Standards for a sustainable world

Providing greater opportunities for economic development

By Frans Vreeswijk

Sustainability is an increasing focus both for society and industry.

In the developed world, our linear economic model whereby products are manufactured, used and then discarded is increasingly and rightfully challenged by one that encourages the development and use of products that last longer, can be more easily repaired and upgraded. IEC work provides the methodologies and requirements that encourage a circular economy, allowing societies to reduce waste and make better use of limited natural resources.

On the other side of the spectrum, developing economies are looking to the UN sustainable development goals (SDGs) to overcome poverty and hunger, increase access to energy and clean water, better health and greater opportunities for economic development.

IEC work provides the technical foundation that helps increase the quality and resilience of infrastructure; encourages technology transfer and makes products safer and more efficient.

The IEC is technology focused and only very few IEC International Standards can be clearly attributed to a single SDG.

Many different IEC technical committees develop thousands of standards that are used by experts during research and development, design, manufacturing, testing and certification, installation, maintenance or repairs. These standards allow quality, safety and efficiency to be built into products and systems from the start.
Quantum computing combined with machine learning enables processing images and calculating probabilities.

Standards allow the global harmonization of efforts to achieve the SDGs.
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Parts become obsolete if production ends or they are produced in regions where availability becomes difficult
Engineers and scientists around the world are racing to build quantum computing devices capable of achieving quantum supremacy, which is broadly defined as solving problems that today’s computers cannot. Quantum devices will eventually have processing power that overshadows anything that contemporary supercomputers can achieve. They are expected to bring massive benefits, such as accelerating medical research, making advances in artificial intelligence and perhaps even finding answers to climate change.

There is still some way to go, however, before the technology moves into the mainstream. “The reality of quantum computing is probably 10 to 15 years away, yet it merits our attention now,” says Dr. Seungyun Lee of the joint technical committee for information technology (JTC 1) established by IEC and ISO. “The excitement in the industry for this new paradigm of computer hardware is understandable, given the promise of far greater computational power with whole new multidimensional capabilities.”

What is quantum computing?

The computers we have today store data using bits, which have two states – either on or off – represented as a 1 or a 0. Quantum computing replaces these binary bits with qubits that have more states which are changing continuously. Qubits can be on, off or somewhere in between all at the same time. This state is called superposition and enables qubit-based computers to carry out far more calculations much faster. When qubits become entangled they share all the possible combinations of the quantum states of the individual qubits, substantially boosting computational power in the process.

Scientists have combined quantum computing with machine learning for processing images and calculating probabilities.

In terms of what is already possible, scientists have combined quantum computing with machine learning for the processing of images and the calculation of probabilities. Shor’s quantum computing algorithm is already having a major influence on the world of cyber security and traditional encryption methods. Elsewhere, quantum simulators are facilitating the study of quantum systems – such as quantum chemistry or quantum field theory – that are difficult to study in the laboratory. These are just three examples.
In order to realize quantum supremacy, though, researchers will need to find ways of increasing the about 20 superconducting qubits in today’s largest quantum computers to at least 50. The challenge is the extreme fragility of quantum systems. Quantum computers are particularly prone to errors because qubits are highly sensitive to external noise. Qubits only function “coherently” when they are enclosed in sealed boxes fitted with vacuum pumps and cooled down to mere thousandths of a degree above absolute zero. This protects them from the destabilizing effects of radiation, light, sound, vibrations and magnetic fields.

**Letting the cat out of the box**

The good news is that scientists may have found the route to solving the problem of errors in quantum computing. Earlier this year, the researchers at Yale University announced they had found a way to save Schrödinger’s cat. The significance and implications are enormous.

In the famous thought experiment, the Austrian physicist, Erwin Schrödinger, places his imaginary cat in a sealed box, together with a flask of poison and a quantity of radioactive material. A single atom of leaking radiation is enough to shatter the flask and poison the cat. Quantum superposition theory suggests that until someone looks inside the box, the cat is both alive and dead, but the mere act of opening the box immediately changes the cat’s quantum state to either alive or dead. This change, which...
was believed to be instantaneous and unpredictable, is called a quantum jump, or sometimes leap.

Until now, the assumption was that property changes to subatomic particles happen in an abrupt way, rather than flowing between states. For example, the thinking was that an electron in a low-energy state would snap rather than transition into a higher energy state when more energy was added. When you are not looking, superposition kicks in and it is in both states and somewhere in-between, all at the same time. As soon as you look, it changes into one state or the other, like Schrödinger’s paradox.

The Yale researchers appear to have demonstrated that although quantum jumps are very fast, they are neither abrupt nor random. The implication is that it might be possible to detect and anticipate imminent jumps. Spotting errors before they arise could offer ways of preventing them.

Two flavours of quantum computers

The research offers a promising point of departure but until a solution is found, there will be limitations on the size and complexity of problems that quantum computers are able to tackle. This has led to the development of devices that take a radically different approach to quantum computing.

Classical computers use transistors, known as gates, to control the flow of electricity through a circuit. They are like power switches, on or off, one or zero. In the quantum model, qubits replace the transistors. When someone eventually achieves quantum supremacy, it will be with a gate-based quantum computer.

Quantum gate-based computers, quantum annealers create an environment where only restricted, local connections are possible. The quantum state of the qubits is more fragile and their manipulation is less precise. For the right kind of problem, however, quantum annealers offer a huge increase in processing speed compared to classical computing.

Quantum annealers have already been used to solve optimization problems in the domains of finance and the aerospace industry, among others, with potential users limited only by the upwards of USD 10 million cost of a quantum annealing device. It would be wrong, though, to think of gate-based quantum computers and quantum annealers as competing technologies. They are simply useful for solving different problems.

The power of quantum cryptography

As computers become more powerful, however, and in the face of rogue states with the technology resources to pose a more serious threat, cryptographers are turning away from mathematics and also looking to the laws of quantum mechanics to achieve greater security. As in the related field of quantum computing, it is based on the behaviour of quantum particles, which are smaller units than molecules. For example, an encryption system called quantum key distribution (QKD) encodes messages using the properties of light particles.

The only way for hackers to unlock the key is to measure the particles, but the very act of measuring changes the behaviour of the particles, causing errors that trigger security alerts. In this way, the system makes it impossible for hackers to hide the fact that they have seen the data.

The threat is so great that scientists are urging organizations to start looking at and adopting quantum encryption systems. Quantum computers may not be available for another decade, but quantum cryptography has already been available for a few years.

Standardization work

IEC and ISO have set up a study group in their joint technical committee to identify the standardization needs of quantum computing. After completing an initial study of key concepts and describing the relevant terminology, the international group of experts is studying the requirements of society, markets and technology for future standardization, as well as closely following developments in quantum computing. Quantum cryptography is an area of interest for several IEC expert groups.
Fifth-generation cellular networks, known as 5G, look set to transform the way we live and work by connecting not just people but things in the so-called Internet of Things. It’ll mean smarter motorways and smarter factories, and being able to control your car, home and pretty much everything else from a single device.

e-tech spoke to Mike Wood, who’s been heavily involved, in the roll-out of 5G, in Australia, and also chairs IEC TC 106 that deals with safety testing standards for mobile devices, base stations and wireless communications systems.

Could you describe in layman’s terms the work of TC 106?

TC 106 is charged with developing the testing standards for electromagnetic emissions. In simple terms, when you’ve got your mobile devices and the networks we have to write the testing procedures for testing those for radio frequency (RF) exposure.

We don’t set the health standards – they’re set by the World Health Organization and the health agencies – but we write the testing standards to ensure that they’re tested safely. So, if you think of all the mobile devices – and most people have one, I think there’s nearly eight billion mobile devices across the globe – we write the technical specifications and the testing standards for all of those phones and the networks that go with them.

It’s a huge responsibility and one that really drives our members because they know they’re making this large contribution to society and it’s a real challenge and one that we’re very excited to be on this journey with.

TC 106 recently published a new IEC Technical Report on evaluating human exposure to radio frequency fields in the vicinity of base stations. What’s in the report and how will it help stakeholders?

The new Technical Report shows how you test base stations and wireless networks for compliance with the emission testing standards. It provides worked examples that include 5G and small cells for the first time.

It’s basically an example of case studies, where we’ve gone out and we’ve tested these networks and small cells and we’ve demonstrated that in the case studies.

“For the everyday person 5G will mean uploading and downloading data much quicker.”
It’s such a useful document because it provides operators with the latest methods for testing.

It provides the facility owners and the regulators with worked examples. And for municipalities and people that own buildings where there are 5G base stations, it gives them the confidence that these new technologies are tested to the latest standards.

It really ticks all of the boxes. You’ve got the detailed standard but you’ve got the Technical Report that actually showcases how it’s done. And that’s the real advantage of having this Technical Report right when 5G is being rolled out.

It demonstrates the latest testing methods and more importantly it provides global consistency across all of the countries using IEC Standards.

Turning to 5G, in what way is it different to 4G technology?

I think for the everyday person 5G is going to mean that they can upload and download data much quicker. And in the years to come, when we get more spectrum, they’re going to be able to do it super-fast.

It’s also going to be the ability to connect millions of devices. With the previous technologies it has been people being connected and their devices, but now it’s going to be the Internet of Things and the extra capacity that the spectrum’s going to bring means that we can cater for all the millions of devices coming.

But I think the really exciting thing is the low latency and that’s the response time of this new 5G technology being much quicker. For example, it’s going to help automated self-driving vehicles, it’s really going to help have safer motorways and safer systems.

But I think the medical side of it, where you can do remote surgery and remote medical applications, it’s so exciting what this technology is going to deliver.

To what extent is it going to be a major game changer?

I think, with the low latency aspect, that it’s going to be a significant game changer because if you think of the applications that can follow from that, in industrial robotics and stuff that we haven’t been able to do before. We don’t know where it’s going to lead, but we do know it’s going to be a revolution in terms of what it can do.

They’re calling it the fourth industrial revolution. The low-latency, the extra capacity and the fact that you’ve got much greater speeds, is going to revolutionize telecommunications.

How has the IEC been preparing for this?

Well, that’s a very good question because they brought forward the specifications for 5G. They wanted to roll it out earlier.

So what we did is we made sure that we had the best experts from industry, academia the test houses and government regulators. We started testing the test networks early.

We had to look at how the devices were going to work, how the base stations were going to work, and then write the testing standards for all devices in the new spectrum and in the existing spectrum, and then test the networks. So we had to look at small cells and radio base stations.

First we wrote some test procedures with technical reports so that we could harness all of that global knowledge into these first rounds of reports. And now we’re finalizing the full standards. And that was to make sure we could meet the accelerated time frame, so that when 5G was here, at the IEC we were ready and we were ready with our standards, which we are.

Staying with the theme of preparing for the future, I know you are a strong supporter of the IEC Young Professionals Programme. Why do you think the YPs are so important?

The Young Professionals are fundamental to IEC because they’re our future leaders and they’re our future technology experts. If you take the work we’re doing in TC 106, where we’re working on the new 5G standards, it’s the young engineers that have been developing these standards because they know the technology.

We’ve got YPs working with us and in fact we’ve just come back from a meeting in Helsinki where the team is a really young mix of people of all ages, of all diversities and from all regions. The YPs want to work with us and in 10 years they will be the convenors, the chairs and the secretaries.

It’s fundamental that IEC keeps this programme up and encourages more young professionals to work with us because they’re our future leaders.
The United Nations defines 17 Sustainable Development Goals (SDGs) at the core of its blueprint for building a better world by 2030. The SDGs serve as a call for action to all countries to promote prosperity while simultaneously protecting the environment. They seek to end poverty and stimulate economic growth while also addressing societal needs, such as health and education, and preserving the environment.

Electricity is the cornerstone of nearly all of the SDGs. And, without electricity, the objectives of the SDGs cannot be reached. For example, electricity makes it possible for children to finish their homework at night (SDG 4), for medicine and food to remain cool (SDG 1 and SDG 3) and for pumps to bring clean water into homes (SDG 6). IEC is an essential partner for ensuring the safe access to clean and affordable energy, whether on- or off-grid. Its work contributes to 16 out of the 17 SDGs.

The IEC Standardization Management Board (SMB) set up ad hoc Group 84 (ahG 84) with the aim of developing an IEC approach to SDGs, which includes educating the IEC community, and establishing SDG related thinking in its standardization and conformity assessment systems. AhG 84 will also explore how technical committees can better reference the SDGs in their work as well as how conformity assessment schemes can be applied to those standards related to SDGs.

e-tech had the opportunity to speak with Vimal Mahendru, Convenor of ahG 84, during one of his recent visits to Geneva.

What is the role of standards in helping to achieve the UN SDGs?

Let me reverse the question. How can we achieve the SDGs without standards? Standards provide the very definition of what we want to achieve and how we can achieve it. For example, SDG 7 is about clean and affordable energy for all. But how do you define ‘clean’? It can be different for everyone which is why standards are so important and integral to defining basic terminology and providing measurement tools for SDGs.

Standards enable global harmonization of efforts to achieve the SDGs. They are key in fulfilling the SDGs. This means that we have a huge responsibility at the IEC!

Which SDGs are impacted by IEC work?

Electricity is everywhere. Name me one thing that makes life more comfortable that does not require electricity? And because electricity is everywhere, the work of the IEC is impacting all SDGs.

How does the IEC support SDG 7 on energy access?

It is estimated that nearly one billion people, roughly 20% of the world’s population, do not have access to any electricity at all. How can they access electricity? One answer could be low-voltage direct current (LVDC) based electricity distribution. Solar PV modules, batteries and electronics used in homes are all using direct current. So, while grid-based electricity might be expensive to set-up and would take a lot of time, deploying DC microgrids is faster and comparable in costs. And the best part, they do not add to pollution since the energy can be efficiently produced using solar PV panels.
IEC started its work on energy access before the UN SDGs. In 2013, some initial work began on enabling energy access and use cases. By 2014, IEC had formed the Standardization Evaluation Group (SEG) on low voltage direct current (LVDC) to determine its impact and relevance to enabling electricity access. This led to the establishment of the Systems Committee on LVDC and LVDC for energy access (SyC LVDC).

Standards are now being developed to allow for direct current microgrids and solar home systems which can power appliances and home electronics. These are consensus standards where the entire IEC community has come together.

It is important to note that these standards are based on the World Bank’s Multi-Tier Framework (MTF) for enabling energy access. This means that the standards are directly beneficial to countries establishing national programmes to implement SDG 7 and rural electrification schemes.

What are some recent activities that IEC is undertaking in support of the SDGs?

IEC has always been looking at development, innovation and new technologies. But one aspect has been less prominent in the past - sustainability. Thanks to the global community coming together in AHG 84, this is now being addressed. We are trying to ensure that whatever important work the technical committees are doing, this work also addresses sustainability. We need to make sure that all IEC work addresses sustainability. For me it is inspiring and humbling that members of the three IEC boards, the Conformity Assessment Board (CAB), Market Strategy Board (MSB) and the Standardization Management Board (SMB) are all working together in AHG 84.

For example, we have standards for electric wires, circuit breakers and switches. But we need to improve how we address the end of life of products. We need to consider a circular economy. Just making standards is not sufficient. We also need to monitor and encourage their implementation. Monitoring is best addressed through the Conformity Assessment Board which is likely to develop new schemes that can address the implementation of the SDGs.

Electricity is the cornerstone of nearly all of the SDGs.
In a city famous for its honking horns and yellow cabs, it is hard to imagine that horse drawn carriages were once the most common form of transportation in New York City. Two images of Fifth Avenue, taken only thirteen years apart, demonstrate the speed of the transformation: in 1900, the street was filled with carriages pulled by horses and in 1913, the horses had been replaced by automobiles. Innovation and change happen for a myriad of reasons, as Henry Ford can attest, but result in bankruptcy for those, like the horse industry, that are not prepared.

Keeping pace with market trends is no easy feat given the unrelenting speed of change. And turning market disruptions into new opportunities becomes essential in a competitive global environment. To help guide the future work of IEC, the Market Strategy Board (MSB) has been set up to help identify key technology trends and market needs in the areas of IEC standardization and conformity assessment activities.

At the IEC General Meeting in Shanghai, the MSB will host a seminar delving into three topics considered as potential opportunities, threats and/or disruptions to the IEC. Peter Lanctot, Secretary of the MSB, provides an overview of what to expect at the seminar this year.

2030 and the IEC: enabling our digital future

Digitalization, data and new technologies will disrupt industry. Economies will be dominated by services and driven by data. Technologies, such as IoT, artificial intelligence and virtual reality will become more prevalent. And with the increased reliance on data, new challenges will
Technical committees

Economies will be dominated by services and driven by data.

The role of the IEC, including its service offering and delivery, must adapt accordingly to keep pace with industry. The traditional approach for developing standards is unlikely to remain a viable business option in 2030. Instead, IEC must consider what new services it can provide, what business models can be adopted and what the process will be, for IEC to adapt to these changes.

As noted by Lanctot, “2030 is only eleven years from now. This part of the seminar will focus on how IEC positions itself at that time. How will IEC address these new circumstances in terms of standardization?”. However, the rapid growth of IIoT technologies generates new security threats that can affect critical infrastructure as well as those relying upon secure networks and manufacturing processes. And because these devices are generally designed to connect cyber and physical environments, the consequences of a security vulnerability can result in physical damage. Critical infrastructure, including power stations and transport networks, are vulnerable to cyber attacks that could have devastating consequences.

To combat security threats, Lanctot noted that “the MSB has put forward a few ideas like working with industry, conformity assessment schemes, fast-track more standards and industry training”.

This part of the seminar will provide an overview of the current trends in IIoT deployment, the current status of security standards and regulation, and recommendations for the IEC to lead a coordinated and harmonized approach to develop security standards and conformity assessment systems.

Infrastructure resilience due to climate change

Hurricanes, heat waves and flooding are some of the extreme weather events occurring with increased frequency. The impact on electricity generation, transmission and distribution infrastructure can be devastating with blackouts affecting millions of people. As a result, Lanctot notes that “how systems are designed and operated may need to be re-examined to ensure that they withstand extreme weather events. It may also be necessary to reconsider recovery efforts to bring grids back into working order in shorter periods of time”.

The addition of international standards that can assess the vulnerability of the grid to climate change and streamline recovery efforts should a disaster strike may be necessary. They can also help support the United Nations Sustainable Development Goal 7 (affordable and clean energy) and Sustainable Development Goal 9 (industry, innovation and infrastructure).

Part of the seminar will tackle the issue of reliance for utilities and the types of solutions that IEC can provide. According to Lanctot, “legacy grid equipment, which can be up to 30 years old in some cases, is at risk as we face more extreme storms and temperatures. We need to ask whether the equipment is resilient enough to comply with a changing environment and what kind of resilience is needed”.

Cyber security and the Industrial IoT

Industrial Internet of Things (IoT) technology is designed to improve the efficiency and productivity in the manufacturing sector. It is a growing technology trend, with an estimated USD 6 trillion projected to have been spent on IIoT solutions between 2015 and 2020. As Lanctot notes, “it affects all of the automation areas the IEC touches upon”.

Organizations, factories and critical infrastructure must be protected against cyber attacks (Photo: www.motioncontrolonline.org)
The work of IEC Technical Committee 21 reflects the changes in battery technology over the last 20 years. Standardizing safety requirements is more essential than ever before.

**Batteries make the world go ‘round!**

Batteries are indispensable devices in our everyday lives: so many items we use on a daily basis, from our mobile phones to our laptops, rely on battery power to function. Yet despite its mundanity, battery technology is suddenly hogging the limelight because it is used to power all sorts of different electric vehicles (EVs), from electric cars to e-scooters, which are regularly in the headlines. For true environmentalists, however, battery technology is more interesting as a way of storing electricity as the generation and use of renewable energy – which is intermittent – increases.

Last but not least, battery technology has attracted press coverage but in a less positive way because of the flammable properties of Lithium-ion batteries. During 2018, around 23 electric energy storage accidents at utilities in South Korea were reported due to battery-provoked fires. Short circuits, overcharge, over-discharge, mechanical damage and high temperatures can lead to thermal runaway, fire, and explosion in the batteries. New technologies are being investigated to improve Li-ion battery safety. The College of Engineering of the University of Illinois is studying graphene, as the material that could take oxygen out of lithium battery fires.

**IEC work is essential**

IEC International Standards and Conformity Assessment (CA) Systems are therefore more crucial than ever to establish and test the safety specifications and performance requirements for batteries, whether lead-acid, nickel-cadmium (NiCd) or, indeed, Li-ion. Several IEC TCs prepare standards for cells and batteries. One of them is IEC TC 21, chaired by Herbert Giess. “IEC TC 21 is the primary TC to deal with battery standardization inside the IEC. It was founded in 1933. In 1965, it was decided to split the work of the TC
into two different areas covering different battery technologies. Subcommittee 21A was given the task of preparing standards for batteries with alkaline electrolyte such as NiCad or nickel–metal-hydride and TC 21 was asked to focus on batteries with acid electrolyte called lead-acid. Both now share the work on Li-ion batteries which have become the new kids on the block in recent years," he explains.

While IEC TC 21 and SC 21A prepare standards for cells and batteries used in multiple fixed and portable applications, IEC TC 120 was set up to publish specifications for their integration into electrical energy storage systems. “TC 120 standards concern the interconnection of batteries with the large energy storage systems and their safe integration into power grids,” Giess says.

IECEE (IEC System of Conformity Assessment Schemes for Electrotechnical Equipment and Components) is one of the four CA systems administered by the IEC. It runs a scheme which tests the safety, performance component interoperability, energy efficiency, electromagnetic compatibility (EMC), hazardous substances, etc. of batteries, chargers and charging stations.

**Standards for EVs**

According to a forecast by the International Energy Agency, the number of EVs on the world’s roads will increase from 3 million to 125 million by 2030. In 2018, IEC TC 21 published several important documents, including a second edition of IEC 62660-2 which is part of the IEC 62660 series on secondary Li-ion cells for the propulsion of EVs. “IEC 62660 has three different parts: the first deals with performance specifications for their integration into electrical energy storage systems. “TC 120 standards concern the interconnection of batteries with the large energy storage systems and their safe integration into power grids,” Giess says.

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Nickel, cobalt, manganese and lithium used in Li-ion batteries are generally recovery rarely top 20%. The raw materials for the time being, the rates of material but this process remains expensive and, Li-ion batteries can also be recycled, Circular economy models

According to most reports, the energy density (energy storage capacity). Li-ion's low weight is especially impressive when you consider Weight is also an issue: Li-ion batteries weigh considerably less than their lead-acid counterparts. Li-ion's low weight is especially impressive when you consider performance. For the same weight as lead-acid, Li-ion batteries have a much higher energy density (energy storage capacity). According to most reports, the energy density of Li-ion is around 3.5 times that of lead acid.

**Circular economy models**

Li-ion batteries can also be recycled, but this process remains expensive and, for the time being, the rates of material recovery rarely top 20%. The raw materials used in Li-ion batteries are generally nickel, cobalt, manganese and lithium which are expensive to get hold of. Some of these raw materials are scarce and can be situated in parts of the world which are difficult to access and politically unstable. Research is progressing fast, however, and some labs have managed to reach 80% recovery levels. Scientists are also looking at Lithium-air chargeable batteries as an alternative to Li-ion.

Another way forward is to reuse these batteries for second life applications. Depending on its chemistry, size, configuration and purpose, according to most reports, a Li-ion battery can perform between 500 to over 10,000 cycles of charging and discharging. This means that a battery that is used every day in a power tool by a professional craft worker might reach the end of its first life in a few months while a battery used in some energy storage applications can last for over 15 years.

**Batteries are indispensable devices in our everyday lives.**

Li-ion batteries that have been used in one application can be assessed for their ability to be used in other, less demanding applications. One possible second life for batteries is as a component for flexible charging stations. These are quick charging stations that can be operated autonomously during large-scale events, such as festivals or sporting events. Batteries from electric vehicles could be re-used in everything from back-up power for data centres to energy storage systems. In Europe several vehicle manufacturers, companies which are pioneers in the electric car market, have installed used batteries primarily in different kind of energy storage systems, ranging from small residential devices to larger containerized grid-scale solutions.

**Standards for renewable energy storage**

IEC TC 21 has issued two essential standards for renewable energy storage systems. The first one, IEC 61427-1, specifies general requirements and methods of test for off-grid applications and electricity generated by PV modules. The second, IEC 61427-2, does the same but for on-grid applications, with energy input from large wind and solar energy parks. “The standards focus on the proper characterization of the battery performance, whether it is used to power a vaccine storage fridge in the tropics or prevent black-outs in power grids nationwide. As these standards are largely chemistry agnostic, which means that they apply just as well to lead-acid or to Li-ion batteries, they enable utility planners or end-customers to compare apples with apples, even when different battery chemistries are involved,” Giess describes.

The TC is also preparing standards for flow batteries. A typical flow battery consists of two tanks of electrochemically active liquids which are pumped past two electrodes of opposed polarity separated by a membrane. “Flow batteries are an interesting technology that can be used for very large energy storage requirements as the storage tanks can be sized at will,” says Giess.

**Future for cars**

Looking ahead, Herbert Giess rather surprisingly favours fuel cells for automotive applications. “Several car manufacturers are actively pursuing this avenue. We often forget that this technology was used to send Apollo 11 on the moon all those years ago! But it has a big environmental potential as cars powered by fuel cells do not generate any harmful emissions only water vapour and there are no battery recycling problems. Of all the technologies used to power cars, it is my personal favourite.”
Establishing trustworthiness is vital in our human-machine world

As long as human civilization has existed, people have needed to trust people in personal and business situations. Trust is at the heart of everything.

By Antoinette Price

Over the last century, automation has advanced in many industries. More recently people must work with non-human entities, which increasingly use artificial intelligence (AI) technologies.

In manufacturing plants, programmed robotic arms and humans work in close proximity side by side. Transport uses more and more automated systems. Self-driving vehicles deploy advanced driver assistance systems, while modern airline autopilot and safety systems use manoeuvring augmentation characteristics systems. Both rely on sensor data processing algorithms to analyze data gathered from many sensors around the vehicles and airplanes in order to ensure safe, efficient journeys. In healthcare, diverse professionals are using analysis from big data mined by machine learning algorithms, to help diagnosis diseases.

“A key barrier to adoption of Artificial Intelligence is concerns about the trustworthiness of the system. Led by SC 42/WG 3, the projects that the committee is pursuing in this area, not only try identify and put a framework around these emerging issues but also provide technical approaches to mitigating the concerns and link to the non-technical requirements such as ethical and societal challenges. This revolutionary approach that SC 42 is taking by looking at the full AI ecosystem will enable wide scale adoption of AI and the promise it has as a ubiquitous technology enabling the digital transformation”, said Wael Diab, who leads the standardization work on AI, through Subcommittee 42 of the IEC and ISO joint technical committee (ISO/IEC JTC 1) for information technology.

In these and many more situations, humans put their trust in machines which is why it is imperative that nothing goes wrong. As new products and services evolve and incorporate AI technologies, their broad adoption will only be successful if people feel they can be trusted. This means that if there is an issue it will be possible to understand what has happened, how it happened, how to avoid it in future.

*e-tech* caught up with Dr David Filip, Convenor of the SC 42 Working Group 3 to learn more about the work on trustworthiness of AI.

**What is trustworthiness and why is it so crucial?**

In our standards work we have identified certain characteristics of trustworthiness, such as accountability, bias, controllability, explainability, privacy, robustness, resilience, safety and security. But for me, before all these aspects can be considered, it always comes back to transparency or transparent verifiability of AI systems’ behaviour and outcomes. Is an outcome of an AI system transparently verifiable or is the system a so-called black box, in other words, is it trustworthy or opaque? Is there someone who can audit it for vulnerabilities or unintended consequences? In order for it to be trustworthy, we need to be able to understand the algorithm’s internal workings.

“A key barrier to adoption of artificial intelligence is concerns about the trustworthiness of the system.”

Since machine learning is functionally defined and based on the huge amounts of data for the training sets, the machines will only be as good as the data they have been fed. So in order to achieve trustworthiness, humans will still need to be part of the process, to vet and control what are the underlying AI algorithms and that associated training data don’t introduce unfair or otherwise unwanted bias.

**How can standards help achieve transparency?**

Standards are behind all systems that make our civilization work as we know it and
there are many examples, such as railways, with a legacy system over 100 years old, or HTML 5, which defines the properties and behaviours of webpage content and without which you could not see all the things you can see in your browser.

We are at an important time for writing the horizontal standards for innovative AI technologies that in five or ten years will be taken for granted by all of us. The pace for standards being taken for granted has obviously increased. This is why we need to get it right now and make sure we consider as many angles as possible, including ethical and societal concerns.

Although standards are voluntary, they are used by policy makers and regulators. For example, many countries are working towards achieving the UN Sustainable Development Goals. Standards will need to ensure many aspects of trustworthy AI use, including privacy and security or functional safety of devices, systems and infrastructures in which AI technologies are embedded. We have a broad range of stakeholders – academia, consumer protection bodies, industry and regulators, who are defining standards which will help regulators to do their work as they have been mandated. However, you cannot enforce something that does not have the right handles defined at the technical level.

Which standards are you working on to address these issues?

We are working on a number of deliverables at the moment including:

- **Overview of trustworthiness in AI** (ISO/IEC DTR 24028), provides a high-level overview of the SC 42 programme of work in the area of trustworthiness as it relates to the AI domain including trustworthiness for AI systems and applications.


- **Bias in AI systems and AI aided decision-making** (ISO/IEC WD TR 24027) describes measurement techniques and methods for assessing bias, with the aim to address inadvertent bias related vulnerabilities, and mitigating these. Various AI system lifecycle phases are covered, for example, data collection, training, continual learning, design, testing, evaluation, use, as well as retirement of a system.

- **Overview of ethical and societal concerns** (ISO/IEC WD TR 24368) relative to AI systems and applications, will look at principles, processes and methods in this area. This is a newly approved project, resulting from the 3rd plenary in Dublin in April and is intended for technologists, regulators, interest groups, and the society at large. The effort will help link these non-technical requirements and challenges to the trustworthiness technology projects to address the issues.

- **We are also developing a key risk management standard for AI** (ISO/IEC WD 23894), which builds on the ubiquitous and generic ISO 31000. We are working closely with ISO TC 262 Risk Management.

Finally, we anticipate starting work on Part 2 of the robustness of neural network series. This would eventually become an international standard and will consider formal methods for assessment of robustness in neural networks. It would be of great use to insurers of heavy machinery, such as ships or construction machines, which contain neural networks. It will help industry demonstrate that their systems containing machine learning technology do still work in a functional, predictable, and explainable way, and that their robustness characteristics that insurers must consider can be formally proven.
This year’s IEC General Meeting is taking place in China, a country with a long tradition of putting up buildings that can withstand earthquakes. Centuries ago the Chinese realized that the best way to protect cities in an active seismic area is to start thinking about safety and security during the design phase. A good example from more recent times is the world’s second tallest building, the Shanghai Tower. The 632-metre structure (2,073 ft) was designed with a reinforced foundation and a system of counterweights and shock absorbers to prevent excessive swaying during earthquakes and high winds.

It makes sense to focus resources on preventing fires rather than waiting to fight blazes. That is why the concept of security-by-design is popular too in software and hardware development, where it means making products and systems that are not only free of vulnerabilities, but also subject to continuous testing during their life cycle. The thinking is that when trouble strikes, it is already too late. According to Deloitte executive Sean Peasley, “Security needs to become embedded into the DNA of operational programmes to enable organizations to have great products and have peace of mind.”

Changing focus

The quote comes from a report that urges organizations to start considering security threats during the initial design and development phase. Such an approach saves time and money. Firefighting may put out the blaze, says the report, but does not deal with the underlying causes.

Cyber security expert Moreno Carullo puts it even more succinctly, “We need to change our focus and shift from just looking for the bad guys to security-by-design.” Carullo is a co-founder of Nozomi Networks, which counts some of the world’s biggest utilities and petrochemical companies among its clients.

He is also key member of a group of ICS operators, SCADA engineers, security specialists and networking engineers who develop a key cyber security on behalf of the IEC. (The IEC prepares and publishes international standards for all electrical, electronic and related technologies – collectively known as ‘electrotechnology.’

Regarded as leaders in the field of security, they work for some of the world’s biggest companies, including the likes of ABB, Siemens, Schneider Electric, General Electric and Enel.

It is the task of the IEC experts to identify industry best practices and the components needed to build a secure-by-design power system. These include encryption, multi-factor authentication and the definition of roles for all users, as well as pervasive monitoring of the system itself and intruder detection.

The challenge for power stations and other critical infrastructure is that the integration of machines and devices with networked sensors and software has blurred the lines between the once separate domains of information technology (IT) and operational technology (OT). As more and more objects are connected, communicate and interact with each other, there has been a surge in the number of endpoints and potential ways for cyber criminals to gain access to networks and infrastructure systems.

IT vs. OT

The problem is that all too often cyber security programmes are led by an IT approach. It is a global issue and the key is to understand the difference between IT and OT, two different but complementary technologies. The primary focus of IT is data and its ability to flow freely and securely. IT is fluid and has many moving parts and gateways, making it more vulnerable and offering a large
surface for a greater variety of constantly evolving attacks. Defending against attacks is about safeguarding every layer, continuously identifying and correcting weaknesses to keep data flowing.

OT systems are designed for specific actions, such as ensuring that a generator is switched on or off, or that an overflow valve is open when a chemical tank is full. The primary focus of OT is ensuring the security and control of what in the past were usually closed systems. Operational technologies ensure the correct execution of all actions. Everything in OT is geared to physically moving and controlling devices and processes to keep systems working as intended, with a primary focus on security and increased efficiency.

**Pervasive and continuous monitoring**

“One of the most critical parts of securing industrial systems is understanding the unique protocols used in ICS environments for retrieving information from field equipment and for sending control commands,” says Carullo.

“They rarely incorporate any security measures, including security against errors, equipment failure or deliberate sabotage. The standard puts forward a series of effective solutions to create secure communication channels inside critical infrastructure networks.”

The security specialists, Nozomi Networks, demonstrated at the recent Black Hat US event how attacks can be detected in real time using the IEC 62351 standard for monitoring industrial networks. The standard provides effective solutions for the remote monitoring of the health and condition of intelligent electronic devices (IEDs), remote terminal units (RTUs), distributed energy resources (DERs) systems and other systems that are important to power system operations.

Properly implemented, IEC 62351 enables the immediate detection of any power supply failure caused by a cyber-attack. The code components included in the standard are also available as a machine-readable file.

Security-by-design can enhance the protection of new power stations and reduce the need for costly upgrades and enhancements during their operating life. It is, of course, also true that security-by-design cannot fully protect a plant from rapidly evolving cyber attacks, which may expose previously unknown vulnerabilities. This is why IEC 62351 incorporates tools for pervasive and continuous monitoring.
Underscoring its strong ties with academia, the IEC will sign collaboration pledges with Shenzhen Technology University, the DKE Next GEN programme and GOST-R Academy. The signing ceremony will take place during the IEC Academy and Capacity Building day on 24 October with the presence of Dr Shihong Tian, Administrator for Standardization Administration of China (SAC), Roland Bent, President of the National Committee of Germany (DKE), Alexey Abramov, Head of the Federal Agency for Technical Regulation and Metrology (Rosstandart), and Frans Vreeswijk, General Secretary & CEO of the IEC.

The IEC Academy and Capacity Building day takes place alongside the IEC General Meeting in Shanghai. It offers an opportunity for participants to discover best practices on training and capacity building programmes, contribute an open discussion and learn about the new ‘Standard in a day’ boot camp concept. It is a full day event that will showcase the work of IEC Academy & Capacity Building and demonstrate how National Committees can benefit from its training and professional development programmes in standardization and conformity assessment.

Working with academia

During the IEC Academy & Capacity Building day, IEC will present the standardization learning activities of the Shenzhen Technology University, part of a larger aim to reach out to academia and cooperate with universities. The collaboration pledges are a first step in developing standardization teaching packages that can be used in universities around the world. With Shenzhen Technology University, IEC will start a joint pilot project on standardization as part of the university’s Bachelor’s programme.

According to Jan-Henrik Tiedemann, Head of IEC Academy and Capacity-Building, “we recognize the unique perspective provided by academics and seek to support projects that can stimulate academic debate and bring new insights on the development and impact of international standards”. Last year, IEC Academy, together with the American Institute of Electrical and Electronics Engineers (IEEE) and the Korean Agency for Technology and Standards (KATS), organized the competition Future Challenges in Standardization. During the IEC General Meeting 2018, five prizes were awarded for best academic publications.

In addition, IEC Academy co-organizes the World Standards Cooperation annual
Academic Day and lectures at universities around the world.

Offering training and webinars

IEC Academy offers high-quality training through webinars, capacity building events and national training workshops in different countries every year to the IEC community. In 2018, IEC Academy provided 350 hours of training to over 3,000 professionals. Workshops and training sessions take place all over the world as well as at IEC Central Office and IEC regional centres.

Each year, IEC Academy provides training to incoming National Committees Officers to help them better understand how to navigate the IEC community. Training is also given to new technical committee and subcommittee Chairs and Secretaries to help inform them of how IEC functions. Capacity building and training workshops were also given to National Committees with the aim of providing best practices for NCs and their mirror committees.

According to Tiedemann, “these workshops offer an opportunity to meet with many members of the IEC community and help them understand how IEC works and how to make the best use of IEC resources available to them. It also allows us to get their feedback and ideas for improving IEC processes”.

IEC Academy also delivers tailored events. In 2018, it organized a one-day capacity building and training event at the HUANENG headquarters in Beijing that was attended by 90 participants and live-streamed to all HUANENG branch offices across China. “This was a very exciting event for us,” noted Tiedemann. “It gave us the opportunity to not only serve an IEC Member but also to help prepare the team of the IEC President-elect, Dr Yinbiao Shu, for an active participation in the IEC”.

Public webinars

IEC Academy offers webinars each month which are open to the general public. These webinars provide a better understanding of different areas of IEC activities, such as the standards development process, conformity assessment, the importance of terminology, etc.

‘Standard in a day’ boot camps

Based on an idea from an IEC Young Professional Leader from Germany, IEC Academy has begun organizing intensive trainings for beginners to standardization. Over a one and a half day period, participants simulate the development of a standard, from a new proposal (NP) to committee draft (CD) and final draft international standard (FDIS), through a mix of training, discussions and role playing.

Two boot camps have already been organized in Germany with DKE, one in China and a fourth in Malaysia. According to Tiedemann, “feedback for the boot camps has been extremely positive. It has even led to one industry leader wanting to further engage in standardization as a result of participating in the boot camp.”

Strengthening collaboration

IEC offers a collaboration platform that National Committees and IEC TC/SCs can use to connect with other experts from around the world and share their standardization work. Users have access to designated workspaces where they can find and share documents. This platform facilitates the process for sourcing comments and views that can then be used to develop a national position.

National versions of the collaboration platform are available. This platform is already in use in eight countries across Europe, Asia and North America.

Online learning

The IEC Academy & Capacity Building is currently in the process of developing an online learning management system that will allow participants to take courses online. This new platform will be composed of courses on topics such as standardization and conformity assessment as well as on the requirements of specific IEC roles such as Convenors, Secretaries or Chairs. Each course is comprised of several modules that, once successfully completed, allow the participant to receive an online recognition and a certificate. National Committees will be able to see in the IEC Expert Management System which of their experts has successfully completed a course.

In his role as Head of the IEC Academy & Capacity Building, Tiedemann is very excited about the prospects for fully developing the IEC Academy and serving IEC Members. “We want to show to the community how active participation can be an effective strategy not only for stakeholders, such as regulators and industry, but also for the personal development of all participants. We receive very positive results from our breakout sessions questions and discussions. It is a give and take. We learn so much from participants, which leads to improvements in IEC processes and tools”.

The work of IEC Technical Committee 3 has much evolved since the early days of the IEC, partly as a result of the gradual digitalization of our societies.

IEC TC 3 is one of the early technical committees of IEC. It was set up in 1911 to produce standards for graphical symbols. The aim was to provide those working in the budding electrical industry with the same graphical representations to be used on electrical devices, systems and parts. Graphical symbols were necessary for technical documentation as well as to help human interaction with equipment.

The power of symbols

One of the most well-known representations developed by IEC TC 3 is the standby symbol, indicating a sleep mode or low power state on electrical devices. This world-famous symbol has become a bit of an icon for techies around the globe. Like all the other symbols used for electrotechnical equipment, it can be found in a database published by both IEC and ISO (IEC 60417 and ISO 7000). The IEC part of the database is maintained by subcommittee (SC) 3C. “We also provide a database of symbols for diagrams, IEC 60617. It includes around 1900 symbols,” explains IEC TC 3 Chair Eirik Selvik from Norway. Both are horizontal documents used across IEC by all the various TCs.

A validation team including representatives from IEC National Committees checks the symbols on an ongoing basis. “Each symbol is standardized separately and we have to make sure that they continue to be used throughout industry,” Selvik adds. The symbols represent conductors and connecting devices, semiconductors and electron tubes, measuring instruments, lamps and signalling devices, etc… Each symbol is shown “as is” in the databases. “Rules for the application of these symbols, especially in documentation, are provided in IEC 61082, a horizontal publication specifying the preparation of documents used in electrotechnology,” Selvik says.

IEC SC 3D works on the Component Data Dictionary (CDD) specified in the IEC 61360 series of standards. It is a technical dictionary for use in the electrical and electrotechnical domain. This work is essential for enabling the exchange of technical data and facilitating interoperability.

Changing focus

The work of TC 3 does not stop there, however. Its emphasis has shifted towards the management of information and the creation of computer interpretable classification and identification systems used during the whole life cycle of a device, system or plant.

“2019 has already been a busy year for the TC, with several new editions of standards. “We issued a new version of IEC 61293 at the end of the summer. The initial standard was published in 1994 by TC 16. The group was disbanded in 2012 and TC 3 took over that part of its work. It is a horizontal publication which establishes minimum requirements and general rules on marking electrical

By Catherine Bischofberger
equipment with ratings. We had to include new information concerning AC and DC supply aspects which had changed. The publication is part of the work we do on safety applications for human machine interfaces.”

Another new edition is IEC 81346-2. “Part 2 of the standard deals with classification schemes and their associated letter codes for the defined classes. This second edition states how to define classes and make different classes of objects. We have defined a hierarchy, including entry classes, sub-classes and sub-sub classes,” Selvik describes.

Like IEC 61293, the new edition of IEC 81346-2 is a horizontal publication which can be used by all IEC TCs but, even more, can be applied throughout all technical areas and branches of industry, whether energy, chemical, construction, automotive, shipbuilding and marine, etc.

“This standard is widely used throughout different industries. We are very glad to have published this second edition. We share the work with ISO on the overall series. ISO/IEC 81346 part 1 and 2 is managed by IEC, while ISO deals with other parts, such as 10 and 12,” says Selvik.

Cooperation with ISO is a routine occurrence. “It is rare to have documentation which is only relevant to electrotechnical issues. We work a lot with ISO TC 145 on graphical symbols, for instance,” Selvik says. The TC also works with the Institute of Electrical and Electronics Engineers (IEEE). “We developed the IEC/IEEE 82079-1 standard together. We worked on the second edition, which was issued in May, with ISO TC10/SC 21 and the Institute. We cooperated with its systems and software engineering standards committee. This second edition is much broader than the previous standard.”

General Meeting: we need feedback!

IEC TC 3 will be holding a workshop in Shanghai to present topics the committee is working on. It will take place on October 24 at 9:00 in the Pudong Shangri-la River Wing building. “We really want people from other TCs to attend because they are our customers, to some extent. We would like them to express their specific needs for graphical symbols, documentation and representations. Our ultimate goal is for end users to receive consistent, unambiguous and coherent documentation providing the knowledge they need.”

Feedback is therefore required and there is no better place to start than at the IEC GM.
IECEE certification benefits diverse industry sectors

Enhancing services through international partnerships

By Antoinette Price

Over the past year, IECEE has been considering several partnerships with other organizations which could enhance certification activities in the area of energy efficient products, sustainable lighting and certain aspects of industrial automation.

**Quality testing**

Following ITU interest to work with IEC to provide conformity assessment solutions for testing laboratories associated with ITU recommendations, IECEE, the System of Conformity Assessment Schemes for Electrotechnical Equipment and Components, has established a joint working group. It is expected that the two organizations will sign a memorandum of understanding. Once established, the new programme and approach will ensure high quality outcomes from qualified testing laboratories and a standardized methodology that will lead to consistent application of ITU recommendations.
Sustainable lighting

IEC standardization and conformity assessment (CA) activities cover many technologies, including the generation, transmission and distribution of electricity. This also includes the products and systems that use that electricity, as well as their interoperability, environmental impact, performance and safety.

IECEE membership is considering a potential partnership with the United Nations United for Efficiency (U4E) programme, related to testing and certification to regulatory models for developing countries, with an initial focus on luminaires. U4E aims to partner with stakeholders who have a specific interest in moving markets to energy-efficient products, in order to contribute to reducing the world's growing electricity consumption and protect the environment.

A large number of IEC International Standards address the needs of the lighting industry requirements for tests, safety and electromagnetic compatibility for lamps, lamp systems and all related accessories. IECEE tests and certifies performance and safety issues for a wide variety of lamps and luminaires and their accessories.

Time sensitive networks

At the request of industry, preliminary discussions are underway related to potential IECEE services for testing and certification harmonization for time sensitive networks (TSN). This would be based on the upcoming joint international standard (IEC/IEEE 60802), which defines time-sensitive networking profiles for industrial automation, including select features, options, configurations, defaults, protocols, and procedures of bridges, end stations, and LANs to build industrial automation networks. Such a programme could potentially lead to a partnership with IEEE.

Functional safety

Based on an expressed need by industry, IECEE established a new programme to define market relevant solutions and services related to functional safety in the IECEE CB scheme. The new proposed functional safety programme is limited to three standards: IEC 60947-5-3 and IEC 60947-5-5 – related to discrete hardware only – and IEC 61800-5-2 – safe torque off function related to discrete hardware only – with the focus on IEC 61508, which comprises methods on how to apply, design, deploy and maintain automatic protection systems known as safety-related systems.

Cyber security

The need for manufacturers to demonstrate that their industrial automation equipment complies with regulations led to IECEE developing a testing and certification programme to address the expanding requirement for conformity assessment (CA) solutions for cyber security in this sector.

The service provides a framework for assessments in line with the IEC 62443 series of international standards on security for industrial automation and control systems. The series generally specifies requirements for security capabilities, whether technical (security mechanisms) or process (human procedures) related.

To achieve this, two evaluations can be done, of an applicant’s security capabilities, which are used to develop, integrate and/or maintain specific products or solutions.

- evaluate an applicant’s ability to provide IEC 62443 compliant security capabilities

- evaluate that IEC 62443 compliant security capabilities have been applied to either a specific product, automation solution or industrial automation control system.

Successful recipients receive the IECEE industrial cyber security capability certificate of conformity.

Certification of personnel competency

Increased human-machine interfaces, the rapid development of artificial intelligence (AI) technologies, and the use of robotics in industrial and commercial arenas has heightened the need for risk mitigation. In this context, engineers must be able to evaluate risks and access methodologies that will enable them to test and certify the safety and functionality of such equipment and systems.

IECEE is developing a conformity assessment market solution, based on this need, to have qualified personnel conducting the evaluations of the functional safety of industrial installations and equipment.

Light weight, collapsible, waterproof lantern provides clean, sustainable solar lighting (Photo: Solight Design)
Certification advances renewable energy industries

As global populations require more energy, the percentage of renewable energies contributing to electricity provision continues to grow

By Antoinette Price

According to the Renewable Capacity Statistics 2019 report by International Renewable Energy Agency (IRENA), 2018 closed with a total renewable energy generation capacity of 2,351 GW, up by 171 GW on the previous year. Of this amount, wind, solar and marine energy, accounted for 564 GW, 480 GW and 500 MW respectively.

The need for certification

Third party certification of wind, solar photovoltaic (PV) and marine energy equipment and services to consensus-based international standards, supports manufacturers in the RE industry, by reducing risks, streamlining costs, as well as enhancing market access.

IECRE, the IEC System for Certification to Standards Relating to Equipment for Use in Renewable Energy Applications, covers three renewable energy (RE) sectors: marine, solar PV, and wind. The system was established in 2014 to address these issues, in a world with growing electricity demands, which at the same time, needs to reduce power generated by fossil fuels.

“Security-by-design can enhance the protection of new power stations.”

Instilling confidence in three RE sectors

Wind

The ICRE wind sector is fully operational with nine certification bodies and more currently being assessed for participation. It has 24 testing laboratories, authorized to conduct testing and certification of wind turbines, their components and/or wind “farms”. ICRE has issued 55 certificates for wind turbines, a significant increase from five a year ago. It is expected that the first certificate(s) for wind farms – or Project Certification will be issued in the remaining months of 2019.

Solar PV

The solar PV sector currently has seven certification bodies and eight inspection bodies operating and issued its first solar PV certificate in 2018. Thomas Sauer, ICRE Convenor of promotions and marketing and President and CEO of EXXERGY, has promoted ICRE certification at several international events in the US and Europe, highlighting that it covers the entire lifecycle of a PV power plant, from initial design aspects to annual inspections and ultimately asset transfer. Sauer also emphasized how the consistent implementation of international standards can reduce costs by streamlining processes and instilling confidence in the industry.

Marine

The marine energy – operational management committee (ME OMC) has been focused on the first deliverables for certification bodies, including IEC Technical Specification 62600-2 which covers design requirements for marine energy systems. IEC Technical Committee 114, which develops international standards for marine energy, has initiated a new project team regarding technology qualification (62600-4) to address gaps in the available standards necessary to support certification, which have been identified by the ME-OMC. Further, IEC TC 114 has recently approved a new Technical Specification (62600-3) in relation to the measurement of mechanical loads of wave, tidal and other water current converters and work is ongoing to develop the associated operation document for the issuance of test reports against this standard. It is hoped the first renewable energy test laboratories will join the ICRE System this year and the first renewable energy test reports will be issued in 2020.
Encompassing most industry sectors

IECEx helps mitigate or eliminate hazards in Ex areas

By Claire Marchand

Explosive (Ex) atmospheres – also termed hazardous areas/locations – may be caused by flammable gases, mists or vapours or by combustible dusts. Some examples include the oil, gas or mining sectors. Most accidents that get wide media publicity are linked to fire and/or explosions on oil rigs or in underground mines.

Ex areas are (almost) everywhere

While almost everywhere, the coverage of Ex accidents and incidents by the specialized press paints another picture. Food processing plants, sugar refineries, gas stations, grain handling and storage, automotive manufacturing and repair, pharmaceuticals, furniture manufacturing, to name a few, have their share of incidents involving hazardous materials such as dusts, mists or vapours. In reality, most industry sectors may have at least one area that qualifies as a hazardous location (storing gas canisters, powders, etc.). They utilize flammable substances in quantities that may result in concentrations that are potentially explosive, whether that is during normal operation or due to abnormal situations arising.
The risks are widespread. Manufacturers or sellers of equipment for use in Ex areas; anyone working in oil and gas, chemicals, petrochemicals or pharmaceuticals, or anyone supplying, specifying, buying or using Ex equipment in the engineering, procurement and construction sector; anyone installing, inspecting or repairing Ex equipment should be acutely aware of the risks inherent to his/her work. The safety and security of staff, community, environment and equipment is of the utmost importance.

Zero risk doesn’t exist

Zero risk may not be conceivable, but measures can be taken to mitigate hazards and make sure that those working in Ex environments do so in the safest possible way. These include installing and operating equipment that incorporates an explosion-protection technique as part of its design and manufacturing. It is also necessary to ensure staff has the required training, skills and competences to work in hazardous areas.

IEC, through IECEx, the IEC System for Certification to Standards Relating to Equipment for Use in Explosive Atmospheres, has the mechanisms in place to help industry, authorities and regulators ensure that equipment (electrical and non-electrical) as well as the people working in Ex locations benefit from the highest level or safety.

IECEx operates the only global online certificate system dedicated to the Ex sector, allowing instant verification of claims of compliance of certificates issued by more than 100 IECEx certification bodies (ExCBs) in 35 member countries.

These certificates of conformity are issued via the following three schemes:

- IECEx certified equipment scheme
- IECEx certified service facilities scheme
- IECEx scheme for certification of personnel competence

In addition, the IECEx conformity mark licensing system operates in association with the IECEx certified equipment scheme.

IECEx certificates issued by the ExCBs are centrally located and available for full public access on the IECEx online certificate system.

Training for the CoPC

The IECEx recognized training provider (RTP) programme, launched a few years ago to assist applicants in their preparation for the certificate of personnel competence (CoPC), is growing fast. The RTPs provide candidates with knowledge and understanding of the terminology and protection concepts for electrical and non-electrical equipment used in explosive atmospheres, based on the IEC 60079 and the ISO/IEC 80079 series of international standards prepared by IEC Technical Committee 31: Equipment for explosive atmospheres, and its subcommittees.

Personnel certification

The number of certificates issued by all IECEx schemes is steadily growing, with special emphasis on the certificates of personnel competence (CoPCs). These provide assurance that the persons working with design, selection, installation, inspection and maintenance of Ex equipment have had their knowledge and competence independently verified. Almost 3 000 CoPCs have been issued so far.

Non-electrical equipment

At the end of 2016, when ISO 80079-36 and ISO 80079-37 were published, IECEx added non-electrical (mechanical) equipment to its certified equipment scheme.

Safety is of the utmost importance in hazardous locations and equipment must be fire- or explosion-proof. For non-electrical equipment, the source of ignition comes from the action of the machinery that may create frictional contact, thus causing a spark or hot surface. Examples include: hydraulic pumps, gear boxes and crushers.

The addition of non-electrical equipment to the scheme has met with success, resulting in an increase from 17 certificates in June 2018 to 109 in June 2019.

United Nations endorsement

Since 2011, the United Nations Economic Commission for Europe (UNECE), has endorsed the use of IEC TC 31 standards supported by the IECEx schemes as the “world best practice model for demonstrating conformity in the highly specialized Ex field”. This was reflected in the UNECE common regulatory objective (CRO), also published in 2011. The UNECE endorsement continues to assist IECEx recognition among regulators, for example, the US Coast Guard use of IECEx for equipment used on foreign flagged ships within their jurisdiction.

The UNECE CRO is currently under review and the updated edition planned for late 2019. To facilitate its input, IECEx has re-activated its management committee (ExMC) working group WG 8: Regulatory recognition.
In many countries, the networked connection of physical objects is the norm today, in homes and businesses, transport, healthcare, entertainment and sports.

**Innovative technologies at risk?**

Artificial intelligence (AI) technologies, robotics, biometrics, virtual reality (VR) and augmented reality (AR), smart transportation, digital health, 5G connectivity and the Internet of Things (IoT) all rely heavily on electronic components, without which they would not exist, and they share a common risk: security. Cyber security involves every sector of industry, individuals and companies.

One problem experts face is the evolving nature of security risks. Keeping up with new technologies, trends and threat intelligence is a challenge that businesses must tackle if they want to prevent information security breaches that cost vast amounts every year in stolen intellectual property and confidential data.

**Enhancing information security**

As explained on the TechTarget website, “the traditional approach has been to focus resources on crucial system components and protect against the biggest known
The Standard specifies requirements for establishing, implementing, maintaining and continually improving an information security management system within the context of an organization, as well as the assessment and treatment of information security risks tailored to the organization’s needs. The requirements are generic and intended to be applicable to all organizations, regardless of type, size or nature. It makes recommendations regarding leadership, commitment and policies, as well as actions to address risks and opportunities. It also covers support matters such as resources, competence, awareness, communication, operational planning and control, information security risk assessment and issues including treatment and performance.

Multiple aspects of ISO/IEC 27001

ISO/IEC 27001 goes further than cyber security and covers how an organization manages the security of information it holds, both for its own operations and from external sources, such as suppliers, customers, etc.

A management system that meets ISO/IEC 27001 will look at overall security such as:

- Are there locks on the front doors?
- Who can have keys and how is the allocation of keys/passwords to enter the building managed?
- Under what conditions can external organizations have access into the building, e.g. cleaners, service organizations, essential services, etc.?
- Is there a policy to lock up files overnight to prevent security staff and cleaners from seeing sensitive information on desks?
- How are old records – paper and electronic – disposed of?
- What happens with the hard drives of computers that are discarded and replaced?

ISO/IEC 27001 also addresses threats that come from deliberate cyber attacks.

**IECQ is part of the solution**

The ever-growing need for organizations to provide independent proof of compliance with ISO/IEC 27001 for their information security management system (ISMS) has led industry to request that certification bodies (CBs) of IECQ, the IEC Quality Assessment System for Electronic Components, be able to cover the assessment and certification to ISO/IEC 27001 under the approved process scheme (AP scheme) while conducting other IECQ assessments, for example avionics or hazardous substance process management.

Certification to ISO/IEC 27001 has existed since the standard was published in 2013. What drove industry to approach IECQ recently was the lack of harmonization among the many certification bodies that offer their own individual certificates and apply their own individual interpretations of ISO/IEC 27001. Over time, this has resulted, in different approaches and differences in what is accepted by the various certification bodies. Thus, industry felt that IECQ was able to offer a single approach to the application of ISO/IEC 27001. All certificates can be found on the IECQ website.

IECQ is a worldwide approval and certification system that covers the supply, assembly, associated materials and processes of a large variety of electronic components used in millions of devices and systems. It provides manufacturers with independent verification that the requirements in IEC International Standards and other specifications were met by suppliers.

**Avionics Users Forum**

IECQ has run the IECQ aerospace, defense and high performance (ADHP) component management scheme (IECQ ADHP) and the IECQ counterfeit avoidance programme (IECQ AP-CAP) for several years. In response to a need from the avionics sector, in 2018, IECQ launched the IECQ Avionics Users Forum (AUF) via its IECQ Hub, a discussion platform that aims to bring together professionals working in avionics and in counterfeit avoidance.

Several technical forums operate under the IECQ AUF:

- TF 1: Audit programmes
- TF 2: Harmonization standards
- TF 4: Electronic component management plan (ECMP) and commercial off-the-shelf (COTS) assemblies, including uprating
- TF 5: Lead-free/REACH
- TF 6: Anti-counterfeit/obsolescence management
- TF 8: Microcircuits, diodes, transistors, passive and semiconductor wear-out
- TF 9: LED lighting
- TF 11: Atmospheric single-event effect (SEE) radiation
- TF 12: Mechanical parts

This year, IECQ AUF held a meeting in Singapore which included cyber-physical systems security and cyber security-embedded security.
Nuclear industry

IECQ has also explored the application of its schemes within the nuclear industry in conjunction with the recent publication of the international standard ISO 19443:2018, *Quality management systems – Specific requirements for the application of ISO 9001:2015 by organizations in the supply chain of the nuclear energy sector supplying products and services important to nuclear safety (ITNS)*. The system is now providing ITNS certification through its CBs under the AP scheme.

Training

IECQ provides industry with a supply chain verification tool for seeking assurance that electronic components, assemblies, processes and related materials conform to declared technical standards and specifications. Because technically-competent personnel are an integral part of the IECQ System, training workshops and standards training course materials are offered for the different schemes/programmes.
IEC Technical Committee 56: Dependability, recently published a second edition of IEC 62402 which establishes requirements for obsolescence management applicable to any company or organization.

Throughout industry, obsolescence refers to the difficulty of obtaining supplies, spares or support by different companies in the supply chain. It is very different from the consumer understanding of obsolescence which most often involves the notion of “inbuilt” or “planned obsolescence”. It implies that a product was intentionally designed not to last for a long time. This notion of obsolescence has been much criticized for encouraging over consumption, at a time when environmental concerns about waste management are reaching new highs.

The B to B definition of obsolescence concerns manufacturers who rely on various supplies or parts to build their devices, products or systems. Minimizing the risks associated with this form of
obsolescence has been standardized by TC 56 in IEC 62402. The idea is for companies to plan ahead to avoid being hindered when spare parts are no longer available, for instance. Parts can become obsolete because production has ended or because they are produced in areas of the world where availability is made difficult for a number of reasons (wars, rebellions, trade disagreements, legislative changes, environmental regulations, etc...)

Management of obsolescence contributes to the dependability of items, which is an essential requirement for international trade. It reduces costs by limiting risks and helping to smooth out problems in the supply chain.

**Widely applicable standard**

“The previous edition of IEC 62402 was more of a guide referring only to the obsolescence of electrical and electronic products and systems. It did not clearly specify requirements for obsolescence management. This second edition has a much broader scope than the previous standard and can be used in any industry, not only in the electrical and electronics sector,” explains TC 56 expert Graham Goring, who heads the maintenance team responsible for updating the standard. IEC 62402 is a 100-page document which specifies how to establish an obsolescence management plan, how to set up an obsolescence management infrastructure and organization inside companies, how to develop strategies to minimize obsolescence during design, etc... “We worked closely with the International Institute of Obsolescence Management (IIOM) and their members helped us get more countries on board for this new edition. It is important to understand that obsolescence should ideally be managed right from the start even before you design your product,” Goring adds.

The standard has already been adopted across various industries in many countries, stretching from Australia to Canada and including at least 12 European countries. “The US is looking at it favourably as well. Experts there would like to name it DSMS for diminishing manufacturing sources and material shortages,” he says. Feedback since the publication of the standard in May has been positive. In Goring’s own words: “It looks like we hit the right buttons this time!”

IEC is also working on a conformity assessment process scheme relating to obsolescence. IECQ, the IEC Quality Assessment System for Electronic Components, has set up a working group, led by Graham Goring, to explore how to widen the use of the current framework for the verification of obsolescence management to other sectors. The existing IECQ framework relating to obsolescence is currently only used in the avionics and defence industries.
In April, the board of ANCE appointed Juan Rosales as its new President, the youngest in the association’s history. With this appointment, ANCE, the leading association for standardization and conformity assessment in Mexico, implements its vision of integrating a new generation of leaders in strategic management positions. Considering that Rosales began his career as an apprentice at ANCE, his appointment is an achievement for experts who are committed to a career in standardization.

Rosales is actively involved in standardization and conformity assessment work at national, regional and international levels. In addition to his Presidency at ANCE, he is also the Vice President of Council for Harmonization of Electrotechnical Standards of the Nations in the Americas (CANENA) and the head of the Mexican delegation to IEC Technical Committee 61 which covers safety of household and similar electrical appliances.

But what is the career path from apprentice to President? Rosales credits the IEC Young Professionals Programme (YP) in which he participated in 2010, and his selection as a YP Leader, as key factors in helping to shape his career success. The YP Programme helped boost his involvement in standardization and conformity assessment work at the national and/or international levels.

Tell us about your background

I am an industrial engineer with a Master’s Degree in Engineering Administration, actively involved in standardization and conformity assessment for household appliances. I represent Mabe, one of the major manufacturers in Latin America, in my role as Regulatory Intelligence Global Manager.

How did the YP Programme boost your involvement in standardization and conformity assessment work at the national and/or international levels?

Being part of the IEC Young Professional Programme 2010 in Seattle has been one of most remarkable experiences in my professional life. Going back nine years, I was part of a testing lab for laundry equipment. However, after being selected as one of the three YP Leaders, new opportunities arose.

I received an invitation from the IEC National Committee of Mexico to share
my experience and ideas for a programme in Mexico which, after several years, has become a strong platform for involving new generations. I also had the opportunity to present my perspective of the YP Programme in regional forums such as CANENA and the Pan American Standards Commission (COPANT) as well as at many IEC events.

These opportunities provided me with a platform on which to build a career as an expert in standardization and conformity assessment, not only at the local level but also at the international level. Being selected to be a part of the IEC family has provided me with a strong sense of confidence throughout these years.

Why would you encourage potential YPs to participate in the programme?

The standards and conformity assessment landscape needs people with fresh ideas and with a new perspective. The way we do business has changed dramatically in the last five years compared with what we were doing in the last decades. In my opinion, we need to make room for a new generation, for individuals who are committed to building a career in standardization.

The YP Programme provides a perfect starting point for this new generation – the fundamental basis - to build a career. And, of course, it is the opportunity to interact with people from many different cultures.

What recommendations would you give to current YPs to fully leverage the benefits of the programme?

I would recommend taking the time and identifying where they are and trace a career plan of where they would like to be. It may be in a technical or management position, and while responsibilities may be defined by the company where we work, finding a place in standardization and conformity assessment depends on each one of us. It is also important to learn from the best players and find a mentor.

In a nutshell, I would recommend using the 4b’s: be visible (committed, open to support), be heard (take an active role), be asked (work hard to obtain responsibilities) and, finally, become a reference.

How does standardization and conformity assessment impact your work at Mabe?

Mabe is a global company with a presence in more than 70 countries. We believe that standards create markets and that it is very important to participate in the standards development process as well as in designing certification schemes or criteria to be considered for accessing markets.

However, our vision goes beyond market access. We see standards as a vehicle to strengthen the relationship with our consumers, enabling us to offer safer products with better levels of energy efficiency as well as being environmentally friendly. The implementation of standards and conformity assessment enhances the industry and provides better solutions that are accessible to all consumers.

What do you think are some of the big challenges currently facing standards development organizations (SDOs)?

SDOs need to keep pace with technology changes, to improve the efficiency and quality of their regulatory instruments and ensure that the benefits derived from standardization and technical regulations match consumer needs in a timely manner.

In a globalized world, it’s also important that SDOs increase their development of international standards but also respect the particularities of national conditions.

Looking ahead, what are some of the key trends in technology impacting your industry?

Internet of things (IoT) is a trend revolutionizing many aspects of our daily life and consumer products. Household appliances are not exempted. Our industry, like many others, will be impacted by smart manufacturing and it’s important that IEC remains as a standards solutions facilitator in order to smooth the implementation of this trend.

How have standardization and conformity assessment benefited the Latin American region?

Decades ago the region was a fertile field for the development of standards and technical regulations and countries such as Argentina, Brazil and Mexico initially led the effort to increase the regulatory landscape in the region.

Today, the reality is that over 90% of countries in the region have implemented regulations for refrigerators, air-conditioning equipment and so on, in most of the cases using IEC or ISO standards as a basis for testing. This translates into real benefits for consumers since they are now able to buy more energy efficient products, saving money on their electricity bills.
Technological advances are having a huge impact on the medical sector. In the upcoming issue of e-tech we will be exploring some of the areas in which technology is being used to aide patients’ recovery or facilitate their lives, including mental health and Active Assisted Living. We’ll also be looking at how advances in AI and robotics are helping doctors carry out their tasks more precisely and across distance while examining questions surrounding cyber security and big data, and the role international standards play in ensuring data privacy.
Share your work in 2020

Get in touch with us

e-tech covers the broad scope of IEC standardization work done by our technical experts and testing and certification carried out by the numerous certification bodies and testing laboratories within the IEC Conformity Assessment Systems. We’d like to report on your work and activities you organize or participate in on behalf of IEC. Please contact Managing Editors Zoe Smart zsm@iec.ch or Antoinette Price apr@iec.ch.

2020 themes:

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**Innovative technologies**
3D printing, biometrics, AR and VR, fibre optics, 5G, EMC

**Issue 02**
**Cyber security**
Critical infrastructure, connected appliances, transport

**Issue 03**
**Energy efficiency**
Motors, storage, renewables, circular economy

**Issue 04**
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**Issue 05**
**Year in review**
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