Experiments and Modeling Using Resistive Wall Mode Feedback Control in DIII-D*

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Experiments in DIII-D are evaluating both feedback and rotational stabilization of the resistive wall mode (RWM) in support of identifying appropriate stabilization coils for ITER where rotation alone may not be sufficient. The goal of the DIII-D experiments is sustained high beta operation near the ideal wall limit with little or no toroidal rotation.[1] VALEN and other models show that as β_N increases above the no-wall limit, the growth rate of resistive wall modes increases, requiring a faster feedback system with less system time delay for stabilization. Recently, high-speed amplifiers (dc to 40 kHz) driving 12 internal non-axisymmetric coils (I-coils) were used on the DIII-D tokamak to assist in stabilizing these faster modes. A novel combination of I-coils, driven by these audio transistor amplifiers, and external coils (C-coils) driven by switching power amplifiers (SPAs) with slower time response were used to help stabilize discharges well above the no wall β limit, i.e. $\beta_N \sim 4$ for durations up to 1.5 s. This system is being upgraded in 2006 with the addition of more amplifiers (12 total), higher processing speed for digital feedback control (~100 kHz), and shorter time delays (~55 μs). We will present results of VALEN modeling which was used to optimize the circuit configuration and examine the effects of system delay times and noise on feedback stabilization especially near the ideal wall β limit. We will discuss RWM stabilization in DIII-D discharges using these high speed amplifiers and the development of low rotation target discharges used to assess feedback performance with little or no rotational stabilization. With the addition of counter neutral beams in 2006 and the upgraded I-coil feedback system, the ability of DIII-D to carry out ITER relevant RWM feedback stabilization experiments will be greatly enhanced.

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