Optimized temperature control in steam power plants

Efficient stand-by operation of a turboset

Benefits at a glance

- Quick and easy installation
- No need to open the pipe
- Accurate and fast additional temperature information from the process for optimized control

Process conditions

- **Measuring point:** Steam line after the conditioning station and cooling water injection
- **Desired temperature of the main pipe on the secondary side in standby mode:** 180 °C (356 °F)
- **Primary steam:** 150 bar (2175 psi), 450-500 °C (842-932 °F)
- **Secondary steam:** 10-15 bar (145-217.5 psi), up to 220 °C (428 °F)

Accurate and fast temperature measurement in steam power plants is crucial to prevent damage to plant components, optimize energy consumption and guarantee the safety of the system. Accurate temperature control is also important in standby mode in order to be able to start up the system quickly and efficiently. Retrofitting an additional invasive temperature measurement point requires considerable effort.

The system must be completely shut down and the pipes emptied. In addition, drilling and welding is necessary on existing plant components, which requires new tests and operating approvals by notified bodies. In contrast, non-invasive temperature measurement can be installed quickly without opening the pipeline. Drilling and welding and the associated tests and approvals are no longer necessary.

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The challenge In the stand-by mode of a turboset, the system is kept in a state in which it can be started up again quickly, all components are in a safe state, and minimal wear occurs:

- **Reduced output:** The output of the steam turbine is reduced to a minimum to reduce energy consumption while keeping the system operational.
- **Temperature control:** The temperature of the boiler and turbine is kept at a certain level to avoid thermal stresses and to be able to restart the system quickly.
- **Steam generation:** A small amount of steam is still generated to keep the turbine moving and avoid condensation problems.
- **Automation:** Modern control systems continuously monitor the operating parameters and adjust them automatically to ensure safe and efficient stand-by operation.

This operating mode is particularly important to be able to react quickly to fluctuations in the electricity grid and ensure supply security.

In an existing thermal power plant, the temperature control in standby mode was inaccurate and slow, which led to an inefficient process and delays in starting up the plant. The task is to maintain a constant temperature in the main steam pipe of the secondary steam when the power plant is in standby mode. This is achieved by supplying steam from the conditioning station for heating or injecting water for cooling.

There are two different temperature measurement modes:

a. **At the steam outlet, bypass circuit: small diameter, high pressure**
b. On the main steam line: large diameter, lower pressure

Due to the high pressure and high steam velocity, the existing invasive temperature measurement used a thick and short barstock thermowell, which resulted in slow response times and inaccurate measurements. As a replacement for the inaccurate temperature measurement, a patented “enthalpy calculation module” was used for control.

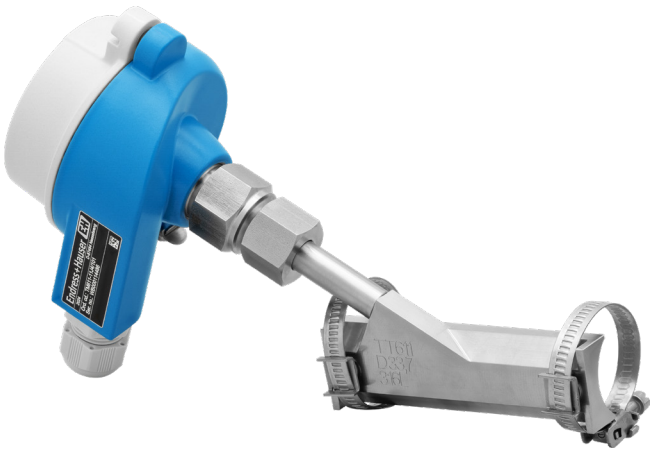
To improve the existing system, an additional temperature measurement is required for **mode a,** which can be installed as simply and easily as possible. In addition, an optimized position for the measurement should be found so that the sensor can be moved if necessary.

Our solution The non-invasive temperature sensor iTHERM SurfaceLine TM611 can be easily retrofitted to the existing pipe and integrated into the control system without any problems thanks to the standardized 4...20 mA signal. This makes it possible to quickly evaluate the new additional measurement with little effort. Thanks to the additional signal, a significantly faster measurement and thus optimized temperature control could be achieved. As a second step, the main steam pipe is also to be equipped with a non-invasive sensor, the calculation module verified and replaced by the measurement.

If the position of the measuring point needs to be changed, this is possible without any problems, as the product can be positioned flexibly at different points on the pipe if the following points are considered:

- **Precisely fitting coupling element:** The pipe diameter should be exactly reflected by the coupling element. Measurements with a larger or smaller pipe diameter lead to considerable deviations.
- **Smooth and clean pipe surface:** Weld seams, dust and corrosion must be avoided. Minor tolerances and damage to the pipe surface are largely compensated for by the heat transfer foil on the coupling element.
- **Intact heat transfer foil:** If the foil has been damaged when removing or moving the appliance, it must be replaced.

Result The non-invasive thermometer TM611 is an optimal solution for the challenges of temperature control in steam power plants in standby mode. The simple, less time-consuming installation, no intervention in the pressure-bearing structures of the plant and the fast and accurate measurement of the temperature convinced the customer. The measurement, originally planned as a test, is now permanently installed.



iTHERM SurfcaceLine TM611

Coupling element with heat transfer foil

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