POWER GENERATION & TRANSMISSION

INDUSTRY SPOTLIGHT
Helping keep power on
IEC standardization work central to global industry and economy expansion

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Hydropower
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Marine renewables
Tidal energy generation and the path to commercialization

TECHNICAL COMMITTEE AFFAIRS
Wind turbines
Wherever it blows, TC work is essential
New IEC TC 120
Electrical Energy Storage Systems
Power generation & transmission

This issue of e-tech looks at various aspects of the power generation and transmission chain. It focuses also on renewable energy sources, such as hydropower – and its role in electrical energy storage, marine and wind energy. The activities of the several TCs (Technical Committees) involved are highlighted as well.

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Pumped-storage hydropower represents the largest and most flexible electrical energy storage solution. Over the last decade, the marine energy industry has become a growing sector of renewable energy. Wind energy is currently the most cost effective new renewable energy source. Services and amenities such as water supply, heating, transport depend in large parts on reliable electricity supplies. IEC recently created IEC TC 120: EES (Electrical Energy Storage) Systems. In October 2012 IECEE welcomed Kazakhstan as its newest member.
Editorial

Power generation & transmission
Safety and reliability of power supplies

Hurricane Sandy, which hit the US Eastern seaboard, after having wreaked devastation in many countries and islands in the Caribbean region, offered a stark reminder of the central role played by electrical power in society today.

Storm-related power cuts left more than 7.4 million homes and businesses without electricity in and around New York City, and knocked out mass transit transportation along a wide swath of the eastern US.

This unprecedented outage brought home to many that water and gas supplies, heating, transportation and many other services and activities depend totally on electrical power.

Sandy destroyed transmitters, downed overhead power lines and flooded underground cables and other systems, showing that failure of a single link in the entire power generation, transmission and distribution chain can bring the whole system down.

This issue of e-tech looks at various aspects of this chain. It focuses also on renewable energy sources, such as hydropower, and its role in electrical energy storage, as well as marine and wind energy. The activities of IEC TCs (Technical Committees) involved in hydropower, marine and wind energy are also detailed.
Pumped-storage key to energy storage

Accommodating supply variations

With rising electricity consumption and costs, and the need to balance increasing levels of intermittent RE (renewable energy) generation from wind and solar systems, EES (electrical energy storage) solutions are being pursued. These use and store energy efficiently and help improve grid stability and flexibility. Long-established pumped-storage hydropower currently represents the largest and most flexible EES solution and is experiencing significant growth.

IEC support for EES systems
The IEC is a strong supporter of EES. The IEC MSB (Market Strategy Board) recently published two White Papers, the first on EES, the second analysing the role of large-capacity EES systems, integrating large-capacity RE sources. Both White Papers stress the crucial importance of EES in future installations.

IEC TC (Technical Committee) 120: Electrical Energy Storage (EES) Systems has been created to prepare International Standards for such systems.

A number of new energy storage technologies under development contribute to compensate for the variations in availability and grid fluctuation of some renewable energy resources. Of them all, pumped-storage hydropower is the most cost effective and technically viable. It has also been around the longest – its first reported use was in Italy and Switzerland in the 1890s. The 1930s saw the development of reversible hydroelectric turbines that could operate both as turbine-generators and (in reverse) as electric motor driven pumps (see article on hydropower in e-tech, January 2012).

The work of experts within IEC TC 4: Hydraulic turbines, also supports the construction, operation and maintenance of pump-turbine storage sites.

Interest in pumped-storage is increasing, particularly in those regions and countries with the most variable renewable resources and where new installations of traditional hydropower are harder to achieve. The vast majority of installations are currently found in Europe, Asia (Japan in particular) and the US.

Principle of pump-turbine arrangement
The technique provides the most widely used form of bulk-energy storage in the short term. Pumped-storage hydropower currently accounts for more than 99% of installed storage capacity for electrical energy worldwide: around 127 GW (gigawatts), according to the EPRI (Electric Power Research Institute – the research arm of America’s power utilities) and Germany’s Fraunhofer Institute.

A combination of water and gravity is used to capture off-peak power and release it at times of high demand.

Pumped-hydro facilities typically take advantage of natural topography, using two reservoirs built at different heights. The “head” refers to the vertical height of the fall of the water stream (or river) from the upper reservoir. Higher heads provide a greater pressure and therefore greater hydropower potential. Because reservoirs for pumped storage can be built at sites fed by small streams, which also make up for water lost through evaporation, topographical restrictions for selecting the sites to construct large capacity plants are far less significant than with conventional hydropower.

Off-peak electricity is used to pump water from the lower to the upper reservoir, turning electrical energy into gravitational potential energy. When power is needed, water is released back down to the lower reservoir, spinning a turbine and generating electricity along the way.

Plants that do not use pumped storage are referred to as conventional hydroelectric plants. These have
significant storage capacity and may be able to play a role similar to pumped-storage plants in the electric grid by deferring output until needed. Whereas the primary goal of pumped storage is short term power and intermittent storage, large hydro reservoirs are primarily intended for long term storage and base power, but they can also be used on short notice for levelling the variability of renewable energy.

Established benefits of pumped storage

Historically, hydroelectric installations are long established leaders in EES because of their excellent response in three main areas:

- They are highly cost-effective, reducing electricity costs by using electricity produced at off-peak times when the price is lower. Systems demonstrate low maintenance costs and typically achieve one of the highest cycles per lifetime at some of the lowest costs. High-performance hydropower equipment can frequently run without interruption for extended periods of time and hydroelectric plants have a lifetime of at least 50 years, making hydropower a profitable long term investment.
- EES systems offer support for users needing to improve power supply reliability as well as to compensate for variations of availability and fluctuations in intermittent RE sources such as wind and solar.
- EES maintains and improves power quality, frequency and voltage by providing spinning reserves that can come online quickly and are needed to maintain system frequency stability during emergency operating conditions and unforeseen load swings. While thermal plants are less able to respond to sudden changes in demand, pumped-storage plants, like all hydroelectric plants, can respond to load changes within seconds, helping instantaneously maintain the balance between generation and net load so as to avoid brownouts, blackouts and overloads.

Pursuing increased capacity, efficiency and flexibility

The market for energy storage is dynamic, reflecting the current state of development in the industry as well as fluctuations within it. Demand is driven by several key trends, including the proliferation of intermittent RE sources and the resultant need for spinning reserves, the onset of the smart grid concept and a shift to plug-in hybrid and electric vehicles. Although utilities are building capacity to meet so-called needle peaks in electricity usage, these only occur for a small number of hours each year. It is therefore expensive and inefficient to size capacity to these peaks, and energy storage can play a large role in providing peaking generation.

Hydroelectric technology storage facilities have always provided the highest capacity in terms of electricity-generating forms of energy storage. While continuing to perform this critical task, facilities are also making a valuable contribution to power grid efficiency and flexibility.

Market applications

The hydro industry maintains its dynamism through the exploration of improved and optimized technologies, development of innovative business models for long and short duration applications and cost-effective technology and project development. Long-established hydro facilities with large storage reservoirs, including pumped-hydro storage, continue to perform as global technology leaders in both developed and emerging markets.

Experts involved in IEC TC 4 are seeing increased demand for clean energy pumped-storage installations because of the known benefits of pump-turbines. In addition, associated production and monitoring equipment provides increased revenues for producers and more affordable pricing for end-users.

Pumped-storage facilities worldwide still expanding

Most of the global installed pumped-storage generating capacity is to be found in Asia – which currently holds over 60 GW of cumulative installed capacity – in Europe and in the USA.

The October 2012 TC 4 Plenary Meeting took place in Japan, which is a prime global user of pumped-storage facilities. The country's complex geological features and an abundance of rainfall have created a number of small river systems that provide opportunities for the development of hydropower. As hydropower resources have been developed, Japan has tapped into pumped-storage as a way of increasing the supply of peaking power.

Recently commissioned units are in operation at the 1 200 MW O'marugawa pumped-storage project, where the head is 646 m. These currently offer the world's highest head adjustable speed, although a higher adjustable unit (where the head exceeds 700 m) is now being constructed at the Kazunogawa pumped-storage facility and will be commissioned in 2014.

China is also developing pumped-storage facilities. It is to start building a 3 600 MW hydroelectric pumped-storage facility in Hebei Province, according to HydroWorld.com. The first phase of the project, offering a capacity of 1 800 MW, is expected to take seven
years to complete. The plant is intended to help retain some of the province’s high wind turbine output, some 5% of which was reportedly lost last year. In the same province a 1 024 MW pumped-storage plant was completed in 2008.

In September 2012 an official from India’s West Bengal state said the government was planning a 1 000 MW pumped-storage plant in the state’s Purulia District. The official indicated that the USD 470 million project would help diversify the region’s energy portfolio which currently places a reliance of “90% on power generated from thermal power stations”.

In 2009 the European Union had 38,3 GW net pumped-storage capacity (36,8% of world capacity) out of a total of 140 GW of hydropower, which represented 5% of total EU net electrical capacity.

The 1 060 MW Goldisthal pumped-storage plant on the Schwarza River, which started commercial operation in October 2004, is the biggest hydroelectric project in Germany and the most modern in Europe. The Goldisthal project is unique because two of the four vertical Francis pump-turbine units feature variable-speed (asynchronous) motor-generators. This benefits its operator, Vattenfall Europe, by providing power regulation during pumping operation, improved efficiency at partial load conditions, and – for grid stabilization purposes – high dynamic control of the power delivered. There are other projects in Slovenia, Austria, and Switzerland.

In 2010 the United States had 40 pumped-storage plants which accounted for about 16% of renewable capacity and 2% of the country’s energy capacity, supplying 21,5 GW of pumped-storage generating capacity (20,6% of world capacity for this category).

Some 40 pumped-storage projects providing an additional 31 GW could be developed in the US in the future to balance variable generation from wind and solar sources. The largest hydroelectric pumped-storage plant in the world, with 2 100 MW peak power, is the Bath County plant located in Virginia, USA.

IEC TC 4 expertise central to pumped-storage expansion

TC 4 hydro experts are in demand for their technical expertise in the construction, operations and maintenance of pump-turbine storage sites. Without their work and involvement, it would be impossible to develop such facilities, although they are vital to ensuring the future of the world’s energy supply.

TC 4 has frequently scheduled Plenary Meeting locations that also include technical visits to turbine-pump storage installations. Recent trips have been to the Goldisthal pumped-storage plant in Germany; the Kazunogawa pumped-storage power station in Japan was visited in October 2012. The technical contributions of TC 4 experts enable the developing energy mix to be optimized, including proper integration with new sustainable energy sources, and increasing demands for improved power grid efficiency and flexibility to be met.

The development of many new pumped-storage projects and the modernization, operation and maintenance of the numerous existing installations mean that the agenda of TC 4 hydro experts is likely to remain full for the long term.
Marine renewables
Tidal energy generation and the path to commercialization
By Jonathan Colby, 2011 Young Professional

Jonathan Colby was one of the three 2011 Young Professional Leaders. Here he outlines the advances that have been made in the marine renewable energy sector and highlights the challenges that still need solutions.

Predictability of tides is a key
Over the last decade, the marine renewable energy industry has become a growing sector of renewable energy that can contribute to renewable portfolio standards in a developing worldwide market. This sector is made up of wave energy, tidal, river and ocean current energy and OTEC (Ocean Thermal Energy Conversion). With the exception of OTEC, which utilizes temperature gradients between surface and deep-sea ocean water to do work, these marine technologies convert existing kinetic energy from water bodies to mechanical energy. This mechanical energy can be used in a variety of ways, with most developers focusing on the conversion directly to electrical energy. In particular, technology that converts tidal energy into electricity offers a significant advantage over other renewable energy sources for electricity production because the tides are highly predictable.

This predictability is an important distinction in the renewable sector over other intermittent renewable energy sources and provides for improved integration into grids (smart or otherwise). It is also more suitable as a distributed generation source for other green energy uses such as electric car/bus charging stations, LEED (Leadership in Energy and Environmental Design) buildings, desalination, etc. that can contribute to a renewable energy future.

Commercial-scale tidal energy projects underway
At present, the available energy in existing tides is captured using a wide range of evolving technologies. Projects are under development across Europe, in North America and Asia ranging in size from scale-model testing to pre-commercial scale multi-unit array deployments connected to national grid infrastructures. The U.S. Department of Energy’s Marine and Hydrokinetic Technology Database provides up-to-date information on marine and hydrokinetic renewable energy, both in the U.S. and around the world. Individual technology developers have begun partnering with global engineering and marine service firms to develop commercial-scale projects and resource assessment efforts have been conducted to highlight regional-scale geographic areas with excellent tidal resources (speed, depth, etc.). [The database referenced above and the Atlas of UK Marine Renewable Energy Resources provide more information].

Additionally, a number of environmental impact studies have been published suggesting the compatibility of individual tidal energy devices (and small arrays of similar devices) with the surrounding ecosystem. Operational monitoring under an adaptive management framework will continue to assess the impact of...
commercial-scale energy extraction on tidal ecosystems to ensure the sustainable implementation of tidal energy technology. Coupled with these resource and environmental assessments, favorable ROCs (Renewable Obligation Certificates) and feed-in tariffs for early stage Pilot tidal array projects being promulgated by regional areas with large tidal resources (the State of Maine in the US, the Province of Nova Scotia in Canada, and the UK) make a promising climate for technology developers.

New York City’s East River project
In the United States, Verdant Power is a leading developer and integrator of tidal energy technology and a pioneer in the environmental consenting process. The company’s RITE (Roosevelt Island Tidal Energy) Project in New York City’s East River (the East River is actually a tidal strait, with nearly symmetric semi-diurnal tides) has demonstrated a number of significant accomplishments and world firsts, including the successful operation of five grid-connected tidal turbines (4th generation) in a tidal array configuration in 2007, and the first US FERC (Federal Energy Regulatory Commission) Pilot 10-year license for an array of its 5th Generation (Gen5) Verdant Power KHPS (Kinetic Hydropower System) turbines. The KHPS is a horizontal-axis turbine with a downstream, 3-bladed fixed-pitch rotor. Rated at 35 kW in 2.1 m/s of flow, the Verdant KHPS turbine yaws passively to capture energy from both the ebb and flood tides at the RITE site. Electricity is produced using an induction generator with the local grid providing the excitation voltage. Three-phase, 60 Hz power is delivered at 480 V to Roosevelt Island in accordance with the local network and relevant standards. Based on the successful grid-connected demonstration at the RITE Project, the technology has now been advanced to a Gen5 commercial class system including full-scale testing of the Gen5 rotor at the RITE site.

U.S. Federal licence for commercial project
The company conducted extensive testing and environmental monitoring to quantify the KHPS turbine performance and its environmental compatibility within the project site. Working with the federal and state regulatory agencies, Verdant characterized the East River ecosystem in and around Roosevelt Island while confirming the environmental compatibility of the multi-turbine array. To do so, it deployed a wide range of underwater acoustic technology to measure a broad set of environmental parameters, from high-resolution SONAR devices capable of imaging the KHPS and fish to arrays of acoustic receivers for detecting tagged species. In addition to identifying spatial and temporal tendencies in the East River, these data validate numerical and statistical models developed to predict the KHPS-fish interaction with operating turbines at the site.

As mentioned in January 2012 e-tech article, Verdant was granted the first FERC license [P-12611] for a commercial tidal array in the United States. This 10-year license permits the phased deployment of up to 30 turbines in the East Channel of the East River, for a rated 1.05 MW of tidal power generation, with a corresponding suite of environmental monitoring protocols. FERC, along with the other federal and state regulators, have also adopted the use of adaptive management for these monitoring protocols to ensure that best practices are used throughout the project life-cycle. [Additional information on the FERC license and associated environmental impact studies and monitoring protocols can be found at www.theriteproject.com].

International Standards vital for marine renewable energy sector
As companies globally continue the development and deployment of commercial-scale licensed projects, the marine energy sector will increasingly require sustained technology development and project financing. For the sector to be successful there must be increasing certainty for regulatory approvals, device reliability and survivability, and operation and maintenance costs, among others. Given the early stage of the marine renewable energy industry, the development of international standards plays a critical role in providing certainty and assurance as the industry grows.

Today, IEC TC 114: Marine energy – Wave, tidal and other water current converters, is developing a suite of technical specifications to support the industry at-large. These efforts focus on wave and tidal energy and cover both resource and power performance assessment. Additional work is underway to provide guidance on OTEC, general system design, mooring design, and electrical power quality, among others. In addition to the development of Technical Specifications, the IEC CAB (Conformity Assessment Board) is investigating the development of a conformity assessment scheme for marine energy systems. This scheme will provide guidance to certifying bodies on how to determine if the requirements contained in the aforementioned technical specifications have been met by a technology or project developer. Taken together, these international efforts are essential for the success of this emerging industry. In particular, certifying a technology and/or a project to these specifications can give developers the ability to more easily enter new markets while providing the financial community with the necessary confidence in the return on their investment. Further, these certifications help prevent the misrepresentation of individual device performance, critical to ensuring public safety and the long-term adoption of similar technologies.
Going with the wind
IEC International Standards support wind power’s remarkable expansion

As demand surges for clean power generation to meet the world’s growing energy need, the renewable energy sector is set to expand rapidly. Wind energy is currently the most cost effective new renewable energy source. Many countries have goals for wind to supply more than 20% of their energy generation by 2030, with offshore turbines playing a significant role in some countries. With the growing demand for more efficient and reliable wind turbines, IEC International Standards prepared by IEC TC (Technical Committee) 88: Wind turbines, are ever more central to the successful development of the industry.

Fast growth and major economic stakes
In 2009 the world relied on renewable sources for over 13% of its primary energy supply and renewables accounted for nearly 20% of global electricity generation, according to IEA (International Energy Agency) statistics.

Wind power now supplies the greater part of the world’s non-hydropower renewable electricity capacity. Global wind power capacity was 238 GW (gigawatts) at the end of 2011, up from just 18 GW at the end of 2000, with a CAGR (compound annual growth rate) of over 25% over the past five years. According to Pike Research, a firm that provides in-depth analysis of global clean technology markets, that capacity is expected to reach 562.9 GW by 2017, representing a USD 153 billion global industry and cumulative investment in new wind power capacity of USD 820 billion.

The supply of wind turbines is a global business, with the six largest producers all based in different countries and the 10 top manufacturers accounting for nearly 80% of global production. Demand for reliable products to feed the fast growth of this industry is satisfied primarily by the products’ compliance with IEC 61400. Wind turbine generator systems, the series of 19 International Standards and Technical Specifications which have become the world’s de facto standards for the industry.

Environmental and other challenges
The increase in wind energy capacity has come from the installation of greater numbers of turbines and also from the availability of larger, more efficient turbines.

IEC 61400-1 outlines design requirements for wind turbines. It isn’t limited to the design of mechanical, electrical and electronic parts, but also takes into account a thorough assessment of the following site-specific environmental and other conditions:

- topographical complexity of the site
- wind conditions
- wake effects from neighbouring wind turbines
- earthquake conditions
- electrical network conditions
- soil conditions
- structural integrity by reference to wind data
- structural integrity by load calculations with reference to site-specific conditions

All these factors determine the optimum and safe choice of sites on which to install wind turbines.

Technical challenges
The origin of wind turbines dates back to several centuries BC when windmills were used to pump water or mill cereals. It is estimated that some 100 000 windmills were scattered throughout Europe during the 18th and 19th century before wind power was displaced by steam engines and other sources of mechanical power. In America, farmers and rural communities relied extensively upon small electricity-generating wind turbines which first appeared in the late 19th century.

For most uninformed observers, the term wind turbine evokes an image of a large three-blade propeller-like mechanism rotating on top of a tower. In fact wind
turbines are complex installations that may come in different shapes and include structural (tower), mechanical (gearbox, drives, etc.), electrical (generator, motors, cables, etc.) and electronic (control, monitoring) systems.

The huge increase in electricity from wind power in recent years is the result of the greater number of turbines installed as well as of the launch of larger turbines. The average capacity of turbines is now greater than 2.5 MW; some now even achieve 7.5 MW with rotor diameters that can exceed 160 metres. The introduction of these very large turbines means that many technical challenges have to be overcome to ensure safe and proper operation of the devices.

Wind turbines can be set up on land and offshore. Their components share most design requirements but specific conditions for offshore installations are dictated by the marine environment.

IEC 61400-3, Design requirements for offshore wind turbines, includes assessments of the external circumstances at an offshore site, such as wind conditions, waves, currents, water level, tides and storm surges, sea ice, earthquake conditions and seabed movement. This International Standard also details recommendations for the assembly, installation and erection of offshore turbines as well as for their commissioning, operation and maintenance.

Other International Standards in the IEC 61400 series cover many additional aspects such as the measurement of mechanical loads and acoustic noise, structural testing of rotor blades, lightning protection, communications for monitoring and the control of wind power plants for maintenance, conformity testing and certification.

Small is beautiful too
If the ten-fold increase in wind power cumulative capacity between 2001 and 2011 (from 23.9 to 238.4 GW) results mainly from the installation of large turbines, small wind power installations can also provide cost-effective electricity on a highly localized level, both in remote settings as well as in conjunction with power from the utility grid.

TC 88 has prepared IEC 61400-2, Design requirements for small wind turbines, to deal “with safety philosophy, quality assurance, and engineering integrity” and to set out “requirements for the safety of SWTs (Small Wind Turbines) including design, installation, maintenance and operation under specified external conditions”.

IEC 61400-2 “applies to wind turbines with a rotor swept area smaller than 200 m², generating at a voltage below 1 000 V a.c. or 1 500 V d.c.”. This part of IEC 61400 is similar to IEC 61400-1, but “does simplify and make significant changes in order to be applicable to small turbines”.

Pike Research forecasts that the global market for small wind systems will have more than doubled in value between 2010 and 2015, from USD 255 million to USD 634 million.

During the same period small wind system installed capacity additions will nearly triple to 152 MW. “The payback period for a small wind system can be 5 to 10 years in a region with adequate wind resources”, says Pike Research senior analyst Peter Asmus, adding: “these economics provide a strong value proposition for a variety of commercial, industrial, and residential applications”.

IEC standards unlock expansion and boost investors’ confidence
IEC International Standards have proven essential to meet the complex challenges and set of issues faced by the wind power industry. The global nature of that industry means that International Standards play a vital role in ensuring the proper production, testing, worldwide installation and acceptance of wind power turbines, whether large or small and installed on land or offshore.

Sandy Butterfield, founding CEO (chief executive officer) and CTO (chief technical officer) of Boulder Wind Power and Chairman of IEC TC 88, notes that when he started in the wind turbine business in the early 1980s, the absence of harmonization and consistency in the design process meant that many important design features that would ensure the manufacture of reliable products were missing. As a result there was a lack of confidence on the part of stakeholders and a reluctance to fund projects. All this changed when the industry started objective testing based on standards developed by the IEC, Butterfield says.

“Standards offered the financial community a way of believing that the machine had been designed according to some objective third party process and that it had been reviewed according to some rules that the entire industry agreed upon.” He adds, “Ultimately, in the wind energy business, all wind turbines end up being certified. It’s a market imperative. If you don’t understand the standards, you have a more difficult time meeting the certification”.

The IEC 61400 series of International Standards and associated referenced documents ensure the wind power industry has all the information needed to allow it to manufacture products that are internationally certified, accepted and marketable.
INDUSTRY SPOTLIGHT

Helping keep power on
IEC standardization work is central to the global expansion of industry and economy

In many countries, everyday services and amenities such as water supply, heating, transport and communications are taken for granted. That is, until a major natural disaster cuts off...electricity, bringing all other services to a grinding halt. When Hurricane Sandy struck the North-eastern United States, one of the world’s most technologically advanced societies, it brought home to millions how central electricity is to their lives. At the global level, all links in the entire chain, from the generation to the distribution of electrical power to end users, rely on International Standards prepared by many IEC TCs (Technical Committees) and SCs (Subcommittees).

Converting primary sources
Electricity generation results from the conversion of mechanical or thermal energy from primary sources, such as fossil fuels, nuclear or renewable energies, into electric energy. This process requires different machines such as hydraulic, steam and wind turbines, or other systems, to harness solar or marine energy.

The fact that IEC TCs preparing International Standards for power generation, transmission and distribution were among the first to be created demonstrates the need for standardization in an industry that is central to the economic activity and prosperity of all countries.

Created in 1913, TC 4: Hydraulic turbines, was one of the first IEC TCs, reflecting the pioneering role played by hydropower in electricity generation.

Hydropower is the primary source of renewable energy worldwide, representing 16% of global electricity generation in 2010, according to the IEA (International Energy Agency). Thanks to pumped storage facilities, it is also the main source of EES (electrical energy storage), making up 99% of the world’s capacity (see article on pumped storage in this e-tech).

The IEC’s commitment to EES is illustrated by its decision in October 2012 to establish TC 120: Electrical Energy Storage Systems.

From fossil fuels to new renewables
Two thirds of the world’s electricity are currently generated by burning fossil fuels, mainly coal but also gas. This requires the use of steam turbines in nuclear power plants and the exploitation of geothermal energy. Steam turbines are also used to generate electricity from biomass.

International Standards for steam turbines are prepared by TC 5, whose origins date back to 1927. Steam turbines have also been adopted in other domains such as integrated gasification combined cycle, industrial and petrochemical plants.

The share of electricity produced from non-hydro renewable sources is increasing rapidly; it is expected to grow more than seven-fold between 2010 and 2035, according to the IEA. This expansion is driven by environmental concerns and the volatile price of fossil fuels.

TC 82: Solar photovoltaic energy systems, TC 88: Wind turbines, TC 114:
Marine energy – Wave, tidal and other water current converters, and TC 117: Solar thermal electric plants, established in 1981, 1987, 2007 and 2012 respectively, prepare International Standards that cover all the different technologies developed to utilize power from these renewable sources, which are expected to generate nearly a third of global electricity in 2035.

Stepping up and down
Electricity generated by power plants must be adapted for transmission and distribution. Transformers are used to convert a system of alternating voltage and current into another system of voltage and current, usually of different values. They are an important link in the electricity generation, transmission and distribution chain.

They are installed in step-down or step-up substations in which outgoing voltage from the transformers is reduced or increased in comparison with that of the incoming power.

Transformers are technologically mature products with a low rate of problems, indicating the overall adequacy of International Standards prepared by TC 14: Power transformers, which was created in 1939. TC 14 work covers “transformers with power ratings above 1 kVA single phase and 5 kVA polyphase”.

Power transformers are produced and procured widely across frontiers without problems. This trade relies on IEC International Standards, against which transformers can be purchased, manufactured, tested and inspected. TC 14 International Standards are adopted as national standards in many countries and used globally by utilities, consultants and project management companies as the basis for the specification of power transformers.

Demand is strong across the entire range of power and voltage, both to accommodate growing demand for electricity and to replace ageing units. However, power transformers are not immune to failure, which is often caused by external factors. This was the case when Hurricane Sandy provoked the explosion of a Consolidated Edison transformer in a Manhattan power station on 29 October 2012. Such failures can paralyze entire distribution networks, as was the case then.

Distributing
Electric power is generally produced some distance away from where it is needed. Proper distribution is therefore essential and relies on many systems such as wires, cables and various electrical accessories. Overhead conductors and lines, as well as cables of all kinds, are what immediately come to mind when power transmission is mentioned. Overhead electrical conductors are an essential link in the transmission chain.

TC 7: Overhead electrical conductors, was set up in 1928 to prepare recommendations for bare aluminium wires and conductors. Its work now covers all kinds of overhead conductors including ground wires and hardware directly connected to conductors for the purpose of maintaining electrical/mechanical continuity. It also prepares International Standards related to guidance for the fabrication and use of overhead electrical conductors and test methods for assessment of their performance when in operation.

TC 7 also prepares International Standards for new types of overhead electrical conductors required by innovative fibre or carbon-reinforced high performance wires. These International Standards are usually specified in projects financed by international agencies such as the World Bank.

TC 11: Overhead lines, prepares International Standards for overhead lines above 1 kV AC and 1,5 kV DC nominal voltage, “excluding railway traction supports and line materials”.

The scope of TC 11 concerns the reliability of overhead lines and also deals with safety aspects, including the definition of clearances, tests on structures, foundations and fittings and
methods of erection. It sees increased interest in EHVDC (extra high voltage direct current) transmission, possible surges in AC transmission voltages and new technologies in the construction of overhead lines as technology trends that will require more work.

TC 20: Electric cables, which first met in 1934, “prepares International Standards for the design, testing and end-use recommendations (including current ratings) for insulated electrical power and control cables, their accessories and cable systems, for use in wiring and in power generation, distribution and transmission”.

The not so obvious
Besides the most conspicuous installations and equipment such as dams, conventional or nuclear power plants, transformers and overhead lines and cables, the generation, transmission and distribution of electric power depends on many other vital additional systems and components that rely on standardization work from a variety of other IEC TCs.

The task of TC 8, System aspects for electrical energy supply, is to “analyze electricity sector evolution (…) and take the necessary initiatives to create and maintain a system approach covering the whole electricity supply chain from production at various levels down to the utilization at the customer level”.

IEC SC 17A and SC 17C prepare International Standards regarding specifications for HV switchgear and controlgear, and related prefabricated assemblies rated above 1 kV AC or above 1,5 kV DC.

TC 36: Insulators, set up in 1949, is another TC involved in the power generation, transmission and distribution chain. It prepares International Standards for insulators for HV systems and equipment including bushings, insulators for overhead lines and substations and their couplings. The demand for insulators and insulated bushings is constant. Customers of TC 36 standards are utilities, electrical equipment manufacturers (power and instrument transformers, circuit breakers, cable, GIS (gas-insulated switchgear), capacitors, surge arresters, etc.), testing laboratories and certification/accreditation organizations.

Huge economic impact and global market
Many other IEC TCs and SCs are involved in standardization work for the systems and equipment used in power generation, transmission and distribution, and for their installation and operation. Not having reliable and regular access to electricity has a direct impact on a country's economy and its ability to participate in the global economy.

It is impossible to put a precise figure on the economic spin-offs of the entire power industry, from generation to distribution, but they are worth trillions of dollars. In its 2012 World Energy Outlook, the IEA notes that “very large investments in electricity-supply infrastructure will be needed to meet rising electricity demand and to replace or refurbish obsolete generating assets and network facilities”. It estimates that cumulative investment for electricity-supply infrastructure will reach USD 16.9 trillion (in 2011 USD value) over the 2012-2035 period. “Investments in power plants account for 57% of the power sector total, 60% of it for renewables”, the IEA indicates.

The expansion of the global electricity-generating capacity and its overall economic impact would not be possible without the multitude of IEC International Standards prepared over decades by many IEC TCs and SCs, and covering the entire power generation, transmission and distribution sector.
Hydropower continues to be the main source of clean energy in the world. Worldwide, it accounted for 16% of overall electricity generation and for 81.6% of electricity generation from renewable sources in 2010, according to the IEA (International Energy Agency) World Energy Outlook 2012. This rather mature technology covers both large and small installations and offers great flexibility as it can respond immediately to on-demand compensations for generation and grid variances. It can also help regulate or make up for shortfalls in power generated from intermittent sources such as solar and wind. IEC TC (Technical Committee) 4: Hydraulic turbines, prepares International Standards for hydropower installations.

Senior TC, but ever more relevant
Created in 1913, IEC TC 4 is one of the IEC’s first TCs. It is “responsible for the preparation, periodic review and updating of standards and technical reports covering the design, manufacturing and rehabilitation, commissioning, installation, testing, operation and maintenance of hydraulic machines including turbines, storage pumps and pump turbines of all types as well as related equipment”.

The demand for large quantities of clean renewable world energy, including extending the life of valuable existing equipment and properly integrated water management has never been so great [see article on hydropower in e-tech, January 2012].

Today, more than 125 technical experts from 34 countries take part in TC 4 work. More than half of these experts regularly attend TC 4 plenary meetings, typically held every 2 years, on a regular basis.

Both large and small hydropower installations
Hydropower, the power derived from the energy of flowing or falling water, had been used for centuries to drive various mechanical devices before being harnessed to produce electricity in the late 19th century. Today, the term is used almost exclusively for hydroelectric power.

Hydroelectricity is generated in over 160 countries and for most people it is associated with large dams and reservoirs and very high capacities that can reach up to 22.5 GW (for the recently-completed Three Gorges Dam in China).

However, small, micro- and pico-hydro stations can also play an important role, in particular in certain countries and environments, and in remote and rural off-grid locations. Micro-hydro schemes can be as large as 500 kW and are generally run-of-the-river developments for villages. Pico-hydro systems are generally used for individuals or clusters of households.

Realizing that small hydro projects had their own requirements, TC 4 prepared IEC 61116, Electromechanical equipment guide for small hydroelectric installations.

TC 4 also published IEC 62006, Hydraulic machines – Acceptance tests of small hydroelectric installations. This International Standard “defines the test, measuring methods and the contractual guarantee conditions for field acceptance tests of the generating machinery in small hydroelectric power installations. It applies to installations containing impulse or reaction turbines with unit power up to about 15 MW and reference diameter of about 3 m”.

Beyond electricity production
In its “Directions in Hydropower” document, the World Bank acknowledges

Okumino 1,5 GW pumped storage station exploiting Japanese topography – head 514 m, commissioned 1994 (Chubu Electric Power Co.)
the importance of hydropower beyond its traditional role of providing electricity. It stresses that hydropower is also viewed now as an integral factor in addressing energy security, climate change, water security and regional cooperation. In addition, the report highlights the fact that hydropower resources can be harnessed for poverty alleviation and sustainable development.

Hydropower dams will play a significant role in managing water resources, an issue set to become more important in the medium to long term as access to water becomes increasingly difficult in many regions of the world.

As many countries seek to increase the share of renewable sources in their energy mix, hydropower – pumped storage in particular – which makes up 99% of worldwide installed storage capacity for electrical energy, will play a central role in regulating the production, distribution and storage of energy from intermittent sources such as solar and wind (see article on pumped storage in this issue).

**Extensive domain, no rest in sight**

The potential for additional hydropower, especially in Africa, Asia and Latin America, is considerable, according to an October 2012 joint Technology Roadmap report on hydropower by the EIA and the Brazilian Mines and Energy Ministry.

The roadmap “foresees, by 2050, a doubling of global capacity up to almost 2 000 GW and of global electricity generation over 7 000 TWh. Pumped storage hydropower capacities would be multiplied by a factor of 3 to 5”.

TC 4 publications cover all areas of hydropower installations and include the following:

- field acceptance testing
- model acceptance testing
- speed governing and controls
- cavitation of hydro machines
- commissioning, operation and maintenance
- vibrations in hydraulic machines
- small hydro installations
- hydraulic turbine control
- nomenclature for hydroelectric power plant machinery
- tendering documents
- scale effects from model
- flow measurements
- small hydro acceptance tests
- particle erosion of machines
- hydropower equipment installation
- rehabilitation and performance improvement and life assessment

Given the huge global hydropower potential that has yet to be exploited and the need for optimized International Standards, IEC TC 4 experts, who work on an extremely wide scope of activities, will have a very busy agenda for the foreseeable future.

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**Wherever it blows, TC work is essential**

Wind at the forefront of renewables field

Governments throughout the world are trying to increase the share of renewables in their electricity generation portfolio both as a precaution against fluctuating prices for fossil fuels and for environmental reasons. Wind power is currently the most cost-effective new renewable energy source and has expanded considerably in the last few decades. IEC TC (Technical Committee) 88: Wind turbines, has made this expansion possible by providing manufacturers and installers with International Standards which ensure that wind turbine installations are designed to time-tested requirements and evaluated according to proven procedures.

*Offshore wind turbines (Photo: Vestas)*
Renewables gradually displacing fossil fuels
In its World Energy Outlook 2012, the IEA (International Energy Agency) forecasts that renewables could “become the world’s second-largest source of power generation by 2015 (…) and, by 2035, approach coal as the primary source of global electricity”. The IEA places wind as the leading renewable source in a variety of scenarios.

Wind power has been used for centuries to propel ships or drive mills to grind grain or pump water. The conversion of wind energy into electrical energy (on a very limited scale initially) is relatively recent, dating back to the late 19th century. As the global quest for cleaner and sustainable sources of energy gathers pace, wind power is seen as offering great potential for growth in the renewable energies’ domain.

Wind astern
Between 2001 and 2011 wind power expanded 10-fold, at a CAGR (Compound Annual Growth Rate) of more than 25.5%, to reach 238 GW at the end of 2011. Extensive work by IEC TC 88 experts has underpinned that growth.

TC 88 was created in 1987, quite a few years before wind power became a major source of electrical energy at the global level.

Its scope, last formulated in 2002, is to prepare International Standards for wind turbines that “address design requirements, engineering integrity, measurement techniques and test procedures. Their purpose is to provide a basis for design, quality assurance and certification. The standards are concerned with all subsystems of wind turbines, such as mechanical and internal electrical systems, support structures and control and protection systems”.

TC 88 International Standards have made it possible to manufacture better wind turbines and to extend the scope of their installation to encompass diverse and more challenging environments. The TC is preparing up-to-date International Standards, exploring new applications and making improvements to existing systems.

Complex TC structure
Experts from 38 countries take part in the TC’s work which is constantly expanding to include all elements of wind turbine installation. The multiplicity and complexity of this task has led to a TC structure that includes two WGs (Working Groups), five PTs (project teams), nine MTs (maintenance teams), two JWG s (Joint Working Groups) and an ad hoc Group on terminology.

WG 3 is tasked with developing an International Standard on the design requirements for offshore wind turbines. These have specifications that differ from those of their onshore equivalents and wave loading represents an additional category that is required. WG 27 will define standard dynamic electrical simulation models for wind turbines and wind farms. The models will be used in power system and grid stability analyses.

PTs prepare International Standards for wind turbine installations and aspects that are not yet covered by their own specific standards. These include, among others, design requirements for floating offshore wind turbines, which present particular constraints, for rotor blades and for wind turbine towers and foundations. The MTs are tasked with updating existing International Standards and projects.

JWG 1 brings together experts from IEC TC 88 and from ISO (International Organization for Standardization) TC 60: Gears. They have prepared IEC 61400-4, Design requirements for wind turbine gearboxes, which is to be published shortly. Experts from IEC TC 88 and TC 57: Power systems management and associated information exchange, work together within JWG 25 to "develop standards for monitoring and control systems and associated information exchange for wind power plants".

Ever more wind on the horizon
The prospects for wind power are very positive: the IEA forecasts that installed onshore and offshore capacity will increase from 238 GW in 2011 to nearly 1 100 GW in 2035, with onshore capacity making up 84% of the total (against 98% in 2011). This expansion will require additional International Standards to cover new areas as well as an update of existing ones to support technical developments in the sector.

As of early November 2012, TC 88 had issued 18 publications, 14 International Standards and 4 Technical Specifications in the IEC 61400 series.

IEC International Standards for the wind turbine industry ensure that wind systems and installations meet the latest technical requirements. For installers, utilities and other users, they guarantee that the equipment they acquire and install is as safe, reliable and efficient as possible. They also ensure that the wind turbine industry will continue to prosper and make an ever larger contribution to electricity generation.
Recognizing that the proportion of RE (Renewable Energy) is likely to increase in all major electricity markets, but that large-scale incorporation of RE into existing electricity grids remains complex, the IEC has created IEC TC (Technical committee) 120: EES (Electrical Energy Storage) Systems.

RE integration into grid is paramount
The aim of the new TC 120 is to accelerate the integration of RE into the grid and to enable a more reliable and efficient supply of electrical energy. As successful RE integration depends on Electrical Energy Storage, small and big centralized and decentralized EES systems will become increasingly important to meet growing global energy needs.

EES systems will also become a crucial element of Smart Grids. With them utilities will be able to store more energy for ulterior consumption. Utilities will also be able to maintain a reliable energy supply by controlling fluctuations in energy demand and support users during network failures. Finally, EES will allow utilities to adjust power quality, frequency and voltage. Overall EES will make energy supply more efficient.

EES International Standards needed
Up until now there is no organization that covers the standardization of entire EES systems. TC 120 will oversee the development of International Standards that address all different EES technologies in a systems approach. It will apply use cases and develop architectures and roadmaps to support industry in building affordable and reliable EES systems that can be incorporated into existing grids anywhere in the world.

The Technical Committee will also address aspects such as safety and environmental compatibility. This will help countries to access practical technologies to integrate more RE into their electricity grids and stimulate smart electrification.

IEC White Papers address grid integration
The IEC has recently published two White Papers on EES. These provide important insights for industry, researchers and policy makers.

Grid integration of large-capacity – Renewable Energy sources and use of large-capacity Electrical Energy Storage
This White Paper, by the IEC MSB (Market Strategy Board), analyzes the role of large-capacity EES to integrate large-capacity RE sources.

Electrical Energy Storage
This White Paper, by the IEC MSB, analyzes the role of energy storage in electricity use and identifies all available technologies. It summarizes present and future market needs for EES technologies, reviews their technological features, and finally presents recommendations for all EES stakeholders.
Kazakhstan joins IECEE

Taking a key step towards enhancing regional and international trade

In October 2012, IECEE, the IEC System of Conformity Assessment Schemes for Electrotechnical Equipment and Components, welcomed the Republic of Kazakhstan as its newest member country. The total number of countries participating in IECEE is now 55.

The national member body representing Kazakhstan within IECEE is the Committee of Technical Regulation and Metrology of the Kazakh Ministry of Industry and New Technologies.

Benefits for Kazakhstan and for EEC

Kazakhstan’s membership of IECEE now puts it on a par with its partners in the EEC (Eurasian Economic Commission), a three-member Customs Union whose other members are the Republic of Belarus and the Russian Federation.

This crucial move by Kazakhstan was the immediate result of negotiations held between the IEC and the EEC in Moscow, Russian Federation, in late September.

IECEE membership provides Kazakhstan and its EEC partners with a strong platform for enhancing competitiveness. IECEE proof of compliance and certification will be highly beneficial to all three economies in facilitating the import of electrical and electronic goods as well as the export of products manufactured in the region.

Quality and safety for all

Today, every aspect of technology is extremely complex, from its production to its consumption. IECEE membership will provide EEC consumers, producers and trade partners with the quality assurance they need. It will ensure that products and equipment sold in the EEC, whether imported or manufactured locally, will meet the highest safety, reliability and performance requirements.

IECEE membership will also help reduce key barriers to trade – such as cost and time – by removing the significant delays and expense involved in multiple testing and approval procedures. Moreover, it will allow EEC industry to increase product and market competitiveness and diversification, so helping it to gain or maintain global market access.

IECEE facilitates access to market

A CB Test Certificate is a global passport that allows products to be accepted in all IECEE member countries. It is so well known that it receives global acceptance, even in countries that are not part of the IECEE community. “One test, one international certificate” opens the doors to the global market.

CB Scheme

The IECEE CB Scheme provides the assurance that tested and certified products meet the strictest levels of safety, reliability and performance in compliance with the relevant IEC International Standards. It helps reduce costs and time to market, eliminates duplicate or multiple testing and offers a high level of confidence for manufacturers, retailers and consumers alike.

CB-FCS

The CB-FCS (Full Certification Scheme) for Mutual Recognition of Conformity Assessment Certificates for Electrotechnical Equipment and Components is an extension of the IECEE CB Scheme in that it also includes factory audits and inspections. It goes far beyond product testing and includes a complete quality system and surveillance methods at the factory that manufactures a certified product. This is interesting for manufacturers who need to provide proof that products manufactured in a given factory offer a consistent level of quality over time.
Outcome of IECEx conference in Dubai
Personnel competence in the Ex field plus UAE’s first Service Facility Certificate

The 2012 IECEx International Conference that took place last March in Dubai, UAE (United Arab Emirates) was extremely successful. The event, organized jointly by IECEx, the IEC System for Certification to Standards Relating to Equipment for Use in Explosive Atmospheres, and ESMA (Emirates Authority for Standardization and Metrology), in conjunction with UNECE (United Nations Economic Commission for Europe), brought together 200 experts from 28 Arab, European, Asian and African countries.

IEC e-tech reported on the conference in its May issue. In this issue, we present two stories that have a direct link to the March event.

Story 1 – Focus on personnel competence

The first story involves CSI (Cenelec Standards Inspections) Ltd and one of its clients, a major international drilling company.

Changing a client’s outlook on IECEx

Mark Temple, Projects Director and Vice President of UK-based CSI, participated in the IECEx International Conference in Dubai last March, together with CSI Executive Director, Alan Gibson. Temple had also convinced one of CSI’s key clients, a major drilling company with worldwide operations, to send one of its executives with them to Dubai to find out more about the IECEx System and its numerous benefits.

Moving towards IECEx compliance

CSI had first assisted this particular client in the transfer of a rig from Bahrain to Romania, helping the company to meet all necessary requirements for the move. Shortly afterwards, CSI gained the compliance requirements support business for all rigs deployed by the client throughout the world. In the past 18 months CSI has sent teams to 25 countries to perform electrical, instrument and mechanical inspections for this particular client.

Expanding geographically has also meant finding ways of ensuring global compliance. While the client had been relying mainly on API (American Petroleum Institute) standards, CSI was already using the IEC 60079 series of International Standards on equipment for explosive atmospheres. So, naturally, the next move was to look at IECEx Certification Schemes and the Dubai event was the ideal venue for a comprehensive briefing on the System.

An eye-opener

The conference was a real eye-opener for CSI’s client. Meeting high-level experts, who shared their experience and detailed knowledge of all matters pertaining to the Ex field, convinced him that IECEx was the future for his company.

For both CSI and its client, the focus will be on the CoPC (Certificate of Personnel Competence) Scheme. CSI has about 50 inspectors, while the client has a staff of more than 200; the objective is to have all of them trained to obtain the CoPC. To meet this new challenge, CSI plans to set up a training facility and establish a comprehensive training programme based on IECEx requirements.

About CSI Ltd

Founded in 1982 by Managing Director Alan Gibson, CSI offers niche hazardous area services for companies looking to comply with legal mandatory

In March 2012, Dubai welcomed the first IECEx International conference in the Middle East
requirements for potentially explosive atmospheres. For the past 30 years, its core business has been electrical and instrument Ex compliance. Mechanical inspection and ATEX compliance were added in 2011, when Mark Temple joined the company.

**Story 2 – First IECEx Service Facility Certificate issued in Dubai**

In September 2012, Dubai-based WWPS (World Wide Power Services) was granted the first IECEx Service Facility Certificate ever issued in the UAE for repair and overhaul according to IEC 60079-19, Explosive atmospheres – Part 19: Equipment repair, overhaul and reclamation.

**Horizon 2014**

At the IECEx conference last March, Mohammed Saleh Badri, Director General of ESMA, revealed that a pan-UAE committee would be established to unify practices and standardization of equipment and services in the explosive atmospheres sector. The committee would propose the adoption of IEC International Standards for equipment in explosive atmospheres, with 2014 set as the introduction date across the United Arab Emirates for ESMA to start issuing IECEx certificates.

**Establishing a culture of safety and performance**

Badri said: “The 2014 timeline is very short, but that shouldn’t be a problem. This is a small country and in the last two years the Government of the UAE has been very keen to have an integrated system with buy-in from all the different stakeholders. The next step is to promote awareness about the role and importance of standardization bodies across the oil and gas sector [...] to ensure compliance with international standards, protect facilities from hazards and prevent accidents and disasters”.

The IECEx Service Facility Certificate obtained by WWPS is definitely a first step in the direction laid out by the UAE government.

**About WWPS**

World Wide Power Services, established in Dubai in 2002, offers electrical engineering services to customers based throughout the Gulf Region, Egypt, India, Pakistan and Azerbaijan. WWPS is recognized as a leading specialist in the rewinding of electrical motors – both AC (alternating current) and DC (direct current) – generators and transformers, as well as in the repair of associated electrical rotating equipment – both LV (low voltage) and HV (high voltage). The company also carries out repairs on a great number of motors from major global manufacturers. The services offered by WWPS cover the drilling, petrochemical, marine, mining and heavy engineering industries.

**About Sira**

The Certificate was issued by Sira Certification, one of the world leaders in the conformity assessment solutions field, specializing in the safety of equipment used in potentially explosive atmospheres. Sira is one of the few Ex CBs (Certification Bodies) that are approved to issue certificates for all three IECEx Schemes: Certified Equipment, Certified Service Facilities and Certified Personnel Competence. Sira is also approved to operate within the IECEx Conformity Mark License System.
Hazardous substance-free components
IECQ provides tools to meet the strictest requirements

IECQ, the IEC Quality Assessment System for Electronic Components, has recently published the 3rd edition of IECQ QC 080000, Hazardous Substance Process Management System Requirements. The specification and its requirements are based on the strong belief that the provision of hazardous substance-free products and production processes can only be achieved by integrating management disciplines fully.

Threat to health and environment
One of the issues associated with electronic components is that some of them may contain hazardous substances such as lead, cadmium or mercury. These substances may be equally as dangerous to the workers who manufacture the components as to end-users and the community in general.

An additional problem is faced at the end of the products’ life cycle: dealing with waste. Manufacturers are under great pressure to produce “clean” products in order to comply with legislation that restricts the use of hazardous substances in electronic products and components. The pressure is even greater as the life cycle of electronic components contracts.

Legislation in place
In July 2006, the EU (European Union) RoHS (Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment) and WEEE (Waste Electrical and Electronic Equipment) Directives came into effect. Both Directives have been revised since: RoHS in July 2011 and WEEE in July 2012. Another EU Directive, REACH (Registration, Evaluation, Authorization and Restriction of Chemicals), came into force in June 2007. It deals with chemicals and their safe use, so as to improve the protection of human health and the environment through better and earlier identification of the intrinsic properties of chemical substances.

The EU countries are not the only ones to have limited drastically the use of hazardous substances. Many industrial countries around the world, including Australia, China, Norway, South Korea, Switzerland, Thailand and the United States, have followed suit and established their own legislation.

IECQ QC 080000 helps component manufacturers comply with legislation regarding the use of hazardous substances

Efficient production of hazardous substance-free products
IECQ has the perfect solution for manufacturers and suppliers who want to produce and distribute hazardous substance-free electronic components.

IECQ HSPM (Hazardous Substance Process Management) is a technically-based management systems approach to implementing and maintaining hazardous substance-free products and production processes. IECQ HSPM was developed in response to component manufacturers’ need to give suppliers the means of demonstrating, through third-party assessment, that their electrical and electronic components and assemblies meet specific hazardous substance-free local, national and international requirements. Many companies today are working to attain IECQ HSPM Certification to QC 080000.

Advantages of the new edition
The 3rd edition clarifies how organizations can use IECQ QC 080000 to manage their hazardous substances other than through the outright removal of restricted substances and avoiding their use in products.

There are numerous advantages in using the 3rd edition of IECQ QC 080000. Among them:

- requirements on restricting the use of hazardous substances in products are supplemented by management requirements on working with such substances. These management requirements will enable an organization to put in place processes that accommodate hazardous substances directives and regulations other than RoHS.
new requirements in the redefined RoHS, such as compliance assessment, preparation of technical files and of self-declarations, use of markings, change control, product recall, and the communication of information within the supply chain in REACH can now be managed through these new requirements in QC 080000.

better alignment and consistency with ISO 9001, Quality management systems – Requirements, in terms of terminology and wordings to facilitate incorporation of the IECQ HSPM requirements into an organization’s existing management system.

removal of ambiguity and clarification of the intention of some requirements that were published in the 2nd edition.

Complying with the requirements laid out in IECQ QC 080000 is by far the easiest and fastest way of obtaining IECQ certification. The specification helps companies to demonstrate that they are making conscientious efforts to reduce the use of hazardous materials in their processes and actively replacing such materials with non-harmful alternatives.

IECQ QC 080000 is available in several languages: English, French, Japanese, Korean and Chinese (simplified and traditional).
Latest nominations and extensions

New member of ACEA and extensions of terms of office

SMB has approved the nomination of Kiyoshi Saito for a first term of office as member of ACEA (Advisory Committee on Environmental Aspects) for the period 2012-07-01 to 2015-06-30.

About Kiyoshi Saito
Kiyoshi Saito has been managing the Environmental Department of JEMA (Japan Electrical Manufacturers’ Association) since 1997. He took part in UNFCCC (United Nations Framework Convention on Climate Change) COP2 in July 1996 in Geneva, Switzerland. After the adoption of the Kyoto Protocol in 1997, Saito participated, as an expert in policy making, in several projects and initiatives led by METI, the Japanese Ministry of Economy, Trade and Industry and Keidanren, the Japanese Business Federation, focusing on industrial design.

Saito is currently involved in several electrical energy efficiency projects at the international level, including a pilot project to encourage the use of CFLs (compact fluorescent lamps) in developing countries.

Saito is Convenor of IEC TC (Technical Committee) 111/WG (Working Group) 2:

- Environmental standardization for electrical and electronic products and systems/GHG (Greenhouse gases) and a member of TC 111 AHG (Ad Hoc Group) 5: GHG, AHG 8: ECD (Environmentally Conscious Design), and PT (Project Team) 62824: Guidance on consideration and evaluation on material efficiency of electrical and electronic products in environmentally conscious design.

Extensions
SMB has also approved the extensions of terms of office of the following IEC TC Chairmen:

- Lloyd Condra, third extension of term of office as Chairman of TC 107: Process management for avionics, for the period 2012-10-01 to 2015-09-30.

- Cyriacus Bleijs, first extension of term of office as Chairman of TC 69: Electric road vehicles and electric industrial trucks, for the period 2012-10-01 to 2015-09-30.

TC 107 deals with process management for avionics

TC 69 develops IEC International Standards for EVs (electric vehicles)
Obituary

Vale Professor John Larmouth, a pioneer of standardization in applied IT and communications

A gifted academic and tireless worker, John Larmouth passed away on 13 August 2012. His active involvement in international standardization started in 1978 and spanned 34 years.

Gifted and devoted to standardization
The world of standardization will sorely miss the vision, presence and dedication of John Larmouth. Born in 1941, John was a highly esteemed contributor to standardization in computing, communications and applied IT. After obtaining a doctorate in pure mathematics and computing from the University of Cambridge in 1967, John Larmouth joined Cambridge academic staff, in the early days of computing. In 1976 he became director of the Salford University computing laboratory, and in 1985 he was appointed head of Salford University ITI (Information Technology Institute). In parallel, John Larmouth worked tirelessly for the cause of international standardization. Upon his retirement as Professor Emeritus of Telematics, he continued to be highly productive through his standardization work and consulting.

Legacy of international computing standards
John Larmouth served as a Rapporteur in of the ITU-T Study Group 17 (Security) for 14 years and he had a key role in the successful development and implementation of the International Standard ASN.1 (Abstract Syntax Notation). He was also Rapporteur and Convenor of the joint work on ASN.1, Object Identifiers (OIDs) and associated registration in ITU-T SG 17 and JTC 1/SC 8. He wrote the definitive book on ASN.1 which is available online and in print. Ratified as a standard in 1984, ASN.1 underpins many areas of communications today, including mobile phones, airlines and secure web site connections. It supports the exchange of any form of information (audio, video and data) and is used in applications ranging from telecommunications to parcel tracking, power distribution, banking and biomedicine.

IEC, ITU and JTC1 contributions
In addition, John Larmouth was a major contributor to the OSI (Open Systems Interconnection) model and SGML (Standard Generalized Markup Language), which provided the foundation for the HTML, XHTML and XML languages. John Larmouth worked as the Editor of ITU-T Recommendations and ISO and IEC International Standards, including ITU-T X.1082, IEC 80000-14 and several standards in ISO/IEC JTC1/SC37: Biometrics.

In 2012, in recognition of his contributions to ISO/IEC JTC 1, he received the IEC 1906 Award. John Larmouth will be remembered for being an outstanding scholar with brilliant academic brain who recognized early on the necessity and value of international standardization in computing and communications. He is survived by his wife Carol and twins Sarah-Jayne and James.
Obituary

Pietro Padori, immediate past Chairman of Technical Committee 55: Winding Wires

The IEC family regrets the sad loss of Pietro Parodi, immediate past chairman of IEC TC (Technical Committee) 55: Winding Wires, who passed away in August 2012, at the age of 78.

National, European and international leadership

Pietro Parodi dedicated a great deal of his professional life to international standardization, strongly believing in the benefits that it brings to industry. At the same time he held a leadership role in a highly productive and profitable company in the winding wire industry. An engineer by training, he served as the Chairman of IEC TC 55 from 1999 until last year. He was also Secretary of CENELEC TC 55 from 1999 to 2006 and Chairman of the Italian National Technical Committee TC 55 for many years. In addition, he played an important role as Technical Secretary of EWWG (the Winding Wire Business Group) of EUROPACABLE until 2008.

Past Chairman of TC 55: Winding Wires

In 2002, Pietro Parodi was recognized with the CEI (Comitato Elettrotecnico Italiano) “Engineer Giorgi” award which recognized his work and technical contributions to the research and development of standards in electrical engineering and electronics. His tireless commitment and dedication to international standardization benefitted the winding wires industry around the world. His colleagues in TC 55 are deeply saddened by his passing but he leaves a valuable legacy to international standardization.

IEC TC 55 prepares international standards for wires for electrical winding, irrespective of conductor material, shape, size or type of covering. It takes into account the needs of all fields of electrical engineering, with attention to environmental protection and health and safety.

Enthusiastic colleague who will be missed

Pietro Parodi will be fondly remembered as a world leader in standardization of wires for electrical machinery. He will also be remembered as a friendly colleague with a warm and enthusiastic presence, a staunch supporter of historic monuments in his home city of Alessandria, Italy, a leading supporter of service club activities and a good sportsman. He is survived by his wife, three adult children and several grandchildren. He leaves behind many friends and colleagues from all spheres of his rich and varied life.

Pietro Parodi and IEC TC 55 Secretary Mike Leibowitz
Ensuring compatibility
Connecting products to build total solutions

IEC Global Visions interviewed
Thomas S. Gross, COO of Eaton and responsible for the company’s nearly USD 7 billion electrical business. In the interview he underlined that most of the major global challenges, and the markets that emerge around them, depend directly on the ability to connect solutions from different suppliers. The transition from products to total solutions requires interoperability and other standards.

A long-term perspective
Eaton is one of the largest power management companies in the world. Founded over 100 years ago, the company takes a long-term view both in how it conducts its business and how it builds its products and solutions because investments need to last for many years or even decades.

From individual products to systems
The demand for power is growing rapidly and electricity is becoming increasingly important. The infrastructure to create and then distribute that electrical energy is becoming more and more complex. No single company, not even Eaton, has everything to get electricity from the point where it’s produced to the points where it’s used. Interoperability standards are absolutely critical from any perspective; because if the solutions, products and information systems of different suppliers don’t connect easily, the market will be impeded.

A day without electricity, even an hour without electricity is scary for most people. Gross believes that in the future it will be even more difficult to imagine life without electricity. The industry as a whole has an enormous responsibility to keep the lights on.

Many people in developing countries are transitioning to middle class, and one of the first things they want is more electricity so that they can have refrigeration and other devices that will create a better standard of living for them. At the same time technologies are going through a major overhaul and solutions will have to move from individual products to systems that can improve efficiency by an order of magnitude. All of this creates a terrific opportunity and a crushing need for standardization – to enable those markets, those changes to occur. Eaton wants to be a clear leader in all of those transformations.

Standardization participation as a strategic tool
Eaton considers standards as a strategic element of its business and key for the entire industry. Gross underlines that the company sees the IEC as the most global standards body that’s available for them to work through. In his eyes the worldwide relevance of IEC work is particularly important because it is simply too expensive and wasteful to have country-specific or even regional standards. Standards play a critical role and they really make markets, that’s why Eaton’s involvement in the IEC is extensive.

Eaton believes that the drive towards increasingly globally relevant standards will continue to accelerate. This is necessary so that companies and their customers can take advantage of different technologies and lower costs.

More similarities than differences
Across the world Eaton finds a surprising consistency in the need, concerns and opportunities to evolve electrical and power infrastructures. Power will become scarcer over time, it will become more expensive and the need for more efficiency and a lower impact on the environment is going to increase. IEC International Standards are widely used by the power industry. They allow companies to develop a solution to a problem and market it nearly everywhere in the world and this helps Eaton to globalize.

Hundreds of the smartest participate part time
There are hundreds of Eaton people involved in the IEC, most of them part-time. Gross believes that that’s how it should be, because Eaton wants the best and brightest scientists, marketing and business people to participate and share their expertise. Gross: “Our industry, and other industries, are right now going through a transition from products to total solutions. The IEC is right in the middle of all of that, and that’s why we participate actively.”
In spite of their often relatively simple appearance, wind turbines are sophisticated machines. Converting mechanical wind energy to electrical power requires a number of components. One of these, the gearbox, is essential for uprating the low speed of the main shaft attached to the rotor hub.

IEC TC (Technical Committee) 88: Wind turbines, has just published an International Standard covering design requirements for wind turbine gearboxes.

From low to top gear
Anyone observing wind turbines may wonder how such an apparently slow moving rotor can produce electricity. This is made possible by the drivetrain which consists of the rotor’s main shaft, the gearbox and a high speed shaft.

The gearbox converts slowly rotating, high torque (turning force) power from the wind turbine rotor and shaft to high speed, low torque power. This is then transferred to a high-speed shaft connected to an electrical generator.

Gearboxes are an essential part of wind turbines. They must be reliable and have a design lifetime similar to that of the wind turbine. For wind turbine classes I to III (high to low wind), this must be “at least 20 years”, according to IEC 61400-1, Wind turbines – Part 1: Design requirements.

Wide scope
IEC 61400-4, Wind turbines – Part 4: Design requirements for wind turbine

IEC 61400-4 applies to wind turbines above 2 MW rated power, like this 8 MW V-164 (Photo: Vestas)
gearboxes, is an essential addition to the IEC 61400 series of International Standards for wind turbines. It has been prepared by IEC TC 88 in co-operation with ISO TC 60: Gears.

This first edition constitutes a technical revision of ISO 81400-4, which it cancels and replaces. Content has been extensively expanded and includes the following significant technical changes:

- extension of the scope to wind turbines above 2 MW rated power
- considerations for converging differing approaches to reliability in gear, bearing and wind turbine standards
- new clause on wind turbine loads specific to drivetrains
- new clause on testing and validation of new gearbox designs
- updated bearing selection tables for different locations in a wind turbine gearbox
- expanded design considerations on the use of bearings based on avoiding standard failures
- new clause on considerations and requirements in the design and analysis of gearboxes structural elements
- updated considerations and requirements for lubricants and lubrication systems
- The proof of the design is in the testing
  Good design is important, but possible design flaws may appear only after equipment has been in use for a while – sometimes this may be after quite some while. Such flaws can be eliminated using design verification. IEC 61400-4 identifies overall and specific test criteria and plans for all elements that need testing and also lists the gearbox and drivetrain design changes that require further testing.

To ensure this is the case, IEC 61400-4 gives detailed guidelines in terms of service, maintenance and inspection, commissioning and run-in, transport, handling and storage, installation, repair, condition monitoring and lubrication requirements – including oil type, oil test and analysis

Comprehensive supporting material
Extensive documentation including terms, definitions and conventions, symbols and dozens of figures is available and ensures this International Standard provides all of
the information needed by manufacturers and suppliers of gearboxes and all associated elements along the entire length of the production line. It is also invaluable to the wind turbine industry in general, since gearboxes form a central element of any wind turbine installation.

**Powerful sales argument**

IEC 61400-4 is a landmark International Standard and the first that applies to gearboxes used in wind turbines above 2 MW rated power, which are currently being deployed throughout the world.

Wind turbine manufacturers, who regularly reference several IEC 61400 International Standards as guarantees of their products’ certification, will undoubtedly be adding a mention of IEC 61400-4 to their sales documentation.

As TC 88 Chairman Sandy Butterfield told IEC Global Visions: “Ultimately in the wind energy business all wind turbines end up being certified; it’s a market imperative. All wind turbine designers who know that their product is going to be shipped internationally will design to IEC standards because they can’t possibly design to the range of national standards that are out there.”

![High availability and reliability of gearboxes limit maintenance and repair costs](Siemens press picture)

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**Safety specifications for LED modules**

Consolidated version of International Standard is published

LED-based lamps are often described as the light of the future. They are very energy-efficient, durable and relatively new. IEC SC (Subcommittee) 34A: Lamps, prepares International Standards for all components in LED lights. A consolidated version of its IEC 62031 International Standard that sets safety specifications for LED modules for general lighting has just been published.

**First main title**

New but with a bright future ahead LED-based lighting solutions have been described as the light source of the future, tiny and more energy-efficient than any other light source, easy to control and with a long service life, and

![Safety specifications are important for the LED modules industry](Photo: Osram)
They can be used for almost any lighting application.

They are set to revolutionize lighting and provide a welcome boost to the industry, accounting for around 60% its revenues worldwide by 2020.

The use of LED (light-emitting diodes) modules for general lighting applications is relatively recent. Acknowledging the need for relevant tests for this new source of electrical light, sometimes called “solid state lighting”, IEC SC 34A prepared IEC 62031, *LED modules for general lighting – Safety specifications*.

IEC 62031 was published in January 2008. Following publication of a first amendment in October 2012, a consolidated version of this International Standard is now available.

Provisions in the standard “represent the technical knowledge of experts from the fields of the semiconductor industry and those of the traditional electrical light sources”. IEC 62031 covers LED modules with integral and external control gear. LED modules require electronic control gear designed to provide constant voltage or current. In LED lamps equipped with a lamp cap (self-ballasted lamp) intended to replace existing lights, such as incandescent bulbs, the control gear is integrated into the lamp.

**Wide scope**

The consolidated standard is very comprehensive and covers the following details:

- Terms and definitions
- General requirements
- General test requirements
- Classification
- Marking
- Terminals (screw, screwless & connectors)
- Provisions for protective earthing
- Protection against accidental contact with live parts
- Moisture resistance and insulation
- Electric strength
- Fault conditions
- Conformity testing during manufacture
- Resistance to heat, fire and tracking
- Resistance to corrosion
- Conformity testing during manufacture and information for luminaire design.

Four annexes to the Standard cover: tests; an overview of systems composed of LED modules and control gear; given the spectacular growth of the LED lighting sector, this consolidated version of an International Standard which will help ensure LED modules are safe will be essential for all producers of all such modules.
GM Special

The next edition of e-tech will summarize much of the 2012 IEC General Meeting proceedings in Oslo, Norway.

It will cover the President’s address to Council and the IEC activity report presented jointly by Ronnie Amit, who stepped down as IEC General Secretary & CEO on 30 September, and his successor, Frans Vreeswijk. The official handover between Amit and Vreeswijk and a presentation made by the latter early December to the ANSI (American National Standards Institute) Board of Directors will also be featured.

Further reports will include the election of the next IEC President and an interview with Immediate Past President Jacques Régis. The ceremonies honouring the laureates of the IEC Lord Kelvin and the Thomas A. Edison Awards, as well as the winners of the IEC-IEEE Challenge, management meetings, the Young Professionals and Industrializing Country workshops and the Affiliate Forum will complete the table of contents.

Not to forget an extensive photo gallery of the event.