Qualification of the SuperRail HTS Cable System

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Abstract–The SuperRail project, backed by the French government, will be the first installation of a high-temperature superconducting (HTS) cable system on a commercially operated railway electric grid. The project's goal is to develop, manufacture, install and operate of a HTS DC cable system at the Montparnasse railways station in Paris. The HTS technology provides here the only viable solution to increase the power supply from the railway substation to a group of railway tracks in such densely populated areas, strengthening and securing the railway grid, and contributing to the achievement of national low-carbon emission targets. Two 60 m long 1.5 kV-3.5 kA HTS DC cables made of 2G conductors will be installed in parallel. They are designed to meet stringent load chart requirements and to sustain a 67 kA-100 ms short-circuit current. Prior to the installation at Montparnasse, a complete 35-m HTS cable type test loop was installed and tested at the SNCF Railway Test Agency (SNCF-AEF). This system includes two terminations, one joint, and a cooling system. This paper provides a detailed description of the type test loop and of the type test results, including thermal cycles, pressure tests, dielectric and lightning impulse tests, nominal current tests, system losses and pressure drop characterization, fault current test, and V-I characterization. The results confirm that the cable system met its design specifications, qualifying it for the SuperRail installation and for future railway projects.

Keywords (Index Terms)– high-temperature supercondcting power cable, railway electric grid, DC power system, type test loop, termination, joint, cooling system, cryogenic skid, thermal cycles, pressure test, dielectric test, lightning impulse test, nominal current test, system losses, fault current test, V-I characteristic, recovery