Industry: Water/wastewater

Customer case study

Declare freedom from legacy control systems, boost resilience, and future-proof your utility

Highlights

- Like many other water/wastewater systems, the New Freedom Waste Water Treatment Plant (WWTP) had an outdated control system.
- The legacy system was not only expensive to operate and maintain, but the outdated equipment also meant a higher likelihood of failure – reducing the resilience of the utility.
- The New Freedom WWTP completely modernized its obsolete, plant-wide control system, reducing maintenance costs, boosting its resilience, and preparing for the future.

> "I want a reliable, redundant PLC that's going to be able to take this plant into the future."
>
> **John Smith,**
> **Director of New Freedom WWTP**

Customer profile

The New Freedom WWTP treats and sanitizes wastewater generated by the residents of four townships and boroughs in southern Pennsylvania.

Challenge: High risk of failure due to obsolete control system

The number one challenge for U.S. water sector utilities is dealing with aging water and wastewater infrastructure. This includes the automated and partially automated control systems that monitor and control critical processes. Outdated or even obsolete control systems are difficult and expensive to maintain. Anecdotal accounts of running a plant with parts from eBay may be more common than imagined. Of greater concern, a failed component can debilitate essential water processes for an extended period, negatively impacting water quality or the environment.

Figure 1: The old PLC, installed in the 1990s, was in danger of failure, which could have disastrous consequences for the residents who rely on the water supply.

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The New Freedom facility faced a common problem, as described by John Smith, its director. Smith explained, "The original equipment that was put in during the 1990s is quite antiquated, and it's getting harder and harder to find replacement parts. In addition, it's getting harder and harder to find programmers that can work on the DOS binary system to make changes."

The programmable logic controller (PLC) system controlling the plant was obsolete, creating a high-risk situation. A failure of any kind could be disastrous, and could negatively impact the environment.

Solution: Seamless migration with redundant PLCs

The Phoenix Contact USA Engineering Services Team led the effort to replace the aging control system with a state-of-the-art, plant-wide control system. To minimize any interruption in the plant's process, the migration from the old system to the new required the new system be installed and tested before seamlessly switching it over as the primary control system. Once the site acceptance test (SAT) was completed and the new system was operational, the old system would be removed.

The first step of the migration process was to duplicate the code of the original system, which was no small task given the lack of documentation. Roughly 40% of the original code was poorly documented or lacked documentation altogether. Replacing a control system on a continuous process is always challenging, even more so when that process is complex.

"Like any treatment plant, we use a combination of biological and chemical treatment processes to convert raw wastewater into clean water. This being an SBR plant – which means Sequential Batch Reactor – there are many, many more moving parts than in a traditional plant," said Smith.

The project was proceeding as expected despite the challenges of writing and verifying an extensive amount of code, and installing and testing the new system with thousands of wiring terminations alongside the legacy system. However, a potentially calamitous event occurred during the SAT. The old PLC had a fatal error, rendering it inoperable. Fortunately, the new control system was quickly brought online without significant interruption to the process.

The fortuitous turn of events underscored the importance of replacing legacy systems before they fail and negatively impact operations. However, replacing outdated control systems brings more benefits than just ease of operation and increased resilience.

The control system features redundant RFC 460R controllers connected on a plant-wide fiber-optic ring. The controllers employ PROFINET Media Redundancy Protocol (MRP) to provide fault recovery time in milliseconds for the controllers and remote I/O stations on the ring, providing the highest level of resilience for control and communications. To further enhance the system's

Figure 2: The redundant RFC 460R controllers are connected on a plant-wide fiber-optic ring. The controllers employ PROFINET Media Redundancy Protocol (MRP) to provide fault recovery time in milliseconds, providing the highest level of resilience for control and communications.

Figure 3: Each station on the ring has a DC UPS battery backup for power redundancy. This further increases the system's reliability and resilience.

resilience, each station on the ring is powered by a pair of redundant power supplies, which also power a DC UPS battery backup. Power can thus be sustained through plant outages as well as local power supply failures.

Results: Upgrade pays off

For New Freedom, the conversion delivers on an important expectation of the client. Smith stated, "I want a reliable, redundant PLC that's going to be able to take this plant into the future." The New Freedom facility has exactly that. The new control system will enable advanced monitoring and control functions needed to address the changing needs of the industry well into the future.

The first significant benefit was the use of the open standard of IEC 61131-3 for the extensive amount of code. IEC 61131-3 is the

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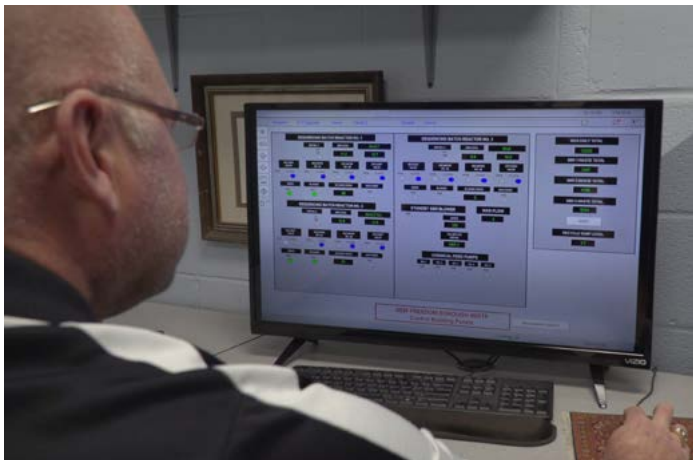

Figure 4: John Smith, director of New Freedom WWTP, monitors remote locations via the modern HMI.

first vendor independent standardized programming environment for industrial automation and was established by the International Electrotechnical Commission (IEC), a worldwide standard organization recognized for standards in the controls industry by over 50 countries. This open approach to the code ensures easy readability and portability to other PLC manufacturers, ensuring unprecedented flexibility. Another benefit of the conversion was a dramatic improvement in the operator interface devices. Pilot devices and single-purpose displays were replaced with touchscreen Human-Machine Interfaces (HMIs). Operators now can quickly assess system status and alarm conditions, providing enhanced situational awareness for plant operation.

An additional benefit of the conversion is the significant enhancement in asset management through control system life-cycle management, critical for continuous processes expected to operate for 20 or more years. Effective life-cycle management maximizes the return on capital expenditures by deriving the greatest value from assets while minimizing the total cost of ownership. As an example, one aspect of life-cycle management is the integration of existing and future peripheral systems into the main control network. Legacy systems have limited or no provisions for communications using industrial Ethernet protocols that are now the standard. New Freedom's control system now offers a wide range of options for communications using current protocols, and is adaptable to future communications as well.

Lastly, the conversion from an obsolete legacy system to a modern control platform enables advanced monitoring and control functions that will allow implementation of new functions and capabilities that go far beyond the traditional scope of industrial control systems. The Industrial Internet of Things (IIoT) holds the promise of enhanced asset management and process efficiencies by gathering and analyzing data from a wide range of industrial devices. Artificial intelligence and machine learning will augment applications such as predictive maintenance and energy management. Control platforms such as the one at New Freedom WWTP are the foundation of IIoT architectures, and they provide the connectivity required for edge-computing and cloud-based solutions, along with security for mission-critical operations.

The staff at the New Freedom WWTP realized many benefits from replacing the plant's obsolete control system. However, the biggest benefit is ensuring the availability and reliability of a critical water process for the residents of New Freedom borough for many years to come.

Figure 5: With the new modern control panel, the Industrial Internet of Things (IIoT) holds the promise of enhanced asset management and process efficiencies by gathering and analyzing data from a wide range of industrial devices. Artificial intelligence and machine learning will augment applications such as predictive maintenance and energy management.

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