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Simulation of emerging faults in electric machines

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Abstract

The article presents simulation based on finite element technique of the most common faults in three-phase squirrel-cage induction motors. Faults examined in this paper are: rotor broken bars and inter- inter turns short-circuit in stator windings.
Fault in rotor broken bars was simulated taking two consecutive bars to see how the flux density is affected. Inter-turn short-circuit faults was simulated taking 40% inter-turn short-circuit of the windingin one phase.
Simulations were performed using finite element software FEMM to obtain the flux density waveform in the airgap and in the electromagnetic core. Results from simulations were exported to MATLAB for further process and analysis. Flux density waveforms were plotted and processed by FFT analysis to observe harmonic distribution.

*Keywords:*Harmonic dirtibution; motor's simulations; inter-turn short circuit;finite element simulation; FEMM;

1. Introduction

In the industry the induction motors break down is common because of inter-turn short-circuit in the winding. This inter-turn short circuit can be generated by moisture in the winding, hating by overload,

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bad quality in the insulation. If these faults are detected early, it is possible to repair the motor, otherwise the motor will break down severely.

Other common fault is the broken bars in the rotor, this fault is more difficult to detect if there is not the appropriate equipment.

Studies carried out between the Electric Power Research Institute (EPRI) and the General Electric in 1985 showedthe true causes of faults in induction motors (see fig. 1) [1].

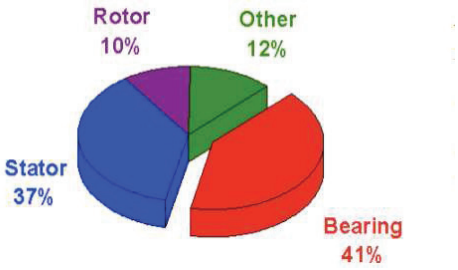

Fig.1. Study of statistics faults in induction motors.

According to the study of Fig. 1, the most common faults in ac motors are about bearing (41%), but this kind of fault is easily to identify by the noise when theyoccur. The second most common fault inmotorsoccurs in the stator, but this fault is more complicated to identify because it takes place inside the winding.

All of these faults have been studied by several methods [7]. The faults of interest are intern-turn short circuit and broken bars. In this paper thecharacterization faults simulation mentioned above is proposed. This characterization will be realized through a finite element simulation. MATLAB was used in order to analyze and process the data obtained.

An useful tool to know motor conditions is the measurementof voltage and current waveform and theiranalysisby Fast Fourier Transformer (FFT). The analysis can be done applying the FFT algorithm to current, voltage or power motor to obtain the harmonic distribution.Any change in the harmonic distribution, means that a fault will occur. The failure type depends on which harmonic components changes [7].