Serbia Gas is responsible for production, transportation, distribution and storage for Serbia’s natural gas system. As the Serbian state energy company, it seeks to utilize the most advanced process control equipment. When developing strategies to meet customer demand in its region, Serbia Gas determined that one technology — FOUNDATION fieldbus — provided a fully integrated automation solution for its expanding natural gas operations.
Background

Today, end users want to remove the constraints of closed, proprietary control systems and free up their plant’s profit potential. They’re seeking an open automation infrastructure that integrates installed assets and co-exists with legacy systems — all while protecting valuable investments.

Fieldbus technology is now replacing the traditional 4-20 mA platform, and even more recent developments such as the HART Communications Protocol, as the basis for a modern plant automation architecture. A bidirectional, fully digital communication system, fieldbus supports increased intelligence in field devices and enables tighter control of the process.

Fieldbus communications makes it possible to “mine” important information from the plant floor. Delivering information to the right person, at the right time, empowers operators, technicians and process engineers — making plant operation easier, faster and better. Fieldbus also unifies today’s smart instrumentation and analytical highway to provide all-digital access to operational parameters and data at the point of measurement.

Expansion helps meet growing demand

To keep pace with its developing natural gas infrastructure, Serbia Gas undertook construction of an expanded underground gas storage facility. Located in Banatski Dvor in northern Serbia, the facility is used for gas injection, extraction and production. Gas is injected into a bearing enclosure with compressors, and production includes exploitation of gas from stalled wells.

As a result of its ongoing expansion and site improvements, the Banatski Dvor operation will increase its injection capacity from 1 million m³/day to 7 million m³/day. Long-range plans call for a production capacity increase from 1-5 million m³/day to 10 million m³/day. This project will benefit Serbia Gas, and its customers, by reducing excess electrical power consumption during the winter, and lowering gas costs during the summer.

Gas plant seeks advanced technology

As part of the Banatski Dvor project, Serbia Gas wanted to install the latest process control technology to optimize plant efficiency and reduce operating costs. Serbian engineers specified a plant automation solution utilizing standard industry protocols — not specialized software — as well as an open, supplier-independent control system platform.

The Banatski Dvor project involved integrating existing compressor controls and other legacy equipment as part of a unified, plantwide automation architecture. The plant required intrinsically safe (I.S.) technologies with high availability and redundancy as part of the new process control framework. The system needed to support Emergency Shutdown (ESD) and custody transfer systems, as well as integrate ladder logic functions.

The system for gas treatment consists of: wellhead controls and supervision; pipeline gathering and auxiliary equipment; separation vessels; utilities, transformer substations, and compressor cooler; ESD controls; gas custody transfer subsystem; and compressor controls.

HSE enables enterprise integration

Serbia Gas, through its engineering firm WIG, has had experience working with Foundation fieldbus since 2001, so the technology was a natural choice for its Banatski Dvor facility. A modern control platform based on Smar’s SYSTEM302-7 enterprise automation...
solution was implemented to handle Distributed Control System (DCS) functions throughout the gas storage and production plant.

The Fieldbus Foundation’s High Speed Ethernet (HSE) implementation was ideally suited for use as a control backbone at the Banatski Dvor facility. Running at 100 Mbit/s, HSE is designed for device, subsystem and enterprise integration. It supports the entire range of fieldbus capabilities, including standard function blocks and Device Descriptions (DDs), as well as application-specific Flexible Function Blocks (FFBs) for advanced process and discrete/hybrid/batch applications.

HSE provides the same benefits as H1 (31.25 kbit/s) fieldbus, but at the subsystem integration level instead of the field device level. The technology supports interoperability between disparate controllers and gateways in the same way that H1 supports interoperability between transmitters and actuators from different suppliers. FFBs in HSE devices can be set up using programming languages such as those found in the international standard IEC 61131-3.

**How the control system operates**

The Serbia Gas control system integrates H1 fieldbus devices with HSE remote I/O, legacy HART devices, and an ESD subsystem. The system links dedicated compressor controllers via ModBUS and ties all Human-Machine Interfaces (HMI) together using HSE through an OPC server. HSE serves as a data highway for communication between linking devices and operator workstations, as well as a network allowing communications between various controllers.

With **FOUNDATION** HSE, various CPUs can work together as one — providing a powerful backbone for enterprise integration. At the same time, FFB technology enables complete integration of conventional I/O and logic in the fieldbus system. Horizontal communications across the gas plant is achieved using 14 HSE nodes and more than 100 HSE external links. The system design also comprises a number of OPC servers and OPC clients for online diagnostics, maintenance and calibration; third-party HMI integration; and historical trends and reporting.

At the heart of the new control system are multi-functional, high performance, integrated **FOUNDATION** fieldbus controllers. The controllers can work as an H1-H1 bridge or an H1-HSE gateway, allowing wider communication between field devices and greater flexibility in continuous control strategies. Through their I/O cards, the controllers can also execute discrete control via relay diagram logic — supporting a single, integrated system.

For the gas well architecture, remote cabinets are used for local control gas injection and extraction. Each well is equipped with surface and subsurface valves with hydraulic actuators. The fieldbus controllers are programmed so they can independently control the process at wells even if there is a break in connection. The system also employs automatic remote control and manual local override. A local UPS provides the voltage supply for at least one open-close cycle of on/off valves.

In the process control scheme, one fieldbus controller is assigned per well. A HART/H1 fieldbus gateway integrates the legacy HART transmitters, and digital I/O is connected directly to the controller I/O modules. The fieldbus controller supports FFBs for ladder logic, allowing full integration of digital signals to the **FOUNDATION** fieldbus system.

For the gas pipeline and collector architecture, all wells have the same fieldbus equipment. This includes one temperature transmitter, one pressure transmitter, one mass flowmeter, and one valve positioner per well. The devices are connected through four **FOUNDATION** H1 channels to the fieldbus controllers. The automation system processes signals from instrumentation and valves on the separation vessels, as well as mechanical equipment around the vessels. In the second phase of the project, new vessels will be

![Diagram](image-url)
installed and instruments from these vessels will be connected to a spare controller. A controller located in the transformer substation processes signals from utility meters in the substation, and from the compressor cooler.

An interoperable ESD controller provides emergency shutdown of the process control system. This controller is connected to the host system using the ModBUS TCP/IP Remote Terminal Unit (RTU) protocol.

The gas custody transfer subsystem employs a redundant control configuration consisting of three ultrasonic flowmeters, three pressure transmitters, three temperature transmitters, two flow computers, and a gas chromatograph. Each flow computer is used for all three lines. The ultrasonic meters are set in the same pipeline, one behind the other, in order to measure the same flow.

For the compressor station, dedicated operator panels and controls are connected to the DCS by the Allen-Bradley 5/04 DH+ protocol. The panels are integrated into the control system using an Allen-Bradley to ModBUS TCP/IP converter.

The control system’s I.S. interface utilizes a unique “split architecture” design concept. The MooreHawke ROUTE-MASTER solution includes packaged field device couplers with automatic segment termination and fold-back (i.e., non “current limiting”) spur protection. This solution allows a full 1,900-meter segment length without any FiSCO-type restrictions. It also supports very high plant availability because of integral surge protection, redundant DC power, and passive power conditioning.

Results show improved performance

Thanks to FOUNDATION fieldbus, Serbia Gas has achieved true distributed control across its process automation architecture. Control is completely distributed on different controllers, ensuring better reliability of the entire system. In addition, the fieldbus solution expanded data availability throughout the gas plant. This includes increased opportunities for process supervision; better alarm management, events and trends processing; and improved asset management with remote configuration, diagnostics, predictive maintenance, and calibration of FOUNDATION fieldbus and HART devices.

FOUNDATION fieldbus also helped to improve Serbia Gas’ bottom line: initial cost savings were realized through cable reductions—not to mention simple and quick acceptance testing and commissioning.

Conclusion

Serbia Gas started up its new automation system in June 2007, and the equipment is now under operation. Plans call for continued expansion at the Banatski Dvor site, including an increase from seven to 21 wells and the addition of two more compressor units. The FOUNDATION fieldbus-based control system will grow to keep pace with this progress, including an ESD package expansion and additional enclosures, usage of existing spares for additional signals, and installation of new fieldbus transmitters.