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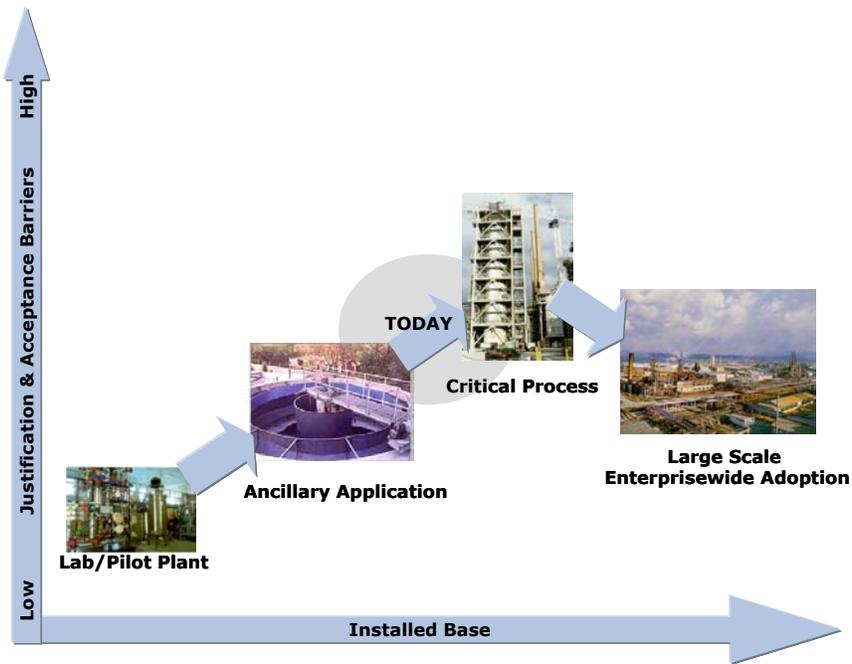
By ARC Advisory Group

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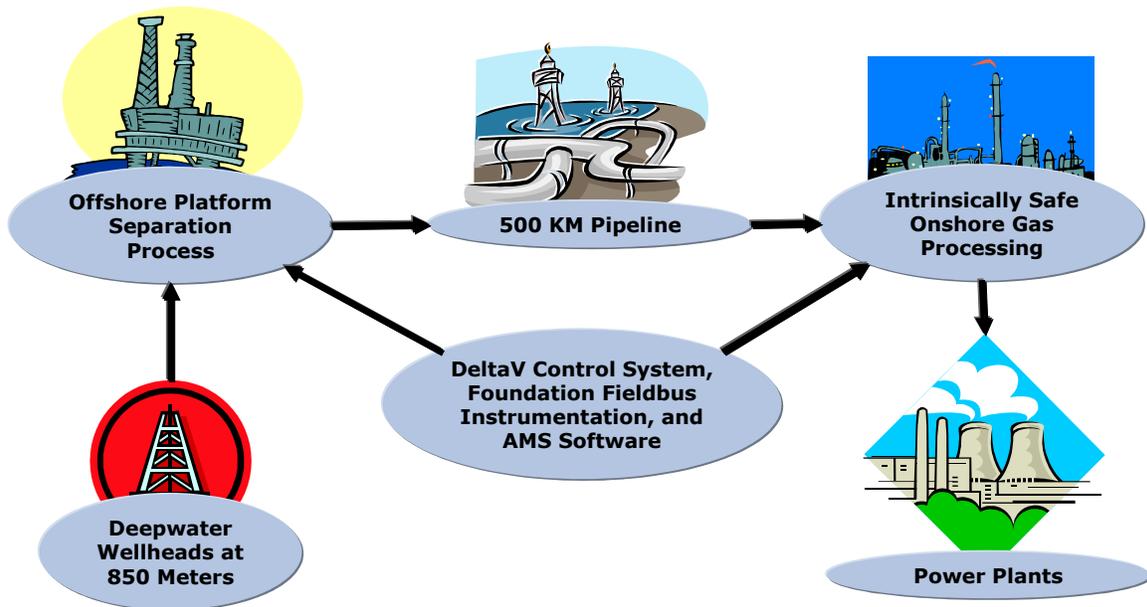
Malampaya Project Puts Fieldbus to Work in Mission Critical Applications

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FOUNDATION Fieldbus Is on the Cusp of Enterprisewide Adoption in Critical Applications



Malampaya Project Scope

Executive Overview

Process fieldbus in the form of FOUNDATION Fieldbus H1 and HSE and Profibus PA and DP have all moved into the mainstream of process automation and are being installed in large plants for critical applications. For many users fieldbus compatibility is becoming a key criterion for control system selection.

SPEX's decision to implement the relatively new technology of Foundation Fieldbus at Malampaya was driven by the close match between the benefits offered by Foundation Fieldbus and the corporate and business objectives of SPEX.

Shell Philippines Exploration B.V. (SPEX), operator of the Malampaya project (co-venturers ChevronTexaco and Philippine National Oil Company) was one of the first companies to deploy FOUNDATION Fieldbus in a mission critical application on a large scale with the construction of the Malampaya offshore gas platform, pipeline, and onshore gas processing plant. SPEX chose FOUNDATION Field-

bus (FF) as the primary communications infrastructure for process instrumentation. The offshore phase of the project was done with intrinsically safe (IS) instrumentation, while the onshore portion of the operation uses explosion-proof electrical protection. The Malampaya project has installed over 1,600 FOUNDATION Fieldbus-compatible devices, and Shell has many other larger FF installations in progress or on the drawing board now.

SPEX selected Emerson Process Management as the primary process automation system (PAS), field device, and control valve supplier. SPEX chose the Emerson DeltaV control system as the primary process automation system (PAS) platform for both the offshore platform and onshore gas treatment plant. Emerson's ability to serve as the main automation vendor (MAV) and coordinate installation and commissioning of the automation system and instrumentation were primary drivers behind SPEX's decision.

SPEX's decision to implement the relatively new technology of FOUNDATION Fieldbus at Malampaya was driven by the close match between the benefits offered by FOUNDATION Fieldbus and the corporate and SPEX business objectives. This report discusses selection criteria used by SPEX for choosing a FOUNDATION Fieldbus system, as well as some of the supporting technologies such as OPC and plant asset management (PAM) software. FOUNDATION Fieldbus benefits are discussed from both an ini-

tial cost and lifecycle cost perspective. Lessons learned and future strategies for success are also discussed.

Malampaya Project Overview

After many years of being relegated to the sidelines in pilot plants and non-mission critical applications, FOUNDATION Fieldbus is becoming a standard technology in many traditional heavy process applications such as oil & gas, refining, and petrochemicals. Many of the major end users in these

Malampaya was an ambitious undertaking and will eventually provide 30 percent of all the power for the island of Luzon, which is the largest island in the Philippines.

industries are making FOUNDATION Fieldbus part of their purchase specification. Shell is one of the leading adopters of Foundation fieldbus today and has specified FOUNDATION Fieldbus for many new projects, including the Malampaya offshore platform installation that is regarded as the largest single industrial investment in the history of the Philippines.

Malampaya was an ambitious undertaking and will eventually provide 30 percent of all the power for the island of Luzon, which is the largest island in the Philippines. The project is operated by Shell Philippines Exploration B.V. (SPEX). Offshore flowlines transport the natural gas from the Malampaya field to the Malampaya shallow water platform, where the gas is then separated from condensate. The gas is then transported from the offshore platform to Batangas Bay in South Luzon, where it is treated and supplied to three gas customers who produce almost 3 Gigawatts of power.

The project involves many unique considerations not normally encountered in offshore applications. For example, Malampaya is a deepwater gas project with sub sea wells at 850 meters in depth. The pipeline carrying the separated gas from the platform to the shore is over 500 kilometers long and passes through some rough, uneven terrain, including active fault zones. The gas is treated once it reaches shore and is transported to three combined cycle power plants.

SPEX and the Philippine government were determined that Malampaya also be a showcase for sustainable development, meaning that the project had to have minimal environmental impact with continuous, uninterrupted delivery of gas through the pipeline and production chain. Sustainable development also means stringent health and safety standards. The Philippines have very few of their own resources and must rely on im-

ported fuel for the bulk of their energy requirement. Malampaya is a showcase for the country's energy independence. The project came online in October of 2001. The onshore gas plant began receiving gas from the offshore platform in September of 2002.

Why Did Malampaya Choose FOUNDATION Fieldbus?

SPEX decided to go with FOUNDATION Fieldbus (FF) as the primary communications infrastructure for process instrumentation. The offshore phase of the project was done with intrinsically safe (IS) instrumentation, while the onshore portion of the operation uses explosion proof (Ex) electrical protection.

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Emerson's ability to serve as the main

automation vendor (MAV) and coordinate the installation and commissioning of the automation system and instrumentation was a primary reason why SPEX chose Emerson. Other criteria include Emerson's expertise in FOUNDATION Fieldbus installations, the scope of instrumentation and control valves offered by the company, as well as the company's Asset Management Solutions (AMS) plant asset management (PAM) software.

Key Statistics for Malampaya Installation

- Over 100 FF-Compatible Devices
- Mix of FF and HART Devices
- DeltaV Control System
- AMS Plant Asset Management Software
- Control Residing in Field Devices
- Fieldbus Installed in Offshore Platform and Intrinsically Safe Onshore Processing Plant
- Wireless Satellite Data Transmission from Offshore Platform PAS and Gas Plant Automation System
- Offshore Platform Uses "Lights Out" Operations
- OPC is Primary Data Exchange Mechanism

Primary Fieldbus Benefits Obtained After Startup

The value proposition of fieldbus has changed from the initial perceptions of the marketplace. Benefits such as reduced wiring costs, reduced installa-

tion costs, and field control are not the primary perceived advantages. According to ARC's research, the primary advantages of fieldbus occur in the areas of maintenance and operations. In other words, fieldbus itself is not the cost-saver, but merely an enabler to a new level of asset management effectiveness that can significantly reduce operating costs and produce operational excellence. As users gain more experience in a real world plant setting, they continue to discover many of the benefits of fieldbus and device networks.

FOUNDATION Fieldbus Meets SPEX's Corporate Objectives

SPEX's decision to implement the relatively new technology of FOUNDATION Fieldbus at Malampaya was driven by the close match between the benefits offered by FOUNDATION Fieldbus and the corporate and business objectives that SPEX had in mind for Malampaya. The motivation for choosing FOUNDATION Fieldbus went beyond a mere desire to have the latest technology. One of SPEX's imperatives was to minimize exposure to hazards and avoid putting personnel and assets at risk. SPEX felt that

fieldbus would provide them with a path toward higher system availability and single loop integrity, although they are not yet using FOUNDATION Fieldbus as a network for safeguarding applications.

SPEX also chose fieldbus for the increased accuracy and precision provided by fieldbus-compatible devices. SPEX believes that the reliability of FOUNDATION Fieldbus devices is quite good and the accuracy of measurements is greatly enhanced. The devices purchased by Malampaya

were calibrated in the factory and needed no further calibration was required in the field, although field calibration was done with safeguard transmitters.

SPEX also views fieldbus as an enabler, and the company wanted the technology behind the system to be transparent to the user and to be a platform for creating knowledgeable workers that can effectively use advanced plant asset management applications to make their job easier and maintain high process availability.

Shell Selection Criteria for Foundation Fieldbus

- Increased accuracy of fieldbus devices
- Improved safety
- Improved high availability control
- Single loop integrity
- Creation of a Knowledge Workforce
- Remote diagnostics and device information
- Enables unmanned operations

The Malampaya platform is also minimally manned, so SPEX wanted to provide their operators with as much data and information about the process as possible, and to provide them with access to data related to turbine machinery and other plant equipment, including field instrumentation and control valves. The PlantWeb design has also enabled access to data for equipment suppliers to carry out remote diagnostics.

Education and Training Essential for Success

To ensure the success of the project, SPEX informed its upper level management about what they were buying into with Foundation Fieldbus.

For SPEX and Malampaya, FOUNDATION Fieldbus and all it affords was a new concept that required increased training and education for operators. A lot of education also had to take place at the senior management level. To ensure the success of the project, SPEX informed its upper level management about what they were buying into with FOUNDATION Fieldbus. While operation for the DeltaV control system itself did not require a lot of training, significant training was required for users to understand the fundamentals of FOUNDATION Fieldbus. FF-related training focused heavily the diagnostic capabilities and use of the AMS application.

FOUNDATION Fieldbus Enables High-Availability Control

Achieving high availability control was a primary driver behind SPEX's choice of FOUNDATION Fieldbus. Avoidance of unplanned downtime was a consideration, as Malampaya is the sole gas supplier to three power stations. SPEX observed that they had to take great care in the installation of their fieldbus devices and control systems to ensure high availability. Clear design and installation guidelines need to be in place before the installation to ensure success. There were, for example, some problems experienced with instrument grounding. Again, the overall quality and experience of the supplier partner and/or systems integrator is an essential ingredient for success in achieving high availability control.

Mix of HART and FOUNDATION Fieldbus Devices

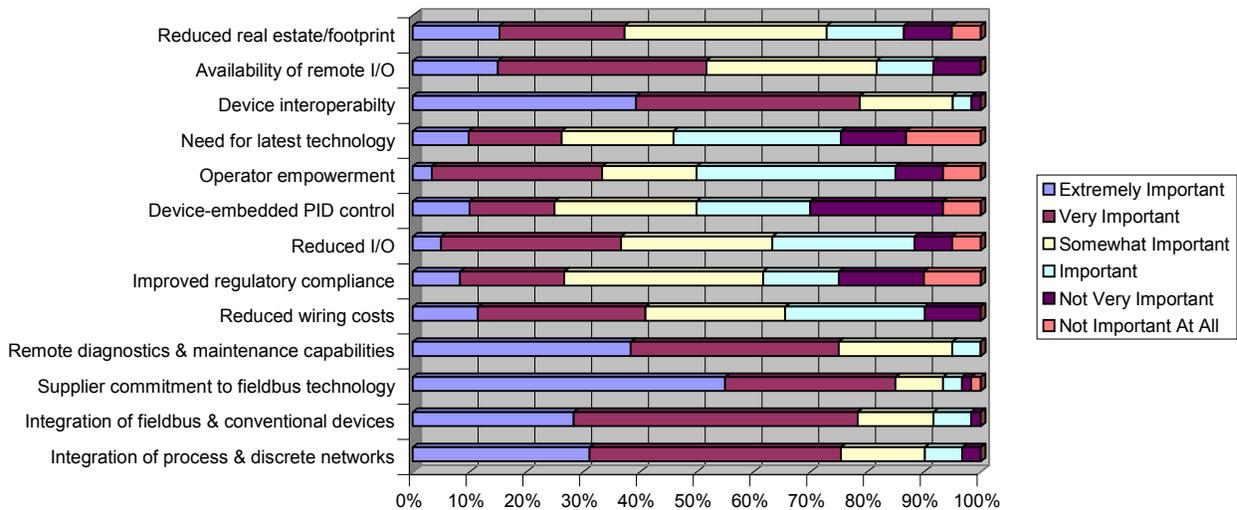
ARC has always believed that the world today and in the future will consist of a mixed bag of protocols deployed in function-specific roles. No single network will ever prevail in manufacturing in the near future. Similarly, Malampaya is not exclusively a FOUNDATION Fieldbus installation and

incorporates a mixture of HART-compatible and FF devices. Many of the HART devices installed at Malampaya are used for safeguarding applications, since SPEX does not feel comfortable using fieldbus-compatible devices for this purpose yet. HART provides much of the same functionality as FOUNDATION Fieldbus and incorporates similar technology, such as device descriptions.

Benefits of Control in the Field

Embedded control in field devices has been a topic of debate among process industry end users for a long time. Many do not see the value in field level control. For SPEX, however, control in the field is viewed as a path to high availability control and single loop integrity and they are running control blocks in many of their fieldbus devices.

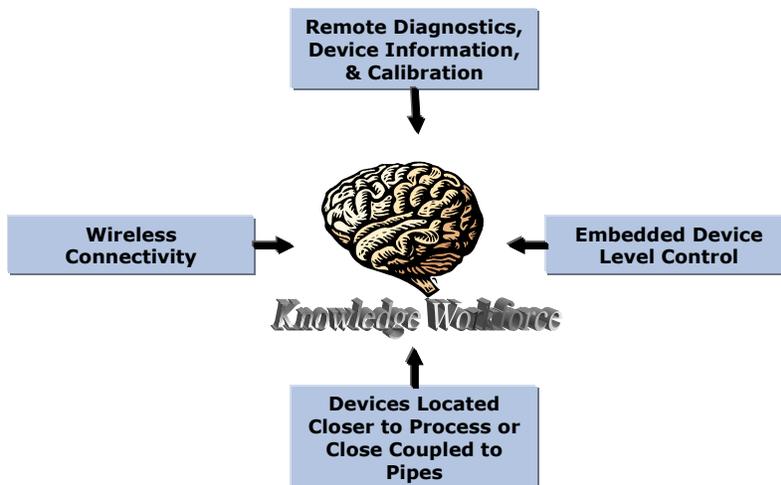
The basic premise is that field level control takes over when the controller fails or is cut off from the field device. SPEX has managed to avoid unplanned downtime since system startup when field level control took over after interface card failures. Avoiding downtime is essential to achieve the high-availability figures required by their gas customers.



Users Respondents to an ARC Fieldbus Survey Rate Remote Diagnostics as One of the Most Important Selection Criteria

FOUNDATION Fieldbus as a Path to Remote Operations

Remote diagnostics and maintenance capabilities continue to be primary selection criteria for most users that purchase fieldbus control systems. Most users see remote diagnostics as a way to save on labor costs because they can avoid sending maintenance personnel on needless trips to the field to check or diagnose problems with instrumentation without the benefit of remote diagnostic data. SPEX recognized the benefits of minimizing the exposure of their personnel to hazardous environments through use of the remote diagnostic facilities.



Fieldbus Enables Creation of a Knowledge Workforce

tors to spend a minimum amount of time in the control room so they can be doing tasks in and around the plant environment. Extensive tests have been carried out that prove the feasibility of operating the platform from the onshore gas plant 24 hours a day.

Since the platform was built with remote diagnostics in mind and the very high field device availability requirements, many instruments located on the platform are close coupled and cannot be physically accessed without using scaffolding. The close coupling has benefits as the platform is in an earthquake zone and has been designed to be seismically hardened. The use of FOUNDATION Fieldbus and the remote access to the devices that it affords has minimized the exposure and risk that platform operators must face in the hazardous environment of the platform process area. While the scheme for remote operations of the platform is in place and could function now, SPEX continues to train its operators and put procedures in place to

The philosophy behind the Malampaya offshore platform is for it to be “thinly resourced”. The platform today includes only 46 beds. The intention is to operate with a core crew of only 14. This reduces logistics and support and again minimizes the exposure to offshore hazards. At night, SPEX eventually plans to leave the control room unmanned. Even during the day, SPEX wants its opera-

ensure that the required high platform availability is maintained with the remote operations.

The compatibility of fieldbus with wireless networks also makes remote operations possible in an offshore platform environment. The offshore platform is connected to the onshore gas plant through a 512 KBPS satellite link enabling sharing of data cross a wide area network (WAN).

The remote connection supports measurement and control of the process automation system (PAS) as well as the AMS PAM system that provides all the necessary field device information and diagnostics, as well as remote calibration. ARC believes that FOUNDATION Fieldbus and its remote diagnostics have the capability to transform the role of the traditional plant engineer or operator, but this can only be accomplished with the right software in the form of a PAM platform. Advanced knowledge of the process is required to operate sophisticated processes in an exclusively remote fashion, and the increased level of process and diagnostic information from fieldbus-compatible devices allows users to make intelligent decisions about the process and also act on them, rather than playing the role of a monitor in a central control room.

Installed Cost vs. Lifecycle Cost

ARC maintains that the real benefits of fieldbus are obtained after startup, not during the installation or initial cost phase. Benefits such as reduced wiring costs, reduced installation costs, and field control are not the primary perceived advantages. According to ARC's research, the primary advantages of fieldbus occur in the areas of maintenance and operations. In

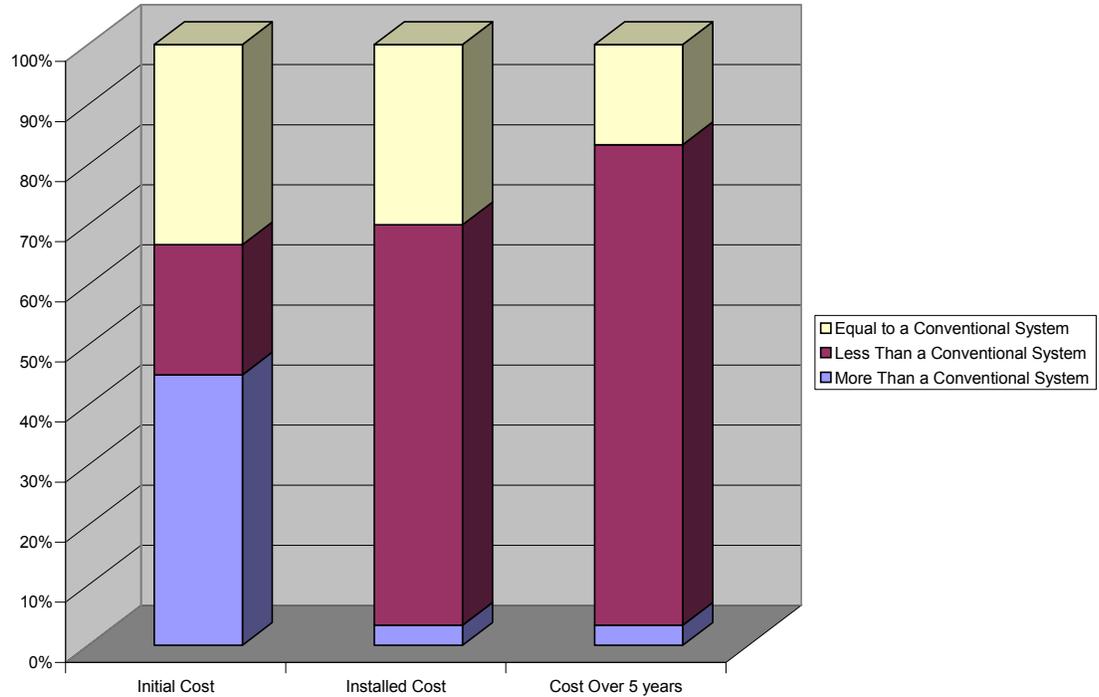
TCO Benefits of Foundation Fieldbus

- Reduced maintenance/labor costs
- Preventative maintenance prolongs asset life
- Reduced hardware requirements
- Increased performance through diagnostics improves throughput & ROA
- Avoidance of unplanned downtime through high availability control and single loop integrity

other words, fieldbus itself is not the cost-saver, but merely an enabler to a new level of asset management effectiveness that can significantly reduce operating costs and produce operational excellence. Many of the benefits of fieldbus and device networks are still being discovered as users gain more experience with these technologies in a real world plant setting.

In SPEX's experience with Malampaya, they are still in the discovery phase when it comes to total cost of ownership (TCO) advantages. This is not surprising, since most process automation end users do not have a comprehensive view of the total lifecycle cost of a system and do not have methodologies in place for measuring lifecycle costs across the spectrum of automation products.

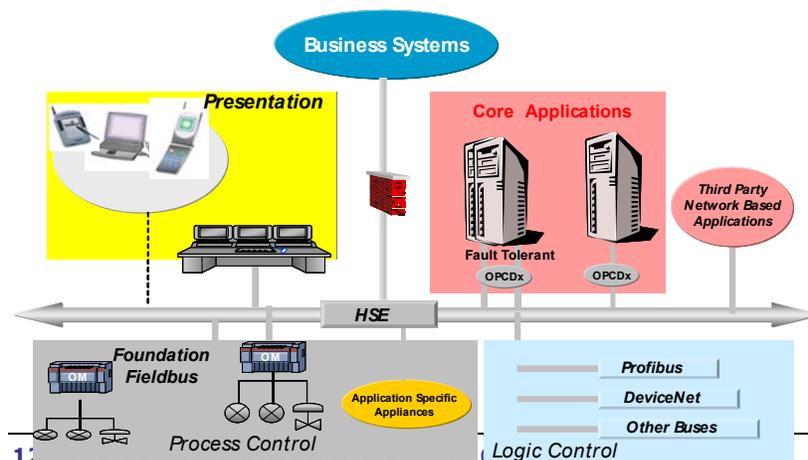
SPEX did observe that the installed cost of its offshore platform fieldbus control system was approximately thirteen percent more than a traditional installation, which is also consistent with ARC's findings. Initial cost of FOUNDATION Fieldbus-compatible devices is slightly higher, and intrinsic safety barriers and repeaters were also a necessary addition to the project. Intrinsic safety barriers were required for the hazardous environment in the onshore gas plant, while repeaters were utilized on every fieldbus segment to avoid signal distortion. As an early large-scale implementation of Foundation Fieldbus, newly developed devices were available at premium prices. The cost savings on cabling were there but were not substantial. The onshore phase of the project, however, had significant cost savings of 22 to 23 percent. Most of the onshore cost savings came from the decision not to use intrinsically safe instrumentation, so hardware cost related to barriers and other equipment was eliminated. By avoiding the limitations of intrinsically safe protection, more devices per segment were achieved.



According to ARC's Fieldbus User Survey, Most Fieldbus Systems Are Higher in Initial Cost than Conventional Systems, But Much Lower in Installed Cost and Total Lifecycle Cost

SPEX has close-coupled transmitters directly onto pipes because of the remote access fieldbus affords. This has reduced the number of potential leak paths, thereby improving the process integrity and platform availability. Time is not wasted doing scheduled maintenance activities that were often unnecessary, SPEX is now able to implement condition-based maintenance strategies. SPEX are still exploring various elements of the fieldbus, Plant-Web, and AMS systems, and are still getting used to the technology.

OPC Benefits and Challenges



The implementation of OPC has been one of the biggest challenges in the Malampaya project. SPEX uses OPC extensively as the primary connection for auxiliary systems to the DeltaV system, and views themselves as pos-

sibly one of the biggest OPC users. One of the biggest problems SPEX found, however, was that many of their smaller unit and OEM suppliers for products were not fully familiar with OPC and did not incorporate off the shelf OPC functionality into their products.

Emerson, however, was able to assist SPEX by producing a portable DeltaV process automation system that could fit in three suitcases. This allowed unit suppliers to interface with FF-compatible devices and OPC interfaces at their own factory and ensure interoperability. Despite the assistance from Emerson, however, SPEX did find that a number of problems per-

OPC-DX functions as an interface between the various independent industrial Ethernet communication protocols such as the Open DeviceNet Vendor Association's (ODVA) Ethernet/IP, PROFIBUS International's ProfiNet, and Foundation Fieldbus' High Speed Ethernet (HSE).

sisted. Many of the OEM suppliers persisted in their reluctance to run OPC software on their servers. To some extent, this resistance was due to the poor OPC diagnostics, which have made fault finding very difficult in some cases.

To resolve these problems, SPEX has separated out some of the OPC Mirror functionality from the application server so OPC can run on its own. For example, SPEX is using an OPC interface from

DeltaV to its safety system. Other interfaces, however, such as the ones to the compressors interface, have continued to be a problem. SPEX had to redesign and hardwire some signals to ensure availability.

ARC believes that OPC is a de facto standard in the automation industry today. All of the major PAS suppliers have embraced OPC and will continue to expand on OPC in the future, with such enhancements as OPC DX. OPC-DX delivers interoperability for automation systems across heterogeneous, non-interoperable Ethernet networks. At a fundamental level, the specification allows a single device to act as both an OPC client and an OPC server.

Additionally, OPC-DX functions as an interface between the various independent industrial Ethernet communication protocols such as the Open DeviceNet Vendor Association's (ODVA) Ethernet/IP, PROFIBUS International's ProfiNet, and FOUNDATION Fieldbus' High Speed Ethernet (HSE). The OPC-DX specification will not affect the specifications of the respective industrial Ethernet protocols.

OPC has high awareness in the industrial community at the plant level, and that OPC is making inroads at the enterprise level. The awareness of OPC

in the automation community surpasses the awareness level of DDE, which has had the benefit of Microsoft's marketing of this method that forms the basis of connectivity for desktop application software.

The introduction of HSE FOUNDATION Fieldbus into the control scheme will hopefully ease OPC connectivity issues as well. When Synchronization services are required by OPC applications outside of the PAS, for example, the PAS can support OPC DX connectivity to HSE. In this case, the Object model is OPC and the transport is RPC (Remote Procedure Calls) in conjunction with TCP/IP services.

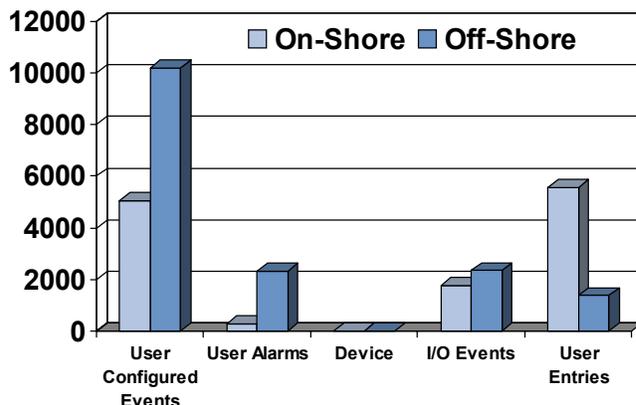
Using PAM Tools Effectively with Fieldbus – Avoid the Data Flood

Overall, SPEX believes that most users do not follow through on the asset management capabilities of FOUNDATION Fieldbus when used in conjunction with a plant asset management (PAM) application such as Emerson's Asset Management Solutions (AMS). SPEX believes that too much time is spent focusing on the initial cost of a project and the reduction of capital spending than the cost of ownership of return on assets (ROA) that can be achieved through the use of FF. SPEX recognizes that even they have not begun to realize many of the true long-term savings that FF enables.

ARC agrees with SPEX's position. Deploying fieldbus in a plant environment without utilizing a PAM suite is like buying a car with no engine. The diagnostics and device information available through PAM applications is a key part in the value add equation for fieldbus deployment, but the wealth of information that is available from fieldbus devices must be carefully

managed in order to avoid a flood of user alerts and alarms. SPEX learned this lesson with AMS and FOUNDATION Fieldbus.

Initially, the increased data available from fieldbus devices created an excessive amount of alarms that needed to be controlled. SPEX reported having in excess of 20,000 alarms a day. It took the

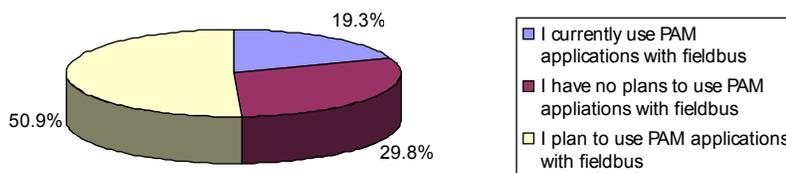


Most of the Flood of Events and Alarms Initially Experienced by Malampaya Were User Configured

company a year to sort through this problem, and they developed an alarm management solution to rationalize alarms using static and dynamic masking. This also involved going through every alarm and giving it the right categorization. For example, an offline pump will override discharge low flow and low-pressure alarms. Critical tags are used to show the pump in operation and remove overrides. SPEX used third party specialists to get this accomplished. Of course, alarm management facilities should be available within the PAS itself, and the DeltaV system does feature some limited functionality currently.

In other areas, SPEX believes they did not exploit the AMS and fieldbus diagnostics capabilities enough. SPEX observed that a lot of the construction and commissioning people involved with the project tended to be older and less familiar with new technology. They were too quick to start ripping out wires when things went wrong when they should have used the diagnostics capabilities that were included with the DeltaV system and AMS software. SPEX stated that a good tactic would have been to set up dummy loops and training simulation in the commissioning phase. Although SPEX embarked on a comprehensive training program, they realize that more effort should have been made with construction and commissioning personnel.

In retrospect, SPEX believes that with a little more training of construction and commissioning personnel, they could have avoided initial problems with slow commissioning times and equipment damage. SPEX observed that normally, if you install and commission a single control loop, you

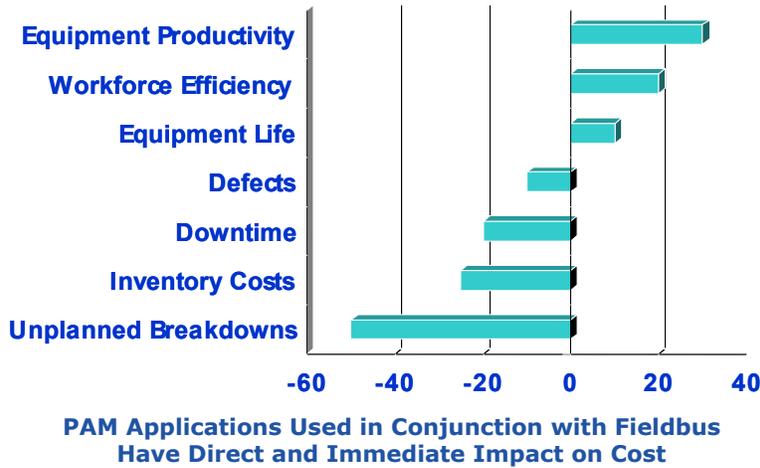


Most Fieldbus Users Also Have PAM Applications Deployed

could then run that loop. With FOUNDATION Fieldbus segment topology, however, an instrument is connected to the segment and it runs, but if another device is connected improperly during subsequent work, it has the potential to blow the power supply. SPEX needed to look at new ways of commissioning complete segments in one go. Devices are now available that will avoid device damage due to short circuits.

As a result of alarm problems, one of the things SPEX did to ensure they did not miss process alarms was to turn off most of the device alerts in the transmitters and start over again from scratch with a more intelligent approach to enabling specific kinds of alerts for specific devices. While the

% Improvement vs Traditional Maintenance



majority of the device alerts were deactivated, they are now in the process of being reactivated and the devices continue to offer high availability and self-diagnostic information.

SPEX does acknowledge that FOUNDATION Fieldbus made a drastic difference in the commissioning process, and after initial teething problems, it drastically reduced commissioning time and saved a considerable

amount of money. While there were some minor problems with loops, it was less than SPEX expected. SPEX did have some lingering problems with some segments where devices showed up as being disconnected, but they did not cause major system failures. SPEX recognized that putting a digital communications system into an industrial environment required tight quality control on cable installation and termination. A particular type of cable sleeving on screen wires, for example, was found to produce problems until replaced with a different type.

Benefits, Challenges, and Strategies for Success

SPEX obtained many benefits from FOUNDATION Fieldbus, DeltaV, and AMS software. In SPEX's view, choosing Emerson as the main automation vendor and single source supplier was key to the success of the project. In

SPEX's view, Emerson was extremely committed to bringing the project through to a successful completion. According to SPEX, Emerson was very proactive, shared many of the risks involved in development. Many new hardware and software developments were required, as

Foundation Fieldbus Benefits Obtained by SPEX/Malampaya

- Shorter commissioning time
- Predictive maintenance benefits
- High availability control
- Enables remote operations
- Reduces risk to operators in the field
- Reduced lifecycle costs

Malampaya was the largest implementation of FOUNDATION Fieldbus at the time. For example, it was Emerson's first implementation of redundant H1 foundation Fieldbus interface cards. Emerson was able to meet the project schedule, and at no time did they expect to be held up by lack of supply. Ongoing commitment after installation is also important. Users should choose a supplier that will provide ongoing support and product development after the installation is complete.

SPEX expected a lot from FOUNDATION Fieldbus, and it has delivered what they expected. The company did not run into as many problems with the implementation of FOUNDATION Fieldbus as they expected, especially on the commissioning side. SPEX is monitoring the next phase of FOUNDATION Fieldbus development, which will involve FF devices for safeguarding applications. These applications are currently handled with HART devices on the Malampaya project.

While grounding has been reported to be a problem in some fieldbus installations, this was not so with Malampaya. SPEX reported that the only area they had grounding problems was in the onshore gas plant and was related to cable sleeving and terminations.

Another area that SPEX benefited from FF implementation was in advanced process control (APC) software. Engineers have been working on APC for methanol column control and compressor control applications. SPEX found that FOUNDATION Fieldbus improves APC by providing more highly accurate, better quality data to the APC application.

Recommendations for Fieldbus Project Success

Fieldbus Benefits Must Match Corporate Objectives

Management buy-in is just as important as plant operations buy-in for fieldbus implementation. In the case of Malampaya, project leaders believed that the benefits of fieldbus matched their corporate objectives, which are to "engage efficiently, responsibly, and profitably" in all their businesses.

Ongoing Fieldbus and Related Challenges Faced by SPEX/Malampaya

- Intelligent implementation of device diagnostics.
- Effective implementation of OPC.
- Exploiting the full benefits of AMS software.

Management and Employee Buy-in Critical

No fieldbus project can be successful without the buy-in of plant operations personnel and

management. The enabling technology of FOUNDATION Fieldbus can provide no benefits if employees are not willing to use the tools. After the benefits of FOUNDATION Fieldbus had been communicated effectively, employees were eager to try it out in real world applications.

Finding Right Supplier and Engineering Partner Is Crucial

Having the right partner for a fieldbus implementation project is also important. Manufacturers should choose their fieldbus implementation partners carefully. Is your supplier really committed to supporting fieldbus in the long-term? SPEX, for example, went with Emerson Process Management primarily because of their ability to serve as a main automation vendor for their large-scale fieldbus implementation.

Form a Fieldbus Team

Deploying a successful fieldbus-based control system is really a collaborative effort between the user and the supplier and/or systems integrator. Forming collaborative teams consisting of members from the user company, supplier, and systems integrator can help preserve knowledge and create an improved feedback mechanism that will make for smoother project implementation and improve operations throughout the lifecycle of the installation.

Total Cost of Ownership Is Key to Justification

To appreciate the advantages and disadvantages of device networks fully, users should look beyond installation costs and consider the total cost of ownership (TCO). A TCO analysis must take into account all of the expected costs of a machine or production line over its complete lifecycle. During the early phases of the project, these costs include hardware and software purchase costs, installation labor costs, costs for additional application programming and testing, and training costs for commissioning engineers.

Get Management/Employee Buy-in

Meet Corporate/Manufacturing Objectives

Find the Right Partners

Focus on Lifecycle Benefits

View Fieldbus as an Enabling Technology

Keys to Fieldbus Project Success

Analyst: Larry O'Brien

Editor: Dick Hill

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

AI	Artificial Intelligence	ERP	Enterprise Resource Planning
ANSI	American National Standards Institute	HMI	Human Machine Interface
API	Application Program Interface	IT	Information Technology
APS	Advanced Planning & Scheduling	LAN	Local Area Network
B2B	Business-to-Business	MIS	Management Information System
BPR	Business Process Reengineering	MRP	Materials Resource Planning
CAGR	Compound Annual Growth Rate	MSPC	Multivariate Statistical Process Control
CAN	Controller Area Network	OLE	Object Linking & Embedding
CMM	Collaborative Manufacturing Management	OPC	OLE for Process Control
CNC	Computer Numeric Control	PAS	Process Automation System
CPG	Consumer Packaged Goods	PLC	Programmable Logic Controller
CPM	Collaborative Production Management	ROA	Return on Assets
CRM	Customer Relationship Management	ROI	Return on Investment
EAI	Enterprise Application Integration	SCE	Supply Chain Execution
EAM	Enterprise Asset Management	TMS	Transportation Management System
		WAH	Web Application Hosting
		WMS	Warehouse Management System

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