CASE STUDY

State-based alarming solves problems for coker unit

Key facts:

Industry: Oil and gas

Octave products used: Tempo Control System Effectiveness *(PAS PlantState Integrity)*

Key benefits:

- Substantially reduced alarm rates
- Reinforced operator trust in the alarm system
- Coker alarms now indicate abnormal conditions requiring operator intervention

About the project

A new, five-furnace coker unit at a major Middle East refinery experienced high rates of non-relevant, inappropriate alarms during its normal cyclic operation. Since such an alarm system is ineffective, an alarm system designed to eliminate those nuisances was desired.

Coking in brief

A refinery coker unit processes residual refinery oil into more useful products, leaving behind solid carbon "coke." A coker consists of multiple drums, furnaces and additional equipment that process in a cyclic operation.

The coking process is as follows:

- Sartup heating of the hydrocarbon feed to a temperature high enough for cracking in a ready drum
- Steady-state cracking operation, during which product is made, and by-product coke is formed and fills the drum
- Diversion of feed flow to another ready drum
- Decoke: steaming of the coke-filled drum to remove residual product
- Water quench of the coke-filled drum, then removal of the coke via automated high-pressure water wash
- Repeat the cycle

Each coker sub-unit is heavily instrumented, with hundreds of sensors and potential alarms. Each state of the operating cycle has possible but different abnormal situations that can arise. Ancillary equipment for each coker drum also undergoes multi-state operation.

The challenge

Alarm settings to warn of problems during one state are inappropriate for other states. Since the distributed control system (DCS) has only fixed alarm settings for each sensor, operation of the coker unit will produce hundreds of nuisance, irrelevant or non-actionable alarms. The operators must recognize and ignore those based on each drum's current operating state. The potential for error and missing actual, important abnormal conditions was high.

Such a situation was unacceptable to the refinery owners. They desired an alarm system that reliably warns of abnormal situations relative to the actual operating state.

The answer involved using a comprehensive, state-based alarm solution in which the current operating state of all the equipment is monitored, and alarm setpoints, priorities and suppression status are automatically changed in real time to pre-determined values appropriate to the current state.

The solution

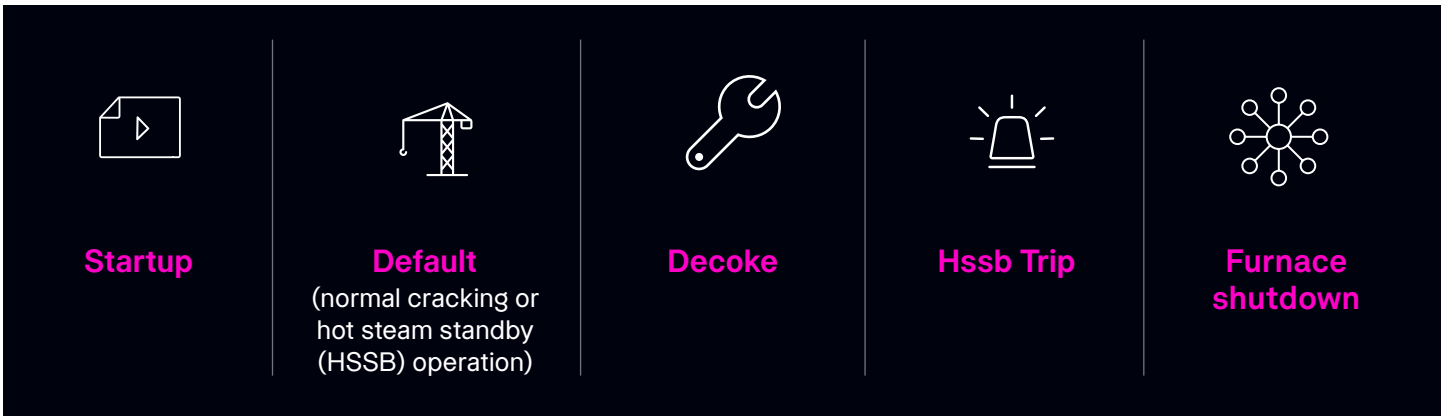
Octave Tempo Control System Effectiveness platform is modular in nature. The refinery owner activated the license for the dynamic alarming module. This provides integrated capabilities for state-based alarming, advanced alarm shelving and alarm flood suppression.

State detection

In state-based alarming, operating states are defined for each piece of equipment. The master alarm database then stores the proper values for alarm parameters (setpoints, priorities, suppression status and logical conditions) for each separate process state.

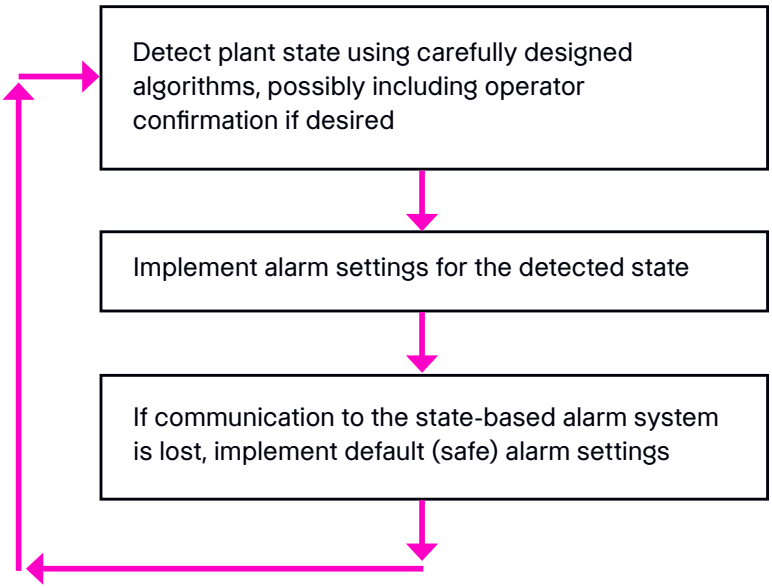
State detection can be fully automatic (based on logical combinations of sensed values), manual (operator input) or automatic with confirmation of the state change by the operator ("training wheel" mode). For a regularly cyclic operation, fully automatic is the proper design case.

For the coker unit furnace/drum combinations, five states were defined:



A state detection algorithm (SDA) for each equipment item was created. The algorithm uses logic involving multiple sensors, with values read via open platform communications (OPC) every 15 seconds. The SDA logic incorporates error handling for sensors not transmitting good values.

When an equipment's state changes, the separate state enforcer component writes the correct alarm settings via OPC to the control system.



State-based alarming logic flow

Alarms affected

For each of the five furnace/drum combinations, 36 different temperature alarms had settings, priorities or suppression status changes made automatically.

Besides those, dozens of alarms in the following systems were also made state-based:

- Five boiler feedwater systems
- Dilution steam control
- Furnace fuel gas
- Fuel gas seal testing (eliminating false alarms during an automated test cycle)
- Train diluted steam generation
- Ethane sphere vaporizer
- Acetylene reactor
- C7 splitter
- Decoke air compressors

Common trouble alarms (CTAs)

A CTA is a single alarm that occurs based on the alarm states of many related input sources, avoiding multiple alarms for the same event. Implementation of CTAs has complexities associated with re-annunciation avoidance and clearing. It is often much simpler to create CTAs using the Tempo Control System Effectiveness state-based solution than creating a CTA structure on the DCS.

In this case, the refinery created six different CTAs, comprising an average of 32 input alarms each. Diagnostic graphics show the specific input sources causing the alarm. This further reduced unnecessary alarm load.

Failsafe

As a standard part of implementing Tempo Control System Effectiveness, a watchdog timer will detect a loss of communication between the dynamic alarming module and the DCS. In that event, it will alert the operator and restore the DCS alarm setting to a predetermined default. In practice, this is a rare circumstance.

The results - optimum operations

Since implementation of the Tempo Control System Effectiveness dynamic alarming module, all the coker unit alarms now indicate abnormal conditions requiring operator intervention specific to the phase of operation. Alarm rates were substantially reduced, and operator trust that the alarm system is a useful tool is reinforced.

For a full description of state-based alarming, with platform-independent advice on state detection algorithm creation, alarm settings for shutdown states, and similar topics, learn more about alarm management at octave.com.

Summary

A coking unit is an example in which the built-in limitations of single-value DCS alarm systems result in suboptimum alarm performance. Industrial processes contain many similar examples, such as multiple trains, operations with different feedstocks or making different products on the same equipment in campaigns.

Implementing a proven state-based alarm system can restore the usefulness of an alarm system, ensuring operators are always aware of truly abnormal situations.

About Octave

Octave is a leader in enterprise software, turning data into decisive action and intelligence into your edge. Our software solves for and simplifies complexity, from the design and build to operations and protection of people, property and assets – for any scope, at any scale. For decades, we've partnered with customers to sharpen performance, elevate efficiency and amplify results. From factory floors to entire cities, our solutions are tuned to scale up what's possible from day one onward.