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Generation of the disruption mitigation trigger: developing a preliminary design for ITER

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Plasma disruptions, occurring above a given plasma current and thermal energy, will have to be mitigated in ITER, to avoid or suppress runaway electrons, reduce thermal and mechanical stresses on the machine components, and mitigate their damage. The necessary conditions for the fulfillment of –what is called here - the Disruption Mitigation Function (DMF) are, firstly, the capability of recognizing that a disruption is going to occur, and secondly, the existence of a mitigation method and the technical feasibility of a mitigation system. Methods of “disruption prediction” and “disruption mitigation” are currently subject to R&D on the existing tokamaks and provide the know-how for the design of the DMF concept. The Disruption Mitigation System (DMS) will exploit impurity injection and is currently being designed [1].

The DMF is assigned in ITER to a cluster of systems. The Central Interlock System (CIS) is responsible for the ITER investment protection and may trigger the DMS as an ultimate tool to mitigate device damage. The Plasma Control System (PCS) is, however, the first line of defense and will assist CIS in performing the DMF. The PCS will have the responsibility of recognizing that a disruption is going to occur, of prescribing how an emergency and mitigated plasma shut-down should be executed, and of initiating its execution. The DMS executes the DMF. Each of these three systems involved is in an advanced design phase and the interfaces among them are being discussed and established.

This conference contribution presents the preliminary design for the generation of the trigger to the DMS, which has been developed during the PDR phase of the ITER PCS in collaboration between the ITER team and a consortium of external institutions [2]. The term “DMS trigger” indicates an array of signals, carrying the information that given DMS injectors must be fired at a given time, i.e. the DMS injection scheme. The generation of the DMS injection scheme requires processing sets of real time inputs with appropriate algorithms and therefore it will take place within the PCS.

The trigger development will need to follow the plasma scenario evolution in ITER and the trigger reliability will have to increase along with the magnitude of the disruption loads.

[1] M. Lehnen et al., Journal of Nuclear Material 463 (2015) 39

[2] J.A. Snipes et al. this conference

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