



FUELS INDUSTRY
Association of South Africa

Fire Protection Renewable Energy

Wind Turbines

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S Erasmus



Fire Fighting Developments

+ There are 7 Types of Renewable Energy

- Solar
- Wind Energy
- Hydroelectric
- Ocean Energy
- Geothermal Energy
- Biomass
- Hydrogen

Types of Renewable Energy Sources



①

Hydropower



Gravitational potential energy of water converted into electrical energy through a hydraulic turbine

②

Wind Energy



Kinetic energy of wind converted into electricity by wind turbines

③

Solar Energy



The sun's energy turned into electricity heat energy by solar panels/solar heaters

④

Biomass



Energy obtained from plant & animal remains; e.g. burning wood produces heat energy

⑤

Geothermal Energy



Heat energy trapped underneath the earth's crust converted into electricity by steam turbines

⑥

Ocean Energy



Oceanic thermal and tidal energy converted into electricity by turbines and other systems

⑦

Hydrogen



Hydrogen's potential chemical energy converted into electricity by Hydrogen fuel cells



Wind Turbines

Introduction

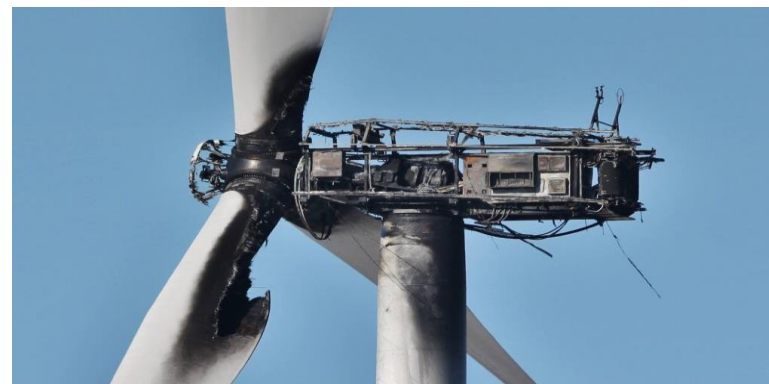
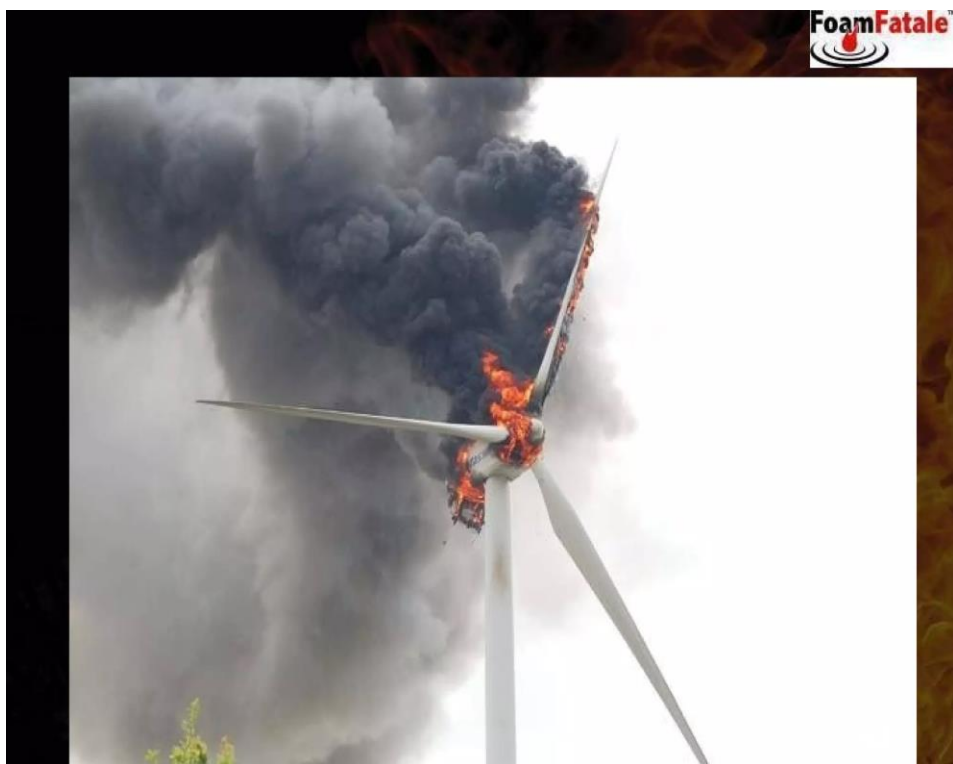
The second-leading cause of wind turbine accidents is fire, which is one of the most common factors leading to property and personnel loss in wind turbine failures and accidents. Therefore, an educated and proactive approach to fire prevention and fire suppression within this renewable energy source is required.

90% or more of wind turbine fires originate in the nacelle. The nacelle contains the gearbox, the generator, the controller, the transformer, the low- and high-speed shafts, and the brake—and it sits atop the tower, which supports the structure of the turbine and the blades. Fires are typically ignited by:

- A lightning strike
- Electrical malfunction or mechanical failure
- Maintenance activities (which is when personnel are present and would be at risk)



Wind Turbines





Wind Turbines Concerns

- No possibility of fighting the fire-by-fire brigades because it is too high.
- Remote, sometimes difficult to reach locations of the wind turbines.
- Due to the high density of technical equipment and combustible material in the nacelle, fire can spread rapidly.
- Working on heights.
- Working in confined spaces.
- Increase fire risk and flame spread in components like the hydraulic system, insulation and wiring can be highly flammable.
- Fire risks due to faulty electrical systems.
- Lack of fall protection, insufficient anchor points or guardrails.
- Lack of secondary evacuation.





Wind Turbines Evacuation



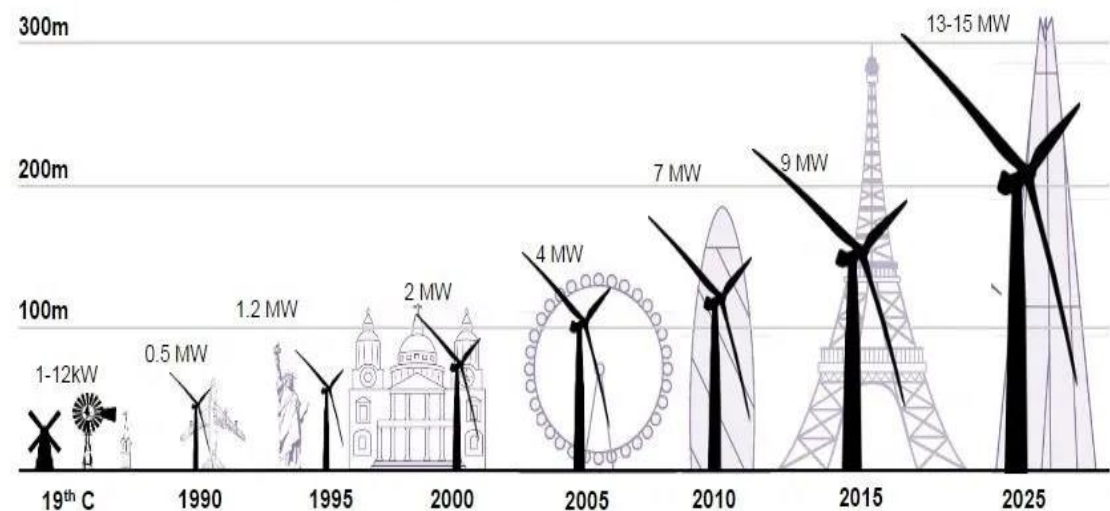
- Besides implementing specialized fire protection measures for detection, suppression, and prevention, it is essential to have procedural safety protocols and advanced control systems to monitor operational processes and conditions.
- Means of escape involves using the internal ladder system or service elevator to descend the turbine.
- **Secondary means of escape**
- Controlled Descent Devices (CDDs): Such as evacuation systems (e.g., rope-based systems) that allow personnel to descend safely from the nacelle or hub.
- Platforms or Rescue Baskets: For offshore turbines, rescue baskets or platforms may be used with support vessels or helicopters.
- Complex evacuation systems, difficult to use under stress and requires extensive training



Wind Turbines Considerations

- Need for automatic fire detection and fire suppression system.
- Advance monitoring system to reduce the need for physical inspections
- Replace flammable material with fire-resistant alternatives.
- Provide proper circuit protection, grounding use of high-quality electrical components.
- Weak tower design may not withstand extreme weather.
- Blade design prone to cracking or failure due to poor material selection.

Evolution of wind turbine heights and output



Sources: Various; Bloomberg New Energy Finance



References Codes and Standards

- *GL Guideline for the Certification of Condition Monitoring Systems for Wind Turbines, Edition 2007*
- **DIN EN 50308** (VDE 0127-100) *Wind turbines – Protective measures – Requirements for design, operation and maintenance*
- **IEC 61400** series *International Electrotechnical Commission (IEC) specifically for wind turbines*
- **NFPA 850** *Recommended Practice for Fire Protection for Electric Generating Plants and High Voltage Direct Current Converter Stations*
- **NFPA 70** *National Electrical Code*
- <https://www.youtube.com/watch?v=-eCqMjbNQTA>

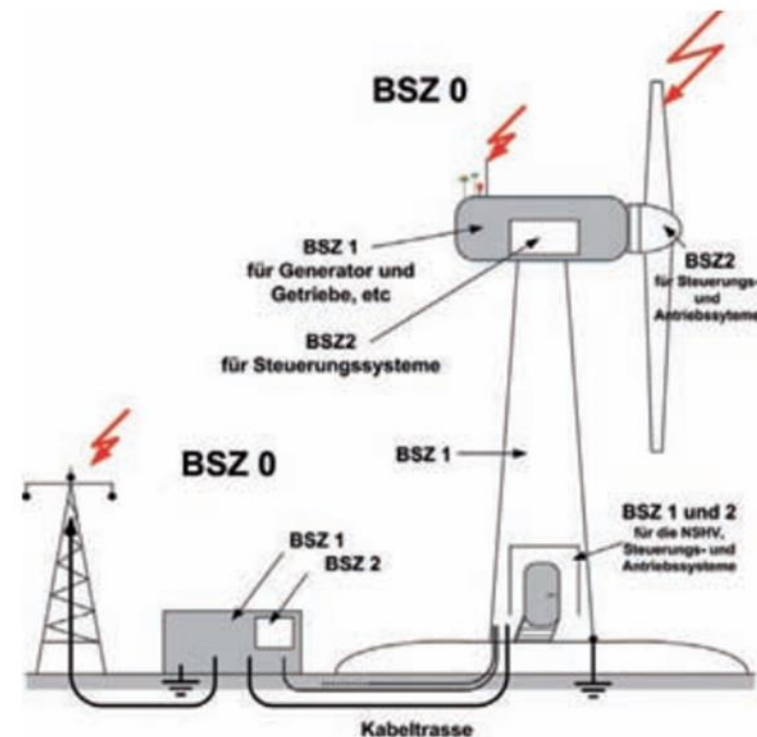


Fig. 5: Allocation of lightning protection zones (BSZ) at wind turbines with metal nacelle (Source: Phoenix Contact)



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Thank You

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