

Standardizing Excitation and Plant Controls On Ovation™ Platform Improves Hydropower Fleet Reliability and Performance

Emerson modernized four Salt River Project hydroelectric dams by integrating legacy excitation systems with the Ovation™ distributed control system on a unified architecture. The upgrade delivered a 30% reduction in operations and maintenance costs, 50% faster troubleshooting, improved startup and shutdown efficiency, and unit reliability in the 90th percentile—demonstrating how a single control platform enhances performance, diagnostics, and lifecycle support for remote hydro assets.



Introduction

Salt River Project (SRP) hydro fleet generates 265 megawatts of clean, fast-response power—enough to power more than 60,000 homes annually—while supporting critical water delivery in the Salt River watershed in Arizona. The reliability of SRP's hydro fleet is increasingly important given the Phoenix area's population growth and extreme temperatures. However, aging excitation hardware and limited OEM support increased the risk of generation loss, particularly for units requiring pump-back operation and black-start capability. Salt River Project sought a modern excitation solution that would meet the following objectives:

- Replace legacy excitation systems fleet wide to avoid age-related failures and spare part shortages.
- Integrate excitation with the control system for better visibility, alarm differentiation, and remote diagnostics.
- Support pump mode and black start capabilities with robust protection and control logic.
- Reduce operating and maintenance costs and streamline training/spare parts inventory by standardizing on one platform.

Discussion

Project Overview

Salt River Project standardized on Emerson's Ovation Automation Platform for both plant controls and excitation systems, integrating excitation controllers natively onto the Ovation network. Notable features include high-speed oscillography, redundant processors with bumpless transfer, dynamic bridge balancing, independent base field current regulation, integrated Power System Stabilizer (PSS), and comprehensive limiters and protection elements—all accessible through common HMIs, historian, alarming, and engineering tools.



Salt River Project retained certain hardware, for example, dry type exciter transformers, while replacing all other excitation control and protection hardware, including cabinets and bridges.

Timeline and Scope

The first Ovation excitation system was installed at Roosevelt Dam in 2022, with final upgrades of this multi-year program completed in February 2025 at Mormon Flat Unit 1 and Unit 2. The team finished excitation change-outs in only 10-12 days per unit—roughly half the time that is typical for similar projects. During the change-outs, the team replaced the full control and protection cabinets and bridges while retaining the dry-type exciter transformers. This efficiency was made possible by pre-outage planning, streamlined cabinet layouts and coordinated Factory Acceptance Testing (FAT) and commissioning.

Salt River Project crews handled most of the installation work. Emerson supplied the excitation control cabinets and field engineering support deployed across all sites, which reduced startup troubleshooting and ensured consistency across all phases of the project.

Key Elements of the Upgrade

▪ Advanced Protection Integration

SRP and Emerson integrated SEL-2664 relays for ground fault detection (GFR) and reviewed how they interact with SEL-300G generation protection relays. The team established a Modbus connection between the SEL-300G and the Balance of Plant (BOP) controller to monitor ground resistance, mapping IP addresses to ensure proper communication.

▪ Custom Patches for Implementation of Pump Storage and Synchronous Condense Operation

Engineers created custom patches for Digital Exciter Controller (DEC) modules at Horse Mesa Dam and Mormon Flat Dam to allow proper operation in both pump and synchronous condense modes. They configured coding to maintain the functionality of important limiter/protection elements, the power system stabilizer, and reactive compensation.

▪ Compatibility with Existing Hydropower Distributed Control Systems

The upgraded Digital Exciter Controller modules were fully compatible with Salt River Project existing hydro control systems. The enhancements provided operators with improved graphical visibility into excitation system performance.

▪ Enhanced Troubleshooting Tools

Hydro staff now use Digital Exciter Controller Oscillography to analyze trips with high-speed reference points and populated I/O data, making it easier to pinpoint timing and root causes.

▪ Pump-Back Capability for Specialized Units

Two units required unique excitation behaviors in pump mode. Horse Mesa Unit 4 uses a separate starting motor to bring the unit up to speed. A liquid rheostat controls the speed of the starting motor prior to excitation interaction, which allows the unit to maintain rated synchronous speed independently for pump entry. Mormon Flat utilizes a “reduced voltage across the line” starting method. A motor discharge contactor (MDC) shorts the generator field and the unit is run as an induction motor. Once up to rated speed, the exciter is started and the MDC is opened to transfer to synchronous motor operation. This required cabinet redesign and added relaying inside the exciter during the design phase. Ovation logic was designed to control all of these unique functions.

▪ Cybersecurity and Networking Upgrades

In April 2025, Salt River Project executed a fleet-wide Ovation Evergreen upgrade, constructing new data center rooms at the hydro sites, migrating copper to fiber, standardizing plant network architecture and



firewalls, and bringing excitation assets under the plant network cybersecurity umbrella. Patch management and switch configurations were aligned across excitation and the control system.

Integrated Excitation Control for Reliable Plant Operations

Integrated Ovation Platform and Excitation System Design

The Ovation platform provides native generator excitation control for rotating or static exciters. By leveraging the platform's common HMIs, network, historian, alarming system, engineering tools, diagnostic data and security functions, the Ovation excitation solution enhances decision making and improves operator efficiency.

The excitation system includes high-speed triggered-event recording and real-time oscillography for advanced monitoring and analysis. A triggered-event recorder captures high-resolution excitation data whenever a user-defined condition occurs, with configurable event durations and sampling rates up to 2560 Hz. Voltage changes are measured at this same high frequency, while the Digital Exciter Controller performs internal computations, control actions, and oscillography at a fixed rate of 2560 Hz. This capability provides pre-populated, high-resolution event data for commissioning and post-event analysis—reducing reliance on ad hoc trending and accelerating root cause investigations.

System reliability is further strengthened through redundant components, including digital excitation controller modules, standard Ovation controllers, and I/O modules. Additionally, excitation system power and protection are ensured through such components as field breakers, power rectifiers, field flashing circuits, de-excitation circuitry, and discharge resistors.

Project Results

Improved Startup and Operational Performance

- The fleet now operates with unit reliability in the 90th percentile, ensuring consistent performance during peak demand periods.
- The upgrade eliminated manual resets that previously added 15–20 minutes per startup. Automated alarm handling now prevents delays and enables faster response, even on single-operator shifts.
- Operators start units from any HMI onsite, using unified single-line diagrams and alarm lists to quickly localize faults.

Diagnostics and Remote Support

- Digital Exciter Controller Oscillography captures high-speed, pre-triggered data—including terminal and field voltage/current and frequency deviations—cutting troubleshooting time by 50%.
- Engineers can now provide remote support through the Ovation network, reducing reliance on on-site interventions.

Reduced Costs and Complexity

- Salt River Project reduced operations and maintenance costs by approximately 30% through platform standardization and streamlined maintenance practices.
- Salt River Project lowered spare parts inventory and training complexity by consolidating on the Ovation platform.



Safety and Maintenance

- Remote operation of the 41E field breaker and faster shutdown response improved personnel safety.
- Maintenance on bridges and fans is now shorter and more visual, without increasing overall maintenance windows.

Conclusion

The Salt River Project's hydro fleet excitation upgrade demonstrates how strategic technology integration can deliver measurable operational benefits. By standardizing on Emerson's Ovation excitation and control system platform, Salt River Project achieved significant cost savings and reduced installation time by nearly 50% through in-house execution and pre-outage planning. Beyond financial and schedule advantages, the project introduced innovations such as remote visibility, automated resets, and oscillography for advanced troubleshooting, which collectively enhance reliability and responsiveness for critical pump-storage units. These improvements position SRP to maintain its high reliability metrics while supporting growing energy demands and water delivery requirements in the Southwest. The success of this initiative underscores the value of collaborative engineering, forward-thinking design, and a commitment to operational excellence.

Learn More



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