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Institute of Marine Engineering, Science & Technology IMAREST

SAFETY FIRST

Fire protection systems are often viewed as an unloved but necessary expenditure rather than a means to safeguard the lives of crew and valuable cargo

Although the value of the marine assets that fire systems protect is increasing rapidly, the competitiveness of the free market encourages cost cutting. Often, cheap systems only minimally comply with the regulations and, in fact, there are very few qualified engineers who may be considered experts on the subject. This creates an environment in which a 'safety first' culture is both eschewed and unrewarded.

"This attitude feels in direct opposition to that in the aerospace sector, where if a fault occurs on an aircraft, that information is quickly and openly shared with airline operators, civil aviation authorities and engineering organisations," says Carl Hunter, CEO & MD of Coltraco Ultrasonics. "In shipping, unless a fatality occurs, incidents are often left unreported."

With many ships sailing with partially-filled, over-filled or empty carbon dioxide cylinders and many undisclosed instances of accidental discharges or slow seepages there is real cause for concern – and impetus to change.

Marine servicing

In terms of ships' extinguishing systems there are two broad categories: sprinklers and CO_2-based gas systems. The former can suffer

from leakages but the latter can cause catastrophic effect given the high physical pressures. An average ship's CO_2 system comprises between 200 and 600 cylinders each containing 45kg of CO_2 at 720 psi/ 49 bar pressure. Discharge are most likely to occur during maintenance. Some marine service companies estimate that 20% of a vessel's CO_2 cylinders have discharged or partially leaked their contents at some point in their lifetime.

Man-hour maths

This makes the resources and time given to servicing particularly important. In many cases, marine servicing contractors have to reach the vessel on a launch and then only have access for about four hours. "The traditional approach was for the service crews to shut down the ship's CO_2 system, dismantle it and weigh each cylinder. This process takes about 40 minutes, which on a vessel with 600 cylinders on board would take 400 man-hours. That's completely impossible in a four hour visit," Hunter argues.

Luckily modern methods are less time-consuming: a portable, ultrasonic liquid level indicator (such as Coltraco's Portalevel MAX Marine) can check the contents of a perfect condition cylinder in 30 seconds. Adding the average time needed to record and validate readings, it would take a technician between 1-3 minutes for each properly-filled cylinder. This would translate to 10-30 man-hours for this task alone. Again, this is impossible when allocated such a short time on the vessel.

Unsafe solutions

Given the time restrictions illustrated above, it is clear why even good marine servicing companies may not physically be able to perform the inspections required. While they can flag this to the customer, there are less scrupulous companies that are said to randomly check some cylinders and then place 'tested' stickers on the rest.

"Given that both crew lives and cargo are at stake, **it seems unfathomable** that these systems are not **permanently monitored** rather certified just once a year, particularly since it is a **regulatory obligation** to ensure that crew are in a position to check these."

Although random checks are suitable in some sectors, it is worth remembering that because the normal design concentration of CO_2 of 34-72 v/v % is above the nearly immediate acute lethality level, these systems have an extremely narrow safety margin. As these systems extinguish fires through oxygen dilution rather than the chemical disruption of the combustion chain, insufficient CO_2 during an emergency may allow a fire to spiral out of control.

"These points are separate to the frankly dangerous actions of certain companies that may deliver systems portrayed and installed by contractors as NOVEC 1230 but that are actually filled with sand or water," says the Coltraco head.

Other anecdotal evidence provides stories of over- or under-filled cylinders; high pressure gas systems being fitted without the means to actuate them; cheap cylinder pressure gauges sticking in position under humidity or mechanical fatigue; safety pins being retained in position in the cylinder valves after installation; or even pipework and cylinders that are freshly painted but have severe internal corrosion leading to particulates of rust which block the discharge nozzle mechanism.

Hunter recalls reports of where weighing scales are chained to the CO_2 cylinders in an effort to comply with IMO's SOLAS Fire Safety Systems (FSS) Code – ignoring the fact that there are no officers or crew that are qualified to shutdown, dismantle, weigh and re-install a CO_2 cylinder on the vessel itself.

Meeting obligations

"Given both the lives of crew and cargo are at stake, it seems unfathomable that these systems are not permanently monitored rather certified just once a year," says Hunter, noting also that that crew should be in a position to inspect them. The FSS Code stipulates that "means shall be provided for the crew to safely check the quantity of the fire extinguishing medium in the containers".

Arguably, the existence of regulations (such as those set by IMO) guides – and occasionally curbs – the direction taken by the free market. This then means that the current state of affairs, where 'price is king' results either from an unwillingness by regulators to create an environment where safe engineering is rewarded or because the industry itself is unaware of new technology that will help it meet both the spirit and letter of the regulation.

Technologies already exist that can easily and accurately monitor everything from gases under pressure to liquefied contents and corrosion of pipework. The traditional method of using a cylinder pressure gauge (located at the meeting point of valve and neck of a pressurised cylinder) is both obsolete and impractical – especially when cost-cutting may result in use of minimally-compliant gauge mechanisms.

Technological answers

Devices that monitor both liquid content and gas pressure safely from the external sides of the cylinder rather than within it are likely to become available in the near future. This means that crew will be able to monitor the contents and then calculate the mass/weight of the liquefied extinguishant. By measuring the pressure of the gas on top of the liquefied extinguishant they can can assess the pressure of an inert gas (which is in an entirely

High profile accidents relating to fire safety systems:

- **August 2011: An accidental discharge of carbon dioxide on board *SD Nimble* resulted in serious injury to a shore-based service engineer at Faslane Naval Base (MAIB, 2011).**
- **May 2010: An uncontrolled release of fire extinguishing gas occurred on board *Marsol Pride*, while working in the Tui oil and gas field off New Zealand's west coast. A valve on one of the CO2 pilot cylinders developed a leak and charged the system ready for release. A second leak in the main control valve then caused the entire system to activate, flooding the vessel's engine room with the gas. (TAIC, 2011).**
- **September 2004: Preparing for a routine inspection, a crew member on a Hong Kong registered ship accidentally triggered the fixed fire extinguishing system, releasing 5,060kg of CO2. Attempts to fix the situation led to the death of four officers. (HKSAR,n.d.)**
- **July 2014: A fire started in the engine room of the bulk carrier *Marigold*, while it was loading a cargo of iron at Port Hedland, Western Australia. Firefighting by the ship's crew included activating the Halon gas fire suppression system. However, a full release of Halon gas did not occur, nor was the engine room effectively sealed (Safety4Sea, 2016).**
- **November 2008: At least 20 people died in an accident on K-152 Nerpa, a Russian Akula II class nuclear submarine, when a Halon-based fire extinguishing system was activated by mistake during sea trials. It was the worst accident in the Russian navy since the loss of the submarine K-141 Kursk in 2000. (BBC News, 2008).**

vaporous form) to ensure that the cylinder is primed to perform when needed.

Greater transparency in monitoring will help convince a vessel owner that his asset is in good hands and reassure the crew that their safety and welfare is taken seriously by both employer and the marine servicing company.

Ultrasound innovation

One of the sciences being harnessed by innovators in the fire safety sector is ultrasound. Although the shipping world employs it mainly as a tool to gauge thickness, it has seen far more varied applications across military, medical and industrial fields.

Sound is, in itself, vibrations that propagate as a mechanical wave or pressure and transmit through solid, liquid or gaseous mediums. Coltraco is among several companies utilising these fundamental physical principles to design and manufacture products and systems that can be used by fire engineers and their customer installations.

At the time of writing, the company's portfolio boasts 11 different Portalevel brand liquid level indicators. Portascanner uses ultrasound to test the integrity of confined spaces and, the company claims, can detect leak sites as small as 0.06mm. Portagauge uses ultrasound to test the internal and external corrosion on pipework and cylinder wall thickness to an accuracy of ±0.1mm.

"We can monitor these around the clock with the fixed, data-logging and autonomous monitoring system, Permalevel Multiplex & Permalevel Single Point," says Hunter. "Signals from these fixed monitoring sites can be viewed simulataneously on the bridge and in the ship's technical office."

He envisages a day when products and systems will be designed to monitor gas vapour above the liquid level and inert gases.

Currently, Coltraco is developing its new Portascanner CO_2 Room product, which will permanently monitor the escape door status plus the ability of the CO_2 discharge space so that the gas cannot escape through leak sites.The company is also due to launch its Portasteele Calculator this year, which will enable liquefied extinguishant weight conversions.

"As the world changes, so must our industry integrate technological solutions and provide standards which all can understand and apply," Hunter adds. ■

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