IEC role in water management

Cities and water

More than half of the world's population resides in cities and urbanization is projected to continue to increase over the next decades. With it, demand for water is forecast to rise by 55% until 2050 (source: OECD). Citizens and urban industries are increasingly competing with other water users for access to water resources.

Already today, large cities of one million or more inhabitants encounter significant challenges in providing sufficient clean water to citizens. Water often has to be brought over great distances and cities are increasingly at risk from both drought and floods. Diffuse pollution can lead to inadequate water quality, generating additional costs in ensuring access to safe water and proper sanitation. In the future, cities might need to consider reusing used drinking water for sanitation to reduce overall water consumption.

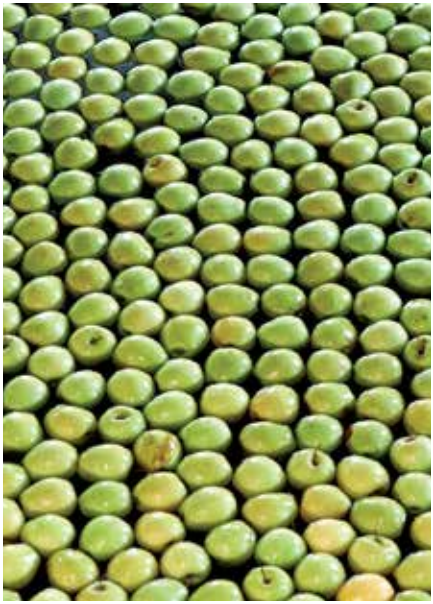
Water – for life . . .

Humans and animals can go without food for many weeks…but only a few days without water.

We use large amounts of clean water every day for drinking, in food preparation, to shower, brush teeth, wash clothes or hands and flush toilets.

...and for economies

Beyond the home, water is used in agriculture for irrigation, watering animals or cleaning and sorting crops. Industry uses water in manufacturing processes as a product ingredient, but also for cooling, steaming and cooking, flushing, cleaning and conditioning of raw materials. Public services like fire brigades, municipal parks or swimming pools use lots of water.



IEC role in water management

During extraction, desalination, water use and sanitation, electrical and electronic systems and equipment play an increasingly bigger role. With it IEC International Standards have grown in importance.

Fresh water

Water extraction

No matter whether water comes from the surface from a river or lake or deep from within the earth, pumps play an important role in moving water from the source to the consumer. The pumping of fresh and waste water is estimated to account for around 10% of the world's electricity supply. Most pumping stations rely on electricity to supply water to cities and water networks. All fresh and waste water electric pumps are driven by electric motors most of which comply with International Standards IEC 60034-30-1 and IEC 61800. Some of the most important pump manufacturers stress that they meet IEC high energy-efficiency ratings which helps to significantly reduce the energy consumption of modern water pumps.

Transporting water

Millions of pipes transport water and in that process billions of valves control water flow, pressure, temperature, liquid levels with the help of sensors and electronics. They are indispensable in distributing water and avoiding leakages. The IEC 60534 series of Standards, which is

developed by IEC Subcommittee (SC) 65B provides among other things the technical foundation for pneumatic actuating control valves with electronic positioners. It is considered the bible for the water purification and waste water treatment industry.

Like during water extraction, pumps are essential to move water to the increasing number of high-rises that are now an integral part of cities. These pumps ensure that water pressure is maintained even at the 50th floor of a building.

Likewise, many industrial applications require strong water pressure which is built using electric motors and pumps.

Automation and control

Most pumping stations are automated and many electronic devices are used for their control and supervision. Programmable logic controllers (PLCs) and remote terminal units (RTUs) are used and integrated in centralized control rooms with supervisory control and data acquisition (SCADA) systems. IEC Technical Committee (TC) 65 and SC 65B develop IEC International Standards for

PLCs (e.g. IEC 61131) and together with IEC TC 57 also for SCADA (IEC 62361-2 and IEC 62734) and for sensors for switches (IEC 60947-5-2 and IEC 60947-5-6).

Water plants are part of critical city infrastructure. For enhanced overall and cyber security they are often compliant with IEC 62443-2-4.

Desalination

Tropical and arid off-shore areas have long relied on desalination of sea or brackish river water to satisfy their water needs. With less predictable rainfalls and increasing droughts this trend is picking up elsewhere too. In many places like the Middle East, Singapore, the Canary Islands or the Caribbean there is no other choice than to look to the sea for water. Desalination is now used in 150 countries around the world.

The energy consumption of desalination was long a hurdle for its broad use. However, today, when water has to be pumped over great distances to transport it to cities, desalination is becoming

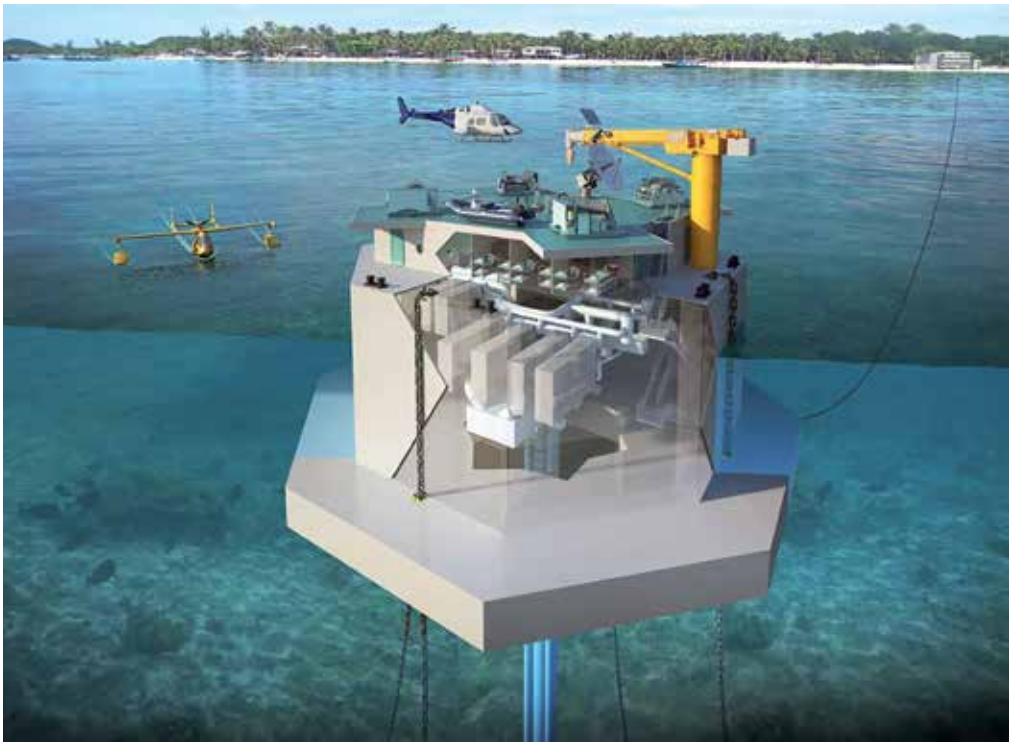
a viable alternative. Desalination of brackish or even waste water is less energy intensive than that of seawater which requires pressure of about 80 bar (20 times more than a car tyre). Renewable energies offer interesting prospects for clean energy desalination projects. A new solar photovoltaic (PV) desalination plant will go on line in early 2017 to supply 60 000 cubic metres of water a day for Al Khafji City in the north-east of Saudi Arabia. In this context, IEC TC 82 prepares the majority of International Standards for solar PV, for example IEC 60904 and IEC 62253.

Desalination can also be achieved using wave energy; an example is the Perth Wave Energy Project. IEC TC 114 prepares Technical Specifications, e.g. IEC 62600, for wave, tidal and other water current converters.

The whole desalination process requires pumps, electric motors, valves, scrapers as well as instrumentation and control (SCADA) and IEC International Standards apply to all along the way.

Another process that is gaining traction is Ocean Thermal Energy Conversion (OTEC). This technology relies on the temperature difference between the hot surface of the ocean and the cooler, deeper layers beneath to drive a heat engine with a turbine. The expanding vapours drive a generator. Rather than with water steam, the turbine is driven by ammonia vapour. A detailed description of the process can be found here: www.explainthatstuff.com/how-otec-works.html

IEC TC 2 and IEC SC 61D prepare International Standards that cover the electric motors that drive the pumps, as well as heat exchangers and generators which are relevant in OTEC. IEC TC 4 also prepares Standards for hydro and steam turbines, some of which may be adapted to OTEC uses. The underwater cabling required for OTEC relies on IEC 60092-350 and IEC 60092-360 as well as IEC 60794-3, IEC TR 62691 and



ISO/IEC 15149. TC 114 is currently preparing the technical specifications that are needed for the design assessment of OTEC plants and Seawater Air Conditioning (SWAC) systems. These are essential for the broad roll-out and commercial development of OTEC technology.

Off-grid water pumps

Solar-powered pumps are often used when grid electricity is not available. They generally use PV panels, controllers for voltage protection as well as inverters, when DC has to be converted to AC for certain pumps. The Standards developed by IEC TC 82 also apply to such off-grid solar pumps.

Water purification

Water is often not pure enough to be consumed without treatment. Undesirable chemicals, biological contaminants, suspended solids and gases need to be removed before it can be used. Methods include physical, chemical and electromagnetic radiation processes. At most stages electricity and electronics are involved.

After extraction, water is generally pumped through pipes into holding tanks. Generally so-called coagulant chemicals are injected to assist in the removal of suspended particles. The thus treated water is then guided to flocculation basins where motors drive large paddles that gently mix the water to enhance the formation of floc. As particles settle, sludge, which represents 3% to 5% of the total water volume, forms on the basin floor. It needs to be constantly removed to avoid clogging. This is done with cleaning devices that are generally driven by electric motors and pumps (IEC 60034 and IEC 61800).

One of the most common disinfection methods involves some form of chlorine. After the removal of large contaminants, chlorine is injected often via an electric booster pump. The uninterrupted supply of chlorine is generally ensured by ball valves that are driven with an electric motor and electronically-controlled pressure gauges. Such pressure gauges generally comply with IEC 61298-2, but also parts of IEC 60534.

Another disinfection method involves ozone which is made by passing oxygen through ultraviolet light or a “cold” electrical discharge. IEC SC 34D produces IEC 60598-1 to ensure the photobiological safety of ultraviolet (UV) light. Ozone has been used in drinking water plants since 1906 where the first industrial ozonation plant was built in Nice, France.

UV light is very effective in the disinfection of low turbidity water and often used in public swimming pools or spas but also for the sterilization of drinking and waste water. It kills pathogens, germs and viruses and reduces significantly the need for chemicals, such as chlorine and bromine. IEC TC 61: Safety of household and similar electrical appliances, has developed International Standard IEC 60335-2-109 for particular requirements for UV radiation water treatment appliances.

In some instances UV light needs to be complemented by certain chemicals in lower volumes, which are added using electronic dosing pumps.

Last but not least, the effects of hard water can be reduced with the use of magnetic or electrical fields.

Water use

Billions of sensors regulate the flow of water in faucets and toilets. Several IEC Technical Committees prepare International Standards that relate to sensors that are used in such environments, for example some Standards in the IEC 60335-2 series, or IEC 60898-1 and IEC 60898-2.

The IEC also provides International Standards that ensure the safety and performance of electrical appliances that are connected to water mains (IEC 61770) or those that use water in their operation, for example humidifiers (IEC 60335-2-88) or water heaters (IEC 62395 and IEC 60335-2-51).

Waste water treatment

The process for waste water treatment is very similar to that used in water purification. It is again a multiple-stage process that involves mechanical and chemical phases, all of which require electrical and electronic equipment in the form of pumps, rotating arms driven by motors, chemical injectors and the like.

And more

Throughout the whole water cycle all electrical and electronic equipment needs to be contained in enclosures that are protected from water ingress to avoid electric shocks. To do so they need to comply with IP ratings according to IEC 60529.

IEC International Standards also ensure the safety and proper functioning of the billions of devices and hardware that are used in and around water such as heat-pumps, lighting, water meters, and much more.

Water for energy

Water and energy are today often still very closely intertwined. Many types of energy production use water. The extraction and treatment of fresh and waste water requires a lot of energy.

In fossil fuel, nuclear or biogas power plants, water cools the steam that spins the electricity generating turbines. Water is also used directly to generate electricity for example through dams and barrages.

The refining of fuels, the extraction of coal, the growing of crops for biofuels all require water. However, this dependency can be overcome by applying renewable technologies such as wind and solar photovoltaics that don't require water.

Many IEC International Standards and Technical Reports apply to power generation from water in rivers or dams. A more detailed list is available from page 18 onwards.

Marine power

Wave and tidal power generation is still in its infancy. IEC TC 114 has published the IEC TS 62600 series on wave, tidal and other water current converters.

All power generation technologies that require water – and those who do not – rely on IEC International Standards and testing and verification in the IEC Conformity Assessment Systems.

Why International Standards

IEC International Standards are developed by experts from many countries around the globe. The IEC brings together 170 countries and provides a platform for 20 000 experts at the global level and many more in each country. IEC International Standards incorporate state-of-the-art know-how and expertise and they are the basis for testing and verification.

When cities use IEC International Standards in their water supply systems, they achieve a higher level of built-in interoperability and gain greater supplier independence, which also lowers cost. A large pool of global suppliers helps ensure long-term availability of spare parts which facilitates repairs and maintenance.

When cities make their needs known through their IEC National Committee or their national representative to the IEC Affiliate Country Programme, IEC International Standards become better and are easier to adopt nationally. With national adoption the whole world becomes accessible.

Key figures

171
Members and affiliates

>200
Technical committees and subcommittees

20 000
Experts from industry, test and research labs, government, academia and consumer groups

>10 000
International Standards in catalogue

4
Global Conformity Assessment Systems

>1 million
Conformity Assessment Certificates issued

>100
Years of expertise

IEC International Standards for water

Below is a non-exhaustive list of Standards that relate to water.

IEC Standard	Topic	Title
IEC 60034-3	Motors, pumps	Rotating electrical machines – Part 3: Specific requirements for synchronous generators driven by steam turbines or combustion gas turbines
IEC 60034-30-1	Motors, pumps	Rotating electrical machines – Part 30-1: Efficiency classes of line operated AC motors (IE code)
IEC 60041	Turbines, pumps, hydro & marine power	Field acceptance tests to determine the hydraulic performance of hydraulic turbines, storage pumps and pump-turbines
IEC 60045-1	Turbines, pumps, hydro & marine power	Steam turbines – Part 1: Specifications
IEC 60092-350	Underwater cabling	Electrical installations in ships – Part 350: General construction and test methods of power, control and instrumentation cables for shipboard and offshore applications
IEC 60092-360	Underwater cabling	Electrical installations in ships – Part 360: Insulating and sheathing materials for shipboard and offshore units, power, control, instrumentation and telecommunication cables
IEC 60193	Turbines, pumps, hydro & marine power	Hydraulic turbines, storage pumps and pump-turbines – Model acceptance tests
IEC 60308	Turbines, pumps, hydro & marine power	Hydraulic turbines – Testing of control systems

IEC Standard	Topic	Title
IEC 60335-2-51	Turbines, pumps, hydro & marine power	Household and similar electrical appliances – Safety – Part 2-51: Particular requirements for stationary circulation pumps for heating and service water installations
IEC 60335-2-88	Humidifiers & safety	Household and similar electrical appliances – Safety – Part 2-88: Particular requirements for humidifiers intended for use with heating, ventilation, or air-conditioning systems
IEC 60335-2-109	Water purification, water waste treatment, UV light	Household and similar electrical appliances – Safety – Part 2-109: Particular requirements for UV radiation water treatment appliances
IEC 60529	Safety	Degrees of protection provided by enclosures (IP Code)
IEC 60534	Transporting water, control valves	Industrial-process control valves
IEC 60545	Turbines, pumps, hydro & marine power	Guide for commissioning, operation and maintenance of hydraulic turbines
IEC 60598-1	Water purification, water waste treatment, UV light	Luminaires – Part 1: General requirements and tests
IEC 60609	Turbines, pumps, hydro & marine power	Hydraulic turbines, storage pumps and pump-turbines – Cavitation pitting evaluation
IEC 60794-3	Underwater cabling	Optical fibre cables – Part 3: Outdoor cables – Sectional specification
IEC 60898-1	Water use (toilets, faucets)	Electrical accessories – Circuit-breakers for overcurrent protection for household and similar installations – Part 1: Circuit-breakers for a.c. operation
IEC 60898-2	Water use (toilets, faucets)	Electrical accessories – Circuit-breakers for overcurrent protection for household and similar installations – Part 2: Circuit-breakers for AC and DC operation
IEC 60904	PV	Photovoltaic devices

IEC Standard	Topic	Title
IEC 60947-5-2	Water use (sensors, proximity switches)	Low-voltage switchgear and controlgear – Part 5-2: Control circuit devices and switching elements – Proximity switches
IEC 60947-5-6	Water use (sensors, proximity switches)	Low-voltage switchgear and controlgear – Part 5-6: Control circuit devices and switching elements – DC interface for proximity sensors and switching amplifiers (NAMUR)
IEC 60953	Turbines, pumps, hydro & marine power	Rules for steam turbine thermal acceptance tests
IEC 60994	Turbines, pumps, hydro & marine power	Guide for field measurement of vibrations and pulsations in hydraulic machines (turbines, storage pumps and pump-turbines)
IEC 61063	Turbines, pumps, hydro & marine power	Acoustics – Measurement of airborne noise emitted by steam turbines and driven machinery
IEC 61064	Turbines, pumps, hydro & marine power	Acceptance tests for steam turbine speed control systems
IEC 61116	Turbines, pumps, hydro & marine power	Electromechanical equipment guide for small hydroelectric installations
IEC 61131	Water automation	Programmable controllers
IEC 61298-2	Water purification, water waste treatment	Process measurement and control devices – General methods and procedures for evaluating performance – Part 2: Tests under reference conditions
IEC TR 61364	Turbines, pumps, hydro & marine power	Nomenclature for hydroelectric powerplant machinery
IEC TR 61366	Turbines, pumps, hydro & marine power	Hydraulic turbines, storage pumps and pump-turbines – Tendering Documents

IEC Standard	Topic	Title
IEC 61770	Water use	Electric appliances connected to the water mains – Avoidance of backsiphonage and failure of hose-sets
IEC 61800	Motors, pumps	Adjustable speed electrical power drive systems
IEC 61850-7-410	Turbines, pumps, hydro & marine power	Communication networks and systems for power utility automation – Part 7-410: Basic communication structure – Hydroelectric power plants – Communication for monitoring and control
IEC 61850-7-510	Turbines, pumps, hydro & marine power	Communication networks and systems for power utility automation – Part 7-510: Basic communication structure – Hydroelectric power plants – Modelling concepts and guidelines
IEC 62006	Turbines, pumps, hydro & marine power	Hydraulic machines – Acceptance tests of small hydroelectric installations
IEC 62097	Turbines, pumps, hydro & marine power	Hydraulic machines, radial and axial – Performance conversion method from model to prototype
IEC 62253	PV	Photovoltaic pumping systems – Design qualification and performance measurements
IEC 62256	Turbines, pumps, hydro & marine power	Hydraulic turbines, storage pumps and pump-turbines – Rehabilitation and performance improvement
IEC 62270	Turbines, pumps, hydro & marine power	Guide for computer-based control for hydroelectric power plant automation
IEC 62361-2	Water automation, SCADA	Power systems management and associated information exchange – Interoperability in the long term – Part 2: End to end quality codes for supervisory control and data acquisition (SCADA)

IEC Standard	Topic	Title
IEC 62364	Turbines, pumps, hydro & marine power	Hydraulic machines – Guide for dealing with hydro-abrasive erosion in Kaplan, Francis and Pelton turbines
IEC 62395	Electroheating	Electrical resistance trace heating systems for industrial and commercial applications
IEC 62443-2-4	Water automation, cybersecurity	Security for industrial automation and control systems – Part 2-4: Security program requirements for IACS service providers
IEC 62734	Water automation, SCADA	Industrial networks – Wireless communication network and communication profiles – ISA 100.11a
IEC TR 62691	Underwater cabling	Optical fibre cables – Guidelines to the installation of optical fibre cables
IEC TS 62600	Turbines, pumps, hydro & marine power	Marine energy – Wave, tidal and other water current converter
ISO/IEC 15149	Underwater cabling	Information technology – Telecommunications and information exchange between systems – Magnetic field area network (MFAN)
ISO/IEC 15149-1	Underwater cabling	Information technology – Telecommunications and information exchange between systems – Magnetic field area network (MFAN) – Part 1: Air interface

Further information

Please visit the IEC website at www.iec.ch for further information. In the "About the IEC" section, you can contact your local IEC National Committee directly. Alternatively, please contact the IEC Central Office in Geneva, Switzerland or the nearest IEC Regional Centre.

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