Generating efficiency

Modern hydropower control optimizing generation management: A case study from Sweden

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Like other power suppliers, hydropower companies are adapting to deregulation. They are meeting this challenge through investment and new working approaches. This article outlines how one Swedish company, Sydkraft Vattenkraft AB, is achieving the transition with the help of automation tools from ABB.

ABB supplies IT-based systems for generation management to the power industry throughout the world. These systems use the latest technology to simplify operations and maintenance through efficiency and rationalization. The approach involves both the supervisory and local levels, ie, control-center and power station, and affects planning, operations and reporting.

Many hydro power plants were built during the sixties and seventies and now require modernization. The short life cycle of electronics often makes it difficult to source spares. New environmental demands also drive modernization.

ABB has developed a modern supervision and control technology for hydropower plants. It is used to modernize existing installations but also for new plants. This article shows how these concepts were applied by Sydkraft Vattenkraft through the example of their Volgsjöfors plant.

Sydkraft Vattenkraft has defined a new working organization and new operating functions for personnel. These include:

- *Production engineer* – focuses on fulfilling short-term (weekly horizon) generation demands. This position is manned 24 hours a day and comprises production planning and optimization activities.
- *Plant engineer* – focuses on the technical status of hydro stations to keep them operating efficiently. This person must plan pro-actively to avoid unplanned downtime and is also responsible for control and optimization.
- *Hydro planner* – works to optimize water usage over a time horizon of one month.
- *Maintenance* – all power stations are unmanned. An external contractor performs maintenance in coordination with the plant engineer.

Set of applications

Advanced applications are installed according to requirements and preparedness of users to take advantage of new benefits. Normally one set is taken into operation at the initial system implementation and new or upgraded applications added as these are released. These are often accompanied by support and service agreements.

Supervisory applications

Production Optimization is the functional module that handles interactive and automatic optimization of power as well as energy production based on cost characteristics and availability of units. It also provides hydro simulation to model water flow through dams, rivers, gates etc. The optimization creates a production plan and flow propagation for the next 48 hours with a minute resolution for each unit. It can also consider balance control commitments for the area in question.

To predict unregulated inflow into the system, which would affect the subsequent water flow, an inflow-forecasting module is provided. This draws on weather measurements, precipitation statistics etc.

Production control may be performed manually or by automatic execution of minute-by-minute control sequences derived from the 48-hour production plan. Each unit-sequence individually models start and stop characteristics of local control equipment of the 130 units – which are of different ages and manufacture. The function automatically starts and stops the unit, opens and closes the gate etc., considering start, stop as well as ramping times – relieving operators of repetitive work sequences. The operators interact via customized displays where, eg, alterations to the operation plans are entered and the reaching of limits is announced.

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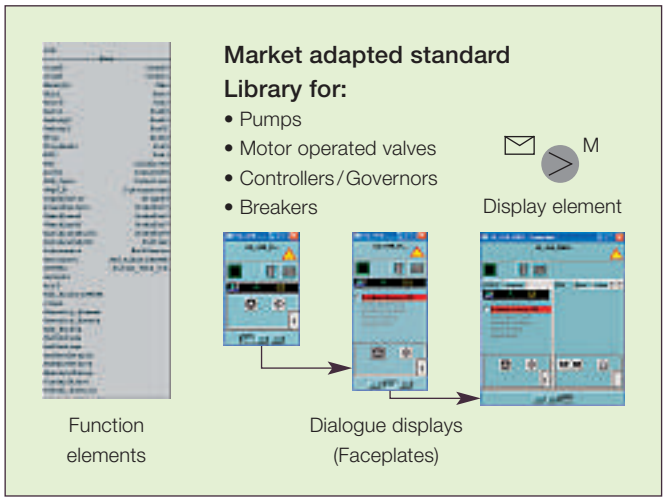
Generation monitoring is the real-time acquisition and monitoring of all data from generating stations - the so-called SCADA (Supervisory Control And Data Acquisition) functions. The monitoring is performed with specified limits to detect status changes. Data is stored for operational as well as long-term statistical analysis.

Sensitivity monitoring detects that a deviation between real and planned operation has occurred and automatically notifies the operator.

Numerous real-time calculations are performed on the acquired data. These calculations range from straightforward calculations of water flow in turbines to complex calculations of, eg, regulation strength for a balance area.

1 ABB supplies a library of standard elements for hydropower plant objects.



Local control applications

ABB provides a library of standard elements for local supervision and for different hydropower plant object and controller types – specifically for the 800xA platform. These standard elements have been developed in consultation with operating and maintenance personnel. The library covers all functions, such as object control, display navigation, authority system, alarm and event handling 1.

By using tested standard elements, the design process is simplified and safety, confidence and quality raised. Ele-

Sydkraft Vattenkraft

Sydkraft Vattenkraft is a subsidiary company of Sydkraft AB, part of the E.On group. The company is responsible for all hydro resources within Sydkraft, Sweden. Hydro generation represents 30 percent of the company's total electricity production. 130 power stations, located in two geographic areas (in the South and in the North of Sweden), have an installed capacity of 2500 MW with a yearly production of 11 TWh.

ments are made up of boxes with predefined inputs and outputs and handle all object logic such as indication, fault handling, start counting, etc. The programmer must only implement the external logic for the process.

The operator is also supported by many functions. When an object, such as a pump or valve does not respond as expected, a representation of the faceplate can be opened on the operator's workstation and the logic inspected. A status list enables signals/objects to be found according to search criteria; for example, all objects that are in manual mode. Operators can also inform the next shift of any special actions taken by attaching messages to objects.

2	Network Manager installation for Sydkraft Vattenkraft.

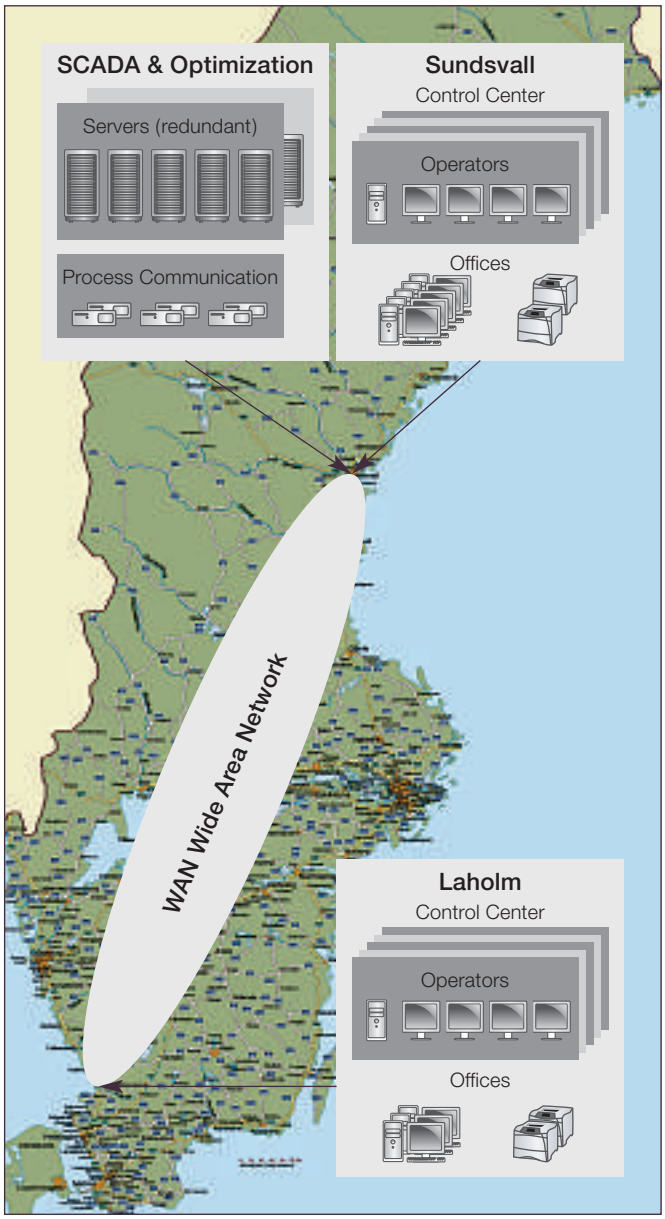


ABB solution

IT-system for supervisory planning and operation

ABB is supporting Sydkraft Vattenkraft with an integrated planning and operation system for hydropower generation based on Network Manager™.

Operational activities (scheduling, monitoring and control) are performed from two separate control centres; in Laholm (in the South of Sweden) and Sundsvall (in the North). The system comprises 9 workstations, with a total of 34 VDUs. The 12 application servers are built on modern client-server structures. A redundant configuration assures high availability 2.

Solution for hydro power plants

ABB's 800xA, Extended Automation platform is used for modernizing hydro power plants. Sydkraft´s Volsjöfors hydropower plant (see title picture) has two units, each with a generating capacity of 11 MW. The automation configuration is typical for medium sized plants.

The turbine governor is based on ABB's long tradition of governor products and implemented in the 800xA control system. A new hydropower governor library has been developed using the advantage of PLC (Programmable Logic Controller) flexibility for custom functions. The governor can run as a conventional stand-alone turbine governor or as a combined unit controller and a turbine governor in a redundant or single controller.

Summary of benefits

The new optimization and SCADA system for supervisory as well as local hydropower control provide significant economical savings through an optimal and efficient day-to-day operation of complete hydro production resources. The optimum operation will result in better use of water and reduced downtime. The automated control ensures stations operate according to plan.

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