hazardex

the journal for hazardous area environments

hazardexonthenet.net

September 2020

Biohazards

How should we manage the new threats posed by biomanufacturing?

Confined space entry

Avoiding confined space pump installation

Fans

ATEX fans – EN 14986

Process Safety

The difference between flammability and combustibility

Lighting

LED lighting provides a safe solution for industry

contents September 2020

The devasting explosion on August 4 in Beirut (page 8) pushed process safety to the forefront of public consciousness as footage and images of the blast were shared across the world. The incident will likely have many long-lasting repercussions – not just for Lebanon, but for process safety and chemical storage globally. This was initially highlighted in the aftermath of the explosion as articles appeared in mainstream media discussing ammonium nitrate (the chemical involved in Beirut's explosion) and the dangers involved with chemical storage.

Followed by this were further articles which highlighted facilities where ammonium nitrate was being stored and questioned whether a similar incident to Beirut could occur in these locations. This included locations in the UK, US, Australia, India, and South Africa to name just a few. In response, businesses and safety regulators issued statements with reassurances that chemicals at those sites were being stored safely and in line with regulations. For example, a statement from the UK HSE said, "The storage of Ammonium Nitrate in Great Britain is subject to a robust regulatory framework, which considers the hazards posed by storage, product safety and measures to deal with emergencies."

As with any process safety-related accident, it is vital that lessons can be learnt so that industry practices can improve and a repeat of incidents can be avoided. Hopefully chemical storage facilities worldwide would have seen the devastation in Beirut and used it as an opportunity to re-assess their own practices and ensure they are operating in line with regulations.

One lesson that can be learnt from Beirut is the necessity for a robust safety culture. The blast is thought to have been caused by welding work at the warehouse where the ammonium nitrate was stored. Welding next to highly explosive chemicals shows an obvious lack of safety knowledge, however there was also no safety manager present and the work had been ordered by senior port officials who had known the warehouse was storing chemicals. The incident shows how a disregard for safety can exist from the lowest to the highest levels of an organisation and what can happen when a safety culture is not present.

Hopefully the continuing investigations into the Beirut explosion will find those responsible and hold them to account, but just as importantly, hopefully high hazard industries around the globe can use the incident as an opportunity to learn, re-assess, and ensure they adhere to safety regulations so that the devastation of Beirut is not seen again.

…Alistair Hookway, Editor, Hazardex
alistair.hookway@imlgroup.co.uk

in this issue

Hazardex is a controlled circulation journal published monthly. Completed print or online registration forms will be considered for free supply of printed issues, web site access and online services. Annual subscription for non-qualifying readers is: UK £147; EU £215.25; Airmail £315 and single copy price is £23.10 plus P&P.

Editor
Alistair Hookway
alistair.hookway@imlgroup.co.uk

Sales Executive
Kathryn Startin
kathryn.startin@imlgroup.co.uk

Production and Events
Holly Reed
holly.reed@imlgroup.co.uk

Group Publisher
Russell Goater
russell.goater@imlgroup.co.uk

Circulation
subscriptions@imlgroup.co.uk
Tel: +44 (0)1732 359990

Design
Graham Rich Design
www.grahamrichdesign.co.uk

IML Group
Blair House, High Street, Tonbridge, Kent
TN9 1BQ, UK
Tel: +44 1732 359990
Email: events@imlgroup.co.uk
ISSN 1476-7376

Gorgon - Image: Chevron Australia

Calls for Chevron gas project in Australia to be shut down after cracks found in critical components

Energy giant Chevron faced calls to shut down its Gorgon natural gas project on the west coast of Australia in August after thousands of cracks, some measuring up to one metre long and 30 millimetres deep, were discovered on critical components. The Gorgon gas project comprises a three-train, 15.6 million tonnes per annum LNG facility and a domestic gas plant with the capacity to supply 300 terajoules of gas per day.

According to the *Sydney Morning Herald*, safety concerns were raised at Gorgon, Australia's second largest gas export facility, after maintenance checks revealed thousands of cracks on kettle heat exchangers which carry pressurised propane on the facility's Train 2.

After being informed of the issues, the West Australian Department of Mines, Industry, Regulation and Safety conducted an inspection of the LNG plant on August 7 and issued Chevron with a notice to also inspect Trains 1 and 3 by August 21. The notice was issued after the state department said that the nature of the cracks in Train 2 meant that there could be similar defects in Trains 1 and 3. Maintenance on all three trains would see all export operations stop for at least a few days at the $54 billion facility.

Chevron will be required to provide the department with copies of the inspection reports and if it does not cooperate, could be hit with a "range of enforcement actions", the department's dangerous goods and petroleum safety director Steve Emery said. A Chevron spokesperson said it was working closely with the state department in conducting the repair work.

As well as finding cracks on Train 2's heat exchangers, a WorkSafe inspection of the site in July found that the propane kettles had been manufactured differently to the designs that had been registered with the state government, the Herald also reports. Chevron was issued with eight improvement notices on July 29 to make the heat exchangers compliant by August 28. This was followed by a further 24 notices on August 6 relating to weld repairs, plant registration, and inspection of Train 3 which must be adhered to by September 24.

The discovery of cracks at Gorgon led to the Australian Manufacturing Workers' Union (AMWU) calling for an immediate shut down of the whole facility. In a statement, AMWU WA secretary Steve McCartney said: "The reports we're hearing of over eight kettles being damaged represents a serious failure in this critical piece of kit. If multiple kettles are showing cracks in testing on Train 2, there is a high risk there are cracks in the vessels on other trains. If these cracks are in the vessels, they cannot be fixed, and they need to be replaced immediately. We're hearing from workers that they're fearful for their safety and are reluctant to even go out to the blast-proof wall. We share their fears."

The Gorgon facility has three LNG trains, but if maintenance work on one of the trains was to last longer than a month then Chevron could lose hundreds of millions of dollars in lost revenue.

The Gorgon Project is located on Barrow Island, around 37 miles (60 kilometres) off the northwest coast of Western Australia. Chevron operates the project and owns a 47% stake, while ExxonMobil and Royal Dutch Shell each have a 25% stake. ■

Image: APS

Causes of 2019 solar facility explosion which injured nine revealed in new report

A final investigative report into the April 2019 explosion at utility company Arizona Public Service's (APS) solar battery facility in Surprise, Arizona was published on July 27. The report into the incident, which injured nine first responders, explains the reasons behind the explosion and offers several recommendations to prevent similar incidents occurring at other battery energy storage systems.

The incident on April 19, 2019 started when there were reports at around 17:00 of smoke rising from the building that housed the battery energy storage system (BESS) at APS's McMicken site in Surprise. Hazardous material units and first responders arrived at the scene to secure the area. A few hours later, at approximately 20:04, an explosion occurred from inside the BESS. Nine people were injured and taken to local hospitals, including one firefighter who was in a critical condition and two others who were in serious conditions.

APS ordered an investigation into the incident to determine the cause of the incident and identify lessons that could be applied to future battery energy storage systems. Once the investigative work was completed, APS chose DNV GL to combine various forensic and expert inputs into the single, consolidated report which was published on July 27.

The report explains how the BESS in Surprise was commissioned and integrated by AES, on behalf of APS and was assembled with Lithium ion (Li-ion) batteries manufactured by LG Chem. The factual conclusions reached by the investigation into the incident were:

- The suspected fire was actually an extensive cascading thermal runaway event, initiated by an internal cell failure within one battery cell.
- It is believed to a reasonable degree of scientific certainty that this internal failure was caused by an internal cell defect, specifically abnormal Lithium metal deposition and dendritic growth within the cell.
- The total flooding clean agent fire suppression system installed in the BESS operated early in the incident and in accordance with its design. However, clean agent fire suppression systems are designed to extinguish incipient fires in ordinary combustibles. Such systems are not capable of preventing or stopping cascading thermal runaway in a BESS.
- As a result, thermal runaway cascaded and propagated from cell 7-2 through every cell and module in Rack 15, via heat transfer. This propagation was facilitated by the absence of adequate thermal barrier protections between battery cells, which may have stopped or slowed the propagation of thermal runaway.
- The uncontrolled cascading of thermal runaway from cell-to-cell and then module-to-module in Rack 15 led to the production of a large quantity of flammable gases within the BESS. Analysis and modelling from experts in this investigation confirmed that these gases were sufficient to create a flammable atmosphere within the BESS container.
- Approximately three hours after thermal runaway began, the BESS door was opened by firefighters, agitating the remaining flammable gases, and allowing the gases to make contact with a heat source or spark.

The report lists the following five main contributing factors that led to the explosion: internal failure in a battery cell initiated thermal runaway, the fire suppression system was incapable of stopping thermal runaway, lack of thermal barriers between cells led to cascading thermal runaway, flammable off-gases concentrated without a means to ventilate, and emergency response plan did not have an extinguishing, ventilation, and entry procedure.

DNV GL's report concludes that, while today's standards better address hazard assessment and training for first responders, the industry expectation should go even further and require that hazard assessments and training take place before and during the commissioning of energy storage systems.

While today's energy storage safety codes and standards acknowledge cascading thermal runaway as a risk, they stop short of prohibiting it, and fail to address the risk of non-flaming heat transfer to neighbouring cells, modules, and racks, the report says. Standards today focus on the means to manage a fire, but have so far avoided prescribing solutions that restrict or slow cell-to-cell and module-to-module thermal runaway propagation (likely due to a reticence to prescribe anything that may be perceived as prohibitively expensive or non-commercial).

The report adds that standards today therefore also fall short in addressing the issue and risks associated with off-gassing. However, it says there are commercially available technologies and design methods available that can address thermal runaway propagation, and the standards should be appropriately updated to acknowledge these methods and technologies.

In addition, the report says that better practices for ventilation, extinguishing, and cooling thermal runaway scenarios exist today and should be implemented in future energy storage systems. Finally, clean agent systems may still be appropriate for use in energy storage facilities to manage incipient fires, but they must be used in conjunction with additional practices – i.e., ventilation, extinguishing, and cooling – to manage thermal runaway scenarios. Clean agent or aerosol extinguishing methods should not be the only barrier against thermal runaway.

Read the full report by DNV GL at: ***https://bit.ly/3iLQUna*** ■


WORLD'S FIRST ATEX
HIGH SPEED DOOR
Ex
WIND-LOAD RESISTANT
SUPERIOR SEALING
DANGER
COMBUSTIBLE DUST
EXPLOSION HAZARD
ULTRA SAFE
ENERGY SAVING
APPROVED
3RD PARTY CERTIFIED
CRASH FORGIVING
Manufactured by Dynaco
T&D
35 YEARS
THORNE &
DERRICK
INTERNATIONAL
Ex
SPECIALISTS
EXPERTS IN EQUIPMENT FOR EXPLOSIVE ATMOSPHERES
0191 410 4292
hpsales@thorneandderrick.co.uk
heatingandprocess.com/atex-doors/


Image: Shutterstock

Former oil executive sentenced to prison, fined $50,000 for role in 2012 explosion

The former president and CEO of US oil company Custom Carbon Processing has been sentenced to 18 months in prison, three years of supervised release and fined $50,000 for his role in a 2012 explosion that injured three workers at the company's oil processing plant in Wibaux, Montana.

A jury found Peter Margiotta guilty of all three counts in an indictment in September 2019, including conspiracy, Clean Air Act - general duty, and Clean Air Act - knowing endangerment. Margiotta was President and CEO of Custom Carbon Processing, a Wyoming-based company that constructed the Michels Disposal Well and Oil Reclamation Facility in Wibaux in 2012. During a five-day jury trial, the prosecution said that the construction of the facility was done in a way that allowed extremely hazardous hydrocarbon vapours and air pollutants to be released into the air.

"By failing to comply with the law in the construction and operation of a plant that handled hazardous materials, Mr. Margiotta endangered his employees, three of whom were injured in the explosion. Companies doing business in Montana must follow environmental regulations," US Attorney for the District of Montana Kurt Alme said.

"By knowingly operating an oil processing facility without appropriate safeguards, the defendant endangered workers and the public. Today's sentencing reflects the egregious nature of the defendant's actions," said Bert Marsden, Resident Agent in Charge of the Environmental Protection Agency's criminal enforcement program.

On July 4, 2012, Margiotta directed the opening of the plant before implementing appropriate electrical wiring, ventilation and other safety measures. On that date, the project manager emailed Margiotta: "The control panels must be moved asap with the explosion proof wiring. We also run the risk of killing someone, not only our operators but also customers."

Margiotta also directed employees to accept shipments of highly volatile and flammable natural gas condensate or "drip gas" into the operations in a purported effort to help thin and process the slop oil at the plant.

Margiotta disregarded repeated warnings from the plant's foreman that the natural gas condensate was not effective in thinning the slop oil and instead was creating a dangerous situation because of its highly volatile and flammable nature.

On December 29, 2012, the plant accepted a delivery of natural gas condensate. During the offloading of the material, hazardous and flammable vapours from the condensate filled the plant building and spread out the open bay doors where the truck delivering the condensate was located. The vapours reached an ignition source, triggering an explosion that injured three employees and extensively damaged both the plant and the truck involved in the delivery.

"Employees expect that their employers prioritise their safety by ensuring adherence to Federal safety regulations. In hazardous material transportation and processing, this expectation is paramount," stated Cissy McCune, Regional Special Agent-in-Charge, US Department of Transportation Office of Inspector General. "Our work with the U.S. Attorney's Office and agents from the U.S. Environmental Protection Agency, which resulted in the sentencing of Mr. Margiotta, is a testament to our commitment to protecting the safety of our nation's transportation workforce." ■

One person killed, two injured after guacamole machine explodes in US

A man was killed and two others injured on August 5 after a food processing machine exploded in Schenectady, New York. The machine was being tested for the manufacturing of guacamole when the blast occurred.

The explosion happened at around 07:00 local time at Innovative Test Solutions, a full-service mechanical engineering and testing laboratory. The man who died was identified as Joseph Kapp, a well-known local businessman and former Mayor for a local county, local newspaper Times Union reports.

A police official told the Times Union that the machine in question was a high-pressure vessel and that Kapp was a client of Innovative Test Solutions.

The two men injured in the incident were transported to hospital with minor injuries. The Schenectady codes department and the Occupational Safety and Health Administration were notified immediately about the accident.

Police remained at the scene for several hours as an investigation was opened into the blast. ■

Image: Shutterstock

Lebanese government resigns in wake of explosion **that killed over 200 and injured more than 6,000**

The Lebanese government resigned on August 10 following the deadly August 4 blast at the Port of Beirut which killed more than 200 people and injured over 6,000. A series of protests led to Prime Minister Hassan Diab resigning along with his entire cabinet. Meanwhile, details emerged in August about the events leading up to the blast, including how Diab and Lebanon's President Michel Aoun were warned in July about the possibility of a devastating explosion at the port.

Prime Minister Diab, whose government will remain in a caretaker role until a new administration is established, blamed the August 4 blast on years of corruption and said that he was not responsible for the disaster.

Several people remain missing since the explosion which was caused by the ignition of 2,750 tonnes of ammonium nitrate stored in Beirut's port. Around 300,000 people have been left homeless and collective losses has been estimated at over £10 billion. The significant blast sent shockwaves across the city, destroying buildings and overturning cars, and was felt as far away as Cyprus, 150 miles (241km) away.

Quoting documents and senior security sources, Reuters news agency reports that Lebanese security officials warned the Prime Minister and President just two weeks before the explosion that the large quantity of ammonium nitrate stored at the port posed a security risk and could destroy the capital if it exploded. The ammonium nitrate had been kept at the port for the last six years after being confiscated from a vessel in December 2013.

Reuters says that a state security report by the General Directorate of State Security on the events preceding the August 4 blast references a letter sent to President Aoun and Prime Minister Diab in July. The letter is said to have included the findings of a judicial investigation from January 2020 which said the ammonium nitrate needed to be secured and stored safely with immediate effect.

The publication of the details surrounding the letter and the report on the events leading up to the August 4 blast are likely to fuel further protests against government negligence and corruption.

After the government's resignation, a spokesperson for the Prime Minister Diab said that the cabinet had only received the state security report 14 days before the blast and acted on it immediately, whereas the previous administration "had years and did nothing."

There are still many unanswered questions about the 2,750 tonnes of ammonia nitrate which caused the fatal explosion. Reuters reports that the letter sent to the President and Prime Minister included details about memos sent by port, customs, and security officials urging judges to order the removal of the vast amount of hazardous material away from the port and city centre. Despite this, nothing was done, and the chemicals remained in unsafe and insecure storage at the port.

The ammonium nitrate was confiscated from a Russian-chartered, Moldovan-flagged vessel called the Rhosus in December 2013. Reuters says that the ship had docked in Beirut in order to take on further cargo in order to afford the fees needed to pass through the Suez Canal. However, the Rhosus was impounded due to unpaid debts owed to two companies which had filed claims in Lebanese courts.

The Rhosus was deemed unsafe in 2014 and sank offshore Beirut in 2018. The state security report, which Reuters quotes, says that a judge appointed an expert in 2015 to inspect the cargo. The expert deemed the cargo hazardous and recommended that it be taken away by the army, however the army refused to take the cargo for unknown reasons. Reuters says that from this point on, various customs and security officials wrote to judges every six months or so asking for the chemicals to be removed.

An investigation was launched in January 2020 after it was discovered that the hangar where the ammonium nitrate was being stored had a dislodged door and a hole in one wall, increasing the risk of theft. The investigation resulted in an immediate order for the door and hole to be fixed. As a result, workers were sent to the hangar where welding work caused a fire to start on August 4. The fire caused an initial explosion of fireworks which were being

Image: NASA/JPL-Caltech/Earth Observatory of Singapore/ESA

Image: Shutterstock

kept in the same warehouse. This fire and explosion then caused the much larger and deadlier second explosion. Reuters reports that the repair crew was not supervised while conducting the maintenance work.

On August 6, 16 staff members at the Port of Beirut were detained after the committee investigating the explosion was given four days to determine who was responsible. Those detained included port and customs officials as well as maintenance workers and their managers.

The rebuilding of Beirut is expected to cost up to $15 billion, Reuters reports, although the country is effectively bankrupt with total banking system losses exceeding $100 billion. The economic situation has been worsened in recent months due to coronavirus and there are fears a food shortage could occur after the blast destroyed a vital grain elevator at the port.

The UN's World Food Programme is sending 50,000 tonnes of wheat flour to Beirut to help stabilise Lebanon's food supplies and prevent a food shortage.

Mapping the Beirut blast damage

NASA's Advanced Rapid Imaging and Analysis (ARIA) team, in collaboration with the Earth Observatory of Singapore, has used satellite-derived synthetic aperture radar data to map the likely extent of damage from the August 4 explosion. Synthetic aperture radar data from space shows ground surface changes from before and after a major event like an earthquake. In this case, it has been used to show the result of the explosion.

On the map below, dark red pixels – like those present at and around the Port of Beirut – represent the most severe damage. Areas in orange are moderately damaged and areas in yellow are likely to have sustained somewhat less damage. Each coloured pixel represents an area of 30 metres (33 yards).

The map contains modified Copernicus Sentinel data processed by ESA (European Space Agency) and analysed by ARIA team scientists at NASA JPL, Caltech, and Earth Observatory of Singapore. Located in Pasadena, California, Caltech manages JPL for NASA.

For more information, visit: ***https://www.nasa.gov/feature/jpl/nasa-maps-beirut-blast-damage*** ■

HSE publishes annual **UK workplace fatality figures**

On July 1, the UK Health & Safety Executive (HSE) published its annual report on work-related fatal injuries for 2019/20. The report shows that a total of 111 workers were killed at work in Great Britain in 2019/20, a decrease of 38 from the previous year and the lowest annual number on record.

The HSE's report says that it is difficult to assess what impact the COVID-19 pandemic has had on the annual number of deaths.

Excluding deaths in February and March, the number of worker deaths for the first ten months of the year was lower than comparable periods in recent years (99 in 2019/20 compared with 123 in 2018/19 and an annual average of 117 in the previous five-years), though it is possible that the difference can be explained by natural variation in the figures. However, looking over the full year, the number of deaths is statistically significantly lower suggesting that COVID-19 has had some impact on reducing numbers further. In statistical terms the number of fatalities has remained broadly level in recent years and the fall seen in the current year, while striking, may not reflect any major shift in the inherent dangerousness of workplaces.

2019/20 causes of death (& annual average 2015/16-2019/20)

* **Falls from height: 29 (34)**
* **Struck by moving vehicle: 20 (26)**
* **Struck by moving object: 18 (18)**
* **Contact with moving machinery: 11 (11)**
* **Trapped by something collapsing/ overturning: 15 (14)**
* **Other: 18 (34)**

The last category includes two fatal injuries from 'Exposure to explosion' and one fatal injury from 'Contact with electricity'.

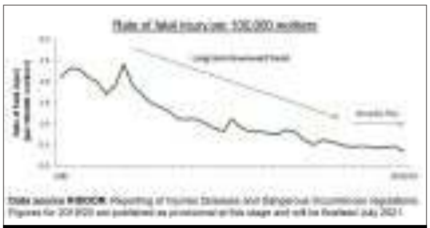


Image: HSE

51 members of the public were killed in 2019/20 as a result of work-connected accidents.

The UK consistently has one of the lowest rates of fatal injury across the EU. In 2017 the standardised rate, at 0.52 per 100,000 employees, was one of the lowest of all European countries and compares favourably with other large economies such as France, Germany, Italy, Spain and Poland.

For a more detailed look at work-related fatal injuries, visit: ***https://www.hse.gov.uk/statistics/fatals.htm*** ■


Image: ANM Colombia

Coal mine explosion **kills nine in Colombia**

An explosion at a coal mine in the municipality of El Zulia in northeast Colombia killed nine miners on July 31. The blast happened at the El Cedro underground coal mine and is thought to have occurred after a build-up of gases occurred within the mine.

An extensive rescue operation began as soon as first responders arrived at the scene. Six miners were confirmed dead at the site after their bodies were recovered from the mine, while the Colombia Mining Authority said that a further three workers were missing.

Following 31 hours of uninterrupted search and rescue efforts, the bodies of the three missing miners were discovered. The Colombian Mining Authority said that rescue efforts had been hampered by the temperature and humidity inside the mine.

An investigation is underway to determine the exact cause of the explosion. Local media quoted a local official as saying that the blast was most likely caused after a build-up of gas in the mine, but did not offer further details on how the gas ignited.

In April earlier this year, an explosion killed 11 miners and injured four others in the town of Cucunuba, north of Bogota. Following the explosion, Colombia's National Mining Agency announced a suspension of underground mining activity in and around Cucunuba while safety regulations were reviewed and an investigation was conducted. ■

Representative image: Shutterstock

Calls for Australian energy giant to pay out A$200m to clean up decaying FPSO it operated until 2016

An Australian government review has recommended that past owners of offshore production sites should be made liable for remediation costs after they have sold a site. The review came after calls were made for energy giant Woodside Petroleum to pay around A$200m (£109m) to clean up an FPSO in the Timor Sea which it owned until 2016.

Woodside owned the Northern Endeavour FPSO from 1999 until 2016 when it sold the site for A$24m (£13m) to Northern Oil and Gas Australia (NOGA). After the Northern Endeavour was sold to NOGA, it experienced three years of disrupted production before Australia's national safety regulator forced work to stop in July 2019, warning that corrosion at the site could cause fatalities, the Guardian newspaper reports.

The Northern Endeavour is permanently moored in the Timor Sea offshore Darwin on the northern coast of Australia. The shutdown of the FPSO led to NOGA filing for administration in September and then liquidation in February 2020. Due to its location in Australian waters, the Australian government was forced to intervene and ensure that the Northern Endeavour was safe. The Guardian reports that the government signed a contract with Upstream Petroleum Services to maintain the FPSO, and potentially took on decommissioning and remediation liability which has been estimated to be up to A$230m (£125m).

This led to a government commissioned review of the events leading up to NOGA's liquidation, a report of which was published on August 13. The independent review was conducted by Steve Walker, a prominent expert with almost 40 years of offshore regulation and industry experience.

The report states that Woodside announced it was planning to cease production and decommission the Northern Endeavour site in late 2016 before a deal was made with NOGA. Walker goes on to recommend that the relevant authorities should consider introducing "trailing liability" where offshore production site owners would continue to be liable for decommissioning even after selling a site. The report questions whether the trailing liability could even be applied retrospectively.

In a statement on August 6, the office of Keith Pitt, the Minister for Resources, Water and Northern Australia, said that the government remained committed to keeping the Northern Endeavour facility and the surrounding marine environment safe and secure, and to finding a longer term solution to the facility and associated oil fields. In April, Pitt announced that Upstream Production Solutions would continue to operate the Northern Endeavour facility and associated subsea facilities and wells in 'lighthouse mode'.

Pitt said, "The safety of offshore workers and protection of the marine environment remains the Government's number one priority. No petroleum production is occurring and critical maintenance necessary to maintain a safe working environment is being undertaken."

Pitt also said that he was committed to consulting with industry on the findings and recommendations of the independent review into the administration and subsequent liquidation of NOGA. "It is crucial that the Government understands how and why this situation arose to consider how best to minimise the risks of a similar event occurring in the future," Pitt said.

The Guardian quotes a spokesperson for Woodside as saying that the company was working with the government on a decommissioning study at the Northern Endeavour and was contributing to policy discussions to prevent similar incidents from occurring again. The spokesperson added that Woodside did not accept it should be liable for any clean-up of the site. ■

Pointe d'Esny - Image: Wikimedia

Mauritius faces environmental disaster as shipwrecked tanker leaks oil

The Government of Mauritius announced on August 6 that an oil tanker which had run ashore on the island nation's southeast coast in July had started to leak oil, sparking fears of an environmental disaster.

The MV Wakashio, a Panamanian-flagged but Japanese-owned bulk carrier, ran aground on July 25 at Pointe d'Esny – an area known as a sanctuary for rare wildlife species. Its crew was evacuated safely but the ship began to break up in rough seas and oil started to leak from the vessel. The ship was not carrying a payload when it ran aground in July, however it was carrying around 200 tonnes of diesel and 3,800 tonnes of bunker fuel.

In a statement, the environment ministry said, "The ministry has been informed … that there is a breach in the vessel MV Wakashio and there is a leakage of oil. The public in general, including boat operators and fishers, are requested not to venture on the beach and in the lagoons of Blue Bay, Pointe d'Esny and Mahebourg."

Despite the order, locals began helping clean-up efforts by making oil booms out of straw, hair, and clothing. The booms were installed around the tanker to help absorb leaking oil before the vessel broke into two parts on August 15. The Mauritius National Crisis Committee said, "At around 4.30pm [12:30 GMT], a major detachment of the vessel's forward section was observed." Around 90 tonnes of oil was thought to have still be on board the vessel when it broke apart.

An estimated 3,000 tonnes of oil was fortunately pumped out of the MV Wakashio and taken to shore and to another tanker before it broke apart. Images posted on social media showed the tanker with slicks of oil spreading way from it into the ocean. It is thought that a spill of around 27 square kilometres occurred by August 11, however a spill three times that size was averted.

Nagashiki Shipping, the owner of the MV Wakashio, said in a statement that it was monitoring the situation. "Nagashiki Shipping takes its environmental responsibilities extremely seriously and with partner agencies and contractors will make every effort to protect the marine environment and prevent further pollution. The cause of the incident will be fully investigated, and the owner and manager will continue to work closely with the authorities to determine cause," it said.

The Government of Mauritius said it would seek compensation from Nagashiki. Police said that they have obtained a search warrant to board the stranded MV Wakashio and take items of interest, including the ship's log book to assist in their investigation. On August 18, police arrested the MV Wakashio's captain and charged him with endangering safe navigation. At the time of writing, Sunil Kumar Nandeshwar is scheduled to appear in court on August 25.

Crewmembers of the tanker who were questioned by police as part of the investigation said that a birthday party had been held on the day that the ship ran aground. According to the BBC, another theory being investigated is that the ship navigated towards shore in order to pick up a WiFi signal. ■


GLAMOX
FX60
– Glamox EX de LED floodlight
Designed for long lifetime and high efficiency
Reduced maintenance
Lower operating cost
High quality LED
5 YEAR WARRANTY
www.glamox.com


H2
BEKA
is ready for
Hydrogen
There is much talk and significant progress being made in the commercial use of Hydrogen as a renewable energy source and reducing carbon dioxide emissions.
Well, BEKA IS ready for Hydrogen
All of our hazardous area certified products can be used in a Hydrogen environment.
BEKA associates
Indicators & displays...
conventional to fieldbus
www.beka.co.uk sales@beka.co.uk +44 (0) 1462 438301


NEW!
INTEGRITAS™
XPR-5584GMX
600 LUMENS
13 HOURS
NIGHTSTICK®
Life Depends on Light™
ATEX ZONE 0
IECEx ZONE 0
CERTIFIED
THE WORLD'S LARGEST SELECTION OF ATEX CERTIFIED PORTABLE LIGHTS,
PERIOD!
IECEx
Visit Nightstick.com for more information
Email us: intlorders@nightstick.com
© 2020 Bayco Products, Inc.

Representative image: Shutterstock

Trump administration issues final ruling on transportation of liquefied natural gas by rail

The US government released a final rule on July 24 allowing liquefied natural gas (LNG) to be shipped by rail despite critics warning that it risks explosions. The US Department of Transportation (USDOT) and the Pipeline and Hazardous Materials Safety Administration (PHMSA) amended federal hazardous material rules which had prohibited the transportation of LNG via train.

The USDOT and PHMSA consulted with the Federal Railroad Administration (FRA) to issue the ruling which allows the bulk transportation of LNG in DOT-113C120W9 (DOT-113) specification tank cars which have enhanced outer tank requirements and additional operational controls.

Traditionally, LNG has been transported by road or sea in the US with regulations only allowing transport via rail when special approval was obtained from the PHMSA or FRA. The Association of American Railroads has petitioned the PHMSA for several years to allow LNG to be shipped via rail due to its similarity to other cryogenic liquids which are transported in rail cars.

The issue was taken to the highest level of the US government when President Trump issued an executive order in April 2019 requesting that the USDOT amended regulations to allow LNG to be transported in rail tank cars. Trump said that LNG regulations were created almost 40 years ago when the industry was still in its infancy and that US energy infrastructure needed to be upgraded.

The new ruling will permit the shipping of LNG in DOT-113 tank cars which already carry other cryogenic liquids such as nitrogen, ethylene, and liquid hydrogen. Following the ruling, US Transportation Secretary Elaine Chao said, "The Department's new rule carefully lays out key operational safeguards to provide for the safe transportation of LNG by rail to more parts of the country where this energy source is needed."

The final rule means that additional safety requirements such as an enhanced thicker carbon steel outer tank will need to be incorporated into rail tank cars to allow them to carry LNG. Remote monitoring of the pressure and location of LNG tank cars and improved braking will also be required while railroads will have to conduct route risk assessments to evaluate safety and security.

The rule also requires a two-way end of train or distributed power system when a train is transporting 20 or more tank cars loaded with LNG in a continuous block, or 35 or more such tank cars of LNG anywhere along the train.

After the rule was announced, critics highlighted the dangers of allowing LNG to be transported via rail. The Center for Biological Diversity and Earthjustice, two organisations that have been opposing the changes to LNG regulations for several years, said that they would fight the ruling in court.

In a statement, Emily Jeffers an attorney at the Center for Biological Diversity said, "The Trump administration's reckless LNG rule risks explosions and fires in populated areas. We'll fight to protect our communities from this deadly threat. The fossil fuel industry is desperate to cover its bad bet on fracking by trying to easily move more LNG. Our climate and communities will pay a terrible price if we let these explosive trains roll through our cities and towns."

The organisations say that the newly designed DOT-113 tank cars will be heavier than before, increasing the risk of derailments and other accidents. Earthjustice attorney Bradley Marshall said, "The explosion risk of transporting this volatile cargo in vulnerable tank cars through major population centres is off the charts. It would only take 22 tank cars to hold the equivalent energy of the Hiroshima bomb. A train of 110 tank cars filled with liquefied natural gas would have five times the energy of the Hiroshima bomb. We will hold this administration accountable for its responsibility to protect Americans from disaster."

The Center for Biological Diversity and Earthjustice have pointed to the 2014 explosion at an LNG facility in the state of Washington which injured five workers and forced hundreds of people to evacuate their homes to highlight the dangers of LNG being transported by rail. ■

Every two months, SGS Baseefa Technical Manager Ron Sinclair MBE gives his perspective on the latest developments in the world of standards.

The pandemic goes on and on

When I first wrote about the disruption caused to international standards meetings and IECEx meetings, I thought we would be getting back to normal about now. How wrong I was. Even when I was writing two months ago, we were looking forward to the IEC TC31 meetings to be held across October and November at the UL facility just outside Chicago. These have now been totally cancelled, except that one meeting, the "Chairman's Advisory Group" will now be held on the same two days in November as planned but, instead of each day being seven or eight hours long and face to face, the agenda will be slimmed so that each of the two days will be a two hour WebEx meeting.

Timing is everything when you have participants from almost every time zone around the world, and it seems that many similar sessions are being restricted to two hours as being a sensible time for maximum concentration and productivity when working remotely.

The various Working Groups, Project Teams (creating new standards) and Maintenance Teams (revising existing standards) will now meet electronically on separate dates and at separate times to suit the participants, although the overall rate of working will have slowed.

Nonetheless, some standards are moving forward towards publication.

There has been a major revision of the basic hazardous area "zoning" standard for gasses and vapours. IEC 60079-10-1. The "Final Draft International Standard" (FDIS) has just been released to National Committees for its formal approval stage, and we look forward to publication in the autumn. It is most unusual for there to be a hiccup in the process at this stage, as all remaining issues should have been resolved at the previous "Committee Draft for Voting" (CDV) stage which, theoretically, is the last chance to get any technical comments considered.

I was not personally involved in the development of this edition, but I am aware that there were some contentious issues that had to be resolved, not least to consider strongly held views from some stakeholders in the UK. With the previous 2015 edition, the EN was published identical to the IEC, so the UK, as a member of Cenelec, was obliged to publish it without alteration, but the BSI committee EXL/31/3 did take the opportunity to write a national foreword, expressing reservations about certain parts of the standard. This list of reservations formed the major input from the UK to the revision process, so we will await with interest to find out if all points were resolved to the UK satisfaction, or if there will need to be a similar national foreword to the new edition.

Another standard to have hit national committees for final acceptance as an FDIS is the new edition of IEC 60079-26. This relates to the use of multiple protection concepts to achieve a level of protection (Equipment Protection Level Ga or Da) which would make it suitable for installation either wholly or partly within Zone 0 or Zone 20.

This new edition of the standard (which was originally written when Ex ia was the only protection deemed suitable for Zone 0) is the first to include consideration of dust protection as well as gas and vapour protection. Although there are certain niche applications of, for example, an Ex eb motor built inside an Ex db carcass to obtain EPL Ga, the principle concern of the standard is relating to equipment which is installed in a boundary wall, for example a motor driving through a shaft into the Zone 0 inside a vessel. Common sense dictates that a solid wall can act as a boundary between two zones, but this standard goes into great detail about how a non-solid wall, with energy passing through the wall in a shaft, a flexible diaphragm or in wires, can be designed to the relevant level of safety.

The basic principle is simple, EPL Gb plus EPL Gb equals EPL Ga. The problems start when you need to consider possible common failure modes that would render both EPL Gb protections invalid at the same time. This standard helps to resolve those issues.

At European level, the meeting of Cenelec TC 31 scheduled for September has also gone "online". I am due to retire as chair of this committee and we will be using this meeting (among many other more important things) to elect my successor. The German secretariat has already suggested that it would not be appropriate for my successor to come from the UK, as there would seem to be a preference for someone from an EU country, even though both the CEN-Cenelec management and the BSI management have committed to maintaining the existing relationship between them into the foreseeable future.

This does make some sense, in view of the close ties between the European standards bodies and the European Commission, but it does indicate how already the UK is losing influence over those European Institutions where it will remain a member body after December 31. CEN-Cenelec settled on July 1 this year as the date when the formal status of the UK would transition from an EU member to a non-EU member (with slightly different obligations and privileges). Reassuringly, in the ATEX field, we can certainly look forward to maintaining the same standards as Europe for the foreseeable future. ■

About the author

SGS Baseefa's Technical Manager Ron Sinclair MBE is a vice-chair of the European Notified Bodies Group for ATEX (ExNBG), as well as Chair of the IECEx Service Facility Certification Committee and a member of the IECEx Executive. He is chair of both the UK and European Standards Bodies operating in this area.

How should we manage the threats posed by biomanufa

Over the last five decades, there have been thousands of incidents in biological laboratories in which pathogen containment has failed.[1] Those incidents have caused over 150 fatalities since 1970. These days, most of the world is suffering a pandemic caused by SARS-CoV-2, a virus closely related to SARS-CoV, which was involved in recent loss of containment events (Singapore 2003, Taiwan 2003, Beijing 2004) in laboratory settings.[2] In addition to the lives lost in the current pandemic, its economic impact alone is forecast by the International Monetary Fund (IMF) to exceed 6% of the Gross World Product, in excess of five trillion US dollars.[3]

There has been some speculation in Western media about SARS-COV-2 accidentally leaking out of the Wuhan Institute of Virology (Wuhan, China). These allegations have been repeatedly denied by Chinese officials and refuted by the scientific community,[4] and we will absolutely not endorse them here. We must acknowledge, though, that:

a) Repeated biosafety incidents have proven that an outbreak can be caused by an uncontained infectious agent. Safety measures in laboratories keep improving but, as we all know too well, there is no infallible safeguard.

b) The 2020 pandemic has proven that a

Image: Shutterstock

e new
cturing?

local infectious episode can propagate to the entire world and end up having devastating consequences.

Therefore, and for the sake of argument, let us consider a Pandemic Induced by a Loss of Containment of a Biological Agent (PILOCBA) as a potential new class of industrial incident.

To put things in perspective, we have

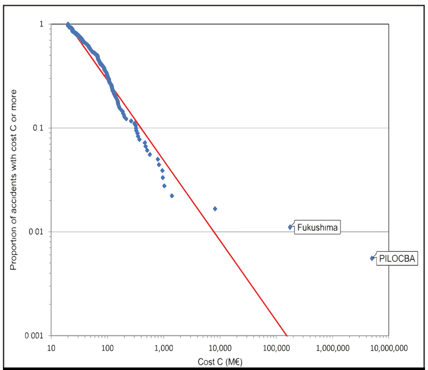


Figure 1 – Distribution of costs associated with industrial incidents

revisited a previous work, presented in 2016.[5] At that time, DEKRA reported that the potential distribution function provided an illuminating means of understanding industrial incidents. To put it in very simple terms, we discovered that for every ten incidents with x fatalities, there is approximately one incident with ten times x fatalities. We have carried out the same type of analysis here, taking the reported cost of the incident as our stochastic variable. Furthermore, we have adopted the IMF’s estimate as the potential cost of a PILOCBA. Figure 1 shows our findings.

If we consider a PILOCBA as an industrial incident, we can see immediately that its cost is substantially more than incidents observed in the past (the Fukushima Nuclear Power Plant incident is another outlier).

It bears remembering, however, that humankind has been using micro-organisms to manufacture goods for millennia, producing bread, wine, beer and cheese to name a few common examples. Recently, we have even developed methodologies to genetically modify micro-organisms and “teach” them to make what we need. The pharmaceutical industry pioneered this development, but it has been extended to other applications, such as:

- Bioremediation: the use of living organisms to clean up hazardous chemical spills underground or in the sea.
- Food manufacturing: in meat replacement products and some other specialty items.
- Biodesulphurisation (BDS): a non-invasive approach to removing sulphur from fuels, used in the chemical and petrochemical industries.
- Microbiologically Induced Calcium Carbonate Precipitation (MICP): for repairing cracks, preventing corrosion in concrete and other cementation applications.

Indeed, we increasingly use micro-organisms to manufacture almost any product we need.

On the other hand, a loss of containment of hazardous biological agents can have disastrous consequences. It is easy to connect the dots: is it possible to have an industrial accident involving biological agents? As it is not *impossible*, we believe it is a matter of when, not if it will occur.

What can be done?

It is not, by far, the first time that humankind has faced hazards of its own making, from the control of fire by early humans to aeronautics, chemistry and the nuclear industry. In every case we have succeeded in harnessing those hazards until they become acceptable. This time will not be different.

At DEKRA we strongly support recycling some of the tools and practices from process safety to deal with the new hazards and risks posed by biomanufacturing. The Center for Chemical Process Safety defines process safety as:

“…a disciplined framework for managing the integrity of operating systems and processes handling hazardous substances by applying good design principles, engineering, and operating practices. It deals with the prevention and control of incidents that have the potential to release hazardous materials or energy. Such incidents can cause toxic effects, fire, or explosion and could ultimately result in serious injuries, property damage, lost production, and environmental impact.”[6]

In order to include the risks associated with a loss of containment of hazardous biological agents, we simply need to replace “hazardous substances” with “hazardous substances and biological agents.”

The approach to managing process safety has evolved over several decades, passing through the stages shown in figure 2.

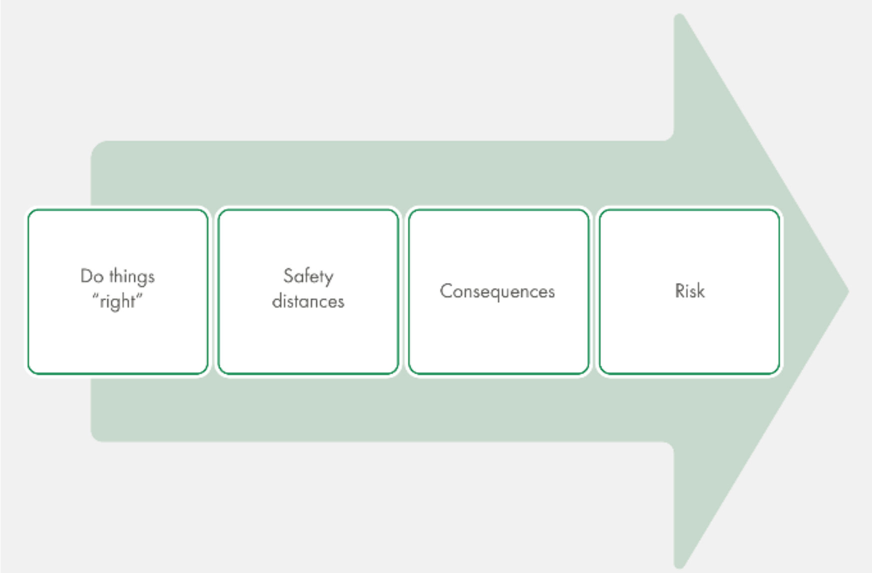


Figure 2 – Evolution of process safety management

At a very early stage, prior to the establishment of the Center for Chemical Process Safety (CCPS), "doing things right" was considered sufficient to safely conduct chemical processes. Much effort was therefore dedicated to developing standards, regulations, guidelines, best practices, etc. Certain dramatic events, such as Bhopal (December 3, 1984) and San Juan Ixhuatepec (November 19, 1984) disproved this line of thinking, and led the American Institute of Chemical Engineers to create the CCPS and task it with the development of appropriate tools to manage chemical hazards. It seems that the biohazard world is still, at least in part, at this early stage, with "Biosafety in Microbiological and Biomedical Laboratories" being a de-facto standard of good practice.[7]

We could summarise the "safe distance" approach as keeping hazardous activities far away from the general population, so that if something goes wrong, people will not be harmed. This criterion was, and still is, rather popular in industrial regulations.

Workstream	CCPS Element
1. Capability	> Compliance with Standards > Process Knowledge Management > Process Safety Competency > Training and Performance Assurance
2. Incident Response	> Stakeholder Outreach > Emergency Management > Incident Investigation
3. Risk Management	> Hazard Identification and Risk Analysis
4. Asset Integrity	> Asset Integrity and Reliability > Management of Change
5. Accountability	> Measurement and Metrics > Auditing > Management Review and Continuous Improvement
6. Operations	> Operating Procedures > Safe Work Practices > Operational Readiness > Contractor Management > Conduct of Operations – Operational Discipline
7. Culture and Organization	> Process Safety Culture > Workforce Involvement

Table 1 – Workstreams and CCPS elements

Its main advantage is its simplicity: anybody can measure distance! Its drawbacks, however, are numerous. It is not easy to envision how this type of approach could be used to effectively manage biohazards; at most, we can think of the "social distancing" practices imposed to control the COVID-19 pandemic.

One of the problems with the distance approach is the difficulty of determining the appropriate distance: too little, and hazards are not mitigated, too much, and the result is suboptimal land use. To solve this problem, a new approach unfolded based on calculations of the consequences of hypothetical incidents and by which vulnerable populations are kept farther away than the calculated distances. This type of approach is theoretically also possible for biohazards, but it is arguable whether it would lead to any meaningful consequences. For, instance, what happens if the calculated consequences are as catastrophic as a PILOCBA?

Finally, the CCPS concluded that the right approach was risk-based: the risk of any given event is the expected value of the damage it causes, or more simply put, the product of its likelihood and the resulting damage. Prevention efforts are then commensurate with the magnitude of the risk. It seems very natural to extrapolate this principle to biohazards: we certainly need to put more effort in preventing a pandemic than a minor outbreak. As a matter of fact, "Biosafety in Microbiological and Biomedical Laboratories" already has an implicit risk approach, calibrating safety requirements according to the infectiousness of the micro-organism being handled.

Furthermore, the CCPS identified the essential elements for world-class process safety performance. These are shown in Table 1, as grouped in DEKRA's Organizational Process Safety solution scheme into seven workstreams.

Every one of the elements and workstreams seems fully applicable to biohazards, as long as its framework is properly identified. Let us consider, for instance, "compliance with standards": certainly, biomanufacturers will need to keep track of applicable trade standards and regulations and comply with them. Another example, "hazard identification and risk analysis": manufacturers ought to be able to identify the potential hazards of any new process and assess its risks. All the elements are, in fact, valid in a biomanufacturing context, and, indeed, exhaustive.

We can conclude, therefore, that the basic framework for managing risks set forth by the CCPS will remain valid with the addition of two further capacities:

- The development of new tools and methodologies or the adaptation of existing ones. Perhaps we can think of applying techniques such as HAZOP or quantitative risk analysis to a biomanufacturing facility, with at least some fine-tuning. We will also need to develop consequence modelling in line with the new types of hazards. The PSM structure will need to be revamped to accommodate this entirely new class of hazards.
- A whole new cohort of process safety experts with knowledge of biological processes to complement the expertise we already have in terms of chemical processes. Needless to say, appropriate competence development programs will need to be created.

Putting human ingenuity to work

New bioengineering technologies are increasingly applied to manufacture diverse types of goods, from food to pharmaceuticals, while other new applications use genetically modified micro-organisms to perform a range of tasks, such as remediating chemical or oil spills. While the possibilities are exciting, we plainly see that exposing humans to new micro-organisms, including engineered ones, can turn into a catastrophe with unprecedented consequences.

Fortunately, the human capacity to innovate and adapt can also make us safer. Process safety, for example, developed as the result of humans working to identify, assess and manage risks caused by hazardous materials, from flammable dusts (sugar, flour etc.) to those linked with dangerous industrial chemical reactions and new chemicals.

At DEKRA, we believe that the process safety framework is sufficiently robust and flexible to accommodate the new risks. What is still needed are new or adapted tools as well as additional experts with the appropriate background to adequately confront biomanufacturing risks. Relying on human ingenuity, experience and know-how, we can meet new challenges and conquer risks head-on. ■

References

1. *Centers for Disease Control and Prevention. Biosafety in Microbiological and Biomedical Laboratories (5th edition). National Institutes of Health, 2009.*
2. *Della-Porta, T. "Laboratory accidents and breaches in biosafety – they do occur!". Microbiology Australia, May 2008.*
3. *International Monetary Fund (April 2020). World Economic Outlook. Chapter 1. The great lockdown.*
4. *https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(20)30418-9/fulltext*
5. *A. Trujillo (2016). "Industrial Accidents: are more Serious Events than Bhopal Possible?" Chemical Engineering Transactions. Vol. 48.*
6. *CCPS (April 2020). https://www.aiche.org/ccps/process-safety-faqs#What%20is%20Process%20Safety*
7. *Amazingly, the first edition, titled "Biosafety in Microbiological and Biomedical Laboratories," is dated 1984, the very same year of the Bhopal and San Juan Ixhuatepec disasters.*

About the author

Dr. Arturo Trujillo is Global Director of DEKRA Process Safety Consulting. His main areas of expertise are diverse types of process hazard analysis (HAZOP, What-if, HAZID), consequence analysis and quantitative risk analysis. He has facilitated more than 200 HAZOPs over the last 25 years, especially in the oil & gas, energy, chemicals and pharmaceutical industries.

Image: Shutterstock

The difference between flammability and combustibility

The words 'flammable' and 'combustible' are frequently used interchangeably but they are different chemical properties. There is a sense in which we suspect that they mean different things, but for the most part it seems that there is a difference without a distinction. There is a distinction, albeit subtle but it is important in terms of process safety.

Flammable materials, whether solid, liquid or gas, can burn with a flame at ambient temperatures. One does not have to raise their temperature to a certain threshold for them to be capable of burning with a flame. Combustible materials, however, must be raised in temperature before they can burn. Consider a pool of diesel fuel; if you were to hold a match to the pool, it would not ignite. To get it to catch fire and sustain a flame, to become 'flammable', it must first be heated to a certain temperature that is dependent on its composition.

It is the vapour that burns. For example, diesel must be heated for it to give off sufficient vapour, which, when mixed with air, will burn. Candle wax must be heated, first to the temperature at which it will melt, and then to the point again where it will give off enough vapour to mix with the air and sustain a flame.

If a material has a flash point more than the maximum expected ambient temperatures in a geographical location, it could be considered 'combustible' (i.e. needs heating) rather than being 'flammable', which can burn spontaneously. If raised to a higher temperature, it could burn with a flame, but at ambient temperatures, this will not occur.

Therefore, it is worth checking the actual flash point of your materials. If the flash point is above, say, 32°C, then it could be classed as 'combustible' and if it is below 32°C, then it is a flammable liquid. These are not strict definitions, but allows you to understand the risks of handling a liquid (or solid) at a temperature above, below or around its flash point and hence whether there is a risk or not of a fire/explosion occurring, depending on the operating temperatures.

Understanding the difference between flammable and combustible when undertaking a risk assessment can save on the cost of protective systems and procedures and still be sufficient to protect your people, plants and process.

Hazardous area classification - avoiding over-zoning

In most organisations, risk assessments err on the side of safety. Whilst this should not be deemed to be an issue, it may be over cautious as it can result in large hazardous areas being designated and, in some cases, a higher than necessary classification of zoning (i.e. Zone 1/21 instead of Zone 2/22) or by blanket zoning an entire area. This can cause a large amount of financial expense in terms of purchasing and maintaining ATEX certified equipment. We have worked with many companies to help them save money by correctly zoning their factories & production facilities.

Standard IEC 60079-10-1 (International Standard: 'Explosive Atmospheres, Part 10-1, Classification of Areas, Explosive Gas Atmospheres', 2008 IEC) states:

> *"…Zone 0 or Zone 1 areas should be minimised in number and extent by design or suitable operating procedures. In other words, plants and installations should be mainly Zone 2 or non-hazardous. Where release of flammable materials is unavoidable, process equipment items should be limited to those which give secondary grade releases or, failing this (that is where primary or continuous grade releases are unavoidable), the releases should be of very limited quantity and rate. In carrying out area classification, these principles should receive prime consideration. Where necessary, the design, operation and location of process equipment should ensure that, even when it is operating abnormally, the amount of flammable material released into the atmosphere is minimised, so as to reduce the extent of the hazardous area."*

Therefore, when preparing a risk assessment report, you should seek to identify the possible sources of release and their bearing on the hazardous area classification, and ensure that any Zones identified are a realistic interpretation of the actual situation, and not an over specification.

The general report format for assessing Unit Operations should include sections as follows:

1. Overview: The Unit Operation is defined and the presence of a flammable atmosphere in normal, or foreseeable abnormal, operation is considered. If it is not possible for a flammable atmosphere to occur, then the assessment stops there.

2. Presence of an Ignition Source: It is not the intention, at this stage, to determine all potential ignition sources, but just to confirm that there is at least one. This should also take into consideration the possibility of an unintentional ignition source being brought into the hazardous area (i.e. maintenance or measuring equipment).

3. Discussion of Risk: If there is a potential for a flammable atmosphere and an ignition source, then there is a discussion to determine the risk to people and whether actions are required.

4. Basis of Safety: The chosen basis of safety for the unit operation is considered along with its implications on adjacent units and their basis of safety and its physical location in the site.

5. Hazardous Area Classification (HAC): If there is a requirement in the Basis of Safety to control ignition sources, then the next section, Hazardous Area Classification (HAC), gives the relevant zones.

6. Recommendations: Finally, there are recommendations. Once the recommendations have been implemented, as far as reasonably practicable, then the Basis of Safety should be 'sound'.

Additionally, there is Auditing of the Implementation of the Recommendations, which is usually a follow-on. It should however be undertaken on regular basis to ensure that the Basis of Safety for each operation is being maintained, or whether another assessment is required to verify the Basis of Safety or to determine whether the Basis of Safety has changed and whether it is acceptable and valid from a reasonably practicable aspect.

The correct application of Hazardous Area Classification (HAC) results in an appropriate budgetary spend on safety in the workplace. Minimising the use of expensive 'Ex' rated equipment and if it is required then helps to reduce the level of equipment down from potentially a Category 2 to a Category 3, reducing installation costs and replacement component stock levels. ■

About the author

Samuel Ayres BEng (Hons), Business Development Executive at Sigma-HSE, studied Electronic Engineering at the University of Portsmouth between 2007-2010 and worked as an Engineering Technician for the Ministry of Defence and a Prison Officer before moving into technical sales positions. He has been with Sigma-HSE's business development team since August 2019. His goal is to increase explosion risk awareness in the workplace and is inspired daily by his young family.

The difference in visibility after LED lighting was installed within a processing plant

LED lighting provides **safe solution for industry**

Europe has long been recognised as a world leader when it comes to setting high standards for human safety and wellness and environmental protection. Not only does the European Union and EU-OSHA set standards across the member countries, but within those countries, individual agencies also bolster those efforts with national directives.

Despite having made great strides over the past 25 years, there's still much work to be done. In 2017 alone, European workers suffered 3.3 million injuries and 3,552 workplace fatalities. With a cost of some €476 billion (£431bn), workplace accidents amount to 3.3% of GDP.

In the UK alone, more than 11,000 enforcement notices have been issued and 364 cases prosecuted, while workers in Germany racked up 669 million days of lost work in 2017, totalling €76 billion (£68.8bn) in lost productivity. The financial cost is just one factor, let alone the impact these incidents have on individuals and their families through disabilities, diminished quality of life and the loss of loved ones.

LED lighting reduces risk by 60%

Recently, as part of its mission to improve workplace safety through proven technology and best practices, the European Commission identified LED lighting as a Key Enabling Technology for reducing carbon energy consumption, improving energy and resource efficiency and providing a huge potential to fuel economic growth and provide jobs. In addition, improving facility lighting, through the use of modern industrial LED lighting for example, has shown to reduce the risk of workplace accidents by up to 60%.

Yet, more than 90% of industrial facilities still rely on outdated, antiquated lighting. In Europe, fluorescent fixtures have become the standard, primarily because they're inexpensive. However, many organisations are realising that a low upfront cost isn't the only measure that matters. In fact, by upgrading to modern, sustainable LED technology, companies can dramatically improve worker safety and reduce environmental impact for substantial savings on energy and maintenance costs that deliver strong ROI.

Upgrading from antiquated fluorescent lighting to high-efficiency industrial LED lighting technology can help any facility run safer, more efficiently and economically in four main areas.

Improved visibility

Poor lighting is a leading contributor to slip, trip and fall accidents as well as those caused by contact with objects and equipment – some of the most common incidents on any job site. Fluorescent lighting fixtures are extremely fragile and very large. They collect a lot of dirt and debris, which hinders light output, thus lowering visibility. They're also at greater risk of being hit by moving equipment, causing cracked lenses and bulb failure. When the fixture isn't fully operational, light output and visibility are therefore substantially reduced, making it extremely hard to visibly detect hazards.

Since visual data accounts for 85% of perceptual information, this poor lighting is like asking staff to work blind. Fluorescents can also take some time to come up to full output after being switched off, which can leave workers in the dark in the wake of a power outage, for example. In addition, the typical Colour Rending Index (CRI) of a fluorescent light can be as low as 60, which can distort colours, making it difficult to differentiate. In situations where colour is critical for detecting danger – identifying the ground wire in electrical wiring, for example, or interpreting safety placards – this poor colour rendering is a substantial safety risk.

On the other hand, the crisp, clear, white light of industrial LED fixtures provides near-daylight quality illumination. This not only improves visibility with brighter light overall, but it also means a higher CRI, so that colours appear natural for easy detection. And, because LEDs are solid-state devices, they're much more resilient to impact or shock. That means no delicate bulbs and fixtures to break and fewer lights out throughout the facility at any given time. As a result, the improved visibility of modern industrial LEDs has proven to improve trip hazard detection by nearly 24%, help workers detect trip hazards 94% faster and spot peripheral motion 79% faster, all of which contribute to a lower risk of accidents and a safer work environment.

Lower maintenance

Because fluorescent bulbs and fixtures are so fragile, they're notorious for their short lifespan, particularly in harsh, high-vibration industrial settings and, as a consequence, demand constant maintenance. Because lighting is commonly mounted at high elevations, and often directly over process equipment, accessing the fixture for maintenance is extremely difficult and dangerous. Not only does it necessitate the use of access equipment, the floor area must be cleared for access and often production equipment stopped to access the fixtures. This not only increases the risk of accidents due to electrocution and falls, but the inefficiency of it all means that facilities often delay maintenance until so many fixture failures force the issue, further contributing to the already-poor visibility.

Long-lasting LED fixtures dramatically reduce the risk of lighting maintenance hazards, as well as the associated costs. With fixtures that last six times longer than fluorescents, industrial LED lighting systems can deliver up to 100,000 hours of continuous performance, many covered by extensive, 10-year warranties. In fact, the US National Institute for Occupational Safety and Health has established: "LEDs have the potential to significantly reduce the frequency of accidents related to the maintenance, operation, and repair of lighting systems because the long life of LEDs would enable an exposure reduction to the associated hazards."

No hazmat exposure

Mercury is an extremely potent neurotoxin that causes nausea, vomiting and bronchitis, as well as tremors, memory loss, intellectual changes, kidney damage, psychosis and delirium from chronic exposure. Strict occupational exposure limits are in place by many agencies to protect workers from these debilitating effects. Yet, every fluorescent bulb contains mercury, phosphorous and other rare earth minerals – so much so that some jurisdictions have set limits on the number of fluorescent tubes that can be disposed of in a certain time. Any in excess of that number requires handling by a hazmat specialist, which adds considerably to the cost and environmental impact. Not to mention, if a bulb is broken during use, handling or disposal, everyone in the vicinity has been exposed to these harmful materials. With millions of these lamps – which are prone to failure and require frequent maintenance/handling – in place at facilities, the risk of exposure is extremely high.

With LED fixtures, not only are there no delicate bulbs to break, but these solid-state devices contain no mercury or other hazardous materials. Therefore, there's

The LED lighting within an aircraft maintenance hangar produces incredibly clear visibility zero risk of hazmat exposure to employees who must handle the fixtures, nor are there any special disposal procedures required to prevent toxic pollution. LED lighting complies with European RoHS and REACH standards, eliminating the need for noncompliance exemptions, which are being phased out under RoHS regulations. In fact, many components of modern LED luminaires can be recycled for an added environmental benefit.

Energy efficiency that drives environmental improvements

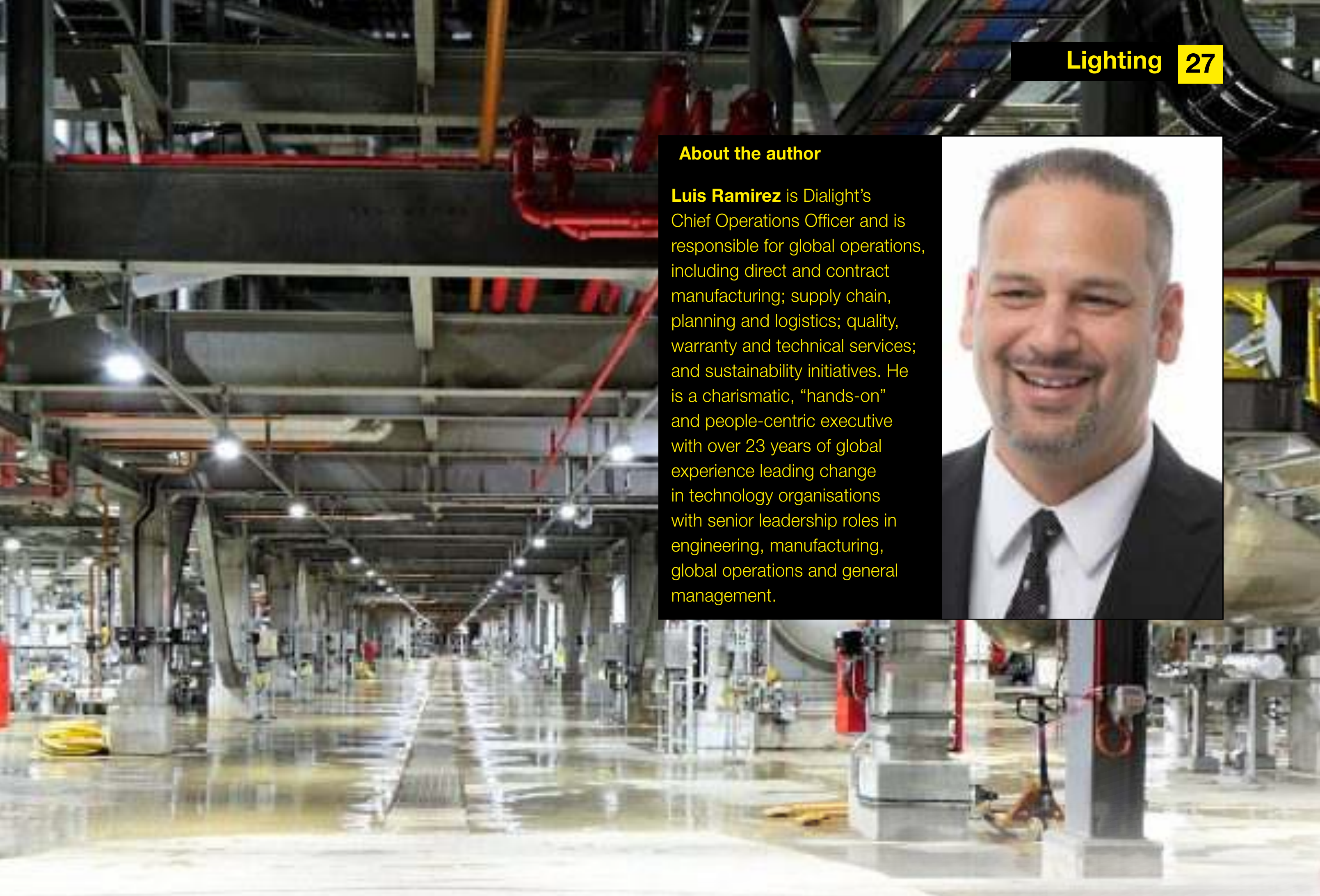
Lighting accounts for 15% of electricity consumption in Europe, and with industrial lights kept on from 10 to 24 hours each day, that amounts to 70 terawatt hours consumed each year. With 176 million industrial light fixtures in place at 2.6 million facilities, industrial lighting alone produces millions of metric tonnes of carbon, nitrous oxide and sulphur dioxide, contributing to global warming, acid rain, smog and human respiratory issues. In order to achieve the necessary light output that industrial settings require for safe and efficient operations, most facilities use VHO, SHO or HO (very high, super high and high output) fixtures. For most common T8 fixtures, this means total ballast and bulb energy consumption is about 212 watts

The European public and public policy overwhelmingly support energy efficiency and a low-carbon economy. Over 90% of Europeans see climate change as a serious problem and have taken action to address it. The European Commission has proposed "a green and inclusive transition to help improve people's well-being and secure a healthy planet for generations to come," and the European Green Deal has set a goal for the continent to be climate neutral by 2050.

Adopting high-efficiency industrial LED lighting at European facilities can help achieve that goal. Linear LED fixtures, the most common replacement for T8 fluorescents, deliver far more and better-quality light with as little as 35 to 65 watts per fixture – about one-fifth to one-third the energy required for fluorescents. That means industrial LED lighting could cut energy consumption by as much as 75%. Combined with the ability to add smart

This German chemical production facility benefits from LED lighting

The difference LED lighting can make within this Food Processing warehouse



About the author

Luis Ramirez is Dialight's Chief Operations Officer and is responsible for global operations, including direct and contract manufacturing; supply chain, planning and logistics; quality, warranty and technical services; and sustainability initiatives. He is a charismatic, "hands-on" and people-centric executive with over 23 years of global experience leading change in technology organisations with senior leadership roles in engineering, manufacturing, global operations and general management.

controls to further reduce burn time and energy consumption, switching to high-efficiency industrial LED fixtures could reduce energy use by as much as 63 terawatt hours – enough to light 45 million homes.

This substantial reduction would eliminate 34 million metric tonnes of carbon emissions – the equivalent of taking 7.3 million passenger cars off the road. In addition, switching to industrial LED lighting would remove 82,000 tonnes of nitrous oxide and sulphur dioxide emissions, along with 400,000 grams of mercury.

LED: the clear solution

Upgrading to industrial LED lighting across Europe has tremendous potential to deliver massive energy and environmental savings that not only help companies save money and reduce the risk to workers, but also to save the planet from the harmful effects of lighting-related pollution. LED lighting costs have declined 80% over the past 5 years, making this innovative technology more affordable, while delivering efficiency, performance and reliability that far exceeds conventional lighting options.

With remarkable energy savings, substantially lower environmental impact and the ability to reduce accidents and injuries, industrial LED lighting technology is clearly the superior solution to creating safer, greener industrial facilities. ■

Atexxo Manufacturing

Explosion Proof ATEX Zone 1 iPad For ATEX and IECEx

Atexxo Manufacturing has released an Apple iPad mini 5 which is suitable for use in Zone 1 and Zone 2 hazardous locations. The explosion proof iPads are originally manufactured by Apple then converted and certified according to ATEX and IECEx by Atexxo Manufacturing. This makes the ATEX and IECEx tablets suited for safe use in gas/vapour Zone 1 and zone 2 hazardous areas. Sim-card can be installed by the end-user themselves, or eSim can be used. The devices are suited for Apple (open) DEP enrollment program.

Zone 1 Explosion Proof iPad Mini 5
ATEX & IECEx Certified
www.atexxo.com

All features of the original product are preserved. Including all pushbuttons and home-button.
The ATEX/IECEx iPad mini 5 comes with an aluminum case finish and is available in both WIFI only and WIFI + 4G Beside safe use as a tablet both versions are excellent for use explosion proof camera or RFID scanner.
For Middle East countries, versions with blocked cameras are available.

Features:

- Explosion safety level: II 2G ; ATEX & IECEx Ex db IIC T4 Gb
- 64Gb or 256 Gb WIFI+4G
- eSim or Self Sim-Card Installation
- Suited for Apple (open) DEP enrollment

Explosion Proof ATEX/IECEx Zone 1 & Zone 2

Applications: Hazardous material storage, petrochemical plants and oil and gas extraction sites.
For more information, visit: ***www.atexxo.com***

Image: Shutterstock

Avoiding confined space pump installation

In a range of industries, confined space entry is often required for the maintenance of critical process equipment, but what is confined space entry, and can it be avoided altogether in pump installation?

Confined space entry is access to an area within industry which satisfy one of the following criteria:

- There is a limited opening for entry and exit
- The space is not designed for continuous human occupancy
- The space is large enough for a person to enter and undertake work

Examples of areas include sewers, above and below ground tanks, reaction vessels, enclosed drains, ductwork, chambers and poorly ventilated rooms which are not always obvious as dangers. There are various risks usually signifying a confined space which are not always apparent to the entrant. These include lack of oxygen, poisonous gas vapour, and dust & fire.

Spaces can lack ventilation or contain gases emitted from previously stored cargo. Products such as grain, slurry, or wood can emit gasses which are not always obvious or visible without sensing equipment. Fluids can also hold dangerous gases, with them being released if disturbed.

Nitrogen, or CO2 can be elevated at noxious levels in such environments, with some processes absorbing oxygen which can reduce already low oxygen levels. Areas do not need to have liquids present to be dangerous. Zones can still contain elevated levels of poisonous and toxic gas even when empty.

Fires or explosions can occur from vapours and residue within tanks which can sometimes be odourless and easily ignitable due to its concentration. Dust generated from products such as cement, flour, cargo, scrap, and dry bulk handling can be combustible and ignite quickly, or it can contain high concentrations of silica leading to breathing difficulties or future health issues.

Product filling or bridging

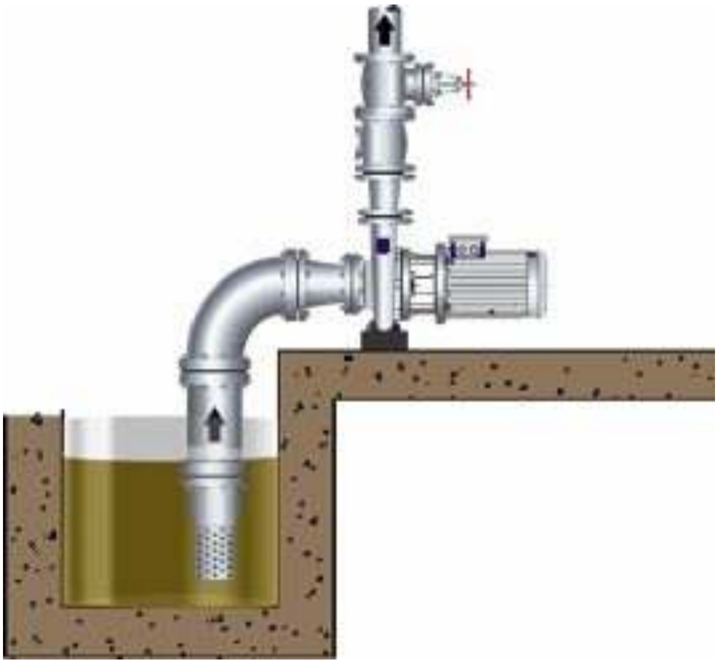
In storage tanks filled with grain, sludge or slurry, product can bridge causing a temporary gap prone to sudden collapse or in some situations liquids or solids can quickly fill space with little or no warning from another process. In 2017, workers in East Greenwich were performing preparatory work in a sewer when a 150-year old penstock failed, engulfing the workers in sewage and carrying them along the sewer.

Excess temperature

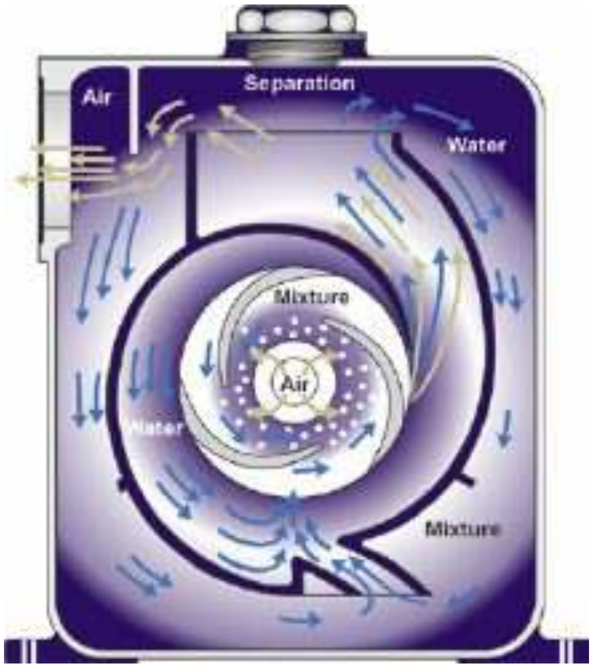
Areas in industry which are used for cooking, conveying of steam, ventilation or thermal transfer can lead to high temperatures within areas requiring admission. If access is made before temperature levels are safe, it can lead to dangerous increases in body temperature in excess of what can be handled capably.

What does entry involve?

Confined space entry involves a number of exhaustive procedures ensuring entry and exit to such areas is undertaken with mitigation to risk. First and foremost a risk assessment is conducted to establish



Suction lift pump



Self-priming pump

procedures, processes, and method for work to be undertaken.

Equipment required includes a provision of oxygen made in the form of breathing apparatus, communication equipment, rescue harness & hoist to enable easy extraction of personnel, provision of tools, and lighting.

A permit to work ensures a formal check is undertaken, ensuring a safe system of work is in place, that there is communication between management, supervisors and operators with clear indications of who is to undertake a task, who bears responsibility for precautions, testing of equipment, emergency arrangements, monitoring and ensuring work is undertaken as expected.

What are the costs?

Access usually requires a full method statement and a risk assessment with entry usually requires 3 people, the entrant, an attendant, and a supervisor with equipment. Operators are expected to remain fully trained with training costing between £500-£1000 per person each year. Such risks to confined space entry should not be underestimated. There continues to be 15 confined space related deaths per year on average and, with the average Health and Safety fine being £150,000 in 2019, steps are being taken to mitigate or avoid such entry.

Regular training is expected, with qualifications kept up to date. Due to the associated costs of ongoing training, certification, and risks, companies often choose to outsource this type of maintenance since retaining such highly qualified and experienced staff becomes difficult. Such highly experienced and certified workers are usually highly sought after with their marketplace value increasing which means turnover in the role is high.

As maintenance is outsourced and outside the control of the plant, downtime periods can be longer, and expensive when required urgently.

How can confined space be modified so entry is not required?

Avoiding confined space is actively encouraged by the HSE to reduce risks, one of which is to have work performed externally. This can involve having pumps mounted outside of tanks, process vessels or in pits. Typically, many applications involve a submersible pump which is often the cheapest initial solution which are guiderail or foot mounted. This can be replaced through the use of immersion or self-priming pumps.

A self-priming pump is a pump which can be surface mounted, outside of tanks, silos and pits to extract fluids. Depending on the nature of the liquid, abrasiveness and viscosity, pumps can be of non-clog design handling large solids, which are fibrous and contain gas slugs.

Low maintenance designs enable part replacement by a single person without the need of additional equipment. Sludges, slurries or other viscous matter can be

Image: Shutterstock

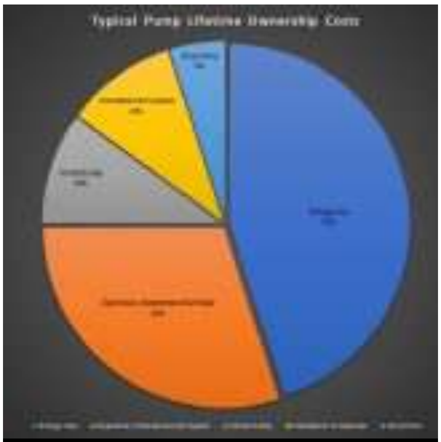
handled capably by such units with the added benefit of being easily accessible, ensuring periodic maintenance is straightforward.

Another alternative is an immersion pump which can be installed in the top of the tank with working parts operated via a shaft within tanks. Designs are available which can be up to 100 metres long working with fluids from water to sludges and slurries. As the motor is mounted externally to the tank and not immersed, it is less susceptible to corrosion, as well as being easily accessible for the early detection of issues.

The costed case

So, how much of ownership does the initial outlay of a pump account for? Typically, a pump's initial purchase price only accounts for 10% of the initial investment. Around 45% of a pump's costs are energy use, with 30% of its cost being operation, maintenance and repair, 5% downtime and 10% installation and disposal.

However, with confined space entry, ongoing maintenance costs can be as much as 15 times the cost of a total pumps cost, meaning designers should seek to engineer out pumps installed in such manner.



Typical pump lifetime ownership costs

Maintenance benefits

Installing pumps externally to tanks provides four main benefits to plant owners and operators which include:

1. Maintenance can be performed by as little as one or two people, at short notice, with little additional equipment and without entry to confined spaces.

2. Longer motor life & quicker sourcing – As motors are externally mounted, outside of the pumped fluid, they are less susceptible to corrosion. Surface mounted pumps typically use standard motor frame sizes enabling easy local sourcing whereas submersible pumps use bespoke motors typically only available from the original manufacturer which are less likely to be available during an emergency.

3. When a flammable liquid is being pumped, manufacturers are no longer supplying submersible pumps for flammable fluid transfer, often meaning surface mounted pumps are the only option.

4. Early detection of issues as symptoms can be easily noticeable on surface mounted pumps. Issues such as grinding, high pitch squealing, or vibration are easily noticeable on surface mounted pumps. Submerged pumps are usually out of sight and out of mind with failure only apparent when the unit fails, after which it is then replaced.

Whatever your process involves, it is imperative a holistic approach is undertaken, with full cost of ownership and maintenance included within the process. Providing any project is engineered towards lowest lifecycle costs and not solely initial outlay, it is likely many confined space installations can be eliminated.■

About the author

Simon Hooton is a Technical Product Manager at North Ridge Pumps Ltd. He has operated in the pump industry for over 10 years since completing his business degree. Simon is a specialist in a wide range of pump types from centrifugal to positive displacement and has been involved in a variety of projects from the handling of seawater, to oils, resins and sludges.

Image: Shutterstock

ATEX fans – EN 14986

ATEX fans are fans designed for use in potentially explosive atmospheres and are governed by EU Directive 2014/34/EU. This Directive is intended to increase safety by using a logical risk identification and mitigation method for design manufacture and use.

With so many fans in operation in potentially hazardous areas, and the real and perceived risk of such fans causing a possible ignition, in addition to the general mechanical standards (ISO/IEC 80079-36 & 80079-37), a specific EN (Euro Norm) standard exists. 'EN14986:2017 *Design of fans working in potentially explosive atmospheres'* details design and documentation requirements for ATEX fans.

As fans are essentially mechanical devices there is no legal requirement for third party certification, issuing of ATEX certification is left to the person or body placing such equipment on the market. However, for an end user, having such a certificate is not the full picture, there is still a degree of due diligence required to ensure the equipment is suitable. Whilst an end user could not reasonably be expected to carry out a clause by clause verification for a given fan, there are a few fundamentals that should be checked.

This article aims to give a guide to engineers on the main features of such fans and to help in verifying their suitability for a given application.

Zones and categories of equipment

Historically electrical equipment was designed for operation in "zones". The zoning of an area within an industrial facility is usually a result of a HAZOP study at the early stage of development. The important thing is that this is an "end user" responsibility, it is not the responsibility of a machinery supplier to specify the applicable zone for a hazardous area.

The recognised zones are:

Gas	Dust	Definition
Zone 0	Zone 20	Hazard present in normal operation or for long periods (typically >1000 hr/year)
Zone 1	Zone 21	Hazard is likely to occur in normal operation (typically >10 but <1000 hr/year)
Zone 2	Zone 22	Hazard not likely to occur in normal operation and, if it occurs, will only exist for a short time. (typically <10 hr/year)

Having established the relevant zone for a given area, the ATEX directives then categorise equipment by its suitability for use in a given zone. The category of equipment can be considered a “degree of protection”. Three categories of equipment are available, category 1 gives the highest degree of protection and category 3 the lowest. Categories are further denoted by either G (Gas) or D (Dust) depending on the nature of the hazard.

Zone 0		Zone 1		Zone 2	
Gas	Dust	Gas	Dust	Gas	Dust
1G	1D	2G	2D	3G	3D

Again, as with zoning, the selection of category of equipment is the responsibility of the end user, though generally this is taken direct from the table above. However, in some circumstances a higher category of equipment may be chosen, i.e. category 2G equipment in a Zone 2 Gas hazard. An example may be where the consequence of ignition is deemed so severe, regardless of the possibility that equipment with a higher degree of protection is selected.

It follows that any fan supplied needs the correct level of protection, or in other words is manufactured to the correct category. This should be clearly shown on both the label (see the labelling section of this article on page 34) and any documentation.

If the category of equipment is not clear on both documentation and labelling, then it may not be the correct fan.

Industrial fans can be roughly split into two sectors:

1) Standard designs – for ATEX units these will carry the manufacturer’s certification, including ATEX Category. In this case the user can ensure it is suitable for their application.

2) Configured or bespoke design – for ATEX units these will be deigned to meet the category specified. Here the user needs to tell the manufacturer the required category.

Maximum Surface Temperature

An important part of the concept for ATEX fans is control of temperature, in both normal and possible upset/fault conditions.

By keeping temperatures below a critical value, ignition can be controlled. Different gasses and dusts have different critical temperatures. These are often called the “auto ignition temperature” meaning the temperature where, even without an additional ignition source, the gas/dust will ignite.

The end user is responsible for products used/produced in their facility and it follows therefore, as with zones and categories, that specifying the maximum allowable temperature is their responsibility.

ignition sources, the second of which is an “explosion proof” case and flame arrestors.

Flame arrestors cannot be used for Da protection as these would blind up due to conveyed dust, hence exclusion of Da EPL.

What does this table tell us?

For fans used in Zone 0 where hazardous gas is normally or frequently present INSIDE the fan case, the highest level of protection “a” is required. The fan is designed so there are two separate mitigations to prevent ignition

Gasses are generally grouped in one of 6 temperature groups – T1 to T6:

Gas temp. class	Max allowable surface temp.	Gas temp. class	Max allowable surface temp.
T1	450°C	T4	135°C
T2	300°C	T5	100°C
T3	200°C	T6	85°C

For dusts, the actual maximum surface temperature is given e.g. T135°C

For dual certified equipment that is suitable for both a gas and dust hazard, both the gas and dust temperature must be given e.g. T4 135°C.

Similar to when the categories of a standard pre-certified fan are being selected, the supplier’s documentation should show the maximum surface temperature to enable the user to ensure correct selection. For a bespoke unit, temperature needs to be given to enable design to be carried out.

in normal operation and during an expected malfunction. The fan is also safe in the event of a rare malfunction which could be two simultaneous expected malfunctions. Such Zone 0 fans are very specialised and are subject to third party testing and certification.

For fans used in Zone 1, a medium level of protection “b” is used to give protection in normal operation and during “expected malfunction”.

For fans used in Zone 2, the lowest level of protection “c” is used giving protection during normal operation.

Equipment Protection Level (EPL)

This is a relatively new concept and is based on the Zoning of equipment and the ignition hazard assessment. Here, possible faults/ sources of ignition in the fan are assessed.

Fans present a couple of anomalies:

1) The use of “material pairings” (see detailed fan design – material pairings on page 34)) is still required for Zone 2 fans in many cases.
2) The possible different zones, categories and protection levels inside and outside

Zone	ATEX Equip category	Ignition source present during:			EPL Gas/ Dust
		Normal operation	Expected Malfunction	Rare Malfunction	
0	1	yes**	yes**	yes	Ga/Da*
1	2	no	yes	yes	Gb/Db
2	3	no	no	yes	Gc/Dc

Notes:
** EN 14986 does not cover manufacture of Zone 0 cat1 Da fans.*
*** For Zone 0 cat1 Ga fans, there are two measures that are required to prevent*

the fan casing. This often requires dual labelling. Generally, to take into account that few fans are truly “gas tight”, only one category difference is allowed between the internal and external of a ducted fan.

Protection Concept

This is a relatively new concept but is a guide to how the EPL has been achieved.

Readers may be familiar with the Exd marking of electrical equipment where the d indicates explosion protection – any explosion is prevented from propagating beyond the motor housing.

For mechanical equipment, the available options are:

Protection Concept:	Flameproof	Pressurised	Enclosure	Construction	Control of ignition	Liquid immersion
Code:	Exd	Exp	Ext	Exh	Exh	Exh

En 14986 covers “constructional safety” so fans complying to it should be marked Exh.

Labelling

Correct labelling is important. It gives a quick easy way to check the suitability of a given fan. Clearly displayed on the nameplate should be something in the format shown below.

If you can’t see this information on your fan nameplate you may not have the correct certified fan, or even not an ATEX fan at all.

Unlike electrical equipment there is no notified body number as equipment is self-certified. As mentioned in the introduction this is acceptable for mechanical equipment but there is a degree of due diligence required from the user that correct equipment has been selected.

If your fan is marked Exd be careful that somebody has not just transferred the motor marking to the fan case – it happens. Fans complying with EN 14986, where this standard is taken as the overarching design document, cannot be marked Exd!

Detailed fan design

EN 14986 sets out a number of minimum design rules to which hazardous area fans should comply. It is legally possible to produce a fan that does not comply with EN 14986, and instead complies with ISO/ IEC 80079-36 & 80079-37, but there would have to be a very good reason why – such special cases where they do exist are beyond the scope of this paper.

The following section looks at some of the more important design requirements of EN14986.

	Internal		External
CE Ex II (1 2 3)	**2GD** (4)	**/**	**3G2D** (4)
Gas	**Exh IIB T4 Gb** (5 6 7 8)	**/**	**IIB T4 Gc** (6 7 8)
Dust	**Exh IIIB T175°C Db** (5 6 9 8)	**/**	**IIIB T175°C Db** (6 9 8)

Key

1. CE – CE mark.

2. Ex - Ex mark showing equipment is ATEX certified suitable for potentially explosive atmosphere.

3. II - Roman numeral 2 denotes equipment group I is for mining equipment, and II for surface equipment. EN 14986 covers only group II equipment.

4. 2GD 3G2D - Equipment category 1,2 or 3. G for Gas, D for Dust & GD combined gas & dust

5. Exh - Protection concept. Applies to internal and external zoning of fan.

6. IIB - This specifies the gas group. Gas groups are IIA typically propane, IIB ethylene and IIC hydrogen.

IIIB - This specifies the dust group. Dust groups are IIIA combustible flyings, IIIB non-conductive dust, IIIC conductive dust.

7. T4 - max surface temp gas. T1= 450ºC, T2= 300ºC, T3= 200ºC, T4= 135ºC, T5= 100ºC & T6= 80ºC

8. Gb Gc & Db - Equipment protection level for gas and dust both inside and outside fan case.

9. T175°C - max surface temp dust. Common values 110°C, 135°C, 145ºC

/ separation between internal and external of enclosed fan case. It should be clear if the fan is certified the same internally and externally or if these are different.

Maximum Surface Temperature

From the section on marking it can be seen that the maximum expected surface temperature inside / outside the fan case should be displayed. This is the highest of either:

1) Maximum temperature in operation due to heating e.g. bearings, seal friction etc.

2) Max temperature at fan outlet. This is as a result of the “work done” on the gas as it passes through the fan. The standard applies a 20% margin on the calculated/ measured outlet gas temperature in degrees celsius.

Note: it is NOT possible to ATEX certify a fan for a given temperature, for example T4, when the maximum design temperature of the gas already exceeds this. This may seem obvious but the author has seen countless examples of this especially on ID fans in the oil/gas & petrochemical industries.

Material pairings

Although the protection concept is ‘Exh’, by design the standard identifies that in the event of expected malfunction or rare malfunction there is a high possibility of contact between stationary and rotating parts. This would be the impeller inlet and inlet cone on a centrifugal fan and blade tips and casing on an axial fan.

The material parings have been selected to reduce risk of sparks and hot spots due to frictional rubbing in the event of movement between stationary and rotating parts.

In general, the common pairings are given in the following table.

A full list of all pairings with notes is given in EN 14986 clause 4.7.2 Table 1.

Common pairings found in industrial fans

Material 1	Material 2	Category 3	Category 1 & 2	Notes
Carbon & Stainless Steel Aluminium alloy	Navel Brass CuZn39Sn	yes	yes	Most common method used 3
Aluminium alloy	Aluminium alloy Navel Brass	yes	yes	1
Steel alloy Stainless steel Nickel alloy	Steel alloy Stainless steel Nickel alloy	yes	yes	2,3
Steel alloy	Brass CuZn37	yes	no	2 Brass should be the stationary part
Plastic	Plastic Aluminium Steel alloy Stainless Steel	yes	yes	4
Rubber coated material	Rubber coated material Steel alloy	yes	yes	5,3

Notes

1. *Aluminium should contain approx. 12% silicone. This gives a brittle structure which will fracture rather than deform under prolonged contact.*
2. *These pairings will cause sparks and therefore are restricted to; motor power 5.5 kW, relative rubbing speed 40 m/sec AND where the specified clearance between parts can be assured on installation and during use. Manufacturers' instructions should include details on how to measure and maintain clearance in use.*

Outside of these parameters, for example where fan is handling corrosive chemicals, other forms of protection are necessary.

3. *Stainless steel should be Austenitic non-magnetic.*
4. *The use of plastic should be carefully considered due to low thermal conductivity leading to hot spots, low mechanical strength and possibility of static discharge. For category 1 & 2 fans, plastic should withstand short term exposure to flames. Details should be given in technical documentation.*
5. *For rubber lined impeller, maximum tip speed 70 m/sec (223mm dia impeller at 3000 rpm, 446mm dia at 1500 rpm). Minimum clearances to be maintained in use.*

What can we conclude from this?

a) For most common methods of protection, correct brass must be used. If "Navel Brass" is NOT used then restricted to category 3 (zone 2 machines) and <5.5 kW & 40 m/sec rubbing speed (see C below).

b) Historically aluminium has been used as a non-sparking material, however if aluminium on aluminium is used the requirement for minimum silicone content may result in material being unsuitable for impeller.

c) If steel on steel or stainless on stainless is used this is limited to small fans (127mm contact diameter at 3000 rpm or 254mm at 1500 rpm). Also, user must be able to confirm clearance when fitted – often this is unrealistic. IOM manual should contain instructions on required gap and how to measure it. User should measure this gap record it and check it as part of maintenance procedures.

d) Plastics need careful selection and IOM should contain details of plastic used with regard to thermal, electrostatic and flame retardant properties.

Image: Shutterstock

Clearances between rotating elements and fan casing

En 14986 states: “the clearances between rotating elements and fan casing is the most important safety feature of ignition minimising fans.”

As such, it is important that this is not only correctly set by the manufacturer but also maintained in operation. As we have seen above regarding material pairings, there is a requirement for certain pairings that this is ensured on site.

The manufacturer’s instructions should give details on how this can be maintained on site. A fan supplied without this information is not an ATEX fan! Similarly, if a fan is installed with, for example, a steel on steel material pairing and no records of the actual running clearance when installed exists, then there is no certification. Bearing in mind the size restriction for such a pairing and the practical difficulties of measuring the clearance, it is difficult to justify such a selection in the vast majority of applications.

If you have an ATEX fan with no information on the running clearances or how to check them, you should ask why not.

Fan casing

These should be rigid design, generally with fully welded seams and designed to minimise leakage. If the fan is not gas tight or leakage rates are not known only one category difference between internal and external is allowed to take into consideration leakage.

Impeller construction

Impellers should be of rigid design, and either:
a) Tested at 115% running speed
b) Designed such that primary stresses (tangential, radial and bending) are 2/3 material yield stress.

A welded construction, cast or moulded with appropriate thicknesses, is deemed to satisfy the rigid design criteria without additional testing regarding rigidity. Conversely a lightweight design of say folded tabs or rivets would require some testing to ensure rigidity. Note rigidity and strength are easily confused, an impeller could be rigid (its resistance to deformation under an applied load) but fail due to strength (stress due to centrifugal loads under rotation), conversely a riveted impeller may pass the 2/3 stress criteria but deform under operation so as to reduce significantly the running clearances.

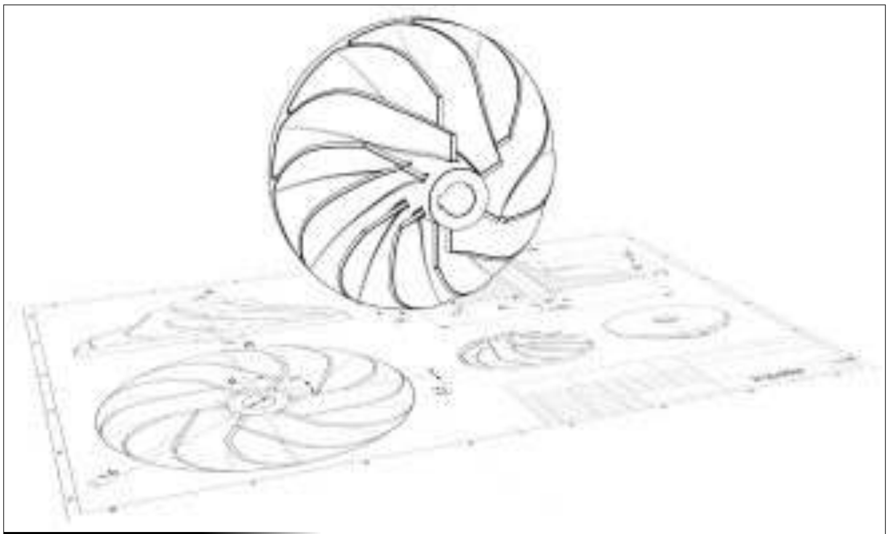


Image: Shutterstock

Whilst it is not reasonable for an end user to check a supplier’s calculations there should be in the fan documentation some indication that either an over speed test has been carried out or reference to impeller stress calculations.

Testing

EN 14986 does not specify a particular test procedure, but it does state that vibration levels should be to ISO 14696:2003. The easiest practical way to do this is to run test the fan. Fan documentation should refer to run test and show residual vibration levels. In the case of large units where a factory run test is not practical this may be done for instance on site with prior agreement.

There should be some reference to a run test and vibration readings in the fan documentation. If not, has this been done?

Technical file

Each ATEX fan should have a technical file. This is a comprehensive document identifying the fan and showing compliance with the detailed requirements of EN 14986. The technical file is not necessarily provided to the end user. For Category 3 machines the manufacturer or importer (the organisation that places the fan “on the market”) should keep the technical file for a minimum of 10 years after the product was last manufactured. For Category 2 & 1 equipment the technical file should be lodged with a notified body.

Note: this does not mean the notified body has any role in checking the technical file, it is simply an independent “safe” storage of the technical file should it be required to be inspected (possibly as a result of an explosion).

The quoting of a notified bodies’ reference for technical file storage on an ATEX certificate does not imply any form of approval/ inspection/certification from that notified body. This is a common misconception giving purchasers and users the false impression of third-party verification.

Documentation

Reverence has been made in proceeding sections to the documentation provided with the fan. This is substantially more than just an ATEX certificate, though this is important.

The document package should include:
a) Shipping and Storage instructions
b) Erection and Commissioning manual typically including:
   I) General installation notes
   II) Checks prior to installation
   III) Erection procedure
   IV) Pre commissioning & commissioning checks
   V) Bolt tightening torques
   VI) Sub supplier’s instructions (e.g. electric motor)
   VII) Minimum and maximum airflow rates required to maintain maximum surface temperature

VIII) Specific information regarding maintaining clearance between rotating and stationary parts

The manual should include relevant forms to focus the installer towards key items. These should form the basis of a check sheet to record such things as clearance vibration levels and ideally be returned to manufacturer

c) Operating and maintenance manual

I) Performance data
II) Detailed description
III) Health and safety
IV) Operation of the fan
V) Maintenance
VI) Fault finding and rectification
VII) Sub supplier's information
VIII) Fan application category (BV1-BV5) according to ISO 14694
IX) Specific information regarding maintaining clearance between rotating and stationary parts

d) Particle limitations with regard to ingress of foreign particles

e) Routine inspection and servicing.

This should make it clear that the ignition minimising properties of the fan and its accessories can only be retained if routine inspections and maintenance is carried out. It should address the following:

I) Inspection intervals taking into account operating conditions
II) Recommended spares
III) Wear of consumable components
IV) Inspection of rotating components
V) Seals and gaskets for fans having different categories internally and externally
VI) Any monitoring devices are regularly checked
VII) Additional cleaning requirements for category 2D & 3D internally fans where dust build up mare cause additional hazards

Clearly there are significant document requirements for all ATEX fans. If the fan documentation does not follow the above this should prompt further investigation.

Conclusion

We can conclude that in order to correctly install an ATEX fan there has to be a considerable interchange of information between User and Supplier.

If an ATEX fan is to be installed in either a new plant or existing, then there has to be interchanges of at least the following information:

- Zone and category of fans both internally and externally
- Gas/Dust group and maximum allowable surface temperature
- Normal and expected operating conditions
- Correct marking that captures the above items
- Information pertinent to maintaining the explosion protection features of the fan
- Certification showing compliance with relevant design code. (EN 14986 in most cases)
- Comprehensive documentation with regard to operating installation and maintenance

Whilst it is possible to buy fans that seem to have blanket certification, making the purchasing easy, the question has to be asked that if the above flow of information is absent then is it really an ATEX fan? ■

Image: Shutterstock

About the author

Scott Harding is Sales Director & joint owner of Woodcock & Wilson and is a member of the Nuclear Institute, National Nuclear Ventilation forum, SHAPA, and the Fan Manufacturers Association. He has over 28 years' experience in the industrial fan industry covering fan design, manufacture & process safety. He has lectured and presented on the ATEX fan standard EN14986 and the introduction of the IECEx non-electrical standard in 2016.

ECOM Presents World's First 10" Android Tablet for Hazardous Areas

The Tab-Ex® Pro expands the Tab-Ex series from the Pepperl+Fuchs brand ECOM and its range of mobile devices for Zone 2/22 and Div. 2 hazardous areas. With a 10-inch display, the Tab-Ex® Pro is perfect for viewing web-based content and for use in demanding applications. In addition, it enables workers to easily transition from the field to the office and back. The tablet is lightweight and easy to use despite its large screen and rugged construction.

www.ecom-ex.com

EEMUA Publication 177 - Guide to the UK Pressure Systems Safety Regulations (2000)

Edition 3 is a practical guide to interpreting the Pressure Systems Safety Regulations (PSSR) that relate to periodic examination of pressure systems.

This new edition with updated guidance on postponing examinations within Regulation 9, and revisions on Regulation 10 for acting in cases of Imminent Danger – including a flowchart to aid Competent Persons when they consider referrals to the British Health and Safety Executive (HSE). It gives additional guidance on modifying & repairing under Regulation 13, and also addresses Regulations 2, 7, 8 and Schedule 2.

As well as being a good companion document to the HSE 'Safety of Pressure Systems' Approved Code of Practice (free from the HSE website), much of the general advice in EEMUA 177 is relevant to practice outside the UK.

https://www.eemua.org/Products/Publications/Digital/EEMUA-Publication-177.aspx

Siemens and Dron & Dickson partnership creates promising competition for fire & gas electrical equipment supply

SIEMENS
DRON & DICKSON

The partnership gives Dron & Dickson UK distribution rights to the full Siemens Fire Safety range including fire protection systems accessories and components, detection systems, alarming and evacuation equipment, and extinguishing solutions.

Siemens Head of Fire Products Robert Yates stated: "Siemens are delighted to announce that Dron & Dickson are now a Solution Partner specialising in industrial fire products offering. With a long history in the Oil & Gas industry focusing on the electrical and hazardous markets and we look forward to a long and successful partnership."

Dron & Dickson Sales and Marketing Director Tom Irwin commented: "This partnership really emphasises Dron & Dickson's unique ability to understand our customers' needs and fulfil them from both a wholesale supply and engineering standpoint.

We really are more than a distributor with a unique in-depth knowledge of safety in hazardous and industrial areas and the associated legislation and requirements.

TEL: +44 (0)1224 874554


Chalmit®
LUNA
Temporary Lighting for Hazardous Areas
Reliable. Robust. Powerful.
• ATEX and IECEx certified
• 150,000 hours at 25°C
• -20°C to +50°C
• 50° Beam Angle
• IP66/67
• Linkable
• Lightweight 9kg
• Marine Grade Aluminium Enclosure
• IK10 Impact Tested
• Stainless Steel Frame
Download our mini catalogue now
Follow us
www.hubbell.com/chalmit/en/Temporary-EX-LED-Floodlight
HUBBELL
Harsh & Hazardous