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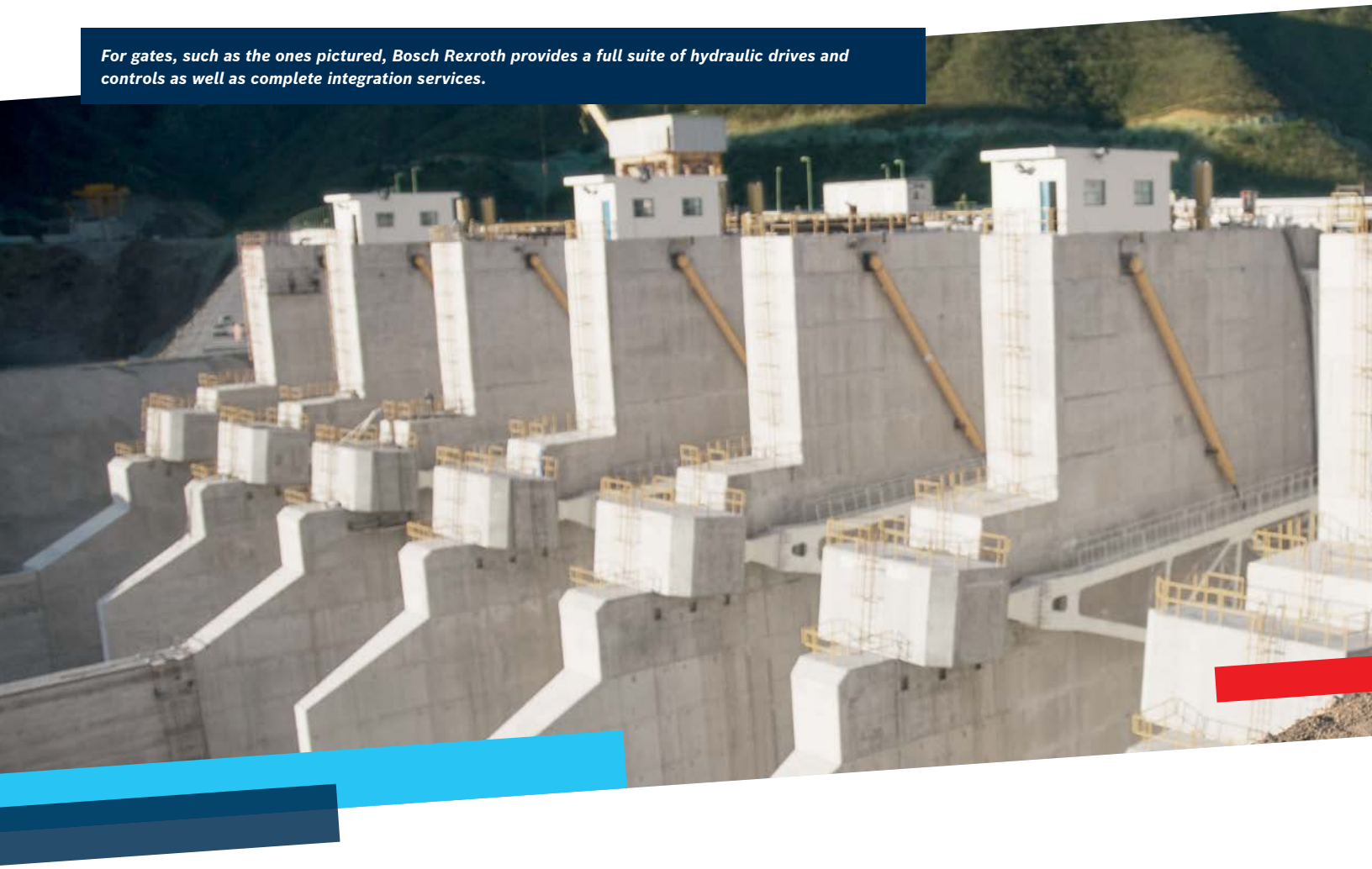


*For gates, such as the ones pictured, Bosch Rexroth provides a full suite of hydraulic drives and controls as well as complete integration services.*

# Modernizing Drive and Control Systems for Large Civil Engineering Projects

**Our current civil infrastructure is the product of decades of investment and management to serve the transportation and supply chain needs of communities and industries. While highways, roads and bridges constitute a large proportion of these vital facilities, there are also major portions of this infrastructure that incorporate mechanical drive and control systems of substantial size and complexity.**

Systems such as locks and dams for transportation, movable bridges, dams for hydroelectric power plants, irrigation and flood control systems, constitute the “moving parts” of our civil infrastructure. In the U.S. and other parts of North America, many of these systems were first engineered and built in the mid-20th century, in the 1950s and 1960s. There is now growing commitment to repairing and modernizing this infrastructure in the U.S., backed by billions of dollars of federal investment approved in 2021. This investment includes expenditures allocated to these civil engineering “moving parts.”

Modernizing these systems will be a cross-discipline engineering, construction and project management challenge. A key part of the process will be selecting and integrating a new generation of drive and control systems that offer the performance, versatility and Industry 4.0 smart capabilities needed to make this modernization productive and long-lasting.

## CHALLENGING INFRASTRUCTURE CONDITIONS

In a 2017 report from the American Society of Civil Engineers, U.S. inland waterways received a D grade. According to the report, roughly 49% of vessels passing through their 25,000 miles and 239 locks of U.S. inland waterways experienced delays as a result of poor conditions, often related to age, as most waterways have well exceeded their 50-year expected life spans. These systems were state-of-the-art when first constructed, with large cylinders, pumps, piping, valves and other equipment designed to move very large, very heavy structures with the most precise motion possible at the time. They had to be rugged, to function partially or fully submerged and in outdoor temperature extremes, operating efficiently for 30 to 50 years — with proper maintenance and management.

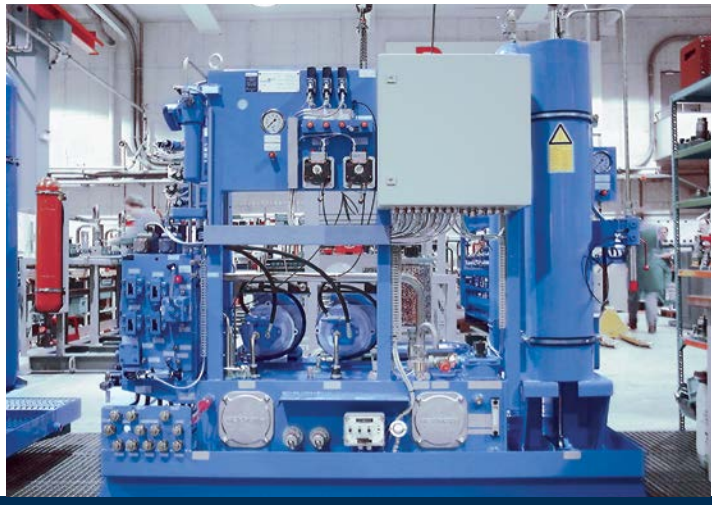
Failure to properly fund maintenance and equipment replacement has contributed to equipment degradation. However, one of the biggest issues is that much of this equipment is long past its intended life cycle — systems installed for 50-year life cycles being forced to operate for 70-80 years. This leads to costly make-do repairs, sometimes fabricating replacement parts for equipment that is no longer manufactured.

There are also environmental impacts: breakdowns or outdated seals can result in hydraulic fluid leaks into sensitive waters, forcing locks and other equipment to be shut down until repairs can be made, which can lead to major backups in river traffic. Older locks and gates on irrigation systems and canals lose excess amounts of water. Especially in regions like California dealing with climate change-driven droughts, water conservation has become extremely critical, and modernizing these systems is vital to help manage the impact of climate change.

The operating controls for many of these moving systems are also much more mechanical and manually controlled, often requiring more operators than would typically be used in industrial facilities using modern controls. The introduction of PLCs and digital drives, even for the largest moving systems, enables greater automation, increased backup systems and easier operation with more efficiently sized staffs — especially since many operators who have worked these older systems are rapidly retiring.

## NEW CIVIL ENGINEERING DRIVE AND CONTROL TECHNOLOGIES

The goal of modernization should be to bring the technology used in the drive and control systems fully up to date, so that infrastructure operators (and the customers who depend on those structures) benefit from improved movable infrastructure performance and significant reductions in delays for repairs, as well as full compliance with the latest safety and environmental rules and regulations. By updating drive and control systems with the technology now used in other industrial applications, a wide range of performance benefits can be realized. Materials that are more durable will maintain efficiency for longer periods, reducing maintenance costs and optimizing uptime. Switching from older hydraulic systems to smarter, more efficient electrohydraulic technology can provide better performance in a smaller package, while reducing energy costs.



***Bosch Rexroth provides modernized hydraulic power units with advanced hydraulic controls systems as part of civil engineering projects.***

Hydraulic technology like large cylinders, pumps, hydraulic direct drives, and power units are now manufactured with much greater precision and tolerances than the systems they are replacing. The older hydraulics systems typically operated within pressure ranges from 500 psi to peak rates of 1,000 psi. Since current hydraulics are manufactured to much tighter tolerances, 3,000 psi is the typical minimum, with higher pressure levels available depending on the system. As a result, the hydraulic systems can become much more compact while delivering significantly increased performance: a large hydraulic cylinder that needed to be 20 inches in diameter in the past can now be 10 inches, and the six-inch pipe feeding it can be reduced to two inches. This not only saves on space; since the system is more compact, it offers much more precise motion control through the duty cycle, offering improved endpoint accuracy that can help make lock and dam operations more efficient and faster and help conserve water.

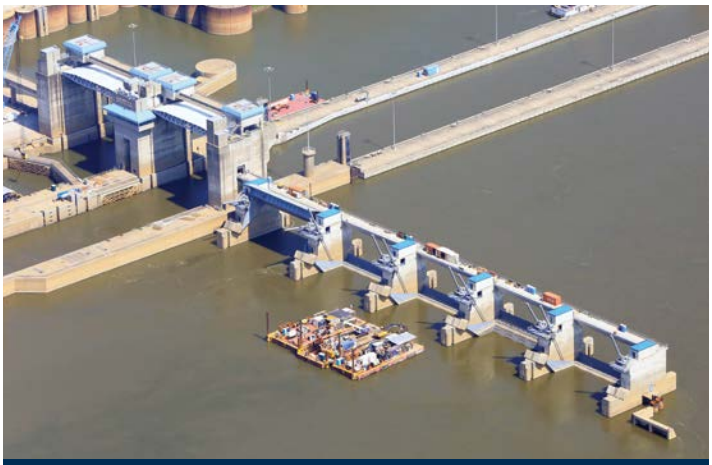
The latest drive technologies feature advances for improved life cycles. These include new, more durable piston rod coating technology for hydraulic cylinders and the latest materials designed for optimal tribology with the goal of reducing wear and therefore maximizing lifetime. The newest generation of hydraulic PLCs and smart drives gives infrastructure operators much greater control and flexibility compared to existing controls platforms, some of which are decades out of date. They offer much more automation and remote control capabilities, which is critical for installations that can spread out for acres.

As with other Industry 4.0 technologies, increased use of sensors, integrated with the new generation of electrohydraulic controls, will support more advanced condition monitoring of all the drive and control equipment. It will enable more efficient predictive maintenance programs that identify potential problems early. This will ensure that critical equipment shutdown and maintenance can be planned, and necessary repairs conducted well in advanced, before serious damage and huge expense occurs. It can also give infrastructure operators greater freedom to staff repair and maintenance teams on a regional basis, rather than having personnel at every location — since the modernized technology will operate with much greater reliability and predictive maintenance programs can make scheduling work crews more efficient.

## SYSTEMS ENGINEERING: ADVANTAGES OF SINGLE-SOURCE APPROACH

Selecting the new drive and control systems for a 70-year-old lock and dam can become time-consuming, particularly if multiple suppliers are used — one for the cylinders, another for the pumps and hydraulic drives, and others for sensors, controls, and hydraulic power units and piping. There are advantages to working with one provider who can supply all the latest generation of hydraulics technology and digital controls, as well as support the integration of the complete solution.

For example: Bosch Rexroth provided a full suite of hydraulic drives and controls as well as complete integration services for constructing the Olmsted Locks on the Ohio River near Paducah, Kentucky, 10 miles upstream from the confluence of the Ohio and Mississippi Rivers. For a five-year period, Bosch Rexroth was fully involved in providing hydraulic drives and controls for the five gates on the lock. The complete solution encompassed six hydraulic power units, ten tainter gate cylinders and spares, multiple custom manifolds and control systems for these hydraulics as well as field piping. The company was also responsible for startup and commissioning, engineering and installing all the piping, sensors, and wiring to make the gate drives fully operational, as well as training on the new systems.



***Bosch Rexroth provided hydraulic drives and controls for the gates on the Olmsted Locks. The solution included large hydraulic cylinders, HPUs, custom manifolds, digital controls and all required hydraulic piping and wiring.***

This approach helped simplify the project for the Olmsted Locks general contractor, who was mainly responsible for the more massive “concrete and steel” construction of the project. Also, since Bosch Rexroth already had in-depth expertise on similar projects in Europe and in the rebuilding of the Gatun Locks in the Panama Canal, the Olmsted Locks team could draw on their experience to keep the project on track.

With society’s renewed commitment to infrastructure modernization, the latest generation of drive and controls systems can be realized. The right technology, carefully selected to meet the unique demands of each installation, can help protect the environment, conserve water, reduce transportation delays, and ultimately provide a renewed and more productive transportation system.

## ABOUT THE AUTHORS

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