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FTP/P7-31: Critical Design Factors for Sector Transport Maintenance in DEMO

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Maintenance is a critical issue for fusion DEMO reactor because the design conditions and requirements of DEMO maintenance scheme are different from that of ITER remote handling. The sector transport maintenance scheme has advantages to maintain blankets and divertors without the use of sophisticated remote handling devices including sensitive devices to radiation in the reactor. SlimCS designed in JAEA adopts the sector transport maintenance scheme in which every sector is pulled out horizontally through a port between TF coils. A critical design issue for the horizontal sector transport maintenance scheme is how to support an enormous turnover force of the toroidal field (TF) coils. We propose following two options; first option is the horizontal transport maintenance scheme in which every sector is pulled out through four horizontal ports connected with the corridor. Second option is the vertical sector transport maintenance scheme with small vertical maintenance ports (total: 6 ports). The new horizontal sector transport limited in the number of maintenance ports is a more realistic maintenance scheme, and the key engineering issue is the transferring mechanism of sector in the vacuum vessel.
In the maintenance scenario, the key design factors are the cool down time in reactor and the cooling method in maintenance scheme for keeping components under operation temperature. By one-dimensional heat conduction analysis, the sector should be transported to hot cell within 40 hours in the case the cool down time is one month. In the horizontal sector transport maintenance, the maintenance time including removal of cooling piping, drain of cooling water and sector transport to hot cell is about 32 hours. Furthermore, the tritium release in the sector transport can be suppressed because the components temperature drops by forced-air cooling system.
This paper mainly focuses on a sector transport maintenance scheme from the aspects of high plant availability. This design study clarifies critical design factors and key engineering issues on the maintenance scheme, that is, (1) how to support an enormous turnover force of the toroidal field (TF) coils in the large open port for sector transport and (2) the transferring mechanism of sector in the vacuum vessel. In addition, maintenance scenario under the high decay heat is proposed for the first time.

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