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Tue-Mo-Po2.02-05 [7]: Design and Implementation of DC Pulsed Power Supply Employing Self-excited Induction Generators and Flywheels for Toroidal Field Coils of a tokamak device, Plato

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We developed a 600kW pulsed DC power supply employing two pairs of a self-excited induction motor/generator (IMG) and a flywheel for toroidal field coils (TFCs) of Plato. Plato is a new tokamak device to measure plasma turbulence precisely, which is under construction at Kyushu University in Japan. In the presentation, we will describe the details on the structure and experimental results of the power supply.

The power supply is categorized into a type of flywheel energy storage system (FESS) since it converts the kinetic energy of flywheels into electricity with IMGs in a discharge phase. The FESS is necessary to supply TFC current of Plato since the pulsed power consumption of the TFCs reaches 600 kW. Before Plato's experiments, the power supply accelerates the flywheels and stores 2.88MJ of kinetic energy over 3 minutes. After the acceleration phase, it feeds 600 kW of electricity to the TFCs of Plato for 0.5 seconds. In order to achieve the above operation, we adopted two pairs of an off-the-shelf squirrel-cage IMG and an iron plate flywheel. The rated power of the single IMG is 250kW and the diameter and thickness of the flywheel are 0.9 m and 0.04 m, respectively.

As a new feature of the power supply, we utilized combination of two self-excited induction generators (SEIGs), a thyristor rectifier and a DC/DC converter. The power supply employs self-exciting capacitors in order to excite the IMG voltage by self-excitation phenomena. Furthermore, the thyristor rectifier and the DC/DC converter are installed between the IMGs and the TFCs. Although the SEIG voltage is stepwise due to on/off control of the self-exciting capacitors, the DC/DC converter maintains accurate TFC current. Using this method, we realized the compact pulsed power supply compared to capacitor banks, synchronous generators or inverter-driven IMGs.

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