

Natural Gas Well Automation using Kingfisher RTU Products

Introduction

Semaphore's Kingfisher RTU products have been applied to well site installations throughout the world. The product family includes the G30 compact RTU and Kingfisher Plus+ modular RTU. Selection among these products depends primarily on the I/O count. In addition, for locations, which lack power infrastructure, the Kingfisher LP-2 or LP-3 "low power" RTU best uses small, solar power systems.

While the G30 and LP-2/3 are suitable for locations with limited I/O requirements, up to 32 points, the Kingfisher Plus+ is highly scalable and suits processes requiring up to 1024 points.

Monitoring requirements include measurement of operating pressure, temperature, DP or flow, separator tank levels, compressor status, and valve status; periodically reporting this information to operations management; and reporting on exceptions when appropriate, for example, when an alarm indicates low flow or low pressure. Availability of this information not only ensures end-customer satisfaction but also allows a third party service provider to route personnel in the most efficient manner possible.

Automation requirements include operation of a flow/pressure valve or regulator and, often, operation of ESD and vent valves. An increasing number of wells, today, are also in need of optimization control, such as plunger lift.

Inputs/Outputs

Monitoring and automation functionality requirements at a typical well site are as follows:

- Pressure measurement for the well casing pressure.
- Pressure measurement for the well tubing pressure.
- Temperature measurement for the gas line to the meter.
- Differential pressure measurement across the orifice meter.
- Alternately, pulse inputs from a linear meter.
- Level measurement for single or dual separator tanks via analog inputs.
- Contact input indicating whether the instrument enclosure door is opened.
- Contact input indicating the open / closed status of the ESD valve.
- Contact input indicating the open / closed status of vent valve.
- Analog output to the pressure regulator or flow control valve.
- One or two discrete outputs to the ESD and vent valves.
- Optional, discrete input from a plunger arrival switch.
- Optional, discrete outputs to drive an audible alarm or status light.
- Optional, discrete outputs to open/close the feed line valve(s).

Monitoring and automation requirements for a typical well site are readily met by the Kingfisher G30 when equipped with a single I/O module that includes 14 discrete inputs, 8 discrete outputs, six analog inputs and two analog outputs.

Programmable Automation

Kingfisher is the first RTU to support ISaGRAF version 5, which includes IEC 61131-3 and IEC 61499 distributed processing. The IEC 61131-3 standard provides a choice of five languages (ISaGRAF adds a sixth) in order for programmers to use the language they find most suitable.

A set of pre-programmed function blocks provides numerous short-cuts and significantly reduces project engineering time. Semaphore has added, considerably, to the function block library that is standard with ISaGRAF 5. The updated blocks include the flow calculations that are used in conjunction with orifice meters and positive displacement meters as well as compressibility calculations. The Kingfisher library includes AGA3, AGA5, AGA7, and AGA8.

Semaphore has also built ISaGRAF programming into the Toolbox Plus+ configuration environment, which uses familiar Outlook-style menus that users find intuitive. Toolbox Plus+ includes powerful features, such as online simulation, and is designed to provide high functionality, plus the tools to expedite configuration, testing, and startup.



Communications

Kingfisher firmware includes a very large selection of communications protocols to provide wide compatibility with SCADA networks and PLCs as well as intelligent end devices such as analyzers, sensors, tank gauges, and transmitters. The drivers list includes such protocols as DF1, DNP3, Kingfisher, Modbus, SNMP, Cooper recloser, Enraf tank gauge, etc. This allows a Kingfisher RTU to drop into most any SCADA system in the oil and gas patch.

In Semaphore's opinion, DNP3 is the most powerful, SCADA communication protocol. Among the strongest implementations in the industry, the Kingfisher DNP3 suite exceeds level 3. Most RTUs are at level 2. Among such level 3 functions in the Kingfisher implementation is support of both DNP3 master and outstation modes.

Kingfisher also supports data concentrator, report-by-exception, multiple masters, prioritizing, peer-to-peer, objects and unsolicited messaging functions as well as most all data types.

For secure SCADA networks, end-to-end, DNP3 Secure Authentication is included in master and outstation modes.

In addition to the broad selection of communications protocols, Kingfisher is available with a large array of communications hardware. This ensures compatibility with media such as spread spectrum radio, which is popular in remote fields.

Alarm Management

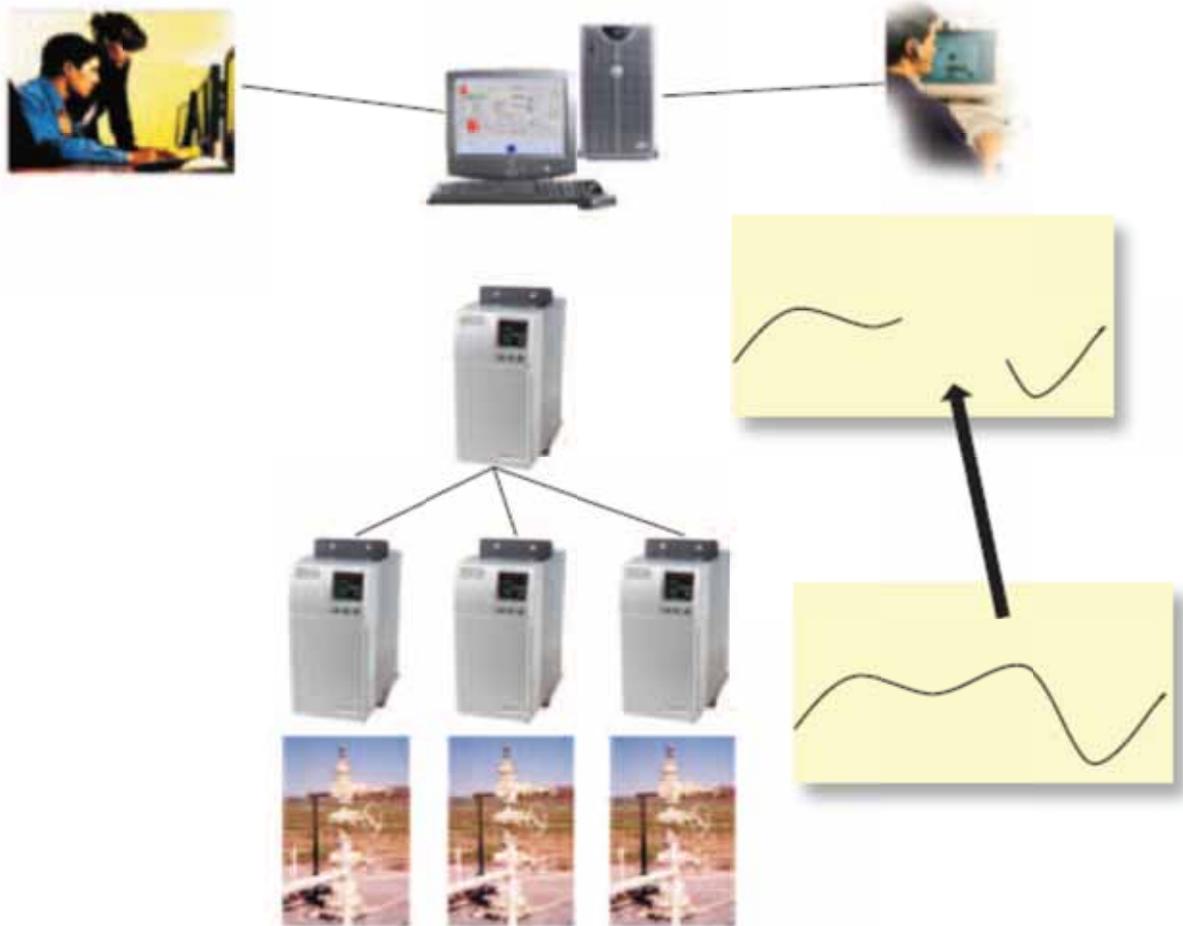
A Kingfisher RTU uses an alarm management system that not only detects and reports alarms but can be configured to require alarm acknowledgement and escalate unacknowledged alarms.

An alarm can be a transition on a discrete input or a condition that is determined by programmable logic. An example of the latter is a low pressure in gas line. The Kingfisher RTU will set an alarm when the analog input is below a user-configured limit. Multiple limits could be used. Some operations implement three low limits, including low, very low and out-of-service.

Historical Data Logging and Trending

On user-defined intervals, a Kingfisher will perform statistical calculations on measured inputs and update the historical log. Averages, totals, minima and maxima can be run over intervals such as hourly, daily, monthly, etc. Using DNP3, historical logs can be transmitted, as files, to a SCADA host computer system.

While the historical information is commonly used for inventory and billing purposes, long-term trends also contribute to continuous improvement programs.



Environmental Hardening

In remote locations such as a well site, Kingfisher products are subject to outdoor conditions. Electronics are designed for a wide range of -20 to 70 degrees C (-4 to 158 degrees F).

At a well site, the equipment could be installed in areas in which a combustible gas is present in the atmosphere. The Kingfisher G30 has Class I, division 2 hazardous area approval and can be installed practically throughout a production field.

Since well sites often exhibit earth grounding problems and electrical noise, isolation in the interface electronics is highly important. While the G30 provides 500V isolation, which meets well site requirements, Kingfisher Plus+ modules have even higher isolation, up to 5000V.

The small footprint in the Kingfisher G30 is conducive to use in very small, inexpensive enclosures. Even though the Kingfisher Plus+ uses modular construction, a variety of backplanes are available in order to meet installation constraints. A four-slot backplane fits in even the smallest enclosures.

Conclusion

Well site management applications take full advantage of the features offered by Semaphore's Kingfisher product line:

- Programmable automation — The IEC 61131-3 standard provides a choice of five languages (ISaGRAF adds a sixth) in order for programmers to use the language they find most suitable. In addition, a rich, function block library provides essential calculations and numerous short-cuts, which significantly reduce project engineering time.
- Communications compatibility — A broad selection of communications networking hardware and protocols ensures compatibility with most any system.
- Strong DNP3 implementation — The Kingfisher DNP3 suite exceeds level 3 and allows users to best exploit the many strengths of this protocol.
- Alarm management — The Kingfisher alarm system detects alarm conditions and reports them using push technology instead of waiting for the SCADA system to poll the RTU. Alarms can be categorized by priority.
- Data logging — Kingfisher data logging capability retains historical information, such as production level, and allows users to adapt operations for the highest efficiency. Trends can also assist in maintenance management and continuous improvement.
- Push technology — End user operations personnel are immediately notified of alarms and important events without waiting for a poll on the network. This takes best advantage of inexpensive data communications plans on public networks.
- Environmental hardening — Kingfisher RTUs are designed to operate in remote environments over extremes in humidity, temperature, vibration, and electrical noise.