

# ACCELERATOR PROGRAMME

### 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 inaccessible, 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.

erlock Action Status		Magnet Temperature   Flow Switch			Valves st	Itus BLFE	Signals Dypose Settings		Dubug panel	Refresh
	GVB Open	<b>CVD</b> Ready	WCS Open	CV1 Close	FE OK	SS Close	FE Maintenance	Beam I	Dwmp	
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BL - 2	Open	Rondy	In the second	C. C.	100	1.000	Filmer Children (Children)	100	N	
3L - 3	Open	Ready	State State	536	1.000	10000	A CONTRACTOR OF THE OWNER	1.1	1910.000	
3L - 4	Open	Ready			0.000	1.000	Contraction of the	1000	2323320	
BL - 5	PERSONAL PROPERTY.	Sector Sector	100	S. Care Lines	28	244		2010		
BL - 6	Open	Ready	SU Sectors	-	1000000	10000045555	1. BR		0.010101	
8L - 7	Open	Ready	a la secondada	-	11100	0.00 + 0.000	1.1.1	100.00		
BL - 8	Nut Open	Not Ready	Not Open	Close	OL	Close	Na	Yes		
BL - 9	COMMONWAY!	P. GARGERS	PARTY NEWS	201002	205	100000000	STATE AND	5.0000	20010000	
BL - 10	State States	No. Constanting	and sections.	Part Contractor		100	Constant Constant States		and the second second	
8L - 11	Not Open	Ready	Not Open	Close	Ok	Close	Se	Yes		
BL - 12	Nat Open	Ready	Not Opens	Clase	Ok	Close	Ne	Ver		
BL - 13	Nat Open	Ready	Not Open	Clase	Ok	Clase	No	Yes		
BL - 14	Not Open	Ready	Nut Open	Close	Ok	Close	No	Yes	and the second second	
BL - 15	Street Store	STATES OF THE OWNER	Solara Colum	State States		A AND A	Storage Storage Storage	C. TRA	12223773	
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BL - 18	Open	Ready	1.0.00	CALINE COLOR	2.5	325	a market and	10000	101072-000	
BL - 19	Open	Ready	No. and Sold	The second	0.00	0.0332.000	10.00	1.1	0.0000	
BL - 20	State Contractor	110.00000	State State	10000		CO REALLY	Recently and the	100	0.00000	
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BL - 22	Open	TO MAN DE LA COMPANY	Too an oral to	-	Stormer's	S State (1)	Li milano Altra	100 MA	1000	
BL - 23	Open	STORE COLOR	STREET, SPACE	States States		55	a let see construction	1000		
BL - 24	Open	The second		-	1.000	-	P. C. Carrier Conference	1000	2000000 (Q	
BL - 25	State State	Sector Sector	Contract Contract	Company of the		1000	a lateral control of the	-	CAN SER	
BL - 26	Open	Ready	COMPANY AND	Constantion of	0.000	30	CO. ADC CO. CO. CO.	4.5	000000	
BL - 27	Not Onen	Not Ready	ALL STRATE	1000		1.188.13	Contraction of the local distance	100	Sector 1	

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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