Wind turbines at the new Waterloo Wind Farm in South Australia have been equipped with dedicated fire detection and suppression systems that provide fast acting, around-the-clock fire protection. Asia Pacific Fire’s Group Editor, Graham Collins, got the low-down from Bob Grieve.

Investments on this scale, safety issues, and the environmental impact of fire-damaged or destroyed turbines has resulted in turbine manufacturers and wind farm operators becoming ever more aware of the need for effective fire detection and suppression. Indeed, it has become such an issue that several countries have developed recommendations, standards or codes of practice. According to some authoritative reports, the cost of a fire damaged turbine can be as much as AUD $2 million.

There is also the very real and ever present risk of sparks, embers or debris from a burning turbine fire falling to the the ground and setting off a bushfire, the consequences of which have been recently highlighted by the Royal Commission enquiry into the 2009 Victoria bushfire.

So, Roaring 40s, having conducted a detailed risk assessment, turned to Brisbane-based Delta Fire Australatia Pty Ltd, one of Australia’s leading high-hazard fire specialists, for a dependable fire safety solution.
Turbine fire challenge
As Delta Fire’s Managing Director, Bob Grieve, explains: “A number of detection and suppression systems have been put forward as being suitable for the protection of wind turbines, but most are simply not designed for the particular fire challenges found in wind turbines.”

He continues: “The most common cause of a turbine fire is a lightning strike, because these increasingly high wind turbines are invariably sited in exposed and often high-altitude locations. Mechanical failure or electrical malfunction is another culprit that accounts for a significant percentage of fires that can be fuelled by up to 750 litres of hydraulic fluid and lubricants in the nacelle, which itself is constructed from highly-flammable resin and glass fibre. Internal insulation in the nacelle can become contaminated by oil deposits, adding to the fuel load.”

“Electrical equipment is another high risk area. Capacitors, transformers, generators, electrical controls and transmission equipment, all have the potential to catch fire, as do SCADA (Supervisory Control and Data Acquisition) systems. There is also the risk of fire due to loose or broken electrical connections or the overloading of electrical circuits. Braking systems pose a particularly high fire risk. Overheating can cause hot fragments of the disc brake material to break off, rupturing hydraulic hoses and resulting in highly combustible hydraulic fluid being expelled under pressure and coming into contact with the hot disk brake fragments. Hydraulic pumps and connections have also been known to fail, allowing the fluid to erupt into flames when it comes into contact with a hot surface.”

Zero tolerance specification
Working closely with Roaring 40s’ management, Delta Fire devised a checklist of essential requirements for a wind turbine fire detection and suppression system.

As wind farms generally are in isolated locations, often beyond the prospect of immediate attention by the fire service, an essential requirement was that the system should deliver around-the-clock detection and suppression reliability and provide 24/7 unsupervised protection. It should also respond to a fire with 100 percent reliability, while offering the certainty of false-alarm-free operation. Equally important was the need to stop a fire precisely where it breaks out and before it has any opportunity to take hold.

Other factors highlighted in the Waterloo Farm analysis included the need for the chosen solution to be able to contend with vibration, dust and debris, airflow through the nacelle and extreme temperature variations. It should also be intrinsically safe and require no external electrical or other power that can fail and so put the system out of operation.

“The analysis also highlighted two other considerations that, while obvious, eliminated some of the possible solutions from the final shortlist,” recalls Bob Grieve. “As a wind turbine nacelle is packed with electrical equipment, it was considered to be essential that a suppressant agent was chosen that is appropriate to the fire hazard and the equipment being protected, and that, on suppression discharge, would not damage the very equipment it is there to protect.”

Dedicated solution
Satisfying all of these needs precluded the vast majority of systems on the market that are purported to be suitable for micro-environment, special hazard protection and, following extensive field trials undertaken in wind turbines in Tasmania by Roaring 40s, the decision was taken to entrust the Waterloo Wind Farm turbine fire safety to Firetrace International’s FIRETRACE®.

FIRETRACE is what is termed as a linear pneumatic system; one that provides both fire detection and suppression in a single, self-contained package. It is an automatic fire detection and
suppression system that ensures fast acting, around-the-clock fire protection, requiring neither electricity nor external power; a solution that is activated without the need for manual activation or monitoring, and requires virtually no maintenance. It is an intrinsically safe solution, as it does not contain any components that produce sparks or which can hold enough energy to produce a spark of sufficient energy to cause an ignition.

FIRETRACE comprises a cylinder that, for the wind turbine application at the Waterloo Wind Farm contains 3M Novec 1230 Fire Protection Fluid. This was chosen from a number of suppressant options offered by Firetrace International because of its acknowledged “green” credentials and Roaring 40s’ determination to adopt the best possible environmental solution. It has a negligible impact on the environment, with an insignificant global warming potential, zero ozone depleting potential and a remarkably low atmospheric lifetime of just five days. The Novec 1230 suppressant is stored in containers as a low vapour pressure fluid that, when discharged, transmutes into a colourless and odourless gas. After discharge, the agent is dispersed through natural ventilation, leaving no residue to damage sensitive electrical equipment; it is also non-conductive and non-corrosive.

The Novec 1230-filled cylinder is attached to a purpose-designed proprietary Firetrace Detection Tubing via a custom-engineered valve. This leak-resistant polymer tubing is a linear pneumatic heat and flame detector that is designed to deliver the desired temperature-sensitive detection and delivery characteristics. It is routed throughout the areas to be protected and, when the tubing is exposed to heat and radiant energy from a fire, it ruptures and instantly directs the suppression agent at the source of the fire.

A key factor in its success in protecting micro-environments around the world – there are over 150,000 FIRETRACE systems installed around the world – is the system’s reliability. The fact is that the only thing that will rupture the system’s tube is heat or flame from a fire, so there is no prospect of false alarms; yet, if a fire breaks out, the response is unerringly immediate and accurately targeted.

The Danish-manufactured turbines were delivered to Roaring 40s at Port Adelaide, where Delta Fire fitted the FIRETRACE systems before they were transported by road to Claire Valley. The FIRETRACE installation in each turbine took 24 man hours, and the final commissioning of the systems took place once the turbines were erected on site.

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Waterloo Installations
The Waterloo Wind Farm fire suppression systems supplied and installed by Delta Fire comprised a single 5lb cylinder, direct-discharge FIRETRACE system to protect each turbine’s three electrical cabinets, while an indirect discharge system with two 35lb cylinders was selected for each turbine’s transformer room.

In the Firetrace Direct Release System protecting the three electrical cabinets in the 3 MW Vestas V90 turbines, the Firetrace Detection Tubing acts as both the detection device and the suppressant delivery system. When the tube ruptures it forms an effective spray nozzle that releases the entire contents of the cylinder to suppress the fire in whichever cabinet the fire breaks out.

The Firetrace Indirect Release System protecting the transformer room uses the tube as a detection and system activation device, but not for the agent discharge. The rupturing of the tube brings about a drop of pressure causing the indirect valve to activate. This diverts flow from the Firetrace Detection Tubing and the agent is discharged from the cylinder through diffuser nozzles, flooding the entire transformer compartment.

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Bob Grieve is Managing Director of Delta Fire Australasia Pty Ltd, the authorised FIRETRACE distributor for Australasia. www.deltafire.com.au
Further details on Firetrace International’s FIRETRACE can be found at www.firetrace.com

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FIRE DETECTION