Energy-efficient solution for world’s largest desalination plant

An ABB solution for the world’s largest seawater desalination plant – currently under construction in Algeria – will boost energy efficiency and cut maintenance downtime from weeks to days compared to current industry benchmarks.

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The solution is a complete and highly optimized electrical package that will power the Magtaa desalination plant in Algeria at an unprecedented level of energy efficiency and significantly reduce the length of scheduled plant shutdowns for maintenance.

Located at Oran, Algeria’s second largest city, the reverse osmosis seawater desalination plant will produce up to 500,000 cubic meters of drinking water a day, enough to meet the daily requirements of about five million people.

When completed in 2011, Magtaa will be the largest seawater desalination plant in the world – built, owned and operated for a period of 25 years by Asia’s leading technology-driven environmental company, Hyflux.

**Reduced power losses**

ABB is supplying a complete electrical solution for the entire desalination plant and a 220 kV outdoor substation that will connect the facility to the Algerian power grid and ensure that the plant receives a reliable supply of electricity without impacting grid stability.

The solution includes 33 medium voltage drives that will reduce plant electrical losses from the benchmark target of 5 percent to only 3 percent – a huge improvement in energy efficiency compared to accepted industry standards.

In addition, the drives will speed up the long plant startup process after maintenance or power-failure related shutdowns, reducing the length of plant downtime compared to the more traditional method of mechanical control.

Over the course of Hyflux’s 25-year operation of the plant these improvements in energy efficiency, plant productivity and reduced wear and tear made possible by the ABB solution will provide a huge and sustained boost to plant profitability.

ABB is one of the world’s foremost suppliers of power and automation solutions to the desalination and water industries, with a complete capability in integrated and optimized ICE (instrumentation, control and electrical) systems that improve the energy efficiency, productivity and reliability of plant assets.

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**Factbox on Magtaa**

Algeria is 95 percent arid land and 80 percent desert. Rainfall is almost zero, but a reliable, cost-efficient desalination process and the Mediterranean Sea offer an abundant source of potable water. When it starts production in 2011, the Magtaa plant in Algeria will be the world’s largest seawater desalination plant using reverse osmosis technology, delivering up to 500,000 cubic meters of drinking water per day to the city of Oran and surrounding region, enough to meet the daily needs of about five million people. ABB will electrify the plant and provide a 220-kV outdoor substation connecting it to the Algerian power grid.
Control systems for ultra-supercritical units in China

ABB has won a contract from Guangdong Yuedian Group to supply distributed control systems for two 1,000 megawatt ultra-supercritical coal-fired generating units at the company’s Hui Lai power plant in Guangdong province, China.

The two high-efficiency low-emission units will triple capacity at the plant and improve power supply in Guangdong province and the Pearl River delta, one of China’s most important and populous regions and the heart of its manufacturing industry.

ABB was selected on the strength of a similar solution it provided for the plant’s two existing supercritical 600 MW coal-fired units, both of which were commissioned in 2007. The order is one of several that ABB has won in recent months for electrical and automation solutions for supercritical and ultra-supercritical units in Germany, Holland and India.

The ABB solution covers the entire scope for both units – boilers, turbines, balance of plant and electrical balance of plant – as well as a common auxiliary system for all four units. ABB has undertaken to comply with a rapid delivery schedule to enable commissioning to take place in 2011.

Ultra-supercritical units pose challenging requirements on control system performance, project execution and post-project support – demands that ABB consistently measures up to as the world’s leading supplier of automation solutions for the power generation industry.
Over the past few years ABB has been selected by two different grid operators and two different utility companies to modernize the aging turbine control and protection systems at the rapid startup gas turbine plants that are used whenever disturbances threaten grid stability and power supply in Finland and Sweden.

Svenska Kraftnät and E.ON in Sweden, and Fingrid and Ålands Energi in Finland, have all entrusted ABB with the modernization of their reserve gas turbine power plants. Together the plants have a total capacity of 1,070 megawatts.

Exceptional levels of availability are key in installations of this kind. When the turbines are activated to meet power shortages or grid disturbances they have to be 100-percent reliable. Grid stability is, as a result of these installations, exceptionally high in both countries.

**System 800xA for Power Generation**

The ABB solutions are based on System 800xA for Power Generation and are comprehensive in scope. They include the plant automation system, integrated turbine control and protection system, field instrumentation, electrical equipment, condition monitoring and exhaust gas analyzing systems, as well as design, installation and commissioning.

Several factors differentiate the ABB solution and explain the reason for its repeated success. Chief among them are the turbine protection system, which is fully integrated with the turbine control and plant automation systems; and the use of discrete components, which interface easily with existing equipment, thereby protecting the customer’s previous investments.

ABB supports these solutions with local expertise in northern Europe and has recently established a core competence center for rapid startup gas turbines, based in Finland.

For the global market as a whole, ABB has supplied more than 1,200 turbine control systems for all makes of turbines and is the world’s leading supplier of control systems for the power generation industry.
These carefully tailored solutions are a direct response to the requirements of power generation utilities to minimize risk during greenfield projects and increase energy efficiency and plant output at their existing power generation facilities. The benefits of the ABB approach have led to some remarkable benefits.

In new power plants, ABB’s modular concept has typically resulted in a 20-percent reduction in delivery and installation times – a huge saving for such a large infrastructure project as a power plant. And for existing power generation facilities, ABB is achieving energy efficiency improvements of as much as 30 percent and significant increases in plant output.

**Reducing greenfield risk**

For greenfield power plant projects, ABB has developed solutions over the past 25 years which combine instrumenta-
tion, control and electrical systems in a turnkey package that enables the customer to transfer risk to ABB.

The control and electrical equipment is installed in standard-
ized, self contained modules that are pre-assembled and factory-tested, then shipped to meet the precise require-
mements of dynamic project schedules. To date, ABB has delivered more than 400 modules for power plants all over the world. The concept achieves significant reduction in project execution times, directly resulting in reduced project costs and improved resource leveling.

**Improving brownfield efficiency**

In addition to the measures related to new power plants, ABB has developed a concept that increase power output and improve plant efficiency by reducing parasitic load and systemic power losses.

Fossil-fueled power plants that are 20 years old or more can lose as much as 15 percent of their gross generation to on-site power consumption and to losses in the transformer yard and other parts of the electrical system.

ABB has a huge expertise and installed base in plant electrical and automation systems, a unique competence that enables ABB to provide efficiency improvements through-
out the plant and reduce on-site power losses by 10 to 30 percent.

These improvements typically yield increases in output of several percentage points.

**Reducing greenfield risk, improving brownfield efficiency**

ABB solutions are finely tuned to meet the diverse needs of new and existing power plants. They include integrated electrical and control system modules that reduce the time, cost and risk of greenfield projects; and energy efficiency improvements that bring huge reductions in parasitic power losses at brownfield plants.
Protecting the customer’s investment

System 800xA for Power Generation has a unique ability to integrate ABB and third-party control equipment into a new state-of-the-art automation system, thereby protecting the customer’s previous investments. Nuon’s showpiece coal gasification plant at Buggenum in the Netherlands is a case in point.

Migrating to System 800xA for Power Generation
For this technically advanced and strategically important site, Nuon decided to replace the existing operating and monitoring systems with a future-proof System 800xA Operations solution.

The Contronic E process control system will remain in service, since ABB can assure Nuon with adequate support in the coming years. This will avoid a lengthy and costly shutdown that would otherwise be needed to install and commission an entirely new control system.

Contronic E will be connected with the new System 800xA Operations system with the help of 15 gateway modules (CCO20). As a result, the lifecycle of the plant can be extended without changing the automation concept, and renewal of the control level can be implemented in steps.

The CE-K replacement will be performed during a scheduled overhaul in September 2010.

Improving operator performance
The new control room will consist of six highly ergonomic operator workplaces, two shift supervisor workplaces and a configuration and engineering area. It will be refurbished and equipped with state-of-the-art large-screen displays and two System 800xA Extended Operator Workplace solutions.

The existing ABB Power Generation Information Manager (PGIM) system will also be integrated with System 800xA. This will provide operators, maintenance staff and management with fast and direct access to relevant plant and process data, thereby facilitating correct decision-making and enabling the speedy analysis of process disturbances.

ABB will commission the new operating system – consisting of around 11,000 I/O signals – during a scheduled shutdown of 28 days.

The Willem-Alexander power plant is Nuon’s showcase power generation facility and the first in the world to gasify biomass as well as coal on a large scale—a process that has reduced plant CO₂ emissions by 22 percent or 300,000 tons a year.

The plant has a net generating capacity of 253 MW and consists of one gasification line, one gas turbine with a heat recovery steam generator, and one downstream steam turbine.

Commissioned in 1993, Buggenum is equipped with an ABB Contronic E automation system and Contronic E Communication (CE-K) operating system. Several ancillary systems and pilot plants have been subsequently integrated. A high-profile carbon capture plant is currently under construction at the site.
The plant was built in 1971 and was the first plant in Denmark to process hazardous and household waste and convert it into heat and electric power. Operated by Kommunekemi, the plant produces around 162,000 megawatt-hours (MWh) of heat for the municipality’s 31,000 inhabitants and generates about 60,000 MWh of electric power, which is sold on the open electricity market. The plant’s CO₂ displacement amounts to 55,000 tons a year.

The plant was previously equipped with an ABB Advant OSC control system, which was based on the UNIX platform and processed some 30,000 signals. Having worked with ABB for many years Kommunekemi naturally turned to ABB when they decided to upgrade the aging control room and install a new process automation system.

100-percent availability

“Our primary demands for the new system were ease of use, reliability and 100-percent availability – both during the replacement process and normal operation,” says Jørgen Pedersen, electrical engineer at Kommunekemi.

“We also wanted a state-of-the-art user interface and the advantages of a Windows-based platform that the UNIX-based system, although extremely steady, didn’t provide. By upgrading to System 800xA we obtain an openness and accessibility – with regard to both the processes and the report and historical data systems – that was previously not possible.”

During the upgrade it was possible to run the old and new automation systems in parallel in order to prevent interruptions to production – a key requirement for the customer when selecting ABB.

With three incineration lines and a processing capacity of 190,000 tons of waste a year, the Kommunekemi waste to energy plant in Denmark is considered one of the largest of its kind in Europe. Ease of use, reliability and 100-percent availability were the reasons for selecting ABB to upgrade the plant process automation system to System 800xA.
Turbine control retrofit at 2,040 MW power plant in the U.S.

ABB has completed the turbine control retrofit at unit 4 of the Four Corners power plant in New Mexico, one of the largest coal-fired generating stations in the United States.

The retrofit is the second that ABB has recently delivered to Arizona Public Service for the 2,040 MW power plant in New Mexico. It follows the successful completion of a similar turbine control retrofit for unit 5 in 2008. Both units have a generating capacity of 750 MW.

ABB’s scope of supply was comprehensive. For the main turbine it included a controls retrofit that encompassed replacing the steam turbine mechanical-hydraulic controls. The project required removing the original mechanical governors and retrofitting the ‘wet box’ actuator and interface to the steam valves, as well as providing a new overspeed trip system.

In addition to the traditional base speed and load control, the solution included an automatic turbine startup program and rotor stress monitoring system.

Auxiliary turbines
The auxiliary turbine scope included a retrofit for the low pressure pilot valve actuators. This type of retrofit requires replacing the low pressure pilot valves and actuators with high-pressure final element actuators. ABB also provided a new overspeed trip system for the auxiliary turbines.

In addition to the main and auxiliary turbine control system retrofits, ABB delivered a turbine vibration monitoring system for unit 4. The solution provides alarm, tripping, and historical vibration data for the main and auxiliary turbines, as well as for fans and motors.

Arizona Public Service, a long-standing customer of ABB, has benefited hugely from the precision control, reduced maintenance and ease of maintenance that the retrofits have made possible. Capabilities such as turbine roll on the main stop or control valves have also been immensely beneficial.
Integrated ICE solution for hydropower plant in Peru

ABB is supplying an integrated instrumentation, control and electrical (ICE) solution that will help double the capacity of an underground hydropower plant in a remote area of the Peruvian Andes.

The solution is part of a complete hydroelectric power generation package that ABB and strategic partner Harbin Electric Machinery of China are supplying to boost the capacity of the Machu Picchu hydropower plant in Peru.

ABB’s complete water-to-wire ICE solution includes all the instrumentation, control and electrical products and systems in the powerhouse as well as connection via a 138 kV gas insulated substation to the power grid.

ABB’s ability to supply the full scope of power plant ICE equipment and integrate the entire solution with a single interface brings numerous benefits to both EPC (engineering, procurement and construction) contractors and plant owners.

Those benefits include significantly reduced cabling and connections (made possible by a unique ABB fieldbus solution), faster project completion times, lower costs, reduced exposure to risk, and the elimination of complex multi-vendor interfaces and site activity.

The 100 MW turnkey solution will more than double the plant’s present generating capacity of 90 MW and benefit the region and the environment in a number of ways.

It will provide consumers with a reliable supply of electricity free from voltage fluctuations and power cuts, and will minimize the risk of landslides and flooding by regulating the flow of the Vilcanota river (the plant was buried by a landslide in 1998 and several casualties ensued).

ABB and Harbin Electric Machinery were awarded the contract by Peru-based EPC Grana y Montero. The end customer and power plant owner is the state-owned utility EGEMSA.

Doubling capacity

Located 1,800 meters above sea level in a remote area of the Andes mountains, the Machu Picchu hydropower plant provides local communities with vital electrical energy to power their homes, businesses, public utilities and infrastructure.
ABB wins EBoP orders in India

Over the past nine months, ABB has won orders worth more than $100 million to supply complete electrical balance of plant (EBoP) solutions for several power plants currently under construction in India.

The plants have a cumulative generation capacity of 3,080 MW and include the high-efficiency, low-emission 2 x 800 MW Krishnapatnam thermal power plant in the southern state of Andhra Pradesh – the first power plant in India to deploy supercritical technology on such a large scale.

Other plants for which ABB is supplying complete EBoP solutions include the 2 x 250 MW Chhabra coal-fired power plant in Rajasthan, the 2 x 135 MW Simhapuri Energy thermal power plant at Tamminapatnam in Andhra Pradesh, the 40 MW captive power plant at Chandrapur in Maharashtra, and the 30 MW bagasse-based cogeneration plant at Gangakhed, Maharashtra.

The solutions comprise several cutting-edge ABB technologies that optimize the plant electrical systems and improve system efficiency.

Extensive scope of supply
ABB’s scope of supply includes extra high voltage substations, generator transformers, station and unit
ABB has won an order to supply five System 800xA control systems for RWE npower’s new 2,000 MW Pembroke Power Station in Wales. Alstom is supplying each of the station’s five power blocks. ABB’s scope of supply includes five EGATROL and five TURBOTROL control systems for the gas and steam turbines as well as the plant control system, a PGIM information management system and equipment for the control room.

ABB has been selected by Italian-based Magaldi Power to supply a System 800xA-based solution to control the ash handling systems at the new 4x300 MW thermal power plant at Jaigad, India. The plant is owned by JSW Energy.

ABB has won an order from the Finnish power producer TVO to supply power solutions that will enhance reliability and ensure trouble-free and safe operations at the Olkiluoto 1 and 2 nuclear power plant units in Finland. ABB will replace the low voltage switchgear systems and supply a range of power products including MNS switchgear, high efficiency RESIBLOC distribution transformers and busbar systems. ABB is also responsible for dismantling the old equipment and for installing and commissioning the replacement solutions during scheduled annual maintenance outages.

ABB has won an order to upgrade the control system at Tata Power’s Jojobera thermal power plant in India. The solution will improve reliability of the turbine and boiler protection system, increase plant availability, and improve diagnostics and fault tracking. Significantly, it will protect the customer’s investment in the existing Procontrol P13 control system.

ABB has delivered the instrumentation, control and electrical system (ICE) for the new 13 MW hydro power plant located at the river Mubuku in Bugoye, in the southwestern part of Uganda. The plant was built and will be operated by TrönderEnergi of Norway and is the first privately financed hydro power plant opened for more than a decade in Uganda. The plant will provide clean and renewable energy for the country and was officially opened by President Museveni in a ceremony in October.

The benefits of the ABB solutions include design expertise, risk mitigation, high schedule impact, rapid installation and reduced commissioning time, which together enable resource leveling during project execution.

The orders reinforce ABB’s leading position in electrical balance of plant in India and expand ABB’s total installed base in EBoP to some 7,900 MW throughout the country.

auxiliary transformers, medium and low voltage switchgear, busducts, control and protection equipment, SCADA-based network management systems, as well as complete system engineering, installation, testing and commissioning and overall project management responsibilities.

“Our ability to deliver complete plant electrical solutions in a remarkably short time and with such high plant efficiency levels is indicative of our technology strength and execution capabilities” says Biplab Majumder, vice chairman and managing director, ABB India. “ABB’s power products and systems will ensure safe and reliable operation while optimizing the energy efficiency of the plants.”

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Sierra SunTower is the first installation of eSolar’s highly acclaimed modular and scalable concentrating solar power (CSP) technology, a concept that has won the admiration of California governor Arnold Schwarzenegger and the financial backing of Google and others.

The plant produces 5 megawatts (MW) of clean, renewable energy, displaces 7,000 tons of CO₂ emissions a year, and provides enough electricity to power 4,000 California households via a power purchase agreement with Southern California Edison.

ABB was brought into the project at an early stage by eSolar to develop an automation solution that works with eSolar’s heliostat field control system and modular receivers to harness the sunlight at the 20 acre site (8 hectares) in Southern California.

“We quickly realized that ABB possessed the elements to play a critical role in the development of our Sierra project,” says Bill Gross, chief executive officer of eSolar. “ABB’s contributions have already exceeded our expectations, both in design and implementation.”

ABB has developed a control solution for the thermal receivers and the balance of plant based on its award-winning and market-leading System 800xA for Power Generation.

The solution includes ABB’s Power Generation Information Manager and a remote diagnostic service capability that enables ABB to diagnose and correct 800xA-related issues by remote. The system is interfaced with the Woodward turbine control system to ensure smooth operation of the steam turbine generator and eSolar’s proprietary heliostat field control system.

Already the eSolar concept is taking off in a big way. The company has signed an agreement with NRG Energy to develop three CSP plants in California and New Mexico that will generate 429 MW of power using eSolar technology.

A licensing agreement has also been signed with the India-based ACME Group for approximately 1 GW of eSolar solar thermal capacity to be deployed over the next 10 years.
Prior to the evolution of its simulators, Ameren UE maintained both a fully stimulated and emulated simulator with a high fidelity model for five of its ten ABB-controlled coal-fired units in Missouri.

The fully stimulated simulators were utilized by each unit at its on-site training center, while the emulated version was used at the corporate training center. This made the already difficult maintenance of the fully stimulated simulators an even more difficult, resource-intensive task.

The simulator evolution process consisted of removing the existing simulator hardware, installing HTS Server computers, and reconfiguring the operator consoles to communicate with the virtual controllers. The hardware from the previous simulator was stocked for use as replacement parts for the actual control system.

Unlike most simulator upgrades, the high fidelity plant models could be reused simply by updating the vendor’s model interface, validating simulator operation and retaking snapshots. The ability to reuse the original simulator model provided a significant cost benefit and allowed AmerenUE to minimize the impact of the evolution on their training schedules.

AmerenUE’s final step, through special arrangements with ABB, was to create a virtual machine (a software implementation of a real computer) from each completed simulator for use at its corporate offices and new corporate training center.

**Benefits of the evolution**

As a result of the evolution, AmerenUE benefits from the following training and operational improvements:

- A realistic training environment that utilizes the actual control system configuration, operator console and graphic displays
- The ability to run multiple unit simulators concurrently and conduct multiple training courses during outages
- The flexibility to easily switch between unit simulators at the corporate training center
- A test bed that allows AmerenUE engineers to comply with a corporate policy that requires all logic changes to be tested before being deployed to running units
- Faster simulator startup time
- Significantly lower simulator lifecycle and maintenance costs through a unified environment
- Reduced hardware costs

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**What is virtual simulation?**

Virtual stimulation utilizes virtual controller hardware instead of actual plant controller hardware within the simulator. The virtual controls are created by ‘re-hosting’ the plant controller environment within the Microsoft Windows environment and executing the controller software on a simulation workstation.

In an HTS virtual stimulation-based simulator, the control configuration and graphics are identical to the actual distributed control system because it uses the same configuration files and operator console hardware as the actual DCS system. As a result, the HTS dramatically shrinks the simulator footprint, reduces simulator maintenance, provides a realistic training environment, and allows accurate analysis and troubleshooting of the system response.
Making fossil-fuel power plants energy efficient

ABB has published a comprehensive manual on how to improve energy efficiency, increase plant output and reduce CO₂ emissions at fossil-fuel power plants. Entitled *Energy Efficient Design of Auxiliary Systems in Fossil-Fuel Power Plants*, the 360-page manual is targeted at power generation employees tasked with improving energy efficiency. It is thought to be the first in-depth guide of its kind ever published.

With around 70 percent of the world’s power plants using coal, natural gas or oil to generate electric power, the handbook is a timely all-in-one reference book on how to achieve significant results in fuel consumption, plant output and CO₂ reductions in the auxiliary systems of the world’s most widely used type of power generation.

Auxiliary systems are a major part of a power plant and include all the drive power applications (pumps, fans, motors, drives), electrical balance of plant and instrumentation, control and optimization systems. Auxiliaries typically consume between 7 and 15 percent of the power generated by a fossil-fuel power plant.

The handbook examines each of these systems in detail, for both new and existing plants, and provides design and engineering guidelines to help improve energy efficiency in each part of the facility. Numerous case studies are provided throughout the manual, and an entire module is devoted to the cost and estimated return on investment of the various efficiency improving technologies.

“The handbook draws on ABB’s century-long achievements and huge installed base in the power generation industry,” says Franz-Josef Mengede, head of ABB’s global power generation business. “It offers a uniquely holistic approach to energy efficiency and plant productivity – an approach made possible by our leading position over many decades in power, instrumentation and control technologies.”

Written in a clear and explanatory style for technical and non-technical users, the manual will be of interest and value to power generation professionals at the operational, managerial and executive levels.

To obtain a free copy of the manual please contact your ABB account manager.
ABB has won an order from Rodax, a subsidiary of the energy, infrastructure and defense contractor, Metka, for a complete distributed control system for the 427 MW Aliveri gas-fired power plant on the island of Evia in eastern Greece.

Based on ABB’s automation platform, System 800xA for Power Generation, the solution includes ABB’s high integrity SIL3-rated safety and protection system. ABB is also responsible for design and engineering, programming, documentation, installation and commissioning, as well as seamless integration with the gas and steam turbine control systems, which ABB is supplying in a separate contract to the turbine manufacturer, Alstom.

Owned by the national utility, Public Power Corporation, Aliveri is part of PPC’s ongoing program to replace aging plants with high efficiency and low emission units. Scheduled for completion in 2010, Aliveri will be the largest gas-fired power plant in Greece.
**OPTIMAX® load scheduling optimization**

To determine their optimal bidding and operational strategy in energy markets, utilities need decision-support tools that take into account existing constraints like capacity, emissions, plant lifetime, etc. This is known as load scheduling optimization or unit commitment. These solutions can now be implemented using the Dynamic Optimizer tool in the OPTIMAX® product suite. The solutions determine the optimal economic balance between generated and purchased power and heat (or water) to satisfy the load demands made by customers.