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Flywheel uninterruptible power supply using superconducting induction machine

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Characteristics of fly-wheel type uninterrupted power supply (FW-USP) using superconducting induction machine (SIM) is analytically studied. In the study, it is assumed that the SIM is iron-cored and composed of Cu wire stator windings and HTS rotor windings. The rotor windings are made with HTS wires embedded in an iron rotor core and connected to HTS end-rings. The whole assemble of the rotor windings are placed in a rotor cryostat and cooled at cryogenic temperature, and there are no electric connections to the outside of the rotor. The stator is at room temperature. When AC currents are applied to the stator windings by an AC power supply to start the SIM, the HTS rotor windings are subject to AC magnetic field. At the beginning, rotating torque is not generated, because the rotor windings are superconductive and the AC shielding currents is induced to expel the magnetic flux. After that, the HTS wires becomes resistive due to the temperature rise caused by the AC losses in the wires, and the magnetic fluxes penetrate in the rotor windings for the rotating torque to be generated. When the revolution speed of the rotor becomes close to the synchronous speed, the temperature of HTS wires of the rotor decreases due to the decreasing losses and the wires become superconductive again. Then, the rotor is pulled into the synchronous state due to the trapped magnetic fluxes in the rotor windings. The back electromotive voltages induced in the stator windings due to the trapped magnetic flux in the rotor windings are kept even when the SIM is disconnected from the power supply. Therefore, by inserting a SIM combined with a fly-wheel between a power line and electric loads, electric power to the load is sustained even when the power from the line is lost.

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