

Steam and Power Optimization

Superior management of steam network complexity



Take advantage of asset flexibility to reduce production costs while at the same time improving steam supply reliability. Achieve 3 % to 5% savings in Steam Costs with ROI below 1 year by applying OPTIMAX technology.

Implement coordinated control of Boilers, Steam Turbines and Gas Turbines explicitly considering equipment efficiency and real time energy prices with Steam & Power Optimization using ABB OPTIMAX Technology.

A Complex Optimization Problem

Control and optimization of steam networks in industrial sites is a complex task and presents several technical challenges. Handling conflicting objectives and slow dynamic responses via traditional DCS strategies is, in fact, very challenging, causing a significant deterioration of control performance compared to digital solutions from ABB when addressing challenges like:

- Need to ensure pressure control for multiple steam headers
- Multiple boilers to generate steam – with different fuels, efficiency, sizing and dynamic response
- Multiple turbines to route steam and generate power – with different efficiency, sizing and dynamic response
- Alternate routing through Pressure Reduction Valves with attenuators
- Possibility to use condensation and venting depending on energy prices

- Many conflicting constraints, including boiler limits, turbine limits, electrical generators limits, tie line power limits, etc.
- Dynamically changing scenario:
 - User demands fluctuate and can change significantly in case of events (e.g. equipment trips and startups)
 - Variable pricing for energy consumption and grid export

Automation Complexity

In many cases, especially true for large industrial sites, there are Complexity in automation systems and separate control rooms covering steam network control. However, it is not uncommon to have separation even for small cases.

Configuring a high performance, unique steam network management strategy on the basic automation layer, at DCS level, is a very demanding task, due to complexity of the objectives, the need to coordinate multiple DCS systems and, also, the equipment different dynamics, ranging from very fast, like steam turbine and gas turbine, to slow response, like conventional boilers and heat recovery steam generator (HRSG).

Additionally, fuel and electricity market prices have become much more volatile. Therefore, leveraging the ever higher price spreads in primary fuels and electricity prices is a priority for operating your plant in the most economical way, while ensuring the secure and continuous production and uninterrupted and sustainable power and steam supply to the critical processes.

For example:

- Fuel price variations are gradual, but significant over a longer time period and favorably priced fuels can be available in limited quantity. Therefore, proper day-ahead and intra-day planning is crucial.
- In case of variable electricity tariffs, the price spreads even for one day can be significant with limited predictability.

In such a complex and challenging landscape, use of a dedicated Optimization software module has grown over the years and especially in this decade.

The advantage of using an overall Optimization software to identify the optimal operating conditions is related to:

- Ability to accurately model equipment efficiency, e.g. turbines and boilers
- Ability to properly model fuel costs and inherent non linearities like, for example, Natural Gas fuel blocks
- Ability to estimate energy prices on the market
- Ability to estimate future heat and steam demand from consumers

Overall Optimization through Advanced Process Control

Proper management of complex Steam Network, with multiple interacting equipment and different dynamics, requires use of Advanced Process Control (APC) software based on Model Predictive Control (MPC) technology. The most immediate benefit is the greatly improved process stability. Main steam pressure standard deviation is greatly reduced, and similar improvement can be observed in all headers.

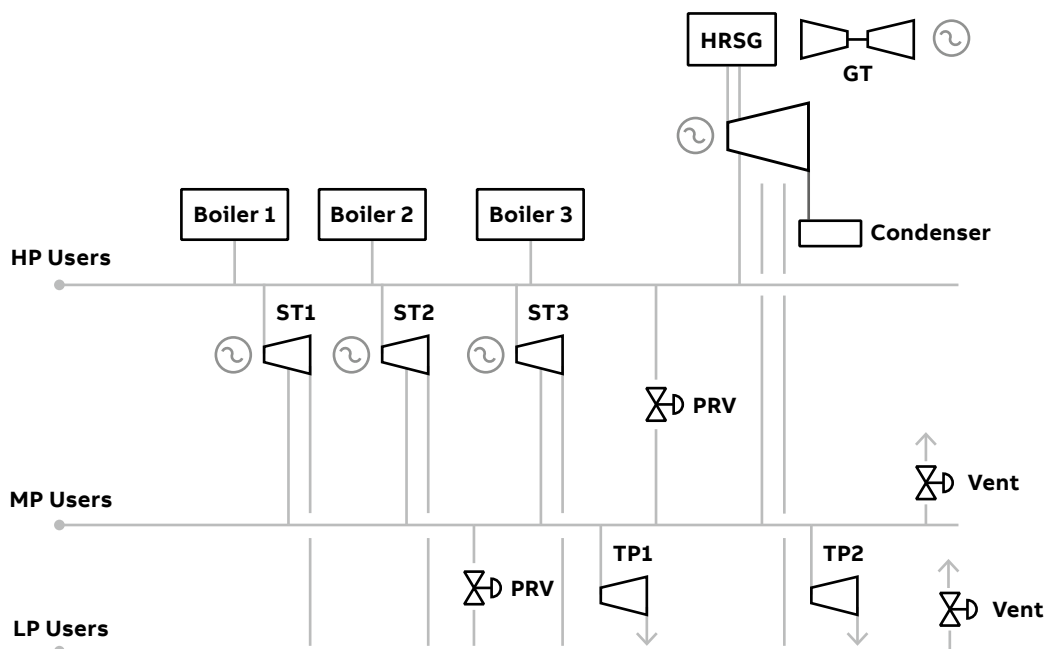
The algorithm provides smooth transitions, whether opening PRVs, closing vent valves or controlling the steam balance with LP boilers when the HP boilers are maximized.

In case of large process upsets, the APC software uses all steam system components to help, allowing temporary deviations from their optimum targets.

As the APC is a multivariable algorithm, all the required operating modes, for example in terms of active boilers, are achieved with a single APC configuration. The overall design is greatly simplified as there is no need for alternative DCS configurations or complex over-ride schemes at the base control layer for boiler-follow, turbine-follow, PRV and other such modes.

Steam & Power Optimization has a very modular, scalable software configuration based on ABB OPTIMAX and Predict & Control multivariable controller software. The same architecture and same software modules can be applied to small and very large Steam Networks.

Figure 1. Steam Network – Complex configuration



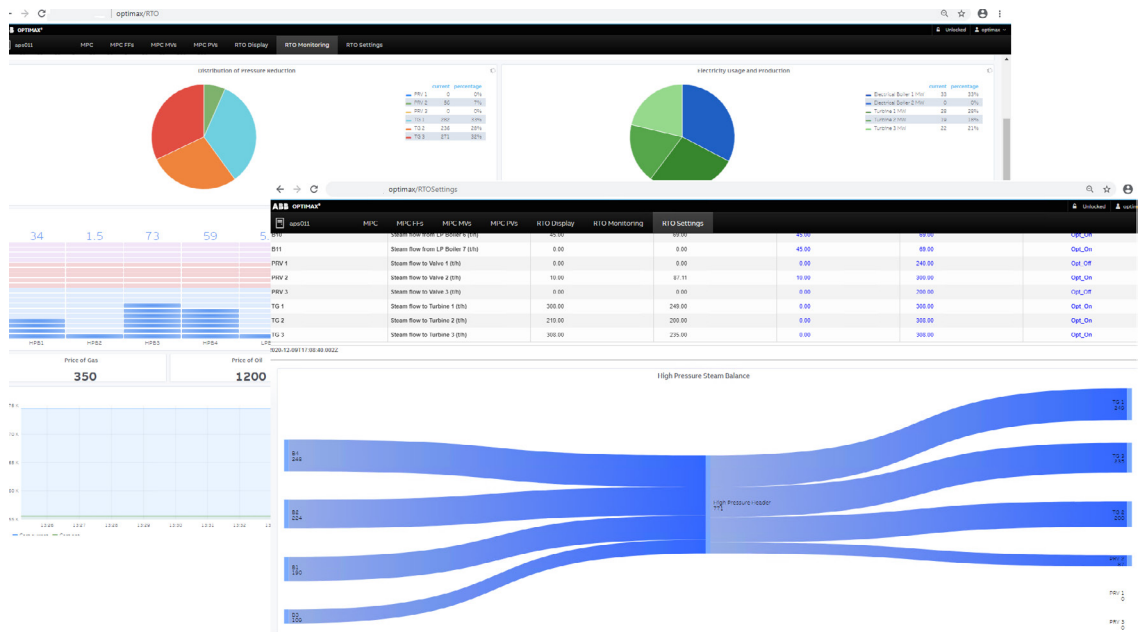


Figure 2. Advanced Dashboards provide insights on Steam Network economics and efficiency

Automatic Power Import/Export trim

Power prices change continuously, as often as every 15 minutes in most markets and natural gas prices change daily. To further complicate the situation, each mode change creates a large disturbance to the power plant. For example, a fast move from “minimize” to “maximize” causes a large increase in steam demand that the turbines and the boilers must respond to. Therefore, keeping the plant at the optimum is a major challenge.

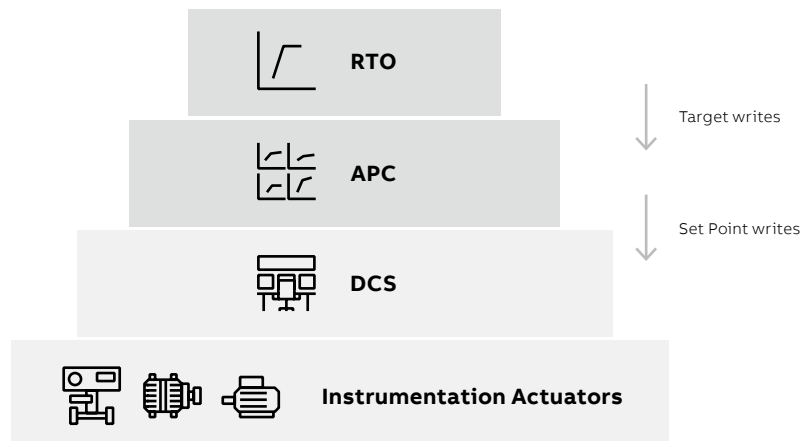
After the implementation of Steam & Power Optimization, the variation of fuel and power prices drives the selection of the power plant operating mode. When the purchased (or sold) power price is high as compared to the internal cost of generation, more power should be generated inhouse, and vice versa.

Advisory vs. Closed Loop Optimization

The highest performance can be achieved with a closed-loop configuration, which continuously implements Optimizer decisions by properly managing setpoints toward the underlying automation systems. However, it can also be used to identify the ideal operating conditions, with no direct implementation of the decisions to the underlying automation systems.

In such a configuration, the Optimizer operates in advisory mode or open loop, presenting targets to operators residing in the various control rooms and leaving responsibility to implement each target to Operators.

Figure 3. Multi-layer solution





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