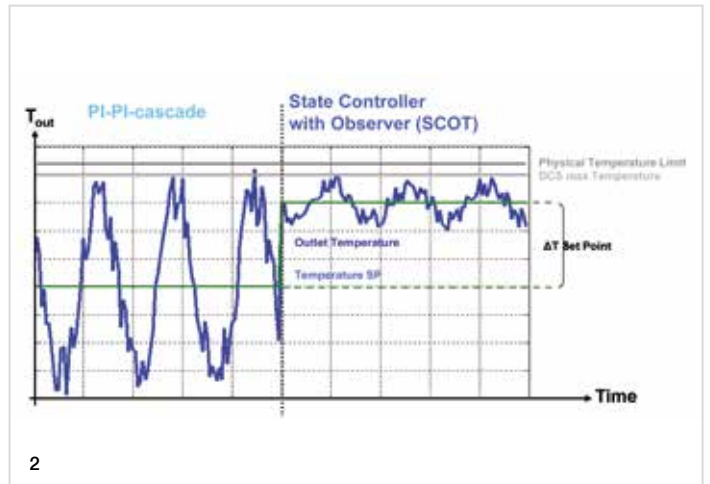
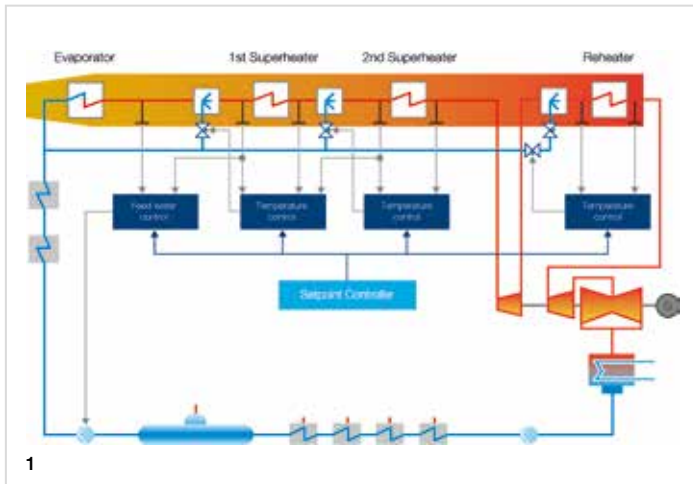


SteamTMax state controller with observer

Precise control of main and reheat steam temperature

ABB's SteamTMax State Controller with Observer increases unit efficiency and reduces wear of thick-walled components.



1 Main and reheat steam temperature controls | 2 Comparison between temperature regulation with classic control and ABB's state controller solution

SteamTMax improves the steam temperature control quality and allows a higher steam temperature set point without violating the material physical temperature limit. Higher steam temperature results in an immediate increment of unit efficiency. Additionally the closer control reduces thermal stress on thick-walled components.

Challenge

Live steam and reheated steam temperatures are controlled process variables critical in steam generation control. They need to be regulated with high precision in order to prevent unnecessary material stress (thermal stress) in thick-walled components, especially in steam generators and turbines.

Traditionally, the live steam (and reheated steam) temperature control was done by means of a PI-PI cascade arrangement or some other simple control structure.

The state controller allows a significantly better control quality, but needs precise tuning of many controller parameters, which not long ago was a lot of work for a control expert.

Solution

Nowadays however, because of higher efficiency and better control performance requirements, SteamTMax has become ABB's standard solution for the live-steam and reheated steam temperature control.

SteamTMax includes an internal calculation function which computes all of the controller coefficients. The special benefits of this integrated commissioning concept are, among other things, reflected by the following improvements:

- It is a transparent and extremely practical adjustment concept enabling a very efficient, reliable and therefore cost-efficient commissioning of the controller.
- Controllers and the commissioning tool are combined in one unit. This way, an often costly external coupling of the two components is no longer necessary and the risk of mal-operation is extremely reduced.
- Clear and directly accessible documentation of the controller setting: one look at the parameters for the corrective-control behavior (settling time, damping), as specified on the module, instantly reports the current setting of the controller.
- Possibly required readjustments can be performed by the plant operator without any major problems and without a specialist having to be called in.

Services

ABB takes over complete turnkey responsibility for engineering, installation, training, commissioning and support.

Controller design

SteamTMax includes a model of the plant. The observer calculates the theoretical internal temperatures in the super heater, making them available to the controller to be used as interstate variables.

SteamTMax accounts for the non-linear load-dependent behavior. The “K” and “R” vectors are dynamically calculated to provide optimum performance at any load operation point.

Thanks to its predictive capability and ultra-fast integration component, the state controller delivers improved performance without sacrificing robustness.

Plant identification

ABB's Plant Identification Tool for super heaters is designed to simplify the identification process and to deliver high accurate plant characteristics.

An accurate identification of the plant is a key factor to achieve maximum performance of the controller.

Implementation

SteamTMax is normally implemented parallel to a simpler control. E.g. when optimizing an existing system, it runs parallel to the existing control structure.

In new implementations or complete control logic replacement (e.g. new power units or full retrofits) the integrated PI-cascade backup system is used.

This simplifies commissioning and avoids disturbances to the process during controller parameterization and fine tuning procedures. The switch-over between controllers takes place smoothly thanks to the built-in tracking mode logic.

The controller is robust towards modifications in time behavior of the super heater. By integrating the commissioning tools directly into the state space controller module, commissioning can be handled in a manner similar to a control concept with PI controllers, i.e. experimental fine-optimization of the real process is easily possible.

Benefits of SteamTMax

- Fatigue of thick-walled components (especially in the turbine and steam generator) is greatly reduced.
- Load change rates can be increased without risk of exceeding temperatures limits. As a result, the power unit is better suited to rapidly respond to load demand changes.
- Improved precision (no overshoot) and speed while correcting temperature deviations minimizes actuator work and helps reducing unit oscillations caused by backcoupling with other control loops in the system.
- Effective for any superheaters; highly effective for superheaters with wide warm-up span (e.g. > 70 °K for coal, > 100 °K for gas / oil fired power plants) and/or a significant dead time and slow transient behavior.
- In most cases, the use of SteamTMax typically allows the max. temperature deviation at the steam outlet to be reduced by 30 - 40%, depending on the warm-up span.
- Increasing the setpoint for main-steam temperature by 5 K increases the unit efficiency by approx. 0.1 % absolute.
- Increasing the setpoint for reheat-steam temperature by 5 K increases the unit efficiency by approx. 0.09 % absolute.

Selected references

Heyden Unit 4 STPP, Germany

Coal fired unit, 920 MWel,
Main steam Control quality at full load < ±2 K and during load ramps of 1 % per minute < ±4 K
Reheat steam Control quality at full load < ±3 K and during load ramps of 1 % per minute < ±6 vK

Ensdorf Unit 1 STPP, Germany

Coal fired unit, 120 MWel,
Control quality at full load < ±5 K

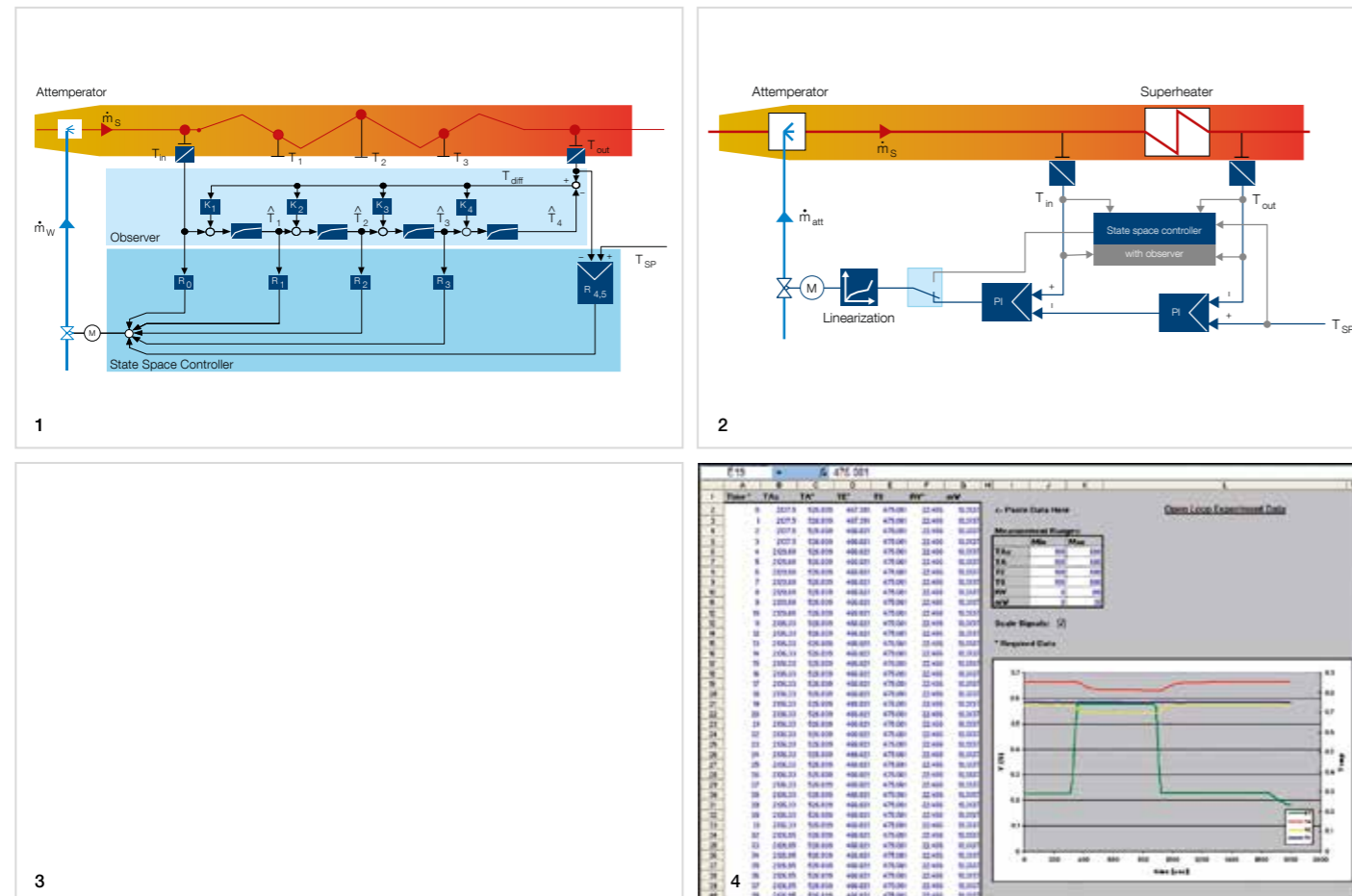
Mainova HKW West Unit 2 and 3 STPP, Frankfurt, Germany

Coal fired unit, 70 MWel,
Main steam Control quality at full load < ±2 K and during load ramps of 2 % per minute < ±3 K
Reheat steam Control quality at full load < ±2.5 K and during load ramps of 2 % per minute < ±4 K

Weisweiler Unit F and G STPP, Eschweiler, Germany

Coal fired unit, 630 and 700 MWel,
Main steam Control quality at full load < ±2 K and during load ramps of 0.6 % per minute < +4.5 / -6.1 K

1 Controller design | 2 Implementation | 3 Caption | 4 SteamTMax identification tool



1 Heyden Unit 4 STPP, Germany | 2 Ensdorf Unit 1 STPP, Germany | 3 Mainova HKW West Unit 2 and 3 STPP, Frankfurt, Germany | 4 Weisweiler Unit F and G STPP, Eschweiler, Germany



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