Mechanical Engineering Section

A large, horizontal, single Radio Frequency (RF) resonator cavity system is designed for 5.5 MHz to 16.5 MHz is used in the K-130 Variable Energy Cyclotron (VEC) for beam acceleration. Beam acceleration is carried out in the beam chamber of the cyclotron, where a vacuum of about 5 x 10^{-6} mbar is maintained. After acceleration, the high energy beam is transported through beam channels to the experimental caves. Mechanical Engineering Section (MES) carries out maintenance of the mechanical system of the RF resonator cavity. Based on the operating experience, MES upgrades the mechanical systems of the cyclotron to improve its performance and increase the availability of the cyclotron for its users. MES is also putting considerable effort to improve vacuum in the cyclotron beam chamber.
The major components for the RF cavity system (Fig. 1) are Dee, cantilever type Dee Stem, RF Panels (fixed and movable) and Trimmer Capacitor. They are made of Oxygen Free High Conductivity Copper. The RF cavity components are cooled by Low Conductivity Water. Dee, made from 20 mm thick solid Copper plate of size 2182 mm x 1194 mm x 67 mm, has the highest voltage of about 70 kV at its free end. The flat and corrugated Dee Stem of size 203 mm x 1300 mm x 2765 mm is fabricated from 1.6 mm thick copper sheet. The Dee stem is placed on a Stainless Steel Dee-stem support structure. Eight large RF panels, 2830 mm x 900 mm, form the outer-conductor of the resonating cavity. Fine tuning is done by moving the Trimmer capacitor, which consists of parallel plate type rotor and stator. The RF resonator system is placed inside a giant H-shaped electro-magnet weighing 262 tonnes.

Fig.1: RF Resonator Cavity of VEC Cyclotron

A new welded beam chamber was designed, fabricated and installed inside the C-shaped 159.5° analyzing magnet (Fig. 2) in the Rare Isotope Beam line and the beam line was re-commissioned. The new vacuum chamber improved the vacuum in

the beam line. Design of the vacuum chamber was carried out in MES using FEM tools (Fig. 3).

The section also participated in the upgradation of VEC and its beam line by adding new diagnostic and beam transport components in the beam-lines, viz., modifying Dee Stem, Trimmer capacitor, scattering chamber drive system, shield wall plug, shielding door, baffle assembly for 89 cm diffusion pump, cooling circuits for steering magnets and vacuum chamber for analyzing magnet.
A thermo-mechanical analysis was also carried out for various RF cavity components to assess the cooling of the trimmer (Fig. 4).

Replacement of corner posts for the beam chamber of K130 cyclotron was carried out to improve the vacuum and availability of the machine.

The section is successfully completed the design and fabrication of Still, Mixing chamber, air-spring type support structure and other components required for indigenous development of a Dilution fridge to achieve temperature around l00 mK. Low temperature i.e. the cold is achievable at mixing chamber through dilution refrigeration method and achieved 47 mK.

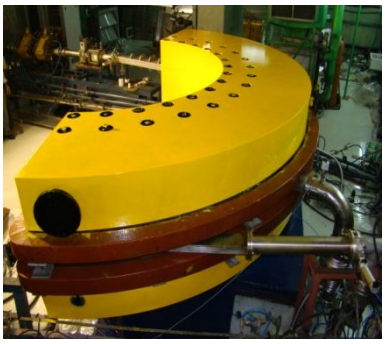

Fig. 2: Analysing magnet with SS beam chamber

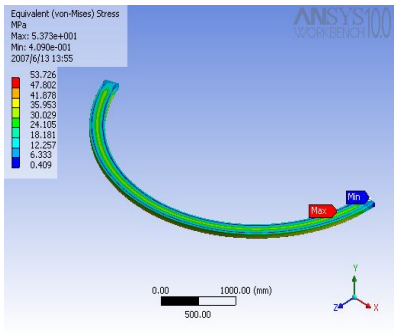

Fig. 3: Von-Mises stress contour in vacuum chamber for analyzing Magnet

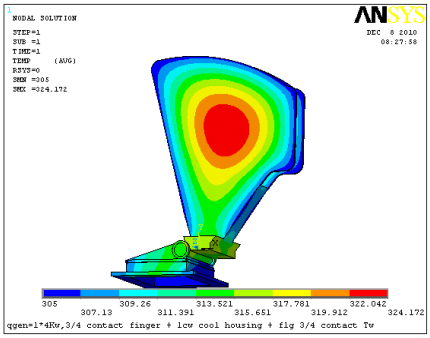

Fig. 4: Temperature distribution in Trimmer Rotor assembly of VEC Cyclotron