Optimizing the Added Value of Power Plants

SR::SPC: Process Quality Monitoring and Condition Monitoring

www.steag-systemtechnologies.com

steag

Cost-Efficient Operation through Continuous Analysis

Today more important than ever: how to reliably gain control of creeping changes and seemingly sudden failures, and to react systematically early on.

Need for action?
Power plants and their components are subject to continuous changes in their operating behavior. Such changes regularly lead to undetected deteriorations of the plant efficiency and seemingly sudden failures of components with considerable consequences for the sustainable, efficient operation.

React systematically!
Statistics condenses data and provides reliable information that allows to react systematically. Therefore STEAG Energy Services has developed the intelligent IT system SR::SPC, based on tried and tested statistical methods for the monitoring and control of processes.

Continuous analysis!
SR::SPC is a reliable software solution for continuous process quality and condition monitoring. SR::SPC is clever as it is able to analyze the most important data on processes and main components out of the vast amount of data of the DCS. Owing to the automatic analysis, creeping and critical changes are detected early and reliably.

Continuous improvement!
SR::SPC covers all requirements for assessing the mode of operation of the plant as well as component conditions quantitatively and thus objectively. The online monitoring increases the transparency, allows for more systematic measures, facilitates a continuous improvement process, and thus vitally contributes to increasing the economic efficiency of power plants as well as their entire added value.

Ranges of application of SR::SPC:

- Process quality monitoring
- Condition monitoring
- Sensor monitoring (plausibility check of measured values)

Three Positive Effects – One Basis

Lay the foundations for an optimal efficiency, decreasing maintenance costs, and consistent plant know-how with just one IT solution!

Increasing the efficiency
SR::SPC condenses the data of the process and plant conditions into evaluable information. Deviations from a reference condition leading to an increased heat rate are thus detected faster. This way, appropriate measures can be initiated in a timely manner.

Decreasing the maintenance costs
SR::SPC permanently assesses the condition of important main components on the basis of performance data. Also creeping changes can thus be detected early and reliably for the purpose of a cost-efficient condition-based maintenance. Unplanned downtimes are reduced, and the availability of the power plant is lastingly increased.

Utilizing resources more efficiently
Experienced staff members with a “procedural feeling” for complex coherences are not available everywhere and at all times.

SR::SPC ensures the continuity and thus the continued existence of this “best practice”. The use of SR::SPC enables a continuous improvement process that can be developed company-wide beyond an individual power plant site.

Tried and Tested Models – Individual Consulting

Physical or data-based models allow for an individual solution strategy for each task in a power plant.

SR::SPC uses tried and tested modelling techniques for determining reference values that match the current plant condition in each case. By comparing these reference values with the current performance data (1-3), normalized characteristics (key performance indicators, KPIs) can be calculated. The normalized KPIs (4) only depend on the respective process quality or component quality. They are independent of external influences like e.g. operating or ambient conditions. These KPIs are the crucial basis for the statistical data analysis (5) for detecting critical changes.

Depending on the application, the continuous determination of the reference values can be effected by means of physical or data-based models:

Analysis on the basis of physical models

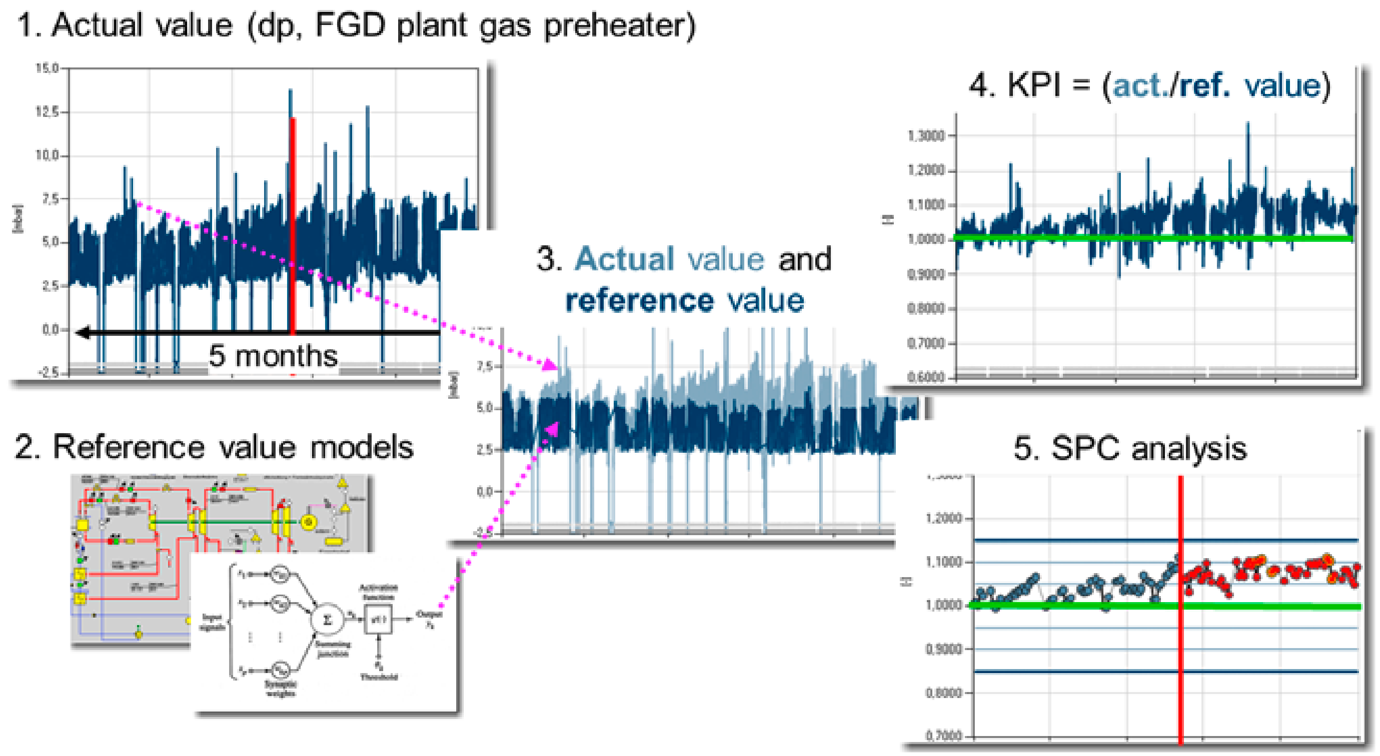
- Determines the reference value for process variables by means of a closed cycle model
- Balances and simulates complex processes very efficiently
- Enables a monetary assessment of the weak spots

Analysis on the basis of data-based models

- Determines the reference value by means of historical component conditions with the help of neural networks
- Calculates reference values also when the precise physical coherences are unknown
- Enables the modelling of the reference values in a very short time

You have the choice

The use of the appropriate method of analysis follows the respective task in the power plant. Of course you have the choice, and we will gladly provide advice!



Automatic Analysis for a Full Dozen of Good Results

Online and automatically: SR::SPC provides a whole range of improvements for a lastingly profitable plant operation.

Automatic analysis

As an advanced IT system for continuous process quality monitoring and condition monitoring, SR::SPC by STEAG Energy Services uses artificial neural networks and statistical tools to analyze the behavior of important characteristics/ KPIs online and automatically.

In doing so, SR::SPC detects significant trends and patterns, but also sudden leaps in the monitored characteristic.

By applying various methods and appropriate rules for assessing the results, the reliability of the statements can be further increased.

The results:

- Permanent, prompt, and automatic calculation of the KPIs
- Objective assessment of the process quality and the component condition
- Intelligent condensation of the abundance of information creates higher transparency.
- Automatic alarming by e-mail allows for fast reaction to looming damages or problems.
- Automatic detection of significant trends (e.g. creeping fouling) and patterns (e.g. “frozen measured value”)
- Supply of reliable planning data for condition-based maintenance
- Higher plant availability and thus economically more efficient operation
- No time-consuming manual analysis of the characteristics/KPIs
- Fast amortization of the investment by avoiding costs
- Lasting improvement of the plant efficiency
- Prevention of undetected, long-term losses
- Preservation of the valuable know-how of the shift personnel

Undisputed Benefit – Proven in Practice

Two examples out of many: where and how the intelligent condition and process quality monitoring SR::SPC provides solutions in everyday life.

The economic benefit of a continuous, automatic process quality and component monitoring is undisputed, as the following examples from practice show.

Process quality monitoring (condenser)

Problem:
Often an ingress of air occurs in the region of the turbine condenser at the gland seals of the LP turbine on the vacuum side, or at the gland seals of the condensate pumps. Other typical leakage points are coolers, condensers or preheaters operated with negative pressure. This ingress of air leads to a vacuum drop and thus to a lower efficiency of the LP turbine section. The result is an increased specific heat rate of the unit.

Problem strategy (previously):
The maximum achievable vacuum in the turbine condenser depends on many factors and is partially subject to considerable seasonal fluctuations, which cannot be influenced. The value for the current condenser pressure recorded by the DCS therefore cannot be consulted as a direct measure for describing the density of the condenser. Thus usually one up to three vacuum reduction tests are carried out per quarter year; here the evacuation system is switched off, and the pressure rise in the condenser is measured. When a plant-specific limit is transgressed, further measures for locating and remedying the leakage can be initiated.

Costs and result (previously):
The tests are carried out in larger intervals. Often, weeks and months pass between the occurrence and detection of a leakage. During this time, the plant is operated at a significantly increased heat rate and generates avoidable costs.

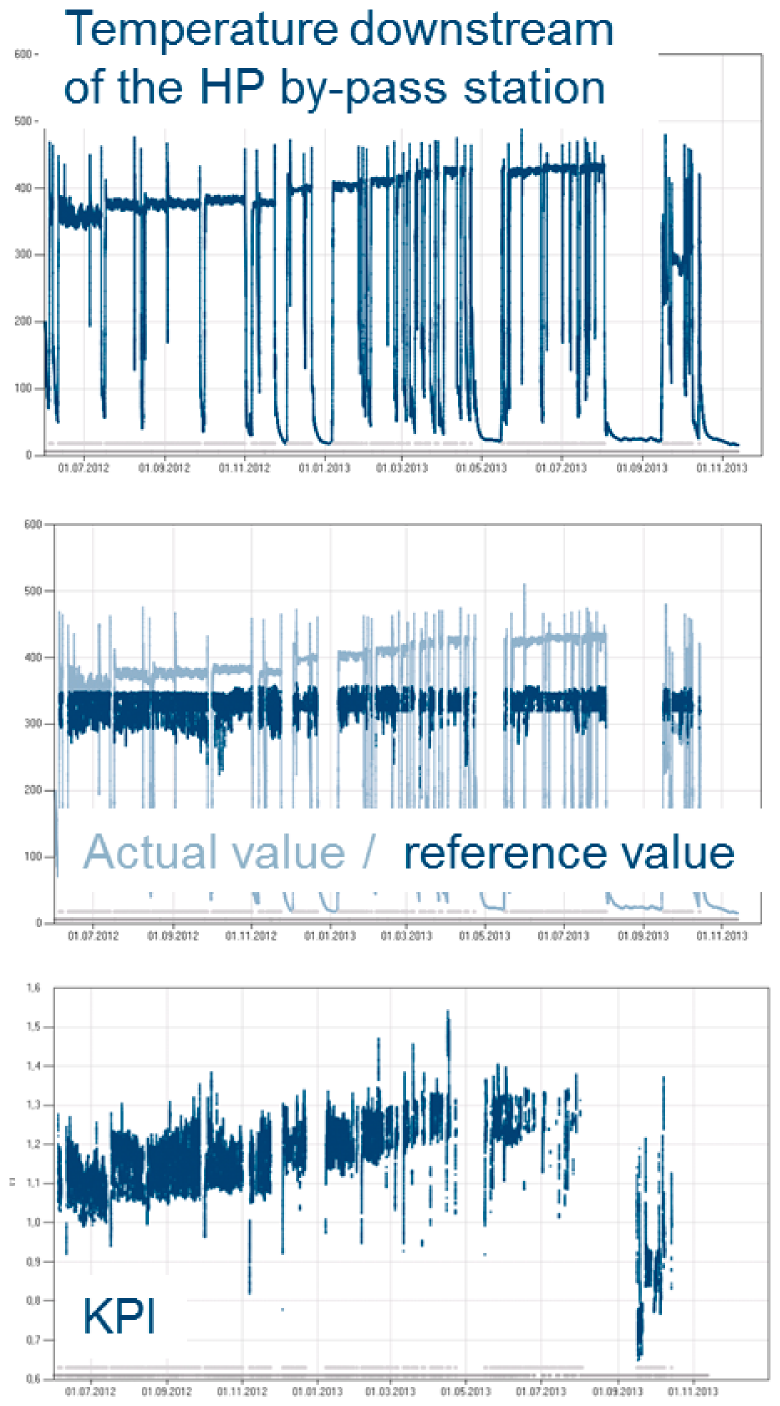
... Using the Example of Condition Monitoring of the High-Pressure Reducing Station.

Condition Monitoring (High-Pressure Reducing Station)

Problem:
In the region of the high-pressure bypass valve, erosions may occur over time as a result of the live steam pressurization, with a leakage developing as a consequence. Live steam flows into the cold reheat while the valve is closed, which leads to an increase in the specific heat rate of the unit.

Problem strategy (previously):
The condition of the high pressure reducing station is typically checked at an interval of four years in the context of the power plant overhaul.

Costs and result (previously):
Within this period of time, significant erosions may already have occurred. The increased heat rate leads to increased costs. Moreover, more extensive maintenance measures may be required.



The temperature downstream of the high-pressure bypass can be used as an indicator of a leakage. When the high-pressure bypass is closed, the temperature will decrease to a plant-specific minimum value. This value will rise with an increasing leakage.

The KPI is determined by comparing the actual and reference value. The resulting KPI observes the closed high-pressure bypass, considers the cooling behavior, and now mainly depends on the leakage quantity.

SR::SPC detects a gradual increase in temperature downstream of the high-pressure bypass and informs the responsible experts end of February 2013.

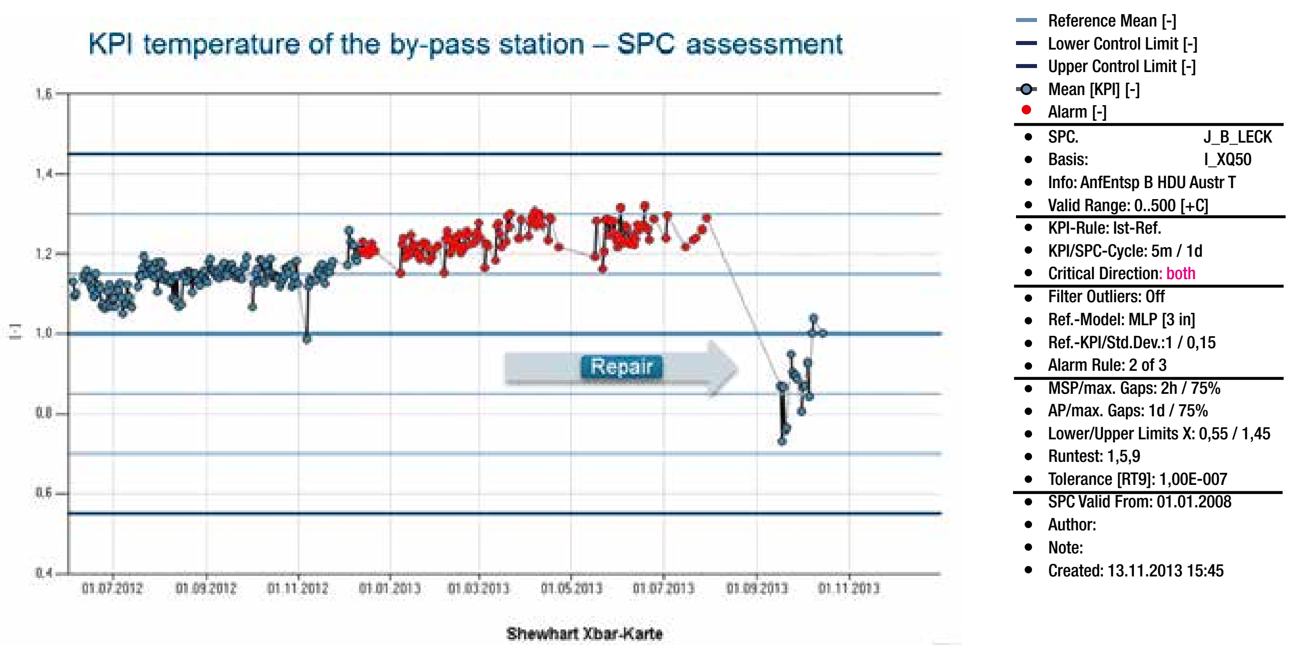
The high-pressure bypass is booked for inspection in the context of the next overhaul. The inspection of the high-pressure bypass confirms the suspected leakage.

The maintenance of the high-pressure bypass was carried out during the overhaul in the summer of 2013.

Summary:

- SR::SPC continuously monitors the high-pressure bypass outlet temperature.
- Experts are informed early on in the event of significant changes.
- Booking for inspection is possible depending on the condition.
- Erosions are detected early on, so that larger damages and a higher maintenance effort can be prevented.
- Reaction times are reduced, thus decreasing losses due to an increased heat rate.

SR::SPC reduces the time before a leakage is detected. On average, the reduction amounts to a maximum of half the time period between two inspections, i.e. typically up to two years.



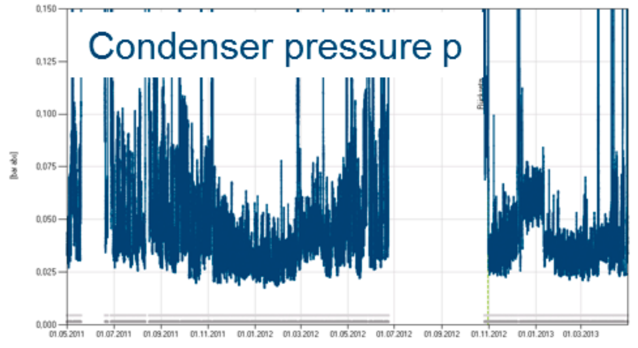
... Using the Example of an Air Ingress at the Turbine Condenser

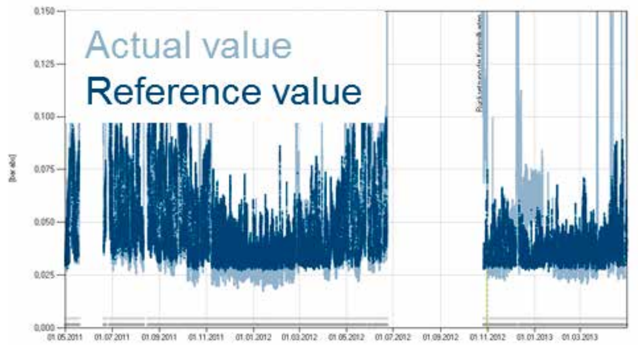
SR::SPC records the condenser pressure online. The pressure rises with an increase in the exhaust steam flow and the cooling water temperature as well as a decrease in the cooling water quantity, among other things.

The KPI is determined by comparing actual value and reference value. Here the reference value is defined in keeping with the respective mode of operation and cooling water temperature. By means of the comparison, their influence is calculatorily eliminated.

The resulting KPI is, among other things, load- and temperature-adjusted; it only depends on the quality of the vacuum and the heat transfer efficiency of the condenser.

SR::SPC detects the vacuum drop beginning of December 2012, and it is also confirmed by routine vacuum reduction tests. Helium leakage tests indicate a leakage in the region of the LP gland seal.



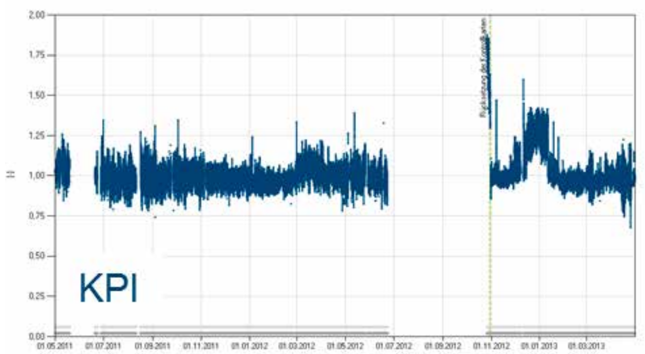


As an immediate measure, the gland steam pressure is increased, with the effect of a significant reduction of the air ingress since end of January 2013.

An evaluation of the plants currently monitored by means of SR::SPC has shown that leakages in the region of the condenser remain undetected very often and over large periods of time. In many plants, the use of SR::SPC has proven to be economically efficient already by monitoring the condenser alone.

Summary:

- SR::SPC records the condenser pressure online.
- The comparison of actual / reference value is effected in keeping with the current mode of operation at all times.
- Seasonal influences like cooling water temperatures are calculatorily eliminated.
- SR::SPC automatically detects the vacuum drop.
- Tests identify the cause of the vacuum loss.
- Costs are avoided by the prompt initiation of measures.



STEAG Energy Services GmbH
Rüttenscheider Straße 1–3
45128 Essen
Germany
Phone +49 201 801-4110
Fax +49 201 801-4102
www.steag-systemtechnologies.com

steag