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June 2019

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Belarus President Alexander Lukashenko said that the cost of the damage from contaminated oil received via the Russian Druzhba oil pipeline was "enormous", the state-run Belta news agency reported on May 11.

According to pipeline operator Transneft, the oil was contaminated with organic chlorine at the Samara terminal in southern Russia and four people have been arrested for sabotage, as we report on page 6 of this edition. The chlorine is used in oil production to boost output from near-exhausted wells but is highly corrosive within pipes and refinery plant.

Lukashenko said authorities were evaluating the situation of the country's affected pipelines, pumps and oil refineries, but that it was clear the costs could run into the hundreds of millions of dollars.

Russia halted oil flows along the pipeline in late April after Belarus revealed the contamination, and Eastern and Central European countries, including Germany, have had to find alternative supplies, which led to a spike in the oil price worldwide. Druzhba

normally supplies some 10% of European oil imports. The incident has tarnished Russia's reputation as a trustworthy supplier of energy products at a time of rising competition from other providers, including the US.

In a meeting with Transneft President Nikolai Tokarev in late April, Russian President Vladimir Putin recognised the gravity of the situation. He said the reputational, economic and material damages to the country were "very serious".

It remains to be seen how quickly Russia can flush out the contaminated product, estimated at up to five million tonnes, from the Druzhba network.

This episode, the latest in a number of supply disruptions over the years, highlights the problems facing those European countries that have chosen to rely on energy imports from Russia, and might persuade some of them to rethink plans for the new east-west pipelines planned for the future.

...Alan Franck, Editor, Hazardex



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Artist's impression of Crew Dragon capsule in orbit - Image: Shutterstock



SpaceX Crew Dragon explosion caused by capsule rocket malfunction

The investigation into an explosion during a test of the SpaceX Crew Dragon capsule at Cape Canaveral is just beginning and the impact on the return to human spaceflight from US soil is yet to be determined, according to NASA's Aerospace Safety Advisory Panel.

SpaceX was testing the astronaut capsule's SuperDraco engines at the space launch facility on April 20 when "the final test resulted in an anomaly on the test stand," according to a SpaceX statement.

The SuperDracos are designed to blast the crew capsule to safety in the event of a main rocket malfunction during launch.

Videos shot near the Cape Canaveral test site and from a leaked internal source show that the "anomaly" was an explosion. On May 1, Senator Richard Shelby, chairman of a Senate committee that manages NASA's budget, confirmed during a hearing that the incident caused the complete loss of the capsule.

NASA's independent Aerospace Safety Advisory Panel met on April 25 at the Marshall Space Flight Center and provided updates on the extensive human spaceflight certification both of the space agency's commercial crew providers -- Boeing with CST-100 Starliner and SpaceX with Crew Dragon -- are undergoing.

The panel also gave initial details about the Crew Dragon "anomaly" but said the investigation was just getting underway.

"The event occurred during a static fire test prior to in-flight abort test," Patricia Sanders, the safety panel's chair said. "The firing was intended to demonstrate integrated systems SuperDraco performance ... for abort environments."

"Firing of 12 service section Dracos were successfully performed, firing of eight SuperDracos resulted in an anomaly," Sanders said.

No one was hurt in the incident, but *Florida Today* said hazardous chemical compounds,

including nitrogen tetroxide, were released into the environment.

"The special propellants for the Crew Dragon capsule -- designed to carefully supply engine firings during liftoff anomalies and navigate the craft in space -- are far more dangerous than those used for the typical launch," the *Florida Today* report said.

"The test site was fully cleared, and all safety protocol was followed," Sanders said.

Boeing's CST-100 Starliner also experienced problems while testing its launch-abort engines in July 2018, which resulted in pushing the first uncrewed test flight of Starliner from April to August, according to Space.com.

The same SpaceX capsule had recently returned from its first successful uncrewed flight to the Space Station, also known as Demo-1. SpaceX was preparing the spacecraft for a launch abort test, which would demonstrate how the capsule blasts away from the rocket in case of a problem during a Falcon 9 launch.

SpaceX is leading the investigation into the mishap with "active NASA participation," according to Sanders. However, she said, the cause of the problem will determine the effect on the flight test with crew, currently slated for July.

SpaceX and NASA must now urgently work to discover the cause of the explosion as well as replace the capsule—calling into question NASA's stated goal of launching American astronauts into space from US soil by the end of 2019.

Safety panel member Sandra Magnus said during the meeting that regardless of the most recent mishap there are still technical issues SpaceX and Boeing need to resolve before the companies receive NASA's certification to launch astronauts into space.

NASA selected SpaceX and Boeing in 2014 to develop spacecraft to launch Americans from Cape Canaveral for the first time since 2011. The US currently pays Russia to transport its astronauts up to the International Space Station. ■

Image: Shutterstock



Arizona solar facility explosion raises questions about utility-scale battery safety

Eight firefighters from two separate groups were hospitalised on April 19 after an explosion and fire at an Arizona Public Service (APS) facility in Surprise, north-west of Phoenix, where utility-sized lithium batteries used in the storage and distribution of solar energy are housed. Four hazmat specialists from the Peoria Fire-Medical Department were seriously injured.

One specialist was left in a critical condition and two others were in serious condition, a fire department spokesperson told local media. Four additional firefighters from the city of Surprise were taken to a hospital with non-life-threatening injuries.

The explosion occurred as the Peoria Fire hazmat team entered the APS McMicken Energy Storage facility after smoke was seen rising from the site.

APS and local and federal authorities are conducting a full investigation into the cause of the explosion.

The storage system in Surprise was installed in late 2016 as part of an agreement between APS and AES Energy Storage for two 2-MW (megawatt) AES Advancion battery arrays in

Surprise and Buckeye. They were AES' first installation in Arizona and APS was among the first to own an Advancion battery storage array. AES and Siemens in 2017 combined to become Fluence.

Advancion battery array – Image: APS



In February, AES said it had won a contract from APS to deliver a 100-MW 4-hour duration Advancion battery-based energy storage system. This represents a substantial scaling-up of the Arizona utility's ambitions in this area and is an important part of its plans to add nearly one gigawatt of clean energy projects by 2025.

In response to the Surprise incident, *Utility Dive* published a report into the safety of utility-scale battery plants, which are proliferating across the USA and around the world as renewable energy (particularly solar

and wind power) take an increasing share of the energy mix.

Energy storage facilities are key to the success of renewable energy expansion as they enable electricity to be delivered when it is needed within the grid, rather than only when it is produced, as is the case with standalone solar or wind farms.

The US energy storage market nearly doubled in 2018 and is expected to double again in 2019.

The fire at its storage facility in Surprise was not the first such incident for APS, according to *Utility Dive*. Back in 2012, a 1.5-MW system near Flagstaff, Arizona, also caught fire. The utility said it took several key design lessons from this fire, including improving air ventilation between cabinets, incorporating a 24/7 monitoring system and the ability to send remote alarms.

Ravi Manghani, an analyst at Wood Mackenzie Power & Renewables, told Bloomberg, "If these fires continue to occur, it doesn't bode well for the industry in the short term and the storage market will almost certainly slow down."

The US Energy Storage Association earlier this month launched an initiative to make safety a priority when manufacturing and operating energy storage systems. A total of 30 companies, including GE Energy Storage, Duke Energy and NEC, formerly known as Nippon Electric Company, have signed the energy storage corporate responsibility pledge.

While most industry stakeholders declined to comment on the incident in Arizona, one told *Utility Dive* that the incident underlined the need for robust protocols for first responders and highlighted the importance of codes and standards.

Another expert interviewed by the publication ascribed the problem to the use of thousands of lithium-ion cells in close proximity, a poorly understood situation. He said he favoured the development of different, safer, battery technologies for this application, although this was a difficult proposition considering price constraints. [For more on this topic, see feature on page 21] ■



European pipelines could contain five million tonnes of contaminated Russian oil

Pipelines in Russia, Belarus, Ukraine and Poland are estimated to contain five million tonnes of contaminated Russian oil, Belarus's state news agency Belta announced on April 23. Russian oil pipeline operator Transneft said the oil in the 5,500 kilometre-long Druzhba pipeline from Russia to Europe was "deliberately contaminated" at a private terminal.

Transneft spokesman Igor Demin told reporters the oil was contaminated at the Samaratransneft terminal which receives oil from several small producers, according to Russia's TASS news agency.

The oil was contaminated with organochlorine, a substance used in oil production to boost output from near-exhausted reserves but can cause severe corrosion damage in refineries. Contamination with the chemical was found to be at levels much higher than the maximum allowable amount, 330ppm against 10ppm.

Russia has been holding talks with client countries after Poland, Slovakia, Ukraine, and Belarus shut down their sections of the Druzhba pipeline on or around April 23. Germany and the Czech Republic also suspended imports via the pipeline.

Several of these companies announced they would tap into emergency reserves to supply refineries.

Russian deputy energy minister Pavel Sorokin said that Russia expects that oil with standard levels of organochlorine will reach the Russian-Belarusian border by April 29 and that the Druzhba pipeline is expected to return to full normal deliveries within two weeks.

But on that date, Belarus state-run oil firm Belneftekhim said Belarusian refineries were still running at reduced capacity and deliveries were still halted.

So far Belarus has suffered the most among the buyer and transit countries,

according to *Die Welt*. Its economy is heavily dependent on oil from Russia, which it gets at a preferential price and processes in two refineries to gasoline, the country's main export and foreign currency producer. Minsk also cashes in on all the oil that passes through the country through transit fees.

The suspension of the Druzhba network and shutdown of gasoline production are a heavy blow to the country's already weak economy. In addition, *Die Welt* says, processing equipment in the Masyr refinery has reportedly been seriously damaged by the organochlorine. At the end of April, Minsk estimated its losses at \$100 million (€89.4 million), and subsequently said that the final bill would be significantly higher.

On May 7, Russian Energy Minister Alexander Novak said that Russian investigation services had revealed a group of companies had introduced the contaminated oil into the Druzhba pipeline network at the Lopatino metering unit in the Samara region in southwestern Russia.

He said a criminal case had been initiated and that four people were detained because of their involvement in the incident.

The minister said uncontaminated oil would start running through the Druzhba pipeline to all the foreign consumers in the second half of May. He said clean oil had resumed pumping through the pipeline to Belarus and Ukraine.

The pipeline divides into two near Masyr. The smaller southern line leads across Ukraine into Hungary, Slovakia and the Czech Republic. According to Ukrainian pipeline operator Ukrtransnafta, clean Russian oil could reach these EU countries on May 18. This would still mean a delivery interruption of more than three weeks for these customers.

How long Poland and Germany will have to wait for Russian oil, however, remains unclear. These countries are supplied via the much larger northern section of the Druzhba pipeline, which seems to be clogged with a considerable amount of the contaminated oil. This material must first be removed and disposed of.

Druzhba network map - Image: IEA



Russia has not offered specifics about how it planned to clean out the full Druzhba network but *Die Welt* said it was initially attempting to mix the contaminated oil in Belarus with clean supplies.

Transneft will load contaminated oil Russian state railway tanker cars and take them to the Russian Black Sea port of Novorossiysk, where it will be mixed with clean oil, pumped into tankers and exported. This same mixing technology will also be used in the Russian Baltic Sea port of Ust-Luga.

To carry out this operation for the millions of tonnes of affected oil in the northern branch would be difficult, industry observers say, and would potentially cost billions of dollars.

Refineries affected include those owned in Poland by PKN Orlen and Grupa Lotos, as well as plants in Germany owned by Total, Shell, Eni and Rosneft.

This is a serious blow to Russia, both economically and politically. Druzhba has a capacity of 1 million barrels per day (bbl/d), amounting to 1% of global crude demand, and the country was trying to take advantage of higher prices to maximise production and exports.

The political import was highlighted when Russian President Vladimir Putin on April 27 called for an inquiry into the incident to be carried out as quickly as possible. Oil and gas are the country's principal exports and future expansion could be jeopardised if it gets a reputation as a supplier of sub-standard or even dangerous product. ■



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Explosion on Indian Navy aircraft carrier kills one, injures nine

A blast in a steam pipe in the engine room of Indian Navy aircraft carrier **INS Vikramaditya** caused a fire that claimed the life of a naval officer on April 26 at the Kadamba naval base near Karwar in Karnataka, western India. Nine others were injured in the incident.

The blast damaged a fuel pipe causing the fire in the carrier's engine room. The fatality was hit by a jet of hot steam when he went into the smoke-filled room to fight the fire, local sources said.

As soon as the fire was noticed in the fuel

pipe, the fire-fighting crew immediately cut the fuel supply preventing any further damage. The sprinklers in the engine room were also automatically activated and the fire was brought under control. There were 1,300 men on board the carrier when the incident occurred, the sources added.

The fire broke out on Deck 3 of the vessel and damaged two compartments. The vessel has 21 decks and a thorough investigation has been ordered to prevent such incidents in future. Six of the nine injured Navy personnel who are being treated at the Naval Hospital in Karwar were said to be recovering.

Formerly the Admiral Gorshkov in the Russian Navy, the carrier was purchased by India in 2004 and was commissioned into service in the Indian Navy in 2013. INS Vikramaditya carries an air group of up to 34 units including the Mikoyan MiG-29K, an advanced, all weather multi-role fighter, and Kamov Ka-31 helicopters.

On 10 June 2016, while undergoing a scheduled major refit, two people were killed by a toxic gas leak on the vessel while maintenance work in the Sewage Treatment Plant compartment was being carried out. Two other people were injured. ■



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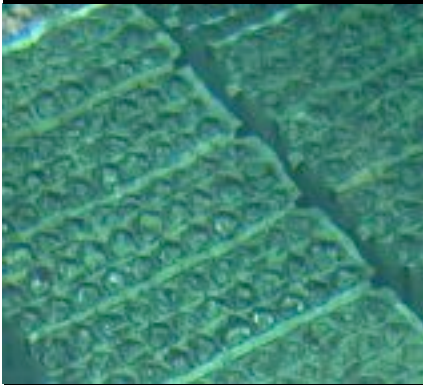
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Nuclear fuel rods in Unit 4 pool - Image: Tepco



Tepco begins removing first fuel rods from Reactor 3 at crippled Fukushima nuclear plant

Tokyo Electric Power Company (Tepco) started removing nuclear fuel on April 15 from the Fukushima-Daiichi Unit 3 storage pool, located in one of the reactor buildings damaged by hydrogen explosions in the 2011 disaster at the site. This is a major milestone in the arduous multi-billion dollar clean-up operation.

There are a total of 1,573 fuel rods, including unspent ones, inside the storage pools at Units 1, 2 & 3, and the large amount of spent fuel is a huge obstacle to decommissioning the crippled reactors as they will continue to generate heat and high levels of radiation for an extended period.

The start of the work has been delayed by more than four years due to a series of malfunctions of the devices necessary for the operation, some due to the exceptionally high levels of radiation in areas of the wrecked reactors.

Tepco said it plans to remove seven unspent fuel rods from the Unit 3 reactor's pool, where a total of 566 spent and unspent fuel rods are


stored, and transfer them to another storage pool on the premises later this month. The work is planned to be completed by the end of March 2021. These seven rods pose a relatively low risk, according to the *Japan Times*.

In 2014, Tepco completed fuel removal work from the pool linked to the No. 4 unit, which was offline for regular checks at the time of the accident and had all of its fuel stored in the pool. Unlike Units 1 to 3, it did not suffer a meltdown.

The utility said it aims to start fuel removal work from pools at Units 1 and 2 fiscal 2023, and has been assessing their surroundings. Of the six reactors at the plant, Units 1, 3 and 4 units suffered hydrogen explosions after the disaster.

The previous day, Japanese Prime Minister Shinzo Abe toured the Fukushima plant complex and nearby areas to check on reconstruction progress since the 2011 crisis. ■



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Drones carry out comprehensive survey of highly-contaminated hot spots around Chernobyl

A team of British scientists has completed the most comprehensive survey yet of Chernobyl's Red Forest – one of the most radioactive sites on Earth. Using fixed-wing and multi-rotor drones fitted with custom-built radiation detectors, researchers created detailed 3D maps that revealed previously undetected radiation hot-spots.

The two-week expedition in April 2019, led by Professor Tom Scott of the UK's National Centre for Nuclear Robotics (NCNR) and the University of Bristol, was the first of several survey missions that the NCNR will undertake in Ukraine over the coming 12 months. 33 years on from the catastrophic accident at the Unit 4 reactor, and with 70,000 tourists visiting the Chernobyl exclusion zone last year, national authorities urgently require accurate radiation maps to update safety protocols to inform both future tourism activity and the ongoing construction of solar energy farms in the area.

Cleaning up legacy nuclear waste is not only an issue at Chernobyl; the UK has 4.9 million tonnes of contaminated material requiring safe disposal, some of which dates back to the 1950s [source: Nuclear Decommissioning Authority]. The National Centre for Nuclear Robotics was created to accelerate and reduce the cost of Britain's nuclear clean-up task by developing state of the art robotics, sensing and AI technologies for carrying out work in complex and hazardous environments.

That expertise is now being called upon internationally.

Working alongside colleagues from Ukraine's SSE Eco Centre, the body responsible for gathering survey and research data within the 2600 sq.km. Exclusion Zone, the UK team flew 50 sorties over 10 days, spending 24 hours in the air to map an area of 15 sq.km.

Starting at the lowest risk site first, the village of Buriakivka, located 13 km from the accident epicentre, researchers then moved on to the partially-demolished settlement of Kopachi before tackling the Red Forest.

In a world first, fixed-wing drones were used to quickly map radiation over larger areas, flying at a height of between 45m and 60m at a speed of 65 km/h. Rotary drones were then used for more detailed investigation of key areas. The aircraft featured a unique sensor system developed jointly by Professor Scott's team and University of Bristol spinout, Imitec Ltd.

With the fixed-wing drone able to fly lower and slower than a manned survey aircraft ever could, and without risk to life, the NCNR team was able to create the most comprehensive radiation map yet of the Red Forest.

Their survey not only reaffirmed current understanding of the radiation distribution at an unprecedented spatial resolution,

it revealed unexpected areas of major contamination in Kopachi. Registering a dose-rate of greater than 1 millisievert per hour (nb. the maximum permissible dose not requiring an individual's classification as a Radiation Worker in the UK is 6 mSv per year), the area is believed to contain material from the original emergency clean-up activities performed over three decades ago.

Professor Scott said, "We have successfully demonstrated that the UK now has the capability to monitor radioactive sites and respond to nuclear incidents without exposing humans to risk – a guiding aim of the National Centre for Nuclear Robotics. We can fly into a contaminated area from a safe zone, perhaps 10 km away from the incident site, and gather detailed information – streaming it live during the flight before returning safely to base".

Professor Scott continued "The same technology has applications in other sectors too. For example, it could be used to identify rare earths, gold or copper mineral deposits, quickly, cheaply and non-invasively. This could be especially useful for developing nations keen to assess the extent and value of mineral resources ahead of, say, signing away mining rights."

NCNR recently started a long-term project at Chernobyl, with drones being deployed to 3D map gamma and neutron radiation – a world first. ■



Trump administration loosens Obama-era offshore oil and gas safety rules

On May 2 the US Government made public changes to offshore drilling safety regulations, which had been imposed by the previous administration after the 2010 Deepwater Horizon disaster in the Gulf of Mexico. This event killed 11 people and released almost 5 million barrels of oil into the sea, the worst oil spill in American history.

Interior Secretary David Bernhardt, a former oil lobbyist who was confirmed by the Senate last month to head the department that oversees the nation's public lands and waters, announced the new rules in Port Fourchon, Louisiana, the major onshore base for most companies that drill in the Gulf of Mexico.

Bernhardt called the rule change an elimination of "unnecessary regulatory burdens while maintaining safety and environmental protection offshore."

The oil industry praised the move. Environmental groups warned that the laxer rules could pave the way for similar crises to happen again.

Among the safety changes put in place is a significant loosening of requirement for oil

companies to test blowout preventers, the last line of defence against well blowouts, and which were at the heart of the Deepwater Horizon disaster.

Other changes to the Well Control Rule included loosening requirements for real-time monitoring of offshore drilling operations and easing requirements for companies to hold third-party certifications of easy access emergency equipment, to be used in the case of explosions or oil and gas leaks from wells.

According to the *New York Times*, the new rules included some changes that had been sought by the American Petroleum Institute, the lobbying arm of the oil industry. A bipartisan commission appointed by President Barack Obama to investigate the Deepwater Horizon disaster had specifically cautioned federal regulators against following the institute's guidance, writing in its 2014 report that "API-proposed safety standards have increasingly failed to reflect best industry practices and have instead expressed the 'lowest common denominator.'"

This move can be seen as part of the Trump administration's programme to facilitate the expansion of offshore drilling

in the nation's coastal waters. Last year the Interior Department proposed opening almost the entire United States coastline to drilling, although Bernhardt recently said the administration may delay those plans while court challenges are addressed.

The Department said that 80% of the original rule was left unchanged under the revision and that the alterations would provide "smarter regulation" and give more regulatory certainty.

Separately, last September, the Interior Department's Bureau of Safety and Environmental Enforcement (BSEE) moved to ease provisions of another key drilling rule focused on safety requirements for the period when an offshore platform is producing oil and natural gas, rather than the drilling process.

The BSEE also announced a new plan last March to increase the time officials spent physically inspecting oil rigs, but drop the frequency of their visits, a move it argued was more efficient.

The final rule will become effective 60 days after it is published in the Federal Register, which is expected to happen this week or next week. ■

Image: Shutterstock



Russian-linked malware found in second Saudi facility

Malware linked to an attempt to sabotage a Saudi petrochemical plant in 2017 has been discovered in a second facility in that country, according to cybersecurity consultancy FireEye. Researchers found evidence of the malware in an unnamed critical infrastructure facility.

The group used a host of different techniques to infect the facility with the malware, but the

intention of the attack – either sabotage or destruction – is still unclear. FireEye is urging industrial control system (ICS) managers to use the information in its report to identify whether the so-called Triton malware is present in their own facilities.

In a blog post, the cybersecurity group said: “This attack was no exception. The actor was present in the target networks for almost a year before gaining access to the Safety

Instrumented System (SIS) engineering workstation. Throughout that period, they appeared to prioritise operational security”.

It is thought that the Triton hackers may have been operating since as early as 2014. Despite being several years old, some of the tools used by the group have not been encountered before which researchers suggest could be an indication that other facilities have been compromised without detection.

The malware’s origins were a mystery when FireEye first discovered Triton in 2017. However, following further research in 2018, FireEye assessed with “high confidence” that the Central Scientific Research Institute of Chemistry and Mechanics (CNIIHM), a Russian government-owned technical research institution located in Moscow, was involved in the attacks.

Despite the sophistication of the attack, the 2017 attempt on the Saudi petrochemical plant failed due to a bug in the malware’s code. ■

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Chinese-owned company fined for fatal 2016 blast at Canada oilsands site

CNOOC Petroleum North America, formerly known as Nexen Energy, has been fined \$450,000 after pleading guilty to charges following the deaths of two oilsands workers at its Long Lake facility in northern Alberta. The two men died from an explosion at the Long Lake SAGD and upgrader facility near Anzac on January 15, 2016.

The Chinese-owned group had earlier denied responsibility for the incident, saying the men were working outside the scope of their approved work activities changing valves on a compressor when the explosion happened.

Nexen Energy was charged by Alberta Labour in 2017 with workplace offences under the Occupational Health and Safety Act. Some of the charges related to ensuring a compressor was properly serviced and that staff in charge of the equipment had read its operating manual and safety rules.

The company initially pleaded not guilty in March last year, but on April 18 at Fort McMurray provincial court subsequently changed this to a guilty plea in failing to ensure the health and safety of the men. ■



Third Arkema manager charged over Hurricane Harvey incident

A grand jury has indicted another senior employee of Arkema, almost two years after two other senior employees were charged with “recklessly” releasing a toxic cloud of chemicals during Hurricane Harvey. Michael Keough, vice president of logistics, was indicted on felony assault charges due to “misrepresentations” he made following flooding in August 2017 at the Arkema plant in Crosby, Texas,

which caused fires and toxic chemical releases on the site.

Following the indictment, announced on April 10, local media quoted Harris County District Attorney Kim Ogg as saying that Keough had misled authorities and put first responders in harm’s way by claiming the plant had off-site, real-time data monitoring that enabled early warning of potential exposure to toxic chemicals.

The incident led to the forced evacuation of 200 residents nearby and 21 people, including first responders, were treated for injuries, mainly from the inhalation of toxic chemicals.

During a press conference, Ogg said that company employees are rarely charged over environmental violations, but that civil regulations had proven insufficient to protect the public. She said that corporations are too often allowed to simply pay a fine, rather than being made to change their behaviour.

In a statement on behalf of Arkema, Attorney Rusty Hardin called the indictments an “outrageous attempt to criminalise a natural disaster” and “a political prosecution in search of a theory”.

Similarly, in a statement on behalf of Mike Keough, Attorney Dan Cogdell claimed what happened was not a crime and that Keough provided safety information hours before the first fires even started which, if followed, would have increased safety for the first responders.

Keough is the third employee of the US subsidiary of the French chemicals giant to be indicted over the incident, following charges against chief executive, Richard Rowe, and the manager of the Crosby plant, Leslie Comardelle, in August 2018. They were each charged with reckless emission of air contaminants and endangerment of persons under the Texas Water Code which carry a penalty of up to five years in prison for each person and up to a \$1 million fine for Arkema. ■



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Every two months, IECEx Chairman Prof. Dr. Thorsten Arnhold provides an update on developments within his organisation.

I must confess that I am not totally convinced of all the supposed blessings of digitalisation. During my professional career, I have visited many manufacturers in many different industries all over the world and most of those with the highest levels of automation continue to employ significant numbers of manual workers, whether in production, transport or logistics.

Every day we see tens of thousands of trucks on our highways driven by experienced and responsible drivers. In the supermarket, I am happier to pay the cashier directly rather than attempt to use a checkout machine that will only allow me to pay on my third attempt, and then only when a human assistant comes over to help!

Call me old-fashioned, but I can't help but wonder what is going to happen to all those people once we are completely enveloped in the digital age with all the innovations and consequences we read about daily in the media, such as autonomously driven trains, ships and vehicles as well as robots dealing with the entire logistics chain in factories and supermarkets.

The pros and cons of digitalisation

The common reply to these concerns is – don't worry too much. Apparently, there will be many new jobs available for people in the age of digitalisation. A study by a US IT consultancy recently suggested several new job profiles in this brave new world including designer of aero taxis, planner of e-sport stadiums, smart-home designer and recycling specialist for data trash. Very good! But are these jobs realistic alternatives for forklift and truck drivers or factory hands?

Despite these concerns, I cannot deny the fact that we can expect many benefits from digitalisation in the hazardous area sector.

At its most basic, to keep standards of safety high throughout the whole operational life of equipment in these areas, it is necessary to conduct regular inspections and maintenance. But those responsible might have to manage a couple of thousand products covered by 'Ex' or functional safety standards, and when paperwork is involved, this can often prove an impossible task.

Now, however, thanks to digitalisation, equipment in hazardous locations is becoming smart.

One advantage is the easy identification of individual products by means of digital type labels. Inspection plans, equipment data, facility layouts, inspection records, repair protocols and many other important data are stored in special data banks.

If an inspection job is due, the database informs the technical management of the plant and the inspection plans and other necessary information are downloaded on tablet computers or smart phones.

These devices together with cameras, smart glasses and other digital

equipment establish a mobile worker concept for process plants, including hazardous areas.

If questions emerge during the work in the plant, experts or supervisors can be contacted, pictures can be taken and transmitted. After the job is done, the new data can be uploaded easily to the database. No more paperwork is necessary, the efficiency of work increases dramatically and sources of failure are removed.

No wonder that process industries are so eager to introduce these new systems into their plants, and so far, so good. However, these shiny new possibilities can make you forget that all these smart devices are powered by electrical energy, normally stored in batteries. As a consequence, those products have to meet all requirements which electrical products intended for use in hazardous areas have to fulfil.

At IEC and IECEx we have recognised these specific issues and their importance for the market. We have established a special IEC working group to deal with questions on how modern mobile digital devices can be safely transformed to meet the requirements of hazardous area standards.

Furthermore, we are making special efforts to intensify market surveillance. IECEx will be working hand in hand with the EU's ATEX ADCO to quickly ban unsafe mobile products from global markets, and a new working group dealing with these issues started work in May 2019 at the Singapore Meetings of IECEx.

So in hazardous areas at least, digitalisation is to be welcomed, and supporting this process will be a crucial part of the IECEx mission into the future. ■

Scotch Whisky Distillery – Image: DPS



Challenges and opportunities: Scotch whisky sector beyond c

Last autumn, the Scottish Environment Protection Agency (SEPA) launched its first Sector Plan with a focus on one of the biggest industries in Scotland: Whisky.

SEPA identified the opportunity which exists, saying: “The sector plan focuses on unlocking the potential of beyond compliance opportunities, building on the exceptional performance of the sector by achieving above 90% in SEPA’s Compliance Assessment Scheme four years in a row, while tackling the remaining compliance issues.”

This sector plan is not about implementation, because all but a small number of distilleries in Scotland fulfil their obligations, says Paul Guppy of DPS Group. This is about a new key phrase which is becoming increasingly important, moving beyond compliance.

The Scotch Whisky sector is of prime importance to the country’s economy. It is responsible for over 10,000 jobs, with a further 40,000 supported across the UK. For example, some 90% of grain used in the whisky-making process comes from UK farms.

There are currently 20 million oak casks lying maturing in Scotland at 126 distilleries. Over a third of these distilleries are planning or undertaking new developments. The whole environment must be managed extremely carefully because of the hazards inherent in the manufacturing process, from the grain to distilling, cask filling, maturation and storage, right through to bottling.

The actual number of distilleries is growing; up over 10% in five years and it should rise by almost the same again in the next 12 months.

I could use the word booming, but when it comes to this high hazard industry, that might be an unfortunate term to use.

In its Sector Plan, SEPA says: “compliance is not up for discussion”. This is recognised by most whisky companies - the best have always recognised the need for the highest standards of safety and quality in the workplace.

Now, we are seeing a new trend; a focus on the value that this approach can bring to a business, both on and beyond the bottom line. Rather than seeing compliance as a necessary cost, businesses are seeing that regulatory excellence can drive productivity and profitability.

This evolving approach is not just about making more, but wasting less, being effective with resources and minimising risks



Taking the compliance

– going beyond necessity to grasp a raft of new opportunities, including in the fields of safety and environmental integrity.

In practice there are several areas where the Scotch Whisky Industry has signed up to achieving beyond compliance, which SEPA recognises.

For example, improving water efficiency by 10% will have a significant environmental advantage, but will also improve the bottom line. Water costs in so many ways.

Energy is also vital. SEPA reports that 85% of energy in distilleries is used to generate heat for the distillation process and to heat buildings.

Installing an Anaerobic Digestion Plant enables the company to recover energy from the waste created by the distillation process, reducing costs and potential discharges.



At North British Distillery in Edinburgh, for example, we expanded their Anaerobic Digestion facilities by installing a water treatment plant to clean effluent, allowing for 40% of water to be recycled, with the remainder being discharged to the local sewer.

We then installed a gas engine to produce electricity from the biogas produced by the Anaerobic Digestion reactors.

This investment resulted in improved effluent quality, lower effluent charges, biogas used for electricity and steam generation, reduction in water usage, reduced energy costs, and the reduction in waste output load from the plant. A good example of going beyond mere compliance to create opportunity and efficiency.

When it comes to ATEX hazardous area testing, things are also changing.

Traditionally, regular testing has required significant resource. Tens of thousands of tests often need to be carried out, often by large teams of staff in what feels like a never-ending process.

At a Shetland Gas Plant some years ago, 45 of our engineers racked up 120,000 hours of testing, conducting 75,000 inspections on site-wide electrical, instrumentation and telecom packages.

This time around? Things would be different because we have introduced digital ATEX

inspections with reports, actions and records all directly uploaded to a cloud-based register live from handheld terminals carried by the engineers.

Going paperless feels a bit last decade, but the technology is now available to make risk-based assessments as a part of the inspection process and to streamline the process and to take a smart and compliant approach to inspection frequency for each device.

There is no explicit requirement for a company's ATEX regime to be digital or paperless, but surely solutions which go further, and improve commercial outcomes are a no-brainer.

Readers will know all about ATEX 137, the European directive which became mandatory for all relevant workplaces on 1st July 2006, which seeks to improve the safety and health protection of employees at risk from potentially explosive atmospheres.

The digital system that we have adopted is built on a data management software platform enabling us to proactively manage hazardous area testing and inspection processes by performing mobile inspections on-site using ATEX certified Android tablet devices.

The whole process is designed to manage electrical and non-electrical inspections in potentially hazardous areas, providing for



of common areas that distilleries need to consider when preparing their inspection regime.

Providing a complete solution which can be implemented throughout the entire process is key to a joined-up approach.

The process starts in the grain handling areas where equipment for grain silos, transfer conveyors and instrumentation within Zones 20, 21 and 22 must be checked.

It then moves through different stages to spirit handling and storage where the area classification would include Zones 0, 1 and 2, so there is a need to cover all protection concepts under IEC60079 standards.

Some of the common misunderstandings about compliance in the distilling industry include how often you need to inspect your equipment.

immediate access to data, early warning signs of equipment failure and immediate cost and time savings.

This is another example of how the beyond compliance culture is becoming more important as data helps businesses to make

smart decisions based on evidence and in real time.

Each distillery has its own unique way of making whisky, which can present challenges for compliance inspection engineers. Despite this, there are a number



Traditionally, there have been regular, scheduled full site inspections or a rotating schedule of inspections working their way around like painting the Forth Rail Bridge.

In reality, a bespoke digital system can optimise the inspection regime by implementing Risk Based Inspection (RBI) scoring techniques. These techniques can not only be applied to the inspection, but also to manage the remedial action strategy.

This approach to managing the DSEAR register optimises both the inspection and repair strategies which support cost control and maintenance management processes.

New solutions to make distilleries safer – and more effective, to reduce waste, improve energy efficiency – are all part of the overall mix that will shape the future of the sector.

Standards of health, safety, environment and quality are only going one way. As sectors like whisky become stronger, so does the need to unlock value from a beyond compliance approach.

That is why we can be sure that companies which ready themselves by turning compliance into an opportunity rather than merely a legislative requirement are likely to be the winners. ■

About the author



Paul Guppy is Project Director at DPS, the UK-based integrated Electrical, Instrumentation & Control provider. Originally trained as an Instrument Service Engineer, he now manages service and maintenance contracts as well as customer support on projects from design to completion.

Loch Lomond Distillery case study

Project Overview

Loch Lomond Distillery was commissioned by the Littlemill Distilling Company in 1964 with first distillation in 1966. In 1984, the distillery closed - or fell silent, to use the traditional term.

Fortunately, Alexander Bulloch and the Glen Catrine company acquired the business and resumed malt production in 1987. Grain whisky production began in 1993 and two new malt stills were added in 1999.

Challenge

Loch Lomond Distillery faces unique challenges because of the extensive nature of the site. Like all distilleries, it must also meet the very high standards demanded of the Scotch whisky industry.

The team at Loch Lomond Distillery wanted to ensure that they not only met the requirements for IEC60079, but also set an example of best practice by going beyond the legislative requirements, or beyond compliance.

To do this, DPS Group worked with the distillery to introduce a fully compliant paperless ATEX Inspection system, which would be accessible by all relevant staff. The previous approach was cumbersome and potentially unreliable.

Managing thousands of ATEX rated devices and the ability to easily distinguish between intrinsically safe and other protection concepts was particularly important to the management team.

Importantly, downtime was to be minimised. Ultimately the Loch Lomond Distillery management team were looking at a long-term solution which would minimise ongoing costs at a time when demands on compliance are continuing to rise.

Solution

DPS Group introduced a paperless

inspections system, supported by a new circuit identification standard, to Loch Lomond distillery.

The system provides live, real-time reporting and asset management, ensuring that staff are always ahead of the curve by implementing an inspection schedule that can be managed based on risk.

In Detail

The paperless ATEX system used for Loch Lomond Distillery allows clients to streamline administration, with a potential to save up to 40%.

As part of the set-up, DPS conducted a comprehensive site survey, building up an accurate asset register giving a clear picture of the equipment across the entire site.

A tailored inspection package was devised for management approval, after which our team then began inspections based on a clear understanding of the areas of priority and high risk.

Whilst this was being carried out, each asset underwent an independent risk assessment resulting in a reinspection schedule based on condition, location and risk.

This bespoke schedule should allow cost reductions in future years without comprising safety.

Using a completely digital asset register means that information is always up to date, and always available because it is updated in real-time. This is useful for identifying problems earlier, and improving planning schedules for remedial works.

The system supports root cause analysis to determine common faults. We can then help clients plan in when issues could arise. Such an approach has an immediate benefit in terms of increased productivity. ■



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Lithium-ion Battery Energy Storage Systems - The risks and how to manage them

The rapid rise of Battery Energy Storage Systems (BESS's) that use Lithium-ion (Li-ion) battery technology brings with it massive potential – but also a significant range of risks.

AIG Energy Industry Group says this is one of the most important emerging risks today – and organisations that use this technology must balance the opportunities with the potential downsides.

The market for BESS technology and Li-ion batteries is growing very rapidly and demand is coming from a wide range of industries and users, many of which are not aware of the risks involved. Consumers are using Li-ion battery technology extensively in their everyday lives – in everything from smartphones to laptops and hybrid cars – and organisations are embracing BESS technology for everything from renewable energy storage to electric cars.

Are these systems safe?

Fire is a major risk, with a number of Li-ion battery-related incidents hitting the headlines in recent years, from exploding Samsung smartphones to electric car fires and even a Dreamliner catching fire at Heathrow, along with a Hawaiian BESS facility fire. One of the most concerning features of battery fires is that they can seemingly ignite or reignite days or weeks after they were thought to be extinguished.

For now, companies that want to use BESS's must assess their fire protection challenges and reduce their risks wherever possible

In this report, we look at the development of BESS's, with particular emphasis on those supplied by Li-ion battery technology and consider the associated risks – as well as what organisations can do to minimise their exposures.

What are Battery Energy Storage Systems?

Battery Energy Storage Systems (BESS's) are a sub-set of Energy Storage Systems (ESS's). ESS is a general term for the ability of a system to store energy using thermal, electro-mechanical or electro-chemical solutions. A BESS utilises an electro-chemical solution.

Essentially, all Energy Storage Systems capture energy and store it for use later. Examples of these systems include pumped hydro, compressed air storage, mechanical flywheels, and BESS's. These systems complement intermittent sources of energy such as wind, tidal and solar power in an attempt to balance energy production and consumption.

Energy storage results in a reduction in peak electrical system demand and ESS owners are often compensated through regional grid market programs. Regulators also offer incentives (and in some cases mandates) to encourage participation.

Types of BESS

BESS's use electro-chemical solutions and include some of the following types of batteries:

- **Lithium-ion** – these offer good energy storage for their size and can be charged/discharged many times in their lifetime. They are used in a wide variety of consumer electronics such as smartphones, tablets, laptops, electronic cigarettes and digital cameras. They are also used in electric cars and some aircraft.
- **Lead-acid** – these are traditional rechargeable batteries and are inexpensive compared to newer types of batteries. Uses include protection and control systems, back-up power supplies, and grid energy storage.
- **Sodium Sulphur** – uses include storing energy from renewable sources such as solar or wind.
- **Zinc bromine** – uses include storing energy from renewable sources such as solar or wind.
- **Flow** – flow batteries are quite large and are generally used to store energy from renewable sources.

Why are BESS's gaining popularity?

All types of BESS offer pros and cons in terms of capacity, discharge duration, energy density, safety, environmental risk, and overall cost. However, BESS's using Li-ion batteries are by far the most widely used system today. This is primarily due to their high energy density and steady decrease in cost.

Decreasing costs

A major factor in the rapid increase in the use of BESS Li-ion technology has been a 50% decrease in costs of energy storage over the last two years. While costs are still high compared to grid electricity, the cost of energy storage has actually been plummeting for the last 20 years. ^[1]

Storage systems can also decrease the need to invest in new conventional generation capacity, resulting in financial savings and reduced emissions from generating electricity. Using storage systems also means fewer and cheaper electricity transmission and distribution system upgrades are required.

Storage systems at the utility customer level can also result in significant savings to businesses through smart grid and Distributed Energy Resource (DER) initiatives, where cars, homes and businesses are potential storers, suppliers and users of electricity.

In a virtuous cycle, the growing market will lead to increased production of BESS's, which will lead to lower prices, which will increase the size of the market further.

Security of supply

Storage technologies are also popular because they improve energy security by optimising energy supply and demand, reducing the need to import electricity via interconnectors, and also reducing the need to continuously adjust generation unit output.

In addition, BESS's can provide system security by supplying energy during electricity outages, minimising the disruption and costs associated with power cuts.

Another reason for the rising popularity of storage systems is that they can enable the integration of more renewables, such as solar, tidal and wind power, in the energy mix.

Financial incentives

Many governments and utility regulators are actively encouraging the development of battery storage systems with financial incentives, which is likely to lead to further growth.

What are the risks involved?

While the use of batteries is nothing new, what is new is the size, complexity, energy density of the systems and the Li-ion battery chemistry involved – which can lead to significant fire risks.

These risks are exacerbated by the fact that many of the new users of BESS's are not energy specialists. Previously, these systems would have been used by companies that had an in-depth understanding of their uses and potential dangers. Today, a buyer of a BESS is just as likely to be a property

developer, council or university, with limited understanding of the inherent hazards.

Thermal runaway

'Thermal runaway' – a cycle in which excessive heat keeps creating more heat – is the major risk for Li-ion battery technology. It can be caused by a battery having internal cell defects, mechanical failures/damage or overvoltage. These lead to high temperatures, gas build-up and potential explosive rupture of the battery cell, resulting in fire and/or explosion. Without disconnection, thermal runaway can also spread from one cell to the next, causing further damage.

In BESS's that utilise lead acid batteries, hydrogen evolution can result in explosive atmospheres unless proper ventilation methods are employed

Difficulty of fighting battery fires

Battery fires are often very intense and difficult to control. They can take days or even weeks to extinguish properly, and may seem fully extinguished when they are not.

They can also be very dangerous to fire fighters and other first responders because, in addition to the immediate fire and electricity risks, they may be dealing with toxic fumes, exposure to hazardous materials and building decontamination issues. Different types of batteries also react differently to fire, so firefighters must be knowledgeable about how they react and how to respond. Otherwise they may decide to contain the fire but leave it to burn itself out leading to the loss of the entire facility

RFID warning zones



Failure of control systems

Another issue can be failure of protection and control systems. For example, a Battery Management System (BMS) failure can lead to overcharging and an inability to monitor the operating environment, such as temperature or cell voltage.

Sensitivity of Li-ion batteries to mechanical damage and electrical transients

Contrary to existing conventional battery technology, Li-ion batteries are very sensitive to mechanical damage and electrical surges. This type of damage can result in internal battery short circuits which lead to internal battery heating, battery explosions and fires. The loss of an individual battery can rapidly cascade to surrounding batteries, resulting in a large scale fire.

Case studies

BESS's employing Li-ion batteries and Li-ion batteries in general have been involved in a number of high-profile incidents in recent years.

Dreamliner fire

In 2013, a Dreamliner 787 at Heathrow caught fire after a short circuit in a battery-operated device caused a thermal runaway reaction. The fire caused significant damage in the cabin, partly because the device was located near insulation materials. The fire also resulted in damage to the fuselage.^[2] The Heathrow incident was one of a number affecting the aircraft in 2013, problems that were said to have cost Boeing in excess of \$600 million.^[3]

Samsung Galaxy Note 7 recalled after devices explode

Samsung hit the headlines in 2016 when it recalled 2.5 million Galaxy Note 7 phones after complaints about overheating and phones exploding. In January 2017, Samsung confirmed that the cause of the problems had been the batteries.^[4] Direct costs of the recall were estimated at the time at up to £4 billion, but it has been suggested that the long-term damage to the brand could be anything up to £20 billion.^[5]

Chevrolet Volt catches fire three weeks after crash

In 2011, a Chevrolet Volt caught fire more than three weeks after a routine side-impact crash test damaged its battery pack. The fire prompted concerns over the safety of using lithium-ion batteries to power hybrids and electric cars.^[6] In a subsequent test on electric cars, carried out by the Fire Protection Research Foundation^[7] in 2013, fire fighters found they needed a very large volume of water to extinguish battery fires, which kept reigniting. In one example, a battery fire reignited, 22 hours after it was thought to have been extinguished.^[8]

Hawaii wind farm has two fires in a year

In 2012, the Kahuku wind farm in Hawaii experienced two fires, which caused significant damage and were attributed to the capacitors being at fault. In the second fire, the fire fighters could not enter the building for several hours because it was unclear whether the batteries were emitting toxic fumes.^[9]

How can companies reduce their risks?

Some manufacturers and utility companies are working on developing guidelines regarding how best to protect Battery Energy Storage Systems and any buildings in which they are installed. However, many of the test results are confidential, so efforts are being made to encourage the sharing of this information.

For now, companies that want to use BESS's must assess their fire protection challenges and reduce their risks wherever possible.

Planning

As a starting point, it is useful to consider these questions:

- How should the BESS be constructed (e.g. using individual containers of batteries, physical separation of batteries, use of dedicated fire areas, fire protection systems etc.)?
- What testing should be conducted during commissioning?
- How do batteries of this chemistry/technology react in a fire?
- How would firefighters make sure this type of battery is fully extinguished?
- How would firefighters handle a damaged battery that is still charged with power?
- Have fire fighters been invited to site to perform a planning review?
- What are the risks to first responders and the public from exposure to toxic fumes, electricity and other hazards if a fire or other incident were to occur?



- What environmental hazards would be created when fire systems interact with failed batteries?

Construction

There are practical steps that organisations can take to minimise their risks when constructing a battery system:

- Use non-combustible materials.
- Check where the batteries were made/who the manufacturer is.
- Transport the batteries very carefully as they are fragile, despite their robust appearance.
- Carry out extensive testing to detect any faults.
- Ensure an effective Battery Management System is included in the design.

For external installations:

- Locate storage systems well away from critical buildings or equipment.
- Where spatial separation is not possible, provide exterior protection such as a passive thermal barrier, or active fire protection such as drenchers.
- Install battery and battery management systems/electrical switch gear in separate rooms.

For internal installations:

- Make sure that the battery system is separate from critical infrastructure.
- Put battery and battery management systems/electrical switch gear in separate rooms, with fire resistive construction (two-

hour fire rated) to adequately cut-off the room from surrounding exposures.

- Provide fire-rated compartmentation and adequate separation between battery units.
- Provide adequate fire doors (>FR60) that are maintained in the closed position and equipped with automatic closure mechanisms. Where insulated metal panels (IMPs) are used, these should contain a mineral wool core and be installed in accordance with the terms of their approval. Only non-combustible IMPs should be installed.
- Ensure proper management of cable/service penetrations. Cable penetrations should be adequately sealed to meet the fire resistance of the compartment (two-hour fire resistance rating). Heating, ventilation and air conditioning ducts should have fire dampers provided that automatically close on activation of the fire alarm. Establish a permit to access system to manage changes to service or cable penetrations under an audited system.

Commissioning

During the commissioning process:

- Check the batteries visually at points of loading.
- Repeat factory tests.



- Ensure that those installing the equipment are properly trained.
- Ensure maintenance and inspection schedules are set up.

Fire protection

Organisations should put automatic fire detection in place, with early warning smoke detection or very early warning highly sensitive smoke detection (using air sampling devices such as VESDA). The system design should include continuous remote monitoring.

As for active fire protection, testing and research is just beginning and there is no publicly available test data that proves any particular type of active fire protection can prevent or control thermal runaway. Therefore, there is no clear guidance for organisations about what kind of protection to put in place.

However, inert gas and foam suppression systems seem unable to control thermal runaway, so the two main options are likely to be automatic fire sprinklers and water mist.

In 2018, a Property Insurance Research Group^[10] project in the US looked into sprinkler protection for BESS's, aiming to determine sprinkler protection guidance and

establish an appropriate sprinkler system design that applies to the majority of locations where a BESS may be found within a commercial facility.

BESS technology is an area in which the technology – and the associated opportunities and risks – are constantly evolving. AIG's Energy Industry Practice Group, which focuses on key issues that could impact the energy industry, considers this a key risk and monitors it on an ongoing basis. ■

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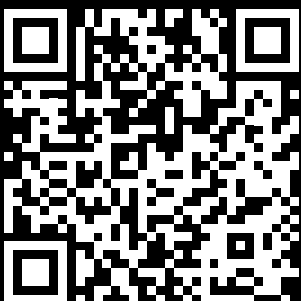
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Why two-way radios make the perfect safety device

Intrinsically safe professional mobile radios not only provide highly efficient, instant group communications for industries working with hazardous materials, but also offer multiple safety applications for workers and added-value SCADA capabilities. In this article, Matthew Napier of Hytera Communications (UK) looks at the many benefits and capabilities of explosion-protected two-way radios.

Safety is of paramount importance for industries dealing with hazardous materials, including potentially explosive liquids, gases and dusts. Hazardous environments are found in the oil & gas, petrochemical, pharmaceutical, mining/extractive, nuclear, chemical and some manufacturing operations. Others sectors such as ports and airports contain potentially dangerous fuel storage facilities.

These types of businesses operate, or at least should operate, under highly regulated conditions designed to protect workers, the wider population, the environment and the facilities themselves from exposure to harmful spills, leaks and explosions.

It is essential that equipment used does not provide an ignition source such as a spark that might cause an explosion. Electronic equipment must be 'intrinsically safe' (IS) and should meet the International Electrotechnical Commission for explosive atmospheres (IECEx) equipment standard and the European ATEX (Appareils destinés à être utilisés en Atmosphères Explosibles) directives.

Communication devices are no exception and therefore need to be designed to avoid heat generation or the creation of sparks. Standard radios or cellular phones are not safe to use for this reason, but a number of two-way radio manufacturers offer intrinsically safe Professional Mobile Radio (PMR), also known as Land Mobile Radio (LMR), terminals and infrastructure based on standards such as TETRA and DMR.

Robust and reliable

The radio is the worker's lifeline, so it must be capable of operating in the most extreme conditions. Radios need to come with a high IP rating certifying their ability to resist ingress by sand, dust (including metal dust), oil/fuel, chemicals and water. They must be tested for resistance to thermal shock (the ability to withstand sudden changes in temperature) and be able to operate in temperatures ranging from -30°C to +60°C.

They should be tested for thermal cycling (the effects of alternating heat and cold) to ensure their reliability and be rugged enough to withstand hits and drops measured according to the US Military Standard (MIL-STD) and not create a spark if the radio or its battery are dropped.

Radios should feature an ergonomic design that makes them simple to use in hazardous or extreme environments, including easy operation with gloves or helmets/visors. Loud and clear voice communications are essential, so it is worth choosing radio terminals that feature extraneous noise cancelling technology.

It is also important to ensure that the correct accessories are used including high-attenuation headsets, throat and skull microphones - all useful for hands free operation, as well as clips and belt fastenings that will not cause a spark. All accessories must be tested and approved as complete systems to ensure safety is not compromised within an intrinsically safe environment.

PMR systems have a number of advantages for industries where communication systems are critical to the smooth and safe running of operations. PMR systems provide private communication networks, which enable coverage, capacity, resilience, security and levels of availability to be exactly tailored to the needs of the business.

Relying on cellular mobile phone networks can be problematic as geographic coverage is dictated by the commercial needs of the operator's business. Many of the industries cited above have sites in remote locations where cellular coverage can be patchy or even non-existent, so a private PMR network is often the only reliable solution.

Voice applications

PMR networks offer the best mission critical voice and messaging applications available, including group calling, individual calling, broadcast calling, emergency calling and even full duplex (telephony) with very fast call setup times of under 300ms utilising push-to-talk (PTT) technology.

Group calling provides a highly efficient way of communicating information to many

people simultaneously, which can be of vital importance in an emergency. PMR systems also enable calls or messages to be prioritised according to the needs of the business.

Types of call (such as emergency calls) can be prioritised to have primary access to the network, as can particular call groups or individuals. Lesser priority calls and messages will be queued and get access to the network as channels become available.

A PMR radio should also be seen as a, if not the, primary safety device for workers. Aside from instant PTT voice, almost all radios come with an emergency button, which will send an alert with the highest priority to the control room, along with the worker's location.

Over the air programming (OTAP) can be utilised by the control room to remotely manage and control the software and configurations on the radios, including the ability to send automated alerts and messages. It is also easy to customise applications to suit individual businesses and industry sectors. They can, for example, support job ticketing and workflow management software.

The radios can be used to receive and activate alarms and to shutdown equipment

if connected to remote terminal units (RTUs) without the need to send any staff, saving time and potentially keeping personnel out of harm's way.

Man Down alarms will trigger an automatic alert if the radio's tilt sensor passes a certain angle and remains there beyond a pre-set time. Lone Worker alarms also send immediate automatic alerts based on tilt sensors. If the worker does not check back in with controllers within a pre-set time the control room is alerted again.

Location-based apps

Integrated GPS provides location-based applications, so if any of the above alerts is triggered, controllers will know exactly where the worker is and be able to coordinate a rescue response more quickly.

More generally, GPS enables workers to be tracked and monitored, so managers know where everyone is at any one time. If there is an accident or an emergency this makes it easier to locate the most appropriate people to respond to the incident - be it first aiders or fire marshals.

GPS technology can also be used to set geofences. The radio will trigger an alert if unauthorised personnel attempt to access

a restricted area, or there is unauthorised movement of tagged equipment. Personnel can also receive an alert on their radio warning them if they come near danger zones.

Most modern digital radios support Bluetooth and other technologies for near field communication (NFC) applications. As GPS does not work well indoors, Bluetooth location beacons can be deployed to track the whereabouts of staff inside buildings, basements, tunnels and the like.

They can be used to identify employees clocking in and out of work or entering certain areas. They can also provide an audit trail for security guard patrols or inspection regimes by maintenance and equipment staff proving who was where, when.

Bio harnesses measuring personal vital body signs such as abnormal temperature, blood pressure and heart rate can also be integrated via Bluetooth. The data is transmitted to the radio and then sent on to the control room. Supervisors can then be more proactive and warn workers of possible health issues.

PMR terminals can also pick up information from either Bluetooth-enabled fixed or



portable gas detector sensors. Managers can analyse the data to see what is in the atmosphere in real time and work out a worker's exposure to toxic gases over time. This may help to prevent diseases caused by exposure to hazardous materials later in life.

IoT/SCADA applications

Another advantage of deploying digital PMR solutions is that the network can also carry IoT (Internet of Things) and SCADA (supervisory control and data acquisition) data. The amount of data involved is quite small and can easily be transmitted from RTUs via narrowband PMR technology.

Remote monitoring of equipment provides much greater visibility of operations to enable proactive management of critical assets. If something goes wrong it is much easier to identify what has failed, where the unit is located, and potentially some immediate diagnostics as to why it has failed.

Early warning of possible equipment failure enables planned preventative maintenance regimes, saving time and money as expensive shutdowns are avoided. The time and opex cost of manual inspections and maintenance is reduced, thereby boosting operational efficiency.

A wide range of equipment can be monitored in this way from drilling well heads, storage tanks, pipelines, petrochemical units, electricity substations and distribution grids. Parameters such as flow, pressure, vibration, temperature and electricity network loads can be controlled and field production processes automated, including remote equipment shutdown and recovery, in distant locations from a single central point.

IoT/SCADA can also be used for environmental monitoring to provide compliance with regulatory regimes and to provide fast alerts of any spillages or leaks of toxic liquids or gases. This helps to reduce the number of incidents and exposure to liability and potentially expensive fines in the event of environmental damage.

Finally, it is worth noting that modern digital two-way radio systems can be integrated with other communication technologies, including back office IT systems, fixed telephony networks, cellular mobile phone systems, CCTV monitoring systems, body-worn and vehicle-mounted cameras and, as already indicated, IoT/SCADA networks.

The latest unified communications connectivity platforms integrate all these data sources and communication systems into

a single stack of information and services, which can be displayed visually using modern control room dispatch systems. PMR systems also offer advanced encryption for extra security, as many operations will be transmitting sensitive business information.

A robust, reliable communications system lies at the core of efficient and safe business operations. As well as being a vital safety tool for workers, having reliable group communications everywhere can also improve the efficiency and productivity of the workforce. ■

About the author



Matthew Napier is Sales Director at Hytera Communications Corporation (UK) Ltd. and is responsible for Hytera's sales operations in the UK, France and the Nordic countries. With over 20 years' experience in the two-way radio and communications industry in various account management and sales roles, he has a wealth of experience and expertise specifying radio systems across a variety of industries in the private and public sector.





What standards and certification infrared viewing panes

This question is frequently asked by clients as they begin to research the utility of infrared inspection windows for their specific application needs. There are many standards and certifications that can apply to infrared viewing panes and this can be very confusing for end users. In this article, Rudy Woderich of IRISS lists the most important standards and their areas of relevance.

Recognised Product Certifications

UL 50V is specifically applied to infrared windows. It serves more as a classification than an actual standard for performance-of-build characteristics and states:

"Infrared viewports are a fixed aperture, consisting of one or more openings or a solid infrared transmitting media, surrounded by a mounting bezel or frame, that provide a means for the passage of infrared radiation. Infrared viewports are intended for factory installation in doors or walls of electrical enclosures for installation in ordinary (non-hazardous) locations to allow the use of IR scanners for monitoring temperatures of the enclosed equipment on which the viewport is installed, without compromising the integrity of the enclosure with respect to access to live parts."

This classification is applied to two different product categories: Infrared Windows and Infrared Ports. Infrared Windows

provide a safety barrier that separates the thermographer from the target environment. In contrast, an Infrared Port is a hole and, when opened, it removes the barrier between the thermographer and the target thus increasing the risk of an accident. Knowing the difference between a Window and a Port is essential when determining the use of Personal Protective Equipment. UL Recognized or UL Listed marking on an infrared window indicates compliance with UL 50V but also with other relevant UL standards including UL1558 and UL746 discussed further below.

The CE Mark on a product or machine identifies it as complying with all the of safety

may be relevant but, at present, there are NO specific CE standards for IR viewing windows so virtually any product can claim compliance and bear the CE mark. For this reason, it is recommended that the other standards be called out to ensure that a robust product design is being deployed.

Other Certifications Relevant to Infrared Windows

UL 50E standard applies to enclosures for electrical equipment intended to be installed and used in non-hazardous locations. This standard covers additional environmental construction and performance requirements for enclosures. This standard does not cover the requirements for protection of devices against conditions such as condensation, icing, corrosion, or contamination that may occur within the enclosure or that may enter via conduit or unsealed openings. Where an individual product standard contains requirements that are at variance with those of this standard, the requirements of the individual product standard take precedence.

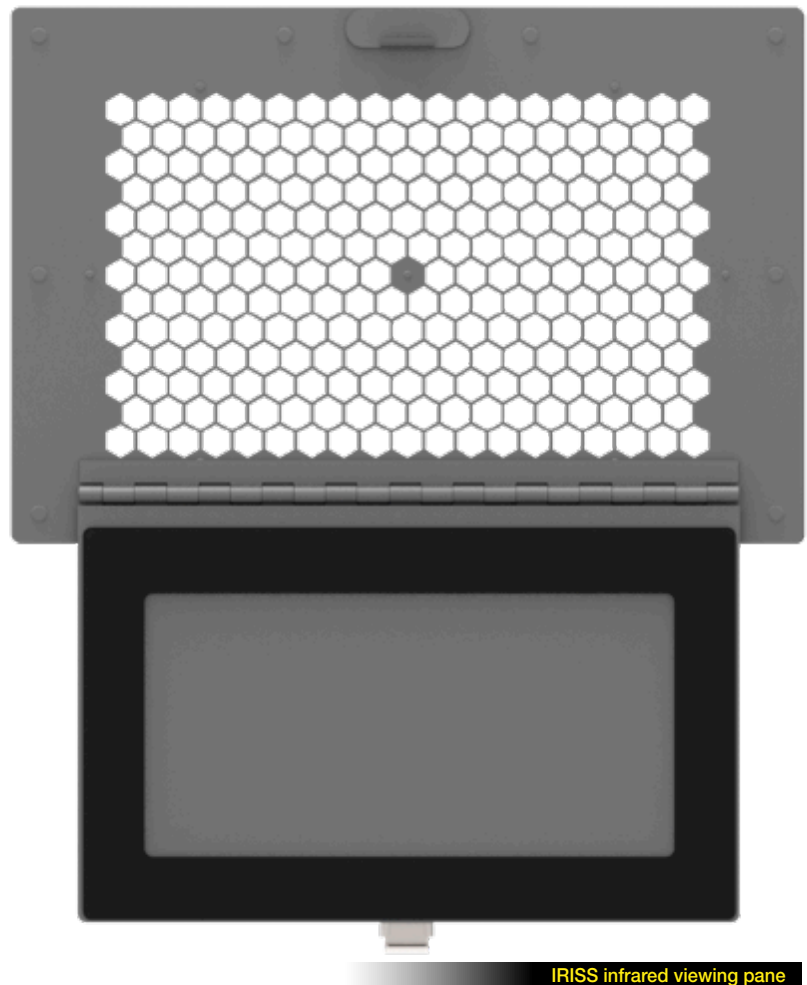
UL 746C contains requirements that set the impact and flammability standards for polymeric materials used in electrical equipment up to 1500 volts. Any plastic or polymer, as a part of an infrared window, must pass flammability tests at room temperature, and must remain intact during an impact test performed at 0°C (32°F). It should be noted that of the fluoride-based crystal optics commonly used as IR window optics and capable of transmitting in the long wave portion of the infrared spectrum (8µm to 14µm), none are capable of passing the impact tests required in 746C. However, because they are classified as “glass” under the standard, they are not required to test for impact as long as they are thicker than 1.4mm.

Load and Impact Testing Standards

UL 1558 has requirement that cover metal-enclosed low-voltage power circuit breaker switchgear assemblies. UL 1558 specifies static load (890 Newtons for 60 seconds)

ns apply to s?

requirements established by the European Union. The CE Mark is a mandatory conformity marking requirement for certain products sold within the European Economic Area and not a voluntary process. The CE marking is the manufacturer's declaration that they have researched the relevant standards, conducted the necessary tests and that the product meets the requirements of the applicable European Community directives specific to that product. It is a self-certification and no third-party tests are involved. Companies that CE mark a product and are subsequently found not to have performed proper due diligence and testing can be subjected to fines. IEC Vibration and Humidity testing requirements



IRISS infrared viewing pane

and impact testing (6.8 Joules via 0.54kg steel ball drop test) requirements for infrared windows used in these assemblies. UL1558 testing can be conducted with the window cover closed and passing criteria is that a ½" rod cannot pass through the window after testing. These requirements cover equipment intended for use in ordinary locations in accordance with the National Electrical Code. These requirements are intended to supplement and be used in conjunction with the Standard for Metal-Enclosed Low Voltage Power Circuit Breaker Switchgear, ANSI C37.20.1, and the Standard for Conformance Testing of Metal-Enclosed Low-Voltage AC Power Circuit Breaker Switchgear Assemblies, ANSI C37.51. These requirements cover equipment rated 1000 V ac or less nominal.

IEEE C37.20.2 (1999 edition) defined further Impact and Load Testing requirements for

viewing panes mounted in medium and high voltage equipment (600 volts to 38kv metal clad and 72kv station type gear) are required to withstand impact and load per IEEE C37.20.2 Section a.3.6. The standard specifically states that the viewing pane must withstand the impact and static load from both sides (inside/outside) and the viewing pane must not "crack, shatter or dislodge". However, 2015 revision to the standard (adopted in 2016) loosened the tests requirements significantly. The standard now allows for static load (445N over 16 in2 area or full window for 60 seconds) and impact (3.4 Joule via 2" diameter ball with mass 0.54kg) BUT from the outside ONLY and with the cover mounted. Again, the product must not "crack, shatter or dislodge".

Ingress Protection

The Ingress Protection rating system is a

classification system showing the degrees of protection from solid objects like dust or liquids coming in contact within the enclosure. The IP rating of an IR window should be the same or higher than the equipment into which it will be installed and ties directly to the **UL50E** ratings.

Vibration Testing

IEC 60068-2-6:2007 test provides a standard procedure to determine the ability of components, equipment and other articles to withstand specified severities of sinusoidal vibration. If an item is to be tested in an unpackaged form that is without its packaging. The purpose of this test is to determine any mechanical weakness and/or degradation in the specified performance of specimens and to use this information, in conjunction with the relevant specification, to decide upon the acceptability of the specimens. In some cases, the test method



may also be used to demonstrate the mechanical robustness of specimens and/or to study their dynamic behaviour. Infrared windows that will be installed in areas with high physical equipment vibration should be tested to this standard.

Humidity Testing

IEC 60068-2-3:2012 test provides a method for determining the ability of components or equipment to withstand transportation, storage and use under conditions of high humidity. The object of this standard is to investigate the effect of high humidity at constant temperature without condensation on a specimen over a prescribed period. It is applicable to small equipment or components as well as large equipment and can be applied to both heat-dissipating and non-heat-dissipating specimens. Infrared windows that will be installed in areas of high humidity should be tested to this standard. Crystal infrared windows are known to experience transmission degradation in the presence of even moderate levels of humidity.

Lloyd's of London Register

Lloyd's Register provides independent, 3rd-party approval certificates attesting to a product's conformity with specific standards or specifications. It also verifies the manufacturer's production quality system through a combination of design reviews and type testing. There is growing international awareness of the importance of third-party certifications such as those offered by Lloyd's.

American Bureau of Shipping

ABS Rules form the basis for assessing the design and construction of new vessels and the integrity of existing vessels and marine structures. The intended service location and environmental ratings for a component are verified by engineers confirming the validity of the testing performed on a component before the design assessment certification process in marine and offshore electrical equipment is completed.

Arc Resistance

An arc rating can only be given to a completed assembly and not to a single component within that assembly. Electrical cabinet designs and dimensions are

infinite and therefore we cannot assume equivalency of the test results from one cabinet design to another unless they are identical in every way. This is the reason why components can never carry a generic arc rating and must be subjected to industry standard tests to confirm that they conform to the minimum required level of mechanical strength and environmental properties for the electrical cabinets and assemblies which they are going to be fitted into. There are three standards most commonly referenced when discussing Arc Resistant ratings.

For International based Metalclad equipment designs, **IEC 62271-200** specifies requirements for prefabricated metal enclosed switchgear and control gear for alternating current of rated voltages above 1 kV and up to and including 52 kV for indoor and outdoor installation, and for service frequencies up to and including 60 Hz. Enclosures may include fixed and removable components and may be filled with fluid (liquid or gas) to provide insulation. Test involves a bolted fault at 6KV, 31.5kA for 60 cycles and typically results in pressures exceeding 18 bar and temperatures >1500C.

Flags mounted 12" in front of switchgear must not ignite and window covers must remain intact after test.

For International Arc Resistant equipment designs, **IEC 60298 Appendix A** testing (63kA, 15kV for 30 cycles at 60Hz). Similarly, for North America based Arc Resistant equipment designs, **IEEE C37.20.7 Type 2B** tests (63kA, 15kV for 30 cycles at 60Hz) is usually applicable. These tests must be completed by the OEM with the IR window



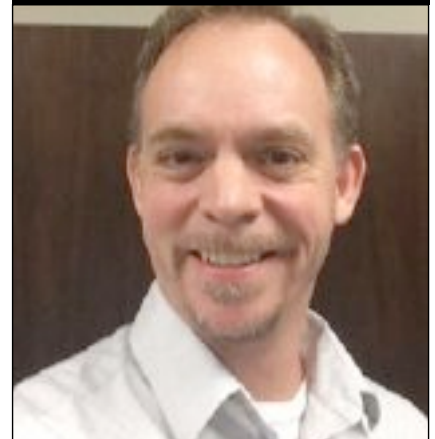
Infrared viewing panes and ports

products installed in the OEM equipment to validate the windows can be offered as an option without downgrading the overall equipment rating.

Conclusion

Infrared viewing panes may have many certifications depending on the specific application or global location where they will be used. The most common certifications are UL Recognized or UL Listed, CE Marked, CSA recognised and Lloyd's of London. Partner with your inspection window manufacturer to determine the best solution for your specific application. ■

About the author



Rudy Wodrich is an electrical engineer whose career has revolved around designing electrical distribution systems for industrial, commercial, and power generation applications. Rudy spent more than 20 years at Schneider Electric and ABB, and now leads new product development at IRISS Inc. in Bradenton, Fla., working on asset surveillance and condition-based maintenance safety solutions.

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Website: <https://globalpetroleumshow.com> ■

20th Asia Oil & Gas Conference (AOGC)



Date: 23 – 25 June 2019

Location: Kuala Lumpur, Malaysia

Kuala Lumpur is set to host global industry leaders as they converge at the Kuala Lumpur Convention Centre on 23–25 June 2019 for the 20th Asia Oil & Gas Conference (AOGC).

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in decades to come.

The 3-day event will see 10+ sessions, 35+ speakers, 4 special programmes and 100+ exhibitors. There are 2,000+ expected delegates and 6,000+ expected attendees. Hosted by PETRONAS, the conference is themed "Forging A New Energy Future", and will feature the Prime Minister of Malaysia, His Excellency Tun Dr Mahathir Mohamad, as a keynote speaker.

- 45 countries joined AOGC 2017
- 96% were pleased with the AOGC 2017

Website: <https://aogc.com.my> ■

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Website: <https://events.renewableuk.com/gow19> ■

ecom Cube 800 – first Ex-certified portable infrared and HD camera

With the Cube 800, the Pepperl+Fuchs brand ecom is launching the first portable and explosion-proof infrared and HD video camera for Zone 1/21 and Div. 1. ecom developed and distributes the Cube 800 in cooperation with Librestream.

Both companies are meeting the increasing demand for a peripheral device that provides HD digital and thermal imaging technology for inspections and maintenance in potentially hazardous areas. In combination with the intrinsically safe ecom smartphone series Smart-Ex or tablet series Tab-Ex, workers can remotely control the camera, view HD video and thermal imaging, or capture and annotate pictures or recordings from a safe distance in real-time. Critical areas on the plant can thus be identified much quicker and repair measures initiated immediately.

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Fluidwell launches E115 Explosion-Proof bi-directional flow rate indicator/totalizer

Fluidwell launches E115 Explosion-Proof bi-directional flow rate indicator/totalizer

Fluidwell introduces a new member to the E-Series family, the E115 explosion-proof bi-directional flow rate indicator/totalizer which detects the flow direction with quadrature signal inputs. Such applications can be found by loading and unloading of ships where one bi-directional flowmeter is used. Another application is the correction of back-flow due to shocks in a pipeline caused by piston pumps or valve behaviour.

The E115 saves time, money and hassle; is designed to withstand the toughest conditions and is simple to use.

Further information: www.fluidwell.com.



Explosion Proof ATEX Zone 2 iPad mini 5 - Intrinsically Safe Apple iPad Tablet

All new from Atexxo Manufacturing BV, the Netherlands. The Apple iPad mini 5 now suitable for use in hazardous locations. The explosion proof iPads are originally manufactured by Apple than converted and certified according to the ATEX directives by Atexxo Manufacturing B.V. This makes the ATEX tablets suited for safe use in gas / vapor zone 2 hazardous areas. Sim-card can be installed by the end-user themselves.

Compliance with ATEX / EX regulations is achieved by modification of the casing together with the intrinsically safe electrical circuit, which makes the tablets suitable for safe use in hazardous locations. All features of the original product are preserved. Even the fingerprint scanner can be used safely at hazardous locations.

The ATEX iPad mini 5 comes with a black case finish and is available in WIFI only and WIFI + 4G versions. Beside safe use as a tablet both versions are excellent for use as intrinsically safe camera or RFID scanner.

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