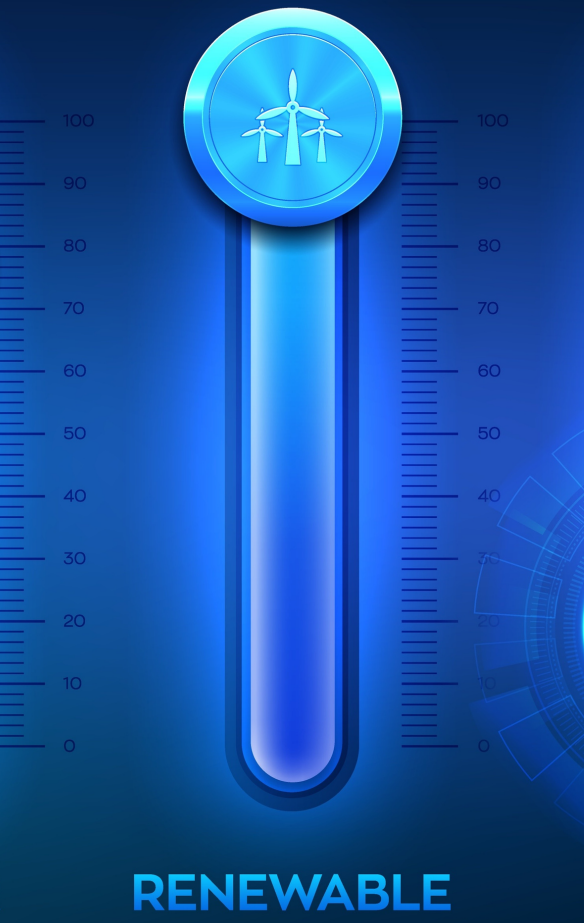

Edge, the 4.0 SCADA ecosystem for the hydrogen economy

Yokogawa considers autonomous operations to be plant operating environments with minimum human intervention and automatic adaptation driven by data.

For many years SCADA systems have combined hardware and software to control and monitor sensors and processes for industrial automation. However, traditional SCADA systems have become limited in the context of Industry 4.0 for extending beyond industrial automation to industrial autonomy. This involves incorporating added dimensions of automatic data-driven anticipation and adaptation to unforeseen plant operating conditions without human intervention.

The insufficiency of traditional SCADA or DCS systems alone for autonomous operations lies principally where there is emergence of multi-site, modular ecosystem business models; where individual site systems need to operate in conjunction with each other, as a system of systems.

Per the Purdue enterprise reference model (ISA-99), both systems (SCADA and DCS) are not designed to simultaneously achieve both vertical and horizontal data integration.

Take for example, increasingly modular green hydrogen production. Horizontal integration refers to the integration of the different on-premise systems with the electrolyzer system, the compressor system and the voltage system, amongst others. Often these systems have different interfaces/protocols such as OPC UA, Profibus DP, Modbus TCP/IP or the IEC61850.

Vertical integration refers to integration with the business domain, the Cloud (e.g. through MQTT interface), remote centers or IIoT devices where cybersecurity is crucial in supporting different architectures and protocols.

For large sites, horizontal and vertical integration is often separated through different systems. However, for smaller and modular operations, separate solutions are too complex and expensive. Therefore, Yokogawa has developed a proven edge computing solution, CI Server, specifically designed for vertical and horizontal

integration, encompassing multiple systems, simultaneously. This integration includes both data and HMI, as well as alarms and safety.

To achieve maximum efficiency with minimum plant operators (or even remotely), operators need one unified interface for operating all systems. This starts with operator graphics for operating all system modules. For the safety of the plant, the alarm philosophy and the safety override philosophy must also be integrated and aligned with all systems.

Collecting alarms from different systems is a common practice, however alarm handling, such as alarm confirmation, alarm suppression or alarm on/off is challenging because there must be bi-directional data exchange between the edge computing system and other systems. The same applies to safety overrides. In the event a module is delivered with a safety system, an operator may wish to override a safety loop to do maintenance, or other activities.

In the case of a Cloud environment, many of the data and messages collected by the edge system on-premise must be sent to the Cloud for analysis, with the outcome of the analysis then returned to the edge system. **In this way, the edge system becomes the data hub of the modular plant, crossing vertical and horizontal domains, enabling autonomous orchestration.**

Autonomous orchestration engines, such as CI Server, are vital for achieving the huge potential of autonomous and unmanned operations for increasing plant operating efficiency, productivity and keeping personnel out of harm's way.