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.

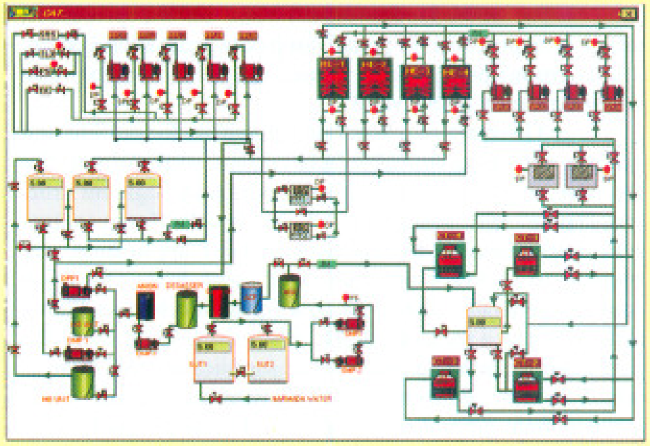

Fig. A.10.1 Indus-2 LCW plant mimic system

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.

An embedded program runs on the processor, which is responsible for actual ramp data generation system, status monitoring and power supply control and communication with layer-1.

There are two separate references for current and voltage with programmable base current, peak current, flat top time, slope, total cycling time, parabolic segment time, inductance and resistance of the load. Ramp signal parameters entered by the user in GUI application, are transferred to OS-9 program over serial link. The OS-9 routines generate 128Kbytes data for each reference signal and keep it in a memory block. A scanning logic scans the data at programmable interval and supplies to DAC boards, which, in turn generate the analog reference signals. Base-current, final current and slope decide this programmable interval. Optically isolated pulses at all reference discontinuities are also provided to the power supply. The system is capable of remotely turning ON/OFF and resetting the power supply. Power supply operation is possible in DC and RAMP mode.

With this reference generation system now it is possible to make beam injection trials into booster ring with variable injection timings and slope. This is possible because of a parabolic rise in the current reference signal. Before installation of this system injection point was fixed. The system has been commissioned and is being used in accelerator operation.

A.11.2 Indus-1 machine status display system

A web based system for displaying the status of Indus-1 over network has been developed. The users all over CAT campus can see the continually updated status of Indus-1 from any personal computer connected to CAT intranet. The status includes the online operating parameters, beam current versus time graph, beam injection schedule and general status information on rotation. Figs. A.11.1 and A.11.2 show the screen shots.

The software essentially comprises two modules. Software module for beam information system console, which displays beam current graphically and logs the data (beam current, integrated current etc) into database server, has been developed in Labview 5.1. Other software module (server side program) which displays the on line status of Indus-1 machine into display terminals' web browser located at various places of Indus-1 building has been developed in Java. Here browsers act as first tier; Java servlets act as middle tier and database server acts as third tier. Status of the machine is displayed in browsers by two dynamically generated html pages. These pages change alternatively at 10 seconds time interval.

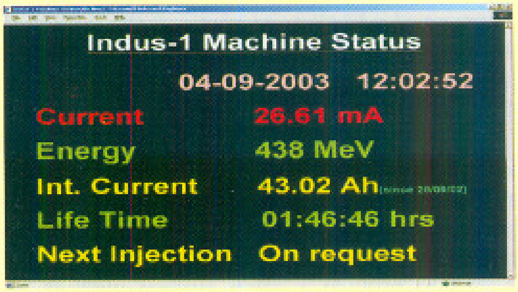

Fig. A.11.2.1 Machine status display

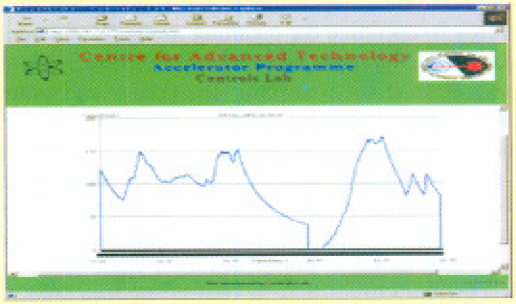

Fig. A.11.2.2 Stored beam current v/s Time

A.11.3 New VME boards developed

VME standard has been adopted for developing electronics for accelerator front-end control interface in modular fashion. More than 15 types of VME boards already exist for regular use in the system. Following new VME bus based boards were developed.

Ramp DAC board: Salient features
- A24, D16 VME slave
- Main DAC and offset DAC for voltage reference
- Unipolar/bipolar outputs
- Onboard DC-DC converters for local isolated power
- 16 bit DACs for high accuracy reference
- Optically isolated from VME bus

Ramp memory board: Salient features
- A24, D16 VME slave
- Memory to store ramp signal data
- Two 256KB memory banks in swinging buffer mode
- Memory addresses generated by onboard counter clocked with ext. clock signal
- One card each for voltage and current reference signals
- Used in new booster dipole power supply

Ramp controller board: Salient features

- A24, D16 VME Slave
- Generates optically isolated memory scanning clock and timing pulses
- Also generates ramp start sequence,
- ON/OFF, reset and DC/RAMP mode control signals
- On board DC-DC conv. for isolated power

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

A.12 VME based fast ADC

A VME based fast ADC card has been designed and developed. This card is a part of the digital signal processing based tune measurement system being developed for Indus-2 synchrotron radiation source. The beam response to a stimulus will be monitored by the strip line beam position monitor and digitized by the fast ADC card. The tune value will be obtained by computing FFT of the acquired data. The card employs a 10bit, 20MS/sec sampling ADC. The digitized data is stored in a 64K word fast static RAM. The number of samples to be taken and the trigger mode (external/internal) is programmable. The sampling rate is decided by an externally applied sampling clock. After receiving the trigger, required number of samples are digitized by the ADC and stored in the memory. The data is then read by the controller and transferred to a PC on serial bus. The GUI software has been written in visual basic language, which displays the acquired signal. It also has provision to evaluate FFT of the acquired signal and display frequency spectrum of the waveform. The number of points of FFT and window functions is selectable by the user. This card has been successfully tested up to a sampling clock frequency of 10MHz. Further improvements in the circuit design are underway.

(Reported by: T A Puntambekar; tushar@cat.ernet.in)

A.13 Planar transformer

Planar magnetic components are planar versions of conventional wire and/or foil wound magnetic components. Principal advantages of planar structure over conventional components include higher ratio of surface to volume ratio, better heat removal, smaller size, low-profile shape, better predictability as well as repeatability of parameters and lower leakage inductance. A planar transformer has been developed for a 1 kW power supply. The design parameters of the prototype transformer are as follows: turns ratio 6:1, number of primary and secondary turns = 18 and 3, respectively, peak flux density = 0.2, secondary RMS current 35A. Thickness of primary and secondary lead-frames is optimized to reduce skin and proximity effect. The windings operate at current densities of 15 A/mm^2. Total loss in the transformer is 25W giving 97.5% efficiency with 35°C temperature rise at full load. The transformer was fabricated using low profile planar cores type – ELP 43. The overall dimensions of the transformer are 110mm length, 70mm width and 15mm thickness. A new technique of core-extension was evolved to help reduce temperature rise, AC losses and HF shielding. Fig. A.13.1 shows the prototype development. The developed planar transformers are successfully used in laser diode driver and dipole magnet power supply for FEL. They can also be used for development of high frequency, high-power-density power supplies for various applications.

Fig. A.13.1 Planar Transformers

(Reported by: M. B. Borage; mbb@cat.ernet.in)

A.14 Development of a Fast Closing Shutter

Fast Closing Shutter (FCS) is a vacuum safety device mounted on the front ends of beamline to protect the storage ring from sudden air rush from the experimental area. The FCS reduces the flow conductance. The shutter fully covers the beam aperture and permits a very low leak rate. The FCS is backed by a UHV gate valve. A prototype FCS has been developed with a total shutter closing time of 8.6msec. The shutter is closed and opened pneumatically and triggered by a solenoid coil.

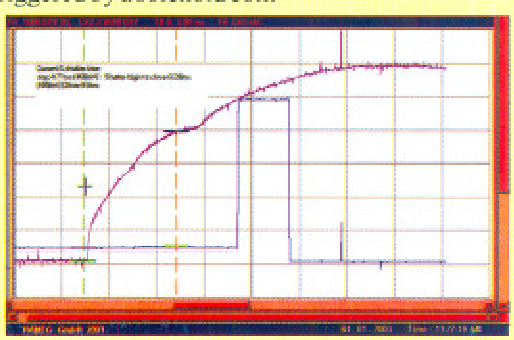

Fig. A.14.1 Out put of the shutter