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Minimising power load asymmetries during disruption mitigation at JET

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The high thermal loads caused by a disruption of an ITER baseline scenario pulse potentially stored thermal energy of 350MJ and magnetic energy inside the vessel of 400 MJ pose a severe threat to the first wall components [1]. Massive gas injection (MGI) into a disrupting plasma has been shown to be capable of reducing the energy deposited onto the plasma facing components by increasing the radiation. However, the uneven distribution of the radiated power following a single local massive gas injection leads to highly localised radiation and hence to significant thermal loads due to the radiation "flash"[2]. In addition, the presence of the n=1 mode during the disruption produces toroidal and poloidal radiation asymmetries. Depending on the phase relationship between the n=1 mode and the MGI-location, this effect can be enhanced or diminished. In order to address this issue, JET has installed three MGI-valves at poloidal and toroidal positions similar to ITER. Single or a combination of two MGI-valves have been fired into a locked error field mode, whose toroidal O-point position was imposed by applying an external n=1 magnetic perturbation field. By measuring the radiated power at two separate toroidal locations and varying the toroidal phase of the perturbation field a toroidal peaking factor TPF, defined as the ratio of the maximum radiation to the average value, could be estimated. For a single injection TPFs in the range of 1.5 up to 1.8 have been found, depending on the type of impurity gas used. Optimising the time delay between two MGI-valves, which are toroidally at opposite locations, allowed a reduction of the TPF down to 1.2. The measured radiated power asymmetries are sensitive to small variations of the delay between the two MGI valve triggering times in the order of less than a millisecond. In this contribution the experimental findings of radiation asymmetries during mitigated disruptions caused by a seeded error field mode and the comparison with a heuristic model will be presented and the implications for the ITER disruption mitigation system discussed.

[1] M. Lehnen et al., Journ. Nucl. Mat. 463 (2015), 39.

[2] R. Pitts et al., Journ. Nucl. Mat. 463 (2015), 748.

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