Researches on Superconducting Power Technologies in CEPRI

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Abstract

Superconductors are materials that can, under certain conditions, carry dc electricity without resistance. AC superconducting circuits, for example, can carry two to five times more current than conventional cable of comparable size. Although this phenomenon was discovered over 100 years ago, its potential has remained unfulfilled because most of these materials needed to be cooled to near zero for superconductivity to occur. In 1986 researchers discovered high-temperature superconducting (HTS) materials that superconduct at the temperature of liquid nitrogen, an inexpensive, abundant, and environmentally benign refrigerant. Also, there has been remarkable progress in the technology for producing BSCCO wires and YBCO coated conductors for the past decade. Long HTS tapes would be widely devoted to various potential applications such as power cables, SFCL and SMES. Since 2007, CEPRI has led basic and applied research to put YBCO materials to practical use in the power industry. An YBCO micro-SMES was developed to investigate the characteristics operating in sub-cooled liquid nitrogen (LN2) temperatures and conduction-cooling condition. The technical feasibility of YBCO SMES was discussed based on experimental investigations and dynamic simulation test of power system. In addition, an YBCO cable project supported by SGCC is planned to launch in Beijing this year. Target of this project is to operate a 110 kV cold-dielectric cable in the real grid in order to demonstrate its reliability and stable operation. The cable length is expected to be 1 km or so depending on a site configuration. Preliminary design of the cable stem has been performed for engineering layout. Test platforms are being built in CEPRI to investigate the characteristics of HTS cable, including transport losses, cryogenic insulation and fault current, etc.