Development of Fully Digital Control of Pegasus Power Systems

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Non-solenoidal startup research on Pegasus relies on programmable control of a ~250 MVA modular power supply system. Digital control systems using real-time and Field Programmable Gate Array (FPGA) technology are in development to support power supply upgrades. These will replace analog PWM feedback controllers and the optical interface between individual power supply switches and the control system. Digital systems will allow for reconfigurable control algorithms, are easily expandable with off-the-shelf hardware, strongly reduce susceptibility to EMI, and eliminate analog drift. Added protections provided by FPGA control will restore Ohmic operations, allowing for experiments to study the Taylor limit and coupling efficiency of Local Helicity Injection (LHI) plasmas. The FPGA-based systems will enable expansion of the PF and TF coil sets. The PF expansion will improve shape and position control. Increased TF is necessary for future non-solenoidal startup experiments that examine: higher-power LHI; EBW heating and current drive; and coaxial helicity injection. Digital control will also drive a new 32 MVA Cuk topology LHI power supply to enable time-varying LHI voltage control and improve energy storage utilization.

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