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EU-DEMO: pulsed vs. steady-state solution

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In the European roadmap to fusion energy, EU-DEMO will be the first machine with a net electricity generation and demonstrating the integration of all reactor-relevant functions, e.g. self-sustaining tritium production. Currently, the EU-DEMO design is based on the tokamak configuration, with a pulsed plasma and a discharge duration not shorter than two hours. In general, the EU approach favours lower risk solutions (although not low risk in absolute terms), in order to maximize the chances of mission success in the foreseen time. Thus, while the advantages of a steady-state tokamak operation are recognized, especially for a future commercial reactor, the pulsed solution relying on inductive plasma current drive has so far been pursued. The higher risks of fully non-inductive scenarios concern the uncertainties in the associated physics assumptions and the challenges to integrate and reliably operate the auxiliary current drive systems. The large fraction of auxiliary driven plasma current negatively impacts on the net electricity output and plant availability, or, in other words, substantial improvements w.r.t.the failure rate of H&CD systems, as well as on the wall-plug efficiency as compared to present day experiments, would be necessary to meet the EU-DEMO stakeholder requirements. Furthermore, high beta, steady-state scenarios with lower plasma current and high confinement capability often require additional plasma control strategies and actuators, e.g. for the tailoring of the safety factor profile or on the resistive wall modes (RWMs), adding further complications to the already quite challenging target of a basically disruption-free reactor. Although the central solenoid in a non-inductive machine can be significantly smaller, allowing in principle a reduction of the plasma major radius, the effective shrinking of the machine size is very much limited by other factors, like the neutron shielding and the size of the TF coils. The balance of plant solutions to cope with an intermittent thermal power generations in a pulsed device are also presented

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