عنوان مقاله:

Impact of Dimensional Parameters and Depth of Penetration on Mutual Inductance and Electrical Resistance of ITCs Verify Analytical and Finite Element Methods

محل انتشار:

بیست و پنجمین کنفرانس بین المللی برق (سال: 1389)

تعداد صفحات اصل مقاله: 11

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خلاصه مقاله:

A toroidal field coil (TFC) is composed of several individual toroidal coils (ITCs), which are connected in a series and distributed in a toroidal and symmetrical form. Cross section of ITCs is rectangular or negligible. This paper presents analytical equations of the mutual inductance of two ITCs applicable to Tokamak reactors using the filament method. These equations are based on those formulated by Neumann. The numerical analysis of the integrations resulting fro these equations is solved using the extended threepoint Gaussian algorithm. The finite element method (FEM) is employed to verify the mutual inductance equations of ITCs. The results obtained using the FEM, when dimensional parameters of ITCs are changed, confirms the analytical and empirical results showing an error of less than 0.2043% in the worst case. This indicates the reliability of the presented equations. This paper also employs FEM to obtain the depth of penetration of electromagnetic waves in high-conductivity conductors (HCCs). The results show that the ratio of the real depth of penetration, obtained by FEM, to the ideal depth of penetration in HCCs is independent of frequency. This ratio shows that the magnitude of traveling plane waves in HCC decreases with e−1.7916 rather than e−1.

کلمات کلیدی:

Toroidal field coil, mutual inductances, depth of penetration, Neumann’s equations, extended three-point Gaussian algorithm, Tokamak reactors