Project Report

Peak Demand Supply – Environment-friendly Pump Storage Power Plant Kaprun, Austria

Successful modernization of control technology at the pump storage power plant in Kaprun, Austria

The provision of electrical energy to match demand is of primary importance to the industrialized world. Storage power stations such as the Glockner-Kaprun power station in the Austrian Alps use the energy of water stored in storage lakes to generate valuable power. They cover peak demand yet do not produce any emissions. The automation technology of the “Kaprun Oberstufe” power plant has now been completely renewed by ABB as a second step after the retrofit of the “Kaprun Hauptstufe”. This has given the Austrian “Verbund- Konzern”, the plant operating company, considerable advantages: the turbines come on load more quickly, the generators synchronize to the network in less time and the entire plant is easier to operate and monitor.

One of the most important production factors of our economy is the availability of electrical energy. A secure and reliable supply of electricity makes a crucial contribution to the ability of a business location or country to compete. For power plant operators this means that they must be able to connect the peak-load power stations quickly and flexibly to the base load and all that at competitive prices. This pressure is steadily increasing through the interconnected network of European grids.

Peak Performance on Demand

The Glockner-Kaprun group of power plants is part of Austrian Hydro Power AG, which in turn is part of Verbund-Konzern, the largest power generation and distribution company in Austria. With its 123 hydro power stations along the major rivers and the storage power plants in the Alps, this Group generates more than half the power required in Austria and distributes four-fifths of electricity in the Austrian highvoltage power system.

Two storage power plants, the “Kaprun Oberstufe” and the “Kaprun Hauptstufe” together with the associated storage lakes, form the Glockner-Kaprun group of storage power stations. Dr. Karl Wimmer, head of the Glockner-Kaprun group explains: „In order to cover peak demand for electrical energy, we can start up the turbines in our storage power stations rapidly. These then synchronize to the net within a few minutes. Our power stations provide a valuable, environmentally friendly source of electricity, both for the base load and for peak demand. Thanks to extensive modernization of the control technology and turbine synchronization in the Kaprun Hauptstufe power station, we can now respond even more quickly and efficiently to short-term changes in the demand for energy in both Austria and Europe.“

Two-staged Concept

The design is based on three storage lakes and two peak-demand power stations. The Margaritze and Moserboden storage lakes are at an altitude of 2,000 meters and are interconnected by an underground duct.
They store water from a 160 km2 area. The altitude of the third lake – Wasserfallboden – is 360 meters lower. Water from the two lakes at the higher level passes through the turbines of the Kaprun Oberstufe power station before it flows into the Wasserfallboden lake.
At times when the demand for energy is low and therefore energy prices are also low, water from the Wasserfallboden may be pumped back into the higher Moserboden, allowing it to be used several times to generate valuable peak demand electricity.

The core of the power station group is the Kaprun Hauptstufe, which is located 860 meters below the Wasserfallboden lake. The water flows along a seven kilometer long horizontal route to pass into a 1500 meter long pressure pipe, before it runs directly down to the turbines. The pressure pipe runs in a pressure shaft which, with a down gradient of 45 degrees, is the steepest pressure shaft in the world that has ever been produced by milling operations.
The Kaprun Oberstufe and Hauptstufe power stations together use two million cubic meters of stored water to generate 660 GWh of electricity each year, 500 GWh of which is produced by the Hauptstufe.

The Power Station

Water from the Wasserfallboden lake situated 860 meters above, drives four units, each of which are equipped with Pelton turbines, in the Kaprun Hauptstufe. This power station has been completely overhauled. ABB successfully renewed all the control technology as part of this project.
ABB‘s advanced Industrial IT control system provides considerable scope for more efficient and cost effective power generation at the Glockner-Kaprun power station. Here the use of new synchronizers has the advantage that it is easier to synchronize the network to the Austrian grid.
ABB’s control system also makes it easier to operate and monitor the plant. These tasks can be carried out both from the control room and decentralized by means of screens, which are integrated in the doors of the control cabinets in the machine hall. If a fault occurs, the plant operators can ascertain the status of the plant easily and intuitively and obtain valuable information on rectifying the faults.

Power Plant Automation using ABB’s System 800xA

Austrian Hydro Power chose System 800xA, ABB‘s innovative control system, for upgrading power plant automation. System 800xA integrates both the operation on site and the power station group‘s central control room but it also integrates with the overall Verbund-Konzern network. Each of the four units is controlled and monitored by AC 800M controllers, which are designed for redundant operation.

System 800xA covers the following tasks:

- Automatic start-up and shutdown control
- Mechanical protection (e.g. speed monitoring)
- Temperature measurements
- Alarms in the event of hazards
- Drive control and
- Turbine control

Remote I/O modules of the type S800 ensure secure connection of instrumentation. These modules are connected to the AC 800M controllers via redundant Profibus.
“As a result of the modernization of the control system we have been able to cut the overall time taken to synchronize a unit with the network to just three minutes. That‘s one and a half minutes less than it used to be, which is a considerable improvement,“ says Helmut Kleon, who is responsible for the electrical engineering installation at the Kaprun power stations. „In addition, the modern visualization enables us to monitor our machines more precisely while, in the event of a fault, we are given an excellent indication of the cause. This substantially reduces diagnostic and repair times and therefore ultimately also the downtime of the power station as a result of fault situations.“

800xA Operations - Easy to Use

„With 800xA Operations, each individual turbine can be operated centrally from the power station’s control room”, explains Karl Hirschböck, ABB’s sales engineer, responsible in Austria. „However, when required operation can also take place on site using a touch screen, which is built into the door of the cabinet. In both cases, a powerful Ethernet-based network is used, which also makes it possible to network the total of four turbine controllers.“
In addition to the automation for the turbine control, ABB supplied and installed the components for synchronizing the generators with the grid. The SYNCHROTACT 5 equipment was integrated in the installation‘s control cabinets.
With the commissioning of the Kaprun Hauptstufe in August 2004, the Austrian Verbund-Konzern can provide consumers with peak demand electricity under both environmentally and economically sustainable conditions.
Apart from covering the conventional peaks in demand in the morning and at midday, peak demand electricity from the Alps can also make up for the shortfalls in the power supplied by wind farms which, for instance, switch off automatically at high wind speeds.

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