A diffusive model for halo width growth during VDEs

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Abstract

The electromagnetic loads produced by halo currents during vertical displacement events (VDEs) impose stringent requirements on the strength of ITER in-vessel components. A predictive understanding of halo current evolution is essential for ensuring the robust design of those components. That evolution is primarily governed by three quantities: the resistivities of the core and halo regions, and the halo region width. A diffusive model of halo width growth during VDEs has been developed that provides one part of a physics basis for predictive halo current simulations. The diffusive model was motivated by DIII-D observations that VDEs with cold post-thermal quench plasma and a current decay time much faster than the vertical motion (Type I VDE) possess much wider halo region widths than warmer plasma VDEs where the current decay is much slower than the vertical motion (Type II). A 2D finite element code is used to model current diffusion during selected Type I and Type II DIII-D VDEs. The model assumes a core plasma region within the last closed flux surface (LCFS) diffusing current into a halo plasma filling the vessel outside the LCFS. LCFS motion and plasma temperature are prescribed from experimental observations. The halo width evolution produced by this model compares favorably with the experimental measurements of Type I and Type II halo width evolution**.**

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