A.3 Calibration System for Indus-2 Beam Position Indicators

The Beam Position Indicators (BPI) plays a very important and useful role in all synchrotron radiation facilities. Their importance arises from the fact that they allow us to measure beam orbit in a non-destructive manner and their effect on beam health is very negligible. One of the most important issues in particle accelerator operation is the efficient control of closed orbit. Measurement, correction and stability of closed orbit are very much essential in high brightness sources like Indus-2. The same is closely related to the performance of the BPIs.

To provide precise and accurate transverse position of electron beam in the Indus-2 storage ring, 56 Beam Position Indicators (BPI) will be installed in Indus-2 machine. Out of 56 BPIs, 40 BPIs are of individual type and rest 16 are integrated with dipole magnet vacuum chamber. The BPIs are of capacitive type having a disk (button) of SS 304L as sensor or electrode. The Beam Position Indicators are required to be calibrated before they can be installed in Indus-2 machine. The calibration is done to determine electrical offset with respect to defined mechanical centre, to determine displacement sensitivities as well as non-linearties of BPI. Ideally when beam passes through the geometrical center of BPIs, all electrodes should have same signal strength. However due to different capacitances and mechanical variation in the areas of the electrodes, the electrical centre (mechanical x, y, where all electrodes show same signal strength) differs from mechanical centre of BPI. A fully automatic calibration system has been developed (fig.A.3.1) to carry out the calibration of Beam Position Indicators. Calibration software has been developed which has necessary utilities to process and display calibration data and results.

The beam position indicator has four electrodes, which allows us to measure both horizontal and vertical beam positions simultaneously. An antenna is used to simulate the field of electron beam. The antenna is mounted on a X-Y motion stage and two stepper motors coupled to the stage provide movement to the antenna. The movement of antenna is controlled by a microprocessor-based controller, which ensures precise positioning of antenna. A 100 KHz sinusoidal signal generator is used as the excitation source. The generator output is stepped up by a 1:5 HF transformer before feeding it to antenna. Typically a signal of 100 V peak to peak is applied to antenna. A wide band voltage follower (buffer) is connected to each button electrode output to sense the signal induced on the button without loading it. RF switches are used to multiplex the four button outputs. The output of the multiplexer is read by a RF milivoltmeter. The stepper motors and RF switches are controlled by a micro processor based system. The data from milivoltmeter is read into PC over GPIB interface. The software developed in house controls the full calibration process.

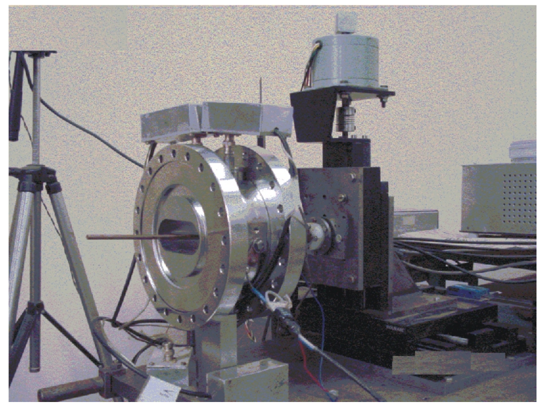

Fig.A.3.1 Calibration Setup for Beam position Indicators (close view)

The system has successfully calibrated the Beam Position Indicators of Indus-1. The system is presently being used for the calibration of BPIs of Indus-2.

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A.4 Versatile driver for laser diodes

A versatile laser diode driver power supply has been developed with varied operational requirements. The important specifications are: wide range variation in pulse width (500 ns to CW), frequency (single-shot to 1 kHz) and output current (10 mA to 5 A). Moreover, it should also be possible to bias the pulse current to the diode by a DC current. The driver power supply developed to meet these specifications follows the principle depicted in Fig.A.4.1. Two current sources Io and Ip are used to independently set the amplitudes of offset (or, bias) current and pulse current, respectively. Schottky diodes Do and Dp isolate the two current-flow paths. A low-resistance pulsar switch is switched on and off in programmed manner to generate pulse current in laser diode stack of desired duration and frequency. Note that the pulse current flows in laser diodes only when the switch is off.

High frequency switch-mode circuits are not used to develop the current sources since requirements of fast transient response and wide setting range of output current conflict. Instead, MOSFET operating in linear mode is used. However, a two-switch forward converter operating at 100 kHz is used at the front-end for AC-DC step-down conversion with output voltage regulation and input power-factor-correction. A microprocessor – controlled front panel and RS232 interface provides individual control of each parameter while the backlit LCD display provides visual confirmation of operating parameters. Various faults are also displayed on the front panel. A user- selectable slow-start function allows configuring the slow-start current ramp. Connections to the laser diode are made through a coaxial cable to reduce stray inductance.

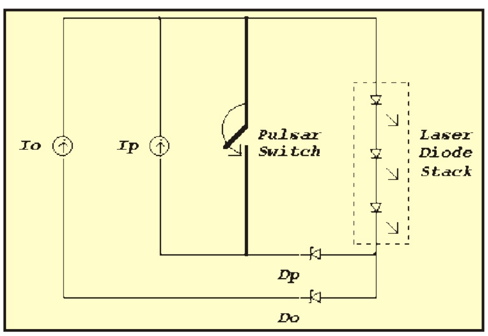

Fig.A.4.1 *A circuit diagram showing principle of operation of the laser diode driver*

Fig.A.4.2 A *photograph of laser diode driver*

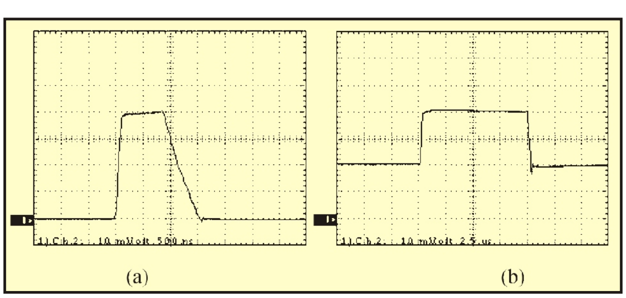

Fig.A.4.3 *Typical output current waveforms of the laser diode driver. (a) 1 µs pulse of 4 A (1 A/div, 500 ns/div) (b) 10 µs pulse of 2 A with 2 A bias current (1 A/div, 2.5 µs/div)*

Fig.A.4.2 shows the photograph of the laser diode driver. Typical output current waveforms are shown in Fig.A.4.3. A relatively high fall-time of current observed is due to the extended length of one of the load connections, to insert current probe for measurement.

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A.5 Treatment of Electroplating Effluent by Ion Exchange Method

Chemical Treatment Laboratory takes up around 6,000 components of accelerators and lasers every year for Chemical cleaning, electroplating and surface modifications. The processing generates huge amount of liquid waste, which contains many heavy metal and non-metal ions. Untreated disposal of waste poses threat not only to aquatic life but also to human beings. Heavy metals can cause different types of cancers, problems related to central nervous and cardio vascular systems. A lab study with suitable ion-exchangers was initiated in the year 1997 to replace the chemical precipitation method for the treatment and safe disposal of toxic electroplating wastes. Based on the lab studies and results, a pilot treatment plant has been installed. The entire set up contains two pairs of FRP columns having capacity to accommodate 65 liters of ion exchangers in each of them. First pair contains strong cationic exchanger, which is capable of removing all polyvalent cations (Nickel, Copper, Iron, Zinc and Aluminum) present in the waste. Another pair contains strong anionic exchanger that removes anions (Chloride, Sulphate, Phosphate and Nitrate) from the effluent. The combined treatment makes the waste free from all hazardous contaminants (as per ASTM & IS). Columns heights are designed and split on the basis of minimum retention time for complete exchange.

Analyses for ionic impurities are being carried out by a double beam UV-Vis- Spectrophotometer, specific ion electrodes and volumetric methods. By this treatment process, the metallic and non metallic ions are reduced by more than thousand times. In some cases the concentrations after treatment are below detectable limits (BDL). The electrolytic conductivity of the plating waste falls nearly to the raw water level. Hence, steps are being planned to feed this treated effluent into the demineralization unit, so that demineralised water thus produced can be reused. In this situation, no waste will be disposed to the ecosystem (Zero discharge). This will