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THERMAL ANALYSIS OF A SYNCHRONOUS GENERATOR TAKING INTO ACCOUNT THE ROTATING HIGH-FREQUENCY MAGNETIC FIELD HARMONICS

ABSTRACT

To increase the efficiency of the rotating machines, it is very important to consider thermal field distribution during design stage. It is well known that even a small temperature increase beyond the normal operating level deteriorates rapidly the properties of the insulation materials and decreases drastically the lifetime of the windings. Therefore, it is necessary to throughout investigate the temperature rise in the rotating machines during initial design stage.

In this paper, we discuss a method for temperature field analysis inside the generators taking into account the high-frequency magnetic harmonics. The method is based on the 2D thermal field analysis using the finite element method. We show that taking into account the high-frequency magnetic harmonics, the accuracy of the computed temperature distribution could be improved. The high-frequency magnetic harmonics are considered for the accurate calculation of the iron loss inside each finite element. In this paper, we applied this method to a three-phase synchronous generator and the comparison between the computed and the measured results is shown.

Keywords: synchronous generator, high-frequency magnetic harmonics, hysteresis (iron) losses, eddy-current losses, finite element method.