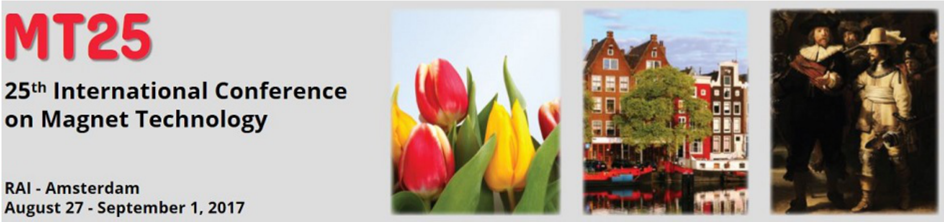

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Thermal limit curve calculation for squirrel cage induction motor based thermal equivalent circuit

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IEEE Standard 37.96-2000, Guide for AC Motor Protection, recommends the use of overcurrent relays for overload and locked rotor protection. Because of the familiar use of overcurrent protection, little attention is paid to the nature of motor thermal limit curves and their relation to winding temperature in an induction motor. Although thermal limit curves are defined in IEEE Standard 620-1996, Guide for the Presentation of Thermal Limit Curves for Squirrel Cage INduction Machines, the guide gives no information as to how the curves are constructed. Some existing papers introduced equation of thermal limit curve based a single time-constant model. But a single time-constant model cannot be accurate exactly because there are at least two time-constants in the thermal response of a motor. In this paper, modeling of 3-dimensional thermal equivalent circuit for rotor is conducted. Thermal equivalent circuit consists of rotor bar embedded in the slot, end-ring, rotor teeth and yoke. rotor bar is divided into n-segments in the radial direction, where n is large enough so that rotor winding loss distribution considering skin effect phenomenon can be calculated at locked rotor and accelerating conditions. All of the thermal resistance and capacity are defined as a function of temperature because specific heat, thermal conductivity and heat transfer coefficient depend on temperature. For each time step, temperature calculation algorithm calclate resistances, heat capacity and rotor bar losses with the temperature value of the previous time step and calculate temperature of following time step. And experimental results of temperature rise in the rotor bar will be compared to the calculation results. Thermal limit curves are constructed based on the thermal equivalent circuit calculation results. Locked rotor and accelerating thermal limit curve calculation diagram will be explained on the full paper.

Submitters Country

Republic of Korea

Author: LEE, Jae-Jun (Hyundai Heavy Industries Co.,Ltd)

Co-authors: LEE, Jae-Kwang (hanyang university); Mr LEE, Gang Seok (Hanyang Univ.)

Presenter: LEE, Jae-Kwang (hanyang university)

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