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Application of the Inverter-Driven Flywheel Generators to Small Tokamak Experiments

インバータ駆動フライホイール発電機の小型トカマク装置への適用

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Until now, power storage device that requires a large amount of power instantaneously was capacitor bank. However, a large space is required for installation. In this research, inverter-driven flywheel generators, which is a compact and low-cost energy storage device, is investigated. An inverter-driven flywheel generators consists of smoothing capacitor and mechanism that making a constant voltage of the smoothing capacitor. In the experiment, while maintaining the smoothing capacitor voltage, we succeeed that obtaining a power of 55kW.

1. Introduction

Capacitor banks are conventionally employed as power sources of small tokamak devices. However, a large space is required for installation. In this research, inverter-driven flywheel generators, which is a compact and low-cost energy storage device, was investigated to apply to a small tokamak. An inverter-driven flywheel generator consists of a smoothing capacitor and mechanism that keeps the voltage of the smoothing capacitor nearly constant.

2. Method

Figure 1 shows the circuit diagram of an inverter-driven flywheel generator tested. First, smoothing capacitor C1 is charged through resistor R1. The RY1 is shorted after C1 has been charged to some extent. Then, the flywheel is driven by changing the inverter mode to motor.
Finally, Using a DC chopper , the current through load R2 is controlled.

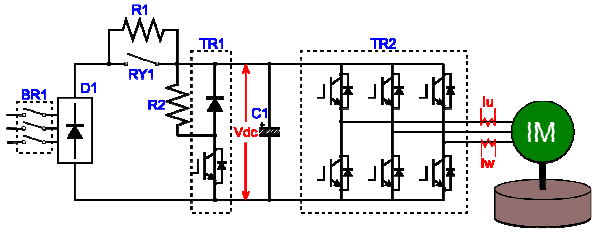

Fig. 1 circuit diagram

3. Result

In a validation experiment, while maintaining the smoothing capacitor voltage, we succeed in obtaining a power of 55 kW for about 1.3 s as shown in Fig. 2.

4. Discussion

Because of IGBT limits, the output power of the present generator is limited to 55 kW. The literature suggests it is possible to obtain powers up to 3 times the rated output power of an induction machine [1]. The goal is to derive power from 100 kW or more from an induction machine. Replacement of IGBT and satisfaction of control is required for higher power generation.

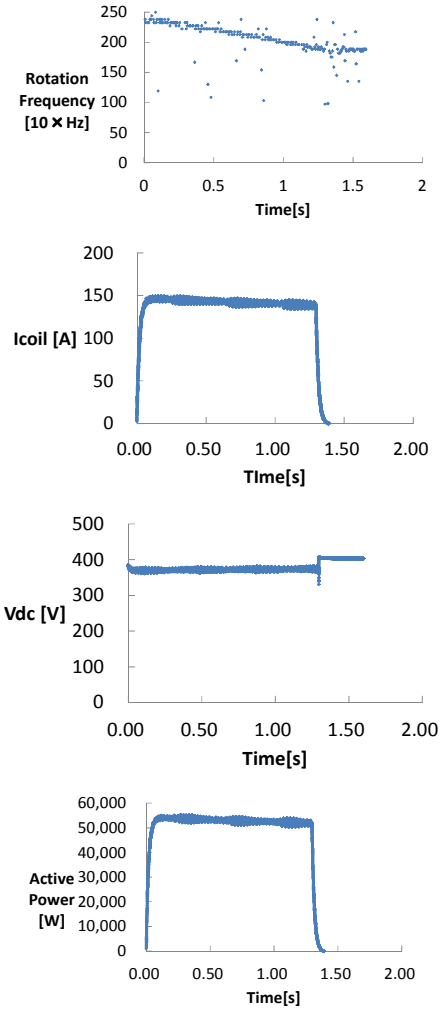

Fig. 2 experimental result

References

[1] M. Godoy Simoes, Felix A. Farret, “RENEWABLE ENEGY SYSTEMS”, CRC PRESS, 2004.