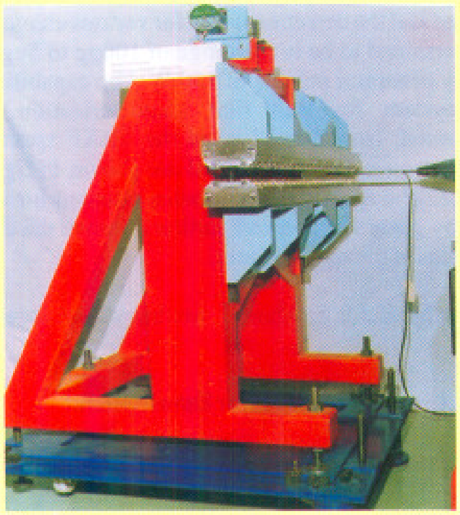

Fig. A.7.1 1.25m undulator structure

Fig. A.7.2 4-cell PWT linac structure

(Reported by: S. Krishnagopal; skrishna@cat.ernet.in)

A.8 Restoration of RF cavity for synchrotron storage ring Indus-1

RF cavity for synchrotron storage ring, Indus-1, is made of stainless steel and it is internally electroplated with copper. The cavity is having an internal diameter of 840mm and length of 600mm. The cavity structure is re-entrant type and there are big "capacitor disks" at 10mm from the median plane which are attached to the end plates through 250mm long "drift tubes". Vacuum in the RF cavity of storage ring, Indus-1, started deteriorating in the month of June 2001 and within few weeks time the vacuum level deteriorated by 3 orders. The leak check, which became quite complicated due to the location and internal electroplated surfaces, showed a leak in the drift tube. Work was done to analyze the problem that involved, design of alternate structure and the cooling circuit, FEM analysis of temperatures and thermal deformations, tuning, manufacturing, electroplating, assembly, vacuum testing, RF testing and integration into the ring for operation. All the work of design and manufacturing was completed in two months time. The cavity is now working in the ring with a vacuum level of 1 x 10^{-8}mbar. The total thermal detuning is now less than 50kHz at 22kV, which is well within the on-line tuner range (80kHz), and start-up time is about 10 minutes.

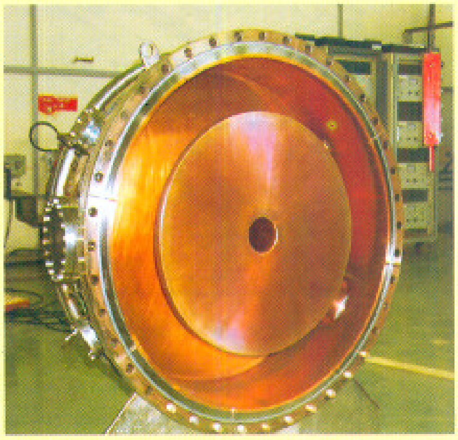

Fig. A.8.1 View of one half of the RF cavity

Figure A.8.1 shows the view of one half of the RF cavity showing stainless steel outer structure, internal copper plated surfaces, large flange for helicoflex seal (with seal in place), capacitor disk, beam port, vacuum and tuner ports.

(Reported by: Jishnu Dwivedi; jishnu@cat.ernet.in)

A.9 Chemical cleaning of aluminum alloy dipole chambers of Indus-2

Indus-2 storage ring vacuum envelope consists of 16 dipole chambers each of length 3.6m, with a bending angle of 22.5°. Aluminum alloy 5083 H321 plates were machined in two halves and welded on mid plane for making dipole chambers. Aluminum being highly electropositive is converted to aluminum oxide upon exposure to air. The thickness of the oxide layer will depend on the treatment it has undergone during fabrication and storage conditions. At temperatures above 340°C, magnesium is incorporated into the oxide film by diffusion, forming a duplex film of aluminum and magnesium oxides. Lubricants used during fabrication are also likely to contaminate the surface of these chambers with organic and inorganic compounds, which can cause incomplete fusion during welding and increase specific out gassing rate at the time of vacuum conditioning. Post fabrication surface treatments are necessary for providing a clean surface required for leak free welding, minimize out gassing and to reduce beam induced desorption of trapped gases. Chemical cleaning plays a vital role in removing the contaminants (cutting oils, dust, finger prints etc.) to provide a clean surface with as little as desorbable gas as possible by modifying the oxide layer.

Aluminum specimens were prepared from the same alloy to optimize the cleaning methods and operating conditions. All the specimens were ultrasonically cleaned in trichloroethylene for removing oil, grease and other dust particles. Three chemical cleaning procedures (a) Vapour degreasing in trichloroethylene (b) cleaning in non-silicate mild alkaline cleaner and (c) strong etching in sodium hydroxide, suitable for this alloy were adopted on separate specimens. All the specimens were dipped in nitric acid to remove other metallic impurities as a final step. Auger analysis for trace impurities, scanning electron microscopic studies and out gassing rate measurements were used in evaluating the effectiveness of cleaning process for welding and vacuum conditioning. From Auger analysis, it was found that carbon contamination is removed to a maximum extent by method 'c' with no peaks for trace impurities like chlorine, magnesium and nitrogen. Leak free welding was achieved after cleaning by method 'c' only. The specific out gassing rates obtained for samples cleaned by methods 'a' and 'b' are comparable, whereas it is marginally high for method 'c'. From these results, strong etching in sodium hydroxide was selected for cleaning of dipole chambers for welding and vacuum applications. All the dipole chambers of Indus-2 were cleaned after welding in the workshop.

(Reported by: P. Ramshankar; prs@cat.ernet.in)

A.10 Indus-2 LCW (Low Conductivity Water) plant control system

A Supervisory Control And Data Acquisition System has been developed for Indus-2 LCW plant. The system is designed to handle (control, monitor, log) more than 600 parameters for effective plant operation. It follows three-layer control system architecture as for Indus-2. The system uses VME based control modules running OS-9 for front-end control, Labview for graphical operator interface and high level application. The software is highly modular and configurable thus allowing for easy system evolution. Fig. A.10.1 shows a view of a screen shot of plant mimic on operator panels.

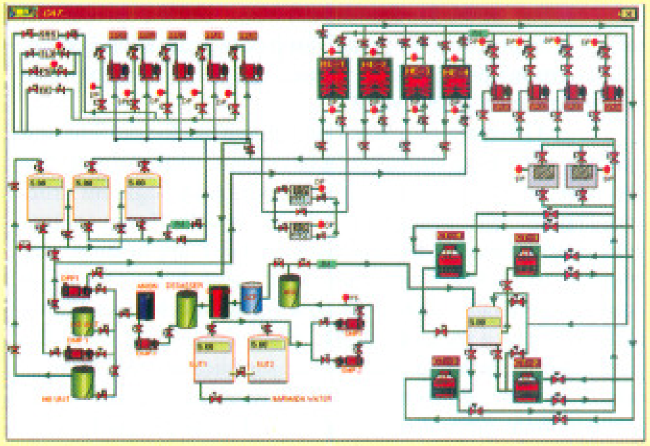

Fig. A.10.1 Indus-2 LCW plant mimic system

Reported by: P. Fatnani; fatnani@cat.ernet.in

A.11.1 Precise reference generation & control system for Indus-2 new booster dipole power supply

Different types of magnets are used in the booster and storage rings for guiding the high current and high-energy electron beam and maintaining a circular path. Dipole magnets are responsible for maintaining a circular orbit for the increasing energy of electron beam. Dipole magnets are connected in series and powered by a dipole magnet power supply. To maintain a stable and precise ramping magnetic field, this power supply should have very high stability and requires a precise, stable and programmable reference signal. For generating such a signal and managing other control operations, a system has been developed and commissioned. It uses the in-house developed VME bus based boards in a modular fashion. This system provides 16-bit resolution and 0.01% accuracy.

The scheme

The system uses a two-layer architecture. Layer one is graphical user interface (GUI) layer, providing human machine interface, periodic status monitoring, reference ramp signal parameter settings and control operations in a user-friendly manner. This is a Visual C++ application running on IBM PC compatible (486 or higher). This communicates to lower layer, Layer-2 VME crate on a serial link.

Layer-2 comprises of an Equipment Interface Unit (EIU) consisting of different VME modules. This VME system is designed around a processor board based on Motorola MC 68000 CPU and running OS-9 real time operating system (RTOS). Other boards used in the system are digital input and output boards, reference controller and DAC boards.