Fig.A.17.2 Photograph of the power supply

(Contributed by : A. Pagare, A.K.Amban , P. Ramshankar; prs@cat.ernet.in)

A.18 Four channel ADC board for Indus-2 beam position indicator (BPI) interface

A four channel sampling ADC board for BPI (Beam Position Indicator) interface has been developed for controls related to Indus-2 beam diagnostic sub-system. The salient features are:

- A24, D16 VME Slave
- 4 independent channels of 16-bit, 100 KSPS sampling serial-ADCs
- 4 digital-input channels for reading status
- Onboard DC-DC converters for local isolated power
- Provision for using separate external power source for ADC portion
- Selectable input range: (0-10 V) or (-10 to +10 V)
- Two stage low-pass filter at each input channel.
- Optical isolation from VME bus
- Selectable, interrupt based data transfer control
- Jumper and switch selectable interrupt level and vector ID
- External trigger can be enabled by software to start conversion and generate interrupt
- Facility to read back the conversion status of each ADC
- All the ADC data handling, VME address decoding and interrupt logic implemented in the on-board CPLD

(Contributed by: P Fatnani; fatnani@cat.ernet.in)

A.19 Reed RGA, the partial pressure analyzer for Indus-2 vacuum control

Partial pressure monitoring is important for knowing status of vacuum in the Indus-2 ring. This is done using the residual gas analyzers (RGA). There are 16 RGA units, which will be kept in different places in Indus-2 ring for partial pressure monitoring. The software takes data from field instruments over RS 422 link using DDE between software modules. The data logging of partial pressure and alarm information, generated in the event when partial pressure deviate beyond the set point, was required. The software provides user-friendly controls and scheme for filament protection. It also provides easy setting of 192 channels for different mass number of gas. It provides panels for setting high and low alarm along with hysteresis band, accuracy, and data log rate, log file name, audio and visual alarm indications, user name and event log, user permission etc.

Reed RGA provides easy approach of click over diagram, to view partial pressure of gas in any part of Indus-2. Tabular display of partial pressure provides data display of 16 RGA units on single panel. User name logging and event log feature helps in ensuring instrument protection and fault finding in hardware. Diagnostic controls are also provided which helps the user in changing the unit name and location online, lock-unlock 'RGA for windows' software module, trigger RGA unit, scan progressing etc.

(Contributed by: P Fatnani; fatnani@cat.ernet.in)

A.20 10MeV, 10kW Electron linac for food irradiation applications

The 10MeV, 10kW electron linear accelerator facility for food irradiation applications has been developed (fig. A20.1). The most crucial and challenging subsystem of the LINAC, the 6MW peak power 25kW average power microwave system has been designed, developed and tested. The 6MW peak power and 25kW average power multi-beam klystron having permanent magnet focusing system is energized by a 55kV, 270A pulse modulator. A line type modulator for 15MW peak and 70kW average power capability has been developed. The microwave system is tested on a microwave load for full RF pulse width of 12.5 microseconds at 150Hz repetition rate and testing is underway upto 300Hz. The rise time of the modulator pulse is 700 nanoseconds for pulse duration of 14 micro sec with flat top variations less than ±1%. The microwave power level flat top variations have been achieved to be within ±0.1dB. The modulator has been connected to the electron gun equivalent impedance and the output pulse has been tuned for the klystron impedance as well as the gun impedance. The electron structure has been received from Russia. Magnet power supplies, safety interlock system, access control system using Cori lock has been designed, installed and tested. Commissioning of the LINAC will commence after getting the approval from AERB.

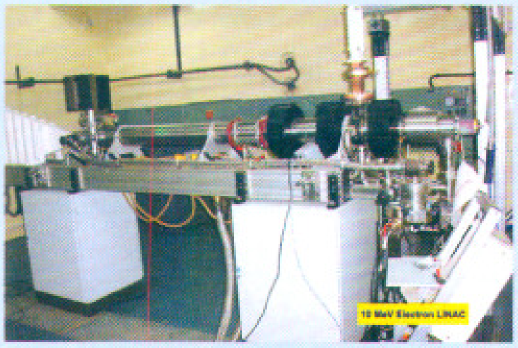

Fig.A20.1 10MeV electron LINAC

(Contributed by: PR Hannurkar; hannurka@cat.ernet.in)

A.21 Radiotherapy machine operational

A microtron based radiotherapy machine for treatment of cancer patients has been designed and developed. The machine (fig.A.21.1) can be operated in both electron and photon modes. The electron mode will be used for treatment of superficial tumors, while the photon mode will be used for treatment of deep-seated and bulky tumors. The specifications of the machine are given below:

Photon energy	6, 9MV
Electron energy	6, 9, 12MeV
Dose rate	0.5 – 5Gy/min
Dose uniformity	±3%
Field size	0 x 0–40 x 40cm²
Gantry rotation	±180°
Collimator rotation	±95°

An electron beam of 6 & 9MeV, beam current on internal target is 22- 25 mA and the extracted current measured with FCT is 19-20mA. The machine has been operated up to 50 Hz pulse repetition rate. The extracted beam is further transported through the beam transport line with 90% efficiency and passes through the treatment head meant for generation of the clinically acceptable radiation field. The treatment head contains combination of scattering foils or x-ray targets with flattening filters to be used with electron and photon modes respectively. Radiation field generated from the treatment head has been measured with a radiation field analyzer (RFA) having 3-dimensional movement mechanism for 3D mapping of radiation field. Profile measurements of 6MV photon beam (without flattening filter) have been carried out in water with miniature solid-state detectors (sensitive volume 0.0003cm^3). The desired dose profiles are generated by plotting the ratio of field to reference signal vs. position of field detector. The percentage depth dose profile in water and transverse profile along principal axis at D_{max} level are shown in figures A.21.2 & A.21.3 respectively. As per the requirements of International Electro technical Commission (IEC)/ British Journal of Radiology (BJR) the desired value of depth of D_{max} and quality index (D_{20}/D_{10}) for 6MV beam is 1.6cm and 0.67 respectively. The measured values of these parameters (without flattening filter) for our beam are 1.7cm and 0.62 respectively. The variations in the values are due to the presence of soft x-ray components transmitted from the x-ray target. By introducing a suitable flattening filter the soft components will be filtered out to meet the desired requirement. Flatness of the transverse dose profile will be achieved within ± 3% by optimizing the shape of the flattening filter. In electron modes the maximum dose rate measured at SAD (100cm) is 10-12Gy/min.

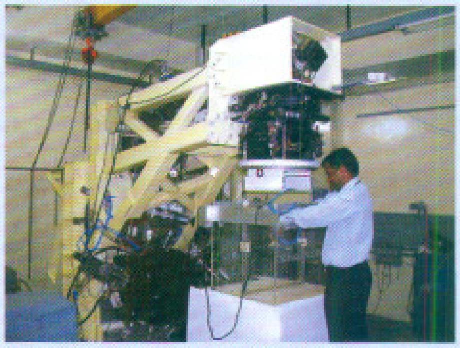

Fig.A.21.1 Microtron based radiotherapy machine

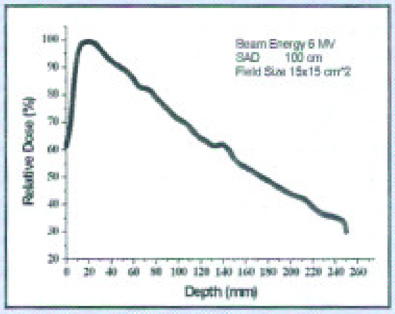

Fig.A.21.2 Depth dose curve in water for 6MV photon beam

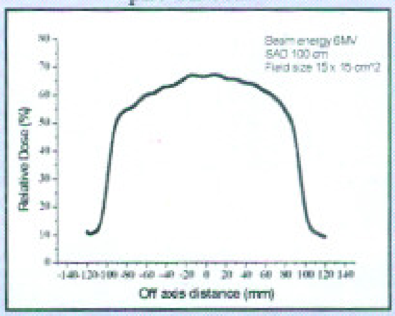

Fig.A.21.3 Transverse profile for 6MV photon beam

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