Commissioning of the Helium Cryogenic System and LN_2 Transfer System in the TPS Ring

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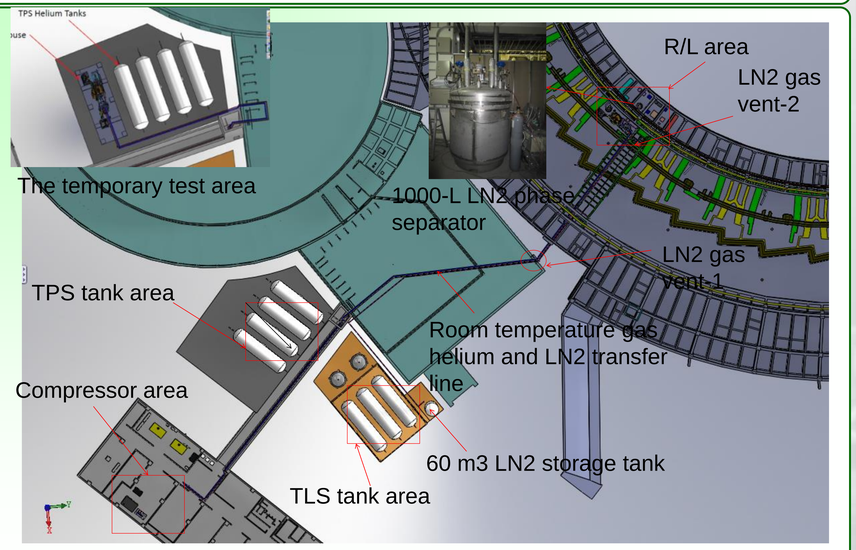
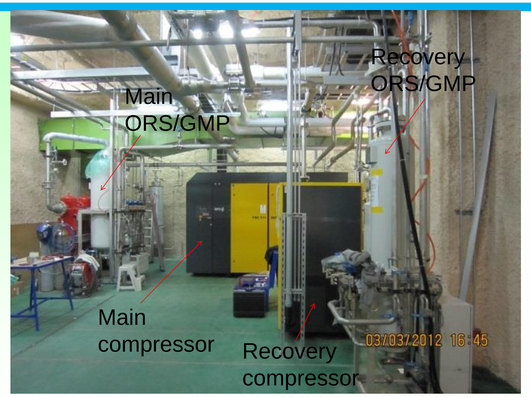
Abstract

Because civil construction was delayed, a separate test area for a refrigerator and liquefier (R/L area) was constructed for the assembly and testing of a TPS helium cryogenic system in year 2012. In 2012 March the TPS helium cryogenic system was installed and tested in the test area with a transfer line for liquid nitrogen (LN_2) without a vacuum jacket in 2012 October. Completion of the civil construction of the TPS ring enabled installation of the system in mid 2013. The cryogenic system in the R/L area was then disassembled and relocated from the R/L test area to the TPS ring. The vacuum-jacketed LN_2 transfer line with a phase separator was installed in 2013 November. We present here the results of disassembly, reinstallation and recommissioning of the cryogenic system. The testing of the functioning and the heat load of the transfer line and phase separator for LN_2 is also discussed.



Layout Over View

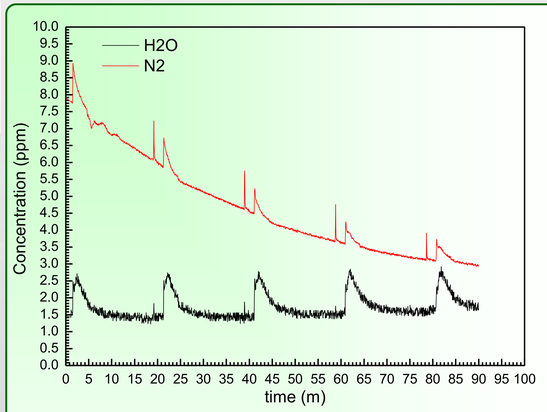


The compressor area

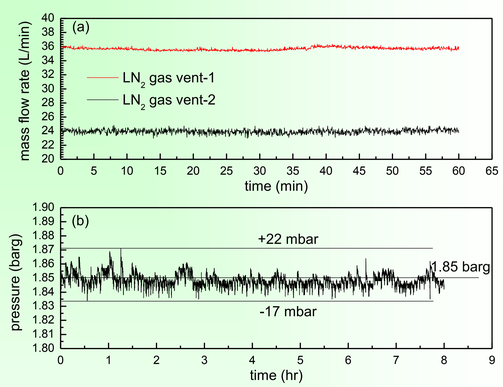
The R/L area

Summary of performance in various modes of operation

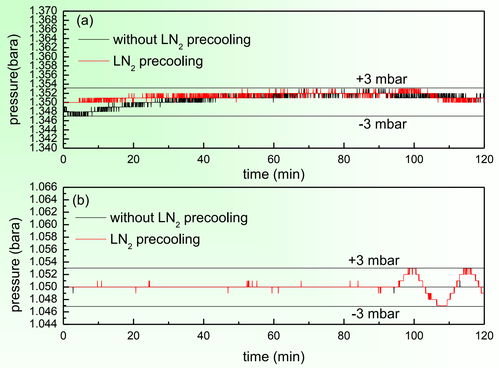
Mode	Dewar Pressure	LN2 precooling	Test Result
Liquefaction	1.35 bara	No	72 l/hr
Liquefaction	1.35 bara	Yes	239 l/hr
Refrigeration	1.35 bara	No	544 W
Refrigeration	1.35 bara 1.35 bara	Yes	890 W
Mixed (Liquefaction + Refrigeration)	1.35 bara	Yes	870 W and 35 l/hr



One mobile cryogenic adsorber and dryer was implemented at the bypass loop of the discharge line and the suction line at the compressor area. A partial flow at 3 g/s and 6 g/s passes through the mobile cryogenic adsorber and dryer, respectively, to trap the moisture and impurities. It is seen that the temporal variation of concentration of moisture and gaseous nitrogen: the gaseous nitrogen was trapped effectively in the mobile cryogenic adsorber; the concentration decreased from 8 ppm to 3 ppm within 90 min. The concentration of H_2O seemed not to alter during this period, perhaps due to the resolution constraint of the multi-component analyzer.



A mass-flow meter was installed at the outlet of the two gas vents. The mass flow rate was measured under conditions of isolation of the LN_2 pipeline from the 60-m^3 storage tank and 1000-L LN_2 phase separator after the inner line was filled with LN_2. The total mass flow rate was 59.8 L/min; the corresponding heat loss was 213.6 W. The pressure was controlled with a gas ventilation-control valve and a gas compensation-control valve. Figure 4(b) shows the pressure stability of the 1000-L LN_2 phase separator; the pressure fluctuation was controlled in the range +22 to -17 mbar with 1.85 barg operating pressure, which was better than the requested ±50 mbar from the SRF cavities.



the pressure stability of the suction line was within ±3 mbar bandwidth and gave better control than with the main Dewar pressure, because the resolution of the bypass flow valve is better than the gas return valve of the main Dewar.

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