a computer program has been developed for this purpose. This program is also used to decide the ratings of resonant network components and inverter. The inverter is developed using IGBT modules. The supply is protected against fault conditions. The power supply has many advantages to encourage its use in future; it also has some limitations such as, load dependent characteristics that do not permit very wide load variations and high circulating energy in the resonant network.

The power supply has been tested and used for the mapping of prototype Indus-2 quadrupole magnet.

Electron Gun for Cherenkov FEL

A collaborative project between the Department of Physics, University of Pune and CAT, which envisage development of a Cherekov Free Electron Laser has been approved by BRNS. Under this project CAT has to develop and supply an electron gun with associated power supplies and vacuum system to Pune University. Recently, Director CAT formally handed over this electron gun facility to Dr. V B Asgekar of Pune University.

The triode electron gun consists of LaB_6 cathode emitter, indirectly heated by a pancaked Tungsten filament, beam forming electrode, non-intercepting grid or modulator anode and accelerating anode. The gun is designed keeping in mind the high temperature of the electrodes during operation. These electrodes are housed inside a ceramic tube, which acts as an isolator. Electron gun is assembled with a water-cooled Faraday cup which has an aperture to length ratio of 1:8 and a low Z graphite, as the base material for negligible secondary electron and low X-ray emission. The vacuum system comprises of sputter ion pump (140 lit/sec) and sorption pump, thus enabling a clean dry system. It produces a vacuum of $1x10^{-6}$ Pa.

The power supply consists of a 20kHz inverter, which drives the filament, bombarder and modulator through a 45kV isolation transformer. The cathode supply is a simple Cockroft-Walton type doubler circuit driven by 230 V to 26 kV 50 Hz transformer. The input is varied to get 40 kV DC. A pulse transformer accomplishes the grid drive. The current at the Faraday cup is monitored by directly terminating the standard RG58 cable at scope with a 50Ω termination.

The electrode configuration is optimised using the computer program EGUN. The perveance and emittance of the gun are 0.07 μperv and 14 π mm.mrad respectively. The radius of the emergent electron beam is 1.6 mm in the down flange region, for injection into the accelerating column.

The present model is a improved model of electron gun reported in Newsletter (Year-6, No.1, Jan-June 1993). The present gun delivers 500 mA current pulses at 40 kV, with pulse duration of 2 μsec. The repetition rate of pulses can be varied from 1 to 100Hz. Dark currents are 30 nano amps for negative bias to the modulating anode.

INFRASTRUCTURAL DEVELOPMENT

Construction of Indus-2 Building

Construction work of Indus-2 building has been spilt in two phases. Phase-1 consists of the S R S ring and transport line-3, i.e. radiation shielded structure. The phase-2 consists of experimental hall & users labs. The Phase-1 is nearing completion.

The building includes an annular ring with 1.5 m thick outer wall and 0.6 m inner wall. The overall diameter of the ring is 63m. The civil works include provision of beam line pipe embedded pipes (EP's), accurate magnet foundation EP's, which are placed to a very high accuracy (±3 mm) and checked using electronic theodolite. Concrete for radiation shielding walls have been placed at controlled temperature of 22 ± 1°C. Special care has to be taken for this, since the ambient temperature in this region goes as high as 46°C during summer. Also special precautions have been taken while placement of concrete to avoid subsequent radiation leakage. This has been accomplished by providing only 'Z' shaped opening and also by staggering the construction joints.

Properties of concrete as shielding material are utilised in two ways, as a structural member to support radiation shielded slab as well as for supporting EOT cranes for SRS ring & experimental hall. Conventionally steel girders are

Cover: Birds eye view of Indus-2 ring, presently under construction at CAT, Indore

Radiation shielding walls of Indus-2 building. In the center is the magnet foundation, also seen at the middle is junction of Indus-2 ring and transport Line-3.

used, which are eliminated here. The SRS ring will house a special EOT crane of 10 MT capacity with 5.3 m span. This crane will facilitate the handling of material in circumferential as well as radial direction. The service gallery of 2.5 m span (cantilever) is also supported over 1.5 m thick shielding wall, to accommodate power supplies & control panels.

Architectural and Civil engineering Division, BARC designed this building. The construction management is looked after by construction group CAT.

CNC Vertical Turret Lathe

A new CNC vertical turret lathe "Dynacut 150" of Kirloskar make has been commissioned at CAT workshop. The lathe was purchased as a manually operated machine and was later retrofitted with FANUC-OT "C" CNC system at CAT workshop.

Jobs of up to 1500 mm diameter and 1000 mm height with a maximum weight of 10 tonnes can be machined with this machine. The CNC system controls two axes i.e. X & Z simultaneously. By this facility any contour can be generated on the job diameter or its face. The X-axis moves the turret head on cross rails horizontally (left to right) and Z-axis moves the turret head in its guide in vertical direction from table face. The turret head carries five tools at a time and any tool can be power indexed for operation remotely by the operator. The CNC system also has a colour monitor with graphics facility.

CNC Vertical Turret Lathe installed at CAT

Development of high power microwave devices, test facilities and components for accelerator applications

The development of electron accelerators for various applications such as, radiotherapy applications, irradiation of food items, sterilisation of medical products, has been taken up at Centre for Advanced Technology, Indore. In this endeavour electron accelerators of energy 20 MeV and 12 MeV have been developed and are currently in use. CAT has also taken up the development of microtrons and linear accelerators with high average beam power capabilities.

The acceleration of electrons in cyclic accelerators is achieved by energising the accelerating cavities by means of a microwave system. This supplies microwave power in the peak power range from 2 to10 MW, depending upon the energy and current requirement. The microwave power is supplied in pulses of 2-10 μsec duration repeating at typically 50-1000 Hz. The microwave system plays a crucial role for development, operation and beam quality of the electron accelerators.

A typical microwave system consists of a microwave high power tube like klystron or magnetron, a pulse modulator to energise the microwave tube and a waveguide line for transmitting the high output power from the tube to the accelerator cavity. The waveguide line consists of a four port circulator, dual directional coupler, waveguide pressurising unit, microwave window and dummy loads. Pulse modulators used at CAT are line type modulators consisting of a regulated high voltage DC power supply, charging choke, charging diodes, a pulse forming network, a thyratron switch and a pulse transformer, whose secondary is connected to the device. In case of klystrons based microwave system the high power klystron needs a driver amplifier and a microwave generator. Devices like klystrons, magnetrons, thyratrons and four port circulators, are at present, imported from foreign sources. The operating life of the klystrons, magnetrons and thyratrons is very limited. During the lifetime of an accelerator, many such devices are required. Any delay or embargo on these components will severely affect the development/ production and operation of these accelerators. Hence the indigenous development of these devices is very necessary. CAT in collaboration with several institutes in India has taken up the work of developing these components indigenously.

5MW pulsed S-Band klystron and high power test station:

Development of an S-Band 5MW peak power klystron is nearing completion under a CAT-CEERI collaboration.