P.4: Commissioning of test cryostat for qualification of superconducting magnets

Superconducting insertion devices are under development at RRCAT as part of ongoing Indus-2 upgradation program. This also serves as a vital technological foundation for the state-of-the-art insertion devices required by the proposed High Brilliance Synchrotron Radiation Source (HBSRS). The development of Superconducting Wavelength Shifter (SWLS) and Multi-Pole Wiggler (MPW), both having superconducting magnets at their core, is in advanced stages. A liquid helium (LHe) pool type cryostat for the qualification of superconducting magnets is one of the critical requirements for the development of these insertion devices.

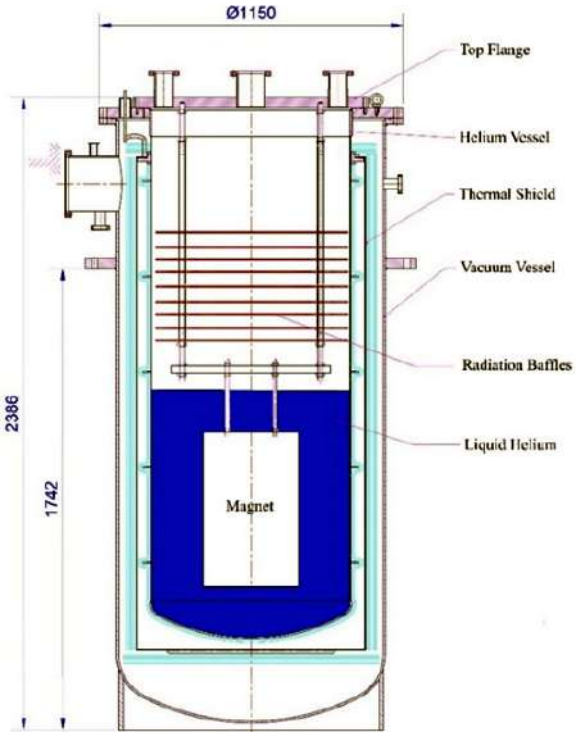

Fig. P.4.1: Dimensional Schematics of the cryostat

Magnet test cryostat consists of three thermal boundaries viz, vacuum vessel at room temperature, helium vessel at 4.2 K and an intermediate LN2 cooled thermal shield at 80 K. A 10-layer Multi-Layer Insulation (MLI) wrapping on helium vessel and 30-layer MLI wrapping on thermal shield are provided for reducing radiative heat leak. Insert assembly for placing the magnets in LHe pool, consist of top cover, magnet suspension rods, radiation baffles and helium gas displacer foam. Cryostat was designed in-house at RRCAT and fabricated by an Indian manufacturer. Cryostat was interfaced with the existing cryogen transfer line and helium recovery systems and successfully commissioned by cooling it down to 4.2 K temperature followed by collection of liquid helium. Superconducting joints immersed in the LHe pool were tested and successfully qualified in the cryostat.

Fig. P.4.2: (a)Test Cryostat, (b) Insert assembly.

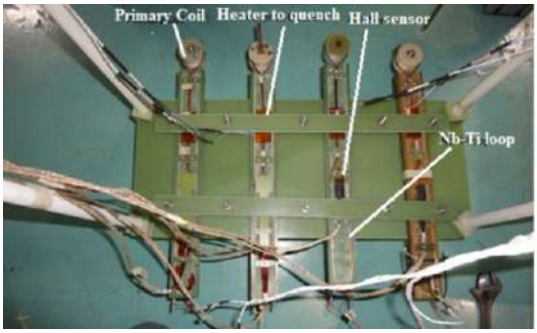

Fig. P.4.3: Measurement of Sc joint resistance.

For the measurement of SC (Nb-Ti) wire joint resistance, a system is created using a primary coil (1500 turns, L~25.6 mH) that is mutually coupled with a secondary loop of Nb-Ti wire (2 turns, L~1.3 H), with the loop ends joined through ultrasonic welding. Four such joints are made and placed inside the cryostat. The primary coil is energized with 1- 4 A DC current keeping the SC loop in resistive state using a heater connected to it. When the primary current reaches to a peak value, the heater is switched off to make the SC loop to reach into superconducting state. Once the SC loop becomes superconducting, the current of the primary coil is suddenly switched-off, thus an induced current is generated in SC loop which is read by the Hall sensor placed in the middle of SC NbTi loop. By knowing the exponential decay of Hall voltage with respect to time and the known value of the inductance of NbTi loop, the resistance of ultrasonic welded wire joint is calculated. The maximum values of the joint resistances are found in the range of 1.9 n (multiple overlap joints) to ~5 n (single overlap joint)

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