Design of Plasma Facing Components for Superconducting Modification of JT-60 (P2-F-341)

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JT-60 is planning to modify the machine as a fully superconducting coil tokamak (JT-60 Super Advanced, the former JT-60SC and NCT) to establish scientific and technological bases for an economically and environmentally attractive DEMO reactor. It will be also a satellite tokamak in a part of broader approach for ITER. It is designed for high beta (betaN=3.5-5.5) and steady-state research in a break-even class DD plasma for 100s or longer. Nominal plasma parameters are Ip=5.5MA, Bt=2.7T, R=3.01m, a=1.14m with double-null configuration. An ITER-like single-null configuration with Ip=3.5MA, Bt=2.6T can be also operated.
In order to study the ITER-relevant high confinement plasma with high density, designed plasma heating power was enhanced from 25MW to 41MW for 100s through the design review with EU and Japan. The heat flux onto outer divertor target exceeds 10MW/m2 with moderate radiative fraction of 50-60% in single-null configuration. Therefore, the ITER-like mono-block CFC target will be adopted to aim at power handling of 15MW/m2. A cooling water system should be reinforced 3 times from original design for double null divertor with high coolant flow velocity of ~10m/s.
The peak heat flux onto the neutral beam armor for perpendicular injected positive NB is evaluated to be 2MW/m2, which needs to be actively water-cooled. A bolt-fixed CFC tile was tested at the heat flux of 1-3 MW/m2 and will be applied to the NB armor.
In order to improve plasma beta value by enhancing wall stabilization effect, passive-stabilizing plates, which are electrically and mechanically connected in poloidal and toroidal direction, will be installed near the plasma surface (rwall/a=1.1-1.3) at the outboard side. Stabilizing plate has double-wall ribbed structure and can be operated at 573K with heating nitrogen gas instead of cooling water between double walls. It has crank-type support legs to allow thermal expansion at high temperature operation.
The remote handling capability for in-vessel components should be required due to the increase in the neutron budget by an order of magnitude with respect to the original design. Upper and lower divertor cassettes and inboard first wall units should be designed to be exchangeable by the ITER-like remote handling system.
Design modification for the increase of heating power and neutron budget will be completed in the end of 2006 under the conceptual design activity in the collaboration with EU and Japan.