FY20 Theory Milestone

"Modeling of Fully 3D Vertical Displacement Event Disruptions"

A Vertical Displacement Event (VDE) is an off-normal occurrence in a tokamak in which position control of the discharge is lost, and the tokamak plasma moves rapidly upward or downward until it makes contact with the vacuum vessel. The discharge current in ITER will be up to 15 MA. When a plasma with this current makes contact with the vessel, it will induce large currents into the metallic vessel, and these currents will cause large forces. Previous studies commissioned by ITER to calculate these forces assumed that the plasma remained axisymmetric during the VDE to simplify the calculation. However, it is known that the plasma column will deform and produce "sideways forces" in ITER that could potentially damage the machine. Our two flagship MHD codes, NIMROD and M3D-C1 now have the capability of modeling a fully 3D plasma interacting with a conducting structure. We plan to use this capability to realistically model a full 3D VDE in ITER and to calculate the expected forces.

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"Modeling of Fully 3D Vertical Displacement Event Disruptions"

Q1: Perform and document benchmark M3D-C1/NIMROD 2D VDE calculations in simplified geometry

Q2: Perform several 2D VDE simulations of ITER using either NIMROD or M3D-C1 with differing “halo current” parameters to determine likely worst case configurations regarding axisymmetric vessel forces.

Q3: Perform and document benchmark M3D-C1/NIMROD 3D VDE calculations in simplified geometry

Q4: Complete a 3D VDE simulation of ITER using either NIMROD or M3D-C1 with “worst case” halo parameters (as determined in Q2) to determine the magnitude of the sideways force.