Fieldbus Success Stories and Strategies

Executive Overview ........................................................................................................... 3
Fieldbus Installations Are Booming .................................................................................. 4
Key Fieldbus Benefits to Users ......................................................................................... 5
Fieldbus Foundation Presses On ......................................................................................... 7
Profibus Gains Ground in Process Plants .......................................................................... 10
BP Implements Foundation Fieldbus in Critical Chemical Application .......................... 12
Statoil Implements Profibus for Remote Offshore Platform ............................................. 16
Implementing Fieldbus in Existing Plants ........................................................................ 19
Reduced Hardware Costs (Wiring, I/O, Etc.)
  Reduced Process Variability
  Increased Product Quality
  Increased Capacity Utilization
  Reduced Maintenance Costs
  Reduced Commissioning/Engineering Costs
  Reduced Spare Parts Inventory
  Improved Safety & Regulatory Compliance

Fieldbus Benefits Go Beyond Reduced Wiring Costs

Not Cost Effective for Existing Installations
Primary Cost Savings Is Reduced Wiring
  Not Enough Products Available
Technology Is Not Field Proven
Technology Not Suited for Critical Applications/Large Installations
We’ll Wait for a Single International Standard to Emerge
Cannot Handle the Training/Learning Curve Costs

Most Arguments for Not Using Fieldbus Are Fallacies
Executive Overview

Many viewed fieldbus as the promise of the next generation of control systems. Fieldbus would finally provide open, common control and field networks for all control systems and would provide unlimited, digital interoperability between field devices and control systems from all suppliers. The original group of process fieldbus developers, once united, has splintered and is now polarized into the Profibus International and Fieldbus Foundation.

Despite the continued squabbling, infighting, and consternation that continues to plague the world of fieldbus and device networks, the installation of fieldbus-compatible control systems and devices in process plants is proceeding at a solid pace worldwide. Today, the Fieldbus Foundation claims to have over 1,800 Foundation Fieldbus-compatible systems either installed or on order worldwide, with over 40,000 devices installed. Three years ago, ARC recommended that users implement fieldbus in small, noncritical installations and pilot plants. Today, fieldbus technology is employed in large, critical applications worldwide. This strategy report will examine the current state of the two primary process fieldbus organizations – the Fieldbus Foundation (FF) and the Profibus International (PI). Two current fieldbus installations will also be profiled.

While new plant construction tends to be rare in the early part of 2001, there are many process plants with older and often obsolete process control systems. Early DCSs cannot easily be converted to take advantage of new smart instrumentation such as HART or Foundation Fieldbus, and often cannot be easily extended to become part of enterprise networks for participation in supply chain planning or collaborative business processes.

While ARC recommends that users adopt fieldbus technology and that fieldbus will be the basis for new control system architectures in the future, this does not mean that fieldbus is a panacea. Any user implementing a new technology for the first time is bound to run into problems, and fieldbus is no exception.
Fieldbus Installations Are Booming

A few years ago, fieldbus was the hottest topic in the world of process automation. Many viewed fieldbus as the promise of the next generation of control systems. Fieldbus would finally provide open, common control and field networks for all control systems and would provide unlimited, digital interoperability between field devices and control systems from all suppliers. The current reality of fieldbus, however, is a long way from that original vision.

Delays in the ISA and IEC fieldbus standardization process in the early ’90s led to the rise of competitors such as the now-defunct Interoperable Systems Project (ISP) and WorldFIP North America, which combined to form the Fieldbus Foundation. The Profinet International took the remaining technology from the ISP development effort and combined it with Profinet DP to create the Profinet PA protocol.

The original group of process fieldbus developers, once united, have splintered and are now polarized into the Profinet International and Fieldbus Foundation. Efforts at international standardization have been affected by this polarization. The latest fieldbus standard drafted by the IEC is an all-inclusive, which includes not only Foundation Fieldbus and Profinet, but other device networks such as ControlNet, P-Net, Interbus, SwiftNet, and WorldFIP. So much for the vision of a single interoperable fieldbus.

Despite the continued squabbling, infighting, and consternation that continues to plague the world of fieldbus and device networks, the installation of fieldbus-compatible control systems and devices in process plants is proceeding at a solid pace worldwide. Today, the Fieldbus Foundation claims to have over 1,800 Foundation Fieldbus-compatible systems either installed or on order worldwide, with over 40,000 devices installed. Similarly, Profinet claims to have an installed base of over 2 million devices worldwide.

Even with all this collateral in the form of installations, products, and continued product development, why does fieldbus continue to be such a low-key topic in the process industries? Three years ago, ARC recommended that users implement fieldbus in small, noncritical installations and pilot plants. Today, fieldbus technology can and is employed in large, critical applications worldwide. This strategy report will examine the current state of the 2 pri-
mary process fieldbus organizations – the Fieldbus Foundation and the Profibus International. Two current fieldbus installations will also be profiled. Both of these installations are relatively large installations in the process industries that involve critical processes.

Today’s automation market is increasingly gravitating toward performance-based automation contracts. With so few new plants being built and capital spending continuing to contract, users are striving to squeeze more and more performance and productivity out of their existing systems and processes. In ARC’s view, fieldbus remains a critical component in the performance enhancement equation. The technology is equally suited to existing installations as well as new plants and retrofits.

The standard arguments for not implementing fieldbus technology are pervasive in the process industries. Most of these arguments are fallacies and are easily refuted. ARC believes that any investment in fieldbus, whether it be in an existing plant, retrofit, or new installation, will more than pay for itself when compared to installation of conventional systems, instruments, and control networks.

Key Fieldbus Benefits to Users

This is probably the most common argument against fieldbus implementation. What is the point in retrofitting your entire control system infrastructure and instrumentation to fieldbus technology when the technology primarily lends itself to new installations?

ARC highly recommends that any users considering a retrofit or modernization of their control systems and instrumentation consider fieldbus technology, regardless if it is Foundation Fieldbus or Profibus. Fieldbus costs savings are not limited to initial installation and commissioning costs. Perhaps the most important area of return on investment from fieldbus is
reduced maintenance costs and implementation of predictive maintenance strategies. PDVSA, for example, recent upgraded their control systems at the company’s Isla refinery in Curacao. Reduced maintenance and configuration costs were cited as primary reasons for upgrading to a fieldbus-based system.

**Primary Cost Savings Go Beyond Wiring**

As stated above, initial costs such as wiring, hardware, and commissioning are not the only areas of cost justification associated with fieldbus. Other primary areas of fieldbus cost justification include increased capacity utilization, reduced process variability, increased plant availability, reduced maintenance and operations costs, and improved regulatory compliance.

The increased accuracy of fieldbus-compatible instrumentation results in less waste and improved capacity utilization, and improved product quality. No matter how sophisticated your control system is, the control implemented is only as good as the measurements that are obtained from the field. Improved measurements from the field mean increased capacity utilization, reduced waste, and improved product quality.

**Fieldbus Technology Is Proven in the Field**

The lack of proven installations was typically a reason for not installing fieldbus technology, but the number of installations in the process industries today negates any of these concerns. Foundation Fieldbus, for example, has close to 2,000 installations either completed or on order. Installations in North America include companies like ExxonMobil, Weyerhaeuser, Anheuser-Busch, and BP Amoco. Both the FF and PI have large user groups that offer support and drive future development of fieldbus technology.

**Don’t Wait Around for a Single International Standard to Emerge**

The lack of a single international fieldbus is not a matter that will be resolved any time soon. With the IEC’s acceptance of the eight-headed fieldbus standard, it seems the issue of which protocol emerges on top will be decide by market dynamics and customer needs. On the process side of the business, users are limited to the choice between the FF and the PI. Waiting for a sin-
ingle standard to emerge will take too long. In the meantime, your plant operations are falling behind in terms of technology, and you may be losing the benefits of better measurements, lower maintenance costs, and resulting tighter control.

**Fieldbus Benefits Outweigh Training and Education Expense**

Many users state that the cost of overcoming the fieldbus learning curve is too much. Learning the new technology and software that comes with it is too time consuming. They also use the argument that fieldbus technology is not yet complete to the point where a large number of suppliers can offer a wide range of products and host software that have passed interoperability testing and certification. While this may be true in some areas (only three suppliers have passed FF host systems interoperability testing, for example), this is a poor reason for avoiding fieldbus technology and its resultant benefits altogether.

**Fieldbus Foundation Presses On**

The Fieldbus Foundation remains dedicated to its mission of developing a single, interoperable fieldbus standard. In the process industries, the Foundation probably has the greatest base of support from a supplier standpoint. The Fieldbus Foundation’s efforts are focused on the development of the H1 (low speed) and H2 (high-speed control network) fieldbus protocols, as well as the testing and certification of supplier products that are based on these protocols.

The FF also has an extensive End User Council (EUC), which provides an international forum for information exchange. Regional End User Councils (RECs), are established in key geographic regions worldwide. EUC members share experiences from field trials and initial installations. The EUC also drives the development of fieldbus technology to ensure that it meets the needs of end users. Membership is open to any end user or institution. Suppliers cannot become members but can attend and contribute to EUC meetings.
**HSE Final Specifications Released with Products Available Now**

High Speed Ethernet (HSE) is the Ethernet-based version of Foundation Fieldbus, fulfilling the H2 control network function. HSE supports the same functions but at a much higher bandwidth (100MB). Its large capacity to move data, along with the inherent FF functionality and publish/subscribe access make it the leading candidate for plant-wide integration in the process industries. In the year 2001, ARC expects most PAS suppliers to offer Foundation Fieldbus HSE as their control level network, bridging directly across multiple Foundation Fieldbus H1 bus segments. ARC also expects to see some direct HSE connections to a few high performance sensors and actuators.

HSE, the high-speed Ethernet-based control network for Foundation Fieldbus, was the missing piece in the total Foundation fieldbus puzzle. The conception and eventual release of HSE specifications was actually a very quick process. The original idea for using Ethernet in conjunction with Foundation Fieldbus to create a high-speed control network was born in 1998. Final specifications for HSE FF were released in March of 2000, after months of intensive testing and validation.

In December of 2000, the FF released a testing kit for HSE linking devices (HTK). With the introduction of the test kit, the FF expects to be registering HSE linking devices soon. Many FF members have already developed alpha linking devices along with the release of the HTK. These companies will use the HTK to test these devices as part of an alpha/beta validation program. Some suppliers are already offering HSE as part of new control system order specifications.

**No Shortage of Products Available, But Certified FF Host Software Is Scarce**

Most of the major process automation suppliers offer at least a couple of token FF products that have been certified and tested by the Foundation. Other suppliers, such as Fisher-Rosemount, Yokogawa, Smar, and Endress+Hauser, offer complete suites of process instrumentation that are FF-
compatible. In either case, no user should have a problem finding a FF-compatible flowmeter, pressure transmitter, or other field device for their application.

Certified host software, however, is another matter. In March of 2001, the FF announced that it would commence Host Interoperability Support Testing (HIST), which will enable suppliers to demonstrate that their host systems deliver an acceptable level of functionality and interoperability. According to the FF, “HIST provides generic test procedures performed or witnessed by qualified Fieldbus Foundation staff on Foundation Fieldbus systems”.

The tests demonstrate that a host system conforms to the feature checklist defined by the FF. The checklist includes features such as: Device Tag Assignment, Device Address Assignment, Configuration of Link Master Devices, Block Tag Configuration, Block Instantiation, Standard Blocks, Enhanced Blocks, Custom Blocks, Function Block Linkage Configuration, FF Alert Configuration, FF Alert Handling, FF Trend Configuration, FF Trend Handling, Device Description Services, DD Method Execution, DD Menu Handling, DD Edit Displays Handling, and Capabilities Files.

Currently, several suppliers have passed the HIST test, including Yokogawa, Fisher-Rosemount, ABB, and Brazilian instrumentation supplier Smar. ARC expects that most of the major control system suppliers that support FF will have HIST compliant host software soon.

**Patent Dispute Issues Resolved**

Last year, there was a dispute between field device supplier Endress+Hauser and Fisher-Rosemount over certain patents filed by Fisher-Rosemount in the process of developing the DeltaV control system and PlantWeb architecture. At the completion of the DeltaV development project, the Fisher-Rosemount engineering team was asked to document and follow-up with patent claims for all new or novel technology in their area of contribution.

Following good engineering practice, these patent claims were intended to prevent any other company from claiming patent coverage in the same areas of technology. Such practice is normal for all product development companies, but the recent trend toward software patents has enabled more patents to be filed with many claims covering all aspects of the technology. En-
dress+Hauser’s problem was not with these patents, but with conditions they perceived were necessary to license these patents.

The FF announced in April of 2001 that it had finalized agreements with Fisher-Rosemount and Honeywell regarding these patent disputes. The agreements involve three of the field control patents, as well as the patent for Distributed Function Blocks held by Fisher-Rosemount, as well as two download patents held by Honeywell for programming field devices. The FF now has rights to all of the technologies described in these patents, which should hasten the development of new FF-compatible products and alleviate any concerns that other suppliers may have had about access to FF technology.

Profibus Gains Ground in Process Plants

Although its roots are in the discrete industries, Profibus continues to build a significant presence in process plants, particularly in Europe. The Profibus for Process Automation (PA) protocol is the PI’s counterpart to Fieldbus Foundation’s H1 field level protocol. Unlike the FF, the PI has had a control level Profibus network for some time in the form of Profibus DP. In fact, it was the control network that was developed first by Profibus, followed by the process field device network. Profibus International has over 1,000 members in 22 countries, as well as competence centers in 20 countries. The main PI support center resides in Karlsruhe, Germany. PI claims to have over 4 million installed devices, over 2,000 available products (includes all Profibus products), and more than half a million systems and applications installed.

Like Foundation Fieldbus, Profibus has a wide range of products available at the field device level. Endress+Hauser, ABB, Siemens, Milltronics, Invensys, Samson, Smar, Vega, and even Emerson Electric subsidiaries El-O-Matic and Brooks all offer Profibus PA-compatible field instrumentation. Profibus host software at the process automation system (PAS) level, however, is markedly different. Siemens, ABB, and Foxboro are the only major PAS suppliers listed on the PI web site as having compatibility at the control system level.
Nevertheless, other suppliers such as Honeywell are listed as having control systems in Profibus installations.

**Profibus Develops Certification Process**

One of the key aspects missing from Profibus for many years was a good certification process. Profibus has now established a certification system to ensure a certain level of functionality and interoperability. PI uses accredited test laboratories to test products for compliance with the specification. PI then issues certificates for devices successfully passing these tests. Currently, there are five laboratories worldwide that are authorized to execute interoperability and certification tests.

**The ProfiNet Strategy**

PI introduced the initial specifications for ProfiNet in March of 2001. ProfiNet includes Profibus communications over Ethernet, but also goes beyond that to specify an entire automation framework based on standards such as OPC, DCOM, Ethernet, and IP in conjunction with Profibus to create an open automation architecture and common object modeling environment. While developing a single common automation framework for all automation systems may seem like an unattainable goal, PI seems unphased by the challenge. Currently, the ProfiNet strategy remains somewhat vague as to the exact architecture of ProfiNet, other than its acceptance of industry standard technologies and development of common automation objects, and Profibus over Ethernet technology. ARC will follow developments in ProfiNet technology as they happen.

**Profibus Introduces Communication Function Blocks**

PI recently developed a common application interface to Profibus DP. The new Profibus Communication and Proxy Function Blocks defines function blocks (FBs) that are based on the IEC 61131-3 standard. PLC and field device suppliers can create communication FBs and deliver them as part of a library. The new specification will be available soon from PI.
BP Implements Foundation Fieldbus in Critical Chemical Application

The recent implementation of Foundation Fieldbus for control applications at BP Chemicals’ Lima, Ohio plant is an excellent example of how fieldbus technology is ready to be applied in critical control processes in large continuous process facilities. BP also came up against several challenges regarding fieldbus implementation, including justification on the manufacturing, commercial, and project management levels, as well as design, cost, and construction issues. The company also had a tough time deciding which of the available benefits offered by fieldbus they wanted to use to their advantage.

In mid-1998, BP Chemicals was in the early phase of designing a new 70KTY 1-4 Butanediol plant. The project involved the selection of a new process automation system. The previous installed system featured digital integration of field devices through a proprietary digital protocol, so the project team was already aware of the benefits of digital integration. It was decided that adoption of Foundation Fieldbus technology was the next logical step, but the team knew that convincing the conservative management structure that fieldbus was a good investment would be a challenge.

Getting Buy-in from Management and Operators Is Key

To convince management of the viability of fieldbus, the project team looked tried to match the benefits of fieldbus with the corporate strategies set forth by BP Chemicals. Some corporate directives and strategies that the team looked at included manufacturing excellence, quality improvement, empowerment of operators, and process optimization.

Some of the specific features of fieldbus that enabled corporate strategies and directives included remote monitoring and diagnostics capabilities. Reduced maintenance costs, specifically operator-performance of routine maintenance tasks and predictive maintenance of control valves, were key selling points to internal management. The remote diagnostics capabilities in Foundation Fieldbus-enabled control valves ensured that only valves that were in need of maintenance were removed during regular maintenance turnarounds. Remote diagnostics also enabled predictive maintenance of control valves, allowing BP to plan for outages and minimize spare parts inventory. According to BP, the remote diagnostics enabled by Foundation Fieldbus also
helped to avoid five process interruptions, as well as the potential for serious equipment damage. Other key advantages enabled by fieldbus included self documentation of instrumentation.

<table>
<thead>
<tr>
<th>Foundation Fieldbus</th>
<th>Conventional</th>
</tr>
</thead>
<tbody>
<tr>
<td>70 single-pair cables</td>
<td>18 24-pair cables</td>
</tr>
<tr>
<td>&lt; 1500 terminations</td>
<td>&gt; 5600 terminations</td>
</tr>
<tr>
<td>&lt; 100 loops drawings (segment drawings)</td>
<td>200 loops drawings</td>
</tr>
<tr>
<td>0 JB drawings</td>
<td>15 JB drawings</td>
</tr>
<tr>
<td>Reduced loop check</td>
<td>Traditional loop check</td>
</tr>
</tbody>
</table>

**Foundation Fieldbus Benefits for BP Amoco Lima**

Another key aspect that helped internally sell fieldbus was the great enthusiasm that the plant operators had for the technology. The project team invited the operators to preview the technology. Operators in the plant were attracted to Foundation fieldbus features such as real-time feedback of actual valve position, improved measurement diagnostics, the ability to zero transmitters, and secondary variable availability, such as ambient temperature conditions for pressure transmitters. The operators then provided this input to their supervisor, which made it easier to convince him as well.

**Cost Savings Are There, But So Were Trade-offs**

Overall, BP realized approximately $200,000 in savings for the project. Cost savings were most pronounced in the areas of cabling, terminations, loop drawings, junction box drawings, and reduced loop check times. Some potential cost saving areas of fieldbus were not taken advantage of. BP’s use of a chicken foot topology made the installation almost identical to a traditional point-to-point installation in terms of field device to junction box wiring.

The initial cost of the field devices was also higher, since Foundation Fieldbus enabled devices currently have an initial cost that is up to 15 percent more than ordinary smart transmitters. BP also reported that factory acceptance testing (FAT) of the control system was complicated by the inclusion of fieldbus. The installation was also a mix of conventional and fieldbus-enabled devices, which added a level of complexity. BP also chose
the most expensive termination hardware to minimize the chances of a segment being shorted when devices were removed for maintenance.

**Implementing PID in the Field**

The systems integrator that BP worked with was enthusiastic about the application of fieldbus technology, and BP chose to do nothing to indicate fieldbus applications specifically on the P&ID diagrams. The team instead chose to treat fieldbus as a “controls application nuance” similar to I/O card loading. The team did, however, establish several engineering guidelines for loading fieldbus segments.

The first step was to identify critical valves, the failure of which has a high likelihood of leading to a costly process shutdown. The company identified three classes of critical valves. Level 1 valves are valves whose failure would immediately cause a shutdown in the process. Level 2 valves were those whose failure required quick operator intervention to avoid process shutdown. Level 3, valves were those whose failure would require operator intervention but would not cause a shutdown.

The project team determined that no level 1 valve could share an H1 card or fieldbus segment with another level 1 or level 2 valve. Lesser restrictions were placed on level 2 valves with even fewer on level three valves. Through the use of these classifications, the team could effectively plan where to place PID algorithms in the valve positioners. In some cases, the team designed segments with three or more level three valves.

The team applied the Backup Link Active Scheduler (BLAS), and determined that application of PID in the field was actually more fault tolerant than placing all PID algorithms in centralized controllers. The team decided that since a power failure or short would send all valves to failure positions if PID resided in the central control room. PID in the field would mean that control would continue only at the expense of the process view if the H1 interface card were to fail. The team also chose to keep primary and secondary components of cascade loops on separate segments, reasoning that at least one variable would remain visible in the event of a communications interruption or failure.

**Fieldbus Implementation Presents Challenges**

With conventional field device installations, assignment of I/O can occur independently of the piping, instrument location, and electrical design effort.
In fieldbus installations, however, instruments may need to be located before detailed piping design is complete, and before locating junction boxes. Therefore, the allocation of devices to segments must be done with knowledge of their physical location in the plant. Many instrument designers are accustomed to relying on completion of piping design and may be unprepared to locate instruments up-front. In the case of the BDO project, the team had to try to make a best estimate based in the location of major equipment, which turned out to be reasonably good and presented few difficulties.

BP chose not to perform calibration in the field for the project. The company paid an additional $25 per transmitter to have the supplier certify and provide a record of calibration for all devices. BP also opted not to perform any bench checking for control valves and had each valve auto calibrated in place. BP experienced no negative consequences from either of these decisions. For fieldbus devices, BP decided to only perform a communications check. Transmitters were disconnected once at the device level to ensure the correct tag number was installed in the right location. The device was again disconnected at the junction box level to further ensure correct tagging. These tagging checks ensure that the cable is accurately tagged when the instruments is disconnected at the box for maintenance.

So far, BP is pleased with the performance of the fieldbus control system. Most of the problems that have been reported are related to device revisions, device descriptor files, and engineering units. All of those problems were relatively easily solved. Fieldbus will be considered seriously for future projects at BP Amoco.

The current lack of availability of HSE (H2) Foundation Fieldbus was one item that BP cited as a disadvantage. BP instead used Modbus communications for multiplexers, ESD communications, and other tasks. The implementation of Modbus for these tasks, according to BP, consumed half of the configuration time for the project. Foundation Fieldbus-compatible on-off valves were also not available at the time of project implementation, and would have reduced rack room footprint considerably had they been available.
Statoil Implements Profibus for Remote Offshore Platform

Fitting a remote, unmanned oil platform in the North Sea with intrinsically safe fieldbus-compatible devices and control system would probably have been unthinkable just a couple of years ago. Recently, however, Norwegian offshore oil company Statoil is installing intrinsically safe Profibus instruments and systems on the Huldra oil platform, which is being commissioned right now in the North Sea. Over 250 Profibus PA-compatible instruments will be installed for both safety system and process automation system (PAS) applications.

The Huldra field is under development to start producing gas and condensate in the autumn of 2001. Wet gas from Huldra will be piped through a dedicated 150-kilometer line to Norsk Hydro’s Heimdal field for processing and onward transmission to continental Europe. Partially stabilized condensate and produced water from the field will be piped via a 16Km pipeline to the Veslefrikk platform for processing.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Four Instrumentation Systems Installed, Including PAS, Process Shutdown, Emergency Shutdown, Fire &amp; Gas</td>
</tr>
<tr>
<td>2</td>
<td>Approximately 50 Profibus PA Network Segments Installed</td>
</tr>
<tr>
<td>3</td>
<td>180 Field Devices for PAS</td>
</tr>
<tr>
<td>4</td>
<td>80 Field Devices for Process Shutdown System</td>
</tr>
<tr>
<td>5</td>
<td>Wireless 155 Mbps TCP/IP Radio Communication &amp; Control from Veslefrikk Platform</td>
</tr>
</tbody>
</table>

Huldra Project Statistics

Remote, Unmanned Platform Through TCP/IP Radio Communications

Primary control services for the unmanned Huldra platform will reside on the Veslefrikk platform, where the main operator stations are located. The Huldra platform itself replicates this equipment in its own control room, allowing the platform to be managed locally when required. Data will be transmitted to Veslefrikk from Huldra through TCP/IP radio communications.

Data from Huldra is communicated to the manned Veslefrikk platform via a 155Mbs TCP/IP radio link. Though radio links can suffer dropouts in the North Sea environment, communications are normally resumed quickly.
Under most circumstances, this poses no operational problems. The Huldra platform will shut down automatically if the radio link is down for longer than a few minutes. A second set of Ethernet networks and servers provide remote automation services to enable all aspects of Huldra – including valve openings and closures - to be controlled from Veslefrikk.

**Huldra a True Multivendor Fieldbus Installation**

Huldra is a groundbreaking installation for Profibus. Huldra is the first multivendor IEC 61158-compliant Profibus PA installation for an offshore platform, as well as the first time Statoil has implemented an unmanned offshore platform and the first time that Fisher-Rosemount instruments have been used in a multi-vendor Profibus-PA offshore application.

The main engineering contractor for the Huldra project is Kvaerner. Statoil chose Siemens as their Safety and Automation Systems supplier following a competitive bid by several vendors and they specified that Fisher-Rosemount pressure, temperature and differential pressure instrumentation should be used. When Kvaerner was awarded the EPC contract, the SAS contract was transferred to Kvaerner to follow up. The platform also uses Profibus-PA valve positioners from ABB, Vega level instruments, and Siemens process instrumentation.

Four instrumentation systems are installed on the platform. These include emergency shutdown systems (ESD), fire and gas, process shutdown, and a process automation system. Each system is under the control of a Simatic S7-417H CPU, which includes hot standby, redundant Ethernet networks, and dual servers. Redundant local operator stations on these networks can assume control of the platform if needed. Graphics intensive data is separated from measurement data on the different servers to ensure efficient division between process maintenance and supervisory control data flows. Standard I/O is used by the ESD and fire and gas systems to communicate with field safety devices. Failsafe CPUs conforming to Profibus safety technology connect conventional remote I/O via Profibus-DP in parts of the ESD system.

Fisher-Rosemount implemented the Profibus protocol in their instruments, and tests were carried out at an early stage in the project. According to Siemens, the integration of Fisher-Rosemount pressure and temperature
instrumentation into the Siemens system architecture was successful. One of the primary issues faced with the integration of Fisher-Rosemount field devices with the Siemens control system was to meet slightly different failure capabilities. F-R transmitters can handle a maximum power source of 1.2W under failure conditions, so the project team installed Hawk interface modules to reduce the FISCO-compliant 1.8W of Profibus-PA transmitters.

Profibus-PA instruments for the PAS and PSD systems are connected via link modules dropped from Profibus-DP ‘distributor’ fieldbuses. There is a total of roughly 50 of these Profibus PA networks installed at Huldra. These networks connect about 180 field devices for the PAS and 80 for the PSD, making a total of between 4 and 5 Profibus-PA devices per loop. Each loop is connected to a Profibus-DP/PA coupler module and routed to field junction boxes via multi-core cables. All instruments are addressed in sequence as if they were on a single network to simplify operations and maintenance.

Statoil Still Determining Cost Savings

According to Statoil, most of the cost savings are expected to occur in the area of operational savings versus installed cost. The installed cost was actually more than anticipated because of increased engineering expense. The most positive reaction to the installation comes from the maintenance and operations people who have adopted the new technology in new ways. Huldra is in the final stages of commissioning with full production due to start October 1st. There will also be a learning curve as operators discover new ways to use the technology.

Statoil’s discovery that installed cost benefits did not live up to expectations is not a surprising one. BP experienced similar trade-offs, and the fact that this is the first multivendor Profibus-PA application to be installed on such a large scale also adds a level of complexity. The fact that Huldra is a relatively large grassroots installation also adds a level of complexity.
Implementing Fieldbus in Existing Plants

While new plant construction tends to be rare in the early part of 2001, there are many process plants with older and often obsolete process control systems. Early DCSs cannot easily be converted to take advantage of new smart instrumentation such as HART or Foundation Fieldbus, and often cannot be easily extended to become part of enterprise networks for participation in supply chain planning or collaborative business processes. Many plants are still equipped with older single loop analog controls or even pneumatic controllers. The retrofit market looks attractive to suppliers, and should be profitable for users to spend their limited process improvement budgets.

How can the user afford to modernize process control systems when capital budgets are non-existent or too small for a new PAS? Even more, how can we update our control systems when we cannot afford even one minute of plant shutdown? The answer, suggested by this report, is to use incremental process improvement (IPI). While this strategy has always been possible, it now is facilitated by Foundation Fieldbus.
Incremental Process Improvement

The guidelines for IPI are to install modern PAS level controls without shutting down the process or disabling the existing control system. IPI is a strategy to convert controls one loop-at-a-time to distributed digital control. Existing controls remain in place, and are available for backup until the new digital control replacement is fully proven in place. It does not matter if the existing controls are analog electronic, analog pneumatic or older DCS.

The first step in IPI is to install the HMI and one multifunction controller of a commercial DCS qualified for Foundation Fieldbus. Since we are discussing a “minimalist” strategy, a single operator station will do, and it is located adjacent to the operator console of an old DCS, or across the aisle from the existing instrument panel. At present, all of the PAS/DCS require at least one multifunction controller even if all control loops are in Foundation Fieldbus devices in the field. Our choice is to use Foundation Fieldbus HSE for connection to all field instrumentation through HSE Linking Devices.

Select the first control loop to be converted. Usually this is a relatively simple control loop such as temperature or level. There is an existing electronic analog or pneumatic transmitter and a pneumatic control valve with a corresponding valve positioner or an I/P converter. These remain in place and are untouched for a while, but they define the control loop to be migrated to digital control under the new PAS. Write down the instrument tag names, since we will be using them again.

Install new field instrumentation close to the existing analog instrument(s). These will be Foundation Fieldbus “Registered” instruments connected with the same kind of twisted-shielded instrumentation wire used for electronic analog instruments. They will be wired to a new field-mounted junction box with a Foundation Fieldbus HSE Linking Device installed inside. This same junction box terminates several field instruments we will install later, so plan for some expansion space for additional Foundation Fieldbus H1 segments and perhaps some additional linking devices. If the junction box is less than
about 100 cable-meters from the control room or the next junction box, then conventional category 5 or 6 Ethernet cable can be used. For home run cables over 100 meters, 62.5/100 micron optical fiber should be used with a commercial Ethernet fiber repeater. Termination of the home run cable in the control room is into a commercial Ethernet switch. The controller and the HMI stations are also connected to this same Ethernet switch.

The core of all process control loops is the control valve. We cannot just rip off the analog electronic or pneumatic control valve positioner or I/P converter, or that control loop will no longer be operational on the existing control system. In most chemical plants and petroleum refineries control valves are installed with bypass lines and blocking valves.

ARC’s recommendation is to install a new control valve of the same size with a Foundation Fieldbus Registered control valve positioner in the bypass line, and construct a new bypass line. This can usually be accomplished without shutting down the process. The new positioner is then wired to the same junction box as the new field transmitters, and is usually installed on the same Fieldbus H1 segment as the transmitter.

Configure the Foundation Fieldbus field instruments. The transmitter should have the same tag name as the analog transmitter it will replace. It is configured to perform the same function as the analog transmitter and have the same range. It may even share the same process impulse or sense lines or even the same thermowell. The valve positioner should have the same tag name as the control loop, and is configured to do both the AO function block and the PID controller function using the PV of the analog transmitter.

Start up the control loop. The new control loop is started in Manual mode with the valve in the closed position. Then the blocking valves around the new control valve can be opened. Place the analog controller into Manual. At the new PAS console, select the same control loop, and put the loop into Automatic. At the analog loop (which is in Manual), start closing the valve slowly and watch the PAS loop output (valve position) increase.

When the analog control valve is fully closed, the switchover will be complete and the loop will be on full digital control. If anything happens, the loop can be quickly switched back to analog since everything is open and connected. After confidence is built in the new digital loop, the analog components can be removed and recycled as spares. The analog control valve
can be rebuilt with new trim and a new Foundation Fieldbus Registered valve positioner installed so that it can be reused in cutover of other loops.

This stepwise process can be repeated until the whole process is under digital control using Foundation Fieldbus. Complex upper level cascades can be configured in the multifunction controller as necessary. Feedforward, adaptive, advanced, and model reference control features of the PAS can now be used to achieve benefits not previously possible.
**Analysts:** Larry O’Brien, Dick Caro  
**Editor:** Dick Hill  
**Distribution:** All MAS-P and MAS-H Clients

**Acronym Reference:** For a complete list of industry acronyms, refer to our webpage at www.arcweb.com/arcweb/Community/terms/indterms.htm

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AI</td>
<td>Artificial Intelligence</td>
</tr>
<tr>
<td>ANSI</td>
<td>American National Standards Institute</td>
</tr>
<tr>
<td>API</td>
<td>Application Program Interface</td>
</tr>
<tr>
<td>APS</td>
<td>Advanced Planning &amp; Scheduling</td>
</tr>
<tr>
<td>B2B</td>
<td>Business-to-Business</td>
</tr>
<tr>
<td>B2C</td>
<td>Business-to-Consumer</td>
</tr>
<tr>
<td>CAGR</td>
<td>Compound Annual Growth Rate</td>
</tr>
<tr>
<td>CNC</td>
<td>Computer Numeric Control</td>
</tr>
<tr>
<td>CRM</td>
<td>Customer Relationship Management</td>
</tr>
<tr>
<td>DCOM</td>
<td>Distributed Component Object Model</td>
</tr>
<tr>
<td>DCS</td>
<td>Distributed Control System</td>
</tr>
<tr>
<td>EAM</td>
<td>Enterprise Asset Management</td>
</tr>
<tr>
<td>eFS</td>
<td>E-Fulfillment Solutions</td>
</tr>
<tr>
<td>EPM</td>
<td>Enterprise Production Management</td>
</tr>
<tr>
<td>ERP</td>
<td>Enterprise Resource Planning</td>
</tr>
<tr>
<td>ESD</td>
<td>Emergency Shutdown System</td>
</tr>
<tr>
<td>EUC</td>
<td>End User Council</td>
</tr>
<tr>
<td>FB</td>
<td>Function Block</td>
</tr>
<tr>
<td>FF</td>
<td>Fieldbus Foundation</td>
</tr>
<tr>
<td>HART</td>
<td>Highway Addressable Remote Transducer</td>
</tr>
<tr>
<td>HMI</td>
<td>Human Machine Interface</td>
</tr>
<tr>
<td>HIST</td>
<td>Host Interoperability Support Testing</td>
</tr>
<tr>
<td>HSE</td>
<td>High Speed Ethernet</td>
</tr>
<tr>
<td>IEC</td>
<td>International Electrotechnical Commission</td>
</tr>
<tr>
<td>IPI</td>
<td>Incremental Process Improvement</td>
</tr>
<tr>
<td>ISA</td>
<td>International Society for Measurement &amp; Control</td>
</tr>
<tr>
<td>ISP</td>
<td>Interoperable System Project</td>
</tr>
<tr>
<td>OPC</td>
<td>OLE for Process Control</td>
</tr>
<tr>
<td>PAS</td>
<td>Process Automation System</td>
</tr>
<tr>
<td>PID</td>
<td>Proportional Integral Derivative</td>
</tr>
<tr>
<td>PI</td>
<td>Profibus International</td>
</tr>
<tr>
<td>PLC</td>
<td>Programmable Logic Controller</td>
</tr>
<tr>
<td>SCE</td>
<td>Supply Chain Execution</td>
</tr>
<tr>
<td>SPC</td>
<td>Statistical Process Control</td>
</tr>
<tr>
<td>WAH</td>
<td>Web Application Hosting</td>
</tr>
<tr>
<td>WMS</td>
<td>Warehouse Management System</td>
</tr>
</tbody>
</table>

Founded in 1986, ARC Advisory Group is the leader in providing strategic planning and technology assessment services to leading manufacturing companies, utilities, and global logistics providers, as well as to software and solution suppliers worldwide. From Global 1000 companies to small start-up firms, ARC provides the strategic knowledge needed to succeed in today’s technology driven economy.

ARC Strategies is published monthly by ARC. All information in this report is proprietary to and copyrighted by ARC. No part of it may be reproduced without prior permission from ARC.

You can take advantage of ARC's extensive ongoing research plus experience of our staff members through our Advisory Services. ARC's Advisory Services are specifically designed for executives responsible for developing strategies and directions for their organizations. For subscription information, please call, fax, or write to:

ARC Advisory Group, Three Allied Drive, Dedham, MA 02026  USA  
Tel: 781-471-1000, Fax: 781-471-1100, Email: info@ARCweb.com  
Visit our web page at ARCweb.com

Copyright © ARC Advisory Group • ARCweb.com • 23