

HOW TO EVALUATE FIRE RISK AT WIND FARMS

Key steps wind farm operators should take to assess fire risk, protect lives, preserve assets, and save on costs

Summary

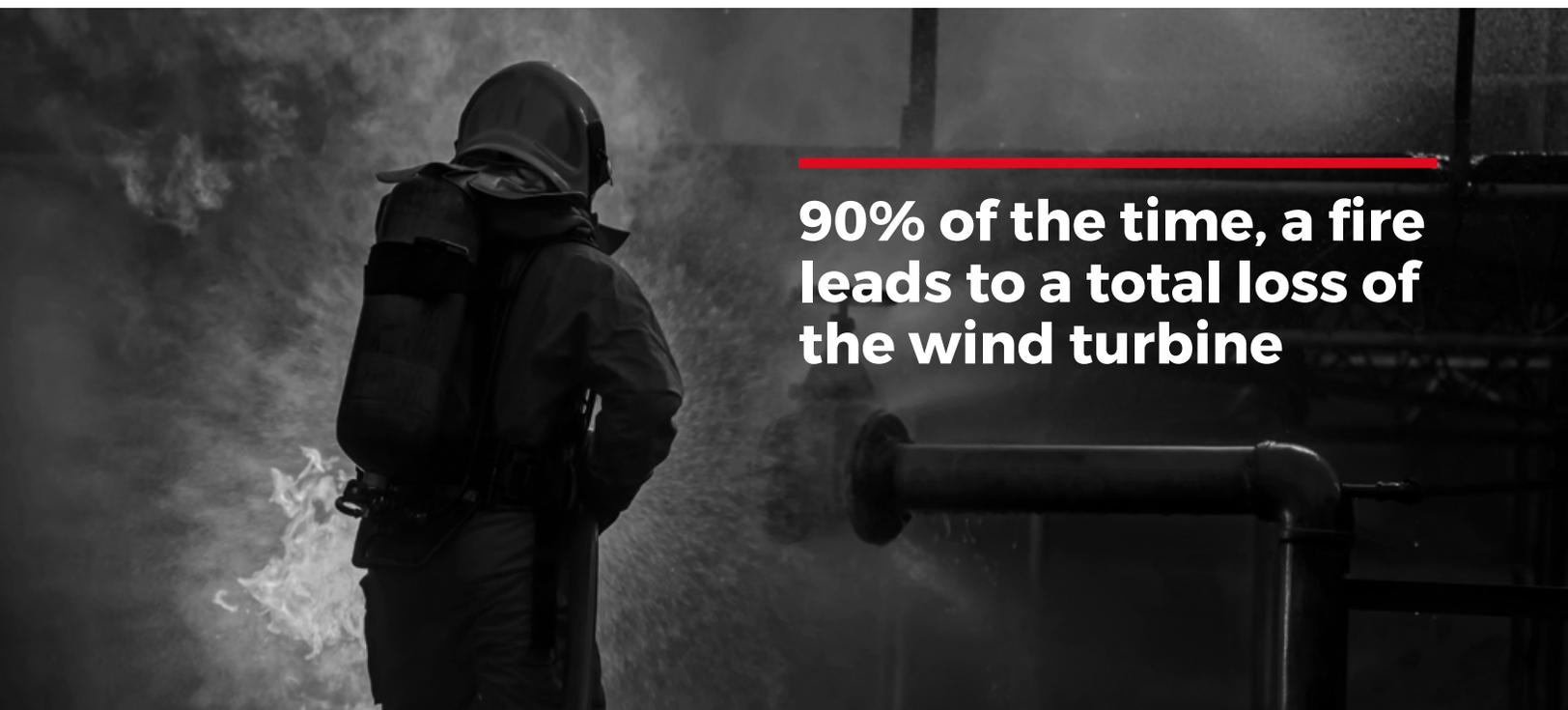
Reducing the risk of injuries to personnel, as well as avoiding fatalities - in addition to limiting damage to assets - should be a priority for all wind farm operators.

In order to achieve these objectives, performing an effective fire risk assessment (FRA) is crucial.

Conducting and acting on an FRA will also increase the probability of saving on costs incurred due to turbines being damaged or destroyed by fire (90% of the time, a fire leads to a total loss of the wind turbine). In addition to the cost of repairing or replacing a turbine (which can be as high as \$9 million), it can also mean 12-18 months of revenue is lost while a turbine is being recommissioned.

An FRA could also reduce the likelihood of wildfires occurring from a turbine fire, which can have a devastating effect on the surrounding area, including the local community.

However, it is worrisome that very few wind farm operators traditionally think to conduct properly structured FRAs, unless they have been previously impacted by fire. This is partly due to the fact there is no requirement to conduct an FRA. In addition, third-party independent service providers do not, generally speaking, include FRAs in their scope of services.



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In order to address this issue, this report explains why it's important to conduct an FRA, and sets out the key steps you should take in order to conduct an FRA effectively.

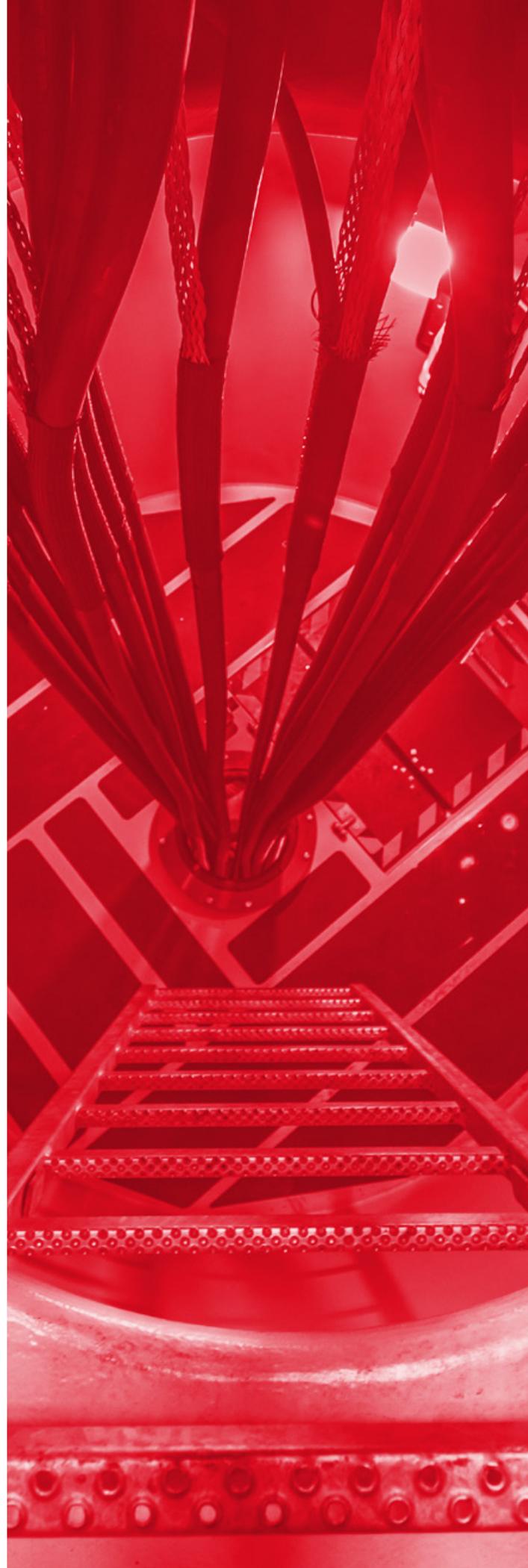
In addition, the report details how you should use the results of an FRA to ensure the maximum benefit for the organization. The report also explains how your organization will benefit from a professionally managed FRA.

Finally, the report explores what technology can be used to minimize fire risk, and what constitutes best practice when conducting an FRA.

Firetrace International would like to thank the following individuals for their contributions to this report:

- **Angela Krcmar**, Global Sales Manager - Wind, Firetrace International
- **JP Conkwright**, Assistant Professor, Fire and Safety, Eastern Kentucky University

SUMMARY



Why it's important to evaluate wind farm fire risk

It is vital that wind farm operators evaluate the fire risks that are present on site.

Effective fire risk assessments will:

- Protect personnel working on site by reducing the probability of fire events occurring
- Increase the level of protection for wind farm assets by reducing the risk of wind turbines being damaged or destroyed by fire
- Save on the cost of repairing or replacing a damaged or destroyed turbine (replacing an individual turbine damaged by fire is becoming increasingly expensive and can now cost up to \$9 million) with 12-18 months of expected revenue loss and down time to get replacement parts
- Potentially reduce the amount your business pays for insurance (insurers could potentially adjust rates if wind farm operators include fire suppression measures)
- Reduce the risk of causing wildfires in the surrounding area
- Boost the reputation of your company from an operations perspective
- Help to bolster the reputation of the wind industry in general

Replacing an individual turbine damaged by fire can now cost up to \$9 million

It's important to note that simply performing one fire risk assessment does not constitute effective fire risk management. Assessments should be updated at regular intervals in order to determine whether the risks posed have changed.

Angela Krcmar, global sales manager – wind at Firetrace International, says: “If the fleet has been in operation for five years plus, the risk factors could be greater as the age of the fleet goes up – if you have a fleet that is five, ten or fifteen years old, the risks are different than if you have a brand-new fleet.”

Krcmar adds that an aging fleet has an increased risk of fire due to its extended use, while new fleets also pose a risk when they are being tested in the market.

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WHY IT'S IMPORTANT TO EVALUATE WIND FARM FIRE RISK



Why are so few wind farm operators conducting FRAs?

Surprisingly, despite the numerous benefits of conducting fire risk assessments, very few wind plant operators are doing so in a formal, structured way.

JP Conkwright, assistant professor of fire protection and safety engineering technology at Eastern Kentucky University, says there seems to be little evidence that wind farm operators are conducting “holistic fire risk assessments following some type of recognized standard”.

Why is this? There is a belief among some experts that some wind farm operators do not conduct fire risk assessments because they feel having insurance means the assessments are unnecessary. In addition, other reasons for the lack of FRAs may include concerns about revenue loss due to down time as well as a lack of resources caused by the Covid pandemic.

However, the National Fire Protection Association (NFPA)’s guidance on recommended practice for fire protection for electric generating plants – known as the NFPA 850 – encourages

the development of a “fire protection design process” and a “fire risk control program” among other measures.

Another possible explanation for unwillingness to conduct FRAs is that wind farm operators greatly underestimate the cost of replacing a wind turbine damaged by fire.

Conkwright points out that, for example, the cost of replacing only one damaged turbine can be more expensive than anticipated because it is not possible to achieve the “economies of scale” that are gained when, say, adapting roads and building bridges to transport the turbines needed for an entire wind farm.

Crane costs are particularly relevant in this context. Krcmar notes that “crane costs are significant and availability is also an issue in the current climate”.

How to effectively evaluate fire risk

In order to conduct an effective wind farm fire risk assessment, it is worth consulting the NFPA's guidance on evaluation of fire risk assessments, specifically its '551' guide.

In summary, when conducting an assessment, key considerations include:

■ **How will the FRA evaluate the likelihood and consequences of scenarios?**

This should be based on past experience (for example, statistics) for well-understood events or on available knowledge for less-understood events where uncertainty and variability are high. The evaluation of consequences may be based on expert knowledge (risk indices, for example) or probabilistic modeling (for example, using a life safety tree).

■ **What is the scope of the FRA?**

It could involve an assessment of one fire risk protection concept or system (a single-system assessment) or the overall level of risk (a multisystem assessment). As highlighted in the NFPA's 551 guide, multisystem assessments often require more sophisticated methods in which the assessment is based on the overall impact of the availability, reliability, and operation of both passive systems – which prevent the spread of fire via fire-resistance rated walls or floors, for example – and active fire protection systems, such as smoke detectors and fixed fire suppression systems.

- **What fire scenarios will the FRA cover?**

Factors to consider in the FRA include:

- Fire ignition***

Would prevention education reduce the probability of the event occurring and help to avoid the consequential risks?

- Fire growth***

Would fire protection systems such as fixed fire suppression systems help to contain the fire? Are the fire control systems reliable enough and effective enough to reduce the risk? The more reliable and effective the fire control systems are, the more the risk will be reduced.

- Failure of fire department to respond***

How effective is the notification procedure and are the fire department's resources adequate?

- **Who is the intended audience?**

The FRA output and the FRA method selected should be consistent with the knowledge and needs of the intended audience.

- **What are the FRA teams' qualifications?**

The qualifications of the team performing the FRA should be addressed in the evaluation of the FRA. Expertise and experience in understanding the risk problem and implementing an appropriate type of FRA should be considered. Consider engaging a consultant, such as insurance loss adjusters and fire risk investigators specialized in wind.

- **Will the FRA utilize a 'Fire Safety Concepts Tree'?**

The NFPA has developed a 'Fire Safety Concepts Tree' that shows relationships between fire prevention and fire damage control strategies that could help to identify gaps in fire protection.

How to use the results of a fire risk assessment

Once the FRA has been completed, how should the results be used?

The FRA should be shared with:

1. Colleagues responsible for personnel safety:

It should be noted that some fire risk assessments fail to address all potential 'fuel sources' and thus it is important to consult safety professionals. Conkwright explains that some FRAs do not cover significant sources of fire such as cable installation, which has resulted in major fires in turbines.

2. Your operations team:

The findings of the FRA should be shared with your operations team, particularly those responsible for maintaining the assets as standards of maintenance can impact on fire risk.

3. Your finance team:

The FRA could potentially have an impact on the organization's budgeting so it is beneficial if the results are shared with the finance team.

4. Colleagues responsible for capital expenditure:

This is crucial because, as Krcmar points out, "the team responsible for the capex for a new development is different from the team responsible for the operations of the fleet once it's online - it's important to make connections with those two teams because there is typically a disconnect".

5. External providers of finance:

There are some small and medium-sized wind plant operators that are financed by organizations that may have gaps in their knowledge when it comes to wind farms' fire risk, says Conkwright.

6. Colleagues responsible for negotiating insurance cover for the asset:

An assessment of the level of onsite fire risk could be an important consideration when obtaining insurance coverage.

7. Your loss adjuster or insurance provider:

It may be necessary to conduct an FRA following a fire event or in connection with an insurance renewal so, in such instances, it could be beneficial to share the results with your loss adjuster and/or insurer.

8. The local fire department:

A knowledge of specific fire risks at a particular site will help first responders tackle any fire that does break out.



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How your organization will benefit from a fire risk assessment

An effective FRA could make it less likely that life is endangered by a fire at your wind farm and could also reduce the risk of the surrounding area being impacted by fire.

In addition, you could also make it less likely that your assets are damaged or destroyed by fire.

Krcmar says when conducting an FRA, it's important to consider whether you are "making your project generally safer for your personnel and the surrounding community and whether you are making your assets safer".

Meanwhile, any steps you take to better understand your assets and the associated risks, will ultimately mean you will be able to make your wind farm more profitable, Conkwright says.

"Anytime that you have a better awareness of your equipment and your operations, you're going to be able to be more reliable when you make forecasts - reliability and variability are very

important, so anytime you get rid of that variability and increase your reliability, you can be more profitable," Conkwright explains.

He adds that another benefit of FRAs is that they enable wind farm operators to better understand their turbines and be more resilient in the sense that if they are aware of potential risks, they are then better able to monitor them.

In addition, this means you are better able to anticipate fire events, which means you are in a better position to respond to them.

"Knowing about your risk up front, instead of being surprised by it, means you can respond really quickly if there is a problem," Conkwright says.

What technology do you need to minimize fire risk?

In addition to fire detection and fire suppression systems, it is also recommended that wind farms have lightning detection and arc detection systems.

With regard to fire detection and suppression systems, there needs to be careful consideration given to where they are positioned. Krcmar points out that detection and suppression systems need to be located near the potential ignition sources so steps need to be taken to identify where they are exactly.

She adds that dust can also impact on internal operations of wind farms. It is important to work with a detection and suppression system that takes the dust

and debris into consideration and select a solution that is the most reliable for this environment.

Conkwright says that the use of arc detection and ground fault detection is becoming more prevalent in wind farms. However, he adds that one of the benefits of an effective fire risk assessment is that it can help you determine what type of detection is best suited to each type of ignition risk.



Checklist: Best practice in fire risk assessment

So, what are the key steps you should take in order to perform an effective fire risk assessment? Here is a checklist:

1. Consult a wind farm fire risk expert

Expertise and experience in understanding wind farm fire risks will ensure that the appropriate type of FRA is conducted. Effective fire risk assessment is a unique skill. It is especially advantageous to work with a consultant with an understanding of both turbine operations and the science of fire protection. “There are fire engineers with little or no experience of the wind industry and there are wind industry professionals who don’t know about fire protection engineering,” says Conkwright. A wind fire risk expert will be able to assess the risks posed to your assets and the surrounding area based on experience gained at other sites.



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...and there are wind industry professionals who don't know about fire protection engineering

2. Develop a framework for communications between specialists in turbine operations and fire risk assessment professionals

Often these two groups struggle to communicate effectively so frameworks for communication should be formalized. Bring experts from both sides together and then use a fire safety concepts tree, for example, as a basis for addressing the issue. For guidance on developing a fire safety concepts tree, it is worth consulting the NFPA 550: Guide to the Fire Safety Concepts Tree.

3. Determine what will be the most effective method of fire risk assessment

Decide what type of assessment will work best for your site – for example, 60 to 70 percent of the FRA could include generic elements, but the remainder may need to be tailored to meet the requirements of the specific site.

4. Consider how the type of turbine being used and the location of the turbine will impact on the level of fire risk

Ignition sources will vary depending on the type of turbine being used, while the location of the turbine will also be a factor.



Conclusion

In order to effectively evaluate fire risk, wind farm operators should consult industry experts on the best approach.

For example, the National Fire Protection Association has issued useful guidance on how to conduct FRAs.

Key considerations include how the FRA will evaluate the likelihood of different scenarios, what will be its scope and who the intended audience will be.

It's also important that the findings of the FRA are shared with and acted upon by a range of stakeholders including colleagues responsible for safety, capital expenditure, and negotiating insurance cover. The findings should also be made known to the operations team, the finance team, external finance providers and the local fire department. It may also be beneficial to share the findings with your loss adjuster and insurance provider.

In addition to using fire detection and suppression systems, it is also recommended that lighting detection systems are implemented at wind plants. Meanwhile, considerations should be given including multiple detection methods, reliable spot detection, arc detection and ground fault detection.

Following these recommendations could reduce the risk of injuries to personnel – as well as fatalities – at your wind plant. In addition, you could also limit the danger of spreading wildfires in the surrounding area as well limiting the risk of incurring substantial costs due to turbines being damaged by fire.

Would you like to talk about the risks in this report?
How about your approach to fire risk in your portfolio?

Get in touch with the Firetrace team today.

www.firetrace.com/contact



FIRETRACE[™]
International

firetrace.com/wind

World Headquarters

Firetrace International
8435 N. 90th St. Suite 2
Scottsdale AZ 85258, USA
+1 480 535 4189

Middle East Office

Firetrace USA LLC (Middle East)
2117 Building 7WB,
Dubai Airport Free Zone,
Dubai, United Arab Emirates
+971 4 295 0167

India Office

Firetrace International
B-149, Ansal Pioneer
Industrial Area, Bilaspur
Guragon Haryana 122413,
India