Integrated Process and Power Automation
Electrical Integration with System 800xA
What is Electrical Integration?

A reliable and dependable energy supply is vital for the functioning of any industry. Monitoring and controlling the power is just as important as monitoring and controlling any other significant process automation parameter. But in reality the two are worlds apart – separated by a lack of common communication and architectural standards as well as organizational differences between departments.

Traditionally, the systems that serve process automation and power automation within the same plant are separate, with the interfacing protection and control IEDs (Intelligent Electronic Devices) coupled by hard-wiring or serial interfaces. Due to extensive cabling and a large number of available protocols, the bandwidth and cost efficiency of this approach is very limited, and could result in solutions having to be implemented on a project-by-project or even device-by-device basis. Furthermore, multiple systems means multiple databases, additional engineering tools, different operator stations, and more system administration and maintenance.

Today, this barrier is a reality for many industrial and power generation plants. It’s a costly barrier. Electrical integration eliminates this costly barrier.

Integrate and integrate now

Electrical integration means integrating process automation and power automation into the same plant control system. This creates a single automation environment that unifies the control of process-related equipment as well as protection, control and monitoring of substation equipment and power transmission and distribution. Integrating the process automation system with the power automation system permits a single strategy in the areas of engineering, operations and maintenance. Whether you generate power or consume it, the economic benefits of electrical integration can run into millions of dollars gained in increased production or saved in reduced operating costs.

Electrical integration has been possible previously, but it was fraught with difficulties. That’s not the case today. There’s never been a better time to integrate. And with ABB’s award-winning System 800xA, there’s never been a better way.
Full plant integration with System 800xA
Using System 800xA’s complete integration capabilities for all process and power automation areas such as process instrumentation, process electrification, substation automation and power management, ABB enables true full-plant integration. Process automation and power automation use the same system architecture, therefore eliminating the need for a dedicated system for power automation. This means just one single system to engineer, operate and maintain.

Electrical integration based on open standards
System 800xA fully supports the IEC 61850 standard for integration of the power automation area providing electrical integration based on an open and global standard.

First released in 2004, IEC 61850 is acknowledged as the global communication standard in substation automation, representing a huge step forward in simplifying the integration of protection and control IEDs.

With its standardized model of the IED and its data and communication services, IEC 61850 ensures interoperability between electrical devices from different vendors and is able to replace all the typical protocols found in the substation automation domain. Based on Ethernet technology and providing a flexible and open system architecture, IEC 61850 makes the application future-proof over entire system lifecycles.

IEC 61850 complements System 800xA’s capability of using open standards to integrate fieldbus devices within process automation. For process electrification devices such as low voltage switchgear, variable speed drives and motor controllers, System 800xA supports open fieldbus standards such as Profibus and Profinet. For process instrumentation, System 800xA has extensive integration with HART, Profibus and Foundation Fieldbus.

Complete portfolio from ABB
ABB supplies all you need to complete a successful electrical integration project wherever you are planning to do it.

With our award-winning System 800xA, found in all types of industrial process automation, we are recognized as No.1 in the Distributed Control Systems market. We are also the market leader in substation automation products, including Relion® protection and control IEDs designed for IEC 61850. We enjoy a similar reputation for process electrification products, including intelligent low-voltage switchgear, variable speed drives and motor controllers.

Finally, ABB has full project execution capabilities within process and power automation for all industries worldwide, plus a wide range of system and product services for operations and maintenance. Our total experience is at your disposal.

Lower your life-cycle cost by choosing a future-proof standard from ABB – the world’s leading supplier of equipment for both process and power automation.
When two worlds become one, dramatic events occur

Investment costs diminish
Using System 800xA for full plant integration and eliminating the need for multiple systems reduces the system footprint and cost of ownership of your plant. Duplication of equipment such as servers, workstations and spare parts is no longer needed. In addition, using Ethernet based electrical integration significantly reduces wiring costs.

Operators collaborate for greater efficiency
In traditional multiple-system plants, operators make critical decisions in silos. They often only have a limited view of the plant, with their knowledge and skill set restricted to just one area – their own system environment, database, and limited Sequence-of-Events (SoE) and alarm lists.

Adopting IEC 61850 technology together with System 800xA also permits standardization of various procedures in substation configuration, control logic, control libraries and operation procedures. The object orientation of IEC 61850 enables standardized device models, supported by System 800xA through its IEC 61850 compatibility.

Comprehensive worldwide project execution capabilities within process and power automation is a key ABB strength. We are the world-leader in power products and the No. 1 DCS supplier, with more than 800 substation automation projects based on IEC 61850 and over 5,500 distributed control systems sold. We can act as both Main Electrical Contractor (MEC) and Main Automation Contractor (MAC). Exercising full control over system design eliminates the risk of multiple supplier-initiated changes. This streamlines project management by minimizing time consuming coordination and uncertainty.

Contrast this limited vision with one of full electrical integration. Both process and power group operators enjoy total plant visualization. They share information and collaborate as never before. Their capabilities expand beyond traditional roles and functions. Operators can now have full insight into the effects that power automation systems have on the process control areas and vice versa.

Having a consistent operating philosophy reduces risk of error, saves money and increases uptime throughout the plant. Trouble-shooting and error analysis is easier and faster. No longer will process operators and power engineers need to manually match unsynchronized event lists from multiple systems. One integrated operator environment instead of two separate also saves on training, control room space, personnel and administration.

With electrical integration from ABB, you can eliminate hard-wired communication and complex software gateways with an Ethernet-based IEC 61850 communications solution.

Photo: courtesy of OMICRON electronics
Maintenance strategies are optimized
Electrical integration extends the typical scope for asset management tools from just instrumentation into electrical power generation and distribution as well. The resulting architecture provides operators and maintenance personnel with current process information plus all relevant electrical asset information. This includes remote access to all equipment diagnostics from the same maintenance workplace.

With System 800xA's integrated Asset Optimization solution, maintenance engineers, process control operators and power engineers enjoy actionable data that they can proactively use to predict equipment failure and prevent plant upsets. For example, if a circuit breaker is taking too long to open, then an alert is automatically generated and sent to the appropriate person for action. With an integrated CMMS (Computerized Maintenance Management System), a work order is generated streamlining the maintenance workflow up to 25% by reducing paperwork and administration effort. Predicting a problem before it occurs is the best maintenance strategy.

Millions of dollars in savings
The true power of electrical integration is measured in real, across-the-board economic gains. For industries whose well-being depends on them producing around the clock such as oil and gas and power generation plants, 24/7 availability and reliable electrical supply are paramount. For more price-sensitive sectors like pulp & paper, managing electricity as a raw material cost with peak-shaving takes precedence.

Increase plant availability with power management
The main objective of a Power Management System is to avoid blackouts in industrial plants, especially those with in-house generation, critical loads or insufficient supply from the electrical grid. ABB is the world-leader in power management, and has delivered Power Management Systems based on System 800xA technology all around the world. Applying IEC 61850 together with System 800xA based Power Management Systems enhances the solution even further. One critical functionality of a power management system is load-shedding; keeping critical loads running should incoming power be lost. Non-critical loads are shed to keep critical parts of the plant running.

Load-shedding applications are now easier to design and can have an even faster response time compared to hard-wired solutions. Using IEC 61850 together with System 800xA, the AC 800M controller functions as an IED, allowing it to communicate horizontally with other IEDs via IEC 61850 high-speed GOOSE (Generic Object Orientated Substation Event) messaging. With GOOSE, load-shedding can be implemented using an Ethernet-based solution, which means faster trips, monitoring of trip data quality and reconfiguration of trip logic without re-wiring. By using IEC 61850 GOOSE in the AC 800M controller, you can respond more quickly to power glitches, resulting in an increase in plant uptime by preventing blackouts.

Optimize energy use
With access to all critical electrical data, cost-sensitive producers can reduce their total consumption of electrical power significantly. An integrated system enables plant operators to see and understand power usage in a more coordinated manner, allowing new energy-saving opportunities to be explored and existing reduction programs to be enhanced. An increase in power consumption by a unit or area due to equipment malfunction and wear can quickly be remedied. Better visibility into power consumption and real-time energy usage and cost allows for easier energy audits and benchmarking.

Process graphics and single-line diagrams familiar to the process control engineer and power engineer in an integrated operator environment with common SoE and alarm lists.
The standardized way
Much of today’s substation automation communication is still hard-wired. Even the introduction of serial communication protocols hasn’t helped much, since most of them are incompatible with each other. The IEC 61850 standard was introduced as a global standard to meet the needs of the substation automation community for interoperability between devices, an open and flexible architecture, and a future-proof solution based on state-of-the-art communication technology. ABB’s System 800xA was the first DCS to support the IEC 61850 standard, thus enabling seamless integration of substation equipment.

IEC 61850 uses mainstream communication technology MMS (Manufacturing Message Specification) over Ethernet. This standard specifies two main types of communication; vertical communication between the control system and the IEDs, and horizontal communication from IED to IED. Vertical communication utilizes the full MMS stack and is intended for the vast amount of data shared between the control system and the IEDs. Horizontal communication, using the special GOOSE messaging, is intended for high-priority data to be shared between the IEDs, replacing the traditionally hard-wired signals. System 800xA can integrate IEDs both with vertical and horizontal integration.
**Vertical communication using MMS**

Vertical integration is implemented via an IEC 61850 OPC server transferring MMS data from the IEDs to System 800xA in the form of regular OPC data items. This gives System 800xA direct access to all selected IED data such as current and voltage measurements as well as time-stamped alarms and events. It can also send open and close commands to circuit breakers or other switchgear via the IEDs. All System 800xA display capabilities like freely-configurable graphics, faceplates and historian capabilities, are available. Furthermore, IED parameterization and reading of IED condition monitoring can be done from System 800xA, as well as upload of disturbance record files for error analysis.

**Horizontal communication using GOOSE**

Horizontal integration is implemented by simply equipping System 800xA’s AC 800M controller with an IEC 61850 interface board. This then communicates with all other IEDs on the same IEC 61850 network in real-time using GOOSE communication. GOOSE ensures fast, time-critical data transfer and can therefore communicate critical status and maintenance information between the AC 800M and the IEDs such as load-shedding during a power outage, interlocking or even analog values.

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**What is IEC 61850?**

IEC 61850 is an Ethernet-based global standard for communications and system architecture in substation automation and power distribution systems. It is a standard defined by the common work of both ANSI (N. America) and IEC (Europe) together with the main vendors in the substation automation market such as ABB.

IEC 61850 has a standard data modeling and naming convention of the IEDs, and a common language to configure the devices, providing interoperability between devices as well as engineering tools. The standard has a flexible and open architecture, enabling freedom in configuration of the IEDs according to the application needs.

Furthermore, as IEC 61850 is able to follow changes in communication technologies, the standard can be considered future-proof.

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ABB has won orders for integrated process and power automation solutions with IEC 61850 from all around the world.

Energy giant E.ON is converting its electrical and control system into a common system based on IEC 61850 at several hydropower plants.
Secure process control plus significant energy savings
Any processing industry that calls itself heavy bristles with a wide array of LV and MV equipment. In power generation, drives and soft-starters are used in almost all applications. The metals industry relies on heavy fans for its blast furnaces and drives and motors for its rolling mills. Paper and pulp needs pumps and compressors, and water treatment and supply needs pumps as well. Furthermore, a typical plant in each of these sectors probably has hundreds of such ‘work-horses’.

Intelligent motor starting, control and protection is a must if operators in heavy industrial segments are to stay competitive. Their common aim is to secure power distribution at the same time as they reduce energy costs and greenhouse gas emissions.

The pre-requisites are all in place. ABB’s portfolio of electrification products and services is complete. System 800xA’s interface to process electrification provides intelligent motor control plus high-integrity automation with wide-ranging operator benefits.

Protection and control IEDs for complete confidence
The Relion® product family offers a wide range of products for protection, control, measurement and supervision of power systems. To ensure interoperable and future-proof solutions, Relion products have been designed to implement the core values of the IEC 61850 standard. IEC 61850 provides considerable advantages such as ultrafast GOOSE messaging between system IEDs, to enable savings in system engineering plus unprecedented flexibility.

With ABB’s leading-edge technology, global application knowledge and experienced support network, you can be completely confident that your system performs reliably – in any situation.

Integrated low voltage switchgear applications
MNS iS is our integrated low-voltage switchgear system configurable for end-user specifications, from conventional to sophisticated. MNS iS integration in System 800xA is focused on providing pertinent information to relevant operators at the right time. This enables proactive actions and appropriate decisions for higher process availability.
Environmental concerns driving motor integration

Social trends and environmental concerns are making a big impact on the way we integrate motors, drives and switchgear today. For example, greater accuracy in controlling process speed improve product yield and quality. Also, better speed control minimizes mechanical wear and the risk of network dips due to too high loads during start-up. Both improve plant availability.

Energy consumption can be cut by as much as 60% by using variable speed drives on pumps instead of crude throttling (about two-thirds of industry’s electricity use is consumed by electric motors).

And as the electricity used to drive motors produces an estimated 37 million metric tons of CO₂ annually and 8 percent of the greenhouse gases, such energy saving is without doubt the quickest, most effective and most cost-efficient way of reducing greenhouse gas emissions and improving air quality.
Petrobras secures production and cuts costs

Energy giant integrates process control and power management using System 800xA and IEC 61850

Of the twelve Petrobras-owned refineries on Brazilian soil, ABB has installed its Power Management System in nine of them and Process Automation System (PAS) in seven. Three years ago, Petrobras decided to add new production units and modernize others. In February 2008, it signed a 61 million USD Frame Agreement with ABB.

Petrobras seeks to integrate its Power Management System and PAS so that functionality and data can be shared and operational visibility improved. At the same time, the company is looking for better performance and reliability, streamlined maintenance and, of course, cost savings.

Total integration of Power Management System and PAS in one unified environment

The REPAR refinery is one of Petrobras’ most important downstream production units. At this refinery, a new power generation facility expansion project with twelve new substations and eight modernized will triple the energy available from 26 MW to 76 MW. Petrobras implemented ABB’s System 800xA with IEC 61850 integration at all substations as the first of nine installations outlined in the Frame Agreement.

In concrete terms, Petrobras now has a single tool set for engineering and device integration. Reusing engineering data cuts the man-hours needed by 30%. Critical data are shared via Ethernet instead of hundreds of hard-wired signal cables. A much simpler system design means a 25-30% reduction in project execution, testing, and commissioning. Finally, Petrobras is beginning to realize lower life-cycle costs. Training costs have been reduced by 20%, for example.
E.ON simplifies operations, standardizes engineering and saves money

Process automation and substation automation integrated with System 800xA via IEC61850

The Ljungan River in Sweden is 350 kilometers long originating near the Norwegian border and opening into the Baltic Sea. It is Sweden’s eighth largest source of hydroelectric power. International energy company E.ON operates five hydropower plants on the Ljungan River. At Flåsjö, a 20 MW plant, the control system needed a total revamp.

ABB delivered both the process automation and the substation automation systems by integrating them into a single System 800xA. Electrical equipment included redundant REG670 generator protection and one REL670 for line protection of the outgoing substation. All devices were from ABB’s Relion protection and control IED family. For process control, System 800xA utilized the AC 800M controller. Integration to substation electrical devices was accomplished with IEC 61850. Profibus DP was used to connect to the S800 I/O, excitation, turbine unit and vibration monitoring. The installation was completed in 2009.

Saves money throughout the plant’s life-cycle

E.ON gained a single, integrated system with a unified user interface and a standard connection to a Remote Control Center, from where the plant is operated. All communication between plant and control center 260 km away now goes via satellite. Gathering plant information and measurements via IEC 61850 and presenting this for operators is now far quicker and simpler.

As installation time was significantly reduced, the delivered solution proved to be highly cost effective. And with a far simpler system to maintain, E.ON will continue to save money throughout its life-cycle. This focus on standardizing how to engineer the automation of hydropower plants will be the key to lower costs for E.ON’s future modernization projects.

The scheme is impressive. E.ON has a 5-year plan to invest 6 billion Swedish crowns in renewing its hydropower plants. This will entail a production increase of about 130 GWh.

International energy company E.ON optimized its Flåsjö hydropower plant with System 800xA and the IEC 61850 standard.

“We have asked suppliers for IEC 61850-integration for years, and now ABB was able to deliver”, says Assar Svensson at E.ON.