Superconducting Magnetic Energy Storage: Status and Perspective

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Abstract - The SMES (Superconducting Magnetic Energy Storage) is one of the very few direct electric energy storage systems. Its energy density is limited by mechanical considerations to a rather low value on the order of ten kJ/kg, but its power density can be extremely high. This makes SMES particularly interesting for high-power and short-time applications (pulse power sources). A SMES releases its energy very quickly and with an excellent efficiency of energy transfer conversion (greater than 95 %). The heart of a SMES is its superconducting magnet, which must fulfill requirements such as low stray field and mechanical design suitable to contain the large Lorentz forces. The by far most used conductor for magnet windings remains NbTi, because of its lower cost compared to the available first generation of high-T_c conductors.

Operation at higher temperatures can bring advantages such as lower investment and running costs for the cryocooler and a much-enhanced stability against perturbations for the magnet. The second generation of high T_c conductor should be more attractive both in terms of cost, performance and possible operating temperature, among other things. First studies on SMES appeared in 1970, with first demonstrations and experiences on the grid in the seventies and eighties. The three main applications of SMES are UPS (Uninterruptible Power Supply), FACTS (Flexible AC Transmission System) and pulse power sources for dedicated applications. Some SMESs throughout the world are briefly characterized and the 800 kJ DGA-CNRS-Nexans high-T_c SMES now developed is described.

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