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Managing renewable energy supply fire risk is one consideration, but what about the insurance risk?

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Wind power is one of the UK's largest sources of renewable electricity. It features prominently in the Government's plan to meet its legally binding target of net zero greenhouse gas emissions by 2050. But this vital source of green energy is not without the potential for catastrophes and current insurance policy wording can be vague.

Turbine fires

According to research by Dr Guillermo Rein, Department of Mechanical Engineering, Imperial College London, an estimated 120 wind turbines catch fire each year globally, which is more than ten times the number reported by the industry[1]. Each onshore wind turbine can cost more than £3 million to install and generates an estimated income of more than £750,000 a year. The impact of a fire is usually severe, and any loss or downtime of these valuable assets makes the industry less viable and productive.

Without a fire suppression system, when a fire develops in a wind turbine, especially in the nacelle (usually 70 metres above ground level), there is very little a fire service can do.

There are four main causes of a fire in a wind turbine (excluding deliberate ignition). **They are:**

1 Incendive electrical fault

Overheating, resistive heating (or poor connection), conductor chafing or damage, tracking (due to moisture ingress) and component failure.

2 Hot surface ignition

Atomised hydraulic or lubricating oil escaping within the nacelle (the housing that contains all generating components) could be ignited at the interface between the slip rings and the brush gear where electrical arcing occurs or by heat generated from the braking mechanism. Hot particles from the carbon brushes are also known to ignite air filters contaminated by grease and carbon oil particulates.

3 Frictional heating

The mechanical failure at the drive shaft, braking system or gearbox could result in frictional heating. This can also cause adjacent combustible materials to ignite or the deformation of seals leading to an escape of oil.

Lightning is a known cause of damage and fire in wind turbines, and it can be extremely expensive in capital and operational expenditure, business interruption and loss of revenue.

4 Lightning strike

Indirect and direct lightning current surges can enter a structure via power and telecommunication lines. The surge can travel in all directions, and overhead line conductors can reach several million volts. The surge must be redirected to earth away from the structure, using surge protectors, lightning protection systems and earth bonding.

Without a fire suppression system, when a fire develops in a wind turbine, especially in the nacelle (usually 70 metres above ground level), there is very little a fire service can do, apart from keeping the public away and extinguishing secondary fires caused by falling burning debris.

Mitigating fire damage

Installed monitoring systems which constantly check the condition of the wind turbine machinery and help ensure that maintenance work is carried out promptly. Manufacturers and operators can use non-combustible hydraulic and lubricant oils and fit heat barriers to protect combustible materials. Manufacturers can also avoid using combustible insulating materials altogether.

The installation of active fire protection measures, such as smoke and fire alarms and suppression systems, is becoming more common. Installed inside the nacelle, they can quickly detect and extinguish any flames.

Lightning protection systems

The *Electricity at Work Regulations 1989*[2] states that lightning protection systems should be tested in accordance with the relevant British Standard. The standard for wind turbine construction is *IEC 61400 – Wind energy generation system*[3]. *IEC 61400-24* references *IEC 62305 - Protection against lightning,* which states that "tests should be repeated at fixed intervals, preferably not exceeding 12 months". A lightning protection test (LPT) involves all lightning conductors and earth grounding installations being visually inspected and tested by a suitably qualified electrical engineer.

Wind turbine fire – a case study

A fire occurred in one of three wind turbines located on farmland. Each turbine was from a different manufacturer, but they had all been ›

Fire damaged wind turbine

Consequential damage to a ball bearing following an incident

refurbished, installed, commissioned and maintained by the same supplier.

Supervisory control and data acquisition (SCADA) systems and telemetry information did not indicate any problems with the operation of the wind turbine up to the point at which communication was lost.

The Distribution Network Operator indicated that their system had sustained a lightning strike locally shortly before the fire. A lightning strike report showed that the nearest recorded strike to the incident postcode was 2km away, which was within the error radius for the report.

However, before we could examine the turbine, the nacelle had been removed from the column and transported 40km on a low loader to a storage yard. During this process, there was some loss of physical evidence from the fire-damaged nacelle, which made it impossible to determine the exact cause of the fire.

So, while a lightning strike could not be discounted as a possible cause of the fire, neither could an incendive electrical fault, hot surface ignition or mechanical failure.

Policy wording

In the above case study, the insurance policy wording was: 'there should be a lightning protection system installed on the wind turbine', but there was no definition of a lightning protection system. The insured provided a photograph showing a lightning finial on the nacelle as the only evidence of a lightning protection system installed, but this was not supported by system design drawings or installation and annual test certificates.

The policy engaged. Even if we could provide conclusive evidence that a lightning strike caused the fire, the policy wording was vague, and repudiation would have been difficult.

During the investigation of a variety of wind turbine failures, we have reviewed other policy wordings:

Example 1 'There should be a lightning protection system installed on the wind turbine', without any definition of what a 'lightning protection system' should be. There were no referenced British or European Standards and no requirement for a test certificate or a certificate of compliance.

Example 2 From the exceptions sections of an engineering policy provided as insurance for a wind turbine: 'we will not indemnify you in respect of (1) damage caused by or consisting of (a) fire, lightning or explosion (except explosion as defined in this section)'.

This policy wording does not provide insurance cover for damage due to fire or lightning. A separate policy or endorsement would be required to cover this possible loss, such as those contained in examples 3, 4 and 5.

Example 3 From the exclusions section of a renewable energy insurance policy: 'damage caused by lightning or over voltage unless the insured property subject to such damage is fitted with zone protection according to *IEC 61024* or alternative standard agreed in writing with the company'.

CS recovered fire-damaged nacelle

The policy wording was repeated in the construction and operational sections of an all risks policy. This policy was written in 2011, and *IEC 61024* was withdrawn in 1999/2000. The wording does not refer to superseding standards.

Example 4 The wording in a renewable energy or wind and solar insurance policy dated 2016 did not exclude lightning or overvoltage as a cause of damage. It did not define or mention lightning or surge protection. It also did not specify any construction or installation standards.

Example 5 The wording in a wind turbine insurance policy stated: 'we will not indemnify you in respect of damage caused by wind, turbulence or lightning unless the property insured complies fully with *IEC 61400* or any other British or International standard which may replace it or apply'.

The wording used in examples 4 and 5 above were included in separate policy documents produced by the same Insurer.

Lightning is a known cause of damage and fire in wind turbines, and it can be extremely expensive in capital and operational expenditure, business interruption and loss of revenue. But specific insurance policy wording relating to the requirements for lightning protection is ambiguous. From experience, the installation and operation of wind turbines that fully comply with lightning protection standards is also rather 'patchy'.

We have not noted any specific wording relating to fire suppression systems in wind turbines. However, we have yet to investigate a loss (either damage or fire) where a fire suppression system was installed.

Corrosion on the rotor windings of wind turbine

It's well worth noting that without specific policy wording related to lightning protection systems, it might be difficult to enable the policy to engage, repudiate the claim or allow subrogation (or recovery) of the outlay against third-parties.

Reference

[1]Fires are major cause of wind farm failure, Imperial College London

[2]*The Electricity at Work Regulations 1989*, Health and Safety Executive

[3]*IEC 61400 – Wind energy generation systems*, British Standards Institution

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