Buildings with brains
ABB’s Building Management System used in its new headquarters at Longmeadow heralds a new era for the construction of buildings

Every bit counts
Improved control software and optimised processes are contributing to increased energy efficiency

Robot welders come home
Universal Storage Systems put ABB’s own robotics technology to work when installing the storage system at Longmeadow
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Welcome to the second edition this year of ABB’s Technology Solutions magazine. It is hard to believe that we are already more than halfway through 2009 in this tough market. The changing marketplace continues to present utilities around the world – whether state-owned or private, global or local, operating in liberalised or regulated markets – with both challenges and opportunities.

The main forces driving the changes are deregulation, increasing globalisation, high pressure on performance improvement and a stronger focus on environmental factors. Coping with, and responding to, these changes has created the need for not only a whole range of new technologies but adaptation of existing ones. Traditional competencies alone are no longer sufficient to be able to thrive in the utility business environment. Energy companies are being pushed to perform – technically, operationally and financially – at increasingly higher levels.

This means that ABB, like its industry peers, has to intensify its performance efforts: improving customer relations, controlling inventory, implementing tighter cost management, engaging in impeccable forecasting and effective cash flow management, and in some cases offering customer funding.

In line with ABB’s focus on research and development, we would also like to focus on helping our customers improve their performance. We seek to provide value for our customers by helping them get the most out of their existing assets and the highest possible return on their new investments. We serve electric, gas and water utilities through a portfolio of economically attractive and environmentally sound products, services and systems.

We also offer power products and systems that fit the specific needs of industry customers, for instance in the automotive, metals and petrochemical industries. In addition, we are working with an increasing range of external channel partners. Original equipment manufacturers and engineering, procurement and construction firms benefit from world-class ABB power and automation products, enabling them to serve their customers better.

Speed, quality and transparency are the guiding principles in all our interactions with customers. This is also reflected in our development strategies for our products and production processes.

In this issue of Technology Solutions we are proud to present a mix of articles that will cover ABB’s latest technology solutions. With this exciting walk-through of ABB’s world, I hope you enjoy your reading!

Carl Watson  
Divisional Manager  
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Great focus on performance
Buildings with brains

The ABB Building Management System used in ABB South Africa’s new headquarters at Longmeadow heralds a new era for the construction of buildings that are as energy efficient and environmentally friendly as possible. By Dirk Visser.

ABB South Africa’s new office and manufacturing complex at Longmeadow in Johannesburg provides a perfect demonstration platform for the company’s Building Management System (BMS).

The BMS is a high-tech system that monitors and controls the building and campus in terms of mechanical and electrical equipment – typically air conditioning and distribution, cooling plants, power, lighting, fire detection and alarm systems, access and egress and security systems.

It is the brain that guides and controls the environmental measures, ensuring they perform efficiently and accurately. However, there are many different dimensions by which a green building and its performance can be measured. The best results come from the correct integration of design, construction, process management and technology. A holistic approach from all involved is required.

The BMS aims to ensure the best return on investment from all building components – such as the IT systems, the space and the structure – to the point where green construction in new projects in South Africa can eventually become as integral to building design as foundations, walls and roofs.

The overriding objective is to be as energy efficient as possible. The sheer size of the ABB Longmeadow complex means that lighting, air cooling and heating and other elements are
major contributors to energy consumption and wastage, and therefore need to be controlled.

Specially designed sensor fittings are present in all individual workstations and human traffic areas. Decentralised intelligent modules are located on the power distribution boards and scan the building's entire lighting system every three seconds. The scanning system searches for movement and/or heat using infrared and if no heat or movement is detected the lighting automatically switches off.

This extends to docking bay lighting at the Longmeadow goods receiving facility, with detection sensors switching on the bay lights only when a vehicle enters the bay for offloading.

Peak demands are monitored closely by the BMS and are adjusted, fine-tuned and customised according to usage patterns. This allows surplus energy from lower usage areas to be directed to busy areas where demand is greater.

The BMS maintains, manages and controls the heating and cooling ventilation systems throughout the complex, using electronic variable speed drives (VSDs) designed and manufactured by ABB to enhance and improve building cooling and heating while reducing the energy requirement.

VSDs provide control over the speed of electric motors driving pumps and fans, the objective being to achieve maximum control of the building environment by driving the fan at the speed needed to maintain the building's desired internal conditions as set by the BMS software and sensors.

The VSDs save energy through motor speed control as the motor runs only at the speed required for the current conditions. The energy saved results in significant cost cutting as warmed or cooled air is passed only to those sections of the building that the BMS indicates require it.

In the security arena, all company laptop computers will be fitted with a chip linked to the personal card chip of the laptop user, meaning that laptops will only be allowed out of the building if the chip read by the BMS on exit matches the personal code of the allocated user.

With development of the Green Star international standard for environmentally friendly buildings, legislation and implementation in South Africa is making good progress. Companies will ultimately be forced to make a minimum saving of 10% on their energy use and it is likely that the achievement of this will result in a rebate in some shape or form.

ABB South Africa aims to make more energy savings in the future, for example with solutions in storage and stock rooms that meet the illumination safety requirements while minimising the energy requirement.

Also, photovoltaic cells in the roof structure of Longmeadow convert solar energy to provide power for the ABB IT department, and it is hoped to extend this to other areas.

Disposal of low-energy lighting tubes will be safely handled. Mercury and gas will be extracted within a sealed environment and the glass will be recycled – although to do this properly high volumes are required.

ABB’s new building at River Horse Bend near Umhlanga Rocks, north of Durban, where similar green measures are in place, will eventually be environmentally monitored from Longmeadow – thanks thanks to internet and wireless technology.

An objective of the green drive is to raise the consciousness of the people working at Longmeadow so that the next generation become an integral part of leaving a legacy for future members of ABB. Actions speak louder than words, and hopefully they will see that we have done the best that we can during our tenure and be inspired to build on that legacy.

Dirk Visser is Manager of the EIB/KNX (European Installation Bus/Konex) hierarchical software system that drives the BMS at ABB South Africa’s new Longmeadow complex at Johannesburg.

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One of the major objectives set for ABB South Africa’s new facility at Longmeadow Park was the reduction of energy consumption. This was achieved through solar heating, assisted by the recycling of heat generated from air conditioning motors – technology that is now key to the green status of the group’s new headquarters.

There are three main components to the indirect pressurised hot water solar heating system. Firstly, a total of 72 two-metre square selective solar heat collectors with interconnecting couplings, isolation valves, air separators and automatic solar air vents are located on the building’s roof. The 144m$^2$ of solar panels face north for maximum exposure to the sun. The system is based on flat-plate panels that are safe, highly efficient and durable, and slightly oversized to compensate for the distance from the storage tank.

Secondly, there are three thermally insulated potable hot water storage cylinders on the north-eastern side of the building, each having a capacity of 10 000 litres. Thirdly, there is a solar heat exchanger that receives heated glycol – a liquid that has a lower freezing point than water and therefore absorbs heat more quickly – after it has been passed through the solar heat collectors on the roof, as well as additional heat extracted from the air conditioning system, which currently supplies 42% of the total water heating requirement.

The heat arriving at the heat exchanger transfers to the water circuit, resulting in hot water accumulating in the three linked 10 000-litre solar system water storage cylinders. Longmeadow Park receives its hot water from the third containment cylinder at 55°C and pressurised at 400kPa. The tank is constantly replenished from the other two storage cylinders. Once the hot water has circulated it is returned to the system, ensuring that large quantities of water and electricity are saved.

Shaun Reiche, manager of Solar Heat, which supplied and installed the solar hot water panels and associated equipment, said that during “periods of low solar contribution”, typically during heavy cloud cover or rainy days, an auxiliary back-up heating circuit can be brought into play if necessary. “This is independent of the solar circuit and, if turned on, will heat water without the solar system. However, even in mid-winter there are usually sufficient hours of sunlight for the solar system to function as designed.”

The solar system deployed at Longmeadow uses internationally certified equipment and components supplied by long-established French solar water heating company Jacques Giordano Industries, for which Solar Heat is the sole distributor in southern Africa. The systems are also SABS approved.

A temperature differential controller (TDC), which collects data from three temperature probes situated at the top of the solar panels, at the bottom of the hot water dispensing tank and at the heat exchanger, is used to instruct the pumps to switch on and off as required and helps to minimise power consumption.

In the daily cycle, the solar panels pump starts up first, as soon as the TDC probe detects that the sun has sufficiently heated the glycol. It
then checks the heat available at the heat exchanger and ensures that heat is also brought into the water heating system.

Hot water is available 24 hours a day. The overall solar panel hot water system saves 300kW of electricity every day, which over a year amounts to almost 110MW – a very significant amount.

System design is such that even if there is no power and the Longmeadow standby generators also fail, a water mains bypass system will still allow hot and cold water to be fed into the building, albeit at lower pressure. The overall building water supply is housed in a 50 000-litre mains tank.

Improvon director José da Costa said the system design caters for the needs of 1 800 people and will soon pay for itself. “The original pay-back period for the investment in the solar water heating systems and ancillary heat drawn from the air conditioning was calculated at five years. Now, with the recent significant increase in Eskom power supply prices, the payback period for the system will be significantly reduced.”

Ivan Goldsmith of Goldsmith Plumbing Consultants, responsible for the overall water distribution design, said very detailed drawings of the overall system were prepared and provided to assist the on-site building maintenance section. “This is a super-simple system that functions very well.”

He added that the building design also enables “grey” water from the showers and hand basins to be collected and cleaned by oxygenation. It is then stored and used to flush toilets and urinals. Surplus treated grey water is also diverted to two attenuation ponds. This water, and rainwater directed into the tanks from the roof, is used to irrigate the indigenous gardens.

Overall, the project has resulted in a state-of-the-art minimal impact water heating system that makes best use of natural resources – in line with ABB’s international environmental policy.

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**Water for wildlife**

Solar power is providing a cost-effective solution to pumping water for animals in a remote part of the Kruger Park. By Neville Hazell.

ABB South Africa has successfully commissioned a solar-powered borehole pump station in the Kruger National Park to bring water to animals in a dry, remote area.

The commissioning was undertaken with ABB's drives alliance partner and irrigation original equipment manufacturer Ugezi Automation.

Riaan van Jaarsveld, ABB South Africa Component AC Drives Sales Engineer, and I trained and assisted Shaun Buckingham and his team from Ugezi on the use of ABB variable speed drives in this application.

The purpose of the pump station is to supply water to the new Giriyondo border post between South Africa and Mozambique in the Kruger Park. This trial site will help to determine the viability of further sites to provide water for the animals in the park.

The borehole site is some 14km from the border post and consists of a 5.5kW multistage submersible pump controlled by one of ABB's ACS350 variable speed drives.

Power is derived from solar panels which charge a bank of batteries, which in turn supply an uninterrupted power supply (UPS) to provide the three-phase power to the variable speed drive. The drive controls the pump using its onboard PID controller around a constant pressure process requirement. The static head is around 150m. The use of current limits, soft acceleration and a “lazy” PID control loop maintains the power utilisation within the supply tolerances of the UPS.

A second solar-powered booster station is situated about half way along the line and consists of a single-phase output UPS which feeds a single-phase input ACS350 variable speed drive to control the 2.2kW pump set, again with control settings to optimise the power supply from the solar system.

The system delivers approximately 2 500l/hour and although it is designed to produce this capacity for two hours a day, initial trials produced it for three hours on a battery charge. It is predicted that, on a good day (full sunshine with the extended daylight hours in summer), six hours of continuous operation will be achieved.

The system is monitored via telemetry with its independent solar-powered system.

The business case was easy to support as the cost of running an overland power supply to the borehole site would have far exceeded the cost of the solar system at the two locations. The maintenance costs of an overland power supply would be great because of the expected damage caused by elephants pushing the poles over.

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One of the most impressive sights at ABB South Africa’s new Longmeadow Park office and manufacturing complex is the stock storage area, where more than 205 tons of steel – storage racking and shelving in eye-catching yellow, red, blue and white – rises more than nine metres (three storeys) from ground floor to the roof.

An indication of the extent of the system is that if all of the steel components were lined up in a single straight line, it would stretch almost 13.5 kilometres.

The linear racking and shelving solution for ABB was designed using CAD technology, manufactured, supplied and installed by Universal Storage Solutions, an enterprise that serves both national and international markets from its head office and factory in Strijdom Park, Johannesburg, and branches in other main centres.

A critical role in the manufacture of the steel storage components for the Longmeadow warehouse was played by two of ABB’s IRB 1410 arc welding robots – supplied to Universal Storage Systems two years ago when the company turned to ABB to solve a production bottleneck identified in its manual welding section.

Lars Mandal, Marketing Manager of ABB Robotics for the South African market, said the six-axis IRB 1410 is based on the IRB 1400 of which more than 14 000 units have been delivered to industries worldwide. The shelving system manufacturing application is a first for ABB.

“For Universal Storage Solutions, the IRB 1410 best met the requirements to weld steel brackets to steel beams of varying lengths from 2.2m to 4.2m and conduct stitch welds along the beams with a circuit time of 17 seconds. The objective, which was achieved, was to improve daily beam production to 1 000 units.”

Mandal added that the 1410 robots are compact, catering for payloads varying from 5kg to 500kg with a radial reach ranging from 500mm to 3.5m. The robots are made up from standard components to best meet the requirements of the specific application and are generally designed for simple system expansion and minimal, easy-to-execute maintenance, with spares availability assured.

The IRB 1410 design is robust, offering low noise levels, long service intervals and long economic life. Coupled with high control levels and path-following accuracy (+ 0.05 mm) the robots ensure top quality; and with the fast and accurate IRC5 controller achieve short cycle times.

“The outcome is the achievement of consistent quality in the production line so that there are no ‘Monday products’. Today’s working environments are beginning to change significantly and robots exceed human limitations in stamina, concentration and consistency. Health and safety are also less of an issue,” said Mandal. “One of the South African factors that encourage the adoption of robotic welding solutions is the shortage of well trained and skilled artisans. Welders, in particular, are in short supply.”
Universal Storage Systems financial director Eric von Oppell said the company turned to ABB because it had always been a leader in the field and was keen to provide welding solutions for the industry as a whole.

“While the robot route removed some of the human flexibility associated with conventional welding, the end result is invariably very effective. Robotics forced us to improve the quality of our products, particularly in terms of the steel cutting dimensions. Today our steel cut sizes are very precise.”

Von Oppell added that the biggest plus from Universal’s decision to undertake welding with robots became clearly evident two years later. “It launched a change of mindset throughout the company and encouraged freer thinking at all levels so that we began to look at other efficiencies. Now we undertake up to eight projects a year focused on efficiency improvements. The ABB robots were the trigger for this change and the doubling of our production capacity.”

Sales director Willie Breytenbach said the robot welding capability and the other efficiencies achieved as a result were instrumental in the company bidding for and being awarded contracts for major projects. Greater volumes took less time, leading to a quicker return on investment in a very competitive industry.

The importance of robot maintenance is a factor that Universal Storage Systems takes very seriously. Inspections are conducted daily, and then weekly in greater depth, and monthly in the form of an overhaul.

“The program detects component clashes and ensures that everything is within specification, because there is just no room for error. When we won the open tender contract for ABB, the design of the system for the ABB manufacturing operations at Longmeadow took a week to complete to our satisfaction.”

It was a very tight production and storage system construction schedule. The fabrication took 33 days as a significant percentage of the components for the system were non-standard and made to order. It would have been much longer without the robots, and installation on-site took 25 days. As Faria commented, it is like “making up and installing a giant Meccano set”.

The ABB storage solution is a combination of a four-tier adjustable pallet racking (APR) system designed to carry heavy palletised loads that are placed and removed by conventional and high-lift forklifts, and a “pick” system on the mezzanine floor that has access corridors allowing hand selection of smaller parts or spares.

Technical director Ricardo Faria said every storage solution is dictated by the products to be stored, the warehouse itself and the product handling system and is designed to make maximum use of available space using a three-dimensional CAD program.

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Every bit counts

Improved control software and optimised processes are contributing to increased energy efficiency.

Christopher Ganz, Alf Isaksson, Alexander Horch

Renewables, nuclear power, clean coal – these are among a long list of buzzwords being used to address the future of energy. In the global struggle to match demand with supply, these are only one part of the equation.

Increasing the supply inevitably requires resources of some kind, whereas reducing the demand results in a reduction of resource consumption. For decades, environmental organisations have sought to limit the use of energy. In the past, this implied reducing the standard of living – i.e. doing less of the same.

A far more convincing idea is doing the same with less – increasing efficiency by applying more efficient technologies. One well-known example is the replacement of incandescent light bulbs with compact fluorescent bulbs or LED lights. And in industry, highly efficient equipment is now available. Efficiency gains are also being made in building technology through better insulation of production sites, re-use of thermal energy generated by the equipment, etc.

This article takes energy efficiency one step further, arguing that the way forward is to make optimal use of existing industrial equipment. Because in most cases equipment is controlled by an automation system, increased energy efficiency can be achieved through improved control software using advanced mathematical optimisation techniques and through optimised processes.
To understand what is meant by running a plant with optimised software and processes, one simply needs to think about driving a car.

A car driven by two different people under the same conditions will not consume the same amount of energy. Why? Because driving techniques differ. In a plant, it is the operation and strategy that governs the actual energy consumption.

The strategies for energy-efficient plant operation are much like those required for energy-efficient driving:

- Stop the vehicle at red lights: produce products according to specs and run the plant only at capacity.
- Shift gears early: be open to change.
- Keep the appropriate pressure in the tyres: run an optimally maintained plant.
- Do not accelerate when approaching red lights: run the production predictively in accordance with maintenance and production schedules.

If these strategies are applied properly, there is no need to “slow down” to save on fuel consumption. Experiences from modern eco-drive trainings exemplify this: it is possible to drive faster while consuming less fuel. In a modern, much more complex plant, the lesson is the same: running a plant optimally leads to greater energy efficiency.

The various functions available in an automation system can be improved to make a controlled process more energy efficient. Functions varying in scope (from individual devices to those covering the whole plant) and time horizon (optimisation within milliseconds up to the lifecycle of a plant) can all have an effect on the plant’s efficiency.

The following three areas are addressed here:

- Advanced control: today’s advanced controllers have the ability to solve an optimisation problem in every step, and can therefore have minimum energy as one of the target functions or boundary conditions.
- Production planning and scheduling: proper planning and optimised scheduling of a plant can reduce waste in terms of time and material, which results in doing more with the same energy.
- Monitoring: to detect whether a plant is running at its peak efficiency, it must be monitored closely to identify any abnormal behaviour that may result in increased energy consumption.

Many people may not immediately connect improved control with energy savings, but rather with improved product quality, increased production and reduced chemical addition. But, regardless of the intended target for the control, a positive side effect is almost always a reduction in energy usage, or more product being produced using the same amount of energy as before.

Just by retuning the basic level-one PID control loops, energy consumption may be significantly affected. Even though the savings for a single loop may be small, the sheer number of loops (hundreds if not thousands for a large process-industry plant) most often makes the total savings significant.

Sometimes an advanced control or optimisation solution targets the energy more directly. Some successful examples where significant energy savings have been verified follow.

A good place to start saving energy is of course at the source – i.e. where the energy is produced.

Co-generation of steam and power

At Point Comfort in Texas, in the US, Alcoa Inc runs a large refinery where bauxite is converted to alumina. Since this is a very energy-consuming process, Point Comfort utilises its own powerhouse with multiple boilers, turbines and steam headers. Most of the energy needed is produced in-house, but electricity is also purchased from the local power grid.

With varying prices of electricity and fuel (i.e. natural gas), the first challenge is to determine the optimal mix of in-house versus purchased energy. This is now done by solving a mixed-integer linear program every 15 minutes using the current fuel and electricity prices, which are downloaded from the internet.

The results from the steady-state optimisation are fed to a model-predictive controller (MPC), which runs with a much faster cycle (< 10s). The MPC is based on an empirical linear dynamic model, and delivers 28 manipulated control set points.

ABB commissioned this system in 2005 and it immediately led to greatly improved process stability; for example, an 80% reduction of steam pressure standard deviation was achieved. A 1% savings in overall energy cost was verified, giving the customer six months payback time. A more detailed presentation of the system and the solution can be found in [1].
Power generation: power boiler start-up
Another example of energy savings is the optimal start-up of fossil-fuelled steam power plants. In the deregulated power market, these power plants are used for more than just base load, and hence encounter many more stops and starts. The start-up time for a boiler is highly constrained by thermal stresses – too-high temperature gradients in thick-walled parts of the boiler and turbine may lead to cracks in the material.

Given a model and online measurements, it is possible to calculate the actual thermal stress. Thus a boiler model – which was not allowed to violate the constraint on thermal stress – was developed and used to optimally manipulate the fuel flow rate and high-pressure (HP) bypass valve position.

ABB has installed this technology at seven power plants, with three more installation projects under way. The typical fuel savings for a single start-up is between 10% and 20%. With 50 to 150 start-ups per year, this corresponds to 0.8 to eight million kWh per installation. For more details on this application, see [2].

Control of TMP refiners
A more typical control problem is of course at the consumer’s end. An example of a very energy-intensive process is the production of thermo-mechanical pulp (TMP). A mix of wood chips and water are ground in a narrow gap (< 1mm) between two disks, where either one or both may be rotating. The rotors are driven by large electrical machines. For a modern TMP refiner, a 30 MW motor is not unusual.

Much of the electrical power goes into producing steam in the refining zone, and a lesser part into the mechanical work on the wood. Now a novel technique to measure the steam temperature inside the refiner is being used in TMP mills for feedback control.

Verified results at the Hallsta Paper Mill, belonging to Holmen Paper in Sweden, show direct energy savings of $7 to $13 per metric ton of produced pulp with improved pulp quality. For a TMP line with an annual production of 100 000 tons, the total savings is then $700 000 to $1.3-million per year (note that mills usually have more than one line). Add to this indirect savings from fewer production stops for the TMP line and fewer sheet breaks on the paper machines, and the annual savings may be more than $2-million for one TMP line.

Any plant operation that does not produce quality-as-planned product obviously wastes energy. Therefore, start-up times, quality changes and the duration of plant upsets need to be minimised. While these are not new solutions, they have been difficult to manage. Now, with modern optimisation methods, it is possible to actually reach optimal operation.

Plant operation and scheduling strategies are often based on heuristics and experience. This in itself is not a disadvantage but it does hinder the transition toward a truly optimised production, with respect to both optimisation and scheduling.

The optimal management of plant assets also implies that those assets are at their optimal condition for production. Non-optimal production is often caused by non-optimally working assets, resulting in quality or yield reduction.

Finally, production scheduling is a key for energy-efficient production. The smooth (and truly optimal) use of production assets prevents the use of too much energy at one time while wasting it at other times. For instance, plant actuators require energy (pumps, heating, cooling etc). Any avoidable variance in such process variables immediately implies avoidable variances in manipulated variables.

Paper re-trimming optimisation
Consider the case of paper production where a pre-defined cutting pattern has been optimally computed based on customer orders. Due to variation in production, the pre-defined cutting pattern typically proves to be sub-optimal given the actual quality of the jumbo paper reel. This results not only in increased waste paper that needs to be recycled, but also in loss of profit.

An innovative ABB software solution – quality-based re-trim optimisation – computes the optimal cutting pattern based on actual quality data. The underlying patented method is able to solve the extremely complex optimisation
problem in just seconds. In so doing, more good-quality paper results from each jumbo paper roll, thus decreasing the amount of paper that must be reproduced.

Based on the energy consumption per ton of produced paper, a saving of just a fraction of the recycled paper is significant. Assuming an annual production of 400,000 metric tons, preventing just 1% of the final paper from being recycled can result in a saving of 10,000 MWh of energy (on both electricity and gas).

Co-ordinated production scheduling

Melt-shop scheduling in steel production is difficult due to the high number of different materials and orders. ABB has developed a solution that is able to simplify and solve this complex problem in an optimal way.

The same solution applies to the next step in steel production — the hot rolling mill. Scheduling of hot-rolling production is not as complex as melt-shop scheduling, but still presents significant challenges.

Having solved those two scheduling solutions, considerable energy savings lie in the co-ordination of both schedules in order to use both production plants optimally and minimise the residence time of each freshly casted steel slab in the slab yard.

This is important as slabs need to be hot before entering the hot rolling mill. The energy required to heat each slab, which is about 1,000 m$^3$, is 10,000 kW. If one out of 10 slabs can be hot charged — fed directly from the caster into the hot-rolling mill (thus avoiding reheating) — a typical mill could save 21,000 tons of CO$_2$, or, in financial terms, $3.9-$million per year.

Manually, these scheduling problems cannot be solved. But modern optimisation software can deliver such results, allowing operators and planners to monitor and — if required — change schedules.

Even if plant controllers, planning and scheduling are optimised to perfection, it is clear that over time the performance will deteriorate due to plant aging and process failures. In the case where some equipment breaks, this might be obvious; in many cases, however, deterioration is gradual, or cannot easily be located in the process by relying on traditional operator tools such as process displays, trend curves and alarm lists. But even if not recognisable by even a skilled operator, abnormal process behaviour leaves its traces in the measurements collected within the plant.

Taking an in-depth look at these measurements using advanced signal-analysis algorithms may reveal the behaviour more clearly.

Some key performance indicators (KPIs) are easily calculated from measurements collected in the distributed control system (DCS). Differences in temperature, together with a flow measurement, can in some cases provide quite a good indication of the energy consumed. Comparing this calculation with a “clean” measurement taken when the plant was evidently operating close to the design (i.e., early in its life or after an overhaul), degradation in efficiency can be easily detected. To then diagnose the cause of the degradation often requires either an experienced maintenance engineer or yet another set of algorithms.

More complex monitoring systems not only apply simple calculations to come up with performance indicators, but they also apply more advanced plant models where parameters are identified, so the model matches the plant (degrading) performance. These parameters then give a better view of the internal behaviour of the system than the measurements available in the DCS.

Monitoring process equipment through electric drive data

A common conclusion when introducing advanced monitoring is to introduce more sensing equipment — after all, obtaining more information about a process does require more measurements. However, very often forgotten is the fact that today’s automation systems already collect a vast number of data points that can reveal a lot about a plant. Even in places that are not obvious, data is collected and continuously analysed.

One example is the drive system. Apart from the algorithms that control the system, it contains a data collector that is normally used to diagnose the drive’s behaviour. However, the data contained therein does tell a lot about the process that is finally controlled by the motor. By matching the drive system’s signal patterns with the observed behaviour of the process, or by tuning process models to correspond to the observed signals, information about the controlled process can be retrieved by means of signals that are already in the system, without introducing new (and costly) measurements.

In addition to the technical complexity of energy savings through optimisation, there is also an operational complexity. Modern optimisation solvers enable fast and reliable solutions to complex technical problems. Another equally important challenge is to integrate computer-based production scheduling and plant operation into plant work processes.

The buy-in of the production planning and plant operation teams is essential for successful modern plant optimisation. Knowing that, topics like usability, maintainability, modularity and proper training will become central concerns for both vendors and users.

If these issues are treated comprehensively, production success and energy savings will not be contradictory.

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References


Living spaces change and rooms redefine themselves. Bathrooms become wellness oases, kitchens turn into communication isles and living rooms are furnished to suit your personal experience culture. The new generation of home control systems adjusts to changing habits and combines comprehensive home control with useful information and entertainment functions. In the process, ABB sets new categories of standards in terms of functionality and ease of operation.

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