Optimization of High Power SMES for Naval Applications

Publisher: IEEE Cite This PDF

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Abstract:
The electrification of transport has been no exception for waterborne vessels. The reduction of emissions, especially during port maneuvering and operation, has accelerated the transition from fossil fuel to electric propulsion. Moreover, military vessels, with specialized electric weapon systems, or civil vessels, like offshore wind tug boats, have high power systems that additionally contribute to a higher electrification of the ship grid. Energy storage systems are essential to meet the power load economically and to improve the system`s reliability and efficiency. Therefore, the use of high energy density storage systems, as chemical batteries, or hydrogen fuel cells, has experienced a significant increase in demand. However, during high frequency load fluctuations, high energy density storage systems are not capable to actuate, since the discharge rate of these systems is physically limited, which may provoke: deterioration and reduction of the lifetime of the storage systems, voltage and frequency fluctuation of the ship grid. To overcome this limitation, this paper studies the use of a Superconducting Magnetic Energy Storage (SMES) as a supporting energy storage device for the ship grid. The guidelines for dimensioning, in power and energy, the SMES are stablished. Furthermore, an optimization method is developed in order to compare different superconducting materials, and operating temperatures.

Published in: IEEE Transactions on Applied Superconductivity (Volume: 33 , Issue: 5, August 2023)

Article Sequence Number: 5700205

DOI: 10.1109/TASC.2023.3250169

Date of Publication: 28 February 2023

Publisher: IEEE

ISSN Information:

Funding Agency: