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Non-solenoidal Startup with High-Field-Side Local Helicity Injection on the Pegasus ST[1] J.M. PERRY, G.M. BODNER, M.W. BONGARD, M.G. BURKE, R.J. FONCK, J.L. PACHICANO, C. PIERREN, N.J. RICHNER, C. RODRIGUEZ SANCHEZ, D.J. SCHLOSSBERG, J.A. REUSCH, J.D. WEBERSKI, University of Wisconsin-Madison — Local Helicity Injection (LHI) is a non-solenoidal startup technique utilizing electron current injectors at the plasma edge to initiate a tokamak-like plasma at high I_p. Recent experiments on Pegasus explore the inherent tradeoffs between high-field-side (HFS) injection in the lower divertor region and low-field-side (LFS) injection at the outboard midplane. Trade-offs include the relative current drive contributions of HI and poloidal induction, and the magnetic geometry required for relaxation to a tokamak-like state. HFS injection using a set of two increased-area injectors ($A_{inj} = 4$ cm^2, $V_{inj} \sim 1.5$ kV, and $I_{inj} \sim 8$ kA) in the lower divertor is demonstrated over the full range of toroidal field available on Pegasus ($B_{T0} \leq 0.15$ T). Increased PMI on both the injectors and the lower divertor plates was observed during HFS injection, and was substantively mitigated through optimization of injector geometry and placement of local limiters to reduce scrape-off density in the divertor region. I_p up to 200 kA is achieved with LHI as the dominant current drive, consistent with expectations from helicity balance. To date, experiments support I_p increasing linearly with helicity injection rate. The high normalized current ($I_N \geq 10$) attainable with LHI and the favorable stability of the ultra-low aspect ratio, low-ℓ_i LHI-driven plasmas allow access to high β_t—up to 100%, as indicated by kinetically-constrained equilibrium reconstructions.

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