

Wind Turbine Nacelle Enclosure Protection with Water Mist

Hong-Zeng (Bert) Yu

FM Global, Norwood, Massachusetts, USA

bert.yu@fmglobal.com

BIO: Bert Yu is a principal scientist at FM Global's Research Division. He specializes in the research and development of water-based fire protection, including fire sprinklers, water spray and water mist. He is the current chair of the IWMA Scientific Council.

Abstract

Wind turbines are a key contributor to the renewable energy generation. A recent survey indicates that wind energy now accounts for about one third of the global renewable power capacity. However, fire inside the turbine nacelle is always a concern in the wind industry due to the presence of various ignition sources and combustibles in the nacelle. Once a fire starts in the nacelle, it is almost impossible to fight the fire externally because of wind turbines' typical remote locations and high nacelle elevations above the ground. Since wind turbines are getting larger and larger for a greater efficiency, the potential fire loss could be huge if the nacelle is not protected with an automatic fire protection, considering that the replacement cost for wind turbines could run \$2 millions per MW capacity.

To select a viable fire protection, we need to first identify the combustibles inside the nacelle. The major combustibles inside the wind turbine nacelle include ignitable liquids and nacelle housing. The ignitable liquids include lubricants used in the bearings and gearbox, hydraulic fluid for adjusting the rotor and blades, and transformer fluid. The nacelle housing is typically made of high-strength insulation foam sandwiched between inner and outer fiber-reinforced-plastic skins. So the potential fire hazards in the nacelle involve ignitable liquids in pool, spray or spill fires, and ignitable-liquid-contaminated insulation fires. Water mist has been successful in protecting machinery and turbine enclosures against fire hazards similar to those in the wind turbine nacelle as mentioned above. So there is a great interest in extending water mist to the protection of wind turbine nacelles.

In this presentation, the efficacy of water mist extinguishment of nacelle fires under wind-driven ventilation conditions is assessed. The evaluation requirements for water mist protection of wind turbine nacelle enclosures are also proposed, for both the reliability of water mist system components and the fire test protocol to determine the fire extinguishing performance.

KEYWORDS: wind turbine, nacelle, water mist, fire extinguishment, test protocol, system reliability