TECHNOLOGIES TO OPTIMIZE ADVANCED TOKAMAK PERFORMANCE*

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Several system studies indicate the advanced tokamak would make a commercially attractive fusion power plant provided the theoretically predicted high plasma performance can be reliably achieved. Experiments worldwide are now demonstrating many of these predictions. Such a power plant would be the size and field strength of ITER but with more highly shaped magnetic configuration and higher power handling capability not achievable in a research device. In addition, the power plant would require advanced plasma control technologies now being developed worldwide that will be employed in ITER research. This paper summarizes engineering features of the plasma control technologies being deployed in DIII-D research.

Central to enhancing plasma performance is an extensive plasma diagnostic system coupled to a fast multivariable plasma control feedback system to control plasma shape, position, fueling, and particle exhaust. In addition, localized heating and current drive power and momentum deposition is controlled to optimize radial current, pressure, and rotation profiles to optimize stability and suppress neoclassical tearing modes. Resistive wall mode magnetic perturbations are detected and suppressed by control coil arrays. In the event of impending loss of stability, massive gas puffing is triggered to insure rapid plasma cool down and gentle current termination. A key technology needing much further development is transport barrier control of burning plasmas that will be ultimately explored in ITER.

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