Contribution ID: **574** Type: **Poster**

Error field experiment and analysis in SST-1

Friday 26 October 2018 08:30 (4 hours)

The SST-1 Tokamak has 16 numbers of toroidal field (TF) coils and 9 numbers of super conducting poloidal field (PF) coils. They have been assembled and the in-accuracy in positioning of these coils is measured. The deviations in coil positions will generate error field and this will degrade the plasma performance. The error field produced by the TF coil misalignment can impact the plasma startup and it is necessary to quantify this error. These averaged toroidal field error can be measured and detected using electron beam source inside tokamak vessel.
In SST-1 tokamak (major radius, R = 1.1m and minor radius a=0.2m), a low voltage electron beam source is mounted on the radial port at the mid-plane and can be moved to any point between R=0.95 - 1.35m. Cameras are mounted in radial port as well as top port to capture the deviation of the electron beam lines. Vacuum vessel is filled with helium gas which creates luminescent trace of electron because of impact excitation, creating a visual toroidal beam of electron inside vacuum vessel when the Toroidal Field coils are energized with a current. This paper present the experimental observation of beam deviation with respect to various TF currents and then, the estimation of measured error field in SST-1 tokamak.
An attempt is also made to explain the electron beam deviations measured through these experiments. The deviations in R, φ and Z are incorporated in the numerical model of SST-1 TF coils for the error-field estimation. Effect of other coils on this error field would also be analyzed. Error field profiles in both R and Z direction would be quantified, which would be a useful information for the plasma operation.

Key words: TF coil, Electron beam, error field

Summary: Electron beam experiments along with the numerical simulations to quantify the error-field in SST-1 tokamak is presented in this article.

Country or International Organization

India

Paper Number

FIP/P7-19

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Session Classification: P7 Posters

Track Classification: FIP - Fusion Engineering, Integration and Power Plant Design