LOSSY MAGNETIC ENERGY STORAGE SYSTEMS FOR IMPROVEMENT OF POWER SYSTEM STABILITY

By

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Certificate

This is to certify that the thesis entitled "LOSSY MAGNETIC ENERGY STORAGE SYSTEMS FOR IMPROVEMENT OF POWER SYSTEM STABILITY" being submitted by Mr. Soumitra Bandopadhyay to the Indian Institute of Technology, Delhi,for the award of the degree of Doctor of Philosophy is a record of the bonafide research work carried out by him. He has worked under our guidance and supervision and has fulfilled the requirements for the submission of the thesis which, to our knowledge, has reached the requisite standard.

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ABSTRACT

Fast acting energy storage devices can effectively damp the electromechanical oscillations in a power system, because they provide storage capacity in addition to the kinetic energy of the generator rotor which can share the sudden changes in power requirement. Earlier studies show the effectiveness of Superconducting Magnetic Energy Storage (SMES) and Battery Energy Storage for this purpose, which are relatively costly options. The present thesis analyses the characteristics of Lossy Magnetic Energy Storage (LMES) and shows the effectiveness of small sized LMES units in improving power system transient response.

The effective use of the small energy storage capacity of LMES units in large power areas require some special control measures. With the help of computer simulation an extensive study has been done to find out the required control measures and to establish an objective basis for the choice of various LMES unit parameters. It has been shown that the optimal parameter settings of the power system are changed with the addition of the energy storage unit. A procedure for finding the new optimal gain settings has also been suggested in the present work.

The 12-pulse converter bridge of the LMES unit has a certain freedom in choosing the reactive power consumption. It has been shown that utilizing this reactive power

modulation capacity of the converter, the LMES unit can function as a static VAR controller using a switched capacitor bank, while acting as a load-frequency stabilizer at the same time. A comprehensive control strategy to achieve the simultaneous modulation of active and reactive power has been formulated. With the help of a power system model coupling the active power - frequency and reactive power - voltage loops it has been shown that this mode of LMES operation greatly improves the overall performance of a power system.

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