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Effect of Cryogenic Temperature on Electrical Parameters of Copper Coil used in SMES

Content :

With the inclusion of renewable energy sources, the variability of the power supply has increased. To reduce this variability, energy storage equipments such as superconducting magnetic energy storage (SMES) are required. The energy is stored in SMES coil, making its design very crucial.

This paper presents the effect of cryogenic temperature on the resistance and inductance of air core solenoid. The experiment is performed on the copper wire wound over teflon and copper formers. The mathematical model for the calculation of the coil inductances is derived and results are compared with measurements performed with an LCR meter. The change in coil resistance and inductance with temperature are measured and the effect of the coil former is analyzed. The cryogenic temperature is maintained by using a liquid nitrogen bath.

The difference between the measured and calculated inductance value for both coils is less than 10%. There is an obvious reduction in the resistance of the coils at cryogenic temperature. Though the inductance of copper former coil reduces by 34%, its resistance is higher at 77K than teflon former coil. The effects may be attributed to the presence of eddy currents and may lead to increase in the cooling overheads for such coils.

Keywords- cryogenic temperature; resistance; inductance; copper coil; SMES

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