Online Analytics for Enhancing Plant Performance and Profit

for gas/oil-fired and combined cycle power plants

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Performance Benchmarking and Aiming for Highest Profitability by Means of Data Already Available

Operation and maintenance in a planned and predictive way require knowledge of the current state of the plant and it's history – at any time. By design, gas/oil-fired and combined cycle power plants (CCPP) are highly automated, offering high potentials for a beneficial utilization of the data already available.

Creating value out of the available data is the key target when applying the SR solutions of STEAG Energy Services (SR = ***S**ave**R**esources*). The methods are applicable locally to support the operation of a specific plant or centralized to support maintenance teams acting fleet-wide.

By application of SR solutions both the availability and the output will be increased. The typical pay-back time of investment is one year, the second year our clients earn additional profit.

The SR solutions contain several modules addressing the demands of operation and maintenance in power plants in an efficient and state-of-the-art way.

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Online Analytics for Enhancing Plant Availability and Performance
Our Solutions:

- **SR::x** – data management, incl. interfacing, long-term storage and access of data and a strong and intuitive visualization

- **SR::EPOS** – physical process quality monitoring, incl. data reconciliation and KPI (key performance indicator) calculation incl. economic impact by assessing what-if scenarios online

- **SR::SPC** – predictive analytics, incl. detection of changes to prevent unplanned outages and improve the scheduling of maintenance activities by means of high-quality KPIs (e.g. based on data-driven models)

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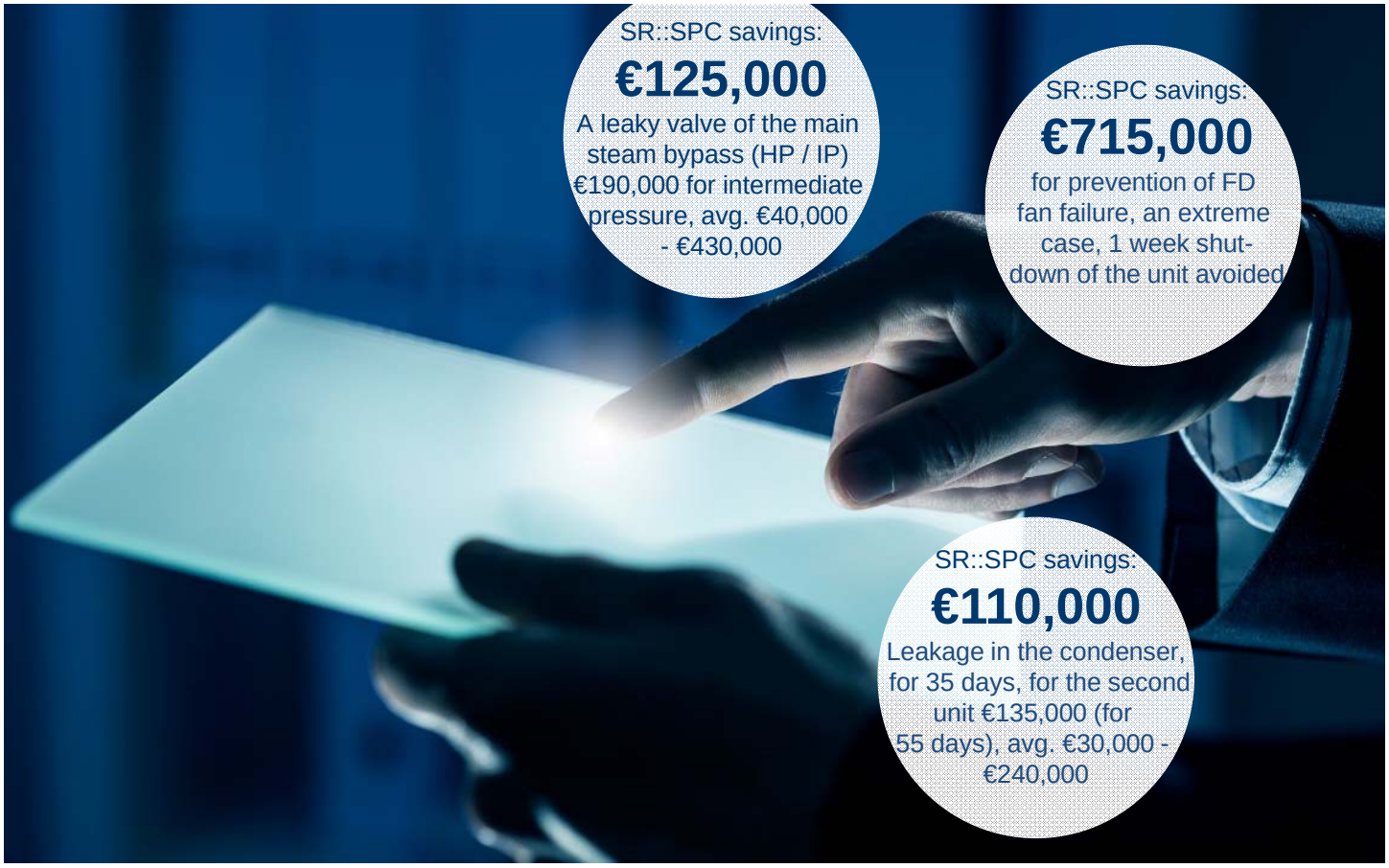

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Your Benefits:

Immediate benefits – Only by executing the project in a professional way, i.e. customizing it properly, assuring quality, and cross-checking the plant condition, a significant ROI is to be expected, for example:

- Trigger for optimization of the vacuum system in a 20-year-old power plant: permanent savings ~ €1,000/day
- Identification of the root cause of ~ 15 MW_{el} loss of output in the HP preheater section during commissioning of a newly built power plant

"Online" savings – Core competence of an online system: identifying events regarding upcoming non-availabilities and poor performance, for example:

- Air ingress to condenser hardly detectable due to changing load and ambient conditions, found and fixed within 12 h, savings ~ €5,000/day
- Loose plug at HP preheater control valve after shutdown, savings ~ €350/day AND scheduled inspection
- Fan deterioration due to deposits on the blades, savings ~ 12 MWhel/day

Additional value – Soft values by strong reporting capabilities, calculating KPIs, benchmarking different plants and assets, OEM-independent information system, platform for offline studies

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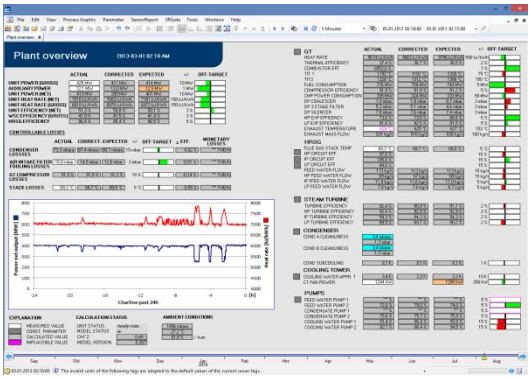
Data Management with SR::x

SR::x is a high-performance data management system that allows numerical data from different sources to be processed/archived with amazing ease and efficiency.

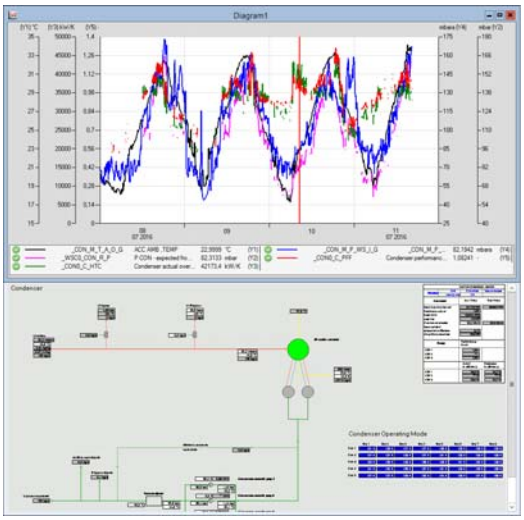
Measured data from control systems and other sources (e.g. bus systems or online databases) are acquired cyclically and transferred to the data management system, where they are archived as time series.

The basic cycle of data acquisition can be configured as required. Typical cycles are between 10 seconds and five minutes. Internally, the data are compressed automatically to higher time classes. This compression does not affect the basic data, which remain available online in SR::x for many years.

The visualization solution and the Excel add-in are user-friendly tools for evaluating the data by means of freely definable trend diagrams or customized reports.



Plant performance overview incl. trend



Exemplary view of condenser performance

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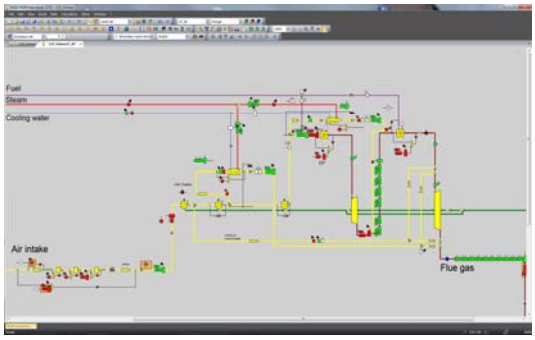
Physical Process Quality Monitoring with SR::EPOS

Deviations from the optimal mode of operation are often masked by the influence of external boundary conditions like ambient parameters or load scenarios and are thus hard to identify without suitable tools.

The continuous monitoring of the process quality with SR::EPOS is a vital chance to efficiently trace potentials for optimization in power plant operation.



Exemplary view of a GT model (GT26)

The distinction of the displayed losses into controllable, operational or externally caused ones leads to a reliable assessment of the plant condition enabling an optimized unit operation and maintenance.

For gas/oil-fired boilers and CCPPs, the correction of the current operation to ISO conditions is essential for any interpretation of the overall unit KPIs. SR::EPOS is able to provide this correction by means of continuous what-if evaluations, i.e. based on the current mode of operation according to ISO ambient conditions – both for actual and (new and) clean conditions.

But SR::EPOS does not restrict the evaluations to the current operating point – it might also optimize the current operation utilizing different optimization scenarios (e.g. regarding compressor status, cooling tower or air-cooled condenser operation) or support by identifying the current operating range incl. impact on heat rates or costs. The latter will be of particular interest if process heat/steam is extracted for delivering heat to industry or water desalination.

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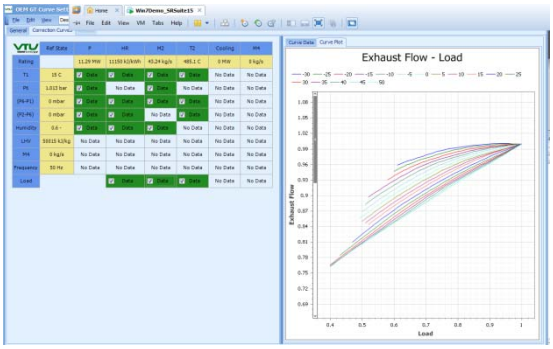
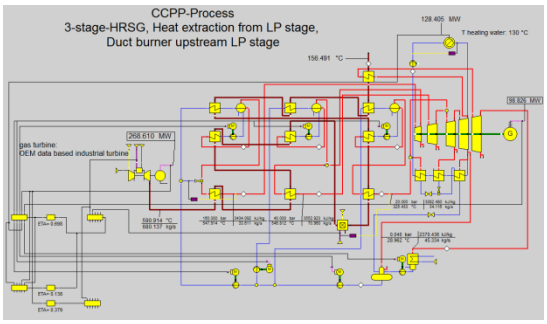
EBSILON®*Professional*, the thermodynamic cycle calculation software known from the field of plant design, is integrated in SR::EPOS as calculation kernel for the various online assessments. Thus applying only one and the same model of the overall unit will offer full access to any required (thermodynamics-based) information like (i) component identification (i.e. performance of components based on measured data), (ii) evaluation of the impact by means of continuously calculated what-if scenarios, (iii) data reconciliation for the consideration of redundancies right up to (iv) offline what-if studies for unit optimization.

Thus the entire scope of state-of-the-art power plant modeling, including, among many others, a comprehensive gas turbine library based on OEM data, physical representations of the different types of cooling towers and an air-cooled condenser are available with a robust calculation kernel and a comfortable GUI.



Exemplary view, GT library



EbsWizard model of a CCPP

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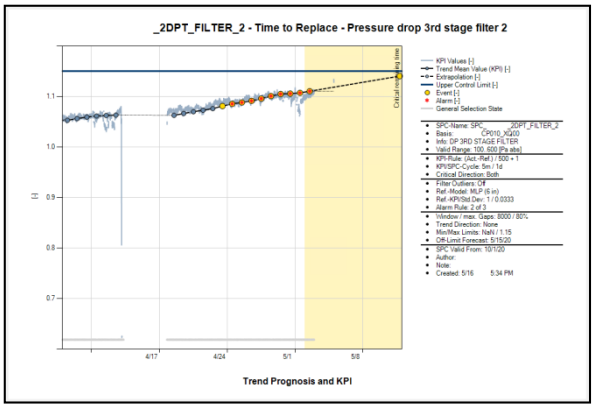
Predictive Analytics with SR::SPC

To prevent additional costs due to creeping changes / unplanned outages, modern methods of data analysis are applied in order to obtain information on impending faults both as early and as reliably as possible.

Among other aspects, the data are analyzed by means of selected techniques for signal filtering, neural process modeling and statistical process analysis as well as trend detection and prediction.



Example: GT filter trend from SR::SPC event view

The reference conditions are either taken from outside (e.g. SR::EPOS or third party) or modeled by means of neural networks. Here the calculation of the reference value is effected precisely suiting the respective mode of operation, the current ambient conditions, and other influencing variables for a specific unit at any time.

The subsequent comparison of actual value and reference value yields the KPI that is independent of the mode of operation and the other external influencing variables, but only depends on the process quality or the component condition. Finally, critical changes are detected by means of pattern detection and statistical evaluation adding further benefit by predicting the degradation trend.

High-quality KPIs are applicable to any kind of gas/oil-fired power plant or CCPP for monitoring e.g. the compressor and gas turbine efficiencies, the overall fuel consumption and el. output of the gas turbine, for assessing critical valve positions, vibrations or any equipment unit in the associated water/steam cycle. An example of application for the trend prediction is the forecast of the probable date of an off-limit condition as defined, like e.g. the transgression of the max. admissible pressure drop via the GT inlet filter or the exceedance of the lifetime consumption budget allocated for a given period of time.

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Our Customers:

Europe – RWE, Uniper (formerly E.ON), EnBW, Vattenfall, Siemens, nuon, Dong Energy, …

Worldwide – ESCOM, DEWA, Alstom, NTPC, BHEL, …

If you want to increase the profit of your power stations, please feel free to contact:

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