IEEE-CSC, ESAS and CSSJ SUPERCONDUCTIVITY NEWS FORUM (global edition), Issue No. 59, May 2025

Superconducting Power Transmission: Status and Prospects

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Abstract—Liquid nitrogen-cooled HTS power cables based on ReBCO-coated conductors offer ultra-high transport capacity combined with exceptional efficiency and compactness. Their adoption has the potential to transform future power transmission and distribution grids. HTS power cables can be designed for both DC and AC operation across various voltage levels, from medium voltage (MV) to high voltage (HV). This versatility makes them a cornerstone for a wide range of applications, including the connection of massive and widespread offshore wind power to onshore substations and the development of supply infrastructures for power- and current-intensive facilities such as data centers or metallurgical industries. Additionally, HTS cables are a critical enabler for upgrading existing AC grids in densely populated areas, eliminating the need for extensive new civil infrastructure.

This contribution presents the fundamental concepts and layouts of HTS power cable technology and reviews their current state of development. It also explores future research directions, emphasizing integrated cable design approaches that ensure compatibility with existing and future trends in power grids.

***Keywords (Index Terms)*—Electrification, Energy Transition, Power Grid, Power Transmission Cable, Renewable Energy**

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Presentation given at CCA 2025, March 11-13, 2025, Geneva, Switzerland.