# ADVANCED OPERATION ASSISTANCE SOLUTIONS FOR OPERATOR ENHANCEMENT AND OPTIMIZATION

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***Yokogawa provides various kinds of Advanced Operation Assistance Solutions to enable plant operators in large process industry companies to improve their operation skills on a daily basis and to consistently achieve ultimate daily operations. Omegaland, an integrated training environment that includes a dynamic simulator as its core, and Exapilot which formalizes the operation knowledge of skillful operators, are both highly effective solutions that enhance operators' skills. As well, CAMS for HIS, which supports alarm design, high-value addition, and integrated monitoring, AAASuite which creates advanced alarms, and Exaplog which quantitatively reveals operational problems, are very effective solutions to make the best use of operators' skills during plant operation.***

## INTRODUCTION

Large process industry companies have recently started building plants with world-class safety and profitability to reinforce their competitive edge in the global market. As for plant operations, support functions for improving operators' plant operation skills and for extending operators' maximum capability are required to the DCS so that an operator can expand the area of plant monitoring or operate a plant with higher cost-consciousness. To meet this requirement, Yokogawa has developed advanced operation assistance solutions such as OmegaLand, Exapilot, AAASuite and Exaplog, and have so far provided more than 1000 systems to our customers.

## IMPROVING OPERATORS' SKILLS

Compared with those at the start of plant operation, environmental conditions surrounding operators working for large process industry companies have greatly changed in view of highly automated operations, longer maintenance cycles, mandatory retirement of experienced operators, young generations' reluctance to work at manufacturing fields and the collapse of the lifetime employment system, and it has become more difficult to maintain and improve the skills of operators. In such a situation, each plant has trained next-generation operators and achieved results by reviewing the role-evaluation system for operators, providing them with realistic training courses that take full advantage of plant simulators or actual DCS and formulating tacit-knowledge-like operation know-how into explicit knowledge by using knowledge management systems.

### Training Simulator

The quickest way to improve the capabilities of operators is to train them through various operations such as troubleshooting during routine and non-routine plant operations (startup or operation condition change). However, highly automated operations and longer maintenance cycles have reduced the opportunity for such OJT-based training. As a result, even operators employed for 10 years may never have had a chance to start up the plant because of the cycle of operation shift within the site.

Our integrated dynamic simulation environment “OmegaLand” contains the dynamic simulator “Visual Modeler” as the core for setting up a training environment where operators

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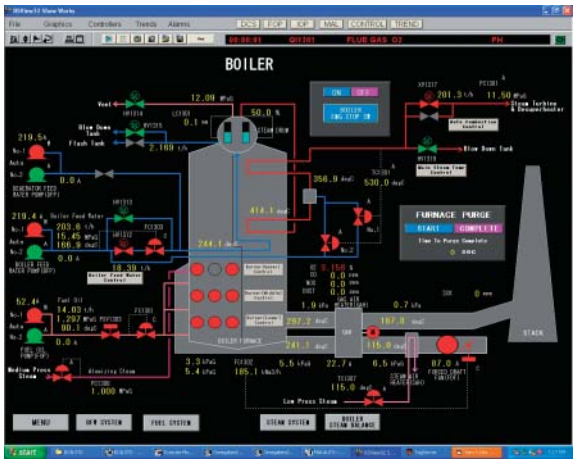


**Figure 1** Example of Operation Monitor Screen for Operator

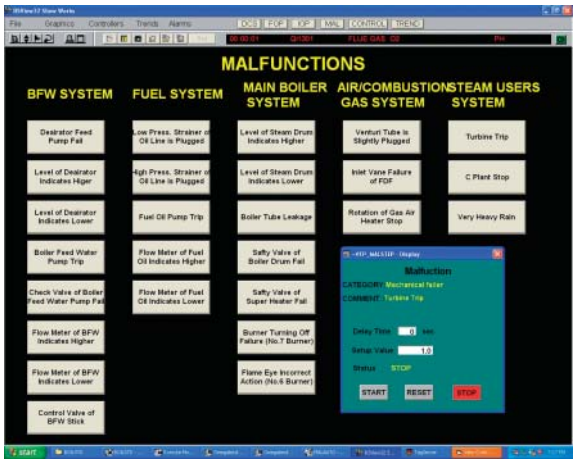


**Figure 2** Example of Trouble Generation Screen for Trainer

can acquire skills via a GUI environment identical to a real operating environment to safely cope with a low incidence of operation events (Figure 1 and Figure 2).

### Knowledge Management

Plant operators who joined companies during the late 1960s when plant operations began will have acquired extensive know-how over the years for safe plant operation today. As their know-how was acquired through trial and error and some operations cannot be experienced now so frequently, it is a valuable property of the process industry company. For this reason, many plants have introduced knowledge management systems to convert their tacit knowledge (know-how) into explicit knowledge to be used by operators in future.

Yokogawa has developed the knowledge management software "Exapilot operation efficiency improvement package" that formulates the operation know-how of experienced operators into explicit know-how using familiar flowcharts and operates independently or in conjunction with a training simulator to enable the operator to learn best practices. Since the sales launch in March 2000, Yokogawa has sold more than 650 systems to help customers accumulate various operational knowledge on plant startup/shutdown, low material/product grade changeover and operation load change from experienced operators (Figure 3 and Figure 4).

Exapilot conforms to the de facto standard interface OPC (OLE for Process Control) of the measurement and control system. When Exapilot is connected to control systems online via this interface, not only can the operator navigate via the interactive dialogs in conjunction with real-time monitoring of operations in progress but the operations can also be automated. In this case, safety and productivity are improved because Exapilot can be used to prevent miss-operations, shorten the operation time and save utility costs. However, when Exapilot is used to automate operations, the operators must be continually trained through offline training courses to maintain their capabilities or a day must be specifically set for not using Exapilot.

## OPERATOR SUPPORT

To exploit the capability of an operator during a board operation for safe plant operation, it would be ideal to realize a control system capable of collecting a wide variety of real-time operation information and extracting only the valuable information and adding value to the extracted information so that the corresponding operator can retrieve it on demand when required. Because hardware and communication capabilities in control systems increased drastically during the late 1990s, it is now possible to partially build this ideal system. With this background, there is an increasing demand among large process industry companies to renew the basic monitoring functions (alarms, graphics and trends) designed during the 1970s, namely at the incunabula of DCS.

## EEMUA NO. 191

As for alarms essential for plant monitoring, the concept and system building method are both described in the guideline "EEMUA No. 191" and other publications, covering all cycles

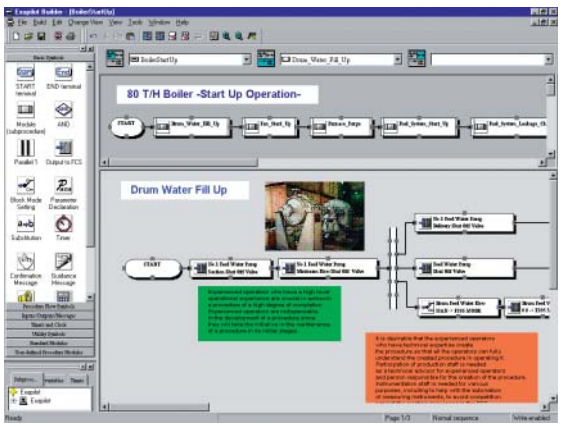


**Figure 3** Example of Exapilot Builder Screen (for Formulating Tacit Knowledge into Explicit Knowledge)

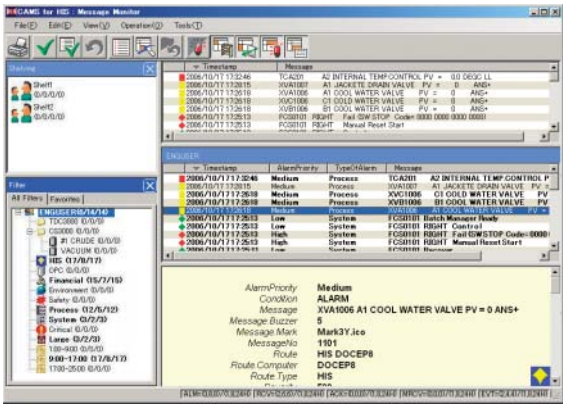

**Figure 4** Example of CAMS for HIS Real-time A&E Monitor Screen

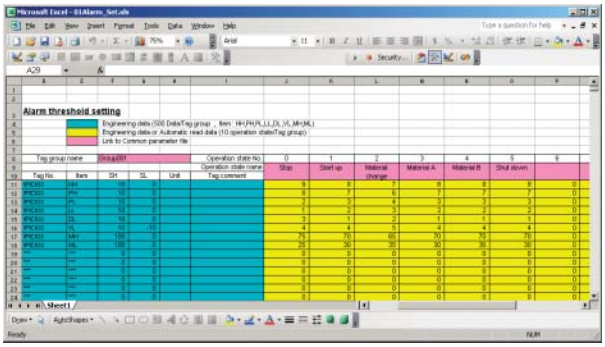

**Figure 5** Example of Alarm Threshold File by Operation Mode Used for AAASuite

from alarm system procurement to improvement through design, implementation, testing, training, operation and evaluation. Yokogawa has provided various solutions conforming to these guidelines. One example is the redesigning of the Plant-Wide alarm integrated monitoring environment and existing alarm, increasing the value and sophistication of the alarm itself.

**Integrated Alarm Monitoring**

When alarms can be monitored entirely from subsystems (such as PLC, compressor control system, APC system and facility management system), upper level systems (MES and ERP) and related plants (upstream plants and utility plants) as well as the DCS alarms from the corresponding plant, the operator can perform safe, stable plant operations more effectively.

To achieve this, it is necessary to install an integrated alarm server capable of supporting multiple communication protocols to collect all alarms and events, translating them to ensure that the operator understands their meaning, normalizing them to remove information mismatches between systems and system-specific interpretation and reclassifying them to communicate only the true alarms.

To deliver only necessary alarms to the right operator at the right time, it is also essential to install a real-time message monitor for classifying duplicate alarms into one group, preventing the generation of unnecessary or redundant alarms, filtering and sorting messages using the attribute or timestamp as a key, shelving the low-priority alarms temporarily and automatically shedding the operator workload during excessive alarm generation.

This concept is very effective in that users are not restricted to operators and all persons related to plant operations (for example, shift manager, maintenance technicians, production planning staff, head office staff and system supplier) can make maximum use of their own ability according to their roles. In addition, when properly arranged alarms and events are saved over a long period of time, they can be used for a wide variety of applications (for example, operation analysis, report generation and parameter change management).

To meet these needs, Yokogawa is developing an integrated alarm management system called “CAMS for HIS “(CAMS: Consolidated Alarm Management System) (Figure 4).

**Alarm Design Support**

In the era of panel instrumentation, alarm design (selection, prioritization and threshold setting) was more important than today because alarm generator was chargeable. In contrast, it tends to be more neglected because various alarms are easily available with the standard functions of the DCS. In reality, there are cases of alarm flooding. Therefore, the system must support alarm design to prevent unnecessary alarms from being defined or activated.

CAMS for HIS allows the user to define the purpose of alarm, time to respond, or consequence to prioritize alarms based on certain evaluation criteria.

In addition, AAASuite alarm rationalization support package dynamically changes an alarm threshold in conjunction with operation mode (for example, startup, 80% load, product grade A) switching and turns off the group of alarms at once for plant maintenance or line switching (Figure 5).

**High Valued-added Alarms**

Although the DCS process alarm is the most often used alarm for monitoring plant operations, it simply notifies the operator of the generated event without indicating the cause, countermeasure should be taken, or the deadline for action. This means that the cause investigation, action determination and action timing rely entirely on the operator's ability. It is desirable to inform the operator of the cause of the alarm and how to remove the cause as part of the alarm information, because it is becoming increasingly difficult to maintain or improve the operator's skills.

In addition, if various attributes (for example, equipment name, user name, purpose and importance) to be used as keys are added to alarms in advance to ensure that the correct operator receives a suitable alarm, they can be easily classified or sorted.

Our CAMS for HIS permits the alarm design builder to easily add various attributes to the existing alarms.

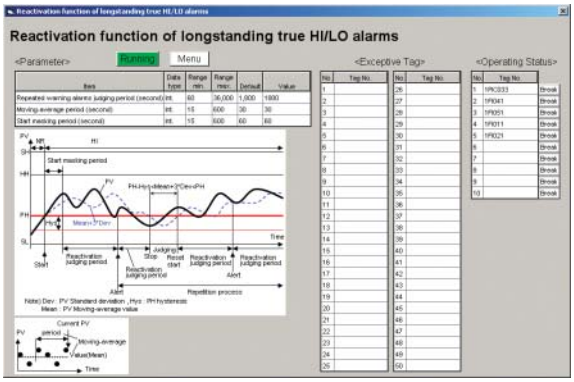


**Figure 6** Example of Reminder Setup Screen for Longstanding Alarm Long-term Alarm

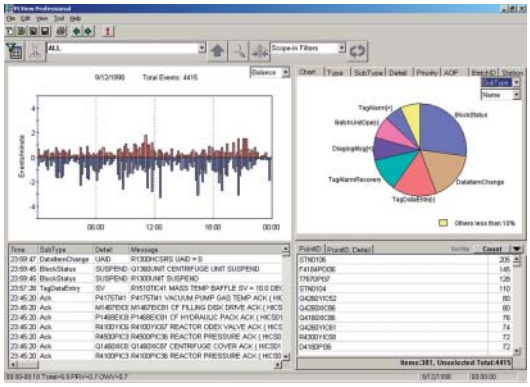

**Figure 7** Example of Exaplog Screen

**Advanced Alarms**

In addition to value-added alarms, advanced alarms are also important. For example, they include prediction alarms for detecting errors faster than conventional threshold-based alarms, and reminder alarms for preventing oversight of longstanding alarm (Figure 6).

AAASuite receives a generated alarm as an event through the de facto standard interface "OPC Alarm & Event (A&E) Interface" of the measurement and control system and monitors its continuation or tendency online through the OPC Data Access (DA) interface to automatically generate various advanced alarms. Maintenance is very simple because the name of monitor tags need not be defined in advance.

## IMPROVEMENT CYCLE SUPPORT

It is important not only to periodically check whether or not an alarm is operating as expected or if an operator is doing the best possible job without any erroneous operation but also to examine the cause of the problem and take countermeasures as needed.

As shown in Figure 7, the Exaplog event analysis package chronologically sorts the alarms and events stored over a long period of time and quantitatively extracts the points to be improved by viewing and analyzing the opposite trends of alarms (upper left plus side in Figure 7) and manual interventions (upper right minus side). Since the sales launch in May 1999, Yokogawa has sold more than 350 systems to improve operations, control and field equipment reliability (Figure 7).

## CONCLUSION

We have discussed our advanced operation support solutions which effectively improve and exploit the abilities of plant operators. Whether or not safe, stable operations can be performed over a long period of time depends on whether process industry companies can employ good operators for a long time. In future, an advanced control system may have a function for raising the motivation of operators in daily plant operations. ◆

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