

Keeping Wind Farm Crews Safe

Don Leick, Director of Product Management, Telvent DTN

Introduction

Lightning safety is a key concern for maintenance crews at wind farms. Turbines are particularly dangerous, not only due to height but also due to the time required to get down the tower. Wind farm maintenance personnel need reliable early notification of lightning information, to avoid dangerous conditions.

Telvent DTN has years of experience working with the largest wind farm operators and turbine manufacturers in the U.S. providing effective weather solutions. From this experience, Don Leick, will speak to the safety issues wind farm operators face, as well as the proven solutions numerous wind farms rely on - including alerts for changing conditions, and real-time lightning information.

Best practices and guidelines currently being used by top wind farms are also addressed.

Why are wind farms so dangerous?

The combination of three factors makes wind farms especially prone to the dangers of lightning:

1. Most North American wind farms are in lightning prone areas
2. Turbines attract lightning
3. It takes substantial time to evacuate

Let's look at each of these points...

Most North American wind farms are in lightning prone areas. The Great Plains are a hotbed of thunderstorm activity especially in the spring and summer. These storms often occur during working hours.

Turbines attract lightning. The turbine where maintenance workers are present is typically 80 meters (over 250 feet) above ground. It's a well-established scientific fact that tall structures are lightning-prone. They provide a conductive channel to ground for lightning. Turbines may be at even higher risk than most tall structures; however, this has not been scientifically proven.

It takes substantial time to evacuate. The evacuation time the towers represents is also significant. When a worker needs to evacuate, typically it can take up to 20 minutes to get down, with equipment & safety harnesses involved, and into the safety of their truck.

Further, some operations want employees out of the wind farm entirely due to possible danger of turbine blades exploding when struck by lightning. So the lead time required here is significant.

Ineffective Solutions (Very Dangerous) – What NOT to Do

The leading organizations that have maintenance people on site, whether operators, turbine manufacturers, or contract maintenance crews, know how to keep their crews safe. However, there are some approaches that some people try to take to address lightning that are not effective and are very dangerous.

What DOES NOT Work:

- Watch for lightning, or listen for thunder:
 - Lightning will be on top of you without time to respond.
- Monitor radar images on a PC or phone and guess whether it has lightning
 - Too many false alarms, too many misses – very dangerous!
- Look at delayed lightning on free internet sites.
 - The average life of a thunderstorm cell is 20 minutes. Free site lightning is delayed 30-60 minutes!

Instead there are very effective means to keep wind farm personnel safe.

Effective Solutions: What TO Do

The approach that has proven to be successful in keeping wind farm workers safe from lightning dangers involves the combination of a national lightning detection network with immediate alerting to the cell phones of workers.

What WORKS:

1. Real-time lightning detection (both ground and cloud; since cloud lightning is often a precursor to ground strikes this provides an additional measure of security in lightning detection).

2. Alerting to your crew's cell phones, well before lightning occurs. Safely evacuate.
3. "All Clear" notification alerts when activity can be safely resumed.

Since wind farm maintenance workers are mobile and don't have PC access, alerting to a cell phone is critical. Today's text message alerting is a very effective communication means. The alerts can indicate:

- When lightning occurred
- Where (distance and direction)
- When it is safe to resume activity.

In addition to actual ground strikes, the NALDN also detects cloud to cloud lightning. The alerts are sent via text message (SMS message). All phones support this. All that's needed for cellular coverage is the lowest level of coverage, akin to what's needed for a voice call, not higher speed connectivity.

The alerts can easily be configured specifically for an organization's practices, for their wind farms.

Wind Farm Safety "Best Practices"

Here are evacuation alerting guidelines followed by many wind farm organizations:

1. Heads up alert: lightning within 50 or 60 miles of wind farm
2. Evacuation alert: lightning within 30 miles of wind farm
3. "All-Clear alert": re-enter farm and resume activity when no lightning has occurred within 30 miles for last 15 minutes. (Some organizations wait for the all clear alert within 60 miles before resuming activity.)

While the above are common distances and times, the alerts can be configured to your organization's needs and practices.

Here are additional best practices measures:

- Equip users with mobile lightning mapping
- Centralized monitoring / Phone call backup
- Each of these requires more explanation. The ability to see real time lightning strikes mapped in the vicinity of the wind farm is useful for determining when to resume activity. Visualize exactly where lightning has occurred and when.

This, along with radar, gives you a better sense as to whether a second line of storms may be approaching, even if there haven't yet been any strikes within your advisory area. This is a very useful capability and with complete weather and forecasts can also be a great tool for maintenance scheduling; avoid starting activities that will have to be suspended due to high winds, for example. DTN provides weather that can be browsed on any phone with a data plan (no software to install). But it does require that you be in an area that supports cellular data transmission. Some wind farms have coverage for text messaging and voice but don't have coverage for data.

Centralized monitoring can also be a valuable safety measure. While it is best to have the crews first and foremost be responsible for their own safety, centralized monitoring can act as a backup, a "safety net" for field personnel. Personnel at a central facility can monitor lightning activity in proximity to wind farms, nation-wide, and call crews about issues. These personnel can also take advantage of PC-based, rather than mobile, alerting and viewing tools.

Cost-Effective Wind Farm Safety

The described approach using real time lightning detection and alerting is a proven, effective way to keep wind farm maintenance personnel safe. It is cost effective as well:

- Cost-effective:
 - Minimize downtime – know when to safely resume
 - Easy to implement and manage
 - Reduce maintenance costs
 - Complete weather solution -- Improve crew scheduling / work planning, and avoid wasted maintenance time

Summary

There is no reason not to take these reasonable measures to keep wind farm workers safe from lightning dangers. The available commercial approaches are simple to implement, they work, and they're cost effective, even providing benefits beyond safety, minimizing downtime and reducing maintenance costs.

References

- [1] DIENDORFER, G, PICHLER, H, MAIR, M., Characteristics of positive upward lightning measured on an instrumented tower, Geophysical Research Abstracts, Vol. 7, 10175, 2005.
- [2] HEIDLER, F., Lightning current measurements at the Peissenberg telecommunication tower, Proc. International Conference on Grounding and Earthing, GROUND'2002, pp.117-122, November 4-7, 2002, Rio de Janeiro, Brazil
- [3] WANG, D., N. TAKAGI, T. WATANABE, H. SAKURANO, AND M. HASHIMOTO, Observed characteristics of upward leaders that are initiated from a windmill and its lightning protection tower, Geophys. Res. Letters, 35, L02803, 2008.
- [4] MAZUR, V. L.H. RUHNKE, Upward leaders and associated electric fields in thunderstorms, Proc. 29th International Conference on Lightning Protection, pp.1-38-1 to 1-38-7, June 23-26, Uppsala, Sweden.
- [5] MAZUR, V. Associated lightning discharges, Geophys. Res. Letters, 9, No. 11, 1227-1230, 1982.
- [6] MAZUR, V. and J.P. Moreau,
- [7] Leick, Don, Telvent DTN, *Safety Issues that Impact Wind Farms*,
www.telvent.com/en/business_areas/environment/solutions_overview/energy/wind.cfm