Disruption physics and mitigation on DIII-D

D.G. Whyte*, D.A. Humphreys, and A.G. Kellman

*University of Wisconsin, Madison, Wisconsin, USA
DIII-D National Fusion Facility, General Atomics, San Diego, California, USA

Contact author: Dennis Whyte, 331 Engineering Research Bldg, 1500 Engineering Dr.,
Madison, Wisconsin, 53706 USA,
Phone (608) 262-4854, Fax (608) 265-2364,
e-mail: whyte@engr.wisc.edu

Total pages: 36 (31 text, 3 figures, 2 tables)

(Received

The contributions of the DIII-D tokamak toward the understanding and control of disruptions are reviewed. Disruptions are found to be deterministic, and the underlying causes of disruption can therefore be predicted and avoided. With sufficiently rapid detection, possible damage from disruptions can be mitigated using an understanding of disruption phenomenology and plasma physics. Regimes of high β are readily available in DIII-D and provide access to relatively high energy density disruptions, despite DIII-D's moderate magnetic field and size. DIII-D, with all-graphite wall armor and wall conditioning between discharges, has proven highly resilient to the deleterious effects that disruptions can have on plasma operations. Simultaneously, exploitation and adaptation of DIII-D's extensive core and edge plasma diagnostic set has allowed for unique plasma measurements during disruptions. These measurements have tied into the development of several physical models used to understand aspects of disruptions, such as magnetohydrodynamic (MHD) growth at the disruption onset, radiation energy balance through the thermal quench and halo currents during the current quench. Based on this fundamental understanding, DIII-D has developed techniques to mitigate the harmful effects of disruptions by radiative dissipation of the plasma energy and extrapolated these techniques for possible use on larger devices like ITER.