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P4.105 Studies of advanced divertor concepts and engineering design issues for a DEMO reactor

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For a recent Japanese (JA) DEMO reactor design (Rp: 8 m size), the exhausted power to the SOL (Psep) is expected to be 200-300 MW, where large power handling (Psep/Rp = 24-35 MW/m) is required in the SOL and divertor. The conventional divertor design with the divertor leg length of 1.7 m was proposed, where the peak heat load at the divertor target was simulated to be less than 10 MW/m2 with the large radiation power fraction (Prad/Psep~80% level), and appropriate remote maintenance has been developed. Some advanced magnetic configurations are attractive for the divertor performance to reduce qtarget with smaller impurity seeding and Prad, which may reduce the divertor size. On the other hand, arrangement of the poloidal field coils (PFCs) and their currents are critical issue for the engineering design, pointed out in the previous JA DEMO design (Rp: 6m size). In this paper, advanced magnetic configurations such as snow flake divertor (SFD) and short super-X divertor (SXD) were investigated appropriate for the recent JA DEMO with decreasing the divertor size. The arrangement of PFCs was investigated, considering the maintenance port for the divertor, and minimal number of the divertor coils were installed inside the toroidal field coil (TFC), i.e. interlink-winding (interlink). Two and three interlink divertor coils were necessary to produce the short-SXD and SFD, respectively, and the maximum coil current for the SFD (~40 MA) was larger than those of the short-SXD (12-16 MA) since the SFD null was produced by merging two magnetic nulls. Issues of the technology and engineering such as R&D on the superconducting coil (reducing AC loss), interlink winding (so call “React and Wind”) and reducing the electro-magnetic force on the interlink coil, are described. In addition, simulation result of the divertor performance (plasma detachment) will be presented.

Presenter: ASAKURA, Nobuyuki (Department of Fusion Reactor Systems Research National Institutes for Quantum and Radiological Science and Technology (QST))

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