Fermilab's Horizontal Test Stand Cryogenic System Upgrade and Commissioning

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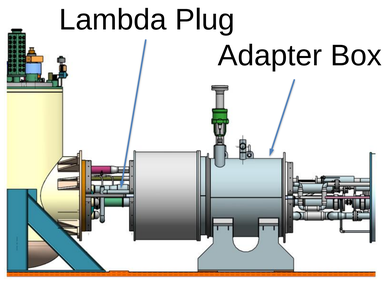
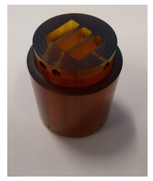
Overview



The original test stand, shown at the above left, included a cryogenic feed box that directly interfaced with LHC interaction region quadrupoles. An upgrade of the test stand was required to accommodate the testing requirements of HL-LHC cryo-assemblies. As shown in the above right, this upgrade included an Adapter Box, a lambda plug, and redesigned interconnects.

Adapter Box and Lambda Plug



The Adapter Box provides an interface between the feed box and the new HL-LHC cryo-assemblies. An LHC lambda plug design was modified to incorporate additional buswork. Together, they provide the interface between 4.5 K and 1.9 K helium volumes. This was previously accomplished using a lambda plate in the feed box. Using a lambda plug instead of the lambda plate reduces the 1.9 K volume and allows the cryo-assembly to reach higher pressure following a quench, not limited by the lower pressure rating of the feed box. This better approximates the HL LHC tunnel conditions.

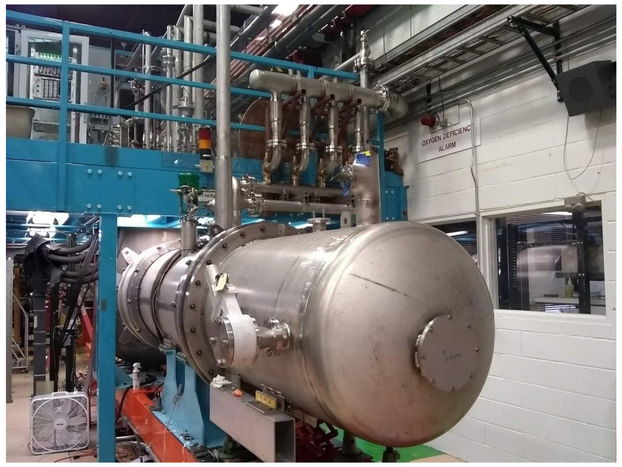
Piping

The test stand upgrade included piping system upgrades, including:

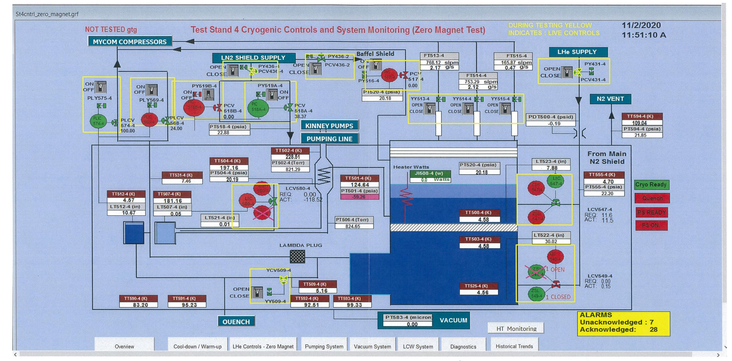
- New U-tubes supplying cryogens (left),
- An LN2 bath and mass flow controllers for controlled cool-down/warm-up (center), and
- New cool-down return, quench recovery, and pressure safety valve systems (right).

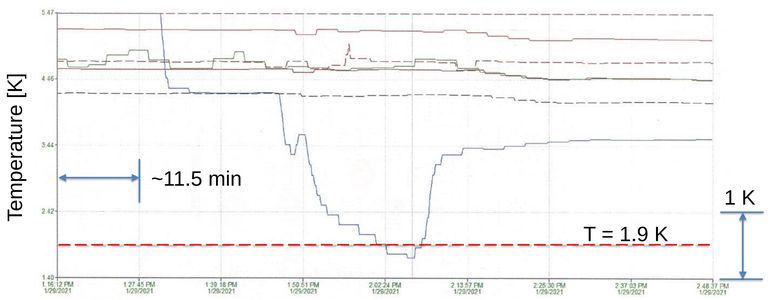
Zero Magnet Test

A zero magnet test was successfully conducted to verify functionality of systems before the start of production testing. The upgraded test stand was cooled down and all combinations of the three vapor-cooled current leads in the feed box were powered.



Process Controls





A Siemens 545 PLC was replaced with a Siemens S7 PLC for cryogenic process control. The original operator interface screens and historical data collection using Intellution Fix32 were upgraded to GE Digital iFix. A test stand monitoring screen and a historical plot showing cooldown of the upgraded pumping line to 1.9 K (blue line) are shown above.

Conclusion

The Fermilab horizontal test stand has been upgraded and successfully operated in a zero magnet test configuration in preparation for production testing of HL-LHC cryo-assemblies.

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