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Power and particle exhaust: recent progress on JET and implications for ITER[1]

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Fusion burn, on the one hand, and particle and power exhaust, on the other, impose different constraints on plasma scenarios – the former requiring sufficient levels of fuelling, heating, and confinement to achieve and maintain ignition, the latter for the helium ash, impurity ions and total power to be removed without undue damage to the plasma facing components (PFCs). Recent experiments on JET have significantly progressed our understanding of tokamak exhaust physics, specifically the steady-state and transient heat loads on divertor and main chamber PFCs, as well as first wall material migration and hydrogenic fuel retention. As part of these experiments, various strategies of reducing plasma loads onto PFCs have been investigated. The reduction of steady-state heat loads was achieved by a combination of fuelling and extrinsic impurity (nitrogen and neon) seeding, thereby increasing the energy radiated from the plasma edge, cooling the divertor/SOL plasma and facilitating its 'detachment' from the divertor target PFCs. Transient heat loads associated with edge localized modes (ELMs) were reduced by increasing the frequency (reducing the size) of ELM events, by fuelling, seeding and active techniques, while those associated with plasma termination (disruption) were partly mitigated by massive gas injection (mixtures of deuterium, argon and neon). Finally, a series of dedicated, day-long experiments were performed to measure the fuel retention under various plasma conditions. In this contribution, the results of the recent JET experiments are summarized and their implications for ITER are discussed.

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