Cryogenic infrastructure for the Serial Test Facility (STF) for FAIR

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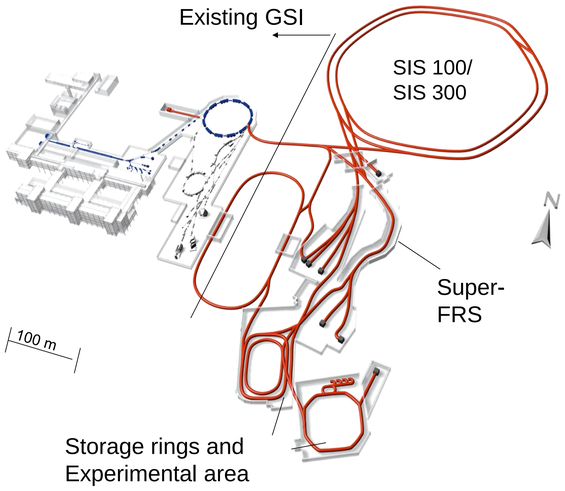
Introduction

For the planned FAIR facility there is the need to test the superconducting magnets and at least one string configuration.



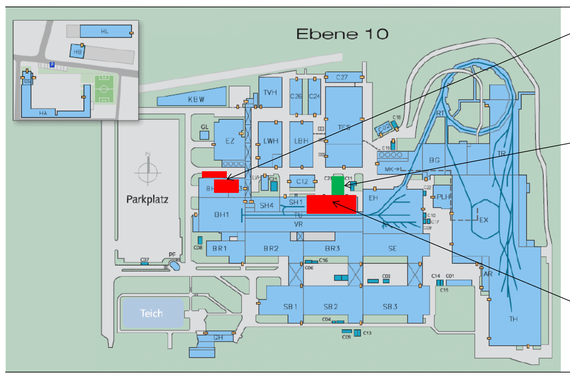
Storage rings and Experimental area

Planned FAIR site near to the GSI site

Following the actual test planning of the project, we will test the SIS 100 dipole series and SIS 100 string at GSI. In addition the cryogenic infrastructure will allow to test also SIS 100 Quadrupols and SuperFRS-Magnets (in small fractions).

Planning started in 2012, see Poster at the ICEC 2012. In meanwhile we finalized the specifications, finished the call for tender and built the needed annex building.

In order to minimize the test bench length and to make installation of the magnets easy we realized an unique design for the Feed- and Endboxes compared to the existing PTF (Prototype Test Facility).



Existing prototype test facility (PTF)

Annex building for the technical infrastructure

Series test area in the existing hall, with about 700 m²

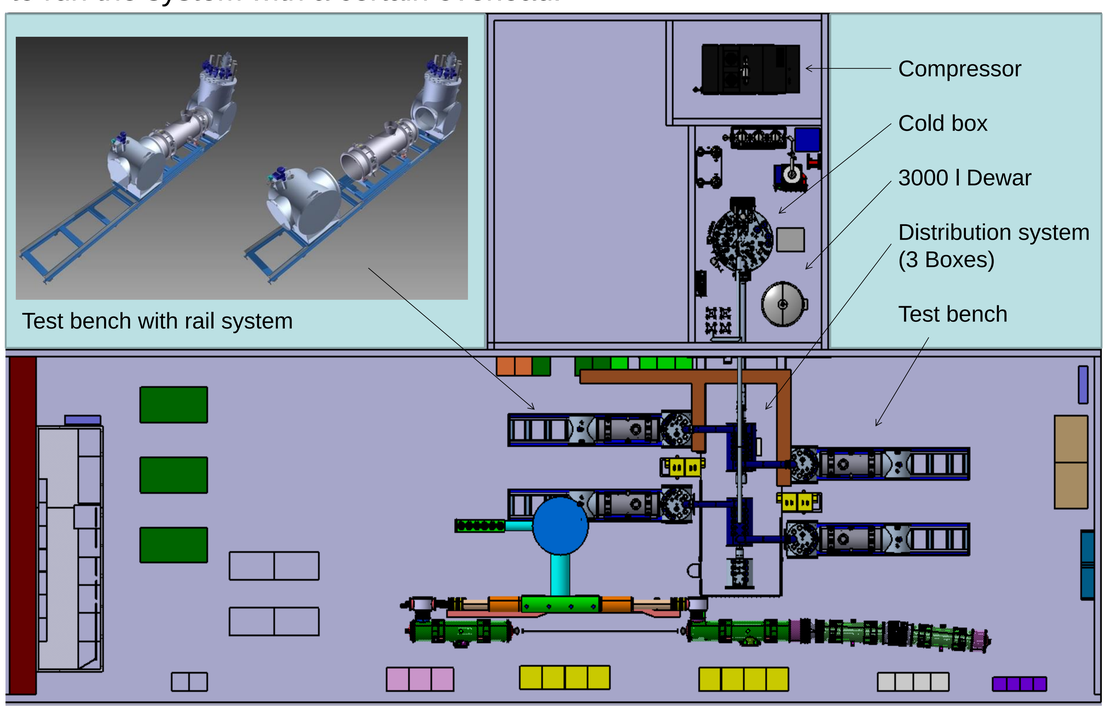
Location within the existing GSI-campus

Annex building with 100 m³ and 50 m³ Helium Tanks

The installation place is an existing hall at GSI with about 700 m². In order to have enough space for the 4 test benches and the string assembly GSI built a technical annex building. This building is housing the cryogenic infrastructure, electrical and water-cooling installations. Especially for the cryo-genics, the compressor and the coldbox is placed in the annex building.

Cryo plant:	
Cooling power @ 4,5 K	700 W
Cooling power @ 50 K – 80 K	2000W
Helium liquefaction rate	6 g/s
Max. power consumption	434 kW

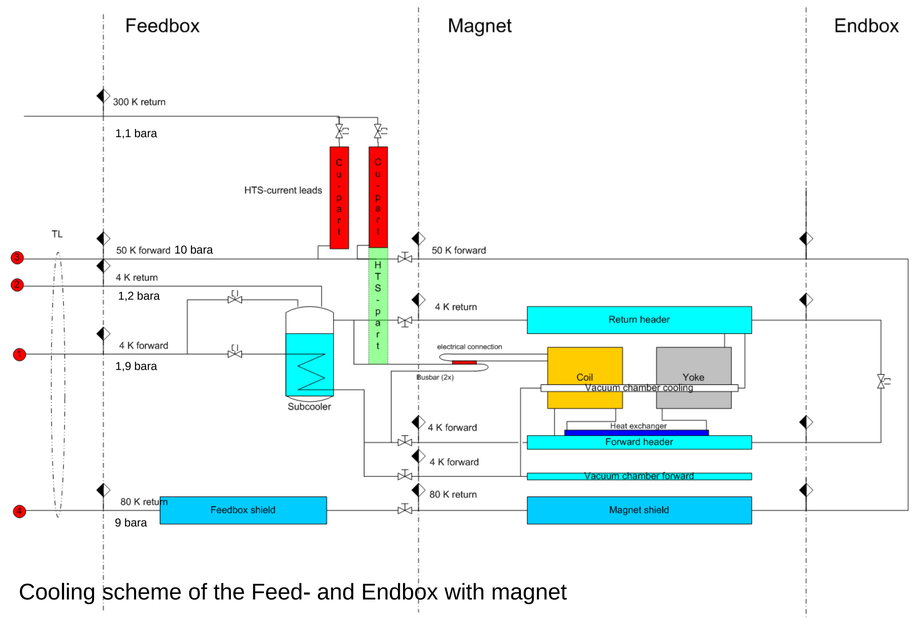
The cryo plant has an over all capacity of about 1,5 kW @ 4.5K equivalent. The distribution system is able to run all four benches independently. A 3000 l Dewar allows to run the system with a certain overload.



Test bench with rail system

Installation overview

The cooling scheme is adapted to the needs of the SIS100 Dipole Magnet. Directly in the Feedbox the subcooling of the 2 phase flow takes place. In order to simulate the parallel cooling in the SIS100 we have the possibility to bypass a part stream in the Endbox.

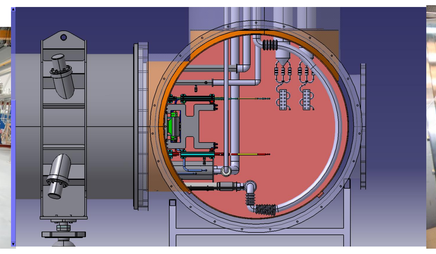


Cooling scheme of the Feed- and Endbox with magnet

Additionally there is a parallel stream used for the cooling of the inner vacuum chambers, which separates the insulation vacuum from the beam vacuum ($<10^{-11}$ mbar). These beam vacuum chambers are directly cooled in order to reach this good vacuum by using the cold surfaces for pumping (T < 18 K).

The Feed- and Endbox design is different to the one which is used in the already existing PTF (Prototype Test Facility). In order to get rid of additional flanges, to save space and to allow easy access for installation we designed the boxes in a way that the magnet penetrates into the boxes and the installation is done from the side.

Installation port open



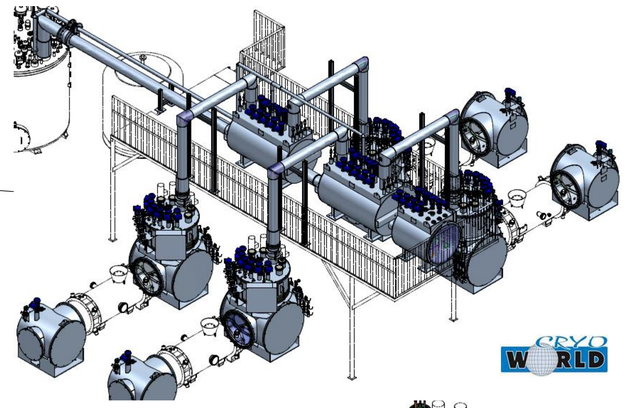
New connecting design

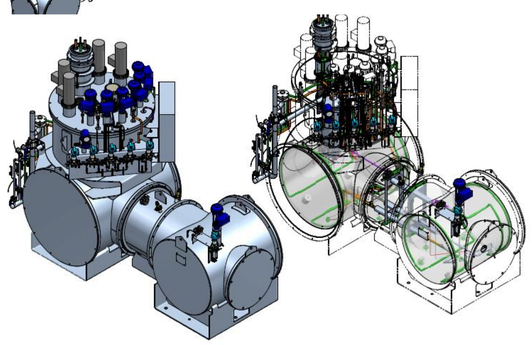
PFT-connecting design

But to allow such a design, one has to consider the forces and the movement of the components. In our system the magnets are fixed in space. Since there is no flexible bellow between magnet, Feed- and Endbox, the two boxes are slightly flexible supported. They are fixed with rubber compensators typically used for compressors. Additionally the transfer lines from the Distribution boxes to the Feedboxes have to compensate moderate movements during installation.

rubber compensators

Transfere line compensator





Complete Feed- and Endbox with commissioning mock up

Conclusion

Final installation will take place beginning KW33/2014, and should be finished 10 weeks later, so we can start commissioning end of October beginning November.

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