

CM1 Thermal Cycle



- **CM1 Warmup**
 - 1/4/12 (Wed.) to 1/6/12 (Fri.) (~50 hours)
 - Uneventful

- **CM1 Cooldown**
 - Began 1/9/12 (Monday)
 - At 15:16 on 1/10/12 a vacuum burst occurred while Nitrogen Shields were at ~ 120K and the insulating vacuum suddenly declined from 1E-6 to 3 Torr.
 - Safety interlock system closed gate valves, protecting turbo pumps and RGA.

Diagnosis of Problem



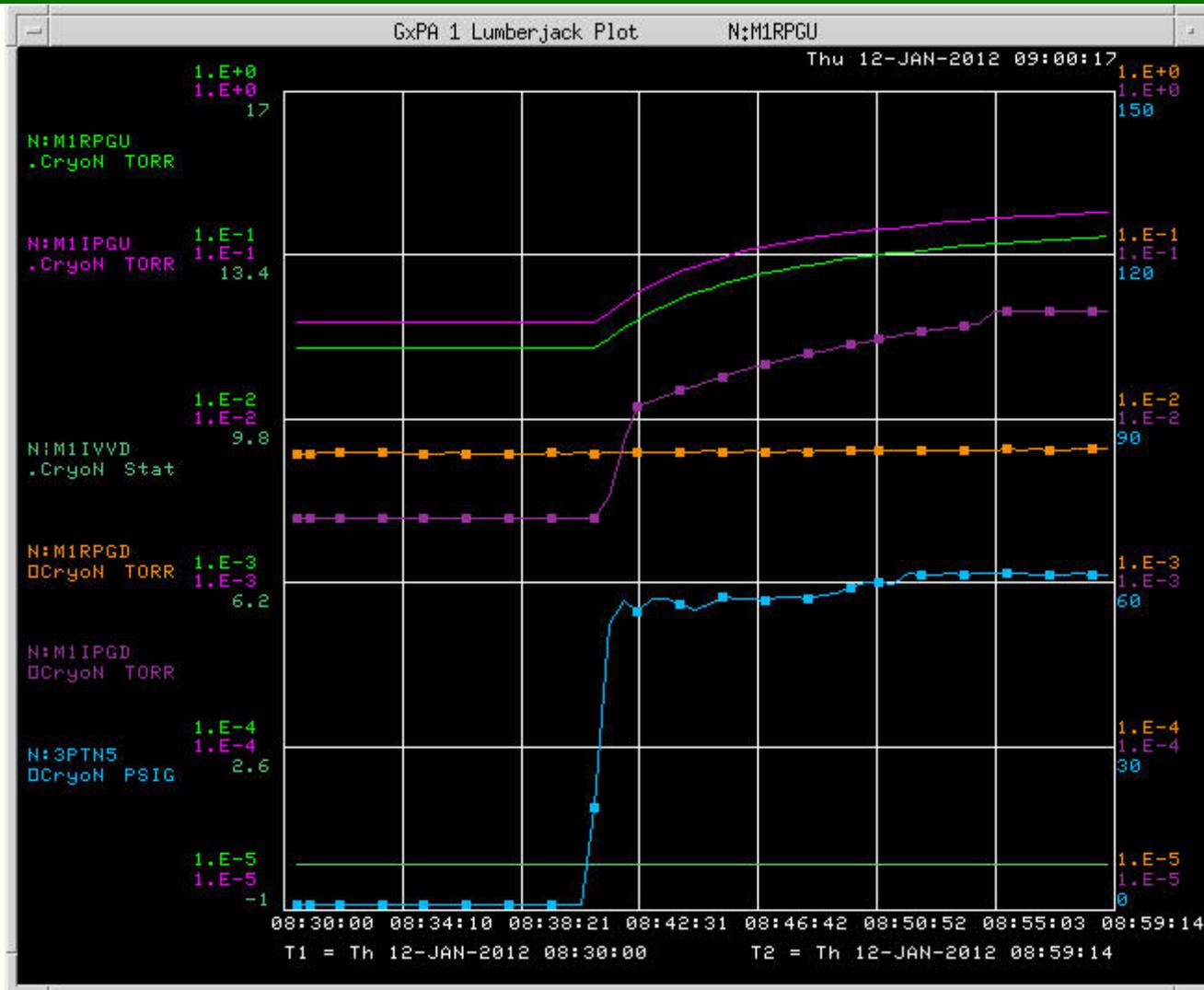
- **Investigation**

- 1/10 evening shift and 1/11 day shift conducted studies that determined it was a leak from Nitrogen circuit to insulating vacuum
 - Installed roughing pumps on insulating vac. and connect RGA via bypass line to insulating vacuum space.
 - Used RGA and vacuum gauges to test each of the circuits (2 He. And 1 Nitrogen)

- **Results**

- Both Helium circuits showed no response (Good)
- Nitrogen circuit showed a direct vacuum and RGA response
- Vacuum was worse at upstream end of CM1

Pressurizing Nitrogen

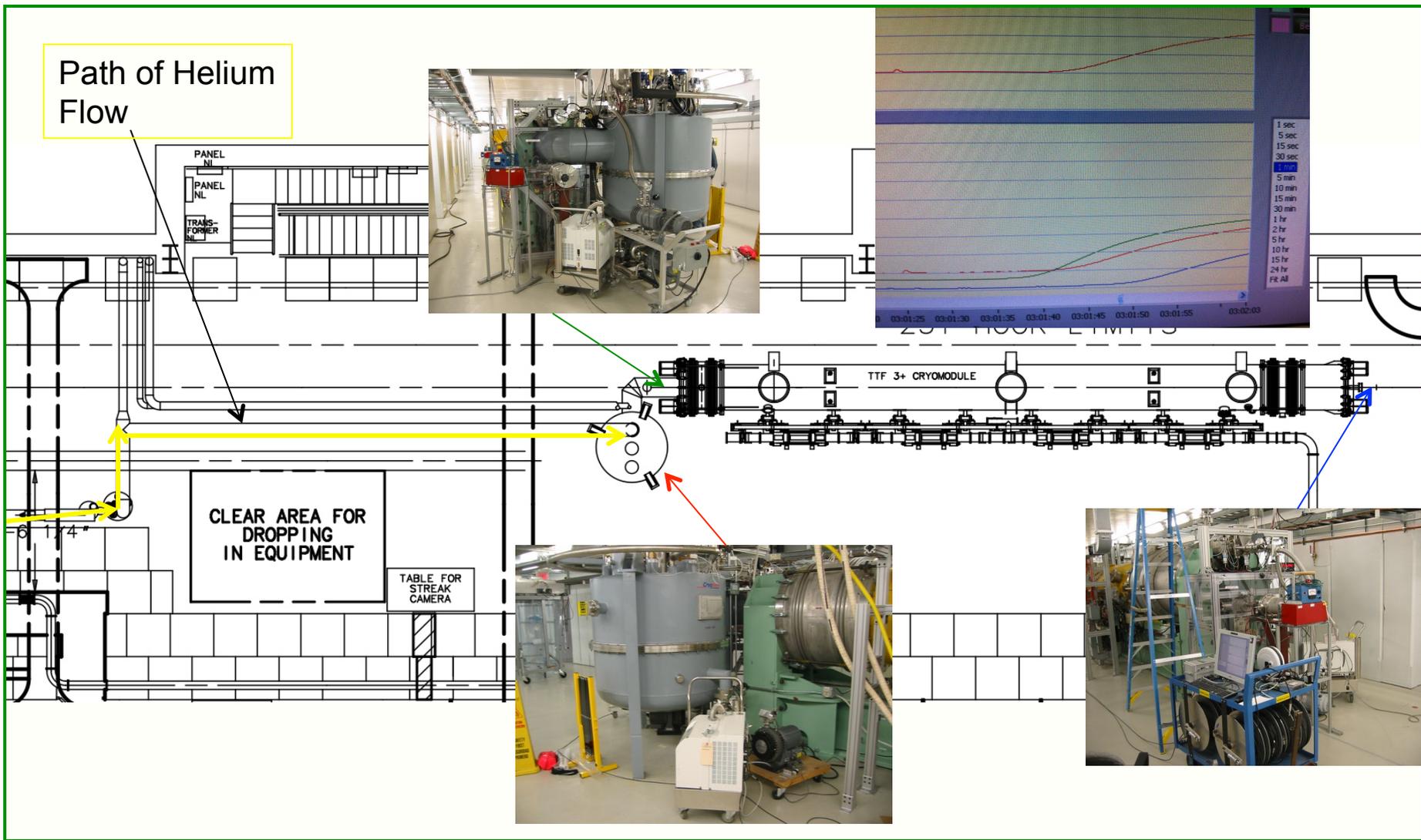


Detailed Investigation

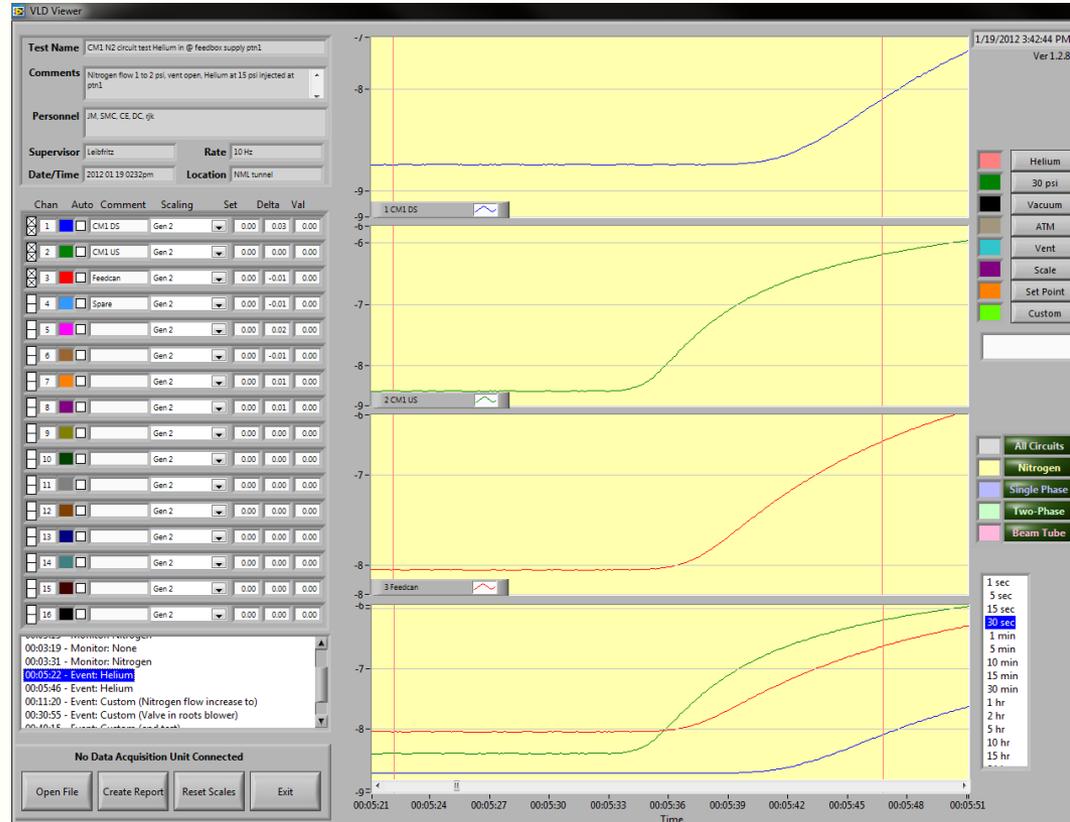


- **Next Step**
 - Since leak was big enough that there was no hope of recovering insulating vacuum and/or cooling down 80K shields, decision was made to warm up, locate leak, and repair.
- **Pinpoint Leak**
 - Involved Cryo, TEV, and NML vacuum experts in leak checking system.
 - At Room temp., first verified warm leak, then connected (3) leak detectors (upstream, downstream, and on feedbox) tied into TEV chart recording cart, to give real-time comparison of response by each detector.
 - Flowed trace amount of helium into Nitrogen circuit from upstream feedbox and monitored response on leak detectors.

Leak Check of CM1



Plot of He Leak Check



- The leak detector test with helium showed the feed cap interface (green) responding first, followed by the feed can (red), and the end cap (blue). The delay is ~10 sec.

Additional Leak Checks

- **Leak detector positions were swapped and test was repeated**
 - To verify the results were not equipment dependent (slower response time, etc.)
 - Results were consistent with first test
- **Additional tests were done to try to pinpoint if leak was in supply or return line**
 - Introduced He from downstream end, with supply line pressurized with Nitrogen and return line venting (to force He to only go through return-line path)
 - Introduced He into downstream end, with Nitrogen supply off (to repeat initial test, but with He coming from other end)

Repair

- **Leak check and vacuum readings were all consistent and point towards leak at upstream interconnect region, supply side (possibly weld, bellows, or feedthru?)**
- **Repair Plan**
 - **Isolate all gas sources ✓**
 - **Vent CM1 insulating vacuum ✓**
 - **Open upstream bellows ✓**
 - **Remove insulation and shields to expose Nitrogen interconnects**
 - **Inspect and leak check as necessary to find leak**
 - **Repair leak**
 - **Certify repair**
 - **Close up and cooldown?**
 - **Consider adding seals to interconnects in future?**

Additional NML Status/Pictures

- **CC1 transported to MP9, End Covers removed, Alignment as-found complete**



Epoxy Coated Floor



CMTF



CMTF – Compressor Build.

- **CMTF**
 - **TEV oil separators being sandblasted, painted, positioned**



NML Complex – Courtesy of T. Nicol

