e.g., which beam line is used and since when. Before installation of this system, the gate valves were opened by respective beam line people as per their requirement of beam.

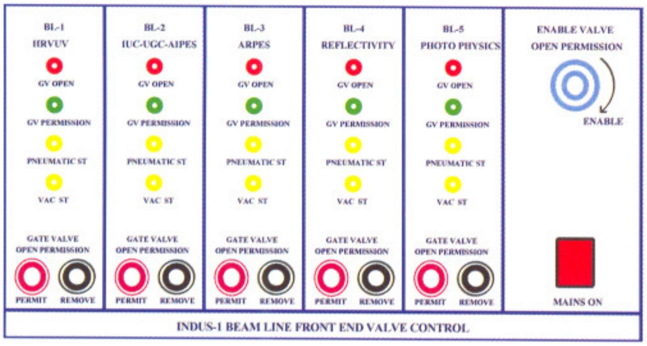

Fig. A.8.1:Master Control Unit

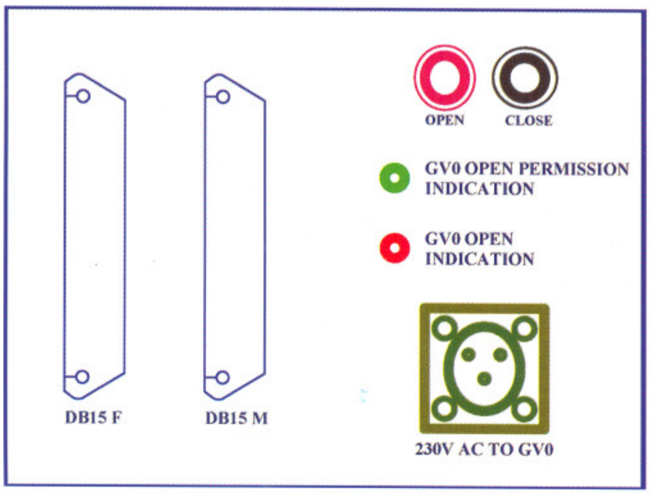

Fig. A.8.2: Field Control Unit

A single master control unit (Fig. A.8.1) in the control room and one field control unit (Fig. A.8.2) per beam line constitute the system. The master control unit is placed in Indus control room and fed from control room power. It has push buttons to give GV0 open permission as well as to remove permission, and indicators to show status of permission, status of GV0 (OPEN/CLOSE), pneumatic pressure good status and Vacuum good status. The permission is to be given by shift in charge after ascertaining proper vacuum level at the beam line. For this purpose, provision of vacuum interlock is also given. A key-lock switch has been provided whose key remains in control of the shift in charge. Key is to be inserted and key switch to be turned to permission enable position, for giving valve open permission using push button. After giving permission, the key has to be removed from the switch. The Valve can then be opened from field control unit by pressing the open button. Permission can be removed from control room, by 'Remove Open Permission' button provided. It can be done even in absence of key in the switch. GV0 can also be closed from field side, using GV0 close button. In both the cases, GV0 open permission would also be withdrawn. GV0 open permission is to be given every time before GV0 can be opened.

The field control unit near each beam line is given AC mains locally at each beam line. Its supply has to be ON before GV0 open permission is given from control room. Open and close push buttons were provided on the unit for opening and closing of GV0 valve. Indicators are also provided to indicate GV0 status and permission status.

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A.9: Indus-1 LCW Plant Control System Automation

Low Conductivity Water (LCW) is the cooling agent, which has been used for cooling of magnets, Power supplies, RF cavities and different equipments used in the accelerator complex. The LCW plant for Indus-1is used for the production, cooling and supply of this chilled LCW to different subsystems like Power supply and RF amplifiers of Booster, Indus-1 ring, TL1 and Microtron. This plant had been operated manually since the commissioning of the Indus-1.

Recently automation of Indus-1 LCW plant has been completed to facilitate the remote control and monitoring of the plant as well as to log and monitor the process parameters like water temperature, flow, pressure, conductivity, level and other data for easy diagnostic of faults and malfunction of equipments. The control system for LCW plant was developed by Accelerator Control Section.

The control system of Indus-1 LCW plant has been realised using VME bus based data acquisition system with two VME Equipment Control Stations (ECS) (Fig. A.9.1). The ECS have been placed in the LCW plant area. One station is used for interfacing of about 350 status input signals and 100 output control signals. Second station is used for interfacing about 200 analog inputs. The local operation of different electrical valves has been provided using the valve controllers. The valve controllers were provided on the wall mounted terminal panels situated at five different locations (service block area, cooling tower area, microtron area, booster area, storage ring area and power supply area). Software reconfigurable interlocks have been exercised for all motors.

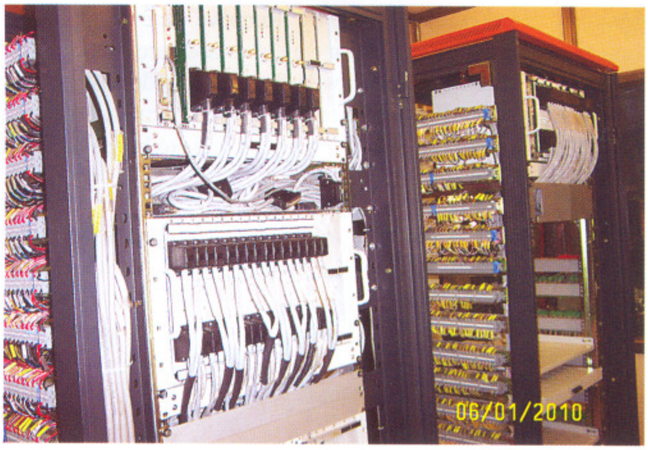

Fig. A.9.1: Indus-1 LCW Plant Equipment Control Stations

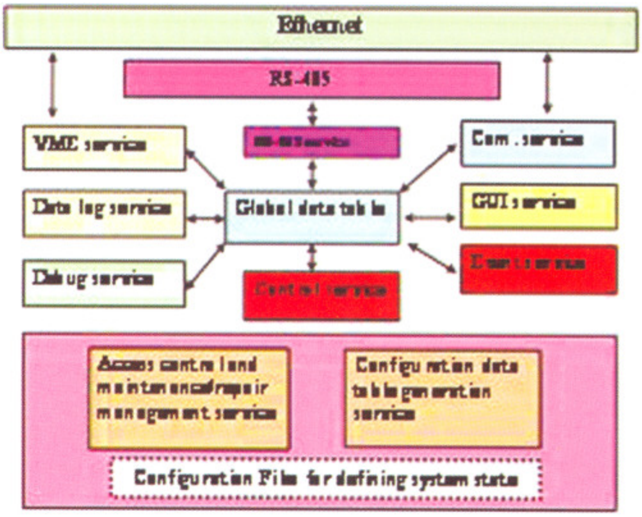

Fig. A.9.2: Indus-1 LCW Plant Control software Architecture

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.

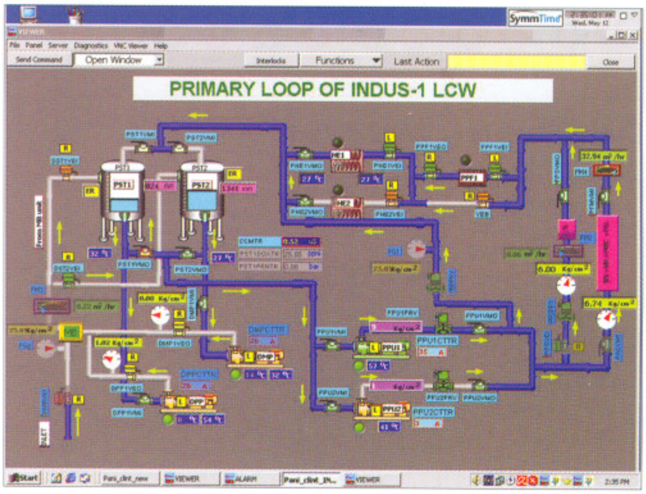

Fig. A.9.3: Indus-1 LCW Plant GUI Panel for Primary loop operation

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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.