FIELDCOMM GROUP™ PLANT OF THE YEAR 2011

Shell Scotford, Scotford, Canada – Plant of the Year 2011 Award Winner

Shell Scotford Uses HART Communication to Improve Device Monitoring and Save Money

PROJECT OBJECTIVES

- Support a safe and successful start-up of a 100,000 barrel per day expansion to an existing 155,000 barrel per day capacity facility

SOLUTION

- Leverage the full intelligence of HART-enabled devices by broadening the application of HART beyond the use of handheld device configuration
- Make all HART information available in centralized control room gathered either by a network of multiplexers or a Distributed Control System with HART I/O
- Use other more critical instruments for regulatory control with conventional HART 4-20mA control

RESULTS

- Safe and efficient start-up and continued safe and reliable plant operation
- Real-time daily instrument troubleshooting
- Preventable and predictive ongoing maintenance
- Overall savings in excess of $7.1 million (hardware replacement and ongoing operational and maintenance expenses). More benefits listed in table below.

As Canadian oil production from oil sands has been growing, many energy companies have been building new or adding to existing facilities to help fill demand for product from oil sand

sites. In 2011, Shell commissioned a 100,000 barrel per day expansion to its existing Scotford Upgrader. Supporting a safe and successful start-up would mean working quickly and efficiently with a minimum of mistakes. HART technology provided a way to streamline testing and pre-configuration of devices so when they were installed, everything was ready to run for a smooth start-up. Andy Bahniuk, R.E.T. Shell Lead Instrumentation Technologist, worked hands-on through the process. Here is his account of the experience.

In late 2010, the team at Shell's Scotford Upgrader Expansion faced a dilemma. How do we safely program and commission over 1,500 HART devices from 26 vendors (including HART Communication Foundation member companies Rosemount E+H, Fisher, Krohne, K-Tek, Magnetrol, Metso and VEGA Americas) in a timely fashion? How do we gain the trust of operations and upper management during loop checks and control narrative testing to guarantee a safe and successful start-up and continued smooth plant operation? How can we continue to provide daily instrument trouble-shooting, and not only preventable but predictable ongoing maintenance?

Benefits and Savings

- ✓ Fast and safe device configuration, programming and commissioning of 1200 HART devices from 26 vendors
- ✓ Loop function testing and process variable simulation performed in 30% of the time normally required without potential for human error
- ✓ Simulation of critical and complex safety narratives involving more than 15 inputs and multiple outputs for more than 50% in overall time saving
- ✓ Eliminated the need to add external hardware to more than 700 smart valve positioners saving approximately $2,000 per valve
- ✓ Monitoring secondary transmitter temperature variables remotely to improve efficiency in preventative maintenance on heated instrument boxes saving more than $200,000 annually
- ✓ Re-calibration, parameter checks and device diagnostics performed from central control room rather than at each individual transmitter location saving $100,000 annually

The answer was easy with the capabilities of HART Communication and a flexible asset management system. All the HART information was readily available in a centralized control room gathered either by a network of MTL multiplexers or our Distributed Control System (DCS) with HART I/O. A majority of the HART instruments are connected to the SIS (safety instrumented system), or to third-party vendor provided skids. Other more critical instruments are used for regulatory control with more conventional HART-enabled 4-20mA control.

The existing Shell Scotford facilities had experienced success using HART technology but were using only some of the full capability of the technology. With an interest in leveraging the full intelligence of their HART-enabled devices, the Upgrader Expansion project team got approval to broaden the application of HART on this project beyond the use of handheld device

configuration. This decision made valuable device information available to staff in operations, maintenance and instrumentation.

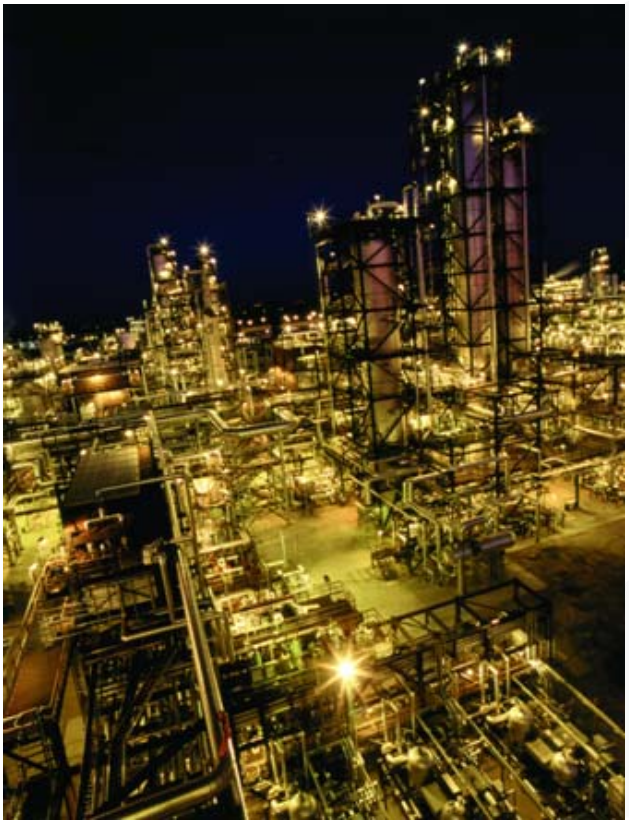
Measurement and control devices were to be shipped pre-configured, but when the devices arrived not configured, the challenge for the Instrumentation and Control team became downloading 1,500 instruments with ranges, engineering units, NAMUR values, and transmitter body temperature alarms.

They began by creating a database to provide these values in tabular form and establishing a systematic process of 24/7 transmitter downloading, allowing these critical values to be loaded in a timely fashion. This process saved time and enabled us to proceed with the next steps of commissioning: loop function and control narrative testing.

Critical testing

Loop function testing and process variable simulation were done using HART Communication and standard HART methods on the devices. All testing was centralized from one location and witnessed by both the Operations and Engineering teams. In some cases, where a device could not be tested without process present, such as a vortex or ultrasonic flowmeter, testing with device methods provided a perfect substitute. This ensured total confidence for both the operator and engineer that all field devices functioned properly. This procedure confirmed that all critical parameters were loaded successfully and saved 30% of the time normally required. It also eliminated the potential for human error associated with this work.

During control narrative and safety cause-and-effect testing, loop test methods were also used to simulate various process values and to walk through different process scenarios. This testing saved considerable time before the final phase of commissioning and start-up. Some of the critical and complex safety narratives involved more than 15 inputs as well as multiple outputs.



Using HART Communication and simulating all these inputs from the control room enabled us to test and complete with confidence. The overall time saving was over 50 per cent during this phase.

The value and versatility of HART technology during commissioning and start-up activities proved even more critical while trying to achieve a steady-state process condition. HART Communication was used for tuning

the smart Fisher DVC positioners for optimal process control and valve response time. It also allowed us to use the DVC6000 methods to fine tune the positioner to match the controller as well as perform valve calibrations in half the time.

Smart valve positioners also provide the ability to read the digital feedback of the valve position value without any additional hardware. With the information we receive from the positioner on the control valve, we are able to pass the digital feedback value using the HART fourth variable (QV) through the FDM gateway. This value is used on graphics to show the actual valve position feedback. This has eliminated the need for any external hardware in addition to the valve positioner, saving approximately $2,000 per valve.

It gets cold up there

During our long, cold Canadian winters the temperature can go as low as -45 °C. To protect the instruments from freezing, our transmitters have been mounted in insulated enclosures with heaters. During these winter months, monitoring the status of this heater is a critical task to ensure safe operation in our facility.

With HART technology we have the ability to monitor transmitter temperature variables and pass this parameter through our asset management system to alert maintenance if it starts freezing. We pass the temperature to operator graphics for live monitoring and surveillance. This has helped us improve our efficiency in executing annual preventative maintenance on heater boxes, saving us more than $200,000 per year. Most importantly, it ensures trouble-free operation throughout the winter.

Having a central location for device configuration and historian data collection is valuable during the life cycle of a HART device. Simple re-calibration, parameter checks and device

Above: Three pressure transmitters mounted in one instrument enclosure with a series of enclosure heater circuits below. By observing the transmitter body temperatures via the HART signal, Shell can detect a heater circuit fail from a low body temperature.

diagnostics can be performed right from the central control room. In the case of device replacement all parameters are stored in a central location and can be readily downloaded to a new device. When considering the expense of permits and gas testing as well as having to carry a handheld device to each individual transmitter, the cost saving is in the magnitude of $100,000 annually.

Safety and reliability

At Shell, safe and reliable operation is a core value. From the beginning, Shell took important steps to ensure the focus on a safe and steady start-up were the priority throughout the process.

During the initial project phase, Shell decided to use the NAMUR settings to prevent spurious trips or unsafe operations caused by faulty transmitters. HART devices compliant with NAMUR standard values provided that infrastructure. Risk of instrument failure tends to be higher during the start-up and by setting our device compliance to NAMUR standard values we could ensure that our start-up went smoothly and without any major instrument issues.

LEFT: A valve with a Fisher DVC positioner. Shell is able to calibrate these types of valve positioners via the HART signal during start-up. They can also monitor feedback right from the valve for valve position via HART while running.

Another challenge was to have a higher SIL (Safety Integrity Level) rating on some critical furnace gas valves to ensure safety and reliability. The partial stroke test (PST) function supports testing valves without the need to isolate them from the process.

With the PST process, the respective valve is moved by approximately 5% to 15% during normal process operation. This testing supports online diagnosis of the actuators and reduces the probability of failure on demand (PFD). Our HART asset management system with Metso positioners using an FDT/DTM driver can execute the PST to provide a sophisticated and quick solution.

All the functionalities, beginning with pre-commissioning to normal operation, were the same for HART and Foundation fieldbus devices. Shell uses both and has taken full advantage of both technologies; the biggest benefit being that we did not have to subject our HART devices to any separate interoperability testing. All our HART devices were plug-and-play, connected through an asset management system. This provided full advantage of EDDL and FDT/DTM technology without any additional testing. We are using the ability to open a virtual window and unlock all the power of HART Communication for any type of measurement device as well as all manufacturers.

Ongoing maintenance

Shell uses HART status byte information (sent with each communication request) to represent the device health status on maintenance graphics. HART device status gives important information such as device malfunction, device in simulation, device variable saturated, and most importantly, the device has more status information available. These graphics create an easy visual of the device status at a glance. Monitoring real-time device diagnostics with more status available will direct maintenance to troubleshoot the device in detail and has reduced trouble-shooting time tremendously. Finding “bad actors” has never been easier.

About Shell Scotford

Shell Scotford is home to three distinct operating facilities:
- *Chemicals*—Manufactures 530kt/yr of styrene monomer and 604 kt/yr of ethylene glycol
- *Refinery*—Capacity 100,000 bpd
- *Upgrader*—Total Capacity 255,000 bpd (including 100kbpd expansion)
- Total staff on site is more than 1,300 (plus contractors).

Host systems:
- Refinery—Foxboro DCS
- Upgrader—Honeywell DCS and Field Device Manager