SCR DI/DT FAILURE MODE IN SOFT STARTERS RE-EXAMINED: CONTROLLED EXPERIMENTS AND SIMULATION

~ *Stan R Simms, Thomas A Farr (EATON)*
~ *Gabriel Braga (PWP Lab)*
~ *Alex Jacobs (Pactiv Evergreen)*

It has long been known that starting a squirrel cage induction motor at full line voltage results in high locked-rotor current and potentially stressful mechanical acceleration while approaching operating speed. Several starting schemes have been introduced to achieve a number of improvements: reduced amplitude of inrush (locked rotor) current, reduced mechanical stress from slower acceleration, limiting voltage sag at the point of common coupling (PCC). A reduced voltage soft starter (RVSS) employs a solid-state silicon-controlled rectifier (SCR) - or thyristor - controller to provide further voltage control options beyond the star-delta, primary reactor, and auto-transformer approaches (outlined by Korndorfer [1]). However, it has some known failure modes linked to the rate of change of current (di/dt) limitations in the SCR device physics where the potential cause has traditionally been linked to amount of load-side parasitic capacitance in the circuit. This paper will further examine how the source and load impedances - including distribution transformer impedance, upstream capacitance, load side parasitics as emulated, and the placement of the snubbing elements of the SCR impact overall laboratory failure response. Results from using an output smoothing inductor to mitigate the root-cause as corrective action is shown as well. The lengths of shielded output cable that present a problem are suggested. Further computer simulations are performed with increased short-circuit available current for comparable results as the laboratory has a fixed value.