## A.2: Pulsed injection kicker magnets for Booster Synchrotron of Indus-1 and 2

Pulsed kicker magnets were fabricated using indigenously developed special Ni-Zn-Co ferrite blocks. In the year 2007, they were upgraded for reduced beam coupling impedances. In this report, a brief overview of the successful kicker magnet development for injection of 20 MeV electrons into Booster Synchrotron is given.

Window type, electrically lumped kicker magnets (called pulsed kicker magnets) are chosen to meet fast response and power supply simplicity. Magnetic design simulations of kicker magnets have been carried out using a FEA package- Flux 2D. The dimensions have been optimized to minimize time dependent reluctance drop in the ferrite yoke, to maximize the flux penetration into the ferrite and kicker operates below the knee of magnetization of B (H) curve (linear region). Each magnet has been constructed in window frame using Ni-Zn Ferrite blocks. Their assembly details are shown in Fig. A.2.1.

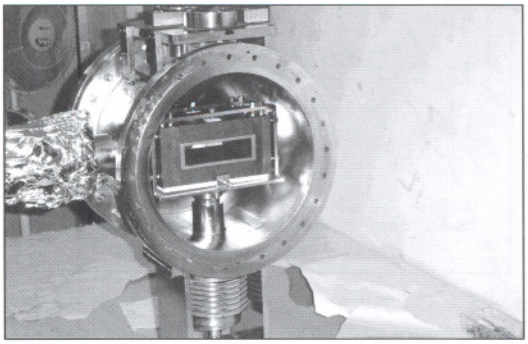

*Fig. A.2.1: Assembled kicker magnet in vacuum tank*

Various schemes for reduction in impedance without distortion of pulse shape and field distribution have been studied. Among three schemes, a kicker with conductor windings around the ferrite showed a significant reduction of impedance without affecting field distribution and pulse shape. A modified kicker section is shown in Fig. A.2.2.

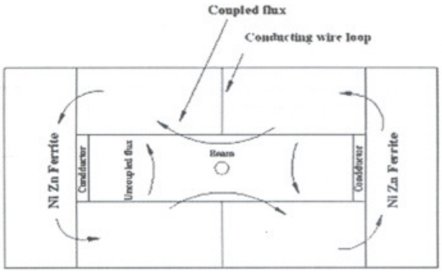


*Fig. A.2.2: Cross section of a kicker magnet.*

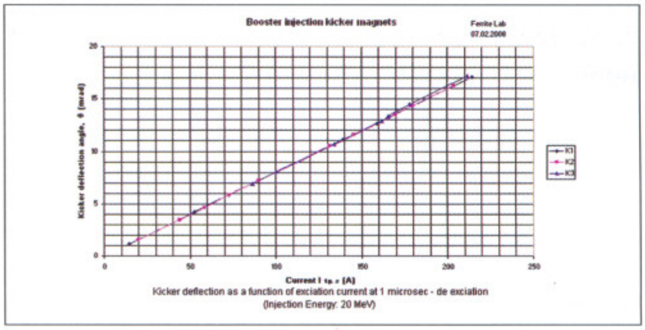


*Fig. A.2.3: Kicker deflection as a function of excitation current at 1 μs de-excitation (injection energy: 20 MeV).*

Existing kicker magnets have been modified by introducing the copper wire loop around the ferrite block, symmetrically in top and bottom. The longitudinal impedance of the kicker magnet with these schemes has been measured using coaxial wire method in the frequency range 0.3 MHz to 100 MHz. The real part of the impedance has a peak value of about 6-7 Ω at a frequency around 10 MHz. The imaginary part of the impedance is inductive within the test frequency. Measured pulsed magnetic field homogeneity (~ $10^{-3}$) and waveforms are shown in Fig. A.2.3. and Fig. A.2.4 respectively. Pulsed kicker magnets are working satisfactorily in injection of 20 MeV electrons into Booster Synchrotron during accelerator operations. They are found to work efficiently and reliably.

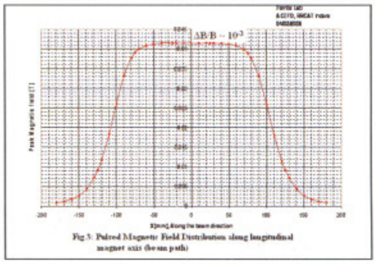


*Fig.A.2.4: Pulsed magnetic field distribution along the longitudinal magnet axis (beam path).*

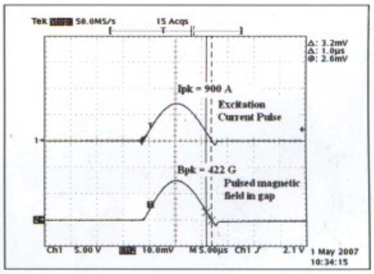


*Fig.A.2.5: Pulse waveforms of the kicker magnet.*

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