

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.

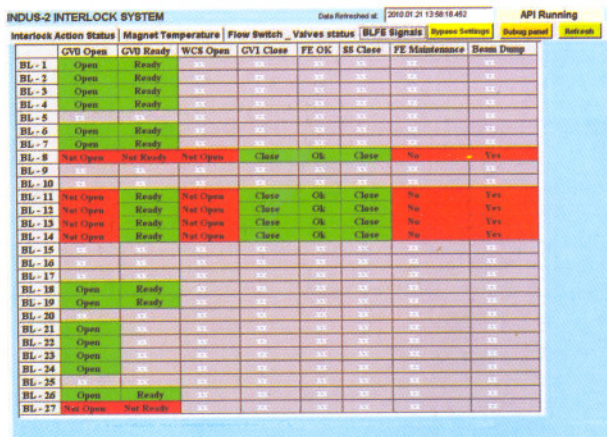
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## A.5: Extension of Indus-2 Machine Safety Interlock System (MSIS)

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.



Interlock Action Status	Magnet Temperature	Flow Switch	Valves status	BLFE Signals	Beam Dump	Subsystem	Status
BL-1	Open	Ready	OK	OK	OK	OK	OK
BL-2	Open	Ready	OK	OK	OK	OK	OK
BL-3	Open	Ready	OK	OK	OK	OK	OK
BL-4	Open	Ready	OK	OK	OK	OK	OK
BL-5	Open	Ready	OK	OK	OK	OK	OK
BL-6	Open	Ready	OK	OK	OK	OK	OK
BL-7	Open	Ready	OK	OK	OK	OK	OK
BL-8	Not Open	Not Ready	Not Open	Close	OK	Close	No
BL-9	Open	Ready	OK	OK	OK	OK	OK
BL-10	Open	Ready	OK	OK	OK	OK	OK
BL-11	Not Open	Ready	Not Open	Close	OK	Close	No
BL-12	Not Open	Ready	Not Open	Close	OK	Close	No
BL-13	Not Open	Ready	Not Open	Close	OK	Close	No
BL-14	Not Open	Ready	Not Open	Close	OK	Close	No
BL-15	Open	Ready	OK	OK	OK	OK	OK
BL-16	Open	Ready	OK	OK	OK	OK	OK
BL-17	Open	Ready	OK	OK	OK	OK	OK
BL-18	Open	Ready	OK	OK	OK	OK	OK
BL-19	Open	Ready	OK	OK	OK	OK	OK
BL-20	Open	Ready	OK	OK	OK	OK	OK
BL-21	Open	Ready	OK	OK	OK	OK	OK
BL-22	Open	Ready	OK	OK	OK	OK	OK
BL-23	Open	Ready	OK	OK	OK	OK	OK
BL-24	Open	Ready	OK	OK	OK	OK	OK
BL-25	Open	Ready	OK	OK	OK	OK	OK
BL-26	Open	Ready	OK	OK	OK	OK	OK
BL-27	Not Open	Not Ready	Not Open	Close	OK	Close	No

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.

- 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
- Data logging:** Vacuum 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.
- 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.
- Machine Web Pages:** Web pages for machine historical data information were enhanced and flexibility added for data selection and viewing.
- 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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