Cryogenic Test of the R3B-GLAD Magnet and Status of its Cryostat Production

C. Mayri, B. Gastineau, W. Abdel Maksoud, P. Charon, A. Donati, L. Genini, P. Graffin, Y. Queinec, and R. Vallcorba

IRFU, CEA Saclay, 91191 Gif-sur-Yvette, France.

Cryogenic test of the R3B-GLAD magnet

After the production of the coils and their mounting inside their casing [1] in 2010, the cold mass was built at Saclay in 2011. In addition to the assembly of the casing together with the cold mass structure, an important work was done on the electrical joints between the double pancakes of the coils. The all 27 joints were copper-stabilized then brazed with the challenge to obtain a joint resistance lower than few nano-ohms on each one. After modification of the feet swivels and production of new pieces the cold mass was ready at the spring 2012 to go inside one of the cryostats of the W7X test facility for the cryogenic test.

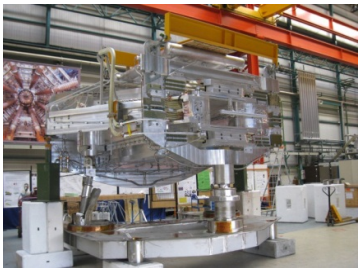

Figure 1: Cold mass on its three feet.

The cryogenic test needed a lot of improvements on the test facility which was not designed for a such big magnet. Unfortunately the first checks showed a small leak which was very difficult to localize and correct. At the present time, the cold mass is at 4.5 K. During the one month cooling down we already validated the behaviour of the feet which support the 22 tons of the cold mass and which have to accommodate the thermal shrinkage of the cold mass. At the end of the cool down, the start of the thermosiphon loops (26 lines in parallel) was also a success [2].

After final checks on the safety system the magnet will be energized soon up to the nominal current of 3584 A. Then we will check the behaviour of the magnet during the current ramping, the fast discharge and a steady state run during which the magnetic field on the axis will be measured.

Cryostat production

After its test, the magnet will be integrated inside its cryostat [3] in 2013. The cryostat production was divided in three parts and ordered at the end of 2011.

The transportation stops were designed to limit the stresses on the magnet feet during the magnet transport from Saclay to Darmstadt. They were delivered to Saclay in 2012 and will be mounted during the integration of the magnet.

The thermal shield surrounds the cold mass to decrease the thermal losses on the 4.5 K level. The panels are in stainless steel and are shared in few parts to limit the eddy current loops. The shield panels are equipped with brazed pipes in which helium gas at 50 K will flow.

The main part of the cryostat is the vacuum vessel which is under construction. This part represents more than the half of the 56 tons of the magnet weight. The shape of the vessel is rather complex and the construction implements specific technologies: electron beam welding or plate shaping by explosion.

Figure 2: Vacuum vessel and thermal shield panel under construction

The superinsulation blankets which surround the thermal shield are ordered and their final design is in progress. The parts dedicated to the satellite have been already delivered at Saclay. Then the integration of the valves and the current leads will start soon.

Figure 3: Magnet satellite

References

[1] G. Disset et al., “R3B-Glad magnet cold mass manufacture: coils and casings fabrication and integration”, MT 22, Marseille, September 2011.

[2] B. Gastineau et al., “R3B-Glad magnet R&D test program: Thermosiphon loop with horizontal section, superconducting cable joints at 3600 A, and reduced scale “coils in its casing” mock-up”, MT 22, Marseille, September 2011.

[3] P. Graffin et al., “The Cryostat design of the R3B-Glad Magnet”, MT 22, Marseille, September 2011.