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EX/P8-12: Towards the Density Required for Runaway Electron Suppression in ITER

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Experiments of massive gas injection (MGI) in existing tokamaks have shown that this technique is suitable for disruption mitigation. A reduction of the localized heat load on the divertor is easily achieved by increasing the fraction of radiated energy with impurity injection. A reduction of the vertical force on the vessel is accomplished when the current quench duration is reduced with respect to the vertical displacement time constant. With the choice of gas type and quantity, the current quench evolution can be tailored to avoid the formation of runaway electrons (REs). Experiments with valves close to the plasma are showing that the large critical density (nc), which assures the collisional suppression of REs, is reachable in mid-sized tokamaks. The MGI method is the prime candidate for an ITER disruption mitigation system but its application to such a large tokamak is not entirely straightforward. The fueling efficiency (Feff) of the injected gas, for example, is a big unknown in the ITER MGI system design: It can vary from a few % to over 50 % across different devices and experimental conditions; in addition, numerical models for the evaluation of the ion/electron source within the plasma do not exist yet. The mitigation system at ASDEX Upgrade has evolved in the last decade from electromagnetic valves located outside the vessel to valves located in the vessel first on the low (LFS) and more recently on the high field side (HFS). The valves close to the plasma exhibit a larger Feff than the valves located further-away. The Feff of MGI from the HFS ranges between 35 and 55 % for moderate amounts of injected neon and helium, which is a factor of two larger than the Feff reached with the fast valve close to the plasma located on the LFS. The improved performance of the HFS with respect to the LFS MGI motivated the installation of a second valve behind the heat shield during the 2011 Summer break. The three valves presently installed in the vessel should allow the attainment of an effective density close to nc in dedicated experiments planned for Spring 2012.

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