Dependence of the shattered-pellet-mitigated thermal quench radiation efficiency on the plasma thermal energy in DIII-D with uncertainties derived from disruption energy flow models

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Experiments were conducted on DIII-D using the shattered pellet injection (SPI) system to study how the required quantity of neon for full thermal quench (TQ) mitigation changes with thermal energy. A super H-mode discharge was used and terminated with the SPI as the thermal energy reached W_{th}=1.9 MJ. The radiation efficiency ($W_{rad,th}/W_{th}$) as a function of injected neon quantity for this discharge will be shown and compared with the previously investigated W_{th}=0.75 MJ discharge [Shiraki et al., Phys. Plasmas, 2016]. The change in the required neon quantity for full TQ mitigation will be compared in the high and low energy cases, and implications for the ITER disruption mitigation strategy will be discussed. To determine this required neon quantity, the fraction of thermal energy radiated is investigated using the fast diode arrays and the foil bolometer arrays. The fast diode arrays can temporally resolve the radiation flash during the TQ, but an estimation of the amount of magnetic energy dissipated during the TQ is required. The relatively low temporal resolution of the foil bolometers requires integrating both the radiated thermal and magnetic (W_{mag}) energies, but requires modelling the fraction of W_{mag} dissipated by the vessel and other conductors in close proximity to the plasma, and requires an estimate of the fraction of W_{mag} that is not radiated. For proper energy accounting, a cylindrical 0D model is developed that describes the evolution of W_{mag} during the TQ and current spike. The measured current spikes will be compared with this 0D model, and the implications on the total radiated energy throughout the disruption will be discussed. Separately, a simple toroidal wire loop model is developed to describe the work done by the vertical field during the major radial contraction. Implications of the dissipated vertical field energy on the predicted radiation efficiency will be discussed. This material is based upon work supported in part by the U.S. Department of Energy under DE-FC02-04ER54698.