PRELIMINARY ASSESSMENTS ON REDUCTION OF THE ITER TF COIL RIPPLES GENERATED BY CN HCCB TBM

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The discreteness of ITER Toroidal Field (TF) coils will produce TF ripple which can cause significant losses in the confinement of high-energy particles (α -particles or high-energy ions from neutral beam injectors), commonly referred to as 'ripple losses'. Moreover the ripple losses can result in a large localized heat load on first wall, which could induce unacceptable level heat load damage in fusion reactor. CN HCCB TBM has chosen the reduced activation ferritic steel (RAFS) as structural material and its magnetization will further increase the non-axisymmetric magnetic field perturbations.

Active ways to reduce the TF ripple generated by TBMs have been evaluated by establishing a 40-degree three dimension solid model along toroidal with Finite Element Models (FEM). It has been shown that the TF ripple due to the discreteness of TF coils exceeds ~1% at 8.2m of plasma edge near the equatorial plane. The introduction of ferromagnetic inserts (FIs) can lower TF ripple to ~0.4%. If the FM in TBM is decreased from 1.44t to 0.729t the maximum local ripple will be lower ~0.5%. The maximum local ripple (TBM +TF coils) is ~0.97%. But the maximum ripple is only reduced ~0.2% by recessing TBM of 0.729t to 20cm. It has been shown that the way to decrease ripple was more remarkable by reducing FM than recessing TBM. Furthermore, the way by installing the compensation coils can offset the magnetized field locally. In a word, it is feasible to reduce the maximum ripple to ITER expectations by synthetically taking account of design and balance among the above mentioned ways.

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