

CAPACITY OPTIMIZATION OF THE SUPERCAPACITOR ENERGY STORAGES ON DC RAILWAY SYSTEM USING A RAILWAY POWERFLOW ALGORITHM

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ABSTRACT. *The electric railway system is one of the most peculiar power systems of which the location and power of electrical load are continuously variable. The variance of the location and power of the vehicle changes the participation factor of each substation for the vehicle and the sign and magnitude of the load current, respectively. Especially, on the substation feeder, there is huge voltage fluctuation generated by the regenerative energy due to the braking vehicles. This regenerative energy is closely related with the energy efficiency since the surplus energy cannot be utilized and dissipated in the resistor. To improve energy efficiency of the railway system and utilize the surplus regenerative energy, the application of energy storage has been studied. In this paper, a DC railway powerflow algorithm considering storages is developed to analyze the railway system with storages and to calculate the optimal power and storage capacity of them. The Seoul Metro Line 7 is selected for the test system and simulated to verify the effect of storages. Also, the optimal power and storage capacity of each SCES is calculated.*

Keywords: DC electric railway system, Railway powerflow algorithm, Regenerative energy, Energy storage system (ESS), Supercapacitor energy storage (SCES), Energy efficiency improvement

1. Introduction. A number of researches to overcome energy crisis against the exhaustion of fossil fuel, environmental pollution and global warming have been performed. Typically, a number of studies on renewable energy, such as wind, photovoltaic generation, etc., are actively in progress. These types of generation have advantages that they do not use fossil fuel as an energy source and emit greenhouse gas [1-4]. The other types of these researches against energy crisis are to reduce energy consumption or loss which deals mainly with how to improve energy efficiency. As a means of efficiency improvement, various types of energy storage devices are being spotlighted and their application studies are making progress over the wide range of power systems [5,6].

Over the whole power system, researches about energy storage and its application scheme to retrench energy consumption and to enhance system efficiency are under progress. For example, on high-speed driving, hybrid car drives motors as generators to store electrical energy on energy storage device, such as batteries or super capacitors. On low-speed driving, it obtains energy not from the gasoline engines but from storage.