

Project Spotlight

Modernization

Innovation

Grand Coulee Dam elevator a proud triumph for Delaware Elevator and team.

submitted by Delaware Elevator

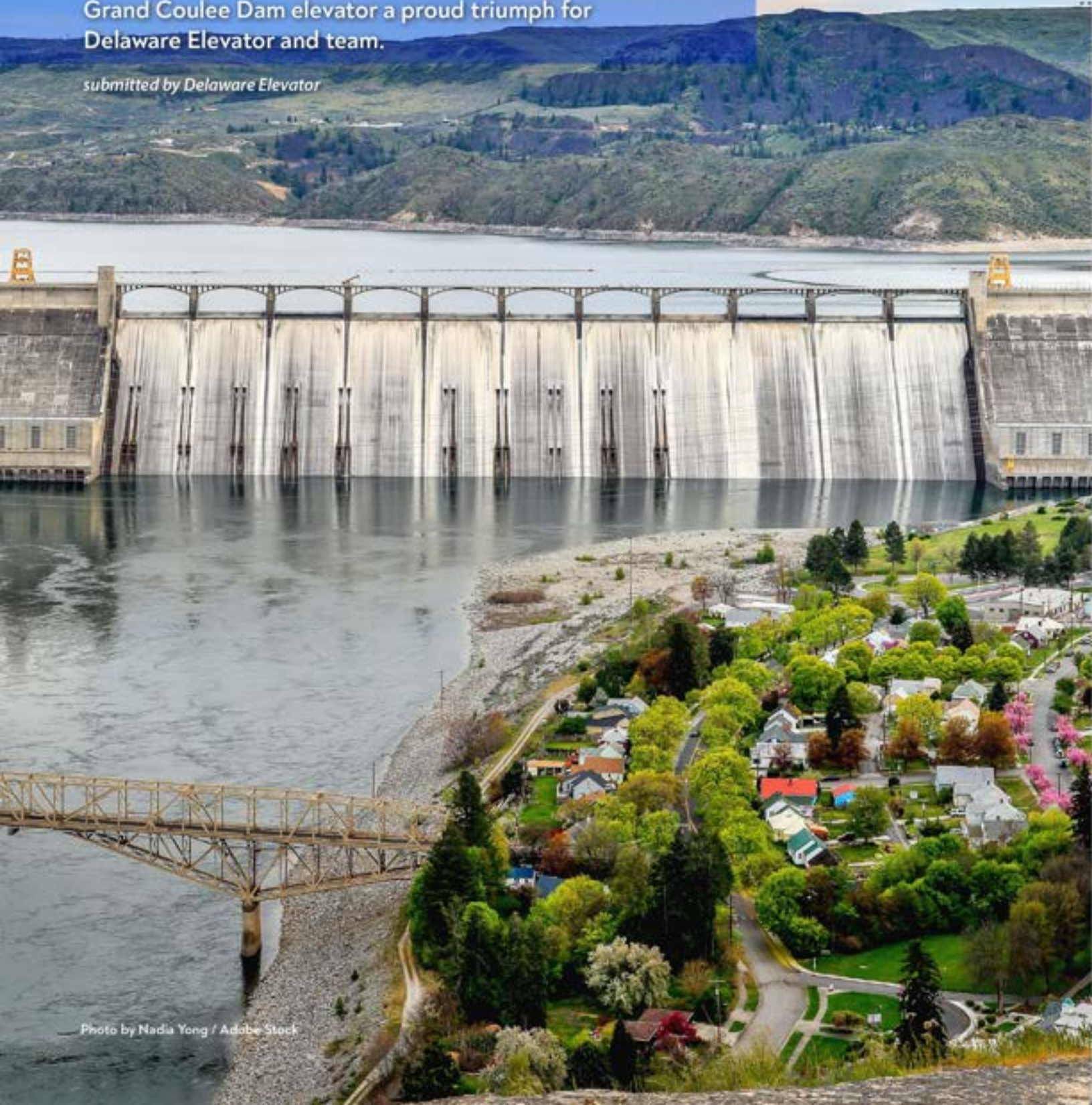


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The comprehensive modernization of a unique 1941 freight and passenger elevator system at the iconic Grand Coulee Dam enhanced safety, improved efficiency and brought the system up to current ASME A17.1, building and International Fire Code (IFC) codes, all while carefully preserving the system's historical integrity within a designated historic site. Serving a massive dam in eastern Washington State on the Coulee River, the elevator serves a critical dual purpose: transporting dam personnel/visitors and moving extremely heavy hydroelectric generator components (ring gates) for maintenance and repair.

The essential challenge was transforming a complex, manually operated system into a robust, modernized and user-friendly solution capable of handling vastly different loads. As elevator contractor, Salisbury, Maryland-headquartered Delaware Elevator, Inc. was a key part of a highly skilled team that successfully addressed this challenge and delivered for the client, the U.S. Bureau of Reclamation. We believe the Grand Coulee Dam elevator project stands as one of the most intricate modernization endeavors in the vertical-transportation (VT) industry to ever be completed.

The existing system, renowned for its dual capabilities of transporting both personnel (10,000 lb) and massive hydroelectric ring gates (44,000 lb), presented incomparable challenges. Historically, switching between these two modes required a laborious manual process of adding or removing counterweights, consuming significant time and manpower.



The Delaware Elevator Grand Coulee Dam team; image courtesy of Delaware Elevator

Furthermore, the original elevator provider did not distribute sufficient technical documentation, necessitating extensive reverse-engineering of components to integrate modern technologies.

The remote jobsite also presented logistical hurdles, such as unpredictable weather patterns throughout the seasons and limited local resources. To move forward, sourcing unique historical and modern parts required a global procurement strategy, which supported the project unstintingly.

At the heart of this modernization was collaboration. Spearheaded by Delaware Elevator alongside specialized contributions from Full Circle Group (prime contractor), ECS/VDA (design consultation), Hilliard Brake (custom brake manufacturing) and Motion Control Engineering (MCE) (custom controller manufacturing), the team developed a groundbreaking, multifaceted solution. Deon Young (DZ Mod) and Kelly Houlihan (DE-Simone) were also contributors to the initial part of the project, where they assisted with the



Hoistway and pit area; images courtesy of Delaware Elevator

demolition and replacement of the major components. Vertical Solutions of Spokane played a key role, as well, assisting with some of the critical installation tasks that required local manpower to support the Delaware Elevator team.

iCONTROL Custom Control System and More

The most significant innovation at play was the fully custom control system utilizing MCE's iCONTROL platform. This advanced software now seamlessly manages the elevator's dual-capacity operation with a single, fixed counterweight stack, eliminating the need for manual weight changes. The system skillfully balances the over-counterweighted condition during passenger service with heavy freight loads, achieved through sophisticated Silicon Controlled Rectifier (SCR) drive adjustments and precise control.

Further technical achievements include the repurposing of existing dual machine brakes as emergency sheave brakes, comprehensive seismic upgrades and the installation of new horizontal and vertical bi-parting doors with modern operators.

The elevator's operation was also streamlined, with automatic passenger service at 100 ft/min and a dedicated, safer freight mode at 50 ft/min, replacing the antiquated manual rheostat control.

Historical Context and Original System Design

To fully appreciate the scope of this modernization, understanding the original 1941 elevator design is paramount. The Block 31 elevator at the Grand Coulee Dam was a truly one-of-a-kind system serving a dual, critical purpose. Its certified capacity was 10,000 lb at 500 ft/min for carrying freight and passengers. However, its primary function was the transportation of massive 44,000 lb of ring gates for the dam's hydroelectric generators, specifically to and from floors two, seven and nine, which featured heavy-duty vertical bi-parting doors.

The original system was powered by two Otis #79 DC overhead gearless machines, operating with a single drive sheave and a double-wrap 2:1 roping arrangement. The elevator's impressive travel extended 361.88 ft into the depths of

the dam, serving 11 landings. While standard automatic operation was available for 10,000-lb loads (freight and handlers), the true complexity lay in its dedicated 44,000-lb freight mode. This mode required a second set of counterweights to be manually attached, sitting on counterweight pit channels, to balance the significantly increased load. This intricate process took a team of people and rendered the elevator incapable of carrying passengers in freight mode.

Further complicating the original operation, riggers and dam personnel loading heavy carts (on mine cart rails that extended onto the elevator platform) had to engage "rail dogs" – heavy-duty mechanical devices – to prevent cart movement. Communication during freight operations relied on radios, with an elevator technician in the machine room manually controlling the elevator's movement via a rheostat switch gear, using selector marks to estimate floor height. The remaining landings featured oversized horizontal doors, each with its own operator and an innovative GAL heavy-duty door operator designed many years ago and located within the hoistway wall.

Goals and Challenges

The overarching goals of the modernization were clear: to bring the entire elevator system up to current ASME A17.1, building, and IFC standards, enhance safety and significantly improve user-friendliness and efficiency for the dam's critical operations. Achieving these goals demanded overcoming an array of complex challenges, including:

- ◆ **Equipment Out of Service During Site Survey:** The elevator was non-operational during the initial site survey, restricting data collection and forcing reliance on historical data and visual inspections.
- ◆ **Remote Jobsite Challenges:** Located in an isolated region of Washington State, the jobsite presented logistical difficulties due to unpredictable weather and limited local resources, impacting scheduling and staffing.
- ◆ **Extensive Modifications to Original Plans:** Ongoing technical discoveries necessitated significant alterations to original

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The C.E. Electronics **Door Lock Monitor** is a modern, code-required safety upgrade designed to bring existing elevators into compliance with A17.3 requirements.

The A17.3 code mandates that existing elevators be retrofitted with additional door monitoring logic to improve passenger safety. While this protection has been standard on new elevators for years, many older systems still require this critical upgrade.

Our Door Lock Monitor adds advanced sensors and intelligent logic that prevents elevator operation if door contacts are faulty or compromised, helping protect passengers and reduce liability.

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Modernized elevator car interior; image courtesy of Delaware Elevator

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designs during implementation to optimize functionality, ensure safety and comply with regulations.

- ◆ **Sourcing Parts and Components:** The difficulty in locating specific, often custom parts within the U.S. market led to outsourcing critical elements from international suppliers in India, the U.K. and Spain, requiring stringent quality assurance.
- ◆ **Historical Preservation Considerations:** As a historic site, the project mandated retaining as much of the original design

and finishes as possible, balancing modernization with respect for heritage. Mike Stevens from ECS/VDA highlighted that components like the safeties needed rebuilding, but the well-preserved gearless machines were retained after thorough checks.

- ◆ **Advanced Software Development:** The most complex aspect was developing advanced software for a freight elevator capable of dual functionality – passenger and freight – at varying speeds and modes. This resulted in what Jose Carrasco described as the “most comprehensive elevator controller design I have ever encountered.”



Field work/installation; image courtesy of Delaware Elevator

The Modernized Transportation System

The modernization package, meticulously designed by ECS/VDA and implemented by Delaware Elevator with key components from MCE, transformed the vintage system into a cutting-edge, highly reliable transportation asset. Specifications are:

- ◆ **Elevator Type:** Freight/Passenger Elevator (Modernized from Otis #79 DC Gearless)
- ◆ **Car Capacities:** 10,000 lb (Passenger Mode, automatic) and 44,000 lb (Freight Mode, constant pressure)
- ◆ **Travel:** 361.88 ft
- ◆ **Landings Served:** 11
- ◆ **Roping:** Double wrap 2:1
- ◆ **Machines Retained:** Two Otis #79 DC overhead gearless machines (thoroughly checked and found in like-new condition)

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THE NANO ELEVATOR

Details:

Weight: 65 lbs / 29 kg

Height: 29 in / 73 cm

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- ◆ Drive Sheave: Single
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Reduced to 100 ft/min | Freight Operation (44,000 lb):
Reduced to 50 ft/min

Key Technical Innovations and Engineering Elements

Dual-Capacity iCONTROL System (MCE)

The cornerstone of the modernization is MCE's iCONTROL platform, specifically engineered to manage the dual-capacity elevator. Ron Ong, senior project engineering manager at MCE, explained that the biggest challenge was balancing the SCR drive perspective when dealing with dual car capacities (10,000 lb and 44,000 lb) with a single counterweight stack.

The counterweight is now set to 40% of the 44,000 lb freight capacity. This means that, during passenger operation (10,000 lb), the elevator is significantly over-counterweighted. MCE's system was custom-tuned through extensive drive adjustments to provide smooth control and minimize vibrations across both operational modes, an achievement that eliminated the complex manual counterweight additions previously required.

The previous manual freight control has been replaced by sophisticated software, vastly simplifying operations.

Unique Dual DC Machine Configuration

MCE's System 12 drive was configured to rotate both original Otis DC machines simultaneously. This was achieved by arranging the machines' armatures in a series configuration, maximizing amperage at 310A. The machines' shunt motor fields were also configured in a combined series arrangement.

Repurposed Brakes

The original machine's brake fields were combined in a parallel configuration and ingeniously repurposed as the system's emergency sheave brake to meet modern safety code requirements, a notable design contribution from Ong's team.

Modernized Door Systems

All new horizontal doors and vertical bi-parting freight doors were installed, complete with new operators. This maintained the unique functional distinction of the original door types at different landings while upgrading their performance and safety.

Enhanced Safety and User Experience

Braking System

Added new, modern brakes (including integration with Hilliard's hydraulic braking controller) for enhanced safety and unattended movement. The entire elevator braking system was a fully custom design.

Load Weighing

A new dual-purpose load-weighing system was integrated to provide precise data for both passenger and freight modes, informing the iCONTROL system.

Seismic Upgrades

Comprehensive seismic upgrades were implemented, including the addition of ring and string, shaker box and seismic fish plates where applicable.

Fixtures and Wiring

All new fixtures and wiring were installed throughout the system.

Buffers, Ropes, Governor

New buffers, ropes and governor were installed to meet modern performance and safety standards.

Operating Procedures

New, streamlined operating procedures were developed for the freight mode, making the system far more user-friendly and

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New control operating panel; image courtesy of Delaware Elevator

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efficient compared to the old manual radio communication and rheostat control. Lobby key switches now control activation of the freight mode.

Machine Room and Infrastructure Modifications (Jacobs)

Jacobs designed all added fire service and machine room modifications, electrical upgrades, hoistway and machine room HVAC. Remote-monitoring fiberoptics run to the elevator lead technician's office, ensuring a complete infrastructural modernization.

The Grand Coulee Dam Elevator Project stands out in the elevator industry as a benchmark for complex modernization and collaborative engineering. As Stevens of ECS/VDA commented, in his 39 years in the elevator industry, "This one tops the charts in my career thus far. I believe this to be a one-of-a-kind system." Roy Hotckin further noted it as the "most custom and labor-intensive project" with which he's ever been involved.

An Industry First

The ability to convert a dual DC machine, dual-capacity elevator system from requiring manual counterweight adjustments to operating seamlessly with a single counterweight stack via sophisticated software is an industry first. This innovation addresses a fundamental operational challenge with elegance and advanced technology.

Enhanced Safety and Operational Efficiency

The project transformed a system with inherent operational risks and manual inefficiencies into one that is fully compliant with modern safety codes, highly automated and significantly easier to operate. This has a direct impact on the safety of personnel and the critical maintenance operations of one of the largest power plants in the U.S.

Preservation of Heritage

The careful balance between modernization and historical preservation ensures that a vital piece of the dam's heritage continues to serve its function, integrated with 21st-century technology.

Exemplary Collaboration

The success of this project is a direct result of the extraordinary collaborative effort among Delaware Elevator, Motion Control Engineering, ECS/VDA, Jacobs Engineering and various subcontractors and suppliers. This teamwork was essential in navigating technical hurdles, logistics and design complexities.

This project is a testament to extraordinary engineering ingenuity, dedicated teamwork and solid commitment to safety and efficiency in a historically significant context. It transformed a complex, manually intensive vintage system into a state-of-the-art, user-friendly and highly reliable transportation asset. 🌐

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