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# Failure analysis of shear pins in wind turbine generator

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ABSTRACT

This paper examines the failure of shear pins that connect gearbox and generator in a wind turbine generator. Chemical and micro-structural together with hardness measurements have been performed to check any deviation in the material specification. The failure mechanism is analyzed by both visual and Scanning Electron Microscope (SEM) inspection on the fractured surface. Finite Element Analysis (FEA) of shear pin is carried out to determine the root cause for its failure. The neck diameter of shear pin is optimized for the safe operation of the wind turbine. It is inferred from the observations based on fractography study on the fractured surface of the shear pins that the misalignment between the driving and the driven elements in the wind turbine leads to low cyclic fatigue growth.



## 1. Introduction

The coupling connecting the gearbox assembly and an electric generator of the wind turbine generator (WTG) are fitted with shear pins numbering seven. The driver and driven ends of the coupling are shown in Figs. 1 and 2 respectively. The shear pin is a mechanical sacrificial component like an electric fuse designed to break itself as and when the mechanical overload arises to prevent the severe damage of expensive components in gearbox assembly and electric generator. The rubber buckles fitted in the coupling provide flexibility during operation. The nacelle comprises the gearbox assembly, coupling assembly, brake disc assembly, generator and cover. The sudden switch over of generator from high speed (1007 rpm – 6 poles) to slow speed (750 rpm – 8 poles), whenever there is a sudden change in wind velocity, is termed as down coupling. During an operation of the WTG, it was observed that the frequent pre-mature failure of the shear pins occurred during down coupling even the WTG did not attain the rated power. The gearbox in WTG is subjected to shock loads due to fluctuating wind force, sudden grid drop, non -synchronization of pitching and sudden braking.

In the present work, a case study of failure occurring in a WTG of capacity 350 kW, commissioned on 31/12/2001, is undertaken. The WTG ceased to function on 06/06/2007 due to the failure of shear pins causing disconnection of transmission of drive from gearbox end (drive) to generator end (driven). During an inspection, it was observed that all the seven shear pins had failed at the neck diameter (Fig. 5). The shear pin is generally designed in such a way that it should fail as and when the mechanical overloads come up so as to protect the highly expensive units, namely, gearbox and generator. The sudden and frequent change in wind velocity, misalignment between gearbox and generator and bearing (rolling contact type) failure are the major sources for mechanical overload. Figs. 3 and 4 shows an assembly of drive train components in WTG and an arrangement of shear pins in the coupling respectively. The researchers in the field of wind energy have been

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