



Practice-Oriented Root Cause Identification

Improving the plant availability by means of intelligent root cause identification with SR::EAGLE

A man with a mustache and glasses, wearing a white hard hat with a 'step' logo and a blue jacket, is looking to the right. The background is a blurred industrial setting with green walls and machinery.

Root Cause Analysis



Cause and effect

In the course of the operation, the behavior of power plants and their components deteriorates. These changes can lead to creeping degradations of the plant efficiency and, in the worst case, to sudden failures. Systems for monitoring and analysis that work online are increasingly applied to detect these developments early on.

Tried and tested systems

Due to the increased requirements to efficiency and availability, systems for the continuous monitoring of the process quality (online process quality monitoring) have gained in importance in power plants. Powerful systems therefore provide solutions for a data or trend analysis of process data as well as a large number of diagnostic tools and performance data.

Time is precious

The manual evaluation of the vast amounts of existing data by experienced staff members involves a huge effort. Only automatic analysis techniques can help here. Otherwise the essential goal of an undisturbed operation cannot be achieved.

Moreover, the data bases of such systems have to be analyzed in the event of a component failure in order to identify the causes. However, less and less time remains to do so.

The main reasons for this are:

- increasing demographic change
- decreasing human resources
- higher load flexibility
- increasing complexity of the plants



Undesired
Top Event

Intermediate
Event

Cause

Use of Classic Event Trees

Predefined or self-defined event trees are often applied for a better root cause analysis.

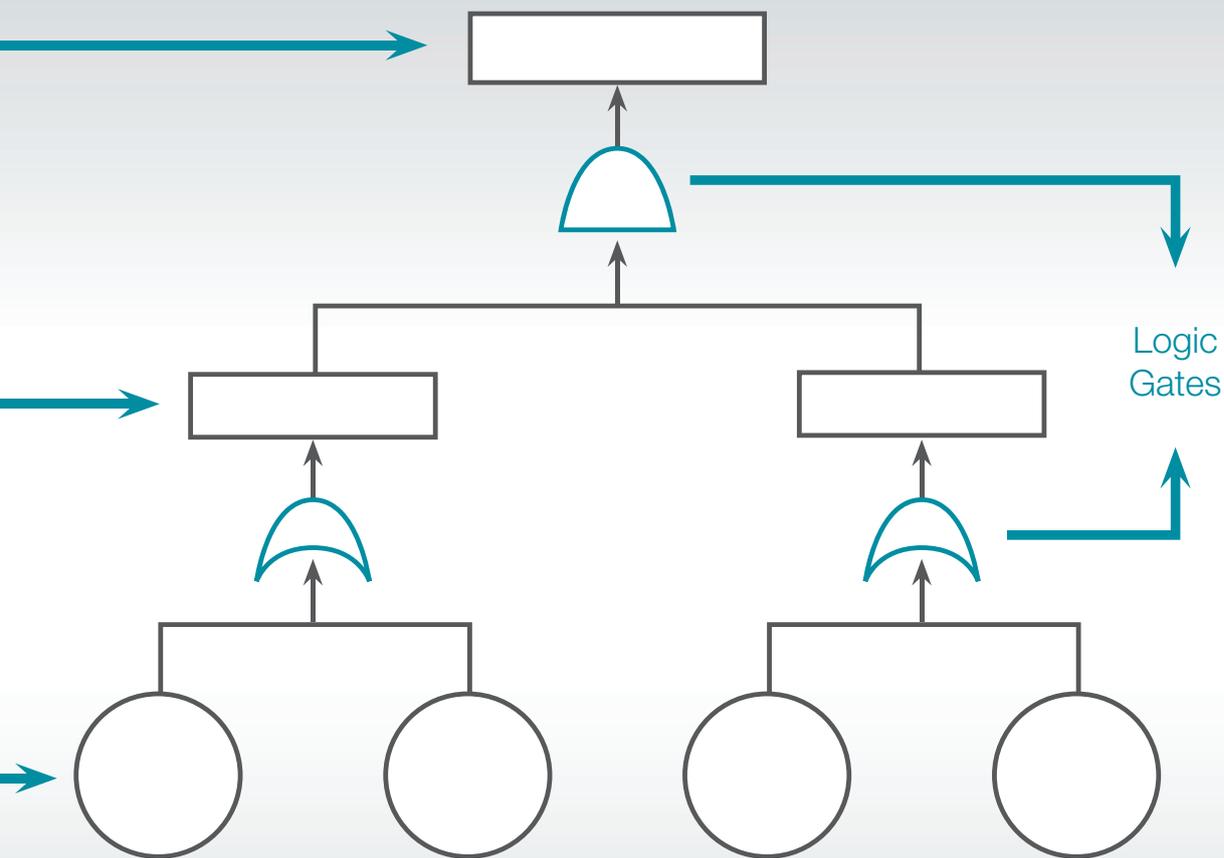
The main disadvantages of such classic event trees:

- inconvenient handling in offline operation
- one-sided binary approach to root cause analysis – will work as long as there is only one cause of a top event

The use of intelligent event trees

Thus intelligent event trees must be able to

- detect several causes of a top event, like e.g. the deterioration of the efficiency
- include different sections of the plant in the root cause analysis
- automatically evaluate all potential causes of a top event.



Systematic decision support

Due to these extended requirements, STEAG Energy Services has expanded their product range for online process quality monitoring and statistical process control.

SR::EAGLE supplements the tried and tested systems SR::EPOS for process quality monitoring and the early warning system SR::SPC with a powerful add-on module for decision support.

What is a decision support system?

A decision support system is a solution that helps to investigate changes in a power plant. In doing so, it applies

a systematic root cause analysis to promptly trace the causes of these changes and makes suggestions for the further course of action.

Structured root cause analysis

SR::EAGLE is organized in an intelligent tree structure (see Fig.):

- Top event: represents the undesired event
- Causes: the essential causes of a top event
- Logic gates: connections at the nodes of which various logic operations like AND, OR or INHIBIT are carried out
- Intermediate events: these are inserted behind the logic operations to group the causes



Crucial Step Forward

Online process quality monitoring and systematic root cause analysis work hand in hand with SR::EAGLE. The result: a prompt recommendation where to search first in order to remedy the causes of the top event.



The online process quality monitoring generates an alarm on the basis of current values or as a result of a deviating behavior over a period of time. This alarm activates the analysis of possible causes. Based on its actual value and a possible load dependency, the possible causes of the event are allocated a contribution to the top event.

The causes are evaluated by means of the respective measurements and physical correlations of the components involved. This allows to calculate the contribution of causes to the top event. In the visualization, the paths with the highest contribution are highlighted in color for recommendation.



One System – Many Special Features...

As an add-on to the SR::Suite of STEAG Energy Services, SR::EAGLE offers a large number of special features for decision support:

- Simultaneous isolation of several causes of a top event
- Automatic real-time evaluation of the system for decision support
- Fast diagnosis within seconds after an alarm
- Precise calculation both of the contribution and of the probability of a cause to a top event
- Precise classification of causes to a sequence that states
 - how big the effect of a cause on the top event is, or
 - how high the probability is that a cause is the actual reason for a top event
- Intelligent system based on a tree structure
- Better representation of different levels of the logical relationship between causes and their relevance



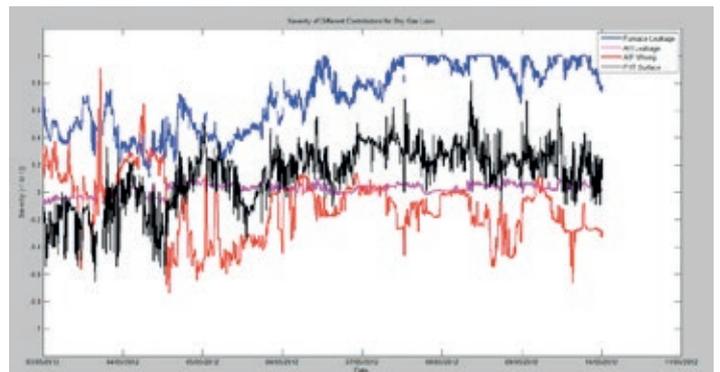
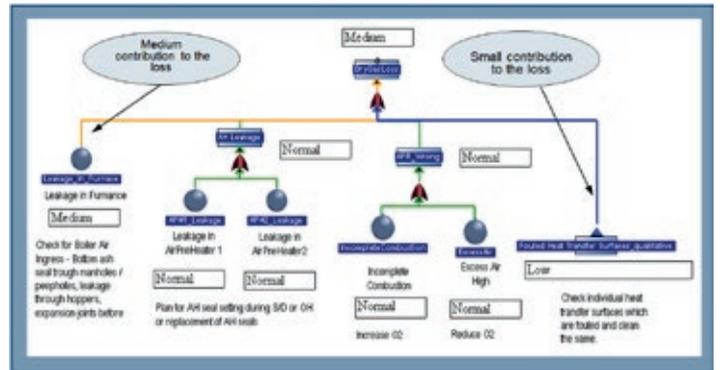
... and Benefits.

- Fast identification of causes leading to a top event
- Fast determination of unplanned modes of operation
- Faster identification of patterns in the case of recurring top events
- Comfortable visualization of the calculated results
- More systematic reaction to recurring top events by means of pattern recognition
- Predictive maintenance that can lastingly reduce the occurrence of top events
- Comprehensive insight into the plant owing to the detection of gradual changes and unplanned operating conditions in combination with a detailed event analysis
- Lasting reduction of unplanned shutdowns of power plant units

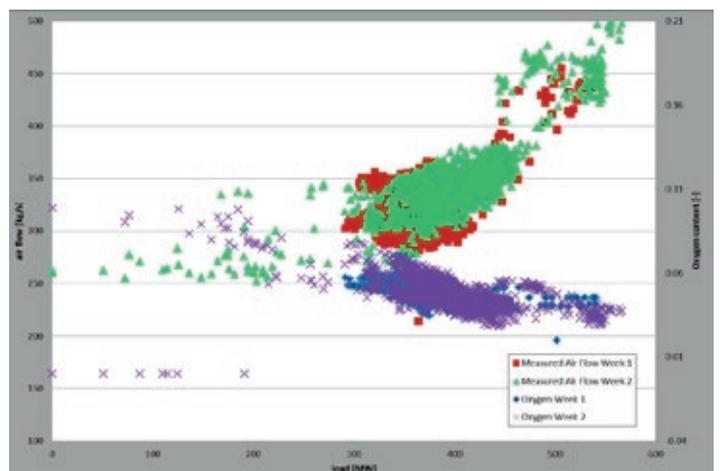




Practical Example



The online monitoring system SR::SPC detects a statistically significantly increased heat rate as the top event. SR::EAGLE determines the cause “furnace air leakage” to have a high contribution to this top event. (Fig. 1 and 2).



The analysis of the relevant process data shows that the data confirm the identified cause “furnace leakage”. The influence of the air/fuel ratio simultaneously detected by SR::EAGLE to be low is the result of the furnace air leakage as the controllers are trying to keep up the specified O_2 level by reducing the overall air flow.

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