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Enhanced Control for Local Helicity Injection on the Pegasus ST[1]

C. PIERREN, M.W. BONGARD, R.J. FONCK, B.T. LEWICKI, J.M. PERRY, University of Wisconsin-Madison — Local helicity injection (LHI) experiments on Pegasus rely upon programmable control of a $\sim$ 250 MVA modular power supply system that drives the electromagnets and helicity injection systems. Precise control of the central solenoid is critical to experimental campaigns that test the LHI Taylor relaxation limit and the coupling efficiency of LHI-produced plasmas to Ohmic current drive. Enhancement and expansion of the present control system is underway using field programmable gate array (FPGA) technology for digital logic and control, coupled to new 10 MHz optical-to-digital transceivers for semiconductor level device communication. The system accepts optical command signals from existing analog feedback controllers, transmits them to multiple devices in parallel H-bridges, and aggregates their status signals for fault detection. Present device-level multiplexing/de-multiplexing and protection logic is extended to include bridge-level protections with the FPGA. An input command filter protects against erroneous and/or spurious noise generated commands that could otherwise cause device failures. Fault registration and response times with the FPGA system are 25 ns. Initial system testing indicates an increased immunity to power supply induced noise, enabling plasma operations at higher working capacitor bank voltage. This can increase the applied helicity injection drive voltage, enable longer pulse lengths and improve Ohmic loop voltage control.

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