

Superconducting Power Cable Application in DC Electric Railway Systems

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Abstract - A superconducting power cable is a prospective application of high-temperature superconductors. Although power cables using Bi2223 or YBCO wires have been developed in the world so far mainly for utility grid application, we focus attention on railway application of a superconducting power cable. We have studied how to introduce superconducting power cables effectively and economically to a DC electric railway. Numerical analysis models based on the MATLAB-Simulink are constructed for a DC electric feeder system of single- and double-track railways. Tractive force and train resistance characteristics are modeled there. Energy saving by the superconducting power cable is investigated with the influences of the number of substations, the train operation interval, etc. taken into account. The results show that the superconducting power cables can improve regeneration rate and system energy saving, and reduce the substation capacity very effectively. It will be also an advantage that if the transportation capacity of a railway line needs to be increased, the introduction of superconducting cables could achieve it without changing the existing substations along the line.

Keywords - railway, regeneration, substation, superconducting power cable.

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