

# Cryogenic Summary - Testing D2L106 in MAGCOOL, Part 1 100 K Cooldown and Failure of Joint on Heat Shield Line

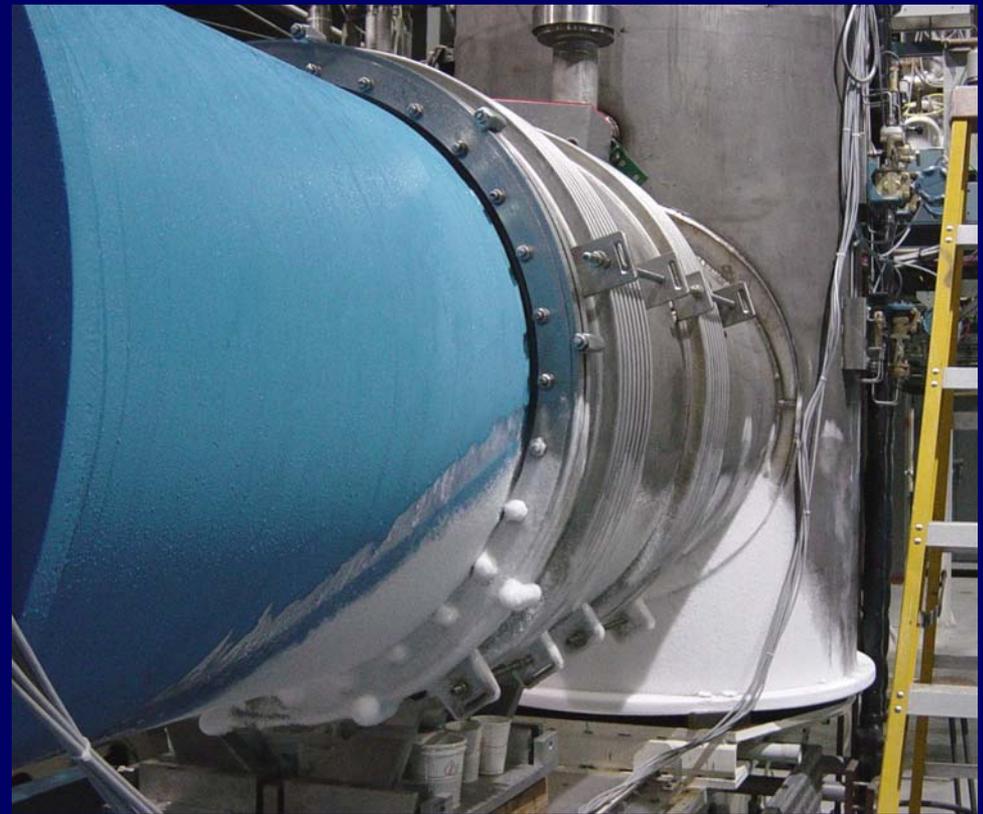
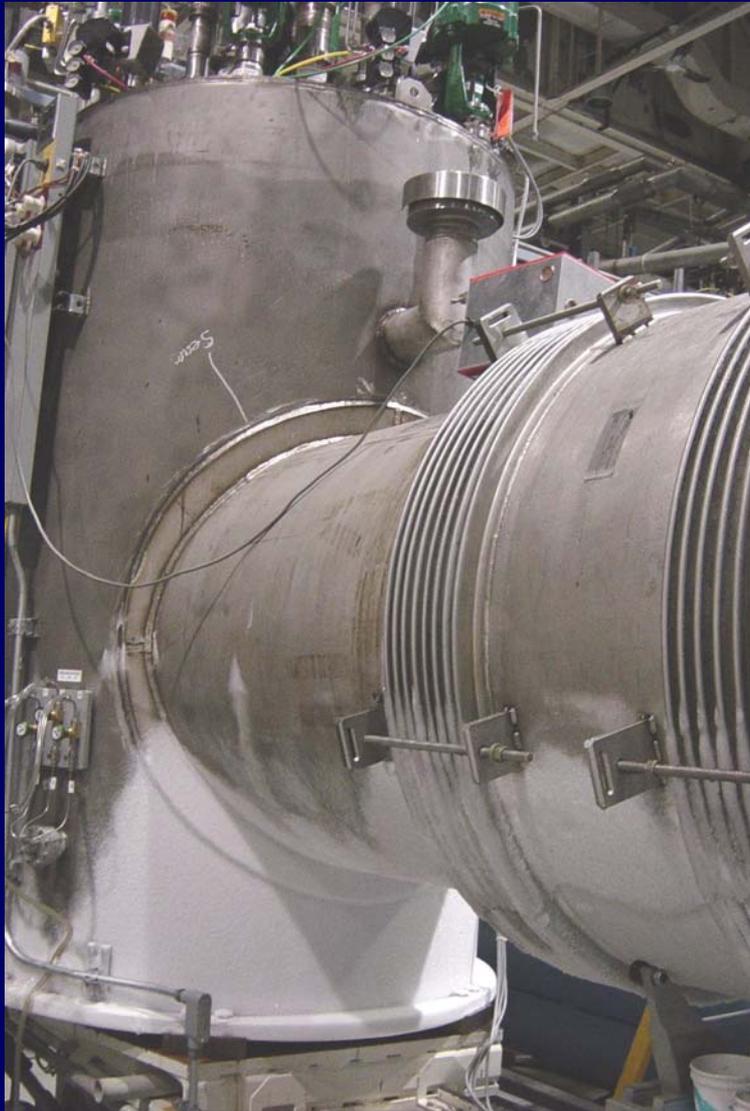
K. C. Wu  
6/19/03

- Summary
- System Description
- Operation
- Inspection Result
- Repair Status - 6/19

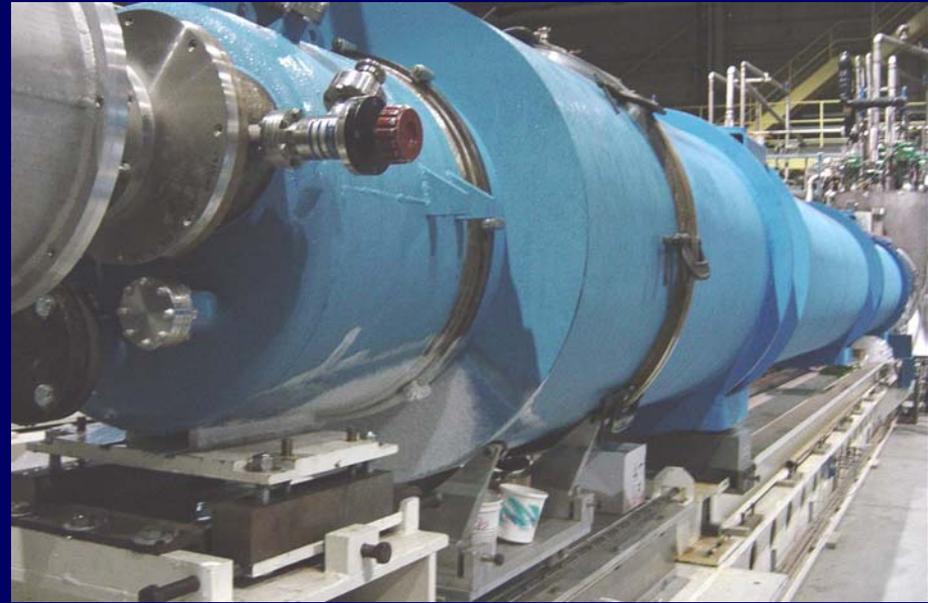
# Summary

- In the morning of the 3<sup>rd</sup> day (6/14) of 100 K cooldown, significant frosting on Feed Can and Vacuum Bellow was found.
- The magnet is  $\sim 130$  K at that time. LN<sub>2</sub> flow through shield started overnight.
- From overall characteristics and time of occurrence, it is believed that failure in the LN<sub>2</sub> system occurs.
- We terminated cooldown and isolated the system.
- After confirming no helium in the insulating space on 6/16, proceed normal warmup.
- The magnet reaches room temperature on 6/17. The vacuum enclosure is opened for inspection. The leak is found on the joint between the bi-braze coupling and the end plate of the aluminum shield line.

# Frosting of Feed Can and Vacuum Bellow (Photo taken ~ 2 hours after shutdown on 6/14)



# Frosting of Vacuum Bellow and End Can (Photo taken ~ 2 hours after shutdown)



# Leak Occurred on the Joint Between the Bi-braze Coupling and the End Plate of Aluminum Heat Shield Line



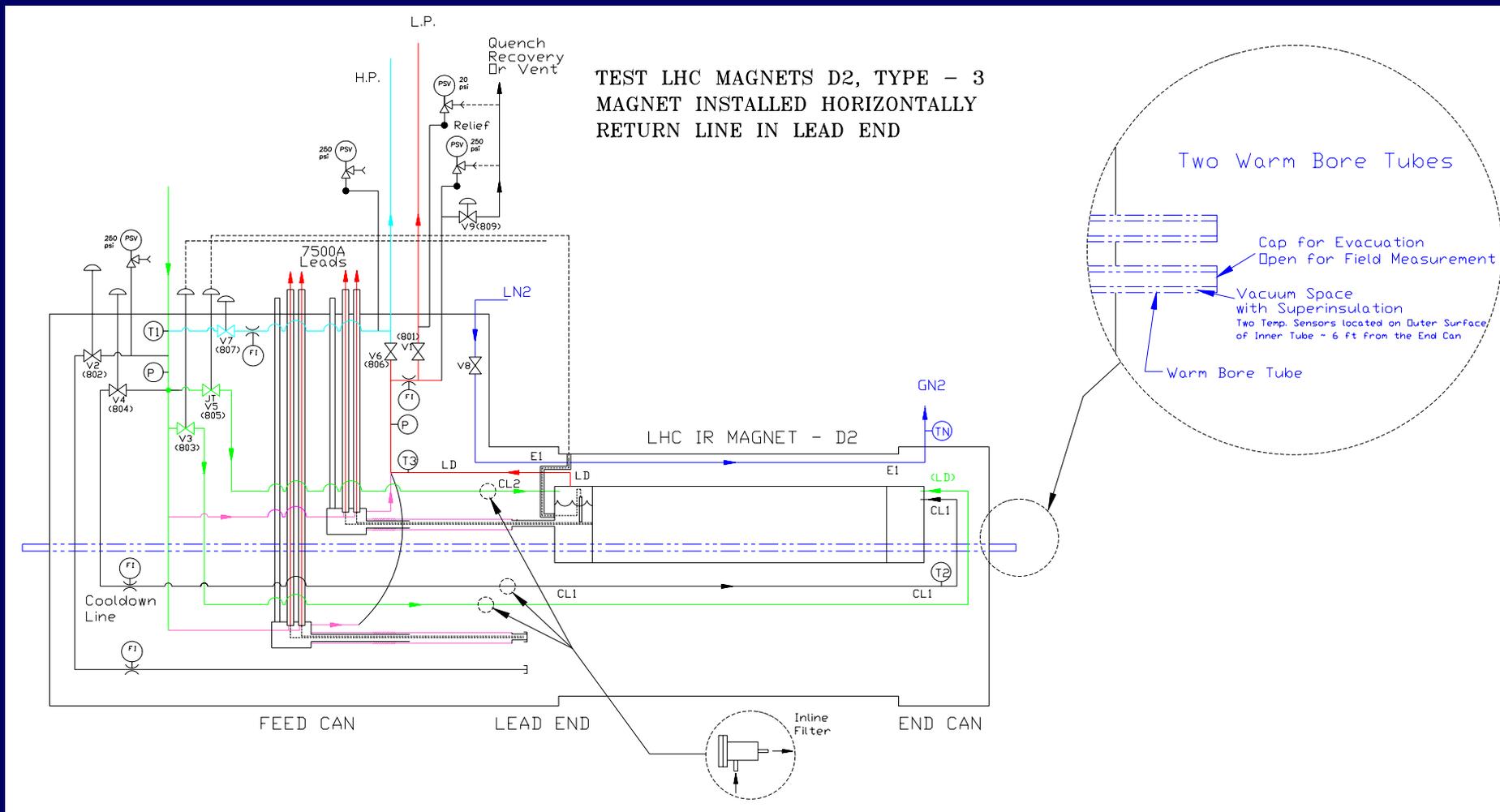
A G-10 Bracket is Used to Support the Bi-braze Coupling and the S.S. Flexible Line for the Test



# System Description - D2L106

- The magnet is installed horizontally on test bay with 0% slope.
- Cooldown/warmup supply in non-lead end, Return from lead-end.
- Warm bore tubes inserted.

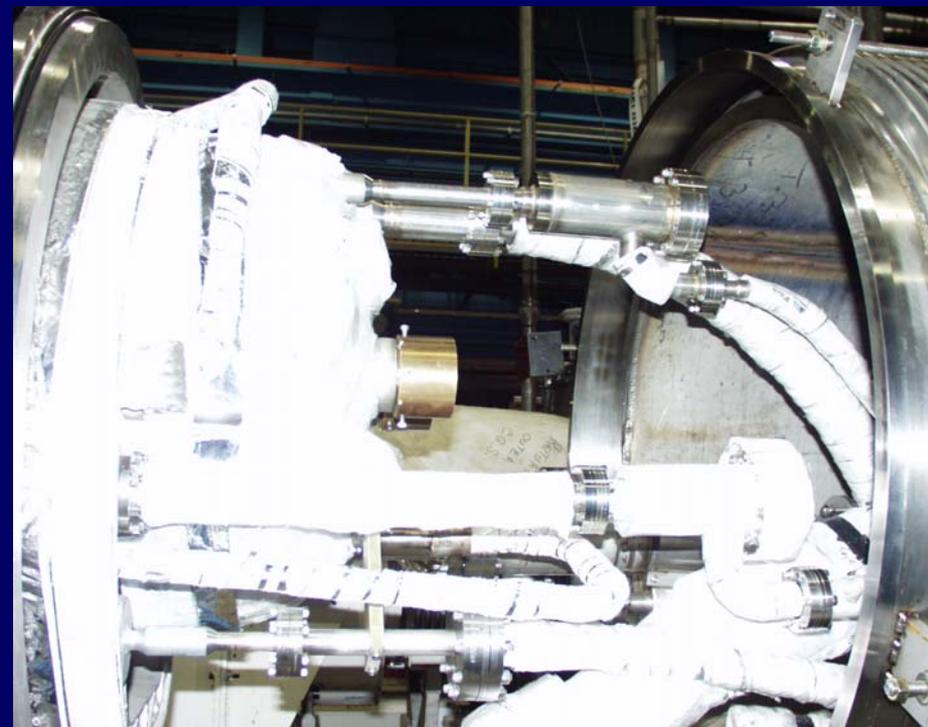
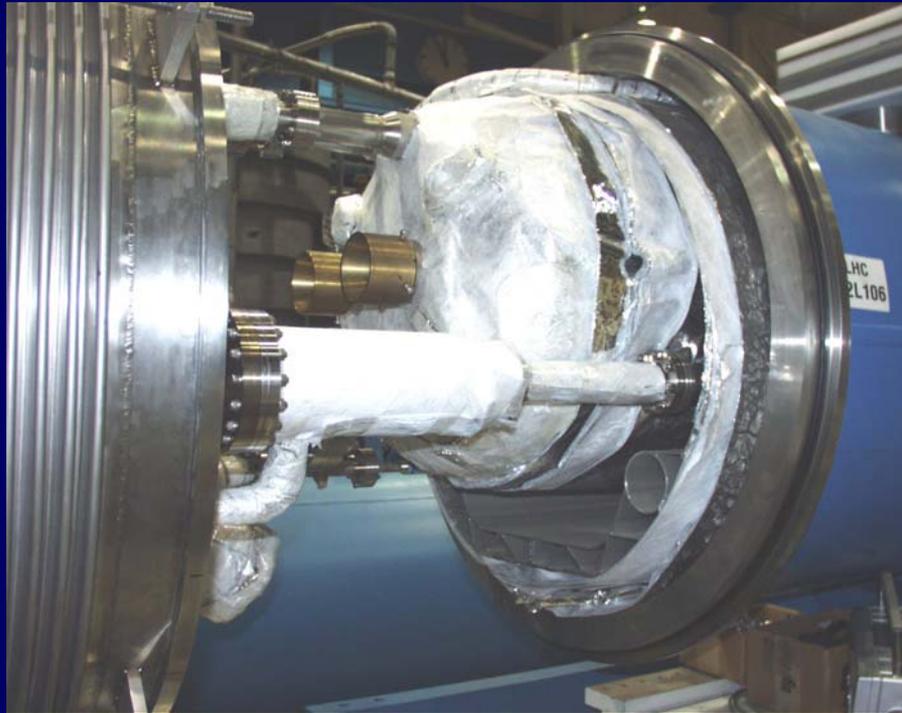
# Flow diagram of D2L106 with Warm Bore Tubes, Three Filters, 0% Slope and Return Line from the Lead End.



# Filters in front of supply nozzles of D2L106

Left: Cooldown/warmup supply in lead end,

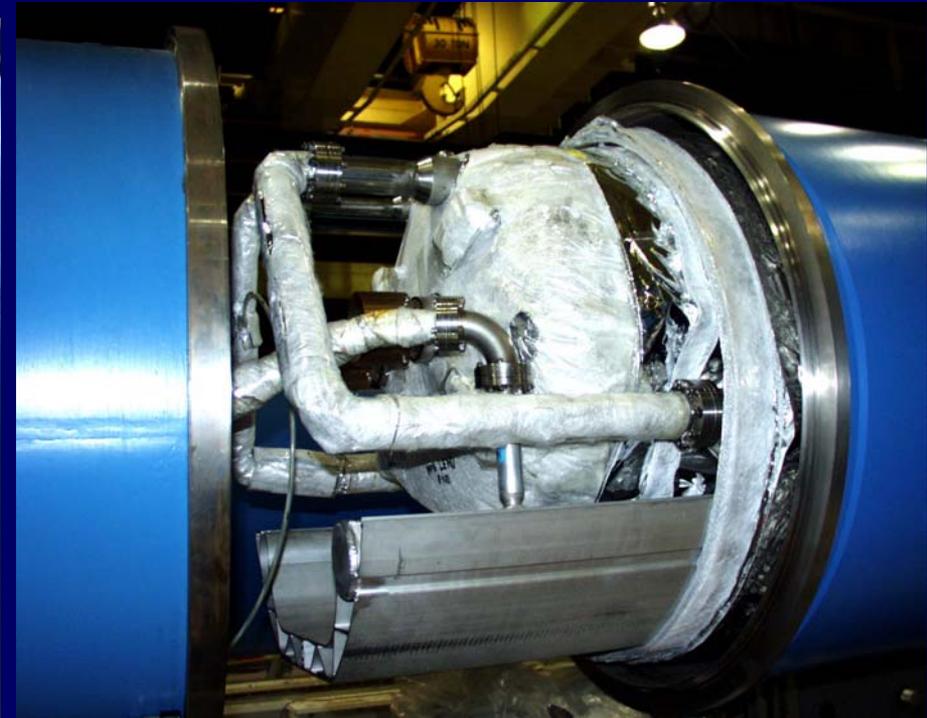
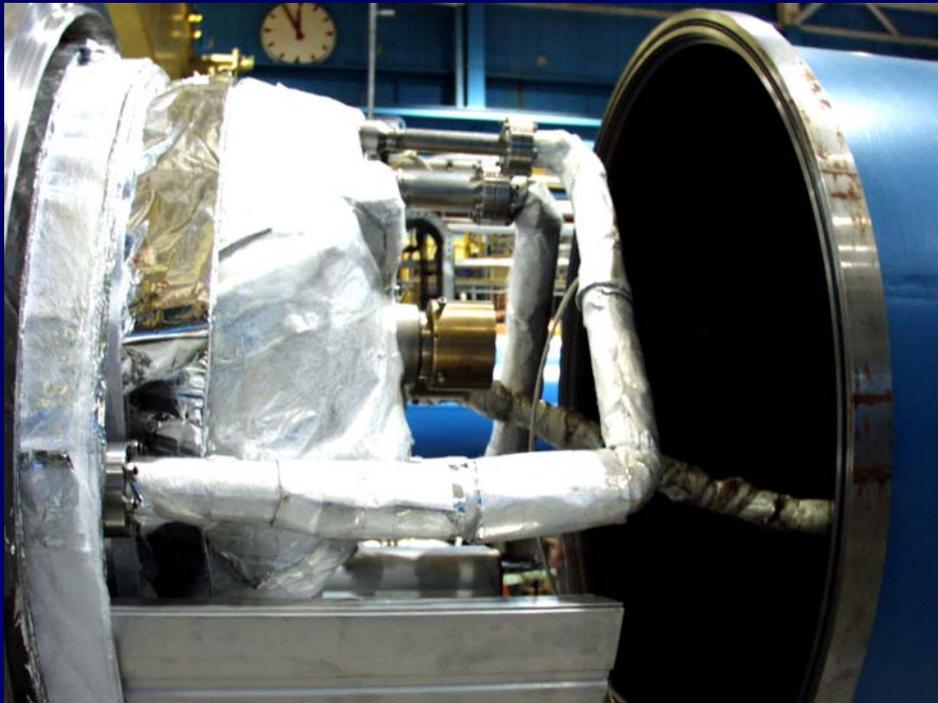
Right: JT supply non-lead end - lower filter, JT supply - lead end upper filter.



# Piping Connection in the Non-Lead End of D2L106

Left: Cooldown / Warmup Supply

Right: Non-Lead End JT supply



## Operation (5/30 – 6/10)

- 5/30 Close vacuum enclosure. Pump on insulating vacuum.
- 6/2 Weld connector for feed through. Start 1<sup>st</sup> Pump down.
- 6/3 Complete pump and purge
- 6/4 Electrical connection, set up for warm measurement
- 6/5 - 6 Warm measurement
- 6/7 – 8 No work in weekend
- 6/9 – 10 Warm measurement

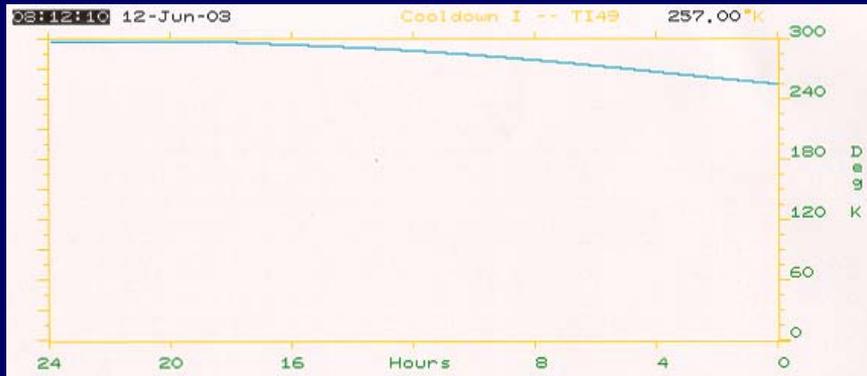
## Operation (6/11 – 16)

- 6/11 Start Cooldown I at 2:30 PM
- 6/12 Cooldown is rather slow. Observe large pressure drop between supply line and D2. Suspect due to contamination of filter. Pressure drop disappear after venting DOV804 a few times. Continue CDI.
- 6/13 CS5 tripped around midnight due to Thunder. Resume Cooldown at 8 AM.
- 6/14 Frost badly on Feed Can, Vacuum Bellow and End Can. Believed due to failure of LN<sub>2</sub> system in the cryostat. Stop CD I.
- 6/15 Drift
- 6/16 Confirm that no helium in insulating vacuum. Proceed warmup.

## Operation (6/17 - 19)

- 6/17 Warmup for D2L106 essentially complete, Middle section CERNOX reaches 296 K, Lead End ~ 281 K, Stop warmup and reduce pressure in D2, Open vacuum enclosure, Find leak on the joint between the bi-braze coupling and the end plate of the aluminum shield line.
- 6/18 Leak is repaired, Pass vacuum leak check, Bracket carefully mounted to make sure no stress is imposed on the pipe, Pump on insulating vacuum
- 6/19 Establish insulating vacuum

# Cooldown from 300 – 100 K for D2L106 (6/11 – 6/14/03)

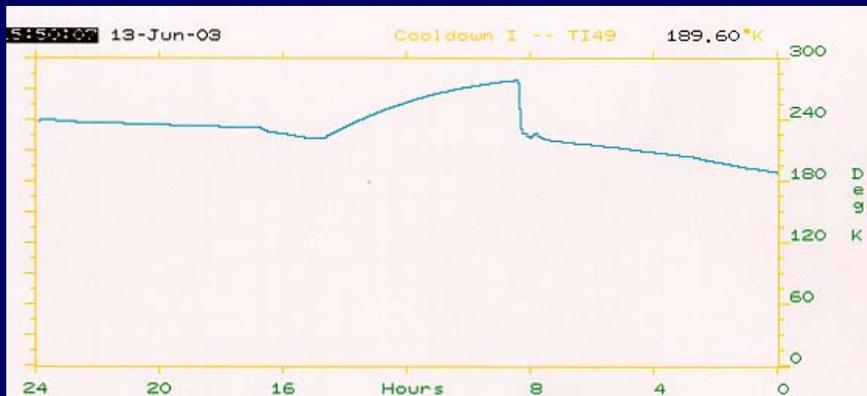


- Cooldown rate:

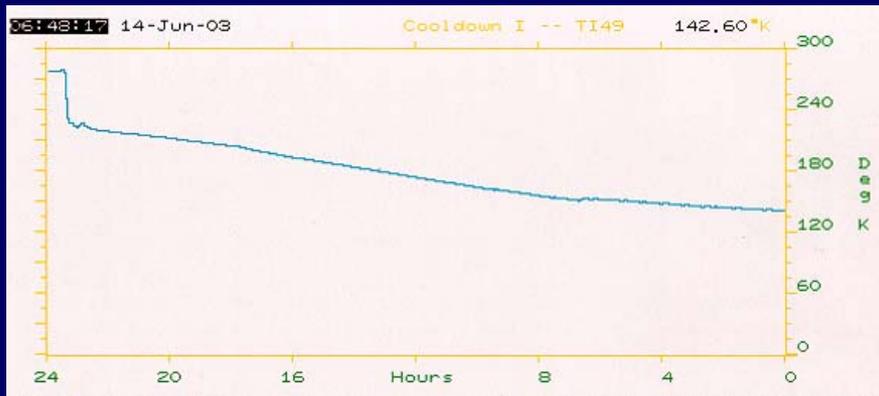
- ~ 2.5 K/hour 300 – 210 K

- ~ 5 K/hour 210 – 150 K

- ~ 1.5 K/hour 150 – 140 K

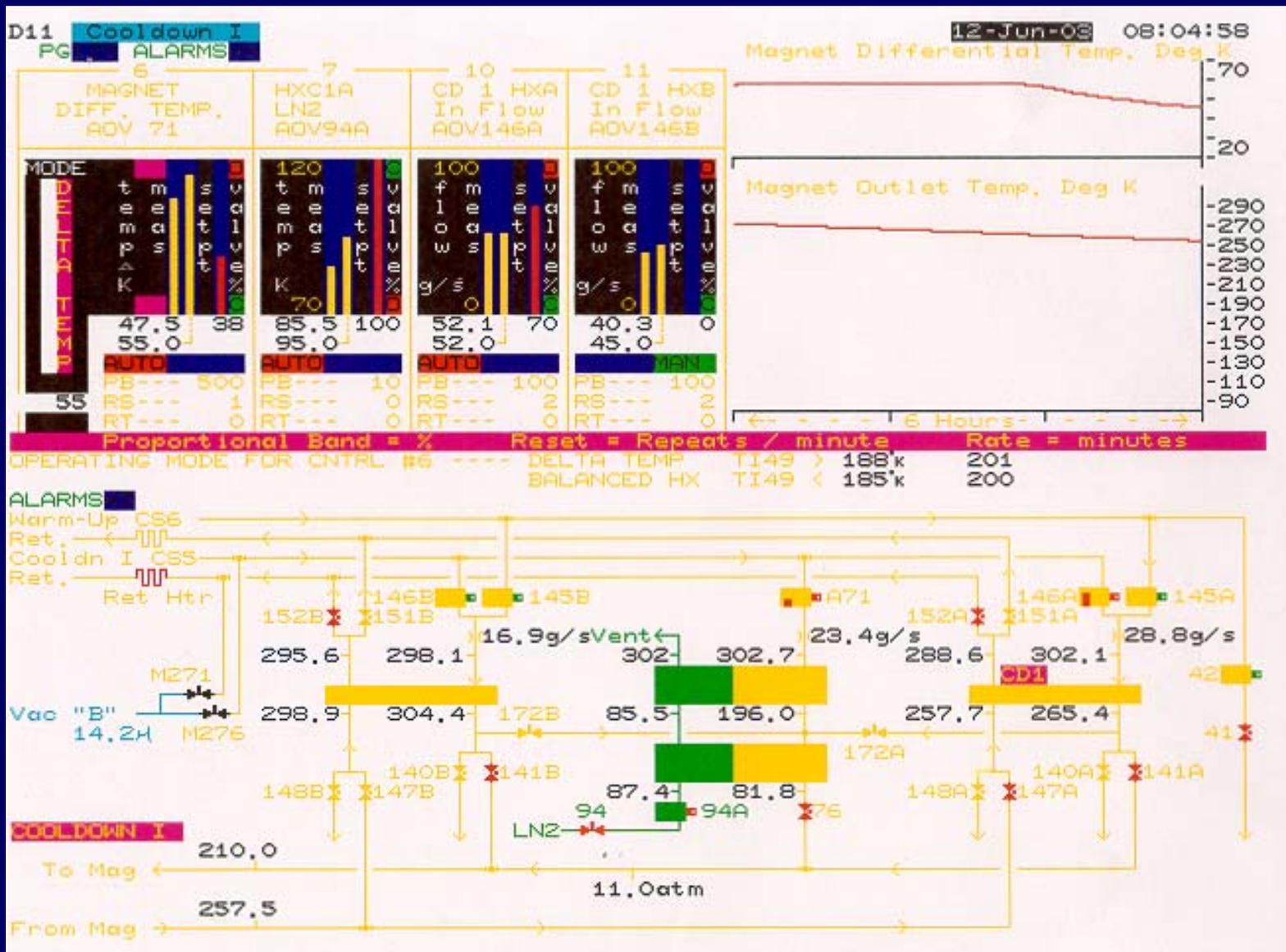


- Cooldown compressor CS5 tripped midnight 6/13. Resume CS5 and CDI at 8 AM.

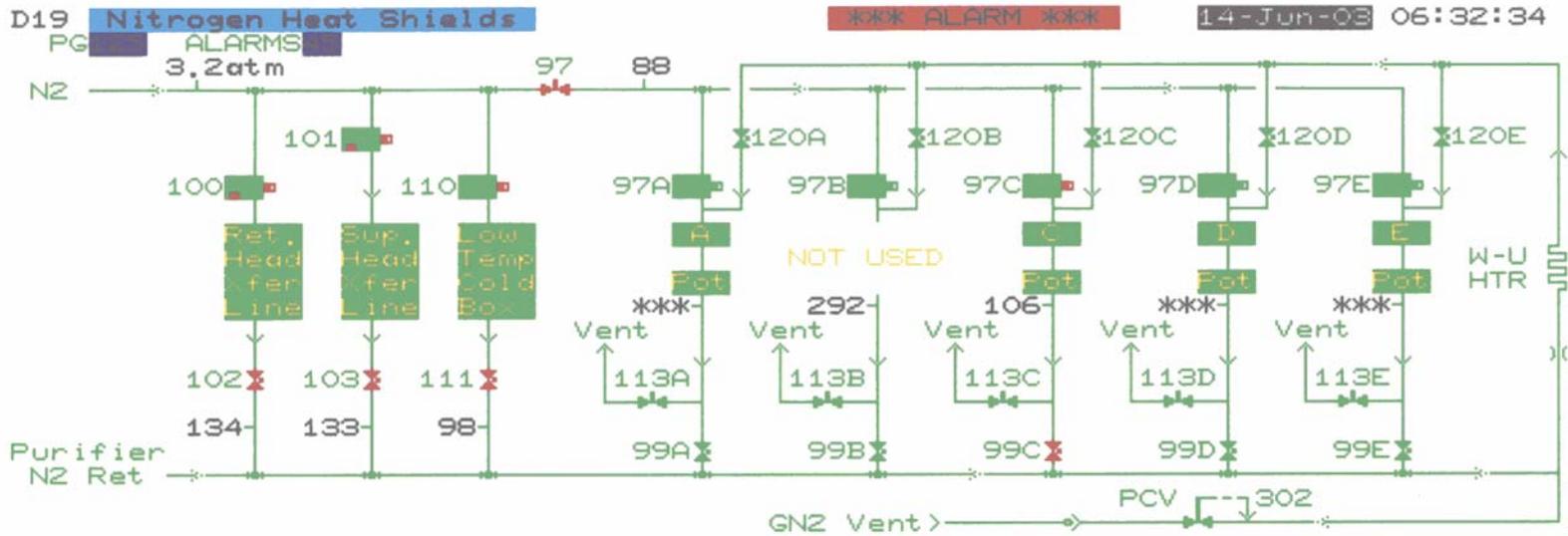


- 100 K Cooldown was terminated in the morning of 6/14 due to significant frosting on the Feed Can, Vacuum Bellow and End Can.

# Operating Condition for 100 K Cooldown of D2L106



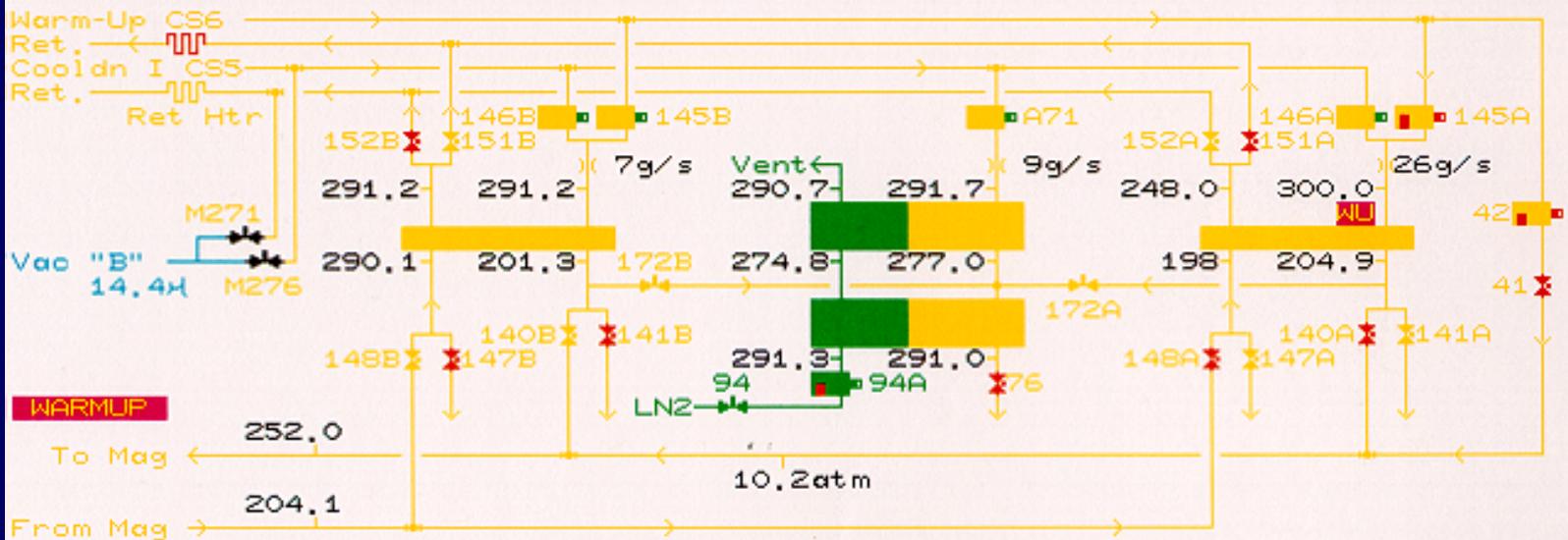
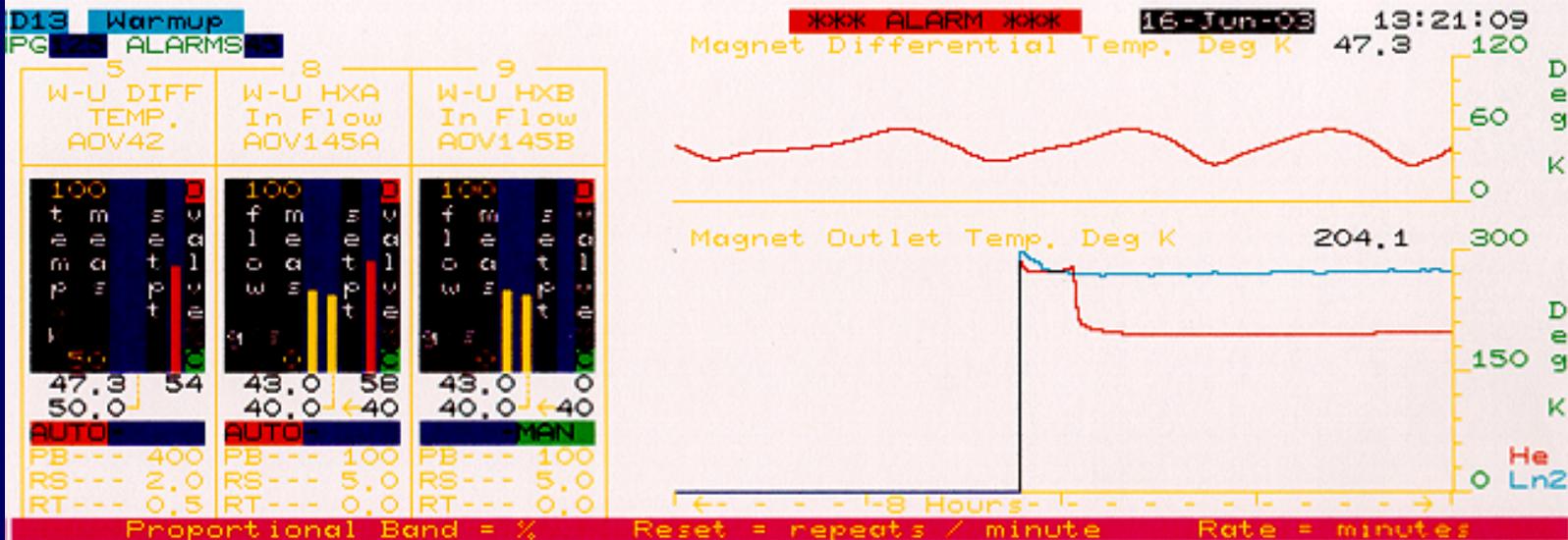
# LN<sub>2</sub> Shield for D2L106 – Date of Failure 6/14/03



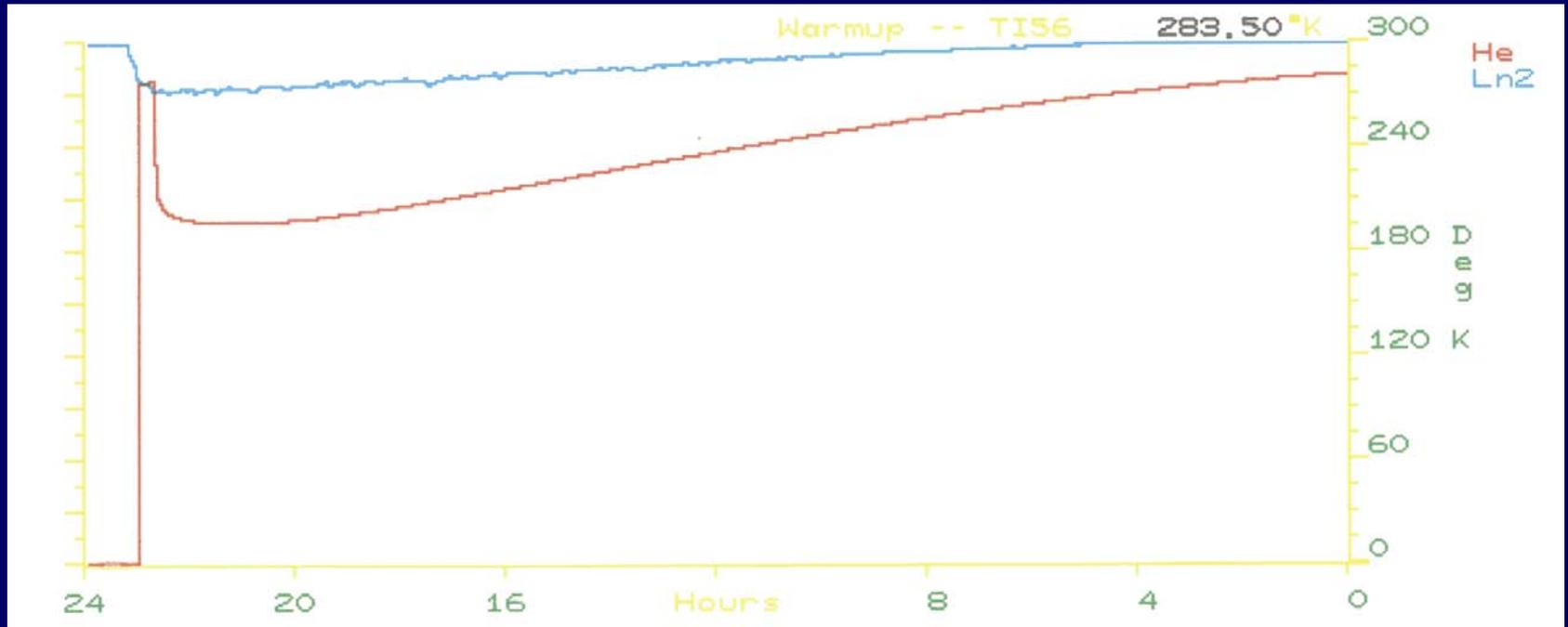
## D20 Controllers - Nitrogen Heat Shields

23	24	25	18	20	21	22
Ret Head Xfer Line A-100	Sup Head Xfer Line A-101	Low Temp Cold Box A-110	Stand A Magnet A-97A	Stand C Magnet A-97C	Stand D Magnet A-97D	Stand E Magnet A-97E
133.5 67 130.5	132.6 73 130.0	97.7 100 130.0	***** 100 110.0	105.5 100 110.0	***** 100 110.0	***** 100 110.0
AUTO	AUTO	AUTO	MAN	AUTO	MAN	MAN
PB-- 200	PB-- 200	PB-- 200	PB-- 200	PB-- 200	PB-- 200	PB-- 200
RS-- 30.0	RS-- 30.0	RS-- 30.0	RS-- 30.0	RS-- 30.0	RS-- 30.0	RS-- 30.0
RT-- 0.0	RT-- 0.0	RT-- 0.0	RT-- 0.0	RT-- 0.0	RT-- 0.0	RT-- 0.0
Proportional band = %			Reset = repeats / minute			Rate = minutes

# Process Control for Warmup D2L106 – 6/16/03



# Warmup of D2L106 – from 165 to 285 K in ~ 22 hours



# Inspection Result

- After D2L106 was warmed up, the vacuum enclosure is opened for inspection. Find leak on the joint between the bi-braze coupling and the end plate of the aluminum heat shield line.

## Repair Status – 6/19

- Leak is repaired. Pass vacuum leak check. Repair joint will be pressure tested after the magnet test.
- Carefully mount the supporting bracket. Make sure no stress is introduced on the piping system and pipe is easy to slide through the hole of the bracket.
- Establish insulating vacuum and ready for cooldown. However, check on electrical system and measuring device may be needed since D2L106 was cooled to  $\sim 130$  K and welding work was performed.