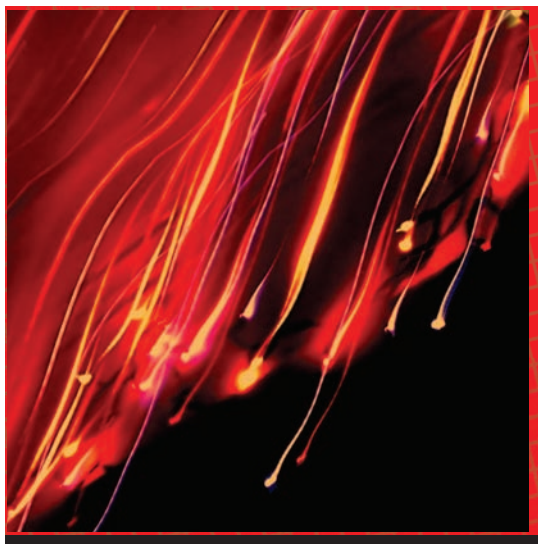

Towards the Next Generation of Integrated Production Control Systems

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Manufacturers today need a high degree of certainty and confidence to achieve timely production, and flexibility to make changes in product and material specifications. This enables them to effectively respond to intense global competition and major market shifts.
At the same time, suppliers of integrated production control systems need to focus on the adaptive evolution of their products by addressing manufacturers' needs to keep up with the fast pace of change in the business landscape and technology while delivering maximum return on assets and the lowest total cost of ownership.

This evolution in the latest generation of control systems represents much more than conventional functional improvements. It brings together concepts such as smart engineering, advanced operation, system agility, and sustainable plant. With these latest developments, plant operators can be assured of an optimum engineering environment that spans the entire plant lifecycle, from plant design and the engineering and installation of systems and devices to the start-up of production, maintenance, and renovation. In addition, it is designed to meet the most stringent industry requirements for safe and reliable plant operations and environmental protection.

The introduction of these crucial new control system components ushers in an operating environment that keeps everyone fully aware, well informed, and ready to face the next challenge. The result is a dramatic reduction in the time required to configure and install a control system.

Fig.1. Key technologies and enablers for the next generation of control systems

Key innovations

As described in an ARC White Paper published in February 2014, Yokogawa has identified four key innovations it wanted its latest platform to deliver (Fig.1):

- hyper-intuitive operation
- total automation management
- intelligent plant conductor
- sustainable plant.

Yokogawa has also identified two key technologies which it is using in developing these new innovations: field digital technology and dynamic simulation technology. These innovations are summarised in Fig.1.

Fig.2.Yokogawa's CENTUM VP R6.01 integrated production control system

Solutions based on these concepts are now being introduced as part of Yokogawa's ongoing development process for its CENTUM VP integrated production control system (Fig.2). The first phase of this process addresses a number of "pain points" felt by many of today's plant owner-operators as they strive for greater operational integrity. These solutions are described below:

New I/O subsystem

Fig.3.Yokogawa's N-IO (Network-IO) field I/O device for handling multiple types of I/O signals

N-IO (Network-IO) is a field I/O device with a versatile I/O module that can handle multiple types of I/O signals (Fig.3).

Control systems rely on field I/O devices for the transfer of data to and from sensors, valves, and other types of field instruments. Using this data, they automatically control a plant's operations. Depending on instrument models, the type of electric signal used to transfer this data varies. With Yokogawa's current field I/O device, a compatible I/O module is needed for each signal type.

The N-IO, a new CENTUM VP field I/O device, fulfils the functions of universal I/O and a signal conditioner, enabling configurable software and flexible I/O assignment. It has an I/O module that accommodates multiple I/O signal types, accepts up to 16 I/O points, and allows specification of an individual signal type for each point. Both analogue and digital I/O signals, which account for the majority of I/O signal traffic, can be handled solely through software settings. Pulse and relay I/O signals can be managed by using additional adaptors. With the N-IO, it is no longer necessary to replace the I/O module, reducing the amount of rewiring that must be done when changing sensor types and/or layouts during a plant revamp. This significantly reduces the amount of work that has to be performed by plant engineers and maintenance personnel.

In addition, Yokogawa has signed OEM agreements with Pepperl+Fuchs GmbH and MTL Instruments Group Limited, under which Yokogawa will receive baseplates and market them as its own products. These will be used in combination with the company's N-IO modules and intrinsic safety (IS) isolators procured from the two companies. Both partners have solid track records in the development of interface products for use in hazardous areas. This tie-up means that Yokogawa is able to ensure that the N-IO conforms to the major IS regulations in Europe, Asia, and the Americas.

FieldMate™ Validator

FieldMate™ Validator is a software tool that is used with N-IO devices to check field device wiring and verify that the device operates correctly. Until now, such verification could only be conducted using the CENTUM operation/monitoring screen, which required engineers to wait for all field I/O devices to be installed and the entire CENTUM system, including all operation/monitoring stations and system controllers, to be set up.

FieldMate Validator is provided with FieldMate, Yokogawa's field device management PC software. When FieldMate establishes a connection with an N-IO device, the FieldMate Validator tool can check in real time the wiring of all field instruments, based on the control loop I/O information in the control system's application software, to verify that they operate correctly. There is no longer any need for the whole CENTUM system to be installed to do this, thus saving significant time and providing added versatility in project execution.

Dynamic process simulator for operation – MIRROR PLANT

Dynamic simulation is also beneficial in the operating phase of the plant lifecycle. It provides visualisation within the control system of predictions from simulation models on the HMI, and can

include predictions of unmeasured process parameters, as well as predictions of future process behaviour, including alarms.

A new key product for delivering this benefit is MIRROR PLANT, Yokogawa's new dynamic process simulator for such applications (Fig.4).

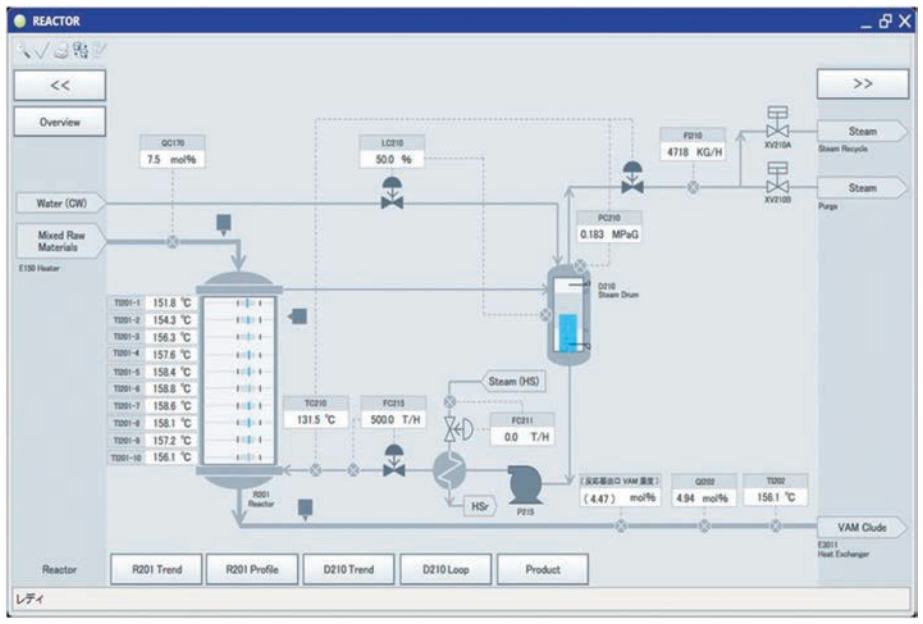

Fig.4.The Yokogawa MIRROR PLANT online dynamic process simulator

To operate the plant safely and efficiently, future plant behaviour is important information. By knowing the future process behaviour, operators can take adequate corrective actions quickly and in advance, avoiding more serious situations.

To achieve this proactive type operation, letting operators know future plant behaviour accurately is the key. The operating process behaviour is not the same as when the plant was designed, and greatly depends on daily circumstances.

MIRROR PLANT is a dynamic process simulator for such operational support. The simulator tracks actual process data, and dynamically modifies its simulation models. Using this mechanism, MIRROR PLANT can provide future process prediction (process data, alarms etc.) and indicate process values which are not directly measured by field sensors. Thus operators can know if the process is optimised regardless of current operation. They may be able to find the causes of periodic productivity reductions or future process conditions which will lead to potential problems later in time. This is critical to achieve safe and productive plant operation.

Automation Design Suite

The Automation Design Suite is an integrated platform that ingeniously facilitates project execution, system integration, and site execution, bringing certainty and confidence through all project phases and the start-up, operation, maintenance, expansion/upgrade, and extension stages of the plant lifecycle.

With advanced program templates for heat exchangers, filters, and other types of equipment commonly used in the field, the Automation Design Suite improves engineering efficiency and helps to ensure uniform quality. It is able to centrally manage the functional design documents that provide the basis for control system engineering, along with all the control program master data stored in the system's database. This approach simplifies history management when programs are modified, and makes certain that the latest design information is available when system expansion, modification, or maintenance is performed.

In essence, the suite generates a total engineering environment, with an entirely new database structure that feeds standardised and consistent engineering information, maintains engineering data integrity, eliminates inconsistencies between the design information and the actual system, manages change, and supports the automation lifecycle. At the same time, it facilitates the reuse of valuable engineering knowhow, eliminating the duplication of work for subsequent projects. This both saves time and reduces cost.

A common interface for control, safety, and asset intelligence provides operators with all the relevant information to aid in decision-making. This, together with embedded mechanisms such as consolidated alarm management software (CAMS), prevents information overload and ensures safe and unified plant operation.

The Automation Design Suite adopts a modular approach to automation design and execution, where process loops, alarm design philosophy, graphics and more are deployed as design patterns: downloaded, shared and re-used as standards across the enterprise, saving time and resources. It retains the entire engineering history of the plant from the design phase, through commissioning and live operation, which ensures up-to-date plant knowledge with every expansion or hardware and software change throughout the plant lifecycle.

The Suite provides dynamic management of design, investment and project effectiveness by auditing and versioning engineering changes, and facilitating effective engineering through modification packages. This serves to maintain project schedules by reducing the delays and the engineering impact of late design changes or scope changes. It also auto-documents and checks inconsistencies in project activity and software resources, easing difficulties in the project management process and signi¬ficantly reducing project risk.

Field wireless for control

Fig.5.Yokogawa's multi-function wireless adaptor enables wired devices that transmit and receive digital on/off signals or receive 4–20 mA analogue signals to function as ISA100 Wireless™ field wireless devices

As indicated above, field digital technology is one of the key drivers in optimising plant operation. Field wireless technology can ease the application of field digital devices to process plants with flexibility, safely, and lower installed cost (Fig.5).

ISA100 wireless technology can be used for highly reliable process control loops with field wireless. To enhance the reliability and to ease the application of ISA100 to control loops, the latest CENTUM VP system supports a specialised PID function block that compensates for any impact of packet loss, and makes the dynamic response after signal recovery smooth and stable. This widens the range of potential applications for field wireless in the plant, contributes to the increase of proactive maintenance capability, and to the accuracy of advanced process control to increase productivity.

Conclusion

The latest generation of integrated production control systems for the process industries feature concepts such as hyper-intuitive operation, total automation management, intelligent plant conductor, and sustainable plant. They aim to provide customers with an optimum operating environment that will improve the safety, reliability, and efficiency of their operations, and bring greater synergy between control systems and devices in the field. This will significantly improve production efficiency and optimise overall maintenance of their production control systems, safety instrumented systems, programmable controllers, and all field devices, resulting in reduced costs, long-term stability of operations, and optimum plant performance.

Reference

"The next evolution of Yokogawa CENTUM": ARC White Paper, ARC Advisory Group, February 2014