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ijirset@gmail.com



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# Fault Diagnosis of Induction Motor by Analysing Stator Winding Faults using FFT

**Binila Mariam Mathew<sup>1</sup>, Jeena Mary John<sup>2</sup>, Parvathy U.Krishnan<sup>3</sup>, Vaishnavi P.<sup>4</sup>, Mr. Prasobh P<sup>5</sup>**

U.G Student, Department of Electrical Engineering, College of Engineering Chengannur, Alappuzha, Kerala, India<sup>1</sup>

U.G Student, Department of Electrical Engineering, College of Engineering Chengannur, Alappuzha, Kerala, India<sup>2</sup>

U.G Student, Department of Electrical Engineering, College of Engineering Chengannur, Alappuzha, Kerala, India<sup>3</sup>

U.G Student, Department of Electrical Engineering, College of Engineering Chengannur, Alappuzha, Kerala, India<sup>4</sup>

Assistant Professor, Department of Electrical Engineering, College of Engineering, Chengannur, Alappuzha, Kerala, India<sup>5</sup>

**ABSTRACT:** Induction motors are an integral part of the industry and consume the major part of the electrical energy produced worldwide. The presence of various faults in induction motors affects its working over time and can cost the industry a huge amount for the maintenance and even for replacing. In this paper the stator winding faults like the phase to ground fault, phase to phase fault and three phase short circuit faults are simulated and analyzed. Initiation of winding faults in phase winding increases corresponding phase resistance, as a consequence of which, stator winding becomes unbalanced. Detection of such change in individual phase can give information regarding the fault. This paper discusses each of the stator winding faults are analyzed using MATLAB by using the Fast Fourier Transform tool and the corresponding harmonic component during each fault is identified. This information can be used to identify the fault and take appropriate maintenance actions. Due to the huge expense associated with unexpected downtime, it may be cost effective to continuously monitor the critical motors in the production line for the stator winding faults before one of these motors become inoperable, causing total system shutdown

**KEYWORDS:** Stator winding faults, Fast Fourier Transform, Total Harmonic Distortion.

## I. INTRODUCTION

Induction motors are an integral part of the industry and consume the major part of the electrical energy produced worldwide. Challenges faced by many industries include rise in down time and maintenance cost due to unexpected and unscheduled breakdown of motor. Several industrial surveys and studies have shown that 30-40% of induction motor failures are because of stator winding breakdown due to various reasons such as dynamic loading conditions, high dv/dt in the input voltage, combination of various stresses acting on stator such as thermal, electrical, mechanical and environmental stresses.

Majority of motor stator winding failure happens due to the destruction of the turn insulation caused by the short circuit in stator windings. The shorts could be inter-turn shorts of same phase, short between coils of same phase, short between two phases and short between phase to earth. The major causes of the stator winding electrical stresses, thermal stresses, mechanical stresses and environmental stresses.

## II. RELATED WORKS

The paper [1] presents theoretical and experimental analysis of uneven stator coil winding and rotor faults in induction machines. The papers [2],[3] explain about the various techniques like motor current signature analysis used for the identification for faults including bearing fault. In paper [4], the concept of derivation of inter turn fault in stator winding from the mathematical model of three phase induction motor is explained. First the model is derived for the balanced conditions and then it is for unbalanced conditions by shorting the stator turns one phase. The performance on both the conditions is presented. Generalised theory of electrical machines [5] includes the concept of modelling of induction motors. Condition monitoring of induction motors is a fast emerging technology for the online detection of

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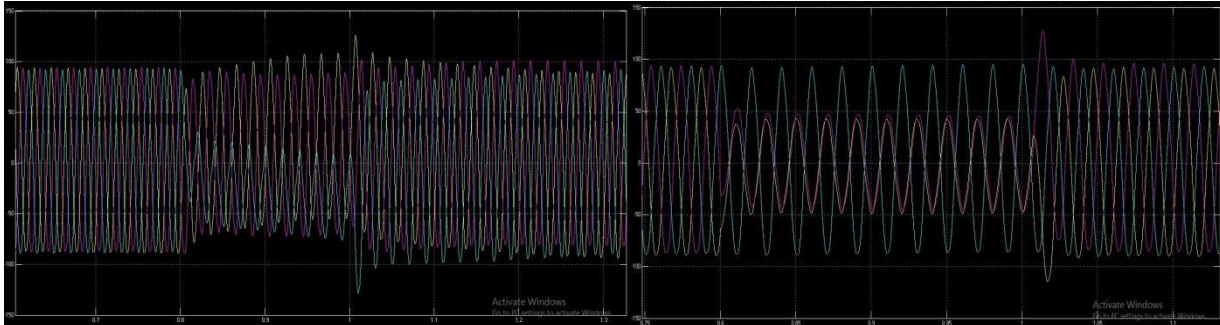


Figure 4(c). Phase C to ground fault

Figure 4(d) Phase A to B short circuit fault

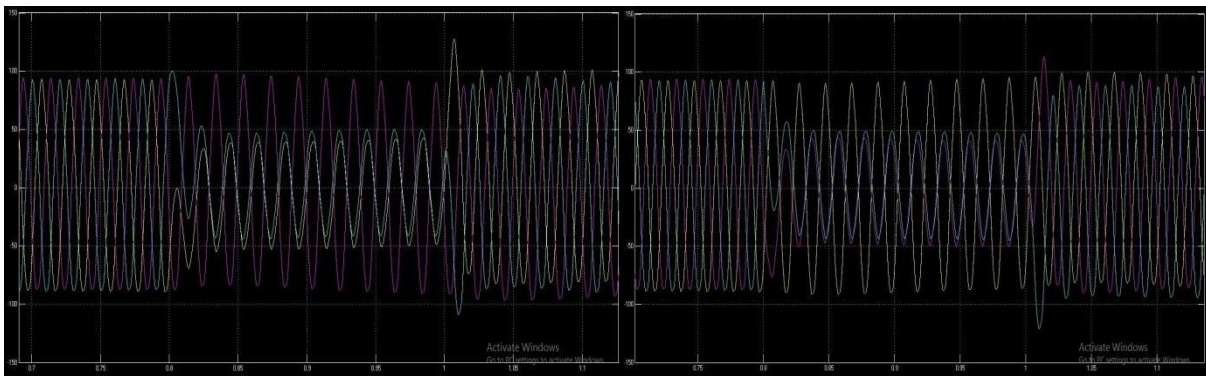


Figure 4(e). Phase A to C short circuit fault

Figure 4(f). Phase B to C short circuit fault

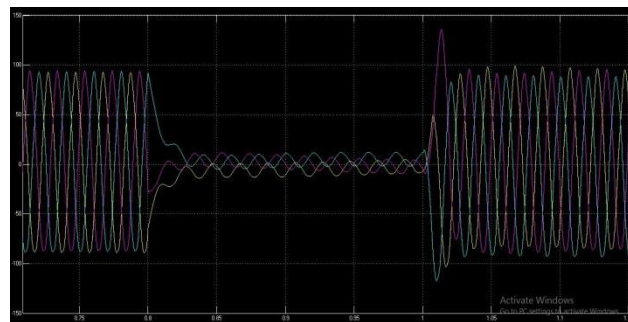


Figure 4(g). Three phase short circuit fault

FAULT	50HP MOTOR HARMONI CS(HZ)	150HP MOTOR HARMONI CS(HZ)	Manual calculati on	THD (in%) 50HP	THD (in%) 150HP	CONCLUS ION (Harmonics for data base)
Phase A to ground fault	0	0	0	40.57	40.36	0
Phase B to ground fault	27.5	27.5	26	27.49	27.32	27.5
Phase C to ground fault	27.5,0	27.5,0	26.5,0	26.23	26.25	27.5,0
Phase A to phase B fault	27.5,52.5	27.5,52.5	26.5,51	51.93	51.55	27.5,52.5
Phase B to phase C fault	27.5,47.5,17.9 6	27.5,47.5,17.9 6	26.2,45.5,17. 5	25.08	25.09	27.5,47.5,17.9 6
Phase A to phase C fault	27.5,47.5	27.5,47.5	26.9,48	49.39	49.52	27.5,47.5
Triple phase short circuit	47.5	47.5	48	99.32	99.30	47.5

Figure 5. Table showing analysis result



## V. CONCLUSION

The common types of faults in induction motor are studied and various types of current based condition monitoring and fault diagnosis techniques are reviewed. From the study it is found that the stator winding faults are vital for an induction motor. Several methods such as current signature analysis, FFT analysis, ANN can be used to analyse the signal during faulty situation is also identified from the studies. Literature survey is presented to summarize the state of art techniques that are applicable to the methods proposed in the research. Then the steps for creating induction motor with fault were carried out. For that we done an induction motor modelling with dq reference using generalised machine theory. But failed to create faults like bearing fault, then move on to stator winding fault here also failed to simulate with the inbuilt three phase source. So we made discrete voltage by using switching sequence and universal bridge. Thus made a six stepped wave and done further procedures for fault making. In all condition monitoring algorithms, base measurements are taken for a healthy motor at the time of commissioning. The fault algorithm monitors the magnitude of amplitude of fault frequencies and track changes in their amplitudes over time. Any significant change of the amplitudes indicates a developing fault. Experiments in various references show that defects may affect mainly two sidebands around fundamental frequency. Hence the faulted signals are simulated.

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