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Preliminary Cooling Channel Design and Thermal-hydraulic Analysis of GDC PE in UPP14

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The GDC PE in UPP14 is one of the plasma facing components in the ITER tokamak device. It will get a large number of thermal loads such as radiation and charge-exchange, neutron heating. So it would need the active cooling requirements from Diagnostic Port Plugs(DPP).
The electrode model consists of three parts: the electrode head, the electrode rod and pipes.The first layer channel shape is a rectangle (11mm×15mm) except for the first and the last one due to the irregular head shape.The shape of the other channels is all circular and many channels are designed in parallel way for two reasons: The thermal load on the second half is less than the front part; Reduce the flow resistance.
To obtain the reasonable cooling needs, the preliminary thermal-hydraulic simulation and analysis has been done, which is based on the turbulence model.
The pressure loss in the fluid channel is about 0.452MPa(allowable maximum pressure drop 1.35MPa) during POS. The temperatures of the electrode volume and the electrode temperature peak is 277.5℃, which is less than limit peak stainless steel temperature 450℃. Therefore, all the results meet the thermal design under the flow rate 0.7kg/s, and they could provide some references for the next design optimization, such as pressure drop matching with other components, etc.
Key words: ITER, GDC, thermal-hydraulic

Eligible for student paper award?

No

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