Abstract

Thermo mechanical analyses of in-vessel components

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The significant thermal load requires efficient cooling in the in-vessel components of fusion devices. The plasma facing components, first walls and first mirrors need the most critical cooling system, because these are the most thermal loaded components, in addition the mostly eroded ones by charge exchange neutrals, which induces shorter lifetime and more often maintenance and exchange interventions. Due to the strict vacuum circumstances the proper attachment principle of cooling supply pipes and channels is the welding, which can be done only as a remote handling operation during shutdown of fusion device and furthermore only in the hot cell. As it is of high importance to keep the maintenance time acceptable short, complex, cooled, exchangeable modules are necessary to develop. During the different phases of design the satisfactory performance of cooling must be kept and checked by thermomechanical calculations.

For complete installation of first wall diagnostic system in ITER there will be diagnostic equipment within the vacuum vessel ports. The diagnostic support structures carry this equipment and bring diagnostic signals out of the primary vacuum. This is referred to as a port plug assembly where the structures and the primary closure are combined in one unit. Equatorial Port Plug performs these basic functions at the Port: - provides neutron and gamma shielding to the VV, main coils and port region, - supports the first wall armour and shielding blanket material, - closes the vacuum vessel ports, - supports the diagnostic equipment within the primary vacuum, on the primary vacuum boundary and in the port interspace. This study handles with numerical thermomechanical simulation the ITER Equatorial Port Plug.

Because of the close proximity of the plasma the structure is subjected to severe heat load. The thermal loads have three types: - plasma heat flux on the plasma facing surfaces, - volumetric heat generation caused by neutron irradiation, - temperature of the port plug back surface and also the coolant temperature.

The aim of this study is to give answer to the thermal behavior of the complete structure and also the sub assemblies. The calculation can confirm the applied geometrical shape and the used materials. These results can be a starting point of further development.