Achieving Steady-State Conditions in the High-Beta Hybrid Scenarios in DIII-D,* C.C. Petty, T.C. Luce, J.R. Ferron, A.M. Garofalo, A.W. Hyatt, G.L. Jackson, GA; F. Turco, Columbia U.; C.T. Holcomb, LLNL; E.J. Doyle, UCLA: The natural attributes of the hybrid scenario, especially the anomalously broad current profile, with $q_{min} \geq 1$, allows steady-state conditions with zero surface loop voltage to be achieved at 1 MA plasma current in DIII-D. Using efficient central current drive, the surface loop voltage is driven down to zero for $>1 \tau_R$, with $\approx 50\%$ bootstrap current fraction when $\beta_p$ is increased above 1.9. Interestingly, good alignment between the current drive and plasma current profiles is not necessary as the hybrid regime self-organizes the current density profile. Steady-state hybrid plasmas can achieve $\beta_N=3.6$ for the full duration of the NB pulse ($>1 \tau_R$) without exciting the $m/n=2/1$ tearing mode, corresponding to $\beta_T$ up to 3.4%. The thermal energy confinement time is excellent, with confinement factors up to $H_{98y2}=1.6$ even during strong EC heating. A 0-D physics model demonstrates that attractive scenarios with $Q_{fus}=3.5–3.8$ exist for steady-state operation in ITER and FNSF.

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