A.3: Indus-1 Magnet Power Supply (MPS) Cycling

The reproducibility of the field in an iron core electromagnet for a particular operating current is ensured by exciting the magnet from a lower limit to an upper limit of currents and back few times before setting the operating current. This is called as cycling of the magnet as shown in Fig. A.3.1.

In routine operation of Indus-1, all the magnets are cycled three times before setting the fixed operating currents to get the required nominal fields as shown in Fig. A.3.2. All dipole (DP) and quadrupole (QP) magnets are cycled. These are controlled by three power supplies - a DP magnet power supply, a QF (Focussing Quadrupole) and a QD (Defocussing Quadrupole) power supply.

Fig. A.3.1: Indus-1 Magnets Cycling Waveform

Fig. A.3. 2:Typical Magnet Cycling in Indus-1

The Magnet Power Supply Control System of Indus-1 had to be modified in hardware and software extensively to provide this facility. This control system uses isolation between the references, status and the control signals of all the supplies which is the specialty of this system. All the control and status signals are connected through optically isolated bus. The reference and read back is also optically isolated. A special power supply control module on the optically isolated bus is used for connecting each supply to the VME equipment controller. The power supply control module contains 16 bit DAC card, 16 bit ADC card and isolated control outputs and status inputs. This module is connected to VME crate through optically isolated bus. Different modules are daisy chained to the VME crate. Rise and fall times of all the modules in the chain were measured, analysed and circuit components were optimised to improve these. The modifications in auto write board were carried out to include interrupt generation and enable update of new reference values supplies undergoing cycling.

The control room software running on PC is a client server application and uses RPC protocol.

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A.4: Control & Integration of Indus-2 Pneumatic Gate Valves (GV0s)

Gate valves, designated GV0s and located at the periphery of Indus-2 ring separate the machine vacuum envelope from those of the beam lines. These are installed at the beginning of beam line front ends (BLFE). A beam line front end is typically the part of beam line which is inside the in-accessible, shielded ring area and connects the actual beam line to the ring with needed regulating and controlling mechanisms for synchrotron beam and vacuum. Recently, many (16) of the GV0s were changed from manual to pneumatic ones. The pneumatic valves allow remote operation. All these were added to the existing BLFE control system to integrate them with machine controls.

The user interface for these valves has been provided in Vacuum control panel as well as BLFE control panel as shown

Fig. A.4.1: Beam Line Front Ends GUI Panel with GV0 Controls

in Fig. A.4.1. Valve control, status monitoring, interlocks, alarms and data logging have been integrated in the machine controls. Since these are strategic devices as far as machine vacuum protection is concerned and sensitive to heat flux due to synchrotron radiation, extreme care is required in operating and interlocking these valves. Therefore, any action taken on GV0s is authenticated and logged.
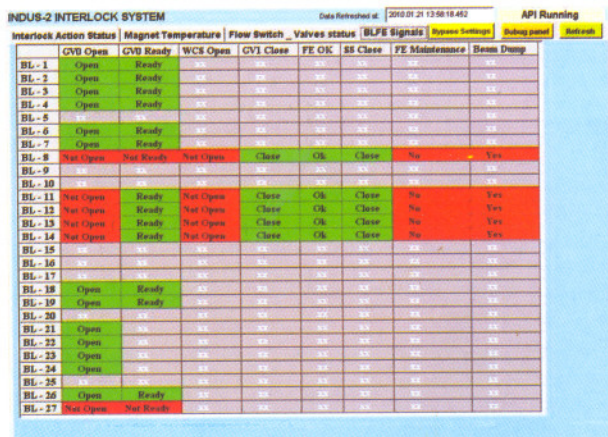
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A.5: Extension of Indus-2 Machine Safety Interlock System (MSIS)

Machine Safety Interlock System (MSIS) for Indus-2 provides safety of machine components against potentially unsafe situations which may occur during machine operation. These include vacuum chamber photon absorber temperatures, magnet coil temperatures, DCCT core temperature, loss of cooling in magnets, etc.

Subsequent to introduction of pneumatic gate valves GV0s in the beam line front ends in the machine, and to handle some other safety related scenarios concerning BLFE components, it was necessary to include interlocks from beamline front ends also into this system to enhance the overall machine safety. So, significant additions and changes were done in the MSIS hardware and software. Fig. A.5.1 below shows a snap shot of the panel highlighting the BLFE signal interlocks status display on the MSIS panel.

Fig. A.5.1: Indus-2 Interlock System Panel Showing BLFE Signals

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A.6: Indus-2 Control System Software Enhancements

The Indus machine control system software is continuously being enhanced to fulfil various requirements. Such enhancements are usually made to provide some facilities for operation staff, for solving some problems faced, for debugging faults and for code size and run time optimization etc. Some recent developments in various categories are reported.

a) System Diagnostics: System diagnostics were enhanced by adding features like bus-error reporting of layer 3 I/O cards to layer 1, messages to trace the sequence of events/faults taking place, adding the card status polling in the API to validate the parameter read back values and status values displayed on the GUI, modifying the GUI to add message box whenever data logging stops (start text file logging if data logging to main database stops) etc

b) Data logging: Vacum being a critical parameter, it needs to be monitored and logged carefully. For better handling of vacuum data logging, a module was added to check logging healthiness at regular intervals (15 minutes) and send messages on vacuum PC in case of any logging error. Data logging facility for parameters of Indus-1 RF like Ion Clearing and RFKO sub-systems was also added. The Indus-1 parameter data logging rates were enhanced for different sub-systems.

c) Indus-2 Timing System: Indus-2 timing system hardware is being incrementally enhanced. Two 2-channel delay generator boards were replaced with one 5-channel coarse delay generator board. The API and GUI were modified in PVSS. OS-9 device driver and descriptor for 5-channel coarse delay generator card were written and OS-9 application programmes were modified.

d) Machine Web Pages: Web pages for machine historical data information were enhanced and flexibility added for data selection and viewing.

e) Indus-2 Cycling: Cycling abort feature on errors like power supply trips, reference not set etc. was added to terminate the process and prepare for the next trial.

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