DOUBLE-NULL DIVERTOR DESIGN FOR JT–60SU, A 10 MAMP CLASS LONG PULSE TOKAMAK

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A conceptual design of the divertor configuration for a next generation long pulse, double-null, high triangularity tokamak is presented. As a specific example, the projected performance characteristics of the JT–60SU device during its D-D operation phase were used. A symmetric double null equilibrium was produced with the EFIT code with a separatrix elongation of 2.0 and a triangularity of 0.63 at a plasma current of 10 MA. Using this equilibrium, the divertor plasma facing surfaces were contoured to minimize surface heat flux in the region near the separatrix strike zones. Carbon fiber composite tiles were chosen as the plasma facing surface. The tiles are brazed to water cooled copper backing plates. This design is shown to be consistent with maintaining a tile surface temperature of <1000°C at the planned plasma heating power of 80 MW and a radiation fraction of 50%.

Mechanical support structures for the plasma facing components must be flexible enough to handle the differential thermal growth during high temperature vacuum baking for wall conditioning, yet stiff enough to resist forces due to halo currents during disruptions. A peak halo current of 4.7 MA, with a toroidal peaking factor of 2, is predicted for a 10 MA plasma and a vertical instability growth rate of 50 s^{-1}. A static analysis of the induced stresses during both load conditions was performed with a 3D finite element model. A double strut design using Inconel 718 is presented which satisfies these constraints.

An estimate of particle throughput in the divertor gaps indicates the design is capable of maintaining divertor gas pressures <1.5 Pa while the total D_2 throughput is consistent with the requirement for divertor impurity enrichment using the “puff and pump” technique.