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ITR/P1-14: Disruption Impacts and Their Mitigation Target Values

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Major disruptions (MD) and vertical displacement events (VDE) in ITER will be the cause of a variety of deleterious impacts due to the high stored thermal and magnetic energy. Extrapolation from the disruption database obtained on current tokamaks and the results of numerical simulations, demonstrate that the thermal loads which will be produced during the thermal quench (TQ) of MD and VDEs in ITER, will lead to large scale macroscopic melting of metallic plasma-facing components (PFC). During the current quench (CQ) phase, runaway electrons (RE) are expected to deposit severe thermal loads on PFCs. The electromagnetic (EM) loads due to halo and eddy currents during the CQ are a critically important factor in the mechanical design of the vacuum vessel (VV) and in-vessel components (IVC).
For reliable operation and machine protection in ITER, mitigation of these heat and EM loads and REs during MDs and VDEs is mandatory. It is essential to realize high performance in the following three elements simultaneously for reliable mitigation, (i) high mitigation performance factor (high reduction of impact), (ii) high prediction performance (high success rate simultaneously with low false rate) and (iii) low disruptivity (by passive and active disruption avoidance). Proper target values of each element are of primary importance to achieve the overall mitigation performance required in ITER and to promote the physics R&D for the development of mitigation, prediction and avoidance systems and algorithms. In this paper, we will quantify proper target values for each element of mitigation based on the assessment of the impacts by heat and EM loads and REs using physics databases and modeling for the present ITER design. Key components like VV, IVC and PFC will be carefully examined to quantify these requirements.

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