A.9: Indus-2 control system software enhancements

The Control System software has under gone many up gradations, modifications and enhancements during the course of time since its commissioning in year 2005. These changes were 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 Accelerator Control Section (ACS) are reported.

a) A facility to reset any Layer-3 station from Layer-1 GUI has been provided for all the sub-systems of Indus-2. This enables an operator at the control room (L-1) to reset an L-3 station in the field, in case of some malfunction, without physically going there.

b) A user command logging facility has been incorporated in PVSS API Managers for all the sub-systems, to keep the time stamped record of various commands issued by various users. This provides help while debugging operational errors.

c) Data logging facility for Indus-2 Magnet Power Supply (MPS) data has been improved to log the data at one-second rate. Previously, data was logged at 10 seconds interval. Faster data logging is useful in fault diagnostics and analysis of machine behaviour.

d) Data-logging and alarm system have been implemented for Indus-1 MPS system.

e) Patterns and timings of Command-response between Layer1-Layer2 and Layer2-Layer3 of Indus-2 Control System have been optimized. This has helped in reducing network traffic and enabled data capturing at every second.

f) Historical data display of Indus machines available on RRCAT Intranet has been modified to Java Applet based tables. It has provided a more flexible view of the information to the users.

g) Modifications in Indus-2 Vacuum Thermo Couple Interface Unit (TCIU) software are done for disabling user defined trip settings and for providing alarm and data logging on Indus-2 main database server.

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A.10: Induction Heating Power Supply for MOVPE System

A 25 kW/ 25 kHz induction heating power supply for Semiconductor Laser Section, Solid State Laser Division, RRCAT has been developed based on a novel high-frequency LCL-T resonant inverter. It is required to heat graphite susceptor to 1200 ^{0}C.

Conventionally voltage-source series resonant inverter (SRI) and current-source parallel resonant inverter (PRI) schemes are used for induction heating. While design of matching transformer is difficult in SRI (since the current in induction heating coil flows also through the transformer secondary) and bulky inductor is required to realize input current source in PRI, the proposed scheme, using LCL-T resonant converter, offers many advantages which are as follows: (i) the converter offers high current gain, which in turn reduces the current rating of the secondary winding of matching transformer and the feeder to coil, (ii) coil current is constant irrespective of changes in effective load resistance due to temperature or work-piece change, and (iii) transformer design is further simplified since its turns ratio is no longer dependent on the Q of the resonant network.

Schematic diagram of the developed induction heating power supply is shown in Fig. A.10.1 A two-stage conversion strategy is adopted. The first stage is a dc-dc buck converter with lossless turn-on and turn-off snubbers, which receives unregulated dc input voltage from a three-phase diode bridge rectifier (not shown in Fig. A.10.1), and the second stage is the free-running LCL-T resonant inverter. Work coil acts as one of the resonant inductor in the LCL-T resonant network and the second resonant inductor is integrated as the leakage inductance of the matching transformer. Water-cooled resonant capacitor is placed near the work coil to minimize the loop of high reactive current (700 A rms) circulating in the work coil. In this way, only active current flows in the transformer secondary winding and the feeder to coil (typically, 70 A rms), greatly simplifying their design. A phase-locked-loop is implemented to track the resonant frequency change with time and temperature. The power supply is housed in standard 24 U rack. Fig. A.10.2 shows the photographs of the power supply being tested in the lab to heat graphite block in air to 1200 ^{0}C.

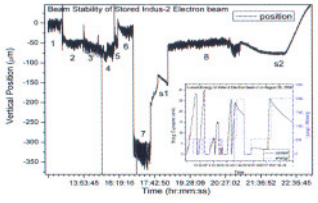

Fig. A.10.1: Schematic of induction heating power supply.

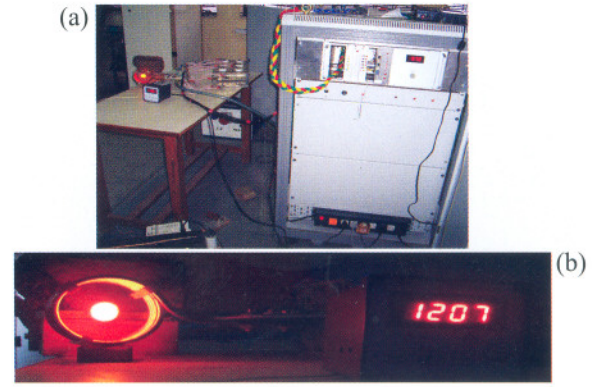

Fig. A.10.2: Photographs showing (a) The induction heating power supply and (b) A graphite block heated to 1200 ^{0}C.

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