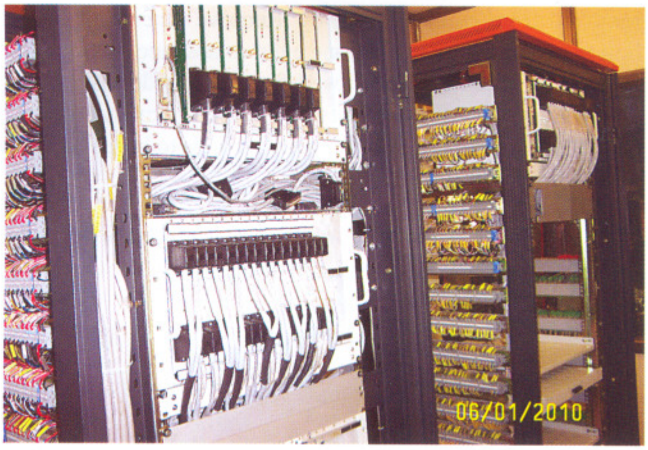

Fig. A.9.1: Indus-1 LCW Plant Equipment Control Stations

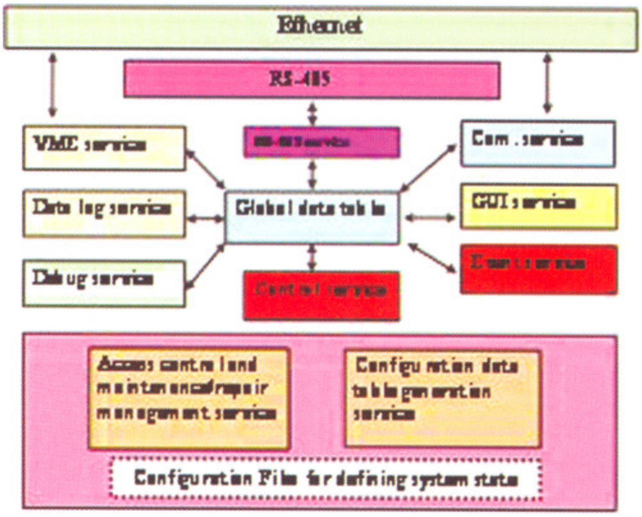

Fig. A.9.2: Indus-1 LCW Plant Control software Architecture

The control software was developed in LabVIEW development environment and is based on modular architecture. Different functionalities have been provided using different modules. Fig. A.9.2 depicts the software architecture of control system. The Graphical User Interface (GUI) panel for primary loop operation and monitoring is shown in Fig. A.9.3. All the actions and monitoring is being performed through device tags to keep the software virtually prone to system modification at lower stages. Debug facility has been provided for fault finding and individual device testing, at the time of commissioning and also at later stages. All the remote command requests are communicated and authenticated at action level. Configurable micro-action verification is provided at device level through feedback status signals, for all motorised valves and pumps through timeout device objects.

All the control actions and pre-action-checks are kept configurable and can be associated with configurable events. The data is being logged to central data base with configurable log-rate. The plant can be controlled by authenticated operators, from multiple locations with the client module installed on the remote PC. Presently the control is configured from two locations: LCW control room and main control room. The socket based communication is used for communication between the server and client applications.

The plant is remotely operated regularly, and has been working satisfactorily.

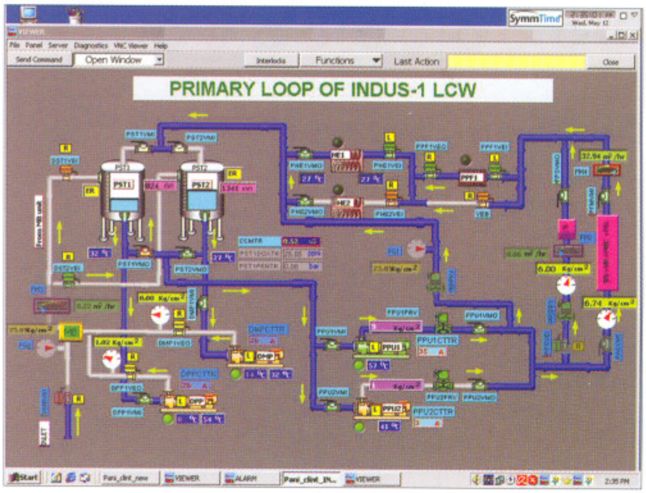

Fig. A.9.3: Indus-1 LCW Plant GUI Panel for Primary loop operation

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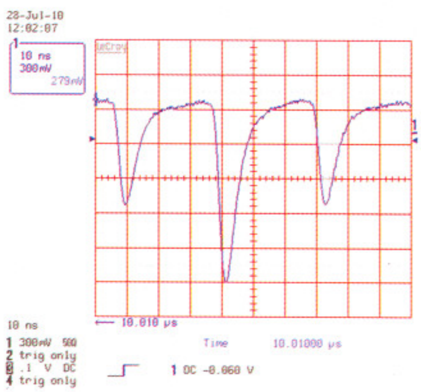
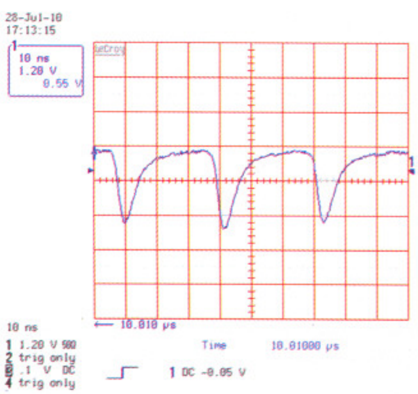
A.10: Development of Online Bunch Filling Pattern Measurement System in Indus-1

In Indus-1 storage ring, there are two RF buckets or bunches. The distribution of beam current in these two bunches is termed as bunch filling pattern. Bunch filling pattern affects the performance of a synchrotron light source. In Indus-1, it is desirable to have symmetric bunch filling pattern for its optimum performance. Measurement of the filling pattern is therefore essential in real-time during operation of storage ring. A bunch filling pattern measurement system has been developed and implemented by Beam Diagnostics Section of Accelerator Controls and Beam Diagnostics Division for online measurement of individual bunche currents and hence the ratio of currents in the two bunches.

This system uses pickup signal of Wall Current Monitor (WCM) installed in Indus-1 storage ring for measurement of the bunch current. The pickup signal of WCM is fed to a digital storage oscilloscope (DSO) kept in the control room. The digitized signal from DSO is transferred on GPIB bus to a PC for calculation of individual bunch current. Software has been developed to interface DSO with PC. The required settings of DSO are automatically done by the software during initialization. During measurement, software automatically changes the volt/div setting of DSO according the input signal level to improve resolution. The software processes the acquired data to calculate the bunch current from the height of the pulses. The bunch current, bunch current ratio and total beam current are displayed online and also stored in a file for later analysis. The system was calibrated with DC current transformer (DCCT) of Indus-1 to get calibration factor for measurement of absolute bunch current. DCCT gives the average current of the storage ring. To calculate the calibration factor, a linear fitting was done between sum of individual pulse heights and average current measured by DCCT. The accuracy of this measurement system is better than 2%.



(a)



(b)

Fig. A.10.1: Typical WCM signal traces captured on DSO for a) 60% and b) 92% bunch current ratio

The bunch symmetry is indicated by ratio of the two bunches. Fig. A.10.1 shows typical traces of WCM signal on digital storage oscilloscope for the case of 60% and 92% bunch symmetry. Fig. A.10.2 shows a screen shot of GUI showing results of online measurement of individual bunch currents and the bunch current ratio. It also shows plot of bunch currents during decay of store beam in Indus-1. Beam life time of individual bunches can be studied using the logged data.

This system is now routinely being used by Indus accelerator operation crew for adjusting the injection timings to achieve symmetric filling and recording bunch symmetry for beam related studies.

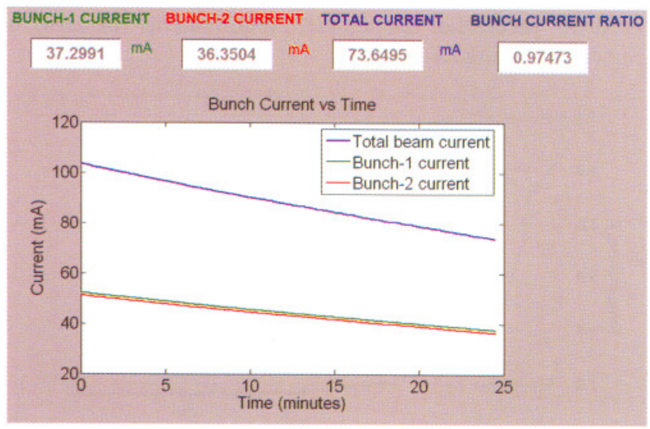


Fig. A.10.2: Screen shot showing plot of bunch currents and total beam current in Indus-1

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A.11: Development of 2 K Cryostat

A Pool type Liquid Helium Cryostat for operating down to 2 K was designed at Cryo-Engineering and Cryo module Development Section. In this cryostat, the temperature of liquid helium, which has a normal boiling point of 4.2K is brought down further by pumping over the liquid. (Cryostat is a specially designed container to keep liquids of very low temperature, typically below -150 Deg C)

This system operates under sub-atmospheric conditions. Below 2.17 K, liquid helium is in "Super Fluid" state. Properties of liquid helium, amongst others, its low viscosity, puts stringent conditions for the inner vessel integrity. Apart from efficient thermal design to minimize the heat in-leak through different mechanisms, there are several technical issues, which are to be tackled in making a cryostat of this type. One of them is the problem of cold leaks. These are leaks, which are not traceable using conventional leak