

## Efficient fire safety for wind turbines

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A fire in a wind turbine can quickly turn dangerous for people and the environment, particularly if the nacelle or rotors catch fire, as these are hard to reach for emergency personnel. From a business perspective, the potential consequential damages are considerable. To address these issues, Siemens has developed an automatic fire detection and extinguishing system for offshore wind turbines. The first of these systems was recently installed at the Riffgat Wind Farm in the North Sea.

Wind power is a key element for regenerative energy generation in the sustainable electricity mix of the future. In 2012 all wind turbines installed worldwide produced an output of 580 TWh – almost the entire annual demand for electricity in Germany. And the potential of wind power is far from exhausted. For example, several large offshore wind farms are being developed in the North Sea.

Because of their design, wind turbines, especially offshore units, are difficult to access in case of an incident. The generators and engineering systems are typically located in the nacelle – a hundred meters or more above sea level.

Fires in wind turbines have been rare. However, technical failure of individual mechanical or electrical components could lead to a fire, which would present major problems for emergency personnel. Because wind turbines are difficult to access – onshore as well as offshore – it is hard to prevent a fire from burning through the entire turbine, particularly a fire in the nacelle. This means total loss of the wind turbine, with serious consequences. Repairs are very expensive if the entire generator system, nacelle or rotors have to be replaced.

**Dangerous and expensive**

An incident of this sort could quickly become expensive. Not only is the material to be replaced pricey but the hoisting equipment and manpower needed for repairs are costly as well. Additionally, the downtime of the damaged turbine affects the bottom line.

In onshore wind farms, there is the risk that the fire could spread. In the summer, a burning nacelle located on a ridge near a forest could pose a high risk for people and the environment. In addition, the turbine is hard to access in these circumstances.

**Fully automated offshore fire extinguishing system**

To solve these issues, Siemens has been working on dedicated fire detection and extinguishing systems for wind turbines. For offshore installations, the Siemens Building Technologies Division has created the Active Fire Fighting System (AFFS). This system detects fires in wind turbines and extinguishes them automatically – without delay and without time-consuming fire fighting maneuvers at sea. The first AFFS units are currently being installed in Riffgat.

AFFS combines intelligent Sinteso fire detectors with integrated ASA technology (Advanced Signal Analysis) with a Sinorix extinguishing system, which uses nitrogen, an inert gas, to fight fires. The fire detection system monitors the pain points and system-relevant components of the wind turbines. If the AFFS detects a fire in the nacelle or in the tower – for instance, caused by a short circuit in a control cabinet – the detector system transmits this information directly to the wind turbine's control unit. If an additional fire detection element verifies the fire, the fire detection system immediately activates the gas extinguishing system to put out the fire, leaving behind no residue. The turbine is shut down automatically by its controller or, if necessary, by operators at a control station, and the system is shut down under no-load conditions. If necessary, the operators at the control station can take further steps, possibly assisted by external Siemens technicians who can connect directly to the fire control panel via a VPN Internet connection. Subsequently, the cause of the problem can be identified and the wind turbine returned to operation in the shortest time possible.

The fire detection system continuously sends status messages and system state information to the control station. To enhance safety, one system is installed in the nacelle and one in the tower base; the two systems are interconnected but operate autonomously in the event of a network outage or power failure, thus providing the highest level of safety.

The Sinorix extinguishing systems operate on the principle of inertization, i.e. oxygen displacement. The oxygen content in the area to be extinguished is diluted by nitrogen until a non-explosive, non-flammable environment is created. Nitrogen is inexpensive and can be obtained quickly and easily by removing it from the ambient atmosphere. The environmentally-friendly extinguishing system is thus consistent with the concept of “clean” wind energy.

### **Easy maintenance after a fire**

By implementing an automatic extinguishing system, wind farm operators save themselves the cost of a fire-fighting helicopter. Serious damage that could result from the spread of fire can also be avoided. Using a remote connection from the fire detection system to the Siemens Customer Support Center makes it possible to trace alarms and configure the fire safety and extinguishing equipment from afar. This saves additional costs.

The AFFS systems have a modular design, which is very beneficial in case of fire. The elements can be replaced in the wind turbine by crane quickly and easily after a fire, as well as for service. Even less experienced employees will be able to smoothly replace the fire detection and extinguishing system, as well as connect the systems to the existing power lines. This makes it unnecessary to provide maintenance for the modules once installed. Instead, the modules can be simply replaced at the regular service intervals. The extinguishing modules, for instance, are tested by their manufacturer for reliability and filled, if required. Only the nozzle piping and fire detection lines are permanently installed. They are inspected visually for external damage.

**Certification for AFFS**

The Siemens AFFS fire detection and extinguishing system for offshore wind farms is certified by VdS Schadenverhütung GmbH and according to GL Renewables by Germanischer Lloyd. The AFFS is therefore officially approved for use as a safety system in offshore wind turbines. The AFFS concept was developed by the Siemens Building Technologies Division over a period of one-and-a-half years and the system was subsequently tested extensively in a pilot phase in Brande, Denmark and Flensburg, Germany. During the VdS certification process, experiments conducted in the VdS fire laboratory proved that the behavior of the nitrogen in the extinguishing areas was fully stable. After certification, the first systems were installed in the Riffgat Wind Farm, northwest of the island of Borkum. The AFFS is used in thirty turbines installed by the Siemens Wind Power Division for EWE, a northern German energy provider, and Enova Energiesysteme, the project developer.

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