A Flexible Multi-Coil Programmable Power Supply System for the Pegasus Toroidal Experiment

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Abstract text: A new generation of magnetic field coil set power supplies has been developed and deployed for flexible waveform control of the magnetic fields in the Pegasus ST. In the original configuration, almost all of the power supplies consisted of resonant L-C circuits fired through ignitrons and SCRs. Very limited waveform control was available through commutation of switches, which led to severe constrictions on plasma operations. The new configuration consists of 40 independent power systems switched with PWM (pulse-width modulated) H-bridges. The majority of the coil systems operate at 900 V and utilize IGBT (Insulated Gate Bipolar Transistor) technology. The higher-power ohmic heating system operates at 2700 V and utilizes IGCT (Integrated-Gate Commutated Thyristor) technology. These systems allow for precise preprogrammed wave shaping of current waveforms and active feedback control on ms timescales. Each bridge has an independent electrically isolated capacitor bank and transmission line to allow for parallel operation of multiple switches for higher current needs. Up to 6 MJ of energy is stored in electrolytic capacitor banks located in a vault separate from the research building. The net result of these upgrades is a significant increase in both input power and control. In addition to the new power supplies, significant improvements have been made to the coil sets. The toroidal field has been upgraded to triple the field and reduce the inductance by a factor of 25 over the last configuration. The poloidal field coils have been decoupled from a single set to five independent systems, and two new PF coils have been added. Divertor coils have also been added to allow separatrix operation. Together, these systems provide an unprecedented degree of control and programmability for a mid-sized university based plasma confinement experiment. Supported by U.S. DoE Grant No. DE-FG02-96ER54375