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Multi-machine analysis of termination scenarios, providing the specifications for controlled shutdown of ITER discharges

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The controlled shutdown is an often overlooked, though important, phase of the tokamak discharge. The dynamics during this phase complicate control, making it difficult to avoid operational limits, which in the worst case, may lead to a disruption. This is exacerbated by the fact that at the end of the discharge the device is already operated close to many of its technical limits. For unplanned terminations, triggered by developing problems, the situation complicates further. To improve our understanding of the dynamics and control of ITER terminations, a study has been carried out on data from a large number of existing tokamaks. The aim of this joint analysis is to determine the specifications of ITER terminations. The study examined the parameter ranges in which present day devices operated during their terminations, as well as the dynamics of these parameters. The analysis addresses changes in internal inductance, li, during the plasma current ramp-down, relevant to vertical stability control, the energy (or, the poloidal beta) decay, which relates to the radial position control, as well as the controllability of the density decay, and the H to L back transition. The results can be used to better prescribe the inputs for the modelling and preparation of ITER termination scenarios.

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