Reliability Analysis Of Wind Turbine And Maximization Of Power Output

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Abstract

Present work is done on reliability evaluation of Wind Turbine at Tirumala.

The repair rate of each component in wind turbine is taken and the failure probability of each component is calculated by using exponential distribution and overall functional reliability is determined. The power generation, uptime, downtime of the wind turbine for recent years is taken to calculate operational reliability of wind turbine.

A mathematical model of a permanent magnet synchronous generator (PMSG) is designed for a direct-driven 1MW wind turbine. The simulation model is carried out in MATLAB SIMULINK to determine Wind Turbine power output under given load and no load condition for different wind speeds. Wind Turbine consists of different components namely, Wind blades, Main bearing, Controller, Generator, Rectifier system including Transformer and Grid. The machine side converter is used to extract maximum power from the wind within the safe limits. PMSG convert the mechanical wind energy into electrical energy. The operating point of the Wind Turbine is based on its characteristics and the demanded power. Proper controlling and feed-forward techniques have been deployed to eliminate cross-coupling and mitigate the effect of load side disturbances. To improve the dynamic behaviour of the system, a controller based on Limited Power Point (LPPT) control technique is used.

A detailed electromechanical model of a PMSG wind turbine connected to the power grid is developed in MATLAB SIMULINK environment and its corresponding control structure is implemented in the existing Wind Turbine. As a result Power output is increased.

Keywords: Reliability, Availability, Capacity factor, Limited Power Point Tracking.