

## S.C. Magnet System for a 2 MW, CW, Coaxial Cavity Gyrotron at 170 GHz



MAGNETS  
FOR FUSION



MAGNETS FOR HIGH  
ENERGY PHYSICS



MAGNETS FOR  
MEDICAL  
APPLICATIONS



SYSTEMS  
FOR ENERGY

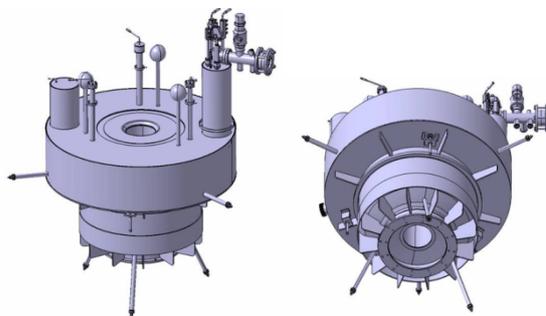


SERVICES & REPAIRS

Supply contract for the delivery of a superconducting magnet system, in the framework of the development of a 2 MW, CW, coaxial cavity gyrotron at 170 GHz for the ITER Electron Cyclotron (EC) system, a joint development effort undertaken by associations and industry adhering to the EFDA Technical Work Programme.

The scope of supply, completed in 2007, included a superconducting magnet system consisting of the magnet itself, realized in NbTi, its cryostat containing several superconducting windings, cryogenic control system, quench protection system and their relative ancillary systems necessary to operate the magnets reliably at the desired performance.

The cryostat is made of 316 L / 316 LN stainless steel components assembled by welding by ASG qualified personnel. The cryostat has been designed and manufactured according to the European pressure vessel code EN 13445. The level of vacuum inside the cryostat is  $10^{-6}$  mbar obtained using a turbomolecular pump and a rotative pump. The coil set is made of two gun coils, a cancellation coil and two asymmetric main coils. A set of four pairs of dipoles (X and Y steering coils) is placed symmetrically about the cavity centre with their axis normal to the main field direction Z, creating a transversal field able to displace the field lines of 1 mm when the magnet is operated at 50% of the nominal field. The system may be operated at a maximum current density of  $92.7 \text{ A/mm}^2$ , that produces a maximum field at cavity centre of 7.2T (8.2T on the conductor). The stored energy at maximum field is 1 MJ. The cryostat has been designed with a He vessel and a boil off rate such to allow 24 h of operation at nominal field plus 72 h at zero field. The helium vessel has been tested to a leak rate better of  $2\text{E-}9 \text{ mbar}\cdot\text{l}/\text{sec}$ .



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| Nominal field at cavity centre           | 6.86 T   |
| Maximum operating field at cavity centre | 7.2 T  |
| Maximum field on conductor               | 8.2 T at 1.05 of nominal field   |
| Stored energy                            | 1 MJ at maximum operating field  |
| Nominal operating current (main coils)   | 88.3 A   |
| Coil configuration                       | 2 gun coil, 1 bucking coil, 2 main coils, 2 pairs of X dipoles (steering coils), 2 pairs of Y dipoles (steering coils) |
| Top plate diameter                       | 1400 mm  |
| Total weight                             | 2.3 t  |



**Gyrotron system ready for shipment**



**Gyrotron magnet system operating at Customer's site**