Initial Results from the New Internal Magnetic Field Coils for Resistive Wall Mode Stabilization in the DIII-D Tokamak*

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A set of 12 internal magnetic field coils (I-coils) has recently been installed in the DIII-D tokamak, and will be used in the 2003 campaign to provide feedback stabilization of resistive wall modes (RWM) for advanced tokamak plasmas with toroidal β above the no wall stability limit. Calculations with the 3D electromagnetic code VALEN [1] predict that the performance of this system is superior to the previously installed external compensation coils (C-coils) by providing stabilization up to the ideal wall beta limit without the presence of strong plasma rotation, which was required in previous DIII-D experiments [2].

The new 12 I-coil set consists of six single-turn, water cooled coils equally spaced toroidally above the outer midplane and an identical set of six coils below the midplane. The area of each coil is 1.1 m^2 (total DIII-D vacuum vessel area is ~70 m^2). Maximum rated coil current is 7 kA which corresponds to about 9 gauss at the q=3 surface for an m/n=3/1 helical configuration. These coils can be connected in a variety of combinations, allowing for optimization of feedback control of n=1 or n=2 RWM modes of variable m number. An extensive set of poloidal field and radial field sensors is available for optimizing mode detection and control algorithms. Switching power amplifiers (SPAs) connected to the I-coils have been upgraded for faster response and operation into the low inductance load typical of the I-coils, and the system has been operated at frequencies up to 2 kHz. The recent addition of a faster CPU in the digital plasma control system should provide faster recognition of the mode onset and improve the overall response of the RWM feedback system. In addition to RWM stabilization, the capabilities of the new I-coil system allow for a variety of experiments such as optimization of static error fields, stochastic magnetic fields, rotating magnetic fields, and MHD spectroscopy.

With these improvements in hardware, we can investigate the detailed mechanism of the dynamic error field correction resulting in RWM stabilization. We will discuss the initial operation of this I-coil set, compare it to the feedback performance of the external C-coil set, and evaluate the performance with respect to predictions.

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