Steam Turbine Solutions

Upgrade of Blénod Power Plant, Unit 3 and 4

Summary

Thanks to a systematic modernization of the Blénod power plant, the owner of the plant can take a new position in the energy market.

Optimized hydraulic turbine components and actuators as well as optimized turbine and unit controls have made the power plant fit for the increasing demands of todays power generation business, both from a technical and an economical viewpoint.

Portfolio of solutions

ABB can offer a diversified portfolio of solutions and services designed for upgrading and modernizing unit and turbine operations; these include the following modules:

- turbine control and protection (TURBOTROL®), combined with thermal monitoring of critical components (TENSOMAX)
- the necessary upgrade and optimization measures for sensors, actuators and hydraulics equipment of the turbo-generator set
- a modified condensate flow stop to be able to meet higher demands on the dynamics, at minimum throttling losses of the turbine (MODAKOND)
- a model-based unit control procedure (MODAN) for coordinated boiler and turbine operation
- model-based, predictive monitoring for thick-walled components, and optimization of boiler startups (BOILERMAX)
- model-based, predictive startup optimization for the steam turbine (PREDIMAX).

Optimal coordination of these modules releases the dynamic reserves of the systems that would not be utilized otherwise. Thanks to the modular structure, scalable solutions can be created that are tailored to the customer's specific needs and budget.

Existing components can remain in use as far as they are in appropriate condition.

These solutions are available virtually for almost any type of boiler and turbine, no matter what make.

Customer benefits

ABB's range of solutions for upgrading unit and turbine operations gives customers in the utility industry a number of possible advantages:

- high unit dynamics allowing for thermal limits and smooth operation
- improved control accuracy
- minimized startup times and losses
- reduced throttling losses of the turbine
- Increased efficiency, especially during partial-load operation
- enhanced stability and intercept reliability achieved through an improved linearity and optimized positioning times
- a higher availability level thanks to control redundancies
- longer component lifetimes can be obtained thanks to the use of new control concepts

References:
The CPT Blénod 3 & 4 EDF power plants

The fossil-fueled units 3 & 4 of EDF's CPT Blénod power plant are more than 30 years old located at Pont a Mousson, Lorraine, France.

The maximum net output is 265 MW.

The upgrading measures were designed to improve the maneuverability of the plant and to fulfill a number of technical requirements:

- fast power output increase for the purpose of primary grid frequency control; at an amplitude of up to ± 25 MW within 30 sec
- participation in 'télérèglage'; the load ramps being specified by the load dispatch center for the purpose of secondary frequency control, at an amplitude of up to ± 50 MW and a gradient of 7 MW/min
- a higher economic efficiency achieved by an enhanced operational efficiency

Upgraded electrical-hydraulic and mechanical components of the turbine to ensure the required dynamic response.

Mechanical components replaced by low-maintenance electronics devices

Before technical improvements could be implemented, the unit and turbine control systems had to be upgraded.

The new digital turbine controller is of a modular and flexible design and provides
— in combination with new mechanical-hydraulic activation devices for the HP and IP control valves — the basis for meeting the dynamic demands of the process.

The previous mechanical linkage facilities and drives showed excessive clearance and effects of wear and tear.

They were replaced by new low-maintenance ABB servo drives which were adapted to the specific needs of the turbine.

Coordination of boiler and turbine

The new MODAN unit control system operates on a model basis and coordinates the operation of the boiler and the turbo-generator set.

The unit control explicitly allows for the dynamic and highly varying behavior of the two major components, i.e. the boiler (dynamically slow) and the turbo-generator set (dynamically very fast).

Positioning interventions are effected via the turbine control valves and the fuel setpoint of the boiler.

As a result, the operation can take place both in coordinated boiler-following mode, with the turbine being output-controlled, and in turbine-following mode, with the boiler being output-controlled.

The output setpoint is adjusted to the level requested by the power purchaser via an external grid controller and is additionally superimposed to the manually specified basic unit setpoint.

New servo drives

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Enhanced economic efficiency

The economic efficiency of the plant has been enhanced by ABB's experts by migrating from constant-pressure mode to sliding-pressure mode. This way, it was possible to reduce the auxiliary power consumption of the feedwater pumps and to increase the overall efficiency of the units. With these goals being accomplished, the plant can now demand higher prices when selling its electricity in the power market, as the price for providing secondary-frequency power control is determined on the basis of the maximum possible power amplitude and by the change gradient of the load ramp. Moreover, the plant is also able to participate in the European power market, although this is not intended at present.

A comprehensive solution concept leading to success

A comprehensive solution concept in conjunction with high-quality ABB products and solutions for the mechanical, hydraulic and control components (TURBOTROL) of the turbine, including the MODAN unit control system, are the heart of ABB's innovative concept.

This concept includes full-scope services — from site assessment (inspection on arrival) and conception, to engineering and installation, to commissioning.

This overview chart shows the improvements achieved in the Blénod plant:

	Before modification	After modification
Load shedding	only < 80% load	across the entire load range
Isolated mode	No	Yes
Télérèglage	No	Yes
Primary grid frequency control	No	Yes
Control accuracy	± 10%	± 1%

Integration into automation systems

ABB offers the optimized integration of the solutions presented here — either as individual components or as an overall system — into existing and/or future automation and plant management systems.

This way, the customer's investments are protected and future reliability is ensured.

ABB Utilities GmbH
P.O. Box 10 03 51
D-68128 Mannheim
Kallstadter Straße 1
D-68309 Mannheim
Phone: +49 (0) 621 381-3000
Fax: +49 (0) 621 381-2645
E-mail: powertech@de.abb.com
Internet www.abb.com

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