

Electrical Integration with System 800xA

E.ON's hydropower plant in Flåsjö is a world pioneer – control of process and power in the same system using IEC 61850



The river Ljungan flows through the border region shared by Sweden and Norway. The 350 kilometer river's first upstream hydropower plant is E.ON's plant in Flåsjö. There, in the middle of the Jämtland forest district, a breakthrough in the field of automation has recently been made. The Flåsjö hydropower plant is the first in the world to have the power automation system integrated in the same System 800xA, which handles process automation, by taking advantage of the IEC 61850 standard.

The technology is not just reserved for power plants. Regardless of industry, System 800xA can now be used to integrate power automation systems into the same systems that handle the process automation. This enables improved monitoring capabilities, higher availability and simplified engineering.

Flåsjö is an unmanned hydropower plant that is controlled and monitored by E.ON's control center in Sundsvall. Process control and the electrical control system have previously been handled separately. When it was decided to replace the hydropower plant's electrical and control systems at the beginning of 2009, it was natural to create a common system based on the new global standard IEC 61850. ABB's ability to provide a solution that corresponded to the set requirements was also a consideration.

"IEC 61850 is something we've included in our requirement specifications since 2005, but no one has previously been able to tender such a system. When ABB gave us the opportunity, we couldn't say no," says Assar Svensson, responsible for technology related to control and monitoring systems at E.ON Vattenkraft (the company's hydropower division).

System 800xA is the first process control system to support the new IEC 61850 communications standard. The combination of ABB's protection and control products from the Relion® family and System 800xA process control system was the key to the order. The Relion family's IEDs (Intelligent Electronic Devices) are designed for IEC 61850 and can communicate with other IEDs and systems adapted to the standard. The Relion family also has full support for communications via GOOSE (Generic Object Oriented Substation Event), which replaces the traditional hardwired solutions for horizontal communications between IEDs. GOOSE is also supported by ABB's AC 800M controller and enables interoperability between IEDs and the process control system.

This means that E.ON's 800xA system, which among other things handles turbine control and vibration monitoring, now also has access to data from the substation, including but not limited to, measurements of power, reactive power, voltage and current, as well as indications and operations. This provides a uniform method of configuring, controlling and maintaining the entire system from a common interface – from one operator station.

"ABB has done a very good job. It's impressive that they managed to do it in the short time that was available – less than six months."

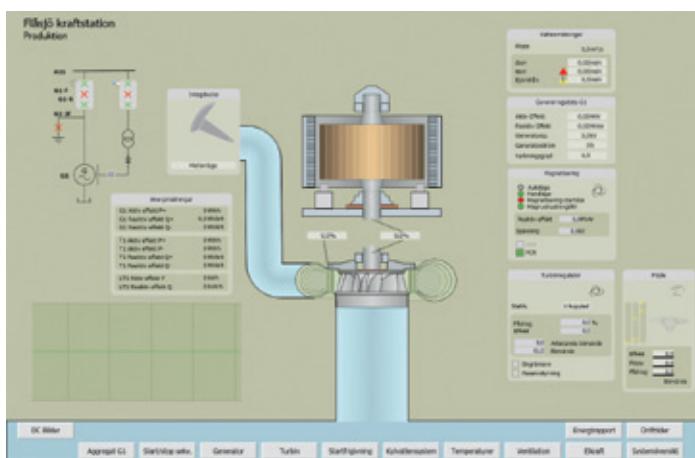
A very good job

Installation began in Flåsjö in April, 2009. The plant went back into service on October 17, 2009 after a stop of just eight weeks. The hydropower plant has just one unit and it is therefore important to keep downtime to a bare minimum.

"ABB has done a very good job. I'm especially impressed with how well they managed the short amount of available time. Less than six months from signing of the contract to initial operation is very quick," says Tomas Kristoffersson, site manager for three of E.ON's total of five hydropower plants on the river Ljungan.

In the spring of 2010, ABB began a similar installation at another of E.ON's hydropower plants on the Ljungan River.

According to E.ON site manager Tomas Kristoffersson ABB has done a very good job in a short time.



"We're now moving forward with the power plant at Trångfors, where in the same way, we'll be converting the electrical and control system into a common system based on IEC 61850. This plant is similar to Flåsjö and was built at the same time. After this, both projects will be carefully evaluated."

Standard creates structure

The reason E.ON is putting such strong emphasis on these pilot projects is that the upgrade of the power and process control systems at the hydropower plants on the Ljungan River are included in ongoing renewal of E.ON's hydropower plants. A large portion of the power and process control systems will be replaced during coming years. Up to 2015, E.ON is investing 6 billion Swedish crowns in renewal of hydropower plants.

"With the installation in Flåsjö, we have hopefully just opened the door to the future," says Assar Svensson, responsible for technology related to control and monitoring systems at E.ON Vattenkraft Sverige AB.



"This is an extensive conversion job we have ahead of us. We're therefore looking for standardized solutions in accordance with IEC 61850. Thus far, it only concerns relay protection," says Assar Svensson, who worked with technology assessment and plant design for the power plant in Flåsjö, and who is now involved in the majority of E.ON Vattenkraft's upgrades and modernizations.

For E.ON, IEC 61850 will provide new opportunities to increase availability and simplify engineering. Several standardized components provide the capability to build plants in a more structured manner.

"We'll therefore continue to ask for IEC 61850 in our tender requests. We want, for example, to be able to receive deliveries in which all components can be tested together prior to initiating operations."

Another important reason for a more standardized structure for the control systems is that all E.ON Vattenkraft facilities in Sweden are controlled from a single control center.

"When controlling so many power plants from one location, it's very important that there is a standard on which everything is based."

Obvious advantages

There are already obvious advantages demonstrated by ABB's installation in Flåsjö. Besides enhanced information about the entire plant that the operators can now access, service work can be shifted from troubleshooting to more preventive maintenance. The system itself can indicate when a component needs service or replacement. For example, it is much simpler and faster to replace a transmitter when all parameters are stored in a database, thus eliminating all manually made settings.

"Moreover, installation work goes faster since significantly less wiring is required. Reduced cabling also means that sources of faults in a plant are reduced. Another plus is that the fire-load density decreases."

Assar Svensson adds:

"I now have major expectations regarding our supplier's ability to give us additional capabilities to standardize and simplify construction of electrical and control systems for hydropower plants. With the installation in Flåsjö, we have hopefully just opened the door to the future."

"We also have major expectations regarding ABB fully utilizing the capabilities that IEC 61850 offers, so that it is not just used as another new communications protocol."

This is the control center in Sundsvall from which all of E.ON's hydropower plants in Sweden are controlled and monitored.



About E.ON

Upstream, Flåsjö is the first of E.ON's hydropower plants on the 350-kilometer-long Ljungan River. The Ljungan runs to the northeast of Helagsfjället and flows out into the Gulf of Bothnia just south of Sundsvall.

The power plant was built in 1975 and has a maximum head of water of 46 meters and flow through the turbine of 60 m³ per second. About 73 GWh are produced here with an installed capacity of 24 MW. The plant is unmanned, and controlled and monitored from E.ON Vattenkraft's control center in Sundsvall. Communications between the power plant in Flåsjö and the control center in Sundsvall are via satellite transmission.

E.ON Vattenkraft, a subsidiary of E.ON Sverige, is the third-largest hydroelectric power producer in Sweden. In a typical year, E.ON Vattenkraft produces about 8 TWh at 77 hydro-power plants, from Kristianstad in the south to Lycksele in the north. In the years leading up to 2015, E.ON plans to invest 6 billion Swedish crowns in renewal of the hydroelectric power plants. Among other things, this will entail an increase of production of about 130 GWh.

E.ON Sverige is owned by E.ON, the world's largest privately owned energy company with 90,000 employees.

The AC 800M controller communicates with all process and power related equipment, with IEDs using IEC 61850 GOOSE.



ABB's supply

The delivery to the Flåsjö hydropower plant includes the following:

- System 800xA with an AC 800M controller and operator station
- Relay protection REG670, REL670, COMBIFLEX relays and the COMBITEST test system
- MNS low voltage switchgear

The most important tasks for process control are turbine control, vibration monitoring and excitation. Electrification of the process and control of peripheral equipment and pumps are conducted via PROFIBUS communications with the MNS low voltage switchgear from ABB.

For the electrical control system, the IEDs are the most important components in the plant. They protect, control and monitor the generator and the outgoing high voltage line from the transformer station.

The IEC 61850-compatible ABB Relion IEDs are integrated with System 800xA, where two redundant REG670 IEDs are used for generator protection and an REL670 for protection of the outgoing 130-kV grid line. All IEDs are integrated with AC 800M controller through IEC 61850 GOOSE. This enables the AC 800M controller to not just control the process but also serve as an IED in the IEC 61850 network, where it can communicate both with electrical components and with the control center.

The measurement values for power, reactive power, voltage and current, as well as for breakers and disconnectors, are examples of important data from the IEDs. These data are visualized in the local operator station for System 800xA and are also transferred to the control center in Sundsvall, from which the system is normally monitored and controlled. Alarms and other events from the combined monitoring system for process and power provide the operators in Sundsvall with valuable information about the entire plant.

From the control center in Sundsvall, all E.ON hydroelectric plants in Sweden are monitored using ABB Network Manager, which is an important aide in controlling and optimizing energy production to match current market needs. Via this system, the 800xA system in the hydropower plant in Flåsjö can even be remotely connected, which allows redundant connection to the control system.

In Flåsjö, the protection and control IEDs are entirely integrated with the AC 800M controller using IEC 61850.



The outgoing high voltage grid line from Flåsjö is protected by REL670 relay protection.



Each second, 60 cubic meters of water pass through Flåsjö's turbine.

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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