A.4: Power converters for sextupole coils in combined function corrector magnets in Indus-1

Due to the space limitation in the Indus-1 ring, a set of eight combined function multipole magnets are being developed to facilitate closed orbit distortion (COD) correction. Each magnet will produce four required magnetic field components, namely; sextupole component to correct the chromaticity, skew quadrupole component to reduce the coupling (between the horizontal and vertical planes), and vertical & horizontal dipole components for steering the beam in both the planes. Each skew quadrupole coil, horizontal corrector coil and the vertical corrector coil will be energized independently by separate true-bipolar power converter, whereas for chromaticity correction, sextupole coils of four magnets will be connected in series and energized by one unipolar power converter. Therefore, two unipolar power converters of maximum output rating 125 A/25 V and output current stability of ± 100 ppm are required to energize the two series circuits of sextupole coils. A brief account of the design and development of 125 A/25 V unipolar power converters is reported here.

The power converters are developed based on switch-mode, two-switch forward converter topology. The converter is operating at 25 kHz switching frequency. IGBTs are used as switching devices. The main features of the design are: high efficiency, smaller size, less cooling requirement, low audible noise, high stability, better maintainability, etc. The power converters are designed and developed in modular fashion. Each module, namely, power module, breaker panel and control rack are developed and tested separately.

It was important to design the system of power converter keeping in mind the available space in Magnet Power Supply Hall in Indus-1, as well as the utilization of existing load cables for facilitating their installation. With this constraint, the mechanical assembly of power converters was planned in two 38 U cabinets with footprint of 0.8 m x 0.8 m, each housing one125 A/25 V unipolar power at the bottom in 17 U height. The remaining 21 U space in each cabinet was left to house the bipolar power converters. Figure A.4.1 shows photograph of one cabinet with the 125 A power converter assembly at the bottom. The inset of the figure shows assembly of power module and breaker panel inside the cabinet.

Rigorous testing has been performed on the power converters. Open and closed loop testing at low and high power has been carried out. Apart from various functional tests, heat run test and special endurance tests, such as current cycling tests, periodic on-off cycles, etc., have been carried out. Stability for eight hours of continuous operation has been recorded to be well within the specification of ± 100 ppm, as shown in Figure A.4.2.

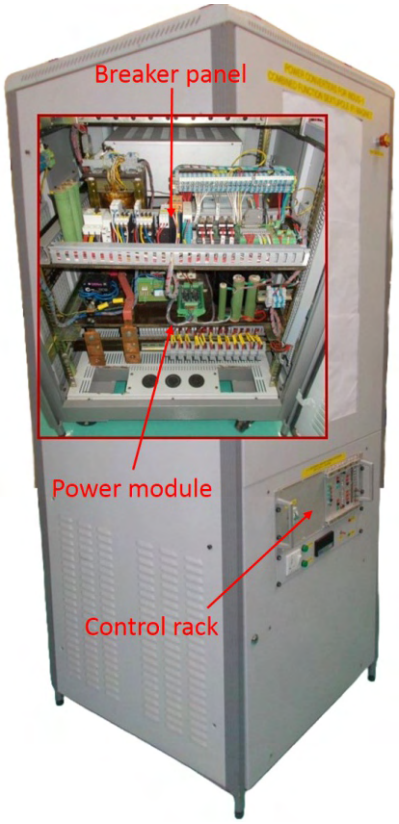

Fig. A.4.1: A view of one power converter cabinet showing 125 A / 25 V power converter at the bottom and inset shows the inside assembly.

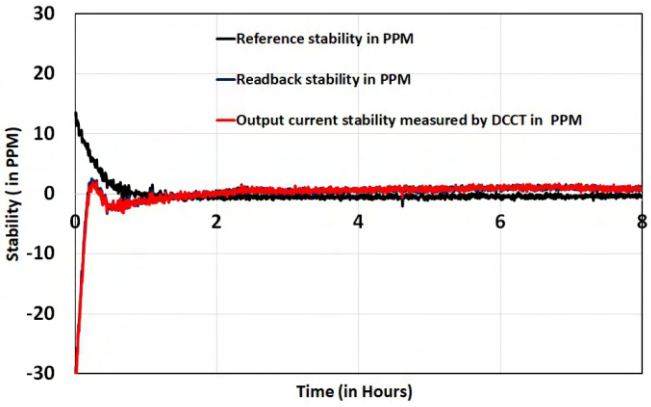

Fig. A.4.2: Output current stability for eight hours of continuous operation.

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