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Case Study

World's most automated seamless pipe-making plant counts on Siemens portfolio, expertise, and support to drive plant safety, quality and efficiency

Tenaris

Customer: Tenaris, a leading global supplier of tubes and related services for the world's energy industry and other industrial applications.

Challenge: Build the world's safest and most efficient seamless pipe plant to serve customers better.

Solution: Sole-source advanced automation, networking, drive and power technology, plus expertise, from Siemens, using the TIA Portal for programming.

Results: Improved testing throughput, visibility and safety, with a 50 percent return on investment.

In recent years, the oil and gas industry worldwide has responded to severe market-pricing pressures by finding ways to gain new efficiencies. That includes the industry's many thousands of suppliers, large and small. Among those is Tenaris, a leading global manufacturer and supplier of steel piping and related services needed for exploration and production (E&P) operations. Each year, the company's plants in North America, South America, Europe, and Eastern Hemisphere produce more than six million tons of steel pipes. With a focused eye on plant safety while staying competitive and profitable, Tenaris is always seeking to drive greater production quality and efficiency. In 2017, it achieved these goals with the opening of its newest showcase plant, TenarisBayCity. Five years before, with about 40 percent of its sales from North America, Tenaris began planning the world's largest and most automated seamless pipe making plant for Bay City, Texas.

The location is ideal. The $1.8 billion plant covers 1.2 million square-feet and employs more than 600 people. It sits on 1,500 acres in the heart of Texas oil country, near E&P customers in the high-growth Permian Basin and Eagle Ford shale formations.

After four years of construction, the facility completed commissioning and began operations. The plant adds 600,000 tons of seamless pipe-making capacity and services to the output from five other Tenaris facilities in the U.S. as well as the company's integrated global manufacturing network.

"We were excited that Siemens technology could help solve the novel engineering challenges Tenaris faced with this innovative plant," said Raj Batra, president of Siemens Digital Factory USA. "The TenarisBayCity plant is a testimony to the power of digitalization for driving innovative manufacturing into a new age."

Challenge: Build the world's safest and most efficient seamless pipe plant to serve customers better

According to Pablo Fushimi, Tenaris Project Senior Director providing for the safety of plant personnel and advanced equipment was one of the plant's three core design principles. The other two were quality and efficiency. This was a challenge for the plant's design team.

"On the one hand, operators must be close to machinery and inventory, whether it's feedstock, work-in-progress or finished goods, to monitor production quality and processes from end-to-end, while remaining mobile to get to and from their stations and work cells," he says.

"Safety is our top priority in everything we do. It guided the plant's design and architecture from the very beginning precisely because this is an industrial facility that makes seamless pipe."

Ensuring quality from start to finish. In designing the plant, engineers made sure that every part of its operations would support the company's global adherence to the rigorous ISO 9001:2015 quality management system. The company has integrated these and other quality, health, safety, and environmental standards into all its management practices worldwide. That's why Tenaris can produce piping up to 26 meters in length with tolerances of less than 5 millimeters and its products from source feedstock all the way through to customer delivery.

Maximizing asset utilization. Efficiency was the third design principle, which covers many different dimensions of the plant. Those included asset utilization, production throughput and visibility, plant reliability and energy-efficiency.

"To ensure we're always getting the most out of the plant's physical assets of machinery, inventory, and skilled personnel, maximizing uptime and availability would be critical," Fushimi says.

"So, for all that, we needed extreme operational reliability, which meant system and network redundancy as well as excellent diagnostics and maintenance capabilities. We also need operational visibility and the ability to track the provenance of every single pipe we make."

As for energy-efficiency, Fushimi takes pride in pointing out the Bay City plant is seeking LEED (Leadership in Energy and Environmental Design) certification. That readiness required detailed planning in all the plant's building and production systems from the outset.

"While Tenaris is one of the world's largest suppliers to the energy industry, we're also 100 percent committed to conserving our use of energy," he says. "Beyond the cost savings, it's the right thing to do for our environment and our future. Given the plant's size and complexity, energy conservation was a big design challenge for us."

Tenaris BayCity seamless pipe plant sits on 1,500 acres and covers 1.2 million square feet. It is the world's largest automation implementation using the Siemens TIA Portal to program and manage nearly 50,000 IO points across 4,000 network nodes.

Virtual commissioning. Finally, Fushimi wanted to reduce, if not eliminate, the fits and starts that can typically plague the commissioning phase of any new manufacturing facility. These occur when components, machines and systems, especially from different suppliers, are found to not "play well" together because they're difficult to integrate or don't interoperate. Another source of commissioning headaches is discovering the plant's layout design and process architectures fall short of expectations.

"No matter what the source of a commissioning issue, resolving it takes a lot of time," Fushimi says. "Our target was to bring the Bay City plant online timely, without sacrificing safety or quality. So, to streamline this final phase, we wanted to use software to conduct test simulations of just about everything in a virtual environment before going to the real version – virtual commissioning, if you will."

Solution: Sole-source advanced automation, networking, drive and power technology, plus expertise, from Siemens, using the TIA Portal software engineering framework for programming

To address these challenges and meet the plant's operating goals, Tenaris needed a fully automated approach for its production lines and inventory management. But few suppliers could qualify to help Tenaris with the complexity and scale of that task. Fushimi and his team carefully considered a short list of candidates with a sufficiently broad and integrated product portfolio, proven expertise, and financial strength to do the job.

They also wanted to sole-source as much as possible, so they could simplify and compress procurement cycles while later ensuring one point of contact for commissioning, support, and service. Most of all, they sought to create a standardized platform for Tenaris that would make it easier for maintenance technicians and operators to diagnose and repair problems, while also minimizing their spare parts stock. So, after evaluating their options for an automation partner, Tenaris chose Siemens.

"Siemens brought more to the table – their portfolio of integrated automation, drives, and power, plus expertise that's proven in large-scale projects like ours over the world."

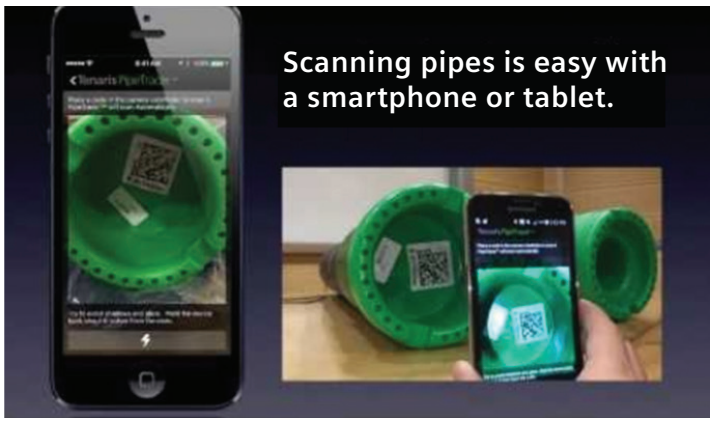
Automation Director Nain Rivera explains the decision: "Siemens brought more to the table – their portfolio of integrated automation, drives, and power, plus expertise that's proven in large-scale projects like ours over the world. A team of their experts in all these areas opened an office and lab on the construction site, so when questions or issues arose, we could address them right away. If an escalation was needed, they had the right person readily available. As our strategic partner, Siemens also managed more than 40 global OEMs and solution partners. That took a huge amount of risk out of the project, and ultimately saved us months over the course of our multiyear build-out."

TenarisBayCity Plant By the Numbers

SIMATIC Controllers	**124**
SIMATIC HMIs	**156**
SIMATIC Distributed IO	**4,042**
SINAMICS Drives	**1,620**
SIRIUS MCC Starters	**176**
SCALANCE Networking Devices	**843**
Network Nodes	**4,000**
Total IO Signals	**47,348**

Safety Integrated. The plant's automation landscape features 124 Siemens SIMATIC S7 Controllers from the Siemens Totally Integrated Automation (TIA) portfolio. Most are the advanced S7-1500F fail-safe models with integrated safety features. The built-in safety capabilities eliminated the cost and time of installing separate safety controllers across the plant. "The fail-safe SIMATIC S7-1500 Controllers have safety fully integrated, which has enhanced our plant safety, while increasing our operating visibility and management of the SIMATIC control fabric across all our operations."

To extend the plant's automation reach across its vast expanse, more than 4,000 ultra-compact, high-performance SIMATIC ET-200 remote IO modules (S, M, and Pro models) were deployed using a third-party's simple, push-in wiring connectors, which saved up to 20 percent in commissioning time. In addition, more than 150 Siemens SIMATIC HMI Comfort Panels were installed to provide personnel with color touchscreen interfaces to the automation controls.



The SIMATIC automation system supports the efficient tracking and traceability of each pipe via 2D-code scanning as it's fabricated and enters finished goods inventory and eventually ships out. And, to track tools, a SIMATIC RFID system was installed.

Vast network. PROFINET industrial Ethernet – supported by more than 800 Siemens SCALANCE switches, wireless access points, and related devices – handle the plant's communications requirements. "In all, we've connected more than 4,000 PROFINET nodes, making our Bay City mill one of the largest PROFINET implementations in the world," Rivera says. "We've deployed them in a ring network architecture for redundancy, using the Media Redundancy Protocol, which enables faster recovery times in case of failures."

The unique Siemens iPCF (industrial Point Coordination Function) technology enables IO communications over wireless LANs (WLANs) as fast as 16 milliseconds to operate within the cycle times of the plant's machines. "We deployed SCALANCE X-500 managed Layer 3 switches to give us the ability to segment the plant's large network into scores of sub-nets for better manageability, visibility, and security," Rivera says.

Two specialized PROFINET extensions – PROFIsafe and PROFIenergy – are used in the plant's network to more efficiently and effectively manage safety and energy communications respectively. The first prioritizes safety-related messages over other network data traffic, providing up to Safety Integrity Level (SIL) 3 risk-reduction. The second permits a coordinated, centralized shutdown of devices during standby periods, such as nights and weekends. For a facility the size of Bay City and with the number of devices, this can save a lot of energy over time.

Drive time. In addition to the SIMATIC Controllers and SCALANCE Network Infrastructure, Tenaris has deployed over 1600 SINAMICS drives. Some of the drives are installed on cranes as part of a SIMOCRANE solution package that also includes sway control, CeNIT straight-run controls and a crane management system (CMS). "Siemens also provided a great deal of training and remote support for starting up the drives," Fushimi says. "Both helped minimize startup issues and quickly resolve the few that did pop up."

Tenaris also implemented a range of Siemens switchgear, motor control cabinets, and other power distribution components. "The extent to which Siemens has engineered integration and interoperability across its many different automation, drives, and power components is impressive," says Rivera. "And given the huge numbers we had to install, the interoperability plus sole-sourcing saved us an extraordinary amount of time in installation and commissioning."

Fushimi points to the Siemens TIA Portal, a common automation software engineering framework, as another source of time savings. "With the TIA Portal, our engineering teams were able to manage and reuse code across many different applications, saving up to 30 percent of the time that would otherwise be needed, if they didn't have the ease of use of its graphical interface and code libraries," he says.

"Not only has the TIA Portal saved us probably months over this multiyear project, but it will also continue to save us time in maintaining and upgrading the plant's automation software in years to come," Fushimi adds. "Even more, we can share code with our many other facilities around the world that use Siemens solutions."

Results: Tenaris gains a digital showcase of integrated automation, drive systems, and power ensuring efficiency and safety, along with a flagship operating model for the Tenaris global manufacturing network

Fushimi's observation about reusing TIA Portal code elsewhere in the Tenaris global manufacturing network offers a glimpse into an even bigger potential dividend from the company's $1.8 billion investment in the Bay City plant. That is, the creation and cultivation of its own Industry 4.0 smart factory – the confluence of the Industrial Internet of Things within its factories and across them around the world. "What we've enabled at Bay City is a digital thread of data that provides greater operating visibility, speed, and continual optimization, especially via simulations,' he says.

As an example, Fushimi points to the virtual commissioning that he and his team were able to conduct in 3D software simulations before committing to the physical implementation of the plant's machines and the automation, drives, and power infrastructure supporting them. In effect, his team was able to create a digital twin of the plant's automation controls, drives, and power infrastructure that serves as a baseline initially, then an as-built model later – or a reference model for upgrading other Tenaris plants or new-builds.

"Of course, we did all the factory acceptance testing required to prevent equipment from arriving out of spec or with operating flaws, but that only goes so far," he says. "With the Siemens gear and using the TIA Portal code, we were able to build a 3D model of the plant and test all the Siemens Controllers, drives, networks, IO, and other components in simulation before installation. We were able to make hundreds of adjustments, which translated into significant time savings in the commissioning phase, allowing us to open the plant on time."

Siemens' innovative automation solutions portfolio, expertise, and support to drive plant efficiency, quality and safety, enabled the Tenaris plant in Bay City, Texas, to be the world's most automated seamless pipe-making plant.

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Siemens Industry, Inc.
5300 Triangle Parkway
Norcross, GA 30092

For more information, please contact
our Customer Support Center.
Phone: 1-800-241-4453
E-mail: info.us@siemens.com

usa.siemens.com

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