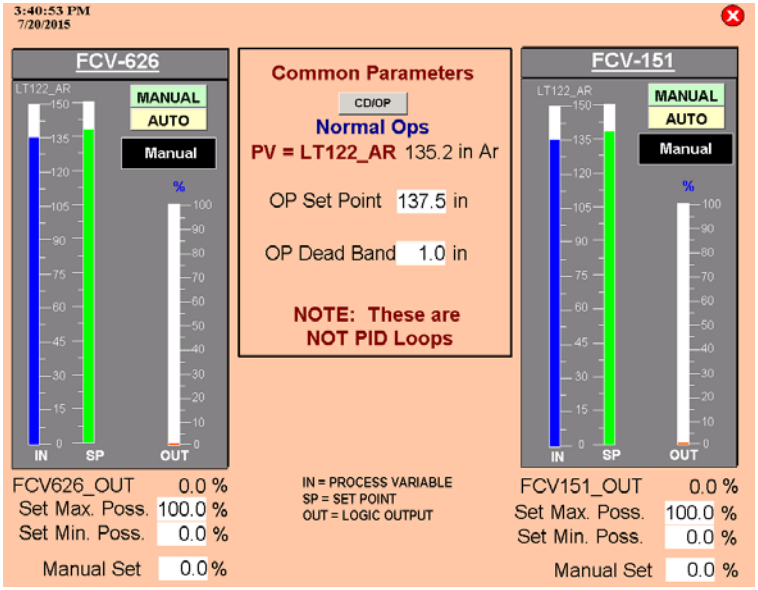
3. Then LN2 is routed to the condenser. The condenser has two control valves. Typically, we use scheme "B" where FCV241 (vent) is 100% open, and FCV257 controls the pressure in the cryostat (e.g. PT102=18 psia). If PT102 goes up, then the flow of LN2 through the condenser needs to be increased and FCV257 is opened. The interlocks associated with these two loops are shown on the valve templates (and described in interlocks section).



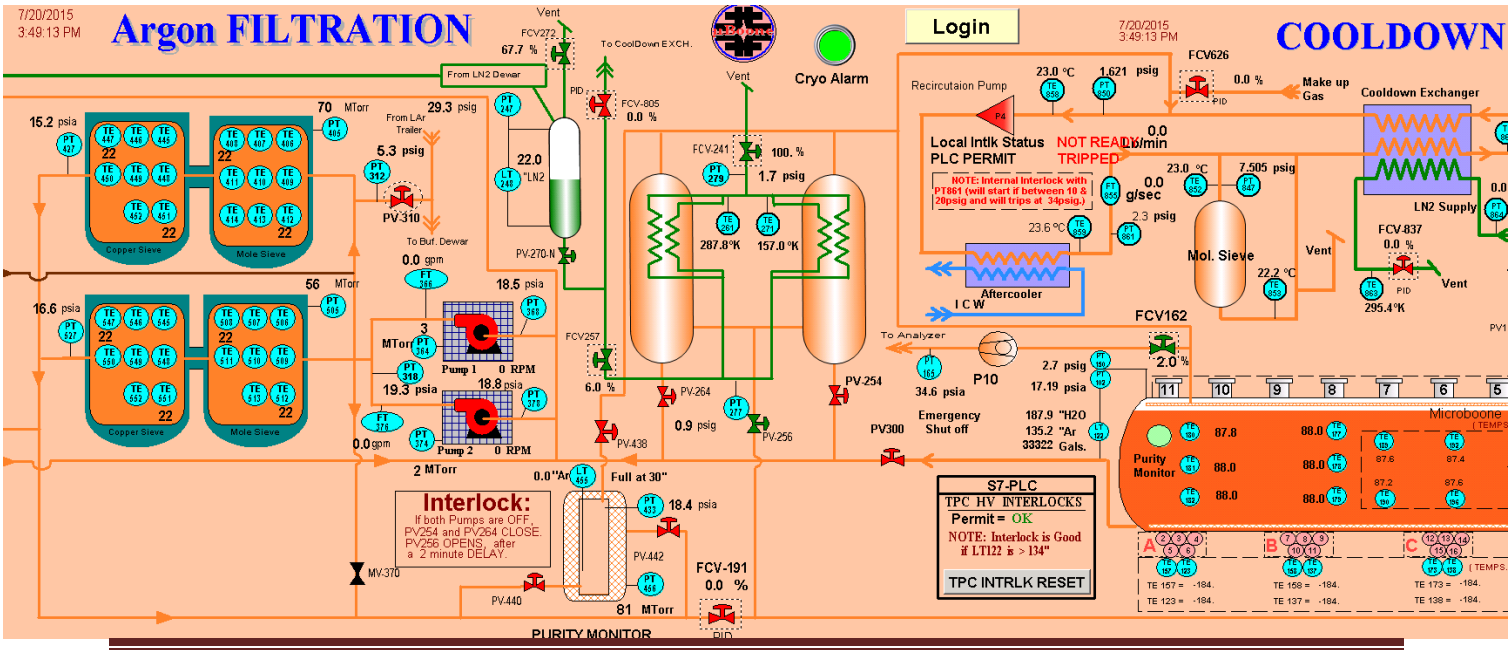
Argon supply and circulation:

4. **GAr** is supplied to a variety of loads. It is supplied to few pneumatic actuators, but most importantly, it is supplied to the cryostat via FCV626 for level control. If set in AUTO and level drops below [set point– dead band], then FCV626 opens to provide enough GAr to condense it and regain the level. Presently set point is 135.5” Ar. Argon is supplied from 500 gal dewar. Typically, Air Products will refill the dewar if the level drops below 30” Ar. Call Air Products if alarm #30 alarms below 100 gal. Air Products # 800-224-2724 (option 9) and **customer # 10714096.**

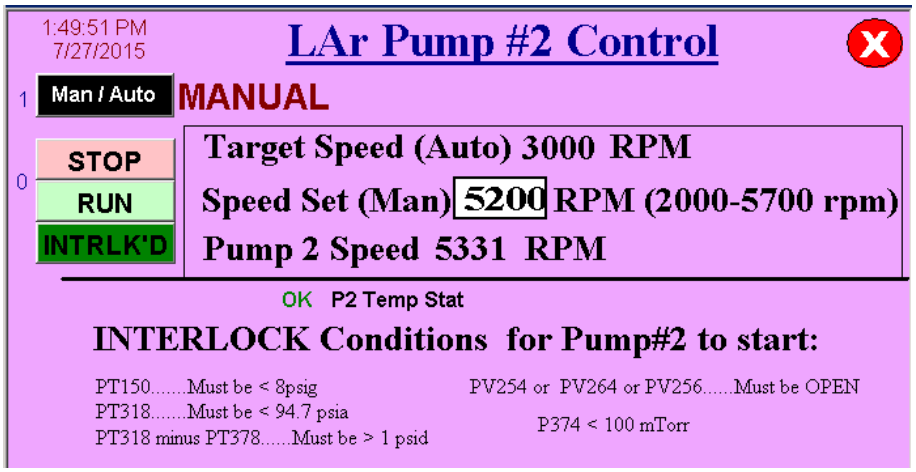


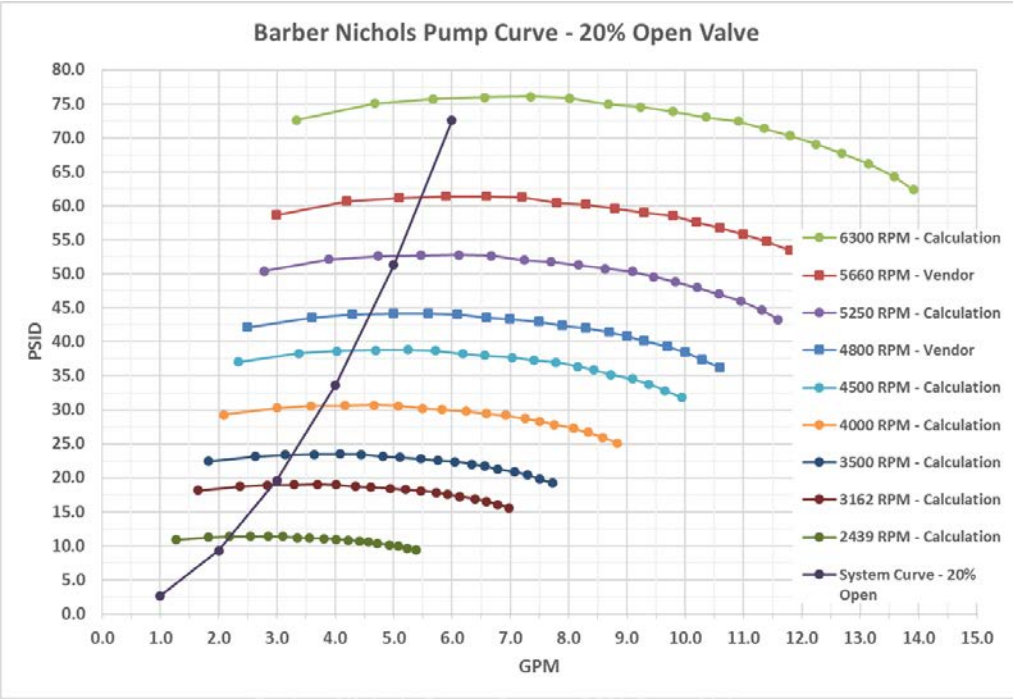


5. Gar+H2 are also supplied to the filters for regeneration, but this is not “normal operations”, and will be handled by cryo engineers.
6. Liquid argon “normal path” is a simple circulation path. Argon flows from the cryostat via PC300 to the pump(s), filtration skid(s), and back to the cryostat via FCV191. When in AUTO, FCV191 regulates PT318 at the pump(s) discharge. Currently, the stable configuration is with FCV191 at 7% in MANUAL.
7. Additional path is via the purity monitor with PV440 and PV442 opened, and PV438 is cycling to maintain liquid level in the purity monitor.



8. The pressure regulation PT102 in the cryostat is done by the LN2 heat-exchange in the condenser, as described earlier. Additionally, the on-off PV142 regulates PT1450 (typically set at 4 psig) and acts as a vent valve. It opens at set point and closes at 2 psig below the set point.
9. The level of the detector LT122 is maintained with the FCV626 as described earlier. Additionally FCV151 could be opened to vent argon if necessary (not envisioned to be exercised).
10. The liquid argon pump(s) are typically operated at constant speed 5200 rpm. See the curves for the pumps shown below for reference. It is very important for the pump to be stable as its bearings are cooled with liquid argon, and any loss of flow (due to cavitation) may result in failure of the pump.

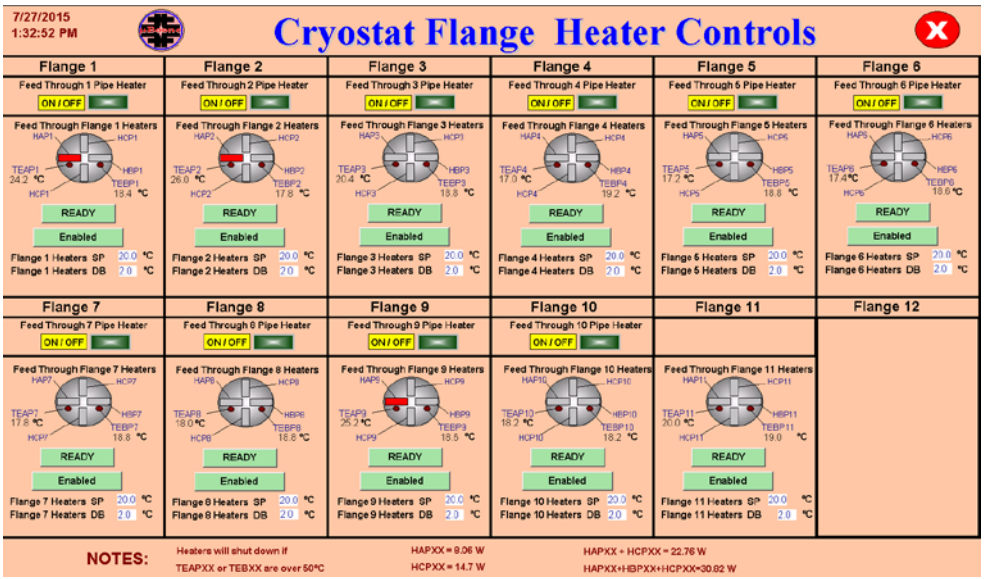


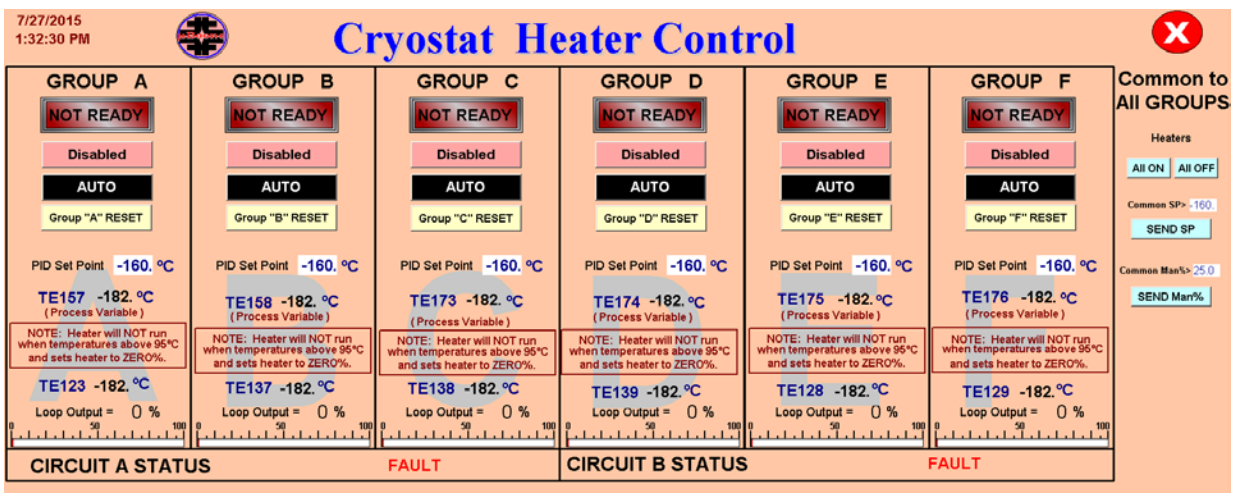


11. FCV162 serves to provide a flow path to the oil-free diaphragm pump in case the sampling to the

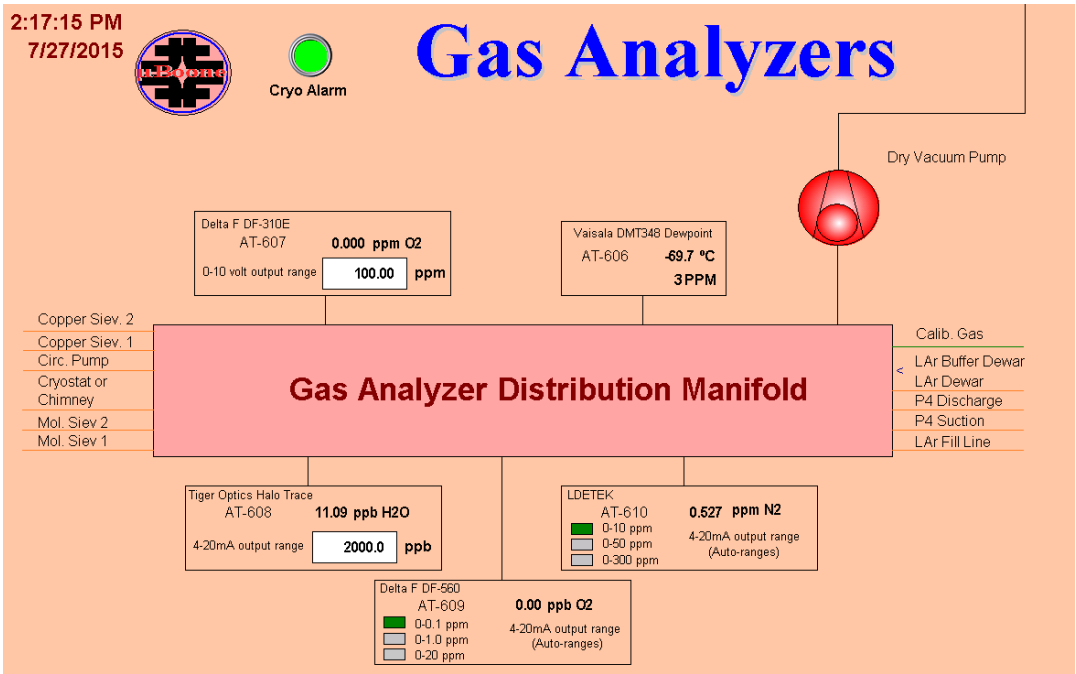
analyzers is done from the cryostat space instead of typically liquid argon pump discharge.

12. There are 11 heaters for the 11 chimney flanges. They are typically are ON to control the surface temperature of the flanges at 20C (since there may be a boil-off flow though the chimneys).
13. There are also the heaters on the bottom of the cryostat, but they are locked out and serve only for boiling argon away.





14. Analyzers used for normal gas sampling. The distribution panel is located in the pit. Typically, the cryo engineers will be handling the switching of the analyzers and calibration. The analyzers are:
    - Vaisala / AT-606 (rough H2O measurement), typically ~ (-)69C
    - Delta F DF-310E / AT-607 (rough O2 measurement), typically 0 ppm
    - Halo / AT-608 (low concentration H2O measurement), should be below 10 ppb
    - LDETEK / AT-610 (N2 measurement), should be below 1 ppm
    - Delta F DF-560 / AT-609 (low concentration O2 measurement), should be below 1 ppb



Below are the descriptions of the **permissives for different equipment**.

Liquid Argon Pumps Run Permit

- PT150 < 8 psig
- PT318-PT368/378 > 10 psid (15 second delay, 1 minute delay at start)
- PT318 < 94.7 psia
- FT366/376 > 1 gpm (15 second delay, 1 minute delay at start)
- PV300 or PV1058 open
- PV254 or PV264 or PV256 open (1 minute delay)
- 2000 – 5700 rpm speed input range
- PT364/374 < 100 mTorr (15 second delay)

Cryostat Heaters

- 6 groups of heaters with 5 100 Watt heaters each, 2 TEs for each group, 1 TE for each group hard wired interlock
- Heater group trips to 0% if hardwired interlock TE is > 95 C
- Individual set points for each group of heaters with the PV set to one of the two non-hardwired TEs

  - If heater group PV TE is > 210 F, heater group trips to 0%
  - Override condition: If heater group non-PV TE is > 210 F, heater group trips to 0%
- Common button to turn all groups on at once to same manual or automatic set point
- Manual reset required for any trip (PLC and/or hardwired)

Condenser Valves

- Valves PV254, PV264, PV256
- Interlock: if both pumps are off, after 2 minute delay, PV254 and PV264 close, and PV256 opens.
- Disabling this interlock puts all 3 valves in manual position, and they could be manipulated independently.

Regeneration System

- If TE699 > 700 F (hardware), HTR1 power turns off, manual reset required.
- If TE696 > 230 C (PLC), HTR1 goes to 0%, manual reset required.
- If any copper sieve TE is > 200 C
  - PV646 closes, manual reset required
  - HTR goes to 0%, automatic reset when TEs are back in range
  - FCV657 and FCV663 go to 0%, automatic reset when TEs are back in range
- If any molecular sieve TE is > 200 C
  - PV646 closes, manual reset required
  - HTR goes to 0%, manual reset required
  - FCV657 and FCV663 go to 0%, manual reset required

Inline Purity Monitor

- PV440: Manual open/close
- PV442: Manual open/close
- PV438: Manual open/close; Auto: PV = LT455 (initial SP = 32”)
  - Opens if LT455 < SP, closes if LT455 > (SP + 1”)
  - Override Condition: Opens if PT433 > Press. SP (initial SP value=85 psig), resets at (SP – 2 psi)

Nitrogen System

- Phase Separator
  - FCV272: PV = LT248 (initial value = 28” Argon)
    - Override condition: If PT247 > 45 psig, FCV272 goes to 100%, resets at

44 psig.

- Condensers Scheme A (not used)
  - FCV241: PV = PT102 (initial value = 18 psia)
    - Override condition: If PT150 > 7 psig, FCV241 goes to 100%, resets at 6.5 psig
    - Override condition: IF PT150 < 0.5 psig, FCV241 goes into auto mode and controls PT277 at 45 psig, resets at 0.7 psig
  - FCV257: PV = PT277
    - Override condition: If PT150 > 7 psig, FCV257 goes to 100%, resets at 6.5 psig
    - Override condition: If PT150 < 0.5 psig, FCV257 goes to 0%, resets at 0.7 psig
- <u>Condensers Scheme B (used)</u>
  - FCV241: PV = PT277
    - Override condition: If PT150 > 7 psig, FCV241 goes to 100%, resets at 6.5 psig
    - Override condition: If PT150 < 0.5 psig, FCV241 goes into auto mode and controls PT277 at 45 psig, resets at 0.7 psig
  - FCV257: PV = PT102 (initial SP = 18 psia)
    - Override condition: If PT150 < 0.5 psig, FCV257 goes to 0%, resets at 0.7 psig
    - Override condition: If PT150 > 7 psig, FCV257 goes to 100%, resets at
    - 6.5 psig
- Condenser Control Scheme C (Cascade Control Loop, not used)
  - The advantage is there is only one set point for tank pressure and upsets will be handled much better since there is no need to manually set FCV241
  - FCV257: Outer loop with SP of PT102
  - FCV241: Inner loop, valve position set by the output of FCV257

Cryostat Pressure and Level

- Same set point for FCV626 and FCV151 with minimum and maximum positions settable PV = LT122_AR (initial SP value = 135.5”)
  - Settable dead bands for both

- FCV626:
  - Opens to maximum percentage at [Set point – FCV626 dead band], closes to minimum percentage at set point
- FCV151:
  - Opens to maximum percentage at [Set point + FCV151 dead band], closes to minimum percentage at set point

- PV142: PV = PT150 (initial SP value = 4 psig)
  - Opens if PT150 = SP, (closes at SP – 2 psi)
- High Voltage Supply Permit
  - No permit if LT124 or LT125 < 2”
  - No Permit if PT150 > 10 psig
  - Manual reset required on LT124, auto reset on LT125 (S7 Safe) trip once back within range

Miscellaneous Valves and Instruments and Comments

- PV290 (LN2 Supply): PS938 (Hardware) shuts at 30 psig/40 psig for cooldown/normal operations
  - Automatic reset when back in range
- PV310 (LAr Supply): PS303 (Hardware) shuts at 30 psig
  - Physical manual reset required (button on PS303)
- FCV162 (P10): PV = PT165 (initial SP value = 20 psig)
  - This is an electric rotary valve, slow open/close
- FCV191: PV = PT318
  - Slow acting loop, the initial values of the gains are estimated.

Section 2 Response to Alarms

If cryogenic alarm is triggered, the blinking red button will be indicating presence of alarms on each of the iFix pages. Additionally, red lights will be blinking at the ground level and at the pit level. In order to acknowledge alarms, the process variable should go outside the alarming zone, and the “SUM_RESET” button should be pushed on the alarm screen. Typical alarm pages are shown below.

Use of datalogging:

It is typically advised to verify the status of equipment or value of the process variable via datalogger. There are two dataloggers, via Proficy portal https://d0-hist2.fnal.gov/proficyportal/default.htm and via iFix Historical Plots. Both require additional training.

2:24:56 PM
7/27/2015

WatchDog
27691

ALARMS

iFIX ALARMS | SUM_RESET | Cryo Alarm | EXIT

TAG-Description	VAL	ENA	HI-SP	HI-ALARM	AD#	LO-SP	LO-ALARM	AD#
Cryostat								
PT102 Cryostat Pressure	18.0	Enabled	21.0	OK	01	16.0	OK	02
PT150 Cryostat Pressure	3.5	Enabled	5.0	OK	03	2.0	OK	04
LT122 Cryostat Gal.	33349	Enabled	34000	OK	05	33000	OK	06
LT124 Cryostat Level	0.0	Disabled	5.0	OK	07	3.0	OK	08
LAr Pumps								
PT318 Pump Dis. Press	74.0	Enabled	80.0	OK	11	60.0	OK	12
PT368 SUC. Pump1 PSI	50.0	Disabled	2.0	OK	13	0.5	OK	14
FT366 Pump P1 Flow	0.0	Disabled	10.0	OK	15	35.0	OK	16
Right Pump (P1) Diff. Pressure	74.0 – 50.0 = 24.0	Disabled	21.0	OK	17	10.0	OK	18
PT378 SUC. Pump2 PSI	27.4	Enabled	32.0	OK	19	20.0	OK	20
FT376 Pump P2 Flow	9.3	Enabled	12.0	OK	21	8.0	OK	22
Left Pump (P2) Diff. Pressure	74.0 – 27.4 = 46.6	Enabled	55.0	OK	23	35.0	OK	24
Tank Farm and Cryo/Gas Supply								
PT486 LP Actuator PSI	26.6	Enabled	35.0	OK	25	22.0	OK	26
PT481 HP Actuator PSI	89.0	Enabled	100.	OK	27	80.0	OK	28
LT686 500 Gal. LAr Lvl Low	357.9	Enabled				100.0	OK	30
PT687 500 Gal. LAr Press.	147.7	Enabled	225.0	OK	31	125.0	OK	32
LT971 Ln2 Dew.Gal.Level	4004.5	Enabled	11000.	OK	33	1500.0	OK	34
PT973 LN2 Dewar PSI	26.3	Enabled	40.0	OK	35	20.0	OK	36
PS938 Ln2 Dewar Fill Line Pressure Switch		Enabled		OK	37			38
PT247 Ph. Separator PSI	25.1	Enabled	45.0	OK	39	20.0	OK	40
LT248 Ph.Sep.Ln2 Level	22.0	Enabled	30.0	OK	41	17.0	OK	42
PT666 Tube Trlr. Press.	91	Disabled	3000	OK	43	150	OK	44
LT1043 LAr Buf. Dew. Level (gal)	-61	Disabled	120	OK	45	13	OK	46
PT1041 Buffer Dew.Press	0.9	Disabled	10.0	OK	47	0.5	OK	48

Vacuum									
PT364 Pump P1 Vac Jacket		2.2	Disabled	50.0	OK	49			
PT374 Pump P2 Vac Jacket		0.5	Enabled	50.0	OK	51			
PT958 LN2 Dew. Vac. Jacket		4.4	Enabled	50.0	OK	53			
PT456 Purity Mon. Vac. Jacket		42.2	Disabled	50.0	OK	55			
PT405 Mole SeiveV8 Vac. Jac.		13.7	Enabled	50.0	OK	57			
PT505 Mole SeiveV7 Vac. Jac.		55.3	Disabled	50.0	OK	59			
Cooldown Compressor									
FT855 Recirc. Flow		0.0	Disabled	20.0	OK	61	10.0	OK	62
PT861 Recirc. Out Press		1.8	Disabled	50.0	OK	63	34.0	OK	64
PT850 Recirc. Inl.Press		1.1	Disabled	20.0	OK	65	18.0	OK	66
ODH									
ODH ALARM			Enabled		OK	67			
ODH TROUBLE ALARM			Enabled		OK	69			
EF1 FAN Trouble Alarm			Disabled		OK	71			
EF1 FLOW Trouble	73 FPM	207 RPM	Enabled		OK	73			
Permits									
HV Permit Trip Alarm (LAr Level) (S7)			Disabled		OK	75			
CoolDown Permit Trip Alarm (S7)			Disabled		OK	79			
Cooldown Permit Trip ALARM (S7-SAFE)			Disabled		OK	81			
Cooldown HI Delta T Warning (S7)			Disabled	8.0	OK	83			
Cooldown HI Delta T Alarm (S7-SAFE)			Disabled	100.	OK	85			

<u>List of cryogenic alarms with descriptions</u>:

CRYOSTAT

<u>Alarm 1</u>: <u>PT102 Cryostat Absolute Pressure (High)</u>

<u>Description/Notes</u>: Normal operating pressure is 18 psia; relief set to 30 psig

<u>Possible Cause</u>: LN2 cooling system upset

<u>Possible Action</u>: Check LN2 dewar historical data, check that PV290 isn't tripped, check for low level or low pressure, verify pressure builder is working of N2 dewar pressure is less than 25 psig

<u>Possible Action</u>: Check cryostat pressure control historical data including phase separator controls and FCV257 (control loop ~30%) and FCV241 (normally 100% open), check for low phase separator level and low pressure

<u>Possible Action</u>: Check N2 analyzer, if reading abnormally high and/or rapidly rising isolate LN2 system with PV270

<u>Possible Cause</u>: Heaters on or gas flow to the cryostat

<u>Possible Action</u>: Check heaters, check if FCV626, FCV657, FCV663 or manual bypass are open and routed to the cryostat or condenser

Alarm 2: PT102 Cryostat Absolute Pressure (Low)

Description/Notes: Normal operating pressure is 18 psia
Possible Cause: LN2 cooling upset
Possible Action: Check LN2 dewar and phase separator control historical data, check for high pressure if recently filled, verify N2 dewar backpressure regulator is working (set ~30 psig) and blow down if necessay
Possible Action: Check N2 analyzer, if reading abnormally high and/or rapidly rising isolate LN2 system with PV270
Possible Cause: Vent open
Possible Action: Check PV142 status and setpoint
Possible Cause: Sudden increase in condenser power
Possible Action: Check N2 valve status', only 1 condenser coil normally open and flowing

Alarm 3: PT150 Cryostat Gauge Pressure (High)

Description/Notes: Normal operating pressure is 18 psia; relief set to 30 psig
Possible Cause: Same as alarm 1
Possible Action: Same as alarm 1

Alarm 4: PT150 Cryostat Gauge Pressure (Low)

Description/Notes: Normal operating pressure is 18 psia
Possible Cause: Same as alarm 2
Possible Action: Same as alarm 2

Alarm 5: LT122 Cryostat Level (High)

Description/Notes: Differential pressure. Normal operating level ~33,350 gallons or 135.5 inches Argon
Possible Cause: Makeup gas system failure or other gas flow into cryostat
Possible Action: Check status and setpoint of FCV626, check status and routing of FCV657, FCV663 and manual bypass

Alarm 6: LT122 Cryostat Level (Low)

Description/Notes: Differential pressure. Normal operating level ~33,350 gallons or 135.5 inches Argon
Possible Cause: Makeup gas system failure or other gas flow
Possible Action: Check status and setpoint of FCV626 Possible Cause: Leak or partially open vent
Possible Action: Visual checks of piping and vent valves on argon circuit
Possible Cause: Equalization valve on 3 valve manifold open, or high/low side closed Possible Action: Check 3 valve manifold mounted on panel to the right of the condensers

Alarm 7: LT124 Cryostat Level-S7 (High) - OBSOLETE, DISABLED

Description/Notes: AMI probe. High voltage trips at 2 inches. Normal operating level ~5.5 inches
Possible Cause: Same as alarm 5
Possible Action: Same as alarm 5

Alarm 8: LT124 Cryostat Level-S7 (Low) - OBSOLETE, DISABLED

Description/Notes: AMI probe. High voltage trips at 2 inches. Normal operating level ~5.5 inches

Possible Cause: Same as alarm 6

Possible Action: Same as alarm 6

LAR PUMPS

Alarm 11: PT318 Pump Discharge Pressure (High)

Description/Notes: Common discharge pressure to both LAr Pumps; pump discharge relief set at 100 psig, trapped volumes set to 90 psig, operational relief on filter skids set at 80 psig; see pump curves or historical data for normal operating value

Possible Cause: Blockage or increased flow resistance

Possible Action: Check historical data, if increase is sudden check valve lineup including FCV191 (normally 7% open), all manual valves in flow path open to 100%

Possible Action: Check historical data, if increase is gradual particulate filter may be clogging

Possible Action: If problem persists and value is greater than 95 psia, pump should be shut down

Possible Cause: Increase in pump speed (normally 5200 rpm)

Possible Action: Contact cryo expert

Alarm 12: PT318 Pump Discharge Pressure (Low)

Description/Notes: Common discharge pressure to both LAr Pumps; see pump curves or historical data for normal operating value

Possible Cause: Decreased flow resistance

Possible Action: Check valve lineup including FCV191 (normally 7% open), check for open vent including PV438 and check for abnormally decreasing cryostat level

Possible Cause: Decrease in pump speed (normally 5200 rpm) or pump has tripped

Possible Action: Contact cryo expert

Alarm 13: PT368 Right Pump P1 Suction Pressure (High)

Description/Notes: Relief set at 90 psig; see pump curves or historical data for normal operating value; alarm only enabled when right pump is running

Possible Cause: Increase in cryostat pressure

Possible Action: Same as alarm 1

Alarm 14: PT368 Right Pump P1 Suction Pressure (Low)

Description/Notes: See pump curves or historical data for normal operating value; alarm only enabled when right pump is running

Possible Cause: Low cryostat pressure

Possible Action: Same as alarm 2

Possible Cause: Inlet filter blockage

Possible Action: Notify cryo expert to switch to other pump for maintenance

Alarm 15: FT366 Right Pump P1 Flow Rate (High)

Description/Notes: See pump curves or historical data for normal operating value; alarm only enabled when right pump is running

Possible Cause: Decreased flow resistance or increase in speed

Possible Action: Same as alarm 12

Alarm 16: FT366 Right Pump P1 Flow Rate (Low)

Description/Notes: See pump curves or historical data for normal operating value; alarm only enabled when right pump is running

Possible Cause: Increased flow resistance or decrease in speed

Possible Action: Same as alarm 11

Possible Cause: If flow is 0 the pump may have tripped

Possible Action: Contact cryo expert

Alarm 17: PT318-PT368 Right Pump P1 Differential Pressure (High)

Description/Notes: Not a differential gauge, mathematically derived from suction/discharge pressures; see pump curves or historical data for normal operating value; alarm only enabled when right pump is running

Possible Cause: High discharge pressure

Possible Action: Same as alarm 11

Alarm 18: PT318-PT368 Right Pump P1 Differential Pressure (Low)

Description/Notes: Not a differential gauge, mathematically derived from suction/discharge pressures; see pump curves or historical data for normal operating value; alarm only enabled when right pump is running

Possible Cause: Low discharge pressure

Possible Action: Same as alarm 12

Alarm 19: PT378 Left Pump P2 Suction Pressure (High)

Description/Notes: Relief set at 90 psig; see pump curves or historical data for normal operating value; alarm only enabled when left pump is running

Possible Cause: Increase in cryostat pressure

Possible Action: Same as alarm 1

Alarm 20: PT378 Left Pump P2 Suction Pressure (Low)

Description/Notes: See pump curves or historical data for normal operating value; alarm only enabled when left pump is running

Possible Cause: Low cryostat pressure

Possible Action: Same as alarm 2

Possible Cause: Inlet filter blockage

Possible Action: Notify cryo expert to switch to other pump for maintenance

Alarm 21: FT376 Left Pump P2 Flow Rate (High)

Description/Notes: See pump curves or historical data for normal operating value; alarm only enabled when left pump is running

Possible Cause: Decreased flow resistance or increase in speed

Possible Action: Same as alarm 12

Alarm 22: FT376 Left Pump P2 Flow Rate (Low)

Description/Notes: See pump curves or historical data for normal operating value; alarm only enabled when left pump is running

Possible Cause: Increased flow resistance or decrease in speed

Possible Action: Same as alarm 11

Possible Cause: If flow is 0 the pump may have tripped

Possible Action: Contact cryo expert

Alarm 23: PT318-PT378 Left Pump P2 Differential Pressure (High)

Description/Notes: Not a differential gauge, mathematically derived from suction/discharge pressures; see pump curves or historical data for normal operating value; alarm only enabled when left pump is running

Possible Cause: High discharge pressure

Possible Action: Same as alarm 11

Alarm 24: PT318-PT378 Left Pump P2 Differential Pressure (Low)

Description/Notes: Not a differential gauge, mathematically derived from suction/discharge pressures; see pump curves or historical data for normal operating value; alarm only enabled when left pump is running

Possible Cause: Low discharge pressure

Possible Action: Same as alarm 12

TANK FARM AND CRYO/GAS SUPPLY

Alarm 25: PT486 Low Pressure Actuator Supply Pressure (High)

Description/Notes: Supply runs off 500 gallon Ar dewar during normal ops; relief set to 50 psig; normal operating pressure ~27 psig

Possible Cause: Regulator adjusted or failed

Possible Action: If regulator needs maintenance connect temporary gas cylinders before disconnecting

Alarm 26: PT486 Low Pressure Actuator Supply Pressure (Low)

Description/Notes: Supply runs off 500 gallon Ar dewar during normal ops; normal operating pressure ~27 psig; valves fail at ~23 psig

Possible Cause: Regulator adjusted or failed

Possible Action: Connect temporary gas cylinder supply and replace/repair regulator

Possible Cause: Leaking line

Possible Action: Investigate all pneumatic lines and repair leak

Alarm 27: PT481 High Pressure Actuator Supply Pressure (High)

Description/Notes: Supply runs off 500 gallon Ar dewar; relief set at 120 psig; normal operating pressure ~90 psig

Possible Cause: Regulator adjusted or failed

Possible Action: If regulator needs maintenance connect temporary gas cylinders before disconnecting

Alarm 28: PT481 High Pressure Actuator Supply Pressure (Low)

Description/Notes: Supply runs off 500 gallon Ar dewar; normal operating pressure ~90 psig; valves fail ~85 psig

Possible Cause: Regulator adjusted or failed

Possible Action: Connect temporary gas cylinder supply and replace/repair regulator

Possible Cause: Leaking line

Possible Action: Investigate all pneumatic lines and repair leak

Alarm 30: LT686 500 Gallon Dewar Level (Low)

Description/Notes: Air Products monitors level and forecasts fill, should be automatically filled before reaching 150 gallons

Possible Cause: Sudden increase in consumption

Possible Action: Verify cause of consumption and call Air Products for fill, if dewar cannot be filled in time evaluate if cause of consumption can be interrupted

Possible Cause: Leak or vacuum failure causing venting

Possible Action: Notify cryo expert and call Air Products

Alarm 31: PT687 500 Gallon Dewar Pressure (High)

Description/Notes: Tank rated to 250 psig, auto vents at ~200 psig, builds pressure at ~150 psig

Possible Cause: Dewar is being filled

Possible Action: Verify as fill is taking place, take no action

Possible Cause: Autovent clogged or malfunctioning

Possible Action: Investigate and/or call Air Products, notify cryo expert

Possible Cause: Vacuum failure

Possible Action: Investigate and call Air Products if vacuum failure is apparent, notify cryo expert

Alarm 32: PT687 500 Gallon Dewar Pressure (Low)

Description/Notes: Tank rated to 250 psig, auto vents at ~200 psig, builds pressure at ~150 psig
Possible Cause: Pressure builder malfunction
Possible Action: Call Air Products, notify cryo expert

Possible Cause: Leak or rupture

Possible Action: Investigate and call Air Products if leak is on dewar or other leased equipment, notify cryo expert

Alarm 33: LT971 Nitrogen Dewar Level (High)

Description/Notes: Tank capacity 11,000
gallons Possible Cause: Alarm set too low
Possible Action: Reset alarm to >11,000 gallons

Alarm 34: LT971 Nitrogen Dewar Level (Low)

Description/Notes: Should always have ~2,000 gallons minimum, typical consumption rate with 1 pump running is 1,000 gal/day

Possible Cause: Sudden excessive consumption

Possible Action: Check historical data for trend and determine reason for extra consumption, check for leaks

Possible Cause: Vendor hasn't filled in excessive amount of time

Possible Action: Call Air Products

Alarm 35: PT973 Nitrogen Dewar Pressure (High)

Description/Notes: Tank rated to 75 psig, reliefs set at 65 psig, during normal ops builds pressure at ~30 psig and vents ~35 psig

Possible Cause: Dewar being filled

Possible Action: Verify the fill with historical data, wait for fill to end, check on cryostat pressure and phase separator controls and take manual action if required

Alarm 36: PT973 Nitrogen Dewar Pressure (Low)

Description/Notes: Tank rated to 75 psig, reliefs set at 65 psig, during normal ops builds pressure at ~30 psig and vents ~35 psig

Possible Cause: Dewar being filled

Possible Action: Verify the fill with historical data, wait for fill to end, check on cryostat pressure and phase separator controls and take manual action if required

Possible Cause: Pressure builder malfunction

Possible Action: Investigate and determine if repairs/replacement are required

Possible Cause: Vent open

Possible Action: Investigate and close

Alarm 37: PS938 Nitrogen Supply Line Pressure Switch Trip

Description/Notes: Trips at 50 psig, automatic reset
Possible Cause: Dewar being filled
Possible Action: Verify the fill with historical data, wait for fill to end, check on cryostat pressure and phase separator controls and take manual action if required
Possible Cause: Same as alarm 35
Possible Action: Same as alarm 35

Alarm 38: PS938 Nitrogen Supply Line Pressure Switch Trip

Description/Notes: Trips at 50 psig, automatic reset

Possible Cause: Same as alarm 37

Possible Action: Same as alarm 37

Alarm 39: PT247 Phase Separator Pressure (High)

Description/Notes: Vessel rated to 100 psig, relief set at 50 psig, nomral operating pressure ~25-35 psig, no pressure control loop

Possible Cause: N2 dewar pressure high

Possible Action: Same as alarm 35, if a fill is the cause wait for valve to catch up or manually stabilize

Alarm 40: PT247 Phase Separator Pressure (Low)

Description/Notes: Normal operating pressure ~25-35 psig, no pressure control loop

Possible Cause: N2 dewar pressure low

Possible Action: Same as alarm 36, if a fill is the cause wait for valve to catch up or manually stabilize

Alarm 41: LT248 Phase Separator Level (High)

Description/Notes: Operating level ~24 inches

Possible Cause: Sudden increase in N2 dewar pressure

Possible Action: Same as alarm 35, if a fill is the cause wait for valve to catch up or manually stabilize

Possible Cause: Sudden decrease in consumption

Possible Action: Determine cause and evaluate

Alarm 42: LT248 Phase Separator Level (Low)

Description/Notes: Operating level ~24 inches

Possible Cause: Sudden decrease in N2 dewar pressure

Possible Action: Same as alarm 36, if a fill is the cause wait for valve to catch up or manually stabilize

Possible Cause: Sudden increase in consumption

Possible Action: Determine cause and evaluate

Alarm 43: PT666 Tube Trailer Pressure (High)

Description/Notes: Normally isolated from transmitter with alarm disabled unless actively regenerating; relief set at 50 psig downstream of regulator; max pressure 3,000 psig
Possible Cause: Disabled during normal ops
Possible Action: Disabled during normal ops

Alarm 44: PT666 Tube Trailer Pressure (Low)

Description/Notes: Normally isolated from transmitter with alarm disabled unless actively regenerating
Possible Cause: Disabled during normal ops Possible
Action: Disabled during normal ops

Alarm 45: LT1043 Argon Buffer Dewar Level (High) - OBSOLETE, DISABLED

Description/Notes: Disabled during normal ops; maximum LAr volume 6,500 gallons
Possible Cause:
Possible Action:

Alarm 46: LT1043 Argon Buffer Dewar Level (Low) - OBSOLETE, DISABLED

Description/Notes: Disabled during normal ops
Possible Cause:
Possible Action:

Alarm 47: PT1041 Argon Buffer Dewar Pressure (High) - OBSOLETE, DISABLED

Description/Notes: Disabled during normal ops, MAWP of vessel is 75 psig; vents at 10 psig; burst disks set to 20 psig
Possible Cause:
Possible Action:

Alarm 48: PT1041 Argon Buffer Dewar Pressure (Low) - OBSOLETE, DISABLED

Description/Notes: Disabled during normal ops
Possible Cause:
Possible Action:

VACUUM

Alarm 49: PT364 Right Pump P1 Vacuum Jacket (High)

Description/Notes: Known to have minor leak (5/26/15) of ~2 mTorr/day, continuously vacuum pumped
Possible Cause: Vacuum pump off or failed
Possible Action: Investigate and replace vacuum pump if necessary, contact cryo expert if leak vacuum level is rapidly increasing beyond 50 mTorr

Possible Cause: Leak from argon to vacuum
Possible Action: Contact cryo expert

Alarm 51: PT374 Left Pump P2 Vacuum Jacket (High)

Description/Notes: Known to have major leak (5/26/15) of ~100 mTorr/day up to ~1 Torr, continuously vacuum pumped

Possible Cause: Vacuum pump off or failed

Possible Action: Investigate and replace vacuum pump if necessary, contact cryo expert if leak vacuum level is rapidly increasing beyond 50 mTorr

Possible Cause: Leak from argon to vacuum Possible

Action: Contact cryo expert

Alarm 53: PT958 Nitrogen Dewar Vacuum Jacket (High)

Description/Notes: Known to hold tight

Possible Cause: Leak

Possible Action: Install vacuum pump and begin pumping, contact cryo expert

Alarm 55: PT456 Purity Monitor Vacuum Jacket (High)

Description/Notes: Vessel is typically warm and alarm disabled

Possible Cause:
Possible Action:

Alarm 57: PT405 Right Filter Skid/Mole Sieve V8 Vacuum Jacket (High)

Description/Notes: Known to hold tight

Possible Cause: Leak from argon to vacuum
Possible Action: Install vacuum pump and begin pumping, contact cryo expert

Alarm 59: PT505 Left Filter Skid/Mole Sieve V7 Vacuum Jacket (High)

Description/Notes: Known to hold tight

Possible Cause: Leak from argon to vacuum
Possible Action: Install vacuum pump and begin pumping, contact cryo expert

COOLDOWN COMPRESSOR

Alarm 61: FT855 Compressor Flow Rate (High) - OBSOLETE, DISABLED

Description/Notes: Disabled during normal ops
Possible Cause:
Possible Action:

Alarm 62: FT855 Compressor Flow Rate (Low) - OBSOLETE, DISABLED
Description/Notes: Disabled during normal ops
Possible Cause:
Possible Action:

Alarm 63: PT861 Compressor Discharge Pressure (High) - OBSOLETE, DISABLED
Description/Notes: Disabled during normal ops
Possible Cause:
Possible Action:

Alarm 64: PT861 Compressor Discharge Pressure (Low) - OBSOLETE, DISABLED
Description/Notes: Disabled during normal ops
Possible Cause:
Possible Action:

Alarm 65: PT850 Compressor Suction Pressure (High) - OBSOLETE, DISABLED
Description/Notes: Disabled during normal ops
Possible Cause:
Possible Action:

Alarm 66: PT850 Compressor Suction Pressure (Low) - OBSOLETE, DISABLED
Description/Notes: Disabled during normal ops
Possible Cause:
Possible Action:

ODH

Alarm 67: ODH Alarm
Description/Notes: Trips at 19.5% O2
Possible Cause: Leak or vent open to room
Possible Action: Call cryo expert

Alarm 69: ODH Trouble Alarm
Description/Notes: Indicates ODH head failure
Possible Cause: Head failure
Possible Action: Notify controls expert

Alarm 71: EF1/ODH Fan Trouble Alarm
Description/Notes: Fan ramps to 600 rpm once an hour and full speed once a day, alarm verifies VFD and ramp are working properly
Possible Cause: VFD failure
Possible Action: Notify controls expert

Alarm 73: EF1/ODH Fan Flow Trouble Alarm

Description/Notes: Fan runs at 200 rpm continuously, alarm verifies there is flow

Possible Cause: Fan failure

Possible Action: Ignore if alarm immediately resets and notify controls expert, if alarm is continuous notify controls expert

PERMITS

Alarm 75: High Voltage Permit Trip Alarm S7

Description/Notes: Trips if cryostat level is 134 inches of Argon or less, manual reset required

Possible Cause: Same as alarm 6

Possible Action: Same as alarm 6

Alarm 77: High Voltage Permit Trip Alarm S7-Safe - OBSOLETE, DISABLED

Description/Notes: Trips if cryostat level is 2 inches or less, manual reset required

Possible Cause:

Possible Action:

Alarm 79: Cooldown Permit Trip Alarm S7 - OBSOLETE, DISABLED

Description/Notes: Disabled during normal ops

Possible Cause:

Possible Action:

Alarm 81: Cooldown Permit Trip Alarm S7-Safe - OBSOLETE, DISABLED

Description/Notes: Disabled during normal ops

Possible Cause:

Possible Action:

Alarm 83: Cooldown High Delta-T Warning S7 - OBSOLETE, DISABLED

Description/Notes: Disabled during normal ops

Possible Cause:

Possible Action:

Alarm 85: Cooldown High Delta-T Alarm S7-Safe - OBSOLETE, DISABLED

Description/Notes: Disabled during normal ops

Possible Cause:

Possible Action:

List of Experts:

Cryogenic Experts:

- Fritz Schwartz 920-988-6231 - cell
- Michael Zuckerbrot, 773-517-3550 – cell
- Michael Geynisman, 630-2448-703 -cell
- Cryo coordinator, 630-255-1324 – LD pager

Controls Experts:

- Dan Markley, (630) 218-9154 – LD pager
- Michael Sarychev, (630) 218-4294 – LD pager

Air Products contact numbers:

800-224-2724

- Liquid Nitrogen - Customer #689-976, Tanker #49, 9,000 gal
- Liquid Argon – Tanker 10714096, 500 gal

Attachment 1

Microboone Cryo Alarms

-Critical alarms generate autodialer cell phone alerts to cryo expert list for all alarms during all hours

-Non-critical alarms do not generate autodialer cell phone alerts between 10pm and 8am, but generate a single autodialer cell phone alert to cryo expert list during normal hours

CRYOSTAT

Alarm 1: PT102 Cryostat Absolute Pressure (High)

Critical: **Yes**
Notes:

Alarm 2: PT102 Cryostat Absolute Pressure (Low)

Critical: **Yes**
Notes:

Alarm 3: PT150 Cryostat Gauge Pressure (High)

Critical: No
Notes:

Alarm 4: PT150 Cryostat Gauge Pressure (Low)

Critical: No
Notes:

Alarm 5: LT122 Cryostat Level (High)

Critical: No
Notes:

Alarm 6: LT122 Cryostat Level (Low)

Critical: No
Notes:

Alarm 7: LT124 Cryostat Level-S7 (High) - OBSOLETE, DISABLED

Critical: No
Notes: Disabled

Alarm 8: LT124 Cryostat Level-S7 (Low) - OBSOLETE, DISABLED

Critical: No
Notes: Disabled

LAR PUMPS

Alarm 11: PT318 Pump Discharge Pressure (High)

Critical: No
Notes:

Alarm 12: PT318 Pump Discharge Pressure (Low)

Critical: No
Notes:

Alarm 13: PT368 Right Pump P1 Suction Pressure (High)

Critical: No
Notes:

Alarm 14: PT368 Right Pump P1 Suction Pressure (Low)

Critical: No
Notes:

Alarm 15: FT366 Right Pump P1 Flow Rate (High)

Critical: **Yes**
Notes:

Alarm 16: FT366 Right Pump P1 Flow Rate (Low)

Critical: **Yes**
Notes:

Alarm 17: PT318-PT368 Right Pump P1 Differential Pressure (High)

Critical: No
Notes:

Alarm 18: PT318-PT368 Right Pump P1 Differential Pressure (Low)

Critical: No
Notes:

Alarm 19: PT378 Left Pump P2 Suction Pressure (High)

Critical: No

Notes:

Alarm 20: PT378 Left Pump P2 Suction Pressure (Low)

Critical: No
Notes:

Alarm 21: FT376 Left Pump P2 Flow Rate (High)

Critical: **Yes**
Notes:

Alarm 22: FT376 Left Pump P2 Flow Rate (Low)

Critical: **Yes**
Notes:

Alarm 23: PT318-PT378 Left Pump P2 Differential Pressure (High)

Critical: No
Notes:

Alarm 24: PT318-PT378 Left Pump P2 Differential Pressure (Low)

Critical: No
Notes:

TANK FARM AND CRYO/GAS SUPPLY

Alarm 25: PT486 Low Pressure Actuator Supply Pressure (High)

Critical: No
Notes:

Alarm 26: PT486 Low Pressure Actuator Supply Pressure (Low)

Critical: No
Notes:

Alarm 27: PT481 High Pressure Actuator Supply Pressure (High)

Critical: No
Notes:

Alarm 28: PT481 High Pressure Actuator Supply Pressure (Low)

Critical: No
Notes:

Alarm 30: LT686 500 Gallon Dewar Level (Low)

Critical: No
Notes:

Alarm 31: PT687 500 Gallon Dewar Pressure (High)

Critical: No
Notes: Add 10 minute delay

Alarm 32: PT687 500 Gallon Dewar Pressure (Low)

Critical: **Yes**
Notes: Add 10 minute delay

Alarm 33: LT971 Nitrogen Dewar Level (High)

Critical: No
Notes:

Alarm 34: LT971 Nitrogen Dewar Level (Low)

Critical: No
Notes:

Alarm 35: PT973 Nitrogen Dewar Pressure (High)

Critical: No
Notes: Add 10 minute delay

Alarm 36: PT973 Nitrogen Dewar Pressure (Low)

Critical: **Yes**
Notes: Add 10 minute delay

Alarm 37: PS938 Nitrogen Supply Line Pressure Switch Trip

Critical: No
Notes:

Alarm 38: PS938 Nitrogen Supply Line Pressure Switch Trip

Critical: No
Notes:

Alarm 39: PT247 Phase Separator Pressure (High)

Critical: No
Notes: Add 10 minute delay

Alarm 40: PT247 Phase Separator Pressure (Low)

Critical: No
Notes: Add 10 minute delay

Alarm 41: LT248 Phase Separator Level (High)

Critical: No
Notes: Add 10 minute delay

Alarm 42: LT248 Phase Separator Level (Low)

Critical: **Yes**
Notes: Add 10 minute delay

Alarm 43: PT666 Tube Trailer Pressure (High)

Critical: No
Notes:

Alarm 44: PT666 Tube Trailer Pressure (Low)

Critical: No
Notes:

Alarm 45: LT1043 Argon Buffer Dewar Level (High) - OBSOLETE, DISABLED

Critical: No
Notes: Disabled

Alarm 46: LT1043 Argon Buffer Dewar Level (Low) - OBSOLETE, DISABLED

Critical: No
Notes: Disabled

Alarm 47: PT1041 Argon Buffer Dewar Pressure (High) - OBSOLETE, DISABLED

Critical: No
Notes: Disabled

Alarm 48: PT1041 Argon Buffer Dewar Pressure (Low) - OBSOLETE, DISABLED

Critical: No
Notes: Disabled

VACUUM

Alarm 49: PT364 Right Pump P1 Vacuum Jacket (High)

Critical: No
Notes:

Alarm 51: PT374 Left Pump P2 Vacuum Jacket (High)

Critical: No
Notes:

Alarm 53: PT958 Nitrogen Dewar Vacuum Jacket (High)

Critical: No
Notes:

Alarm 55: PT456 Purity Monitor Vacuum Jacket (High)

Critical: No
Notes:

Alarm 57: PT405 Right Filter Skid/Mole Sieve V8 Vacuum Jacket (High)

Critical: No
Notes:

Alarm 59: PT505 Left Filter Skid/Mole Sieve V7 Vacuum Jacket (High)

Critical: No
Notes:

COOLDOWN COMPRESSOR

Alarm 61: FT855 Compressor Flow Rate (High) - OBSOLETE, DISABLED

Critical: No
Notes: Disabled

Alarm 62: FT855 Compressor Flow Rate (Low) - OBSOLETE, DISABLED

Critical: No
Notes: Disabled

Alarm 63: PT861 Compressor Discharge Pressure (High) - OBSOLETE, DISABLED

Critical: No
Notes: Disabled

Alarm 64: PT861 Compressor Discharge Pressure (Low) - OBSOLETE, DISABLED

Critical: No

Notes: Disabled

Alarm 65: PT850 Compressor Suction Pressure (High) - OBSOLETE, DISABLED

Critical: No
Notes: Disabled

Alarm 66: PT850 Compressor Suction Pressure (Low) - OBSOLETE, DISABLED

Critical: No
Notes: Disabled

ODH

Alarm 67: ODH Alarm

Critical: **Yes**
Notes:

Alarm 69: ODH Trouble Alarm

Critical: No
Notes:

Alarm 71: EF1/ODH Fan Trouble Alarm

Critical: No
Notes:

Alarm 73: EF1/ODH Fan Flow Trouble Alarm

Critical: No
Notes:

PERMITS

Alarm 75: High Voltage Permit Trip Alarm S7

Critical: No
Notes:

Alarm 77: High Voltage Permit Trip Alarm S7-Safe - OBSOLETE, DISABLED

Critical: No
Notes: Disabled

Alarm 79: Cooldown Permit Trip Alarm S7 - OBSOLETE, DISABLED

Critical: No
Notes: Disabled

Alarm 81: Cooldown Permit Trip Alarm S7-Safe - OBSOLETE, DISABLED

Critical: No
Notes: Disabled

Alarm 83: Cooldown High Delta-T Warning S7 - OBSOLETE, DISABLED

Critical: No
Notes: Disabled

Alarm 85: Cooldown High Delta-T Alarm S7-Safe - OBSOLETE, DISABLED

Critical: No
Notes: Disabled

Attachment 2

LArTF Phase 2 Cryogenic Operations
Pit Emergency Procedures

LArTF ODH Emergency Procedures

The LArTF pit and platform areas (below grade) are classified as ODH 1.

All Personnel entering the LArTF Pit must:
1. Carry a personal oxygen monitor
2. Have current Oxygen Deficiency Hazard training
3. Have medical approval for oxygen deficiency hazard work
4. Exchange their Fermilab ID for a LArTF entrant card so that the Fire Department can account for all entrants
5. Wear a hard hat

Before entry familiarize yourself with the LArTF Emergency Exits and Assembly Areas Schematic at the end of this document. The LArTF stairwells are positively pressurized safe areas (ODH-0).
No Self-Rescue supplied atmosphere respirator (escape pack) is required to enter the LArTF pit. Personnel who work in restricted egress areas or on man-lifts or crane baskets will carry a Self-Rescue escape pack due to the restricted means of egress and increased time to evacuate.

There are four in-place (building) oxygen monitors.

Before entry familiarize yourself with the following responses to ODH alarms (per FESHM 4240):

1. Response to an alarm from a personal oxygen monitor:
1.1. If one person is working alone in an area and his/her personal oxygen monitor alarms, the person must immediately evacuate the area, and dial 3131 to report an emergency.
1.2. If two or more people are working together in an area and a personal oxygen monitor alarms, they should compare readings. If other monitors read OK, then everyone must evacuate the area and solve the problem with the personal oxygen monitor before re-entering. If other monitors confirm low oxygen levels, then everyone must evacuate the area, and then dial 3131 to report an emergency.

2. Response to an alarm from an in-place oxygen monitor:
2.1. If one person is working alone in an area and an in-place oxygen monitor alarms, and his/her personal oxygen monitor reads greater than 19.5%, the person should evacuate the area going away from the assumed source of the alarm. After exiting, he/she should notify the operations department responsible for the area of the problem

– see the posted LArTF call list. He/she should not re-enter until the problem has been solved. If a personal oxygen monitor has alarmed as well, the procedure of 1.1 should be followed.
2.2. If two or more people are working together, they should compare readings of personal oxygen monitors. If all personal oxygen monitors read OK, everyone should evacuate the area going away from the assumed source of the alarm. After evacuating, they should notify the operations department responsible for the area of the problem. They should not re-enter the area until the problem has been solved. If a personal oxygen monitor confirms low oxygen levels, everyone should evacuate the area, and then dial 3131 to report an emergency.

3. Response to other indications of a possible cryogen or gas leak (vapor cloud, sound of gas leak, etc.):
3.1. If one person is working alone and his/her personal oxygen monitor reads greater than 19.5%, he/she should evacuate the area going away from the assumed source of the problem. After exiting, he/she should notify the operations department responsible for the area of the problem – see the posted LArTF call list. If a personal oxygen monitor has alarmed, he/she must immediately evacuate the area, and dial 3131 to report an emergency.
3.2. If two or more people are working together, they should compare personal oxygen monitor readings. If all are OK, they should all evacuate the area going away from the assumed source of the problem. After exiting, they should notify the operations department responsible for the area of the problem. If a personal oxygen monitor has alarmed, they must immediately evacuate the area, and dial 3131 to report an emergency.

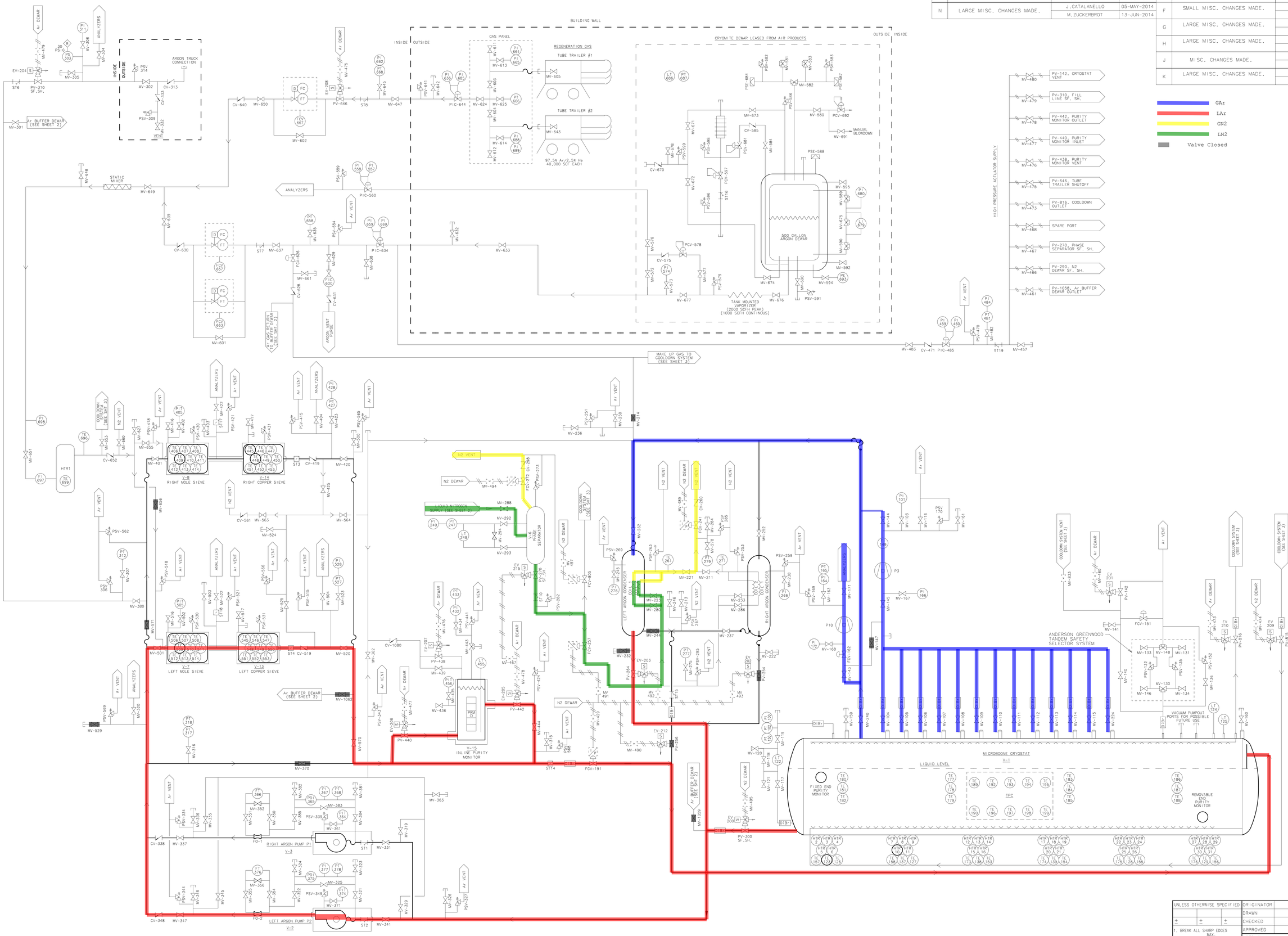
4. Entry into an area with unusual oxygen deficiency hazards:
4.1. Any rescue must be conducted by emergency (Fire Department) personnel. If an area is suspected to be oxygen deficient or to present unusual oxygen deficiency hazards, an unexposed observer and the use of SCBA equipment are required. Training and medical approval are required for the use of SCBA equipment.
4.2. If, for purposes other than rescue, entry must be made into an oxygen deficient area or an area suspected to present unusual oxygen deficiency hazards, the Division/Section Head responsible for the area must submit a written request to the Director or Director's designee which includes a justification and outlines hazards, procedures, and safety measures. The request must be approved by the Director or designee before entry.

LArTF Power Outage Emergency Procedure
In the event of a power outage, personnel must evacuate the LArTF pit. Minor changes to the controls and valves by system experts can be made first, provided an ODH alarm has not sounded and there are no indications of a significant system failure.
Entry into the enclosure during a power outage is restricted to the Fermilab Fire Department.

Attachment 3

REV	DESCRIPTION	DRAWN / APPROVED	DATE
L	LARGE MISC. CHANGES MADE.	J.CATALANELLO	29-MAY-2013
		M.ZUCKERBROT	10-JUN-2013
M	CHANGES MADE TO SHEETS 1 & 2.	J.CATALANELLO	23-AUG-2013
		M.ZUCKERBROT	05-SEP-2013
N	LARGE MISC. CHANGES MADE.	J.CATALANELLO	05-MAY-2014
		M.ZUCKERBROT	13-JUN-2014
E	SMALL MISC. CHANGES MADE.	J.CATALANELLO	02-MAR-2011
		R.SCHMITT	13-MAY-2011
F	SMALL MISC. CHANGES MADE.	J.CATALANELLO	13-JUN-2011
		M.ZUCKERBROT	28-JUL-2011
G	LARGE MISC. CHANGES MADE.	J.CATALANELLO	28-SEP-2011
		M.ZUCKERBROT	03-OCT-2011
H	LARGE MISC. CHANGES MADE.	J.CATALANELLO	29-NOV-2011
		M.ZUCKERBROT	30-MAY-2012
J	MISC. CHANGES MADE.	J.CATALANELLO	12-SEP-2012
		M.ZUCKERBROT	19-SEP-2012
K	LARGE MISC. CHANGES MADE.	J.CATALANELLO	29-JAN-2013
		M.ZUCKERBROT	06-FEB-2013

GAr
LAr
GN2
LN2
Valve Closed



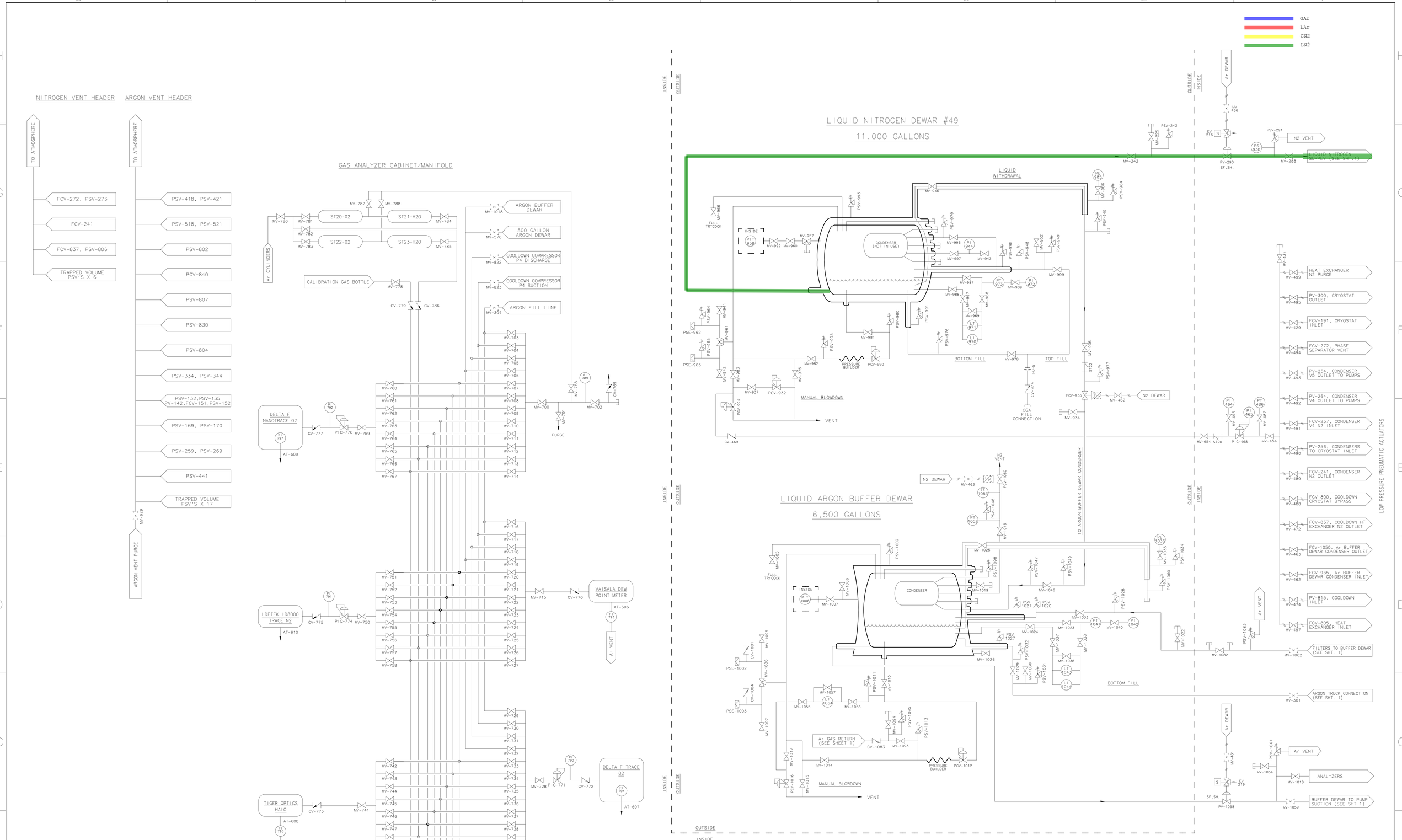
UNLESS OTHERWISE SPECIFIED	ORIGINATOR	R.SCHMITT	26-NOV-2008
	DRAWN	J.CATALANELLO	08-DEC-2008
± ± ±	CHECKED	R.SCHMITT	06-JAN-2009
1. BREAK ALL SHARP EDGES MAX.	APPROVED	R.SCHMITT	06-JAN-2009
2. DO NOT SCALE DRAWING. 3. DIMENSIONS BASED UPON ASME Y14.5M-1994 4. MAX. ALL MACH. SURFACES	USED ON		
5. DRAWING UNITS: U.S.INCH	MATERIAL		

FERMI NATIONAL ACCELERATOR LABORATORY
UNITED STATES DEPARTMENT OF ENERGY

MICROBOONE LAR TPC
PIPING AND INSTRUMENT DIAGRAM
CRYOGENIC SYSTEM

SCALE	DRAWING NUMBER	SHEET	REV
NONE	3974.200-ME-466281	1 OF 3	N

CREATED WITH : Ideas12NXSeries GROUP: PPD/MECHANICAL DEPARTMENT



UNLESS OTHERWISE SPECIFIED	ORIGINATOR	R.SCHMITT	26-NOV-2008
	DRAWN	J.CATALANELLO	08-DEC-2008
± ± ±	CHECKED	R.SCHMITT	06-JAN-2009
1. BREAK ALL SHARP EDGES MAX.	APPROVED	R.SCHMITT	06-JAN-2009
2. DO NOT SCALE DRAWING. 3. DIMENSIONS BASED UPON ASME Y14.5M-1994	USED ON		
4. MAX. ALL MACH. SURFACES √	MATERIAL		
5. DRAWING UNITS: U.S. INCH			

FERMI NATIONAL ACCELERATOR LABORATORY
UNITED STATES DEPARTMENT OF ENERGY

MICROBOONE LAR TPC PIPING AND INSTRUMENT DIAGRAM CRYOGENIC SYSTEM

SCALE	DRAWING NUMBER	SHEET	REV
NONE	3974.200-ME-466281	2 OF 3	N

CREATED WITH : Ideas12NXSeries GROUP: PPD/MECHANICAL DEPARTMENT