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Coupling analysis of the HCCB blanket under electromagnetic, thermal and mechanical loads

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The China Fusion Engineering Test Reactor (CFETR) is a superconducting tokamak proposed by the China National Integration Design Group. The missions of CFETR are achieving 50˜200MW fusion power, and steady-state operation with the duty circle between 0.3 and 0.5.Breeding blanket, a core components of fusion reactor, takes the role of tritium breeding and energy conversion. It located inside the vacuum vessel under a complex operation environment. During the steady-state operation, the blanket is not only affected by its gravity but also a large amount of nuclear heat from the plasma, especially under the plasma major disruption or plasma vertical displacement. Variation magnetic flux will produce a huge eddy current and electromagnetic force in the blanket and seriously affects the structural safety of the blanket. A comprehensive finite element (FEM) structure analysis has been performed to evaluate the rationality of the blanket structure design.
The eddy current and Lorentz forces caused by plasma major disruption from an initial current of 10MA to zero in 36ms have been calculated. The mechanical loads due to gravity have also been account and discussed. Meanwhile, the thermal analysis of the blanket was carried out by means of the nuclear thermal data given by MCNP. All the above loads have been combined as input for a FEM analysis and the stress distribution has been evaluated according to the American Society of Mechanical Engineer (ASME) norms.

Eligible for student paper award?

Yes

Authors: Mr WANG, Ming; Mr LEI, Mingzhun; Mr SONG, Yuntao; Mr YE, Minyou

Presenter: Mr WANG, Ming

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