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Study on dynamic behavior of EAST upper divertor with vertical displacement events

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The upper divertor of EAST had been upgraded as ITER-like monoblock configuration after 2012 experimental campaign. Compared to previous graphite divertor, it can greatly improve handling capability which is capable of offering an opportunity to study ITER-related plasma physics and engineering and to study the performance of the advanced tungsten divertor at the same time. During plasma operation, the divertor will not only suffer complicated thermal load but also experience huge electromagnetic (EM) force. Considering that the EM forces induced by transient events like current quench (CQ) or vertical displacement events (VDEs) will deposit onto the divertor surface for several millisecond, it will bring a large damage to the divertor which maybe reduce the lifetime of the divertor or break the divertor directly. Eddy current induced by CQ and VDEs will greatly decrease since the monoblock structure is chosen as the upper divertor module. Therefore, halo current induced by VDEs which can reach up to about 50 percent of plasma current is the predominant source of the EM force. And it turns into one of the remarkable threats to capability of the tungsten divertor. Aiming at investigating the response and studying the dynamic behavior of the tungsten divertor components with VDEs, dynamical experiments on W and CuCrZr employed in EAST upper divertor had been done already. And based on the experiment results, constitutive equations involving five material constants were built by using Johnson-Cook model to describe the dynamical properties of these two materials. In this paper, three different halo current distributions on EAST divertor module were calculated respectively according to the halo configurations of vertical displacement events on ITER. Then the EM force and statics analysis were completed by importing the current results for each cases. Finally, dynamic behavior analysis on monoblock structure of the inner plates with 1 MA plasma current was performed and strength analysis and life prediction were done to evaluate the effects on divertors with VDEs based on dynamical properties gotten from the experiments and foregoing calculated EM force. This work was supported by National Magnetic Confinement Fusion Science Program of China (Contract No.2014GB101001).

Eligible for student paper award?

No

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