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Measurement of Radiated Power Asymmetry during Disruption Mitigation on the DIII-D Tokamak

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Experiments have been undertaken on the DIII-D tokamak to examine the magnitude and causes of radiated power asymmetries during disruption mitigation. In order to mitigate the most deleterious effects of disruptions, massive quantities of radiating impurities can be injected into the pre-disruptive plasma to pre-emptively radiate away the stored thermal and magnetic energy. However, toroidal and poloidal asymmetries in the radiation pattern could still result in localized melting of ITER's Be first wall. Measurements of the toroidal asymmetry in radiated power during disruption mitigation by massive gas injection (MGI) on the DIII-D tokamak indicate that the asymmetry during the thermal quench (TQ) and current quench (CQ) is largely insensitive to the number or location of injection sites [1]. Moreover, the observed absolute values of asymmetry during the TQ & CQ are well below those expected to be problematic for ITER. Infra-red imaging of the MGI valve location and surrounding wall indicates no highly localized, preferential heating of the injector location relative to the surrounding sector of wall, providing confidence that localized melting of the injector site in ITER is unlikely. Modification of the observed magnitude of the toroidal asymmetry during the TQ by application of a large n=1 error field supports recent modeling results that indicate large n=1 MHD during the TQ is the root cause of the radiation asymmetry [1,2]. Further work examines the poloidal radiation asymmetries resulting from massive impurity injection and the effect of spatially distributed impurity injectors upon those asymmetries. In addition, the radiation asymmetries observed during MGI are compared to those observed during shattered pellet injection [3].

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Author: Dr EIDIETIS, Nicholas (General Atomics)

Co-authors: Dr PAZ-SOLDAN, Carlos (Oak Ridge Institute for Science Education); Dr LASNIER, Charles J. (Lawrence Livermore National Laboratory); Dr HUMPHREYS, David A. (General Atomics); Dr STRAIT, Edward J. (General Atomics); Dr HOLLMANN, Eric M. (University of California San Diego); Dr COMMAUX, Nicolas (Oak Ridge National Laboratory); Dr MOYER, Richard (University of California San Diego); Dr GRANETZ, Robert (MIT); Dr RAMAN, Roger (University of Washington); Ms IZZO, Valerie A. (University of California San Diego)

Presenter: Dr EIDIETIS, Nicholas (General Atomics)

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