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Implementation of a cross-device model for halo current in the DECAF code as a criterion for the determination of disruption mitigation action

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Disruption of a tokamak plasma is a multi-step process in which the loss of the plasma vertical position control is often among the last events that precede the final plasma deconfinement. A flow of current between the plasma and the vessel components -the halo current [1]- is generated through the contact of vertically displaced plasma with the vacuum vessel, resulting in electromagnetic forces applied on the device as the current crosses the confining toroidal magnetic field. The potential damage of the resulting force scales with the pre-disruptive plasma current level, to an extreme of next-step devices carrying high plasma current in which the peak force amplitude could reduce structural lifetime due to increased metal fatigue. Owing to their potential negative consequences, halo currents were studied across many devices and strategies for their mitigation were developed [2-4]. The present work reports on a cross-device implementation of a halo current model into the DECAF* code [5]. This model is part of DECAF's capability to evaluate criteria that discriminate between disruptions that require mitigation, and 'benign' disruptions, i.e. plasma collapses whose consequences can be routinely handled by the device. This level of disruption classification is of the utmost interest for devices in which the mitigation action is highly perturbative to the subsequent device operation (such as ITER). It is thus meant to be deployed under the elevated risk of device damage from unmitigated disruptions, while avoiding ramifications such as delayed plasma recovery due to unnecessary disruption mitigation.

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