DESIGN OF THE TPX OUTBOARD TOROIDAL LIMITERS*

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The Tokamak Physics Experiment (TPX) plasma facing components (PFCs) are being designed for steady-state operation with a maximum power input of 45 MW. The outboard limiters are subjected to steady-state radiative heat loads of 0.4 MW/m^2 and plasma startup loads. The outboard limiter system performs several functions: 1) it protects the vacuum vessel by limiting the plasma boundary, 2) it provides a low atomic mass number material interface with the plasma to limit radiation losses from the plasma due to sputtered atoms, 3) it provides passive vertical stabilization of the plasma by providing an inductive saddle coil circuit, and 4) it acts as a "kink cage" providing kink mode stabilization by locating conductive material close to the plasma boundary.

The outboard limiter structure consists of two toroidal copper rings which are toroidally electrically continuous except at one toroidal location where a high resistance electrical break must exist. Vertical copper conductors connect the top and bottom rings together on either side of the electrical break forming a saddle coil configuration to passively stabilize vertical movements of the plasma. The toroidal rings are each formed by 16 water cooled copper "passive plates" which are clad with bolted carbon-carbon composite tiles. Local areas of the passive plates employ brazed C-C tiles to accept higher ripple particle heat loads (≈1.7 MW/m^2). There are three large plates located on the midplane to provide copper structure near the plasma and provide additional kink mode stabilization. The midplane plates incorporate poloidal limiters to toroidally limit the plasma and to protect the ICRH antennae Faraday Shields.

All of the PFCs are designed for remote maintenance since activation levels will preclude manned vessel entry after two years of operation. Low-activation materials are used to allow personnel entry for the initial two years. The primary materials used are C-C composite, copper, and titanium. The vessel and PFCs are bakeable to 350°C for wall conditioning. Therefore, the supports are designed to accommodate the large mismatch in thermal expansion coefficients between the toroidal copper rings and the titanium vacuum vessel.

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