An LPS inspection using the Voliro T drone and micro-ohmmeter payload

Lightning protection system monitoring: a proactive approach for wind turbine strikes

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Wind power generated by turbines accounts for the largest share of renewable energy production in Europe. Here, Voliro and SkySpecs explore the lingering questions surrounding the effects of lightning strikes on the rotor blades of wind turbines, as well as an effective new method for inspecting and monitoring the state of those blades.

Overview of lightning impacts on wind turbines and blades

Lightning strikes are common when it comes to wind turbines, which can act as a lightning rod due to their height. Having a working and maintained Lighting Protection System (LPS) is crucial to mitigating risk of damage caused by lightning strikes.

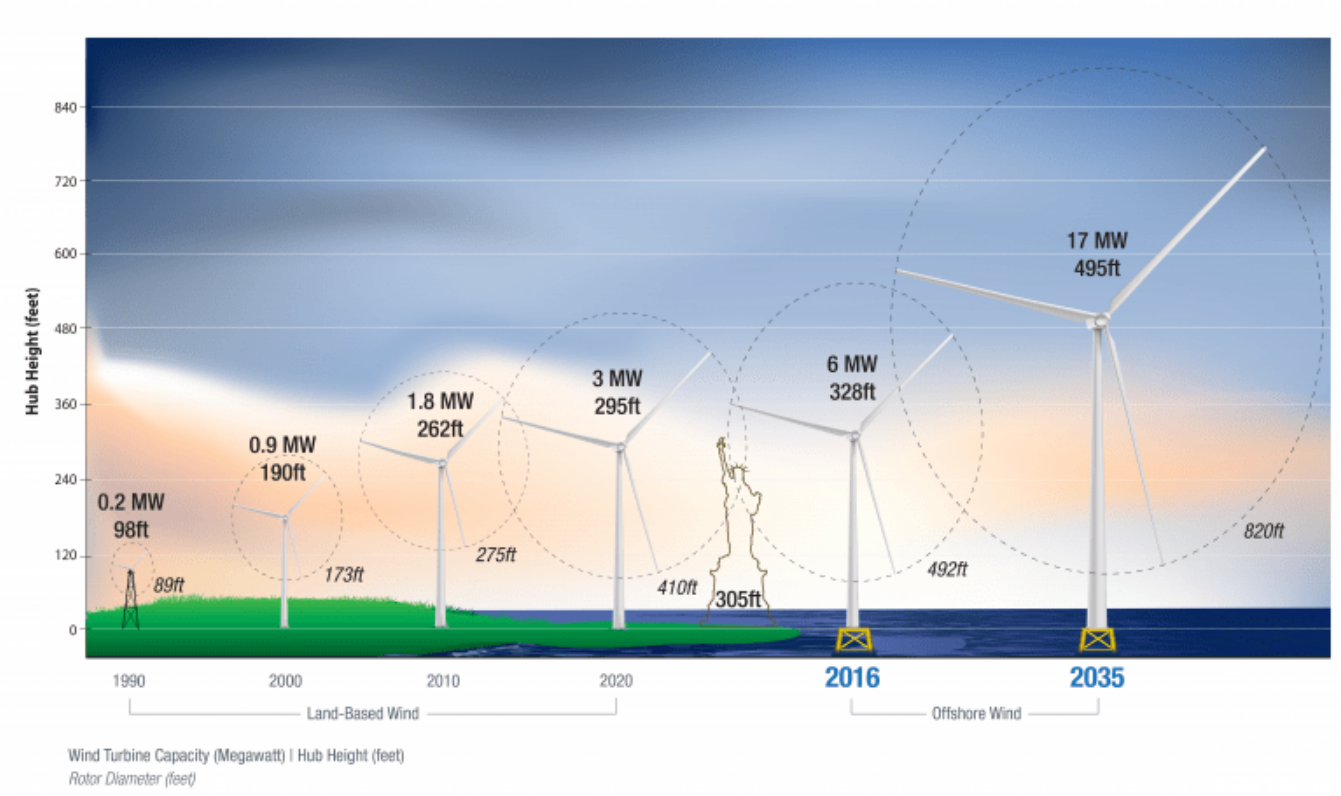
Key issues relating to lightning

There are three key issues to consider with lightning events and their impact. Firstly, the increased demand for green energy means less turbine downtime is crucial.

With the increasing demand for renewable energy, but not enough wind and solar farms to replace traditional energy, ensuring your assets are up and running is crucial. Lightning damage has the potential to cause extensive turbine downtime, reducing availability and power generation.

Secondly, turbine heights are growing. The height of wind turbines has increased 59% since 1998, and that trend isn't likely to stop. Turbine heights could reach almost 500 feet by 2023, meaning more lightning strikes will hit blades and towers.

As assets gain height, LPS monitoring will become more important to keep assets running smoothly and producing clean energy. Considering a turbine is typically struck by lightning one to two times per year currently, this average is likely to increase as turbine heights grow.



Thirdly, more lightning equals more problems. Outstanding questions on climate change's impact on storm intensity and location is a concern. For example, in 2021, there were over 194 million total lighting events across the US, which was 24 million more than in 2020. If rates continue in this direction, wind turbine inspections and LPS monitors will be crucial to extending the health and life of wind turbines.

Reducing your risk profile with inspections & LPS monitoring

One aspect that drives urgency for inspecting LPS and turbines is end of warranty agreements, ensuring that damages covered under warranty are identified and completed in time as part of the due diligence. In Germany, LPS inspections are required annually. While this is not required everywhere, owner operators should still build this testing into their planning budgets, to ensure LPS systems are working properly, and that any lightning related damages are detected before becoming catastrophic damages.

Adding LPS inspections to your normal turbine inspections planning can help further reduce downtime, and gain a better understanding of the overall health of the asset.

Drone-based turbine inspections and data collection benefits

The methods used for inspecting LPS services also play an important role. Traditional inspection methods are manual, rope based inspections which can be time consuming compared to new, drone based methods. From an inspection in 2021 of an onshore wind turbine farm, Voliro found that a turbine's LPS inspection could be done in 40 minutes with their drone technology, saving almost a full day compared to traditional rope inspections. This results in up to 80% quicker inspections, 50% cheaper costs compared to traditional methods, and reduced turbine downtime during the inspection process.

Another benefit of using drone technology for tracking lightning data consistently over time is particularly important with problem sites, where you may be trying to prevent failures and sustained instances of downtime. The more you can collect data, track the types of lightning, and the proximity of strikes that cause damage, the better you can hone in on how frequently inspections need to be done.

This type of data can also tell you if you have a particular turbine that's seeing a significant amount of lightning damage, but isn't a standalone in proximity to storms. This information is helpful in determining LPS system issues and whether a particular type of turbine is showing higher rates of lighting damage.

The solution: SkySpecs and Voliro LPS drone inspections together

A solution to help monitor, identify damage, and inspect your LPS monitoring systems is achievable by using SkySpecs Autonomous Drone inspections and Blade Asset Management software for wind turbine blades, and Voliro's LPS drone inspections.

These technologies teamed together provide a clearer picture of whether an LPS system is functioning, where issues might be, and what type of damage has happened, allowing you to prioritize what needs to be repaired first and allocate your budgets in the right areas. By accurately prioritizing damages with the most potential to create downtime, you can avoid catastrophic failures, better manage your budgets, track data over time to proactively plan repair budgets to problem areas, and reduce overall downtime to stay up and operational.

SkySpecs Autonomous Drone Inspections remove human error and enable a fast, accurate, and safe external blade inspection that minimizes downtime and provides high-quality, easily accessible data on your critical assets. Our fully automated robotic inspection drones take 15 minutes or less per turbine and create 3D models of turbines in real time. Inspection images and damage annotations are available to view and analyze through SkySpecs Blade Asset Management platform. To learn more about our inspection capability.

SkySpecs Horizon Blade Asset Management gives you the ability to centralize, manage, configure and track all inspection and O&M work associated with wind turbine blades from their first operational days to end-of-life. This solution is purpose-built to help you leverage your data, make efficient decisions about resources, and communicate and manage workload. To learn more and see the platform in action.

Voliro provides an innovative UAV with unique capabilities, the Voliro T. They promote the concept of omnidirectional aerial vehicles, where position and orientation of the flying platform are completely independent. This ability is crucial to achieve stable, robust and

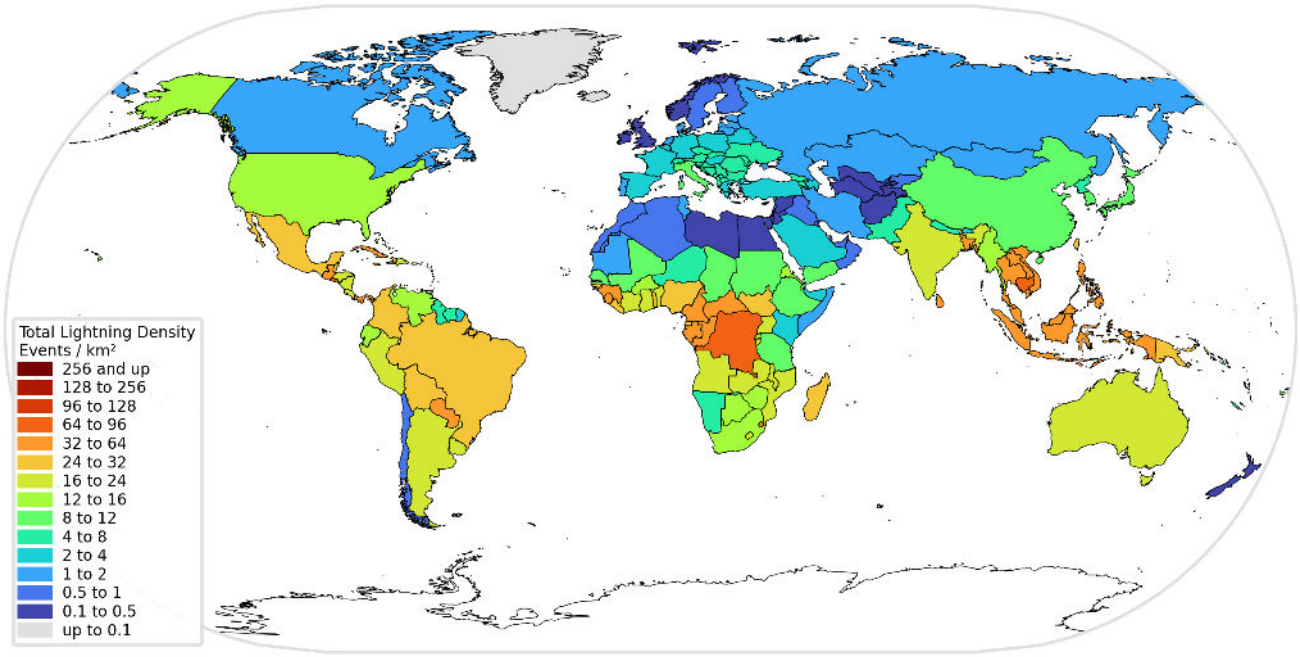


Figure 2

reliable interaction with assets and infrastructure. Voliro therefore expands the abilities of service drones from 'fly and see' to 'fly, see and touch'. The flying robot can be equipped with a variety of payloads, such as in this case, a micro-ohmmeter for LPS measurements and Non-Destructive Testing (NDT) sensors.

The unique 360° drone design of the platform allows inspection of curved and sloped surfaces. No other flying inspection robot boasts these capabilities.

The application of LPS testing is well suited to be performed with a drone. The payload is a Portable Micro-Ohmmeter. As these Ohmmeters are typically >5kg, it is too large to be carried with the UAV and remains on the ground, from here it is grounded to the wind turbine and the Voliro T takes the measurement sensor, a 4-point probe, and cable from the Ohmmeter up to the blade.

When the sensor carried by the Voliro T is in contact with the LPS receptor, the loop is completed and the bulk resistivity measurement can be recorded and this is in compliance with EN 61557 and the guidelines issued by the German Bundesverband Windenergie.

wwwvoliro.com

www.skyspecs.com

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Figure 3: A recent wind turbine failure due to a lightning strike in Crowell TX. Photo credit Brent Havins