



Case Study

Merisol Achieves Total Plant Integration with FOUNDATION Technology

Chemical producer employs smart fieldbus infrastructure for distributed control

Merisol's Greens Bayou plant, a major cresylic acid production facility located near Houston, Texas, has been in operation since the mid-1940s. The facility includes process units, which upgrade and refine phenol, cresols and xylenols. These products find uses in resins, solvents, antioxidants, functional fluids, cosmetics, disinfectants, agricultural chemicals and many other chemical intermediates.

The Greens Bayou facility undertook a total plant integration project aimed at modernizing its process automation systems and improving plantwide data access. The work involved migrating a host of disparate controls and instrumentation into an integrated control system providing full access to process information and displays from any plant location.

■ Background

Over the years, the Greens Bayou plant had a series of process automation upgrades, and thus was equipped with a hodgepodge of control and instrumentation equipment. This included pneumatic and conventional analog instruments, aging distributed control systems (DCSs), numerous programmable logic controllers (PLCs), and other special function subsystems.

The plant operated from three control rooms with the human-machine interface (HMI) consisting of conventional panelboards and DCS operator stations. Additionally, boilers were operated from conventional panels in the utilities building.

In the late 1990s, Merisol decided to migrate Greens Bayou's various instruments and controls into a single, fully integrated, plantwide control system. In particular, the company was seeking a total plant architecture integrating displays and navigation and allowing users at any human-machine interface (HMI) station, in any part of the plant, to have full access to the control system.

■ History of Upgrades

Merisol's controls integration began with engineering and design work for Phase One of the project, which focused on the seven units making up the refinery's Crude Unit. Early decisions included: installation of a total plant, fiber optic, high-speed Ethernet control network connecting existing PLCs and all locations with HMI stations and control system subsets; and integration of navigation and unit displays based on a common approach and dynamic subpictures.

Merisol also decided to integrate its plant information database with an application to accumulate historical information for all process variables, calculated variables, and manual input data at a five-second granularity (excluding manual inputs). Additionally, the control database server would act as the interface to the plant network, providing users with access to daily management and operating reports.

At the time Merisol was developing the basic engineering and funding for the total plant integration project, engineers believed additional PLCs with remote I/O were the logical solution for replacing Greens Bayou's aging DCS systems and other disparate controls. Factors such as the sequential control requirements of the initial units supported this view.

■ Choosing FOUNDATION Fieldbus

Despite its plans for an expanded use of PLCs, Merisol decided that an enterprise automation system based on FOUNDATION™ Fieldbus technology would better support total plant integration, while co-existing with control systems already operating throughout the facility. Unlike PLCs, fieldbus provides robust diagnostics allowing for asset management on field devices and enables a plantwide preventative maintenance program. Additionally, equipment costs associated with a fieldbus installation would be at least 10 percent lower than with PLCs.

FOUNDATION Fieldbus allows industrial organizations to unlock the full capabilities of their existing assets. By providing the means to leverage immense amounts of data generated by modern automation systems, the potential uses and benefits are numerous. They range from enhanced data collection and improved remote monitoring, diagnostics and asset management, to reduced configuration and commissioning effort.

Key to Merisol's choice of a fieldbus solution was the capabilities of FOUNDATION High Speed Ethernet (HSE) technology. HSE is part of a forward-looking digital automation infrastructure that relies on field-proven IIoT concepts to manage data, communication, field assets, and plant events while providing highly distributed control functionality and interoperability between devices and subsystems.

FOUNDATION HSE is ideally suited for use as a control backbone with capabilities for device, subsystem and enterprise integration. The HSE implementation employs a transfer rate of 100 Mbit/s and can be used for connecting hosts like Distributed Control Systems (DCSs) and linking devices via standard Ethernet cabling. It employs a full-fledged redundancy scheme giving control systems greater availability than systems using simple ring-topology. Use of unmodified Ethernet and standard IP makes HSE systems more cost-effective than other Ethernet solutions and proprietary networks. Since HSE is a standard, it enables simple and tight integration between package units and the main control system. The HSE network is easier and cheaper to manage based on common network knowledge and standard SNMP tools.

For Merisol, an important feature of HSE was its ability to provide the common interface needed for plantwide data servers to access control information. HSE servers deliver the information to “clients” across the enterprise, and software application packages and workstations use the clients for functions such as operator display, configuration and

maintenance, plant optimization and supervisory control, enterprise resource planning, and building of databases or “warehouses” for access by business systems.

In addition, Merisol was attracted to FOUNDATION Fieldbus' ease of implementation. The company was seeking a migration strategy allowing fieldbus instrumentation to be implemented throughout the operating units "one bite at a time," thus eliminating the need for a large-scale shutdown. Because of the simplicity of fieldbus wiring and configuration, plant personnel could replace conventional instruments with new fieldbus devices with minimal training.

Merisol also believed it was important to adopt fieldbus at the topside of the product lifecycle. In this way, the company would realize long-term benefits from its early experiences with this new technology, while keeping pace with the latest developments by downloading new firmware as it becomes available.

Most importantly, Merisol regarded FOUNDATION Fieldbus as a natural migration from 4-20 mA technology, which would restore single-loop integrity to the plant. Fieldbus allows almost all regulatory and advanced control functions to be performed in field devices such as transmitters and smart valve positioners/controllers. With control in the field, the loss of a single device only affects a fraction of the overall control capabilities.

■ Integrated Plant Architecture

Working with its main automation supplier, Merisol developed a new, FOUNDATION Fieldbus-based control architecture providing seamless integration of control equipment, field networks, databases, HMI displays and other subsystems at the Greens Bayou refinery.

As part of the control system architecture, six multi-segment bridges are connected to the HSE backbone at judicious locations throughout the plant. The bridges not only support communications between FOUNDATION H1 (31.25 kbit/s) fieldbus segments, but also distribute field device information accessible from any HMI station via an OPC server. This approach permits the co-existence of different systems by allowing displays for each unit to incorporate tags from PLCs, HMI applications, and fieldbus devices connected to any segment.

The control system's tree topology supports 12 field devices per H1 segment, for a total capacity of 48 devices per bridge. The bridges are connected via armored cable to junction boxes which, in turn, are wired point-to-point to field devices on each segment. Power supply redundancy at the termination of each segment ensures devices remain powered even in the event that power is lost to the bridge.

The open, distributed nature of the fieldbus architecture enables Merisol to implement more than 95 percent of regulatory control, and most advanced control functions, in field devices. In doing so, the plant will eliminate the complexities of the DCS environment and return to the reliability and robust performance of single-loop control. Personnel can also implement standardized control strategies on a loop-by-loop basis.

Phase One of the integration project involved the installation of nearly 175 fieldbus devices, resulting in 732 tags in the HMI, for the plant's initial unit. This equipment was supplied by seven different control and instrumentation vendors, and ranges from HSE linking devices with back-up power supply and Syscon configuration and operation software, to an assortment of fieldbus-based pressure, flow and temperature transmitters; Vortex transmitters; flowmeters; 4-20mA to fieldbus transducers; and smart valve positioners.

Phase Two of the project addressed the distillation train in Greens Bayou's Finished Products Unit, and included more than 600 fieldbus devices and over 800 tags.

■ Project Benefits

Merisol attained significant operational improvements and business benefits from its total plant integration project. These included:

- Single loop integrity (distribution of control functionality into field instruments resulted in higher availability)
- Modern architecture (FOUNDATION Fieldbus replaced outdated DCS platform and integrated regulatory controls with sequential logic in PLCs)
- Unified operation (total plant integration unified isolated process units with different generations of controls)
- Less process variability (due to improved measurement and control accuracy)
- Multi-vendor interoperability (open, fieldbus-based solution provided device and subsystem interoperability across the plant enterprise)
- Simplified design (single network design "template" ensured uniform and consistent networks)
- Reduced commissioning time (up to 80 percent reduction in commissioning time compared to traditional analog instrumentation)
- Easier access (access to any part of the plant from a single, central location)
- Protection of assets ("best-in-class" products could be used without loss of functionality or valuable intellectual property)
- Ease of expansion and maintenance (system documentation was easy to use and automatically maintained)
- Fewer spare parts (significant benefit to plants with aging DCS and pneumatic systems)

■ Conclusion

Total plant integration at the Greens Bayou plant proved to be a challenging, but worthwhile, undertaking. By employing FOUNDATION Fieldbus HSE technology, Merisol achieved a modern, fully integrated plant architecture assuring its personnel of access to critical data and displays across the enterprise. Furthermore, by replacing its outdated, centralized controls with a fieldbus-based system that restored single-loop integrity, Merisol took a major step towards ensuring superior plant performance for years to come.

