

## Digital Control Element Drive Control System

The Framatome digital control element drive control system solution replaces all hardware end-to-end for control element drive system retrofits, eliminating the possibility of failures due to aging components, connections and wiring.

### Challenge

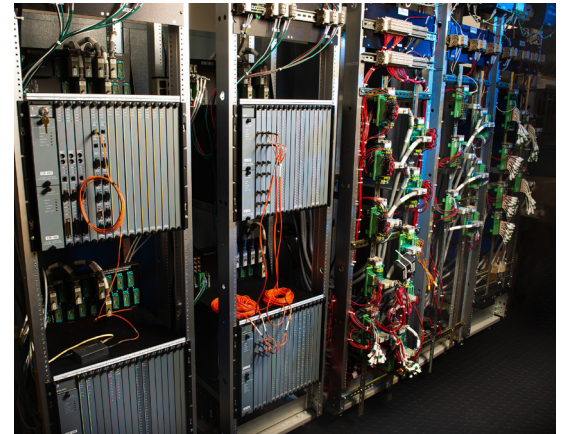
Due to aging components, connections and wiring, nuclear plant operators face the possibility of failures in control element drive systems (CEDs). Some upgrade options only address symptoms of an aging CEDs system, leaving plants susceptible to single-point vulnerabilities and an increased risk of trips and loss-generation time. Plant operators need a complete solution that addresses serious, industry-wide reliability and obsolescence concerns regarding CEDs operation.

### Solution

The digital control element drive control system (DCEDCS) is the most cost-effective solution integrating a combination of CEDs retrofits and digital upgrades, and offers value-added enhancements for desired system functionality. Effective development efforts can also be identified early in the project definition phase leading to even more cost savings.

The Framatome DCEDCS system is the solution with the most certainty to help operators continue producing uninterrupted electricity to their customers, while resolving obsolescence and reliability challenges in a sustainable manner. Our DCEDCS solution extends the life and improves the value of your nuclear assets, resulting in more efficient plant operation utilizing industry-leading maintenance interfaces.

The DCEDCS solution is designed as a direct, state-of-the-art replacement for the existing CEDs system, and is also designed to fit within the envelope of the existing CEDs system. The overall equipment layout and design allow for “plug & play” of major sub-assemblies resulting in easier system assembly, installation and maintenance.



The Triconex Triple Module Redundant (TMR) control platform offers maximum availability for mission critical systems within nuclear power plants.

### Customer Benefits

- Mitigated risk of loss-generation time due to elimination of single-point-vulnerabilities, enhanced monitoring techniques and reduced trips, maintenance time and start-up testing
- Reduced cost of non-quality with proven CEDs retrofits and digital upgrade experience, as well as procurement efficiencies
- More project certainty from a proven system that avoids use of Silicon-Controlled Rectifiers (SCR) and includes a Triple Modular Redundant (TMR) control platform
- Long-term support from a supplier with 40+ years of product lifecycle support and predetermined migration strategies
- More efficient, longer-term operation of your nuclear assets coming from proven technology and a supplier with more worldwide experience performing digital upgrades for existing plants and new plant construction than any other

**Your performance**  
is **our** everyday **commitment**

## Technical Description

- Coil timing is microcontroller based, eliminating the need for coil timing surveillance
- The microcontroller in every M-PGM (distributed architecture) power module can provide low-level fault detection and diagnostic information reporting, including but not limited to:
  - Detailed alarm information
  - Coil current and voltage
  - Calculated holding gripper temperature
  - Calculated gripper inductance
- Displays can be tailored to the customer's needs and plant-specific human factors engineering (HFE) programs
- High configurability of set-points and operating parameters allow for fine tuning of system performance
- All modules are hot-swappable integrating TRUE Triple Modular Redundancy
- Wide selection of interfaces to plant data network — can “speak” almost any language
- State-of-the-art power electronics equipment
- Modern Coil Power Programmers and System Logic
- Highly reliable, low-maintenance control system demonstrating 20-30 hours critical path time savings during plant start-up
- Secondary position indication subsystem implemented on the same platform as the system logic (not in plant computer)
  - Communicate directly via peer-to-peer network
  - No reliance on corporate IT/plant computer experts
- Framatome's rod control solutions have utilized “intelligent” rod positioning logic for decades
  - Automatic rod control mode with supervisory function to detect anomalies
  - Automatic latching accomplishes manual operator function with single button press
  - Automatic rod alignment actively prevents deviation alarms (alignment adjustments only performed during rod withdrawal)
- Complete fault monitoring ensures that no failure goes undetected
  - AC voltage monitoring, power supply voltages, temperature, circuit breaker trip
- Integrated rod drop time measurement has demonstrated critical path time savings of ~eight hours per cycle
  - Pass/fail LEDs for each group provide feedback allowing immediate transition to the next group
  - No user input or control required

## References

- The Framatome DCEDCS system is the latest evolution of the Framatome Digital Control Rod Drive Control System (DCRDCS) that has been successfully installed at five U.S. plants, and incorporates lessons learned from control element/rod upgrades on five continents.
- The DCEDCS system also takes advantage of Framatome's OEM experience as an NSSS Supplier and experienced OEM Control Systems Designer and Manufacturer. The state-of-the-art Framatome EPR (two units in operation, two under construction) uses features common to the DCEDCS system. In addition, Framatome has installed digital control rod drive and rod position Monitoring Systems at 11 other units worldwide since 1999.
- Framatome has more recent and relevant experience in performing digital upgrades for existing plants, and for new plant construction, than any other supplier. Our warranty, post-installation support, and supply chain strategy for spare parts will help increase the value of your nuclear assets, and extend the lifetime of your plants.

## Key Figures

**300** Comprehensive instrumentation and control systems installed in all reactor types around the world.

**1,300** Professionals on our global team

**5** Successful DCRDCS installations in U.S. plants

**11** Digital control rod drive and rod position monitoring systems installed worldwide since 1999

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