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Simulation of DIII-D Plasma Shutdown by Deuterium Dilution Cooling[1] V.A. IZZO, University of California-San Diego, P.B. PARKS, W. WU, General Atomics — To mitigate ITER disruptions and avoid large numbers of runaway electrons, a significant increase in the total (free + bound) electron inventory is likely required. The Rosenbluth criterion — $E_c \approx 0.12\, n_{e,20}$ — determines the critical electric field (in V/m) at which exponential runaway avalanching will occur. Here we consider instantaneous dilution cooling of a DIII-D plasma by the injection of 100 times the initial deuterium density to simulate rapid core penetration of a D_2 pellet train or liquid jet. The 3D NIMROD MHD simulation is initialized with an equilibrium pressure profile, but a 100× density increase and a corresponding 100× temperature reduction. The plasma is assumed to have in situ carbon fraction of 1% of the pre-dilution density, which produces strong edge radiation at the dilution cooled temperatures. A cooling front propagates inward and ultimately triggers a central 1/1 MHD event. The central current density transiently increases by more than a factor of 2. The 3D simulation is compared with a 1D simulation which incorporates a Kadomtsev mixing model for the 1/1 MHD event.

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