THESIS TITLE: - ANALYSIS OF A SYNCHRONOUS RELUCTANCE MOTOR DRIVE CONNECTED TO A WEAK GRID

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ABSTRACT: -

The present scenario of power demand ensures that electricity must be available for all types of applications, starting from pumps to its use in several industrial and commercial application like in electric traction, hospitals etc. Many application sectors may be located in rural areas like pumps in vast agricultural fields and wide network of electric railways in remote areas. It is essential to maintain constant power availability for these applications to perform in a better way. But usually the grids located in remote areas are weak which have varying voltage profile posing serious problems towards proper operation of electrical loads. So in order to maintain constant operation of electrical loads in such weak grids, an analysis need to be done directed towards undisturbed functioning of these electrical apparatus in the presence of lower voltages which may dip for a short time or may remain for a day or even for a longer duration.

Synchronous reluctance motor (SYNRM) due to its promising features over other motors in pump applications, is considered in this thesis for exploration. The analysis has also been extended to synchronous reluctance motors driving constant torque loads like positive displacement pumps and constant power loads like electric railway applications. It can be possible that a motor coupled to a load may not be able to deliver the required output when voltage dip of different magnitudes strike the motor terminals while it is connected to a weak grid. In this context, a novel analysis estimating the voltage dip margin of the SYNRM is presented in this thesis. The estimation of voltage dip margin is discussed in detail for pump, constant torque and constant power type loads. The effect on voltage dip margin as well as other quantities of SYNRM like current, torque pulsations, power output, power factor etc. has been analysed with respect to variations in inductance and current drawn. Inductance variation can be introduced due to manufacturing defects as well as through different inductance measurement techniques. The focus of all analysis is to retain the original speed and torque despite the occurrence of voltage dips of different magnitudes. The solution required to maintain the motor speed and torque in the event of voltage dips is to adjust the direct axis current (i_d) appropriately. The analysis of the performance of the SYNRM when the voltage dip is greater than the tolerable voltage dip margin is discussed thoroughly, where the major aim is to observe the magnitude of change in speed, power output, current and other quantities. All of the above motor quantities are assessed in detail by utilizing their mathematical expressions and are validated through simulations and experiments.