**Web-based status monitoring of fire extinguishing systems for oil tanks**

**Reliable detection and precise suppression of fires**

The safe storage and processing of crude oil as well as other fossil raw materials are of particular importance not least because of the high risk of explosion. The Dutch company Saval BV has therefore designed a special fire extinguishing system for floating roof tanks. Controllers and I/O modules from the Phoenix Contact Inline modular system enable a web-based status monitoring of the system (lead image).

Saval BV, headquartered in Breda in the Netherlands, is part of the SK FireSafety Group. This is a group of companies that has made fire safety products and systems for industry their specialty. SK FireSafety Group has approximately 650 employees divided between its sites in the Netherlands, Belgium, Norway, England and the United Arab Emirates. Saval has over 85 years of experience in fire protection and detection to its name. At the headquarters in Breda, over 200 employees develop, manufacture and maintain various automatic fire detection and extinguishing systems for example for many different tank technologies (Fig. 1). The company has gained international acclaim thanks to its innovative solutions. In certain parts of crude oil tanks, the risk of explosion is so great that the structures are estimated to be in the highest danger zone 0 for gases, based on ATEX guidelines. Saval has developed a future-oriented design that enables the status monitoring of the fire extinguishing systems installed on the floating roof tanks.
Flammable mixture could ignite

When refilling conventionally used fixed roof tanks, an explosive gaseous atmosphere develops between the material to be stored – for example, crude oil – and the built-in roof. As the temperature rises throughout the day, pressure inside the tank increases. In addition, the liquid and gas volumes also increase. In order to decrease the pressure, the gas phase must be partially released into the environment using special ventilation openings. If the ambient temperature decreases again in the evening then the pressure will also decrease. The same applies to the liquid volume. When the amount of liquid decreases, air fills up the space in the tank. This so-called tank breathing leads to a decrease in the stored material and an increased risk of explosion.

“Floating roof tanks provide an alternative solution, because the roof isn’t fixed but just floats on top of the liquid inside,” explains Jan Veraat, Sales and Contract Engineer Oil & Gas at Saval (Fig. 2). This kind of roof construction is able to move; in other words, it rises and falls with the liquid level. Therefore, it must be sealed at the tank walls with a flexible material, for example, rubber. “However, a low volume of gas from the stored material accumulates in the space between the tank wall and the seal,” says Wim Ballemans, Engineering Manager Oil & Gas at Saval. “If the gas mixes with the ambient air, a flammable mixture is produced. Static electricity from a lightning strike or spark can result in a fire that is controllable at least right after ignition.” If it remains undetected, however, then an uncontrollable fire can develop.

Extinguishing agents target the source of the fire

Saval has designed a fire extinguishing system for these kinds of situations, comprising fire extinguishing equipment in combination with a sprinkler system, which can protect a 40 m circumference around the tank (Fig. 3). Floating roof tanks, which can have a diameter of 120 m, therefore sometimes require numerous fire extinguishing systems. Each individual fire extinguisher container is connected with numerous sprinkler heads, which are installed at fixed distances at the rim of the roof. “Sprinkler bulbs that burst when a fire breaks out ensure that the extinguishing agent is released only by the sprinkler head at the source of the fire,” explains Jan Veraart (Fig. 4). Thus the flames are effectively extinguished without the extinguishing agent being dispersed over large areas of the floating roof seal. The automatic fire extinguishing system works completely mechanically without any movable parts. Saval uses Trifluoriodomethane CF3I as an extinguishing agent, which is environmentally friendly thanks to its low emission of greenhouse gases.
Intrinsically safe I/O modules integrate seamlessly into the local bus

As part of the automation of the fire extinguishing system, two digital signals are monitored which provide information on the status of the fire safety system. Each fire extinguishing system has a level switch to control the filling level in the fire extinguishing container as well as a pressure switch to provide information on the pressure in the system. The area next to the floating roof seal is considered zone 0. Both digital signals are collected by distributor boxes installed in zone 1. “In case of a fire the level and pressure switches are simultaneously activated. However, if there is a leak in the sprinkler system, then only the pressure switch turns on. The same applies to the level switch, which turns on as soon as the fire extinguishing equipment experiences a leak,” explains Wim Ballemans.

The centralised solution is designed such that digital signals are hard wired with cables and transferred to a monitoring panel installed in the non-hazardous area. The SK 3000 monitoring panel consists of the modular ILC 171 ETH controller and the intrinsically safe Ex-i I/O modules from the Phoenix Contact Inline product family, which have been specially developed for areas with a high explosion risk. The reliable electrical isolation of the Ex-i and standard Inline modules is a requirement for intrinsic safety. The intrinsically safe terminals have a reliable power supply via a dedicated Inline module. They seamlessly integrate into the Inline local bus of the ILC 171 ETH and pick up the digital signals for level and pressure switch.

Signals are transmitted via Profinet and wireless LAN

If the communications infrastructure for the oil tanks already exists and is in operation, then laying new cable lines can prove difficult. On the one hand, there is the danger of hitting a pipeline during any kind of digging work; on the other, a high level of certification is required for the appropriate construction measures. Saval has developed a decentralised solution to this problem: the SK 3100 protective container in the protection classes IP52 to IP65. A modular ILC Profinet controller with intrinsically safe Inline modules is built into the protective container (Fig. 5). “Each decentralised SK 3100 station monitors up to four fire suppression systems and transfers the signals via wireless LAN to a centrally installed SK 3000 monitoring panel, which has a modular high performance ILC 330 PN controller fixed to it,” reports Jan Veraart (Fig. 6).
WLAN 5100 wireless modules from Phoenix Contact are installed to allow data transmission between SK 3100 and SK 3000. The devices comply with the IEEE standard 802.11e and also enable a transmission of the Profinet protocol. The IEEE standard stipulates that the sender must mark data packets in the wireless LAN with a priority. The WLAN 5100 modules support the so-called Profinet assistance mode, so that both Inline controllers can communicate via the Profinet protocol. Apart from that, individual Profinet packets can be prioritised. The packets with the highest priority can then be preferentially exchanged via the WLAN interface before all other Ethernet packets. The ILC 330 PN operates as a Profinet controller in the local automation solution, while the Profinet bus coupler IL PN BK DI8 DO4 2TX-PAC takes over the task of a Profinet I/O device.

**Web-based visualisation displays the device status as well as any malfunctions**

WebVisit, the web-based visualisation software from Phoenix Contact, is used to monitor the solution. Therefore, the controller must have an integrated web server, as is the case with the Inline controllers in use. Only the IP address is required to enable access to the visualisation on the PLC web server. The data is subsequently displayed on an operating and monitoring device, such as the SK 3000. The visualisation developed by Saval provides information on the status of the pressure and level switches as well as the voltage supply of the controller system. An appropriate alarm is also activated during malfunctions (Fig. 7). For the visualisation Saval uses the WP10 touchscreens

![Figure 7 - The HMI device – a WP10 touchscreen – acts as a web client to access the WebVisit visualisation, which runs on the web server of the ILC 330 PN or ILC 171 ETH.](image-url)
The Inline automation system from Phoenix Contact is extremely versatile. Its sophisticated design makes it suitable for practically every automation task in the control cabinet. Alongside the Ex-i modules for the explosive area and standard terminals, there are also function modules for functional safety, temperature measurement, or pulse-width and frequency modulations.

The central component of the Inline system is the highly modular control family of the Inline controller, which is available in various performance classes. Thanks to the PLC it is possible to implement a wide spectrum of automation solutions for complex as well as small applications. Both the 100 and 300 performance classes comprise an integrated web server. WebVisit software allows the user to create the appropriate visualisation, which can be accessed using any standard browser. No programming skills are required. The pro version of the tool contains an expanded range of functions with alarming, trending, and user level management, as well as many other functional macros.

For further information, visit: www.phoenixcontact.co.uk

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