A successful 2007

In labs across the world, ABB's scientists and engineers are hard at work seeking ways to create new products, make existing products better, or find novel applications for proven products. In brief, they are upholding ABB's tradition of pioneering and innovation and laying the foundations for the success stories of tomorrow.

This article takes a quick tour of a small selection of ABB's achievements in innovation of the past year. These are also discussed at greater length in this (or recent) editions of *ABB Review*.

Signal processing gives instrumentation a boost

The integrity and reliability of instrumentation is indispensable for the efficient operation of a process plant. At the same time, such equipment must be easy to install and low on maintenance. ABB presents a flowmeter that auto-calibrates, a pressure transmitter that knows when it's plugged and wireless standards for device communication.

The circuitry of the WaterMaster range of flowmeter products has been redesigned. It now includes an integrated auto-calibration function, which not only reduces the necessity for human supervision, but also assures continuous accuracy. Because the number of precision components having a bearing on measurement accuracy was reduced from about ten to a single resistor, the overall dynamic behavior of the device in the face of temperature changes has become much easier to handle.

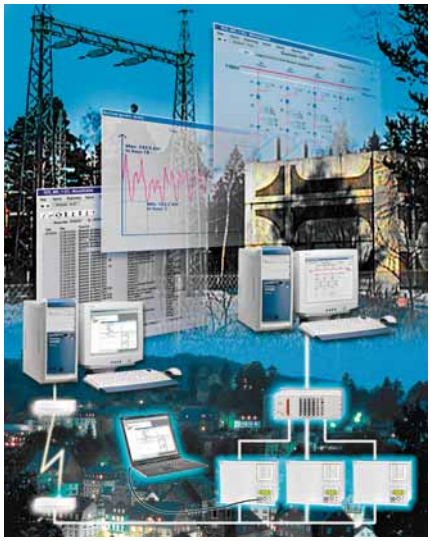
ABB has used an innovation of a different kind to improve a differential pressure meter. As the meter's measurement lines can easily get plugged (blocked), frequent inspections are necessary as such occurrences cannot easily be detected from the control room – until now. ABB's solution lies in observing the process noise – or rapid parameter fluctuations that are normally of no interest to the measurement. ABB now uses an automatic analysis of this noise to check for plugged lines.

Instrumentation traditionally needs a lot of wiring. This not only inflates implementation costs, but is also a potential source of error and limits flexibility when changes are required. This is why interest in wireless communication in instrumentation is on the rise. Just as wired fieldbus standards currently allow devices from different manufacturers to be combined, a wireless standard will soon allow the same to be achieved with wireless products. ABB is working with other leading instrumentation manufacturers on the implementation of two emerging standards: HART 7 and ISA SP100.

For more information and background on these innovations in instrumentation, see "Signaling enhancements" on page 12 of this edition of *ABB Review*.

New tool advances substation automation

The IEC 61850 standard for substation automation was a major advancement in electrical power technology, enabling application of state-of-the-art information and communication technology. And now, engineers can take full advantage of the technology with ABB's new substation engineering environment.



In this new environment, the devices in a substation are able to communicate and provide a broad set of data to describe and control the substation operation. Engineers master the enormous amount of data throughout the complete design phase of the substation. The automation system and individual functionality can be thoroughly tested before on-site operation begins.

ABB's new tool speeds up engineering and testing processes, resulting in faster-than-ever delivery of pretested substations. With its increased reliability and its plug-and-operate capability, the system short-cuts extensive commissioning phases. Outage times are reduced through the manifold possibilities of testing within the virtual engineering environment, providing seamless operation when rebuilding or maintenance is required.

For more information on ABB's new substation engineering environment, see "Speed and quality" on page 38 of this issue.

Silent cooling

Advanced heat pipe cooling answers the demand for lighter and more robust circuit breakers, but more importantly, performance is increased by over 25 percent!

Large circuit breaker nominal currents generate a tremendous amount of heat, which must be limited if other system components are to remain within their rated temperature tolerances. Because natural cooling limits the rated nominal current, many of today's generator circuit breakers (GCBs) employ forced cooling methods – also a source of extra heat – to increase nominal current levels. However, these also limit nominal current capability.

To further increase this current while meeting the ever-increasing market demands for lighter, robust and more powerful products, ABB has developed an innovative cooling method based on the heat-pipe cooling concept. The ABB system is composed of three major components: an evaporator section attached to the GCB conductor (which is effectively the heat source); a transfer section; and a condenser section (or heat-sink) located in the cooler environment outside the enclosure. This solution needs no electricity to operate, requires little maintenance and is impressively silent. Its main benefit, however, is the extension of generator breaker nominal current from 18,000 to 23,000 A.

A more detailed article, "Performing at a higher level," can be found on page 18 of this edition of *ABB Review*.

Turning machining robots into universal tools

Based on ABB's pioneering applications of robots for the delicate assembly of fine structured parts, ABB has now taken a new step towards achieving watchmaker precision in robot motion. The innovative approach – Flex Finishing – can reduce overall programming times by up to 80 percent for robots used to grind castings, vastly improving productivity.

This new, unique robot application combines several innovative elements by using the latest ABB robot controller, IRC5, with its high speed sensor interface, feedback loops to control pressure and speed of the grinding tool, and a programming environment that allows the robot to find the optimum path by itself.

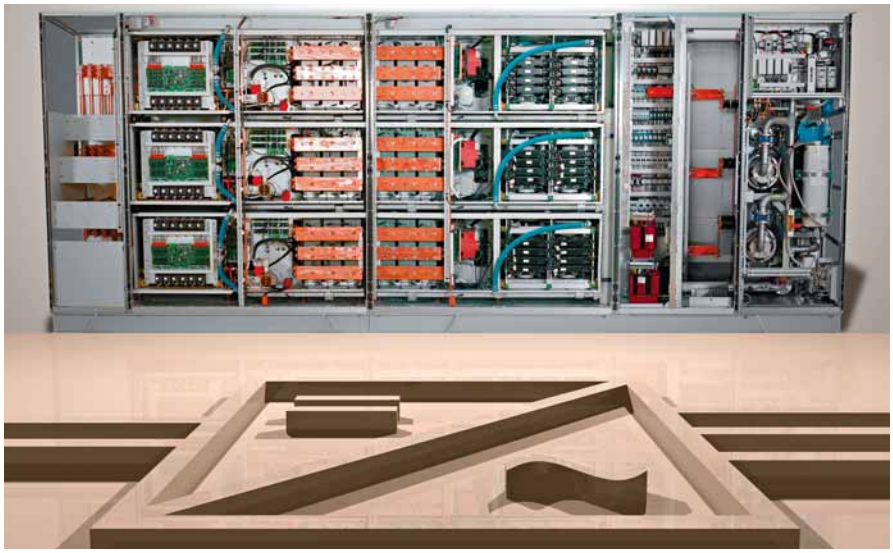
Robots equipped with this ability to learn how to touch and handle work pieces reduce the cycle time of the operation by some 20 percent – and with this better motion control the lifetime of the grinding tools can be extended by 20 percent as well.

Product finishing operations in foundries are now much simpler, enabling finished castings to be produced with a higher quality, faster and at lower cost.

For more information see "A touching movement" on page 22 of this edition of *ABB Review*.

Frequency converters poised to deliver great energy savings

ABB's five-level frequency converters enable significant energy savings by lowering the barrier to the adoption of power-electronics in motor control.



Motors consume about 30 percent of all electrical energy generated in the world. This means that any efficiency improvement in this sector is of huge benefit to the planet's dwindling energy reserves and fragile environment. About three quarters of motors are in variable-speed applications, an area where traditional control methods cause a huge waste of energy.

Frequency converters can change all this. In fact, they are the most efficient method available for such control tasks and adopting them can reduce losses to a fraction of their former value. The worldwide application of frequency converters in medium voltage applications alone has the potential to replace the equivalent output of 144 fossil fuel plants. However, the technology is not universally applicable because such converters produce "harmonics" – or plainly put, the waveform of their output voltage is far from ideal. This can lead to a torque ripple in the drive-chain, heating in the motor and cause electrical interference in other equipment. Also, in medium-voltage applications, it is difficult to obtain the required voltage levels with traditional two- and three-level topologies.

In order to make converters more acceptable, ABB is seeking ways of reducing harmonics and increasing the output voltage. ABB's new five-level converters answer both needs: It produces considerably less harmonics than its two- and three-level predecessors, while at the same time permitting higher voltages to be attained. The technology is now implemented in the company's ACS 5000 drive units.

For the story behind ABB's five-level converters, see "A higher level of efficiency" on page 26 of this issue of *ABB Review*.

Breaking new ground: ABB's flexible and compact DC breaker

When it comes to installing equipment, there are two assets that are perpetually in short supply: time and space. Equipment requiring complex wiring costs much time to install, and the auxiliary equipment to which it must be wired occupies additional space. ABB SACE Emax DC breaker addresses both issues through its unprecedented levels of integrated functionality.

Until now, DC breaker applications could be divided into two categories: breakers that triggered automatically and those that needed an external impulse. The automatic type was of relatively simple construction, and could provide only auto-triggering short-circuit protection. Where more sophisticated triggering was required, monitoring and control equipment had to be installed on an external switchboard.

Now what if this functionality were integrated in the breaker? This would not only greatly simplify installation but also economize on wiring, auxiliary power supplies and valuable space while also improving robustness and reliability. In the field of AC breakers, such integrated solutions have been available for some time. But in DC applications the concept is not as simple to implement because of the more challenging methods of measurement. ABB has come up with an innovative and unique solution. The SACE Emax DC is the only breaker of its type on the market: It offers a wide range of

protection functions, all sensors are fully integrated, and despite being almost a mechatronic system in itself, the breaker can work without an auxiliary power supply.

For more background information, see "Integration breakthrough" on page 32 of this edition of *ABB Review*.

Ultra-high voltages for ultra-low losses

The energy market is changing rapidly: Interconnections and trading are creating new challenges, as are developments such as the growth of wind power in areas where infrastructure is weak. The rapidly rising demand in countries such as China is leading to huge investments in transmission infrastructure. ABB is at the forefront of the development of technologies to meet these challenges.

When bulk electric power must be moved over large distances, it is most efficiently accomplished using high voltages. The higher the transmission voltage, the lower the conduction losses and hence the more power the line can carry. ABB offers both high-voltage AC (HVAC) and high-voltage DC (HVDC) solutions for power transmission. ABB has developed equipment for 800 kV HVDC and 1000 kV HVAC (The previous highest commercially used voltages were 600 and 800 kV).

HVDC is highly controllable and can, for example, be used to "inject" power into an area where shortfalls in generation are threatening to cause blackouts. The mode is also immune to the stability issues that limit the capacity of very long AC lines. As the mode is inherently more reconcilable to space-saving coaxial cables than HVAC is, it is frequently used on submarine links and in other situations where the cable must be buried.

However, the sophisticated converters needed to feed power into and out of HVDC lines mean the technology is best suited for point-to-point links. Where it is necessary to tap power at an intermediate point or even create an entire network, HVAC has a clear practical advantage. The most effective solution for the transmission of bulk power over a long distance is often a mix of both applications: an HVDC line with HVAC feeders.

For more information on ABB's activities in ultra-high voltage transmission, please see **Asplund, G.**, "Ultra high voltage transmission," *ABB Review* 2/2007, 22–27.

Remote service: a new dimension of customer care

Remote service technologies support field engineers, irrespective of location, in ways only dreamed of five years ago. These technologies, combining real-time monitoring of product and system performance and automatic alerting of service engineers have now been extended to larger parts of ABB´s product spectrum.

Using advanced embedded intelligence in the products and secure communication channels across customer firewalls, ABB is permitting remote monitoring of the condition of analyzing equipment. Signals received at service centers are automatically monitored and analyzed using the accumulated knowledge of hundreds of man-years of experience now held in extensive performance databases. By comparing the performance of individual devices with historic data from countless similar devices in the field, the knowledge-based systems support ABB's engineers in proposing the best suitable strategies for maintenance or repair. A faster decision process and subsequent tailor-made service cuts cost and reduces downtime of customer installations.

For more information see "Wellness for your profit line" on page 42 of this edition of *ABB Review*.

TrafoSiteRepair™ – a byword for speed

TrafoSiteRepair™ is an innovative solution created by innovative people to improve power transformer availability.

Repairing, refurbishing or retrofitting power transformers on-site has long been accepted as the best method of getting units back into service in the shortest possible time. However, until recently major repairs, such as repairing or replacing the windings, meant the transformer had to be transported to a factory where the required space and equipment are available, and this was very costly in terms of time. ABB's TrafoSiteRepair™ changes all this by allowing major repairs to be performed on-site. This in turn minimizes the outage time of the transformer, the unavailability of the power supply and more importantly, the loss of revenues.

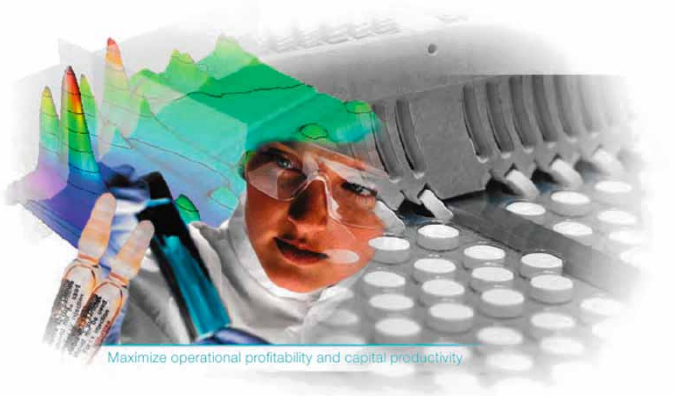
TrafoSiteRepair™ is a combination of years of experience and state-of-the-art technology, and includes verified processes that are to the same standard as those used in a factory environment. Some new innovations have contributed to its success, such as a Mobile High-Voltage Test System, which replaces the heavy and somewhat inflexible motor-generator set; an on-site Low Frequency Heating (LFH) drying system; and a Dielectric Frequency Response (DFR) test to determine the remaining moisture level in the cellulose insulation of a transformer. TrafoSiteRepair™ is already credited with getting some 200 units in 25 countries back up and running in double quick time.

A more detailed article, "On-site transformation" can be found on page 45 of this edition of *ABB Review*.

Building bridges

ABB's Industrial IT for Process Analytical Technology (PAT) delivers real business benefits.

New drugs are the life blood of a pharmaceutical company. Even though it can take years to put a drug on the market at a cost in excess of $800 million, the rewards more than outweigh the investment. However, the balance is shifting somewhat because of two major factors: companies are investing more in R&D than ever before at a time when the actual number of New Chemical Entities being approved is in decline; and increasing production costs. These increasing costs have forced the industry to look at new and innovative ways of becoming more efficient, both in the creation of new drugs and the production of existing drugs.



Together with these innovations, an initiative known as Process Analytical Technology (PAT) has been making its presence felt since its launch in 2002. Its goal is to understand and better control the entire pharmaceutical manufacturing process. Analyzer technology is at the heart of the PAT initiative, but the availability of multiple analyzer platforms combined with the absence of some form of standard for exchanging data has resulted in "islands of PAT." ABB has been building bridges between these islands with its Industrial IT Process Analytical Technology. This is a true innovation that meets many of the key requirements of a truly integrated PAT solution.

A more detailed article, "Integration guaranteed" can be found on page 49 of this edition of *ABB Review*.

Predict & Control pumps up plant performance

Advanced process control technologies, while well established in many industries, have only recently been utilized for power plant control and optimization – and the results are remarkable.

Multi-variable model predictive control (MPC) boasts superior performance over traditional single-input/single-output (SISO) control strategies. By making full use of the increased power of computers, MPC-based solutions can be deployed in large utility power plants.

The main goal of advanced process control is to reduce process variations; for power plants, this translates to improved process stability and reliability, and reduced thermal cycle stress on

the high-pressure parts. Reduced variance allows the power generation process to operate closer to the given plant's optimum. Often, this optimum is defined by constraints. By minimizing variations, the process can move closer to its limit without violating the constraint.

ABB's new product, Optimize^{IT} Predict & Control, answers the shortcomings of previous MPC solutions, such as limitations in the choice of control models and reliance on open loop step testing.

Plants that have implemented ABB's MPC have realized NOx reductions of eight to 40 percent, while generating tens of GWh per year of additional electrical energy with the same fuel consumption.

For more information on ABB's Predict & Control, see "Efficiency up, emissions down" on page 53 of this issue of *ABB Review*.