Abstract Submitted
for the DPP17 Meeting of
The American Physical Society

Discharge start-up and ramp-up development for NSTX-U and MAST-U[1] D.J. BATTAGLIA, M.D. BOYER, S.P. GERHARDT, J.E. MENARD, D. MUELLER, PPPL, G. CUNNINGHAM, A. KIRK, L. KOGAN, G. MCARDLE, L. PANGIONE, A.J. THORNTON, E. REN, CCFE — A collaborative modeling effort is underway to develop robust inductive start-up and ramp-up scenarios for NSTX-U and MAST-U. These complementary spherical tokamak devices aim to generate the physics basis for achieving steady-state, high-beta and high-confinement plasma discharges with a self-consistent solution for managing the divertor heat flux. High-performance discharges in these devices require sufficient plasma elongation (κ = 2.4 – 2.8) to maximize the bootstrap and beam-driven current drive, increase MHD stability at high I_p and high β_N, and realize advanced divertor geometries such as the snowflake and super-X. Achieving the target elongation on NSTX-U is enabled by an L-H transition in the current ramp-up that slows the current diffusion and maintains a low internal inductance ($l_i \leq 0.8$). Modeling focuses on developing scenarios that achieve a suitable field null for breakdown and discharge conditions conducive to an early L-H transition while maintaining vertical and MHD stability, with appropriate margin for variation in experimental conditions. The toroidal currents induced in conducting structures and the specifications of the real-time control and power supply systems are unique constraints for the two devices.

[1]Work Supported by U.S. DOE Contract No. DE-AC02-09CH11466 and the RCUK Energy Programme [grant number EP/P012450/1].

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Date submitted: 14 Jul 2017 Electronic form version 1.4