ACCELERATOR PROGRAM

A.1 Magnetic Measurements on Indus-2 Quadrupole Magnets

The Indus-2 storage ring consists of total 72-quadrupole magnets, out of which 40 are closed type and 32 are open type. Quadrupole magnets have been tested using the rotating coil bench model 692, constructed by Danfysik (obtained on loan basis from ESRF, France). Open type quadrupole magnets are divided into 2 groups (Q3 and Q4, 16 magnets in each group). A pair of open type quadrupole magnets (Q3 family) will be energized in series by one power supply. The entire 16 open type quadrupole magnet (Q4 family) will be energized by a single power supply. Results of magnetic measurements of Q3 and Q4 type magnets are presented here.

The maximum specified gradient of 16 T/m is achieved at a current level of 166 A. The required current is 2.2% higher with respect to the ideal value. This is due to the saturation in the steel. As the non-linearity is low, tracking of the magnets will be easier during the ramping and will also help in minimizing tune excursion during ramping.

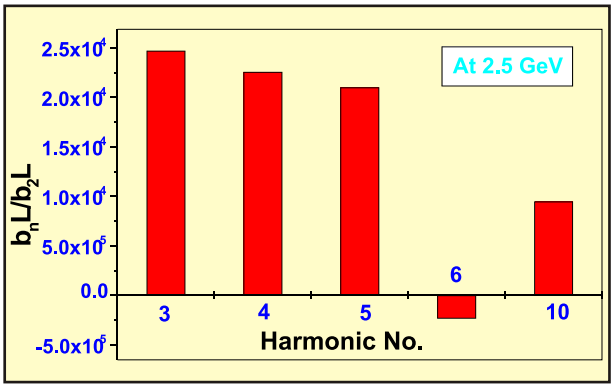

Fig.A.1.1 Harmonic contents in Q4 type Quadrupole Magnet.

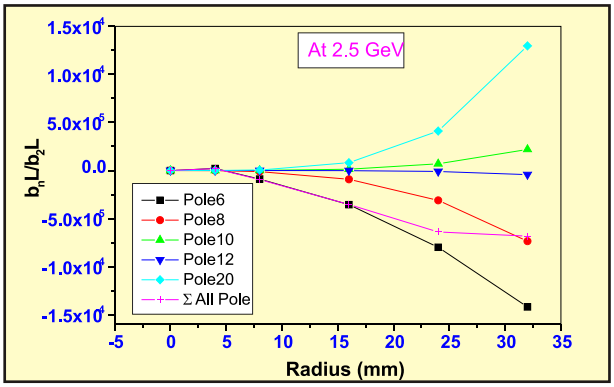

Fig.A.1.2 Transverse field quality of Q3 type magnet

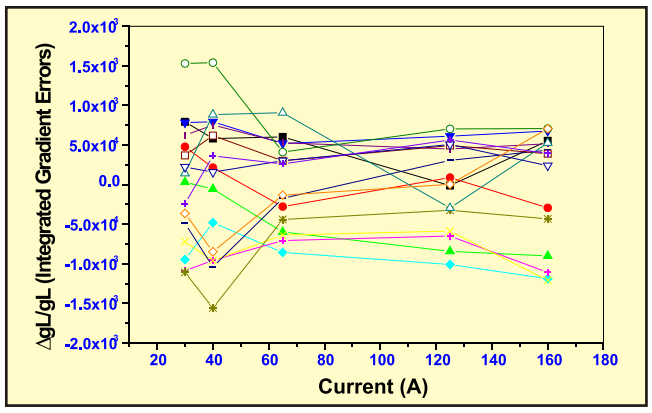

Fig.A.1.3 ΔgL/gL plot at various excitation levels for Q4 type Quadrupole Magnets.

Fig.A.1.1 shows the strength of higher order multi-poles, which are low and meet the beam dynamics requirements. The strength of the higher order multi-poles does not change significantly with excitation level. Fig.A.1.2 shows the transverse field quality in the useful aperture of the magnet. Fig.A.1.3 shows the relative variation in the integrated gradient of all the magnets in Q4 family.

(Contributed by: Kailash Ruwali; ruwali@cat.ernet.in)

A.2 Commissioning of 10 Mev, 10kw Electron Linac for Irradiation of Food and Medical Products

10MeV, 10kW electron linear accelerator for irradiation of food and medical products is setup in CAT. The LINAC structure is received from Russia whereas all the subsystems like microwave system, control system, power supplies, controls and safety system have been developed inhouse. The parameters and test results of trial run are shown in Table below. After getting approval from AERB, commissioning of this accelerator was started and beam current of 370mA was successfully obtained at 10MeV beam energy. Each subsystem was first tested individually and conditioning of the LINAC structure was done slowly by increasing the microwave power from low level. The 6MW peak power S-Band microwave system based on multi beam klystron (MBK) is developed at CAT to energize the LINAC structure and has worked satisfactorily. An electron gun modulator derived from the klystron modulator output is used to energize the 50kV electron gun of triode configuration. Other subsystems like supervisory control system, vacuum system,

various power supplies and safety interlocks are working smoothly. Vacuum is maintained to 2X10-7 torr. Microwave power of 6MW at 2856 MHz frequency is fed to the accelerator by klystron through WR-284 waveguide line. 200W beam power is obtained by operating the microwave system at 6Hz repetition rate. Focusing coil, centering coil, gun collimator supplies are optimized to obtain the maximum peak current of 370mA at 10MeV beam energy. Radiation survey of this facility was carried out with the help of Health Physics Unit. The radiation level is well bellow the recommended level in the control room and equipment hall. Fig.A.2.1 shows the forward RF pulse obtained from microwave system with flat top variations within +/- 1 %. The rise time of the modulator pulse is less than 1µs for 12µs pulse duration. The photograph shows the 6MW peak, 25kW average power microwave system developed at CAT. On the left is shown the klystron modulator, middle portion in red color highlights the 6MW klystron and right side is shown the indigenous microwave generator with driver amplifier and modulator controls.

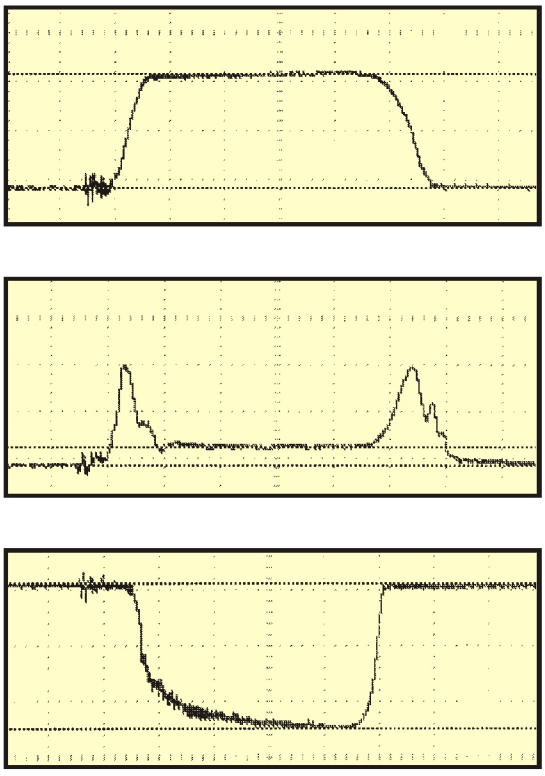

Fig A.2.1 *(a) Forward microwave power 6.2 MW, (b) Reflected microwave power , (c) Trace of beam current pulse 10 MeV, 372mA beam from LINAC, x-axis 2.5s/div.*

Fig. A.2.2 *Photograph showing the 6MW peak, 25kW Average power microwave system developed at CAT for 10MeV LINAC*

Commissioning Results :

Klystron Voltage	kV	50
Microwave power	MW	6
Microwave Frequency	MHz	2857.4
Microwave Pulse Width	ìsec.	12
Pulse Repetition Rate	Hz	6
Electron gun voltage	kV	50
Grid Voltage	kV	1.6
Focusing coil	A	35
Centering coil	mA	550
Beam collimator coil	mA	350
Beam Energy	MeV	10
Peak beam current	mA	370
Beam pulse width	ìsec.	10
Average Beam power,	W	200

Table 1

(Contributed by: P.R. Hannurkar, S.A. Pande, Purushottam Shrivastava, Akhilesh Jain, Y. Wanmode; hannurka@cat.ernet.in).