An Analysis to Identify Critical Component Failure in Onshore Wind Turbine Generators

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Motivation

The aim of this study is to at improve knowledge of subsystem failures in WTG and its effects on Wind Turbine availability. This will also provide results that can be used to address a problem of non-conformance and minimise reoccurrence in emerging renewable energy markets such as SA.

Problem Statement

To address a problem of non-conformance and minimise re-occurrence of subsystem failures, using SCADA data of the logged failures in the WTG.

Methodology

A methodology that uses statistical and quantitative techniques to achieve the project objectives has been developed, allowing the analyse of 60 Wind turbine Supervisory Control and Data Acquisition (SCADA) alarm data, that is exported from a central server, of the Wind Turbine. The Wind turbine alarms data used in this analysis is real operational Wind turbine data that spans over 2 years -a total of 17575 hours. 14959 alarms were analysed in this study

Results

The 6 critical subsystems identified: (3 electrical, 3 mechanical) Generator inverter, Grid inverter, Converter, Yaw, Hydraulics and the Hub.

- Most of the failures that occur in the electrical sub-system last for an average duration of 1-10min., however these affect the Wind Turbine availability most since they occur most frequently in the WTG.
- Most of the mechanical subsystems have failure alarms that on average last longer but appear less frequently than those in the electrical subsystems
- 49.39% of failure alarms last between 1-10min, 29.59% last between 10-59min and 21.09% of alarms last longer than 59min.
- Grid and Generator inverter are the two sub-systems identified to have the most failures
- Incorrect control of the Generator and Grid inverter sub-systems during Low voltage situations is a possible cause of such high failure in DC fuses this can be confirmed by observing the grid voltage and frequency at the time of failure.

Conclusions

Mechanical failures are mostly due to the overheating of hydraulic fluids and components which are issues which can be resolved by redesign, revised maintenance plans or fitting of reliable components. electrical subsystems more specifically in the grid inverter which is most affect during LVRT situations.