RESTORATION OF PULSED SEPTUM MAGNETS FOR 2.5 GeV STORAGE RING (INDUS-2)

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Abstract

The electrical short of thick septum coil with magnet core & mu metal screen was detected in Aug 2009. It was noticed that along with the coils, the core of the septum magnets was also damaged. Subsequently new coils were fabricated & thermally spray alumina coated at M/s SSCT Hyderabad. These newly coated coils were also electrically failed at 800 V on the internal & external 90° corner edges due to poor coating adhesion. It is therefore decided no notch should be machined at the inside 90° corner edge while rounding radius ³ 0.75 mm) provided on it. Further spare coils without notch & rounding on 90° Corner edge was fabricated & alumina coated with fine powder (5-22 µm) using fixtures. These coils were electrically tested at 1 KV ,no arcing has been observed. In view of modified section of coils, we performed transient simulation on thick septum magnet using Flux2D & Ansys.

In this report, a brief overview of magnetic simulation of septum magnet with old (sharp edge) & new rounded edge coil pulsed magnetic testing of NiFe laminations & modified septum magnets.

INTRODUCTION

A 600 MeV e beam injection into the 2.5 GeV Storage ring (INDUS-2) in the horizontal plane is carried out by combination of Thin & Thick Septum magnets & four kicker magnets. The Septa are used to deflect a beam coming from the transfer line-2 (TL-2) into a direction, which is parallel to that of the beam circulating in the Storage ring.

In this scheme, a compensated bump (16 mm) produced by four kicker magnets and the beam is injected through two septum magnets. In order to minimize the thickness of septum magnets launching the e beam, thin & thick septum magnet combination has been adapted. Septum magnets are required to provide necessary deflection to the incoming beam to match the angle of the beam transfer line to the accelerator orbit Septum magnets provide the necessary deflection to the 600 MeV electron beam to match the angle of beam transfer line to the accelerator orbit.

SEPTUM MAGNET SYSTEM

Injection system of indus2 consisting of two Pulsed Septum magnets – thin & thick and four kicker magnets. Injection efficiency is the main requirements of the Pulsed Septum magnets.

Septum magnets have two field regions. High magnetic field region- generate high uniform magnetic field ($\Delta B/B \sim 10^{-4}$) in the aperture for providing uniform beam deflection to the incoming e beam. Whereas zero field region (low field) through which the circulating beam pass without suffering unacceptable deflection or orbit distortion. The space between two regions occupied by thin conductor and hence beams entering thin area strikes the septum & is lost tolerable stray field ~ 2 G meter / Zero.

Septum magnets are operated in Pulsed mode to reduce the average power loss on a thin septum sheet. (electromagnetic – active type). To this end we rely on the field produced by the magnet to have a maximum relative error ($\Delta B/B$), below 10^{-3} in the useful aperture & time interval. There are several constraints on the development of these Septum magnets. These are due to the accelerator geometry, the injection scheme and the pulse response of soft magnetic lamination.

SEPTUM YOKE TEST & REPAIRS

Failure of in-service thick septum coil was noticed on 31st July 2009. Removal of alumina coating on the surface of copper coil. Electrical short between Ni-Fe lamination & copper coil. Electrical short between coil & mu-metal.

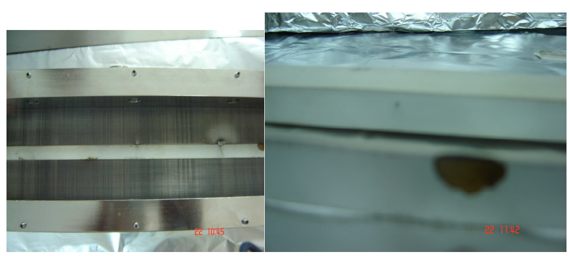

Figure 1: Electrical short of coil with core.

Pulse magnetizations of Ni-Fe laminations & yoke have been measured at 100 µs using in house developed bench. Measured results are shown in figure 2.

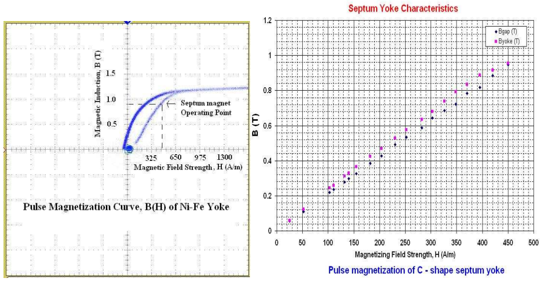

Figure 2: Pulse magnetization of core & yoke.

Nonlinear transient electromagnetic field analysis was performed on the Pulsed thick septum magnet (with sharp & round edge coil) using Flux 2D & Ansys .for its homogeneity, stray fields outside septum edge & on circulating beam axis.

Pulsed magnetic measurements was performed with both point & ∫B.dl coil on septum magnets with

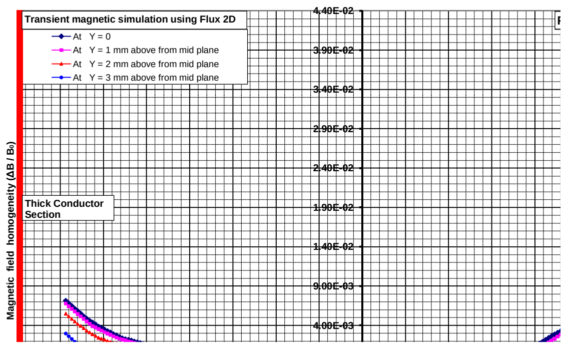

Figure 3: Pulsed field homogeneity in radial aperture.

mumetal screen for transverse homogeneity in midplanes,longitudinal profile , effective magnetic length & integral leakage field outside the septum edge towards circulating beam axis. Fig 3 & 4 shows field homogeneity & measured pulsed magnetic field waveforms. respectively.

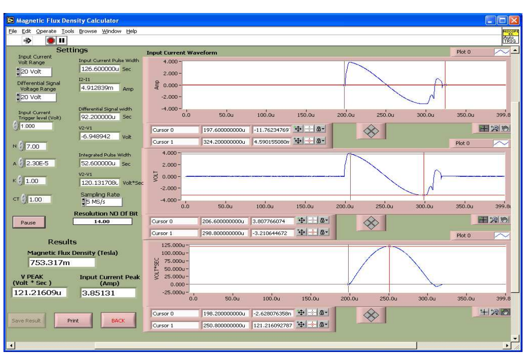

Figure 4: Pulsed Magnetic Waveform for Thick Septum magnet 14 bit digitizer.

Thick septum magnet has been rotated by 0.205 degree about the entry target point of thin septum magnet to get 3.01mm linear movement of extreme end of mu metal towards design orbit. Stray B field of the order of G-m has been measured on circulation beam axis as shown in figure 5.

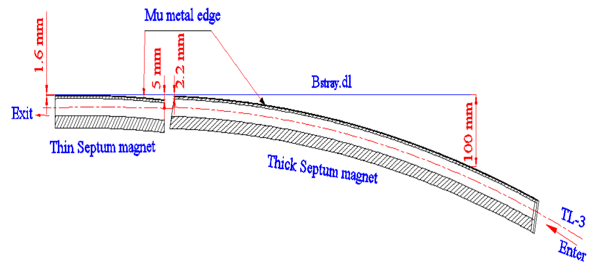

Figure 5: Combined ∫Bstray.dl of septum magnets assembled on new base plate

New septum coil has been modified with round corner for better alumina coating(250 micron) on the surfaces to withstand 1 KV between magnet core & coil as shown in figure .

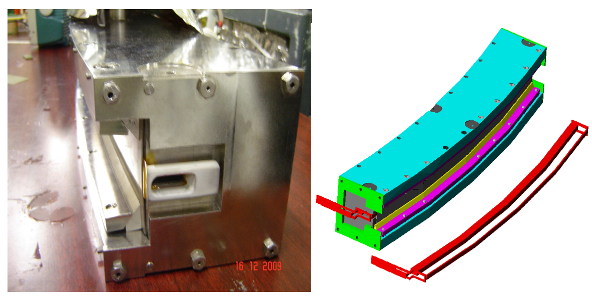

Figure 6: Septum magnet with round section coil.

CONCLUSION

Modified thick & thin septum magnets were installed in to Indus 2 ring. They are working satisfactorily during Indus 2 operation.

ACKNOWLEDGEMENT

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