A.3: Control System for Beam Based Alignment in Indus-2

Indus-2 Electron Synchrotron Radiation Source currently operates at upto 200 mA, 2.5 GeV on round the clock basis. Measuring the correct orbit position is an important aspect for enhancing the performance of the machine in terms of reduced Closed Orbit Distortion (COD), higher beam life time, reduced variation in machine tune and reducing the corrector strengths. This is also important for commissioning of *Insertion Devices (Undulators and Wigglers)* having small apertures for beam.

Better COD reduction can be achieved by knowing the offset between electrical axis of Beam Position Indicator (BPI) and magnetic axis of adjacent Quadrupole Magnet (QP). This offset is measured with the help of electron beam itself and is known as Beam Based Alignment (BBA). BBA works on the principle of steering the beam to pass through the center of the QP leading to no change in beam position at nearby BPI with change in QP strength. This requires independent setting of all the QP magnets. To achieve this in Indus-2 where not all quadrupole magnets are fed by independent magnet power supplies, active shunt power supplies will be put across the quadrupole magnets. A control system for BBA is designed, developed and deployed which comprises of:

1. Control System for *Active shunt power supplies* (ASPS) required for independent setting of QPs.
2. Software application for BBA algorithm.

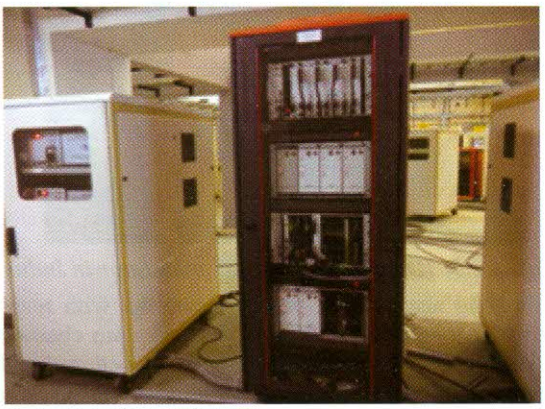

Fig. A.3.1: Equipment Control Station for Active Shunt Power Supplies for BBA in Indus-2

1. Control System for Active Shunt Power Supplies:

This is based on three layer architecture for seamless integration with existing Indus-2 control system. The Equipment Control Station (ECS) (Fig. A.3.1) at lowest layer (layer-3) which interfaces to the ASPS comprises of VME based Equipment Controllers providing stable bipolar reference signal and read back with 16 bit accuracy. Presently this system is implemented for six numbers of ASPS in mission mode and provides all the features in the hardware and software which have been implemented in the existing Magnet Power Supplies Control System (MPSCS). The system would be extended to cater all upcoming ASPS (72 in numbers) and will also serve for performing Linear Optics by Closed Orbit (LOCO) experiments.

2. Software Application for BBA Algorithm:

The process of finding the offset is complex and requires full automation. The BBA algorithm is implemented in the SCADA software WinCCOA. This software application consists of a graphical user interface panel as front end part and a back end Application Programming Interface (API) manager to interface to the Matlab application for curve fitting. The architecture of this application is depicted in Fig.A.3.2.

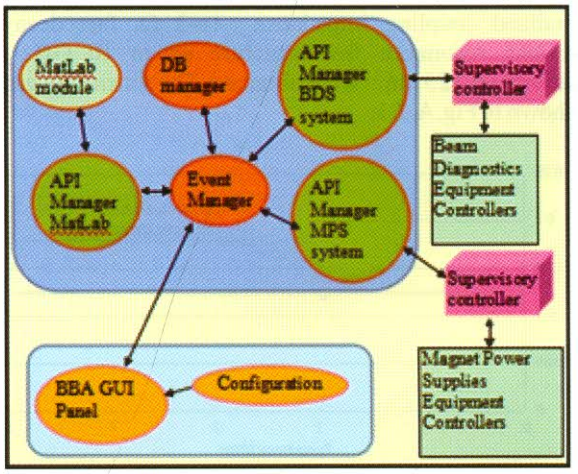

Fig. A.3.2: BBA Control System Software Architecture

The application provides features like configuration file based operation for flexibility, data logging for all measurements and calculation of merit function. The software has provision for selection of individual/all BPIs in one or both transverse planes. It takes care of faulty/non-working BPIs dynamically, providing fault tolerance and ruggedness in day-to-day operation. The Graphical User Interface (GUI) (Fig. A.3.2) also supports on line editing of all the configuration values.

The system was used for obtaining the offsets of 53 BPIs with 6 BPIs at a time. A COD of 0.45 mm rms in horizontal plane and 0.2 mm rms in vertical plane was achieved with correction of these BPI offsets as against 1.3 mm and 0.85 mm respectively without BBA offset correction. This tight COD has immensely helped in the commissioning of two undulators and is essential for machine operation with insertion devices.

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