CRYOGENIC INSTALLATION STATUS OF THE "CRYHOLAB" TEST FACILITY

H. Saugnac, S Bousson, P. Blache, C. Commeaux, N. Hammoudi, T. Junquera, Institut de Physique Nucléaire Orsay, 91406 cedex, France
D. Braud, H. Safa, P. Sahuquet, D. Loiseau, D. Arranger, J. Belorgey, CEA Saclay/DAPNIA/SEA, Gif-sur-Yvette, 91191 cedex, France

Abstract

In the field of SCRF activities the IPN cryogenic group, associated with the SEA and the SIG group of CEA Saclay has designed and built “CRYHOLAB”, a facility dedicated to the test at full power of SCRF cavities and associated components. The cryostat, 2.5 m long and 1 m diameter, is able to cool 5 cells 700 MHz cavities equipped with their helium tank and cold tuning system. Two lateral 500 mm ports allow the insertion of power couplers of various design.

The cold feed box, placed onto the cryostat, and the associated cryogenic utilities (liquefier, cryogenic pipes and the 2 K bath pumping system) are designed to evacuate about 70 W dissipated on the cavity walls at 2 K.

The installation of this facility is achieved and the first cryogenic tests are currently performed. “CRYHOLAB” is scheduled to be operational for a first cavity test in October 2001.

1 INTRODUCTION

In the scope of SCRF cavity R&D the IN2P3/CEA collaboration needs a test facility to validate fully equipped cavity prototypes. These tests require high cryogenic power associated with a cryostat capable to cool various design of cavity and power couplers. The final set up, featuring instrumentation, control/command and the cryogenic utilities has been achieved in July. The installation has been cooled down at 2 K recently and demands more tests, scheduled for the end of September to adjust the control parameters.

The paper describes the cryogenic components of this installation.

2 CRYOSTAT

The cryostat [1] is 2.5 m long with an useful diameter of 1 m. Two articulated doors at the extremity of the vacuum vessel allow the introduction and the connection of equipped cavities. The cavity, fixed to rolling supports, is introduced inside the cryostat by sliding on rails attached to a table cooled at 20 K.

The inner part is surrounded by a copper thermal shield cooled with liquid nitrogen.

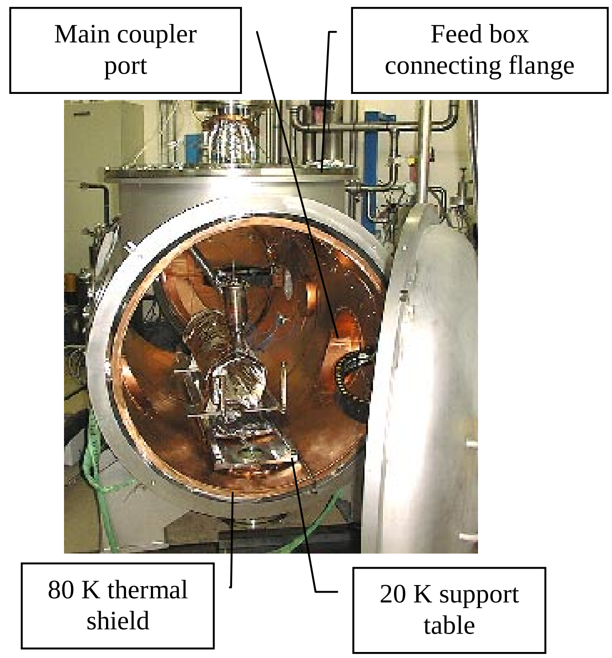

Figure 1 Cryostat

The measured static losses of the different components of the cryostat are presented below.

CRYOSTAT PARTS	LOSSES
80 K THERMAL SHIELD	~ 80 W
CAVITY SUPPORT @ 20 K	~ 3.4 W
CAVITY HELIUM TANK @ 2 K	~ 2.5 W

Tab1. Cryostat thermal losses

3 FEED BOX

The feed box (FB) is placed onto the cryostat with a 1 m diameter flange.

An annular LN2 vessel (1), with 80 l capacity, provides the coolant to the 80 K thermal shield of the cryostat cooled by open-loop thermosyphon, it also shields the 4 K part of the feed box.

The LHe vessel (2) feeds the cavity support table (3) (thermosyphon cooling) and an additional loop (4), dedicated to the main coupler cooling, allowing to evacuate about 50 W from 4.2 K to 40 K .

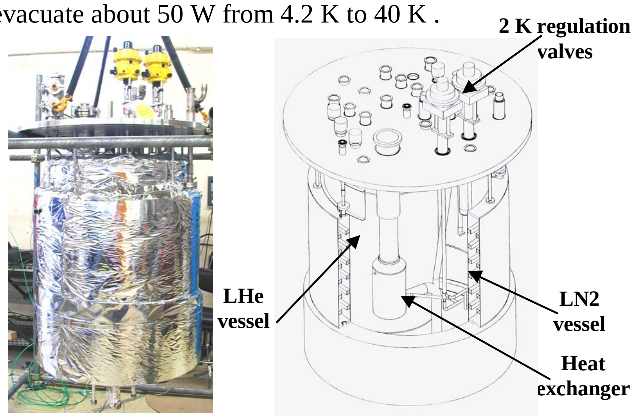

Figure 2 Feed Box

For the cavity feeding a sub cooling heat exchanger (5) limits the flash losses in the JT valves (6). Two JT valves are used to have a better regulation on the full range from 0 W to 70 W @ 2K. They regulate the level in a intermediate vessel (7), connected to the cavity helium tank.

4 CRYOGENIC INSTALLATION

The 2000 l helium (see fig.4) container (8), fed by a 120 l/h Helial (Air Liquide) liquefier (9), regulates the level of the feed box 80 l LHe buffer trough a 80 K actively shielded transfer line (10). The LN2 flow, cooling this line, regulates the level of the feed box LN2 buffer.

The cold He vapour returning via vacuum insulated lines, from the FB vessel, the cavity support table and the main coupler loop are warmed at 300 K in a water bath exchanger (11). It is then distributed toward the gas storage (12) section or directly toward the refrigeration cycle (13).

The pressure of the cavity bath is regulated by the 2 K pumping group (14) with the help of a 20 W heater situated in the intermediate cavity feeding vessel.

The pumping line (15), ~ 100 m long and 100 mm hydraulic diameter, is vacuum insulated to reduce the pressure drops. At the end of this line the cold He vapour is warmed to 300 K by passing in an electric heater (16) situated just before the pumping group.

This utility is installed at the "Orme des Merisiers" laboratory of CEA Saclay.

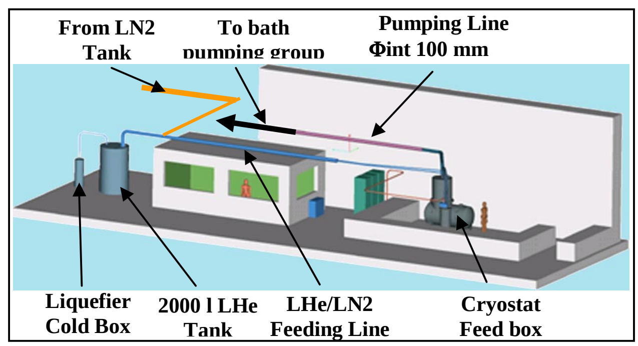

Figure 3 "CRYHOLAB" implantation

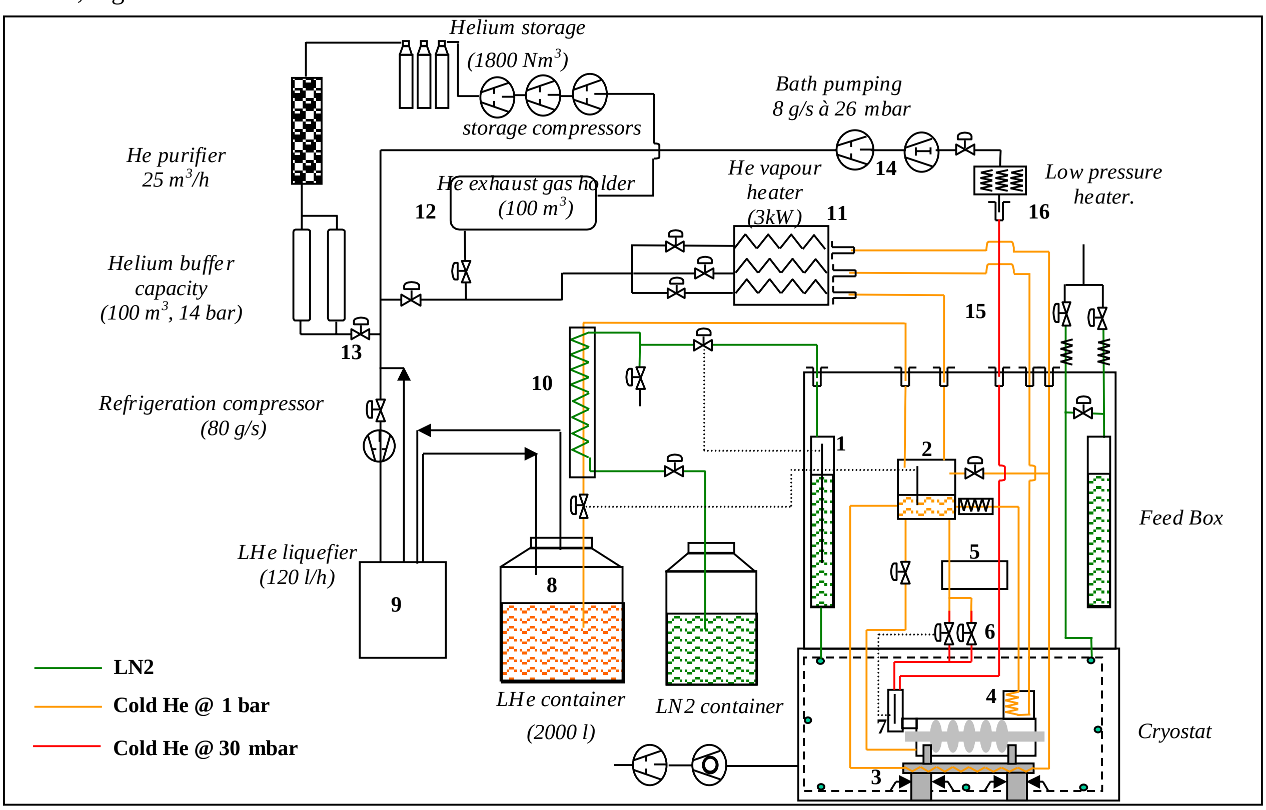

Figure 4 Flow scheme

5 PRESENT STATUS (AUGUST 2001)

First cryogenic tests have been performed to validate the mechanical components and the instrumentation of the installation. The intermediate cavity feeding vessel (3 l) was used to simulate the 2 K part and the liquid helium was fed from 500 l dewars.

The expected cooling times were verified, and leads to a cavity test schedule of :

- a week-end to cool, using LN2, the 80 K shield (~ 8 hours) and pre cool the 4 K parts (BF and support table) to about 150 K.

-24 hours to reach a quasi stationary state at 4.2K

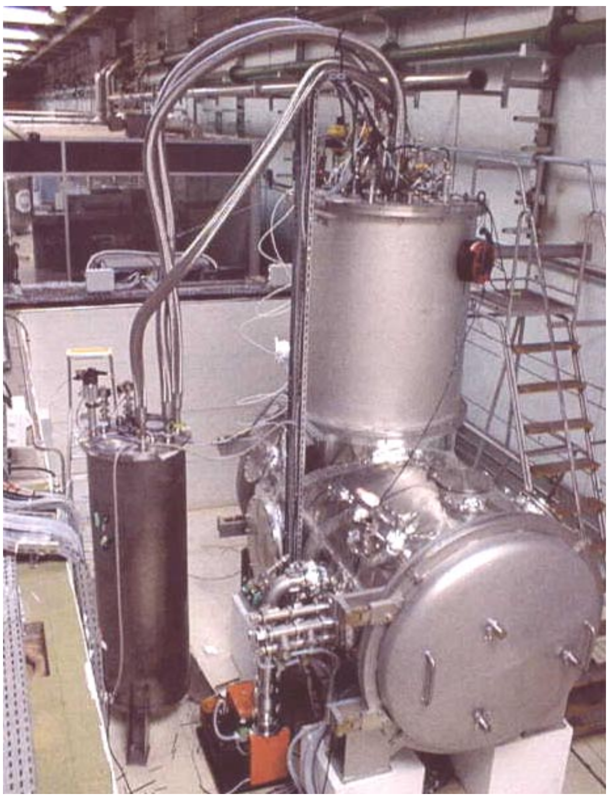

Figure 5 "CRYHOLAB" installation

The intermediate cavity feeding vessel was cooled at 1.9 K at full power (both JT valves completely open) corresponding to an evacuated power of around 100 W at 1.9 K. For these operating conditions the temperature at the entrance of the JT valves was around 2.3 K. These results validates the pumping system, including the pumping line and the JT valves maximal mass flow, and the sub cooling exchanger.

Some modifications must be done, specially concerning the LHe level measurements before performing new tests. These tests are scheduled for October with an equipped mono cell 700 MHz proton cavity prototype. Its goal will be to adjust the cryogenic control/command process having in parallel RF measurements on a first cavity prototype.

6 SUMMARY

We presented the different components of the "CRYHOLAB" cryogenic installation being completed in July. The cryogenic tests campaign is currently performed and the first cryostat cool down gave encouraging results. It would lead to a first cavity test in October.

REFERENCES

[1] "Cryholab a New Horizontal Test Cryostat for Superconducting Radiofrequency Cavities" ICEC 18 : H. Saugnac & al.