§ 13. Development of UPS-SMES as a Protection from Momentary Voltage Drop

Mito, T., Chikaraishi, H., Seo, T., Baba, T.,
Yamauchi, K., Yokota, M., Ogawa, H.
Henmi, T. (Grad. Univ. Advanced Studies)
Kawagoe, A., Sumiyoshi, F. (Kagoshima Univ.)
Iwakuma, M. (Kyushu Univ.)
Okumura, K. (Technoba Inc.)
Hayashi, K., Abe, R. (IDX Co.)

1. Introduction

In information machines and equipment, such as a computer, the uninterruptible power supply (UPS) is becoming indispensable for data protection. On the other hand, in industrial fabrication facilities such as a semiconductor chip production equipment or large-sized experimental facilities for big science such as a nuclear fusion experimental device, there is no effective protection for the momentary voltage drop and power failure due to their large electrical capacities, although serious damage has occurred by a yield fall of products or a discontinuation of important experiment. Most of troubles for the commercial electric power system are less than 1 second. Therefore the UPS with large capacity of MW and short time duration of 1 second is very useful not only for the above-mentioned applications but also for broad fields.

2. Development Program of UPS-SMES

We have been developing the UPS-SMES as a protection from momentary voltage drop and power failure using the superconducting coil as electric power storage suitable for large energy extraction in a short time. Five-year project has started from 2002 fiscal year as one of the research promotion program of NEDO. The most important feature of superconducting coil system for the UPS-SMES is easy handling and maintenance-free. We have selected Low Temperature Superconducting (LTS) coils instead of HTS coils from the viewpoint of cost and performance. However, it is difficult for the conventional LTS coils with immersion cooling of LHe or forced flow cooling of SHe to satisfy the requirement of maintenance-free. A conduction cooled LTS pulse coil has been designed as a key component of the UPS-SMES. As the first step, we have been developing a 100 kJ class UPS-SMES in order to do a principle actual proof. Then we are planning to develop a 1 MW, 1 sec UPS-SMES and to perform the long-term field test in NIFS as the final stage of the project.

3. Development Status of UPS-SMES

We developed a LTS conductor, which reconciles reduction of AC loss and high stability. The cross-sectional structure is shown in Fig. 1. NbTi/Cu compacted strand cable embedded in low purity aluminum (Al-1197). The conductor is designed so that AC loss may become the minimum, when the changing magnetic field is added parallel to the broad side of the compacted strand cable. Since the direction of a magnetic field in a coil changes with places of winding, it is necessary to perform the winding of it, twisting a conductor according to the direction of a magnetic field, as shown in Fig. 2 and 3. The coil is cooled by the conduction from a cryocooler. Manufacture of a conductor, AC loss evaluation, and a coil design has been completed. Manufacture of a 100kJ coil and a cooling and excitation experiment are scheduled in 2003.

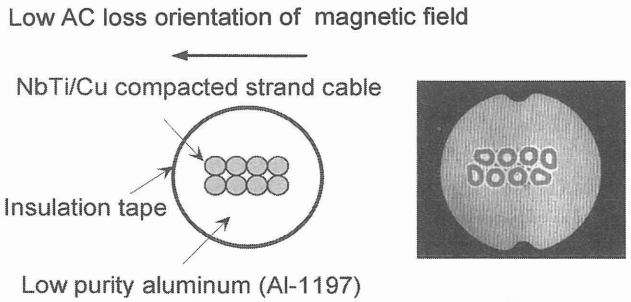

Fig. 1. Superconducting conductor for UPS-SMES with a low AC loss and a high stability.

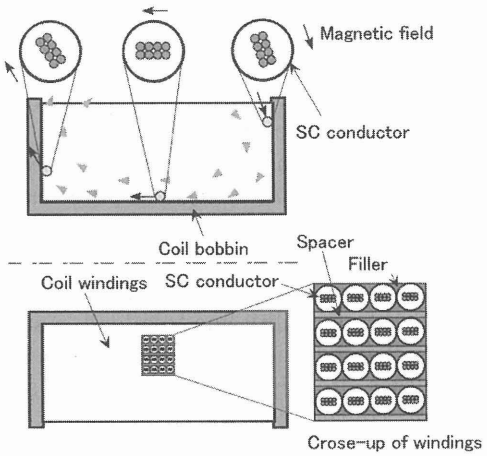

Fig. 2. Conduction cooled pulse coil wound with a NbTi/Cu LTS conductor.

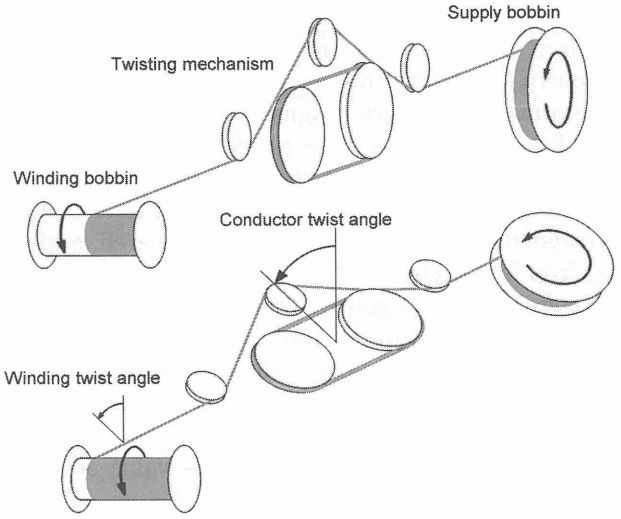

Fig. 3. Twist winding mechanism of the conduction cooled LTS pulse coil.

Reference

1) Sumiyoshi, F., Kawabata, S., Kawagoe, A., Kawashima, T., Mito, T. "The method to reduce AC losses in stable superconducting pulse coils", Annual report of NIFS, April 2002 – March 2003 (this report).
2) Chikaraishi, H., Hayashi, K., Okumura, K. "Development of high speed voltage drop detector for SMES system", Annual report of NIFS, April 2002 – March 2003 (this report).