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P2.111 Thermal electromagnetic and structural analysis of gas baffles for the TCV divertor upgrade

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As part of an ongoing divertor upgrade of the TCV tokamak [1] it is planned to add gas baffles on the inner and outer wall of the vacuum vessel to form a divertor chamber of variable closure. The baffles promise to increase the compression of neutral particles in the divertor and, thereby extend the divertor research on TCV towards more reactor relevant, highly dissipative divertor regimes.
It is foreseen to construct the baffles entirely of polycrystalline graphite, also used for the protection tiles in TCV. The thermal analysis of the baffles considers exposure to heat loads expected both during normal operation and off–normal events. During normal operation even an extremely large extension of the power carrying plasma channel towards the baffle for the entire duration of a TCV discharge of 2 seconds does not give cause for concern with temperatures increasing not more than 400 K. An analysis of off–normal events identifies an accidental limiting on the outer baffle as the worst case scenario, where the peak heat flux reaches 30 MW/m2 resulting in sublimation temperatures of 2200 K in ~0.5 seconds. The electromagnetic analysis considers Halo currents, which can occur during disruptions, as the worst case scenario. It is found that a Halo current of 250 kA will result in an average vertical force in the baffles of up to 620 kN/m3. The worst case scenarios for thermal and electromagnetic loads lead to a maximum tensile stress of 19 MPa and a maximum compressive stress of 90 MPa and, thereby remain below their respective material limits of 37.5 MPa and 150 MPa.
The obtained results of the thermal, electromagnetic and structural analysis validate the proposed solution for the baffles and guide further optimisation of their design.
[1] H. Reimerdes, et al., Nucl. Mater. Energy 12 (2017) 1106.

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