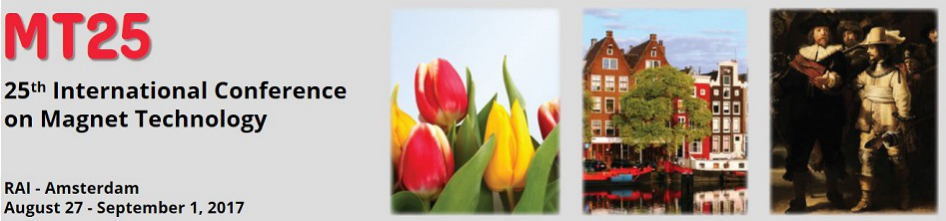

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Quality and Stability Improvement of DC Power Systems in All Electric Ship Using SMES/Battery

Wednesday, 30 August 2017 13:15 (1h 45m)

As All Electric Ship (AES) capacity increasing dramatically, load fluctuation of such systems may cause serious problems, such as voltage fluctuation of the ship power grid, increasing fuel consumption, and environmental emissions. In order to reduce the effects of system load fluctuations on system efficiency, and to maintain the bus voltage, a Hybrid Energy Storage System (HESS) is implemented in the AES. The HESS consists of two elements, a battery as a high energy density storage and a Superconducting Magnetic Energy Storage (SMES) as a high power density storage. A droop control is used to control charge/discharge prioritization. In our model, a SMES works as energy buffers to accommodate the quick changes in the load, reducing the power fluctuations, and as a result improving the stability and quality of the system, reducing environmental emissions, and allowing the system to work to its maximum economic efficiency. Manoeuvring and pulsed loads are the main sources of the power fluctuations. There are several types of pulsed loads including electric weapons, such as Electromagnetic Railgun (EMRG). These types of loads need large energies and high electrical powers which makes HESS the perfect power source. Many studies have been done to show the effectiveness of the supercapacitor/battery on the AES power grid, whereas to our knowledge, no study has been done to show the influence of SMES/battery on the AES power grid. In this paper, we propose to use SMES/battery in the AES power grid as a major novelty. Also, a DC droop control is used to coordinate charge/discharge of SMES/battery system. A model of the AES power grid integrated with SMES/battery has been built in Simulink / Matlab to show the effectiveness of SMES/battery on power grid quality. The effectiveness of the SMES/battery and supercapacitor/battery on the AES power grid will be compared under various scenarios.

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