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Disruption loads in SPARC

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SPARC is a compact, high-field, burning plasma experiment, with the mission to demonstrate net fusion energy and retire risks on a fast-track development path toward an ARC-class pilot plant.

SPARC is designed to operate at 12.2 T at the plasma major radius, 1.85 m, and 8.7 MA in a double null configuration with elongation up to 1.97, for a 10 s flat-top. The device is conservatively engineered assuming disruption frequencies normally observed in tokamaks and prediction accuracy already demonstrated in present day machines. In-vessel components are designed to withstand the fastest current quench of 3.2 ms predicted by the ITPA disruption database (IDDB) scaling [1]. The vessel and its support system are designed to withstand the slowest current quench of 40 ms as scaled from observations in the JET-ILW [2], accounting for a halo current fraction times toroidal peaking factor of 0.7 consistent with the scaling in the IDDB and including magnetic damping.

The SPARC disruption mitigation strategy includes both a massive gas injection system and a runaway mitigation coil. SPARC operational space will expand progressively while its disruptions are characterized and compared with the design load cases to inform the operational limits and preserve the integrity of the SPARC structures. The plasma facing components are optimized for normal operation; they are expected to degrade gently and mostly away from the power handling regions of the divertor.

The material presented will focus on the derivation and application of the disruption electromagnetic loads.

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