



Coal Stock Heat Detection

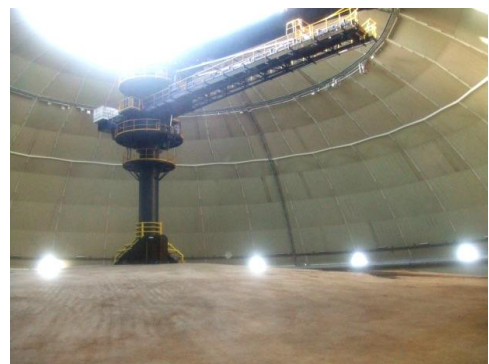
Spain



Introduction: Puerto A Coruna, Spain

One of the most innovative bulk handling facilities has been undertaken in Spain. “La Medusa”, a coal storage, which was built at Puerto A Coruna. Operated by Union Fenosa, not only does this enclosed coal handling facility achieve zero dust emission, but the structure itself is architecturally pleasing. Due to its impressive design, the plant is called “la Medusa” which means “the jellyfish”.

“La Medusa” stores the loads of coal ships until it is transported to the coal power plant of Meirama. Its capacity is 100.000 tons; it is 27m high and 105m in diameter. The design is not based on aesthetics, but on environmental considerations: the cupola reduces the dust in the air by more than 70%.





The incident

In November 2007 an unforeseen incident occurred due to an undetected hot spot in the accumulated coal. Clouds of smoke left the top of the picturesque enclosure – bringing dust and a pungent smell to the port vicinity. It took four long days but eventually the fire brigade was able to locate and extinguish the smoldering fire by removing the coal from the interior to the wharves deposit. The lack of ventilation within the enclosure and the late detection were the main causes of this incident. Consequently Union Fenosa undertook structural and technical measures to improve the safety situation.

Lessons learned

The safety measures included several different fire detection systems, like smoke and gas detectors for Nox, SO₂ and CO. Eight Infrared cameras were installed inside the dome to monitor the upper surface of the accumulated coal, but the most critical area is close to the enclosures annulus. Due to the insufficient ventilation, advanced pressure and friction, the occurrence of smoldering fires is more likely here. An infrared camera cannot always detect hot spots within the bulk. Therefore the engineers of Union Fenosa, together with **AP Sensing's partner TASC SE** decided to use the AP Sensing "Linear Heat Series" to protect the annulus space of "La Medusa".

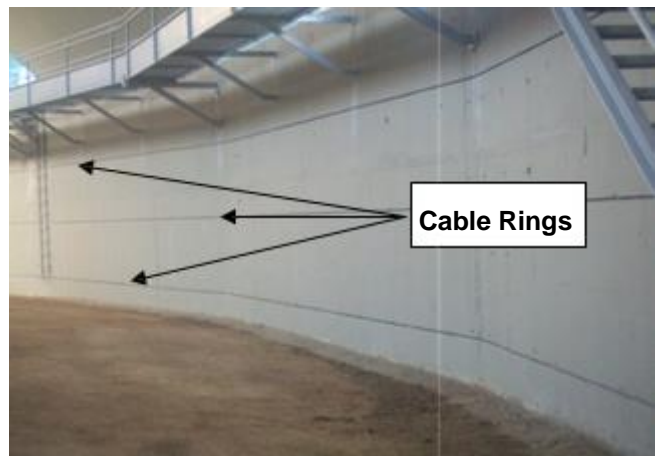
Why AP Sensing?

Several unique features led to the selection of the Linear Heat Series as the most appropriate technology for this environment. The Linear Heat Series is approved according EN54-5 and provides the lowest laser output power (< 25 mW) in the market, enabling deployment in hazardous areas (EX-Zones) without additional measures. The use of the system is safe for all conditions including fiber break (Inherently Safe Operation).

Laser power of more than 35 mW (Class 3B laser sources) is capable of igniting explosive atmospheres (like small coal particles) and has to be considered as a source of danger (IEC 60079-28). Keeping the harsh environment in mind, the sensor cable is made of stainless steel with additional armoring to offer highest robustness to severe mechanical impacts like crush, shock and tension.

The installation

Three rings of sensor cable are mounted on the concrete wall in the enclosure, at 0.6m, 1.6m and 2.5m heights. To avoid damage during the loading and unloading procedures the cable is seated in a cleavage and is fixed with special cable anchors. The total length of each ring is about 500m and is monitored by a separate Linear Heat Series instrument to offer maximum redundancy in case of a fiber break or instrument failure.



Furthermore the dual ended (loop) measurement capability of the DTS is used to calibrate the instrument automatically in the unlikely case of an attenuation of the optical fiber due to substantial mechanical stress. Additionally continuous monitoring is ensured with the loop configuration even in case of a sensing cable break. Due to the low laser power of less than 25mW the instrument is safe to continue its operation even in case of such a cable break.



Each DTS instrument has been configured with 10-second measurement cycles, 1m spatial resolution for fast and accurate detection of small smoldering fires. The entire 360° circle is subdivided into 16 alarm zones providing a precision in hot-spot localization of 22.5° angle. (The total DTS can have up to 256 zones defined.) Each zone can be defined with one of 5 alarm criteria (maximum temperature at 55°C; delta to the zone average of 8°C; and three temperature gradients of 13°C at 40s; 17°C at 120s; 28°C at 360s). The delta to zone average alarm enables a quick localization of small smoldering fires as it adapts to the ambient temperatures, which changes with day/night and sun/cloud cycles. If only one point within the zone is 8°C above the average of the zone the fire control panel is notified.

The infrared camera pictures show the top-down view during the commissioning. The upper right picture shows how sunshine has heated the concrete wall of about 30m. This corresponds to the hot spot of the Linear Heat Series DTS temperature profile at around 130m.

Two peaks at about 45m and about 420m are areas of higher temperature of the sensor cable caused by direct exposure to sunlight on the way from the control room where the DTS instruments are installed to the entry of the enclosure.

