ANALYZING THE AFTERMATH:
COMMON WIND TURBINE FAILURES

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Background

Highlights
- Electrical Incidents
- Mechanical Incidents
- Structural Failures
- Cyber Incidents

Over the past decade, U.S. wind power has more than tripled and is now the largest source of renewable generating capacity in the country with the demand expected to increase in the coming years. As with any high-growth industry, failures and outages within Wind Turbine Generators (WTGs) are extremely costly. Between lost Power Purchase Agreement (PPA) revenue and Federal Wind Production Tax Credits, a WTG that is out of service may cost a producer a significant amount of revenue each week. Continuous improvement programs have reduced failure rates year after year, but with the increasing volume of turbines being installed across North America, the number of incidents will inevitably increase.

U.S. wind power has more than tripled over the past decade, and wind is the largest source of renewable generating capacity in the country![1]

Following a WTG incident, it is imperative that all affected equipment and systems are properly assessed by a qualified and licensed engineer and, if necessary, decontaminated by a professional equipment expert. Failure to do so may result in operational problems for the remaining life of the WTG. Across the energy industry, loss prevention and mitigation best practices exist so that incidents involving business-critical equipment are not catastrophic. The wind energy industry is rapidly growing in North America and for WTG owners, the consequences of lost production, unforeseen downtime and serious incidents that may occur are very real.

In this whitepaper, we outline the common failure modes associated with WTGs, from electrical and mechanical failures to structural disasters and trending cyber risks, as a background for carriers and other professionals that work with this industry.

Electrical Incidents

Historically associated with traditional power generation failures, electrical incidents such as arc flashes can pose significant risks in the wind energy industry, namely fires. Consider the engineering of an electrical hazard, in a WTG, these are often magnified because of the compact design of critical

components, such as bus bar systems, sensors and other crucial electrical systems. WTGs often operate in harsh environments. While they are built to endure nature's elements, the harsh environments make them susceptible to fires and other mechanical and electrical incidents. Fire is the second leading cause of incidents in turbines after blade failure, mainly due to lightning strikes, electrical malfunction, mechanical failure and maintenance errors.[2]

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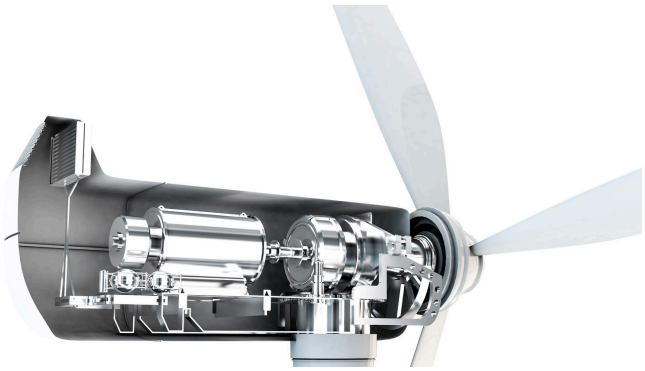
Mechanical Incidents

WTGs rely on sophisticated mechanical systems to operate, any of which present risks for failure and fire. Because they are constantly running WTGs are vulnerable to fatigue, issues with overspeed, vibration, resonance and frequency.

When weather-related incidents occur, such as hurricanes or high-wind storms, rotor blades, gearboxes, generators and hydraulic systems can all be impacted. This includes control system malfunction, component wear and tear and fatigue or loosening of parts. These incidents may result in dangerous overspeed conditions, overload, vibration issues and reduced or impacted power generation.



When Quality Assurance and Quality Control (QA/QC) measures are not properly reviewed and assessed, including reviewing if the work did in fact take place, serious risk for failure and safety concerns are likely to arise.

Structural Failures

Extreme winds can severely impact the structural integrity of WTGs. Whether it be a tower collapse or blade fracture, structural failures caused as a result of high-wind or weather-related events, these incidents are often catastrophic. They can result in property damage, and in the worst-case scenario, the loss of life. Overstress, strain in the tower, and stress to the blades can all contribute to severe structural failures. Following any type of structural failure involving a WTG, experienced engineers and experts must be deployed on scene to evaluate the failure and determine potential causes and what, if any, mitigation measures may be taken.

Cyber Incidents

According to the U.S. Department of Homeland Security[3], the energy sector, specifically renewables, will be a significant target for hackers in the coming years. Wind farms are extremely vulnerable to hackers due to the lackluster physical security, outdated and decentralized communication systems, protocols and operational technologies (OT), as well as an overall lack of training on cyber preparedness.

For example, if the wind farm is older and the owner no longer subscribes to the updated version of remote monitoring software needed, they are liable for potential security threats.

It is imperative that the insurance industry becomes familiar with the apparent cyber risks and mitigation strategies, including identifying and appointing experienced cyber security professionals should the worst occur.

Summary

U.S. wind power capacity continues to grow at impressive levels. As WTG installations continue to increase nationwide and the market simultaneously begins to mature, the occurrence and severity of incidents involving WTGs will also increase.

Following any loss or incident involving wind turbine equipment, it is crucial that experienced engineers and experts be consulted immediately. Therefore, it is helpful to have a team of reputable, electrical, materials, mechanical, and structural engineers pre-vetted so that these kinds of incidents can be responded to quickly and efficiently.

References

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