Long Pulse Advanced Tokamak Discharges in the DIII–D Tokamak*

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One of the main goals for the DIII–D research program is to establish an advanced tokamak plasma with high bootstrap current fraction that can be sustained in-principle steady-state. Substantial progress has been made in several areas during the last year. The resistive wall mode stabilization has been done with spinning plasmas in which the plasma pressure has been extended well above the no-wall beta limit. The 3/2 neoclassical tearing mode has been stabilized by the injection of ECH into the magnetic islands, which drives current to substitute the missing bootstrap current. In these experiments either the plasma was moved or the toroidal field was changed to overlap the ECCD resonance with the location of the NTMs. Effective disruption mitigation has been obtained by massive noble gas injection into shots where disruptions were deliberately triggered. The massive gas puff causes a fast and clean current quench with essentially all the plasma energy radiated fairly uniformly to the vessel walls. The run-away electrons that are normally seen accompanying disruptions are suppressed by the large density of electrons still bound on the impurity nuclei.

Major elements required to establish integrated, long-pulse, advanced tokamak operations have been achieved in DIII–D: $\beta = 4.2\%$, $\beta_p = 2$, $f_{BS} = 65\%$, and $\beta_N H_{89} \geq 10$ for 600 ms ($\sim 4\ \tau_E$). The next step is to integrate the different elements. This will be the goal for the next five years, when some new hardware is going to be added. Twelve resistive wall mode coils are scheduled to be installed in DIII–D during the summer of 2003. The future plans include upgrading the tokamak pulse length capability and increasing the ECH power.

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