

## Improving CRDCS through Digital Technology

### Challenge

Nuclear facilities that are currently using the original 1960s vintage Diamond Power Control Rod Drive Control Systems (CRDCS) are facing obsolescence and reliability concerns. As a nuclear supplier of various products and services for many of these plants, Framatome is prepared to provide a viable digital upgrade to meet these emerging needs.

Implementation of a digital control rod drive control system (DCRDCS) can eliminate aging issues such as lack of spare parts and failure of critical components. The DCRDCS is designed to improve the reliability of this critical plant system and provide long-term, maintenance-free operation.

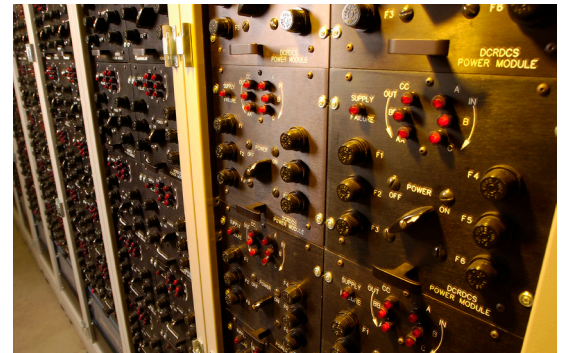
### Solution

Framatome's professionals are uniquely qualified to provide the comprehensive solutions to complete the engineering and design, system material procurement and manufacturing, delivery, setup and testing of the DCRDCS.

Framatome performed the first-of-a-kind DCRDCS build and installment at a U.S. nuclear site and has completed the subsequent installations at its second and third units. In addition, Framatome has built and is planning installation and commissioning for a second U.S. customer.

Lessons learned from these initial installations have been incorporated into the design for future installations. For example, several of the field interface connections have been redesigned to allow a "plug 'n play" concept to reduce disassembly, assembly and field installation time. "Plug 'n play" will also ease any future maintenance activities associated with major components or assemblies.

Designed as a direct, state-of-the-art replacement for the existing CRDCS, the digital system has many benefits. The DCRDCS provides higher reliability, simplified maintenance and streamlined system configuration through the use of Triple Modular Redundant (TMR) controllers, which implement the logic and control functions as well as other design enhancements.



### Customer benefits

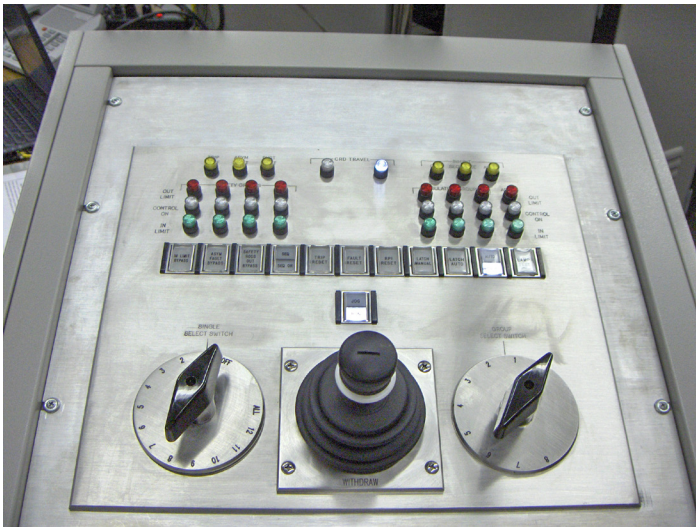
- Automatic latch of control rods rather than manual operation
- Redundant single rod power supplies, which eliminate the need for transfer logic
- Eliminating manual steps enhances human performance
- Improved operational performance
- Reduced maintenance costs
- Designed for maximum flexibility to fit within the envelope of existing enclosures and cabinets



## Same Look. Same Feel

The DCRDCS is designed to replace the current CRDCS in fit and function. All functionality of the current CRDCS is retained except where approved design enhancements are made. The new DCRDCS input and output signals are compatible with the existing CRDCS inputs and outputs in terms of impedance, voltage, current, frequency, speed and timing. System operation and response should be transparent to the operator.

The digital system eliminates the numerous steps and actions previously required to line up and transfer power supplies from one rod group to another. The individual redundant single rod power supply for each group results in decreased risk potential for dropping rods and other human performance errors.

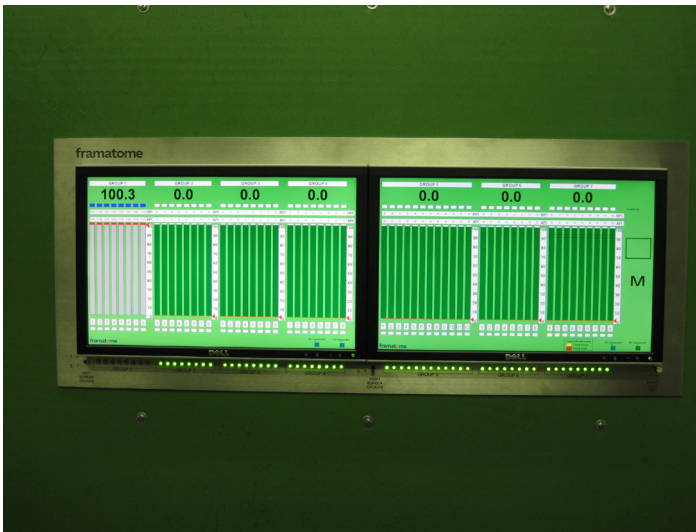


## Key Features

A particularly important feature of the DCRDCS is the redundancy in the design. The system's mission or design has five key points. No single failure of any DCRDCS component is capable of:

1. Causing an uncontrolled withdrawal of the control rods.
2. Preventing a reactor trip action.
3. Causing an unwanted reactor trip.
4. Causing the loss of both the Absolute Position Indication (API) and Relative Position Indication (RPI) control rod position indications.
5. Inhibiting rod movement.

In addition, a new enhanced feature is a fully digital and redundant Position Indication Panel, which can be tailored to your key plant parameters.



## Training at Your Fingertips

Framatome will provide comprehensive training for the system that addresses operation, maintenance and servicing of the DCRDCS. Our customized training program provides an in-depth understanding of the operational features and aspects of the system, including a review of the required and recommended maintenance procedures related to software and hardware. The training courses utilize the latest revision of the system hardware and/or software and will help operators distinguish differences between the current and new systems.

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