

Innovation highlights

ABB's top innovations for 2014

ABB is continuously working to strengthen its product portfolio and create new technologies to put its products at the forefront of innovation.

The current selection is a cross section of the company's innovative achievements. Many of these, as well as other technological successes, are discussed at greater length in this and forthcoming issues of *ABB Review*.

Increased battery life

ABB is developing truly wireless instrumentation that generates power by harvesting energy in the environment.

To overcome the short lifetime of batteries in wireless instrumentation, particularly at high-update rates, ABB is designing low-power devices, each powered by a normal D battery but with the ability to dramatically increase the battery life by harvesting the power from the process it is measuring. A very high efficient Peltier cell embedded in the transmitters will use the thermal gradient between the process and the environment to generate energy.

The ABB transmitter is powered by an onboard micro-thermoelectric generator (micro-TEG), which is driven by the temperature difference between the process and the ambient surroundings. The device will be capable of running independently from the battery with a temperature difference of around 35°C.

The thermal harvesters are integrated into temperature transmitters and sold as an external option for pressure transmitters, without the need for any additional mechanical device for the connection or electronics circuitry for the power conversion and adaptation.

In addition, ABB is studying a smart power management platform that will accept external power sources and allow connection of different harvesters (vibration, solar, etc.) to power the devices. The platform will be extended



to other product lines like level and flow transmitters.

The devices will be released early in 2014, within the respective series: 266 Pressure, TTF300 and TSP3xx Temperature.

USB – and tea

Busch-Jaeger, a member of the ABB Group, has developed a SCHUKO® mains outlet with an integrated USB connector.

This award-winning product neatly solves the perennial problem of hunting for a USB charger and a cable and then, once found, deciding which domestic appliance should be unplugged to make way for it. With more and more domestic devices appearing that need to be recharged via a USB connector, the SCHUKO mains outlet with integrated USB connector will come as a relief to many consumers.

The flush-mounted outlet delivers up to 700mA charging current and features child protection. Because the form factor matches existing SCHUKO outlets exactly, upgrading to the new USB socket is easy.

The company has developed two companion USB charging products for the SCHUKO USB outlet – a USB power supply and a USB charging station. The former provides two 700 mA (or one 1,400 mA) USB connectors for charging purposes; the latter features a nonslip device holder and charges via a micro-USB connector that can deliver up to 1,400 mA charging current – enough for even power-hungry tablets.

Several international prizes have been conferred on the SCHUKO USB outlet,



including the Audience Choice Award at the design pavilion of the 2013 IFA trade fair in Berlin.

For more information, please see the article "Smart outlets for smart phones" on page 55 in this issue of *ABB Review*.

Boosting wayside energy efficiency for DC trains

Rail vehicles regenerate braking energy through their traction motors (which work as generators). Most of the time, a small portion of this kinetic energy powers onboard loads, while the remaining energy is sent back to the network and reused if a nearby vehicle is accelerating. If this is not possible, the surplus is usually dissipated using onboard or wayside resistors. Thanks to ABB's Enviline™ Energy Recovery System (ERS), this waste can now be avoided and overall energy consumption reduced by 10 to 30 percent – without the need to invest in new rolling stock or network control systems.

Enviline™ ERS consists of an IGBT inverter installed in parallel with existing diode rectifiers at the DC substation. It forces energy from the DC traction grid back to the AC grid. The ERS not only recovers energy from braking, it can also mitigate reactive power, provide active



filtering to reduce the effect of harmonics and support existing rectifiers.

Where selling back surplus energy is not an option, ABB offers the Enviline™ Energy Storage System (ESS). ESS is the industry's smallest, most modular and flexible energy storage system and can be provided with supercapacitors for short duration storage, or with batteries to provide additional benefits and revenue generating services.

The benefits of the ESS include sustaining the voltage against sags, augmenting traction power during acceleration and reducing the penalties associated with

high demand peaks. The ESS can also be used as a permanently installed or mobile standalone traction power system to replace conventional grid-connected traction power systems. When used with batteries, ESS can also provide emergency power and even generate revenues by participating in local energy markets, such as in ABB's project with the South East Pennsylvania Transit Authority (SEPTA) in the United States.

ABB's ERS won the electrification category award at Railtex 2013 in London.

For more information, please see the article "Braking news" on page 28 in this issue of *ABB Review* and also <http://www.abb.com/railway>

The lake that is a battery

One of the great strengths of hydropower is that energy is stored and can be released as and when required, making it ideal for meeting demand peaks. Pumped storage takes this concept one step further: Water can be pumped up the mountain, meaning both demand peaks and troughs can be mitigated. Pumped storage is playing an increased role in grid regulation and assuring the continuity of supply.

ABB has supplied the world's most powerful frequency converter for pumped storage to the Grimsel 2 plant of Kraftwerken Oberhasli AG (KWO) in Switzerland. This plant connects the upper reservoir of Lake Oberaar to the more than 400 m lower Lake Grimsel.

Until now, the pump operation could only be controlled by regulating the number of pumps in operation up to a



maximum of four pumps. The 100 MW power-electronic frequency converter allows the speed of one of these pumps to be controlled according to the surplus energy available. The pump can now be started, operated and stopped more quickly, and water used more efficiently and flexibly for power production while also increasing the plant's contribution to grid stability.

Despite progress with other storage technologies, pumped storage remains the only mature and affordable means

of energy storage suitable for grid regulation, and thus has an important role to play in the generation landscape of tomorrow. The new converter at Lake Grimsel is a contribution to the Swiss Energy Strategy for 2050, which seeks to assure the continuity of the Swiss energy supply while increasing the use of renewables.

The Grimsel frequency converter will be presented in greater detail in an upcoming issue of *ABB Review*.

Flash charging on the bus

Two major barriers to the adoption of electric vehicles are long charging times and the need to recharge frequently. Especially when it comes to public transport, the downtime associated with battery charging can be a major obstacle to the commercial viability of electric operation. Furthermore the size and weight of onboard batteries increases energy consumption and reduces space available to passengers. The TOSA bus, which is presently being demonstrated in the Swiss city of Geneva, presents an elegant response to this challenge.

ABB's flash charging technology permits a bus to be recharged in only 15 s. Furthermore, this occurs at bus stops at which the bus needs to stop anyway, meaning schedules are not negatively affected. As soon as the bus has drawn to a halt, a contact on its roof automatically rises, using laser guidance to align with an overhead receptacle. A flash charger then delivers 400 kW for 15 s.

The energy delivered suffices as a top-up charge and helps reduce required battery capacity. Further brief recharging occurs as energy is recovered in braking. A longer and full recharge is provided at the bus terminus, where 200 kW can be delivered for 3 to 5 min using the same roof-mounted contact.

Because a 400 kW draw during flash charging can pose a challenge for the



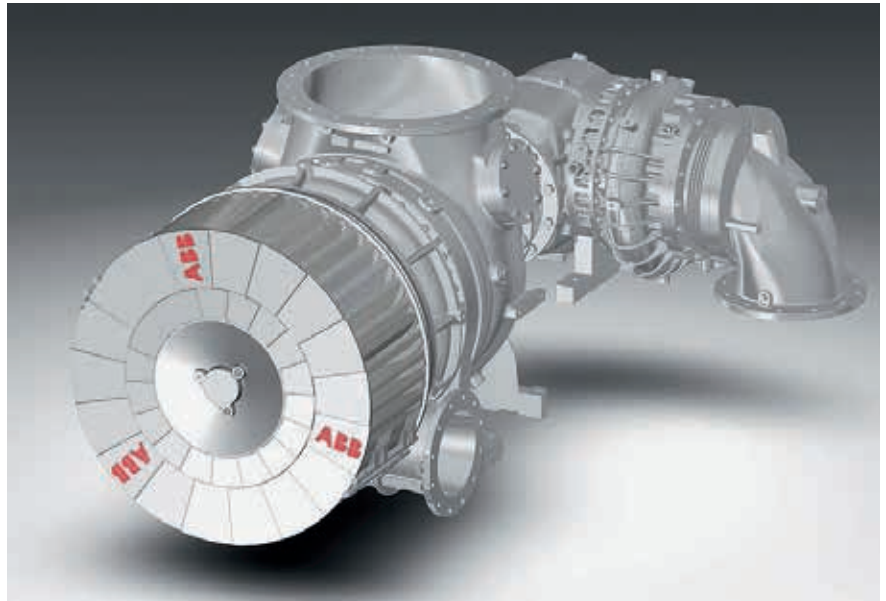
local electricity grid, the charger station uses super capacitors to flatten out the current peak and reduce the load on the grid. In contrast to solutions relying on recharging at night, TOSA is naturally suited to the use of solar power and its daytime availability.

For more information, please see the article "Taking charge: Flash charging is just the ticket for clean transportation" on page 64 of *ABB Review* 4/2013.

Power2 turbocharging gets a boost

Two-stage turbocharging is an important technology that offers reduced fuel consumption and emissions while enabling an increase in engine power density. With the Power2 800-M series, ABB introduces the second generation of two-stage turbocharging for large four-stroke diesel and gas engines.

The most important factors driving the development of modern four-stroke medium-speed engines are high total engine efficiencies, low operating costs and high power density while complying with ever-more stringent emissions legislation. ABB's second generation of Power2 presents a two-stage turbocharging system providing boost pressures up to 12 bar that enables engine designs to meet all of these targets.



All of Power2's parts have been optimized to meet the requirements for a two-stage system operating in marine, offshore and power-plant applications.

The new system features a new extractable cartridge with dedicated tools for easy removal and fast

maintenance, along with new compressor and turbine stages optimized for combined operation in a two-stage system. The entire system has been reduced in size in order to minimize space requirements while still providing optimum performance.

Large industrial robots – the next generation

For over 30 years ABB has been developing large industrial robots to meet modern manufacturing needs. And now ABB has introduced a more robust robot than ever. The seventh generation of large industrial robots – the IRB 6700 – features a multitude of next-generation improvements derived from intimate customer relationships and exhaustive engineering studies.

The new generation robots show enhanced performance, reliability and significantly reduced cost of ownership. The IRB 6700 robots have higher payloads and longer reach and at the

same time are faster, lighter and more accurate, with energy consumption reduced by 15 percent.

Every robot in the 6700 family is designed to accommodate Lean ID – an integrated dressing solution that places the most exposed parts of the dress pack into the robot. Equipping an IRB 6700 with Lean ID makes it easier to program and simulate with predictable cable movements, creates a more compact footprint, and lengthens service intervals due to less wear and tear.

In designing the new robot, easier serviceability was identified as a critical aspect for improving its total cost of ownership. Service routines for the machine have been shortened and intervals between them have been increased. Access to motors has also been improved. The first six robots in



the family, with payloads from 150 to 235 kg and reaches of 2.6 to 3.2 m, were introduced at the end of 2013. Two additional robot variants are being developed to meet the demands for payloads up to 300 kg, with a planned release by the end of 2014.

AC500-S Safety PLC speeds and simplifies safety engineering

The AC500-S Safety programmable logic controller (PLC) is a new addition to ABB's AC500 PLC product portfolio. It offers engineers flexible and powerful facilities that speed and simplify the development of safe control solutions for even the most complex control applications. It has already been used successfully in cranes, hoists, robots and wind turbines.

The AC500-S features a dual-processor architecture that complies with SIL3/PLe functional safety levels. It is programmed using Automation Builder, ABB's integrated engineering suite for AC500 PLCs, CP600 control panels, drives, motion control and robots.

The PLC has many new features appropriate to the safety machinery market, including support for high-



level structured text (ST) programming, ladder logic and function block diagrams. The inclusion of ST programming support is a unique feature in the PLC world and it simplifies development when complex algorithms and mathematics are involved.

The AC500-S Safety PLC offers a choice of SIL3/PLe-certified Safety I/O modules including digital input and outputs, and a dedicated 0–20 mA (or 4–20 mA) analog input module.

To simplify system design and improve productivity, Safety I/O modules may be installed as part of the main PLC solution, or located in a remote I/O rack and linked using the PROFINET/PROFIsafe protocol.

The new AC500-S Safety PLC is perfectly integrated into the scalable AC500 PLC platform. This allows the customer to select the performance level appropriate to the target application and includes operation in harsh conditions and extreme climates.

SafeRing Air – a compact solution

ABB has developed a ring main unit (RMU) as compact as the traditional SF₆ insulated RMU but using dry air as an alternative, environmentally friendly, insulation gas, thus avoiding intensive use of epoxy materials.

SafeRing Air provides a solution using an insulating gas that consists of atmospheric components, without enlarging the physical dimensions of the product.

SafeRing Air is available for up to 12 kV in circuit breaker and load-break switch configurations for RMU applications that require alternative solutions.

The switchgear design is based on a completely sealed system with a stainless steel tank containing all live parts and switching functions. SafeRing Air is ideal for use in compact secondary substations, light industry, building and infrastructure applications. SafeRing Air has full three-way functionality with the same footprint as the current SafeRing with SF₆ insulation and is optimal for new installations and retrofit applications.

The switchgear design is based on the existing SafeRing/SafePlus portfolio, providing the same user interface, footprint, spare parts and operation in retrofits.



Digital switchgear

Innovative technologies have enabled the continued development of ABB switchgear for almost a century. UniGear Digital is the newest product available for medium-voltage air-insulated switchgear.

UniGear Digital combines the well-proven UniGear switchgear design with a unique solution for protection, control, measurement and digital communication. In the new design, state-of-the-art digital current and voltage sensors are integrated into each panel, alongside ABB's multifunctional Relion IEDs, which ensure compatibility with the IEC 61850 digital communication protocol.

Packaging switching and communication functions together enables shorter delivery times by up to 30 percent,

simpler installation, commissioning and testing, and energy savings of up to 150t of CO₂ equivalent compared with a conventional UniGear ZS1 substation of 14 feeders with a 30-year lifetime.

Using IED connectivity packages makes connecting the digital switchgear to a customer's SCADA system simple and fast. New, high-performance applications such as high-speed busbar transfer and fast load shedding are enabled through the digital approach, thus enabling a higher performance level. UniGear Digital is built for flexibility and expansion without needing complex additional wiring.

The use of current and voltage sensors greatly enhance safety, as there is no risk for open current circuits, or for ferro resonance in the voltage transformers. The sensors also enable up to 30 percent shorter delivery time, due to variant standardization that eliminates the need



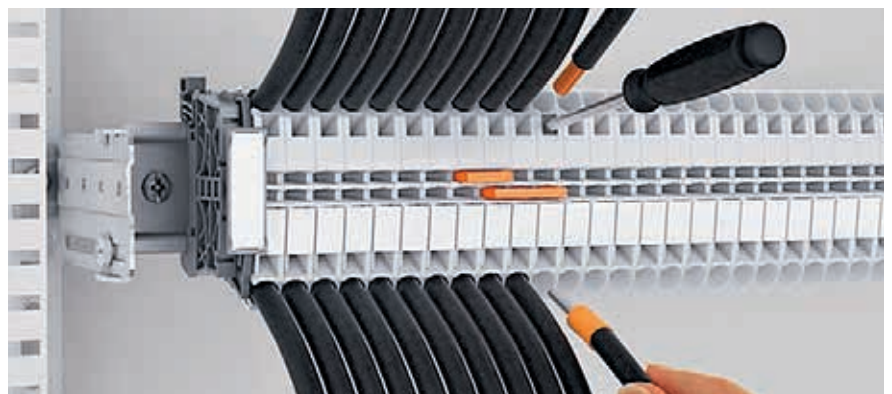
for made-to-order instrument transformers. Deploying IEC 61850-9-2-based communication throughout the switchgear grants highly dependable protection and control functions.

UniGear Digital is currently available for ratings of up to 17.5kV, 4,000A and 50kA. ABB plans to extend the digital concept to the entire 12 to 24kV UniGear portfolio.

High-performance terminal blocks with screwless technology

Control cabinets are becoming a common sight in more and more industrial settings. Dozens of cables (thousands in larger installations) can run to such cabinets and each cable has to be properly terminated as just one faulty, connection can render the whole installation inoperable. ABB has now launched a new, patented PI-Spring terminal block, aimed at both standard and premium applications, to significantly increase connection reliability.

The PI-Spring terminal blocks allow push-in connection for rigid, or flexible, ferruled conductors; nonferruled flexible conductors can be connected by operating the block spring with a screwdriver during insertion. Cable connec-



tion is now 50 percent faster than with standard technologies.

The PI-Spring connectors are resistant to vibration, shock and aggressive atmospheres, and global certifications give access to worldwide markets and many industrial applications, including hazardous environments and marine duties.

As the push-in and spring modes are both provided by one single stock profile, inventory can be reduced by 50 percent. In addition, the PI-Spring range shares the same accessories as

ABB's SNK screw terminal range and all PI-Spring end sections fit many blocks, further reducing logistical effort.

The asymmetrical block design allows an immediate visual check for reversed terminal blocks. Quick premarking with a pen before final labeling is facilitated by the large, flat marking surface, and the 30° angle of the conductor entry saves up to 15 percent in height while still allowing for a generous bend radius.

ABB's PI-Spring terminal blocks will be presented in more detail in an upcoming edition of *ABB Review*.