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The influence of an ITER-like wall on disruptions at JET[1]

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Disruptions are a key issue for tokamaks such as ITER because the fast release of the high thermal and magnetic energies will result in large forces and heat loads. Hence, finding methods to avoid them or mitigate their impact is vital. The recent replacement of carbon tiles with a metallic ITER-like wall (ILW) has greatly increased the significance of disruptions for JET operations. This paper summarizes how the metallic wall influenced the disruption physics itself and its influence on the causes of disruptions. Tolerable heat loads on the ILW are reduced compared to the carbon wall because of the potential for melting. This is exacerbated by the fact that with the ILW, significantly less energy is radiated during the disruption and thus more energy is conducted to the wall. The lower radiation and thus higher temperatures also slow down the current decay, yielding larger vessel forces. Mitigation by massive gas injection had to be applied routinely in order to safely operate JET with the new wall. The start of operations with the ILW showed a marked rise in the average disruption rate from 3.4% to 10%, although in the last 2 weeks, H-mode operations with only 3.3% disruptions was achieved. The increased disruption rate can be attributed to the influence of the new wall on plasma operation and control, requiring adjustments of the established carbon-wall scenarios. A detailed survey of disruption causes will be presented, showing the improvements made to avoid various disruption classes, but also indicating those disruption types responsible for the enhanced disruption rate. The latter can be mainly attributed to disruptions due to too high core radiation but also due to density control issues and error field locked modes. Detailed technical and physics understanding of disruption causes is essential for devising optimum strategies to avoid or mitigate these events.

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