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Parametric study on starting method with fast torque response in high-temperature superconducting induction/synchronous motor

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Our research group has developed a High Temperature Superconducting Induction/Synchronous Motor (HTS-ISM) for next-generation transportation equipment. It was clarified based on the experimental and the analytical studies that the fabricated HTS-ISM possesses not only the excellent steady performances such as high torque density, high efficiency, but also the novel transient characteristics such as autonomous stability, hysteretic rotating characteristics. In order to start the HTS-ISM, however, it is necessary to break the magnetic shield of the HTS cage winding loop and interlink the magnetic flux. Since the starting current for the above process is much larger than the driving current, its starting time needs to be as short as possible. In order to realize the above requirements, we proposed the new starting method[1], in which input rms voltage was changed as single square pulse wave while starting and afterwards kept stable at driving voltage (Zero voltage → Highest voltage → Driving voltage).

In this presentation, we report on the parametric study on the pulse waveform(pulse width, voltage level, voltage-rising or falling time) of the input rms voltage in the new method. This study was examined with model-based analysis for 20 kW class prototype HTS-ISM, which consists of BSCCO rotor and copper stator and under fixed driving voltage (80 Vrms), fixed frequency (60 Hz) and 10 kW load (= half load) conditions. We found that results can be classified into 4 types in terms of whether rotational speed reached or not to synchronous speed before voltage dropped to driving voltage, and whether the motor finally kept rotating or stopped. We also try to give the explanation on the behavior of the motor in these results. These results would be important in fast acceleration and operation of HTS-ISM. Details will be reported on the day.

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