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EX/P2-02: ITER Demonstration Discharges on Alcator C-Mod in Support of ITER

Tuesday, October 9, 2012 2:00 PM (4h 45m)

Alcator C-Mod is providing discharges that match several simultaneous parameters expected in ITER in the rampup, flattop and rampdown phases, and simulations of these discharges with time-dependent transport evolution codes. Discharges have been produced at both B = 5.4 T and 2.7 T, utilizing H-minority heating fundamental and 2nd harmonic, respectively. Discharges with rampup durations appropriate to ITER's show that ICRF heating obtains V-s savings with only weak effects on the current profile, in spite of strong modifications of the central electron temperature. Significant V-s savings in ohmic rampup by utilizing lower densities appears only to be effective at very low density, n/nGr ~ 0.08. Injection of lower hybrid during the rampup is effective for saving V-s, again only at similarly low densities. Simulations of C-Mod rampup discharges have been performed with the Tokamak Simulation Code (TSC), utilizing TORIC full wave calculation of the ICRF deposition, and using the Current Diffusive Ballooning (CDBM), Bohm-gyro Bohm, Coppi-Tang, and modified GLF23 (enhanced thermal diffusivity near plasma edge) transport models showing that they are not reproducing the temperature profile evolution, and consequently do not reproduce the experimental internal self-inductance or the V-s. Discharges which obtained EDA H-modes during flattop, with B = 2.7 T and Ip = 0.65 MA, obtain parameter values between (bN, n/nGr, H98) = (1.9, 0.60, 1.0) to (1.5, 0.8, 0.67). The lower n/nGr values are associated with the higher H98 and bN. Discharges showed a degradation of the energy confinement as the higher densities were approached, but also an increasing H98 with net power to the plasma (Pnet = PICRF + POH –dW/dt –Prad). For these discharges up to 3 MW was injected, while intrinsic impurities (B, Mo) provided radiated power fractions (Prad/Pin) of 25-37%, typical of those required in ITER. Experiments at 5.4 T have demonstrated the plasma can remain in H-mode as the rampdown phase is entered with at least 0.75 MW of ICRF injection, the back transition occurring when the net power reaches 1 MW, and the density will decrease at the same rate as Ip when in H-mode, maintaining the flattop n/nGr value. Maintaining the H-mode longer into the rampdown and ramping the plasma current down faster can mitigate the OH coil over-current associated with the back transition.

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