Press Backgrounder:
Preventive fire protection for wind turbines

It is extremely difficult to extinguish a fire in a wind turbine using conventional methods. The 130-meter high turbines are effectively outside the range of the fire department, and when it comes to turbines at sea, human intervention in the event of fire is virtually impossible. That's why a comprehensive fire safety concept needs to focus on preventive fire protection, because this is the only way to effectively avoid serious monetary losses. An extensive product portfolio covering the variety of possible causes of fire is essential:

- **Lightning strike:** Lightning and overvoltage protection customized to the specific turbine type is necessary in order to prevent fires. To guarantee optimal protection, the potential paths of lightning current – for example, from the rotor blade via the hub, the nacelle, and tower to the foundation – must be taken into account when performing the risk assessment. Lightning current and overvoltage surge arresters are used to protect electrical equipment from overvoltage and high currents resulting from direct lightning strikes.

- **Fire prevention** in electrical systems: Protection systems, including fuses and circuit-breakers, are capable of selectively detecting faults and promptly disconnecting defective parts of the network or individual electrical equipment such as transformers, cables, and generators. Protection systems must also ensure an immediate and controlled shutdown of the wind turbine with all-pole disconnection from the grid. If protection devices are triggered, a fault signal should be sent to the remote monitoring center.

Graduated protection concepts achieve the best possible fire protection. When there is a close intermeshing of the protection devices of adjacent equipment, a mutual reserve protection is provided. This means that with a suitable configuration it is possible to avoid the fire risks that arise, for example, from the occurrence of an arcing fault in a low-voltage switchgear with a resulting failure of the circuit breaker. The proper arcing fault detection system detects the fault and...
opens the medium-voltage circuit breaker on the high-voltage side of the transformer. In this way, defective system parts are selectively disconnected from the grid.

Preventive fire protection products
A comprehensive fire protection concept includes an extensive portfolio of monitoring and protection devices aimed at guaranteeing the high availability of the wind turbine:

• **Open circuit breakers** in wind turbines have the job of switching and protecting the main circuit and enabling it to be disconnected from the network to allow maintenance work to be safely performed. In their fire protection function, they prevent fires that are triggered by overload and short-circuit currents and afford protection against non-permissible heating of cables due to overloading. Open circuit breakers also provide alarm signals for integration in the communications system of the wind turbine.

• **Compact circuit breakers** switch and protect the auxiliary circuits. Like open circuit breakers, they are used to protect against non-permissible heating of cables due to overloading and to provide a means for communicating alarms.

• **Semiconductor protection fuses** prevent fires that are due to the dangerous uncontrolled failure of power semiconductors such as IGBTs. They also protect high-quality devices and system components like thyristors in converters and soft starters from the impact of a short circuit.

• **Differential current monitoring devices** reveal undetected ground faults in the electrical installation by indicating the presence of differential currents. By sending an immediate signal, these devices enable preventive maintenance to be performed before the fault current causes a fire.

• **Measuring instruments for power monitoring** make it possible to measure the quality of the in-feed from the wind turbine and to monitor the electrical quantities of the main circuit. This allows the early detection of overloads and operational faults and the prevention of associated damage.

• **Residual-current devices** are vitally important for the safety of maintenance personnel, because they protect against dangerous shock currents in the event of direct or indirect contact. These protection devices detect fault currents caused, for example, by insulation faults. They initiate the disconnection of the affected circuit and thus also prevent fires.

• **Busbars**: The installation of busbars instead of cables in wind turbines can also make an effective contribution to fire safety, and also provides some crucial advantages. Unlike cables insulated with
PVC, the sheet metal housing of busbars has a considerably lower fire load. Epoxy coatings that are resistant to aging also offer a high degree of surface protection for the conductors. Additional benefits of busbars are the high short-circuit strength of the tap-off units and their greater thermal loading capacity in the event of lightning strikes.

**Fire alarm and extinguishing systems**

If a fire develops in spite of prevention measures, automatic fire alarm and extinguishing systems can minimize the damage and reduce downtimes.

- **Detection**: Highly sensitive smoke and heat detectors and fire alarms that detect thermal as well as optical signals can detect a fire even at a very early stage and forward the information to the central fire alarm system. This initiates the immediate shutdown of the wind turbine and activates the extinguishing system. In order to guarantee maximum safety, detectors should be installed at all critical points, from the nacelles and switchgear cabinets to the foundation.

- **Fire extinguishing**: Due to the height and location of wind turbines, classic firefighting methods come up against their limits. However, modern automatic extinguishing systems like the Sinorix solutions from Siemens can be very effectively deployed. These systems are activated directly by a fire alarm system in the event of a fire. The best possible protection is afforded by a combination of two different extinguishing technologies. Fire extinguishing systems that use natural gases such as carbon dioxide, argon, or nitrogen are especially appropriate for dealing with fires in electrical systems. They extinguish the fire quickly and reliably, and do not cause any damage through the use of solvents that could harm the sensitive electronic systems. Modern water spray technologies are also optimally suitable for getting open blazes under control, especially the types of fire that affect mechanical components like the nacelles, hydraulic system, and brakes. These extinguishing systems spray a fine water mist that ensures fast extinguishing of the blaze and a maximum cooling effect.

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