Long term stability of output current was tested to be well within the specified limits. Figure A.3.2 shows the stability curve for 8.5 hrs of continuous operation of power supply after initial warm-up time of 1.5 hrs. Following steps were taken to achieve the required stability:

- A stable shunt made of zeranin is used in the feedback network.
- OP07 precision OPAMPs are used in reference, feedback and error amplifiers.
- Stable MFR resistors are used in reference, feedback and error amplifiers.

Conducted electromagnetic interference (EMI) was measured and pre-compliance was achieved with CISPR-11 norms as shown in Fig. A.3.3.

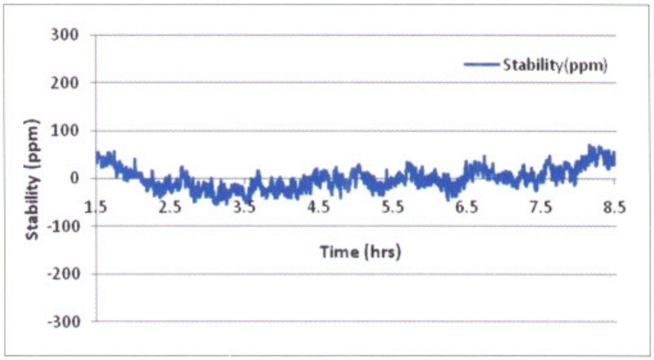

Fig.A.7.2: Output current stability of power supply

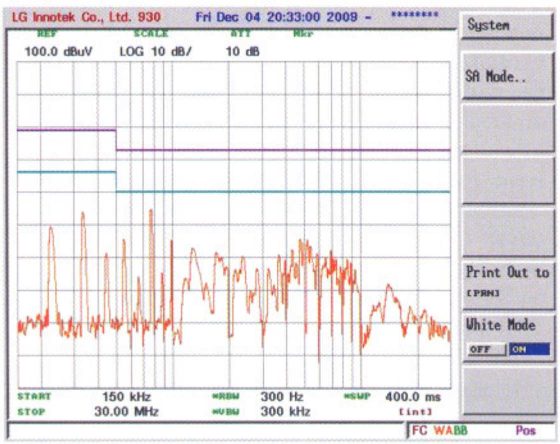

Fig.A.7.3: Conducted EMI of the power supply along with CISPR-11 quasi-peak and average limit lines.

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A.8: Further testing of 1.3 GHz Single cell SCRF cavities

Two numbers of 1.3 GHz prototype Single cell Superconducting Radiofrequency (SCRF) cavities have been successfully developed processed and tested under IIFC collaboration (RRCAT newsletter - article A.3, vol.23 issue2, 2010). The single cell SCRF cavity TE1CAT002, which was tested to achieve 21 MV/m in the first run was further processed and tested at Fermilab, USA.

The internal optical inspection of the cavities has revealed certain irregularities in the inner equator weld at few locations. In order to polish it, the cavity was processed using Centrifugal Barrel Polishing (CBP). A total of 140 μm at Equator and 40 μm at iris were removed in cumulative four processed steps. The cavity was then subjected to heat treatment under vacuum (800°C for 6 Hrs) to expel out the hydrogen. This followed the light electro-polishing 20 μm, high pressure rinsing (80 bar for 6 Hrs) and low temperature baking at 120°C for 48 Hrs. The cavity was tested at 2 K in Vertical Test Stand (VTS) as shown in Fig.A.8.1.

Fig.A.8.1: The single cell SCRF cavities mounted in VTS for 2K test at FNAL.

The cavity was quench limited to maximum gradient of 23 MV/m. Multipacting was observed at 19 MV/m, and the cavity experienced several quenches due to this multipacting, at gradients between 19.1-19.4 MV/m. As a consequence of these quenches, the cavity's Q values decreased somewhat, presumably as a result of trapped magnetic flux. There was no field emission observed at any time, but some minor radiation levels were briefly observed accompanying the multipacting.

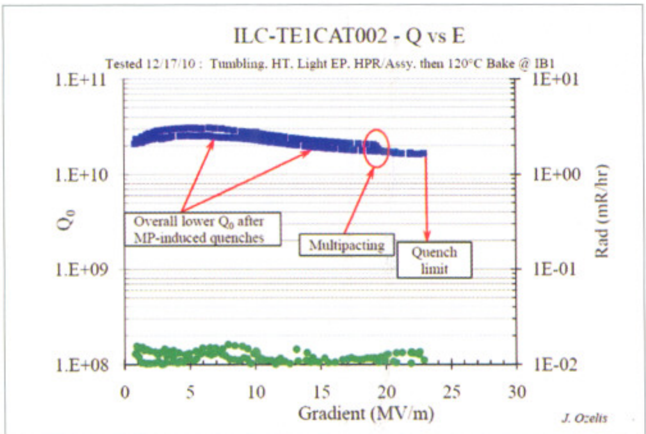

Fig.A.8.2: Q vs E_{acc} plot of Indian SCRF Cavity TE1CAT002 second test run

Both low field and high field Q_0's were reasonably good - 2.5×10^{10} and 1.7×10^{10}, respectively. The cavity's performance improved somewhat as a result of the processing undertaken since its first test - especially noted is an overall improvement in quality factor Q0 as shown in Fig. A.8.2.

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A.9: Development of Centrifugal Barrel Polishing Machine

Superconducting RF cavities are designed to operate for accelerating gradients of ~ 25-40 MV/m. The fabrication

Fig. A.9.1: Barrel polishing machine for Single cell 1.3 GHz SCRF cavity.

processes introduce defects in the surface layer. Therefore surface layer of up to 120-150 microns is to be removed by mass finishing operations. Surface finish of the cavities needs to be of a high quality for operation at high RF voltages. A surface finish of around 100 nm is obtained using barrel polishing. Fig. A.9.1 shows a centrifugal barrel polishing designed and developed at RRCAT, Indore with the help of a local fabricator. The machine has been designed to accommodate two numbers of single cell 1.3 GHz SCRF cavities. The rotational speed can be varied from 0 to 200 rpm.

The mass finishing media is filled inside the cavity. The cavity is mounted on fixtures and placed in barrels that are fixed on a rotating turret. The barrels rotate on their own axis as well as revolve about the turret axis.

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A.10: Electron beam irradiation for quarantine disinfestation of seeds

A 750 keV DC accelerator and product irradiation system is operational at RRCAT in the energy range of 500-750 keV with a typical beam current of 10 mA. The electron beam is scanned using a scanning magnet to the desired width based on the product requirement (maximum scan width is 1 meter). The beam is extracted out in air through a thin titanium foil for irradiation of products.

Under a collaboration between RRCAT and National Bureau of Plant Genetic Resources, New Delhi (NBPGR), work is being done to study the effective dose of electron beam as quarantine disinfestation treatment in some important crops. The study also includes irradiation of the seeds infested with the target pests at different development stages to find the lethal dose and effect of exposure on the insect survival, fecundity and survival of the pests in the next generation.

As part of this collaborative work, various uninfested seeds, infested seeds with different development stages of target pests and various harmful male and female insects were irradiated using the accelerator irradiation system. This included seeds of soybean, chickpea, mungbean, rice, cotton, wheat and brassica, and various insects viz. callosobruchus chinensis, callosobruchus maculatus, trogoderma granarium, sitophilus oryzae.

The dose delivered to the product is a function of electron current and speed of the conveyor belt on which it is moving across the electron beam. Based on the dosimetry experiments using B3 film at 500 keV, we determined the required beam current and conveyor speed to deliver dose of 250 Gy in one pass as shown in Fig. A.10.1.