Characterization of Heat Loads From Mitigated and Unmitigated VDEs in DIII-D

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Experiments were conducted on the DIII-D tokamak to study the distribution and repeatability of heat loads and vessel currents resulting from vertical displacement events (VDEs). For unmitigated VDEs, the radiated power fraction appears to be of order 50% (based on measurements at two toroidal locations), with the remaining power dominantly conducted to the vessel walls. Shot-to-shot scatter in heat loads measured at one toroidal location is not large (less than factor of two), suggesting that toroidal asymmetries in conducted heat loads are not large. Conducted heat loads are clearly observed during the current quench of both mitigated and unmitigated disruptions. Significant poloidal asymmetries in heat loads and radiated power are often observed in the experiments; the origin of these asymmetries is not understood yet. Energy dissipated resistively in the conducting walls appears to be small (<5%). Also, the mitigating effect of neon massive gas injection (MGI) as a function of MGI trigger delay was studied. With MGI, improved mitigation is observed as the MGI trigger delay is decreased: for sufficiently early MGI mitigation, close to 100% radiated energy and a reduction of roughly half in vessel forces is achieved. Due to the slow (>100 ms) VDE time scales in ITER, these results suggest that it should be possible to implement MGI sufficiently early in ITER to reduce conducted heat loads from VDEs.

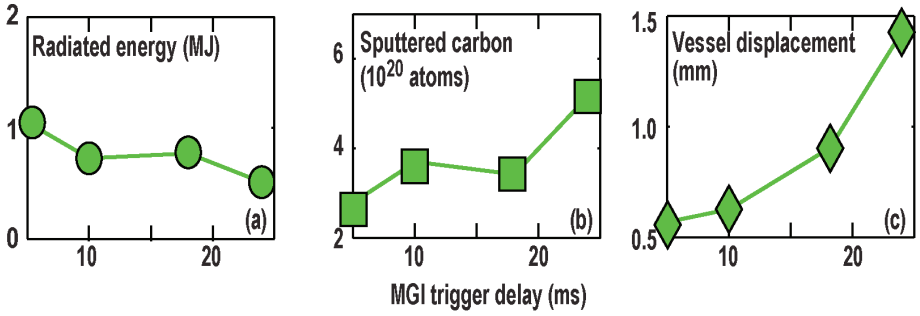

Fig. 1. (a) Radiated energy (measured at toroidal angle 210 deg.), (b) sputtered carbon yield (representative of total conducted heat loads), and (c) vertical vessel displacement as a function of MGI trigger delay relative to VDE trigger.

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