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Flux Mapping System (FMS)

Challenge

Most Pressurized Water Reactor (PWR) plants are still using their vintage Flux Mapping Systems (FMS), which were installed in the 1970s and 1980s. As these systems age, component failures increase to the point that the plant cannot depend on the system to provide a reliable flux map when needed. Although each component failure can be handled as an isolated event and repaired as needed, the age of these systems and the number of components in the system makes the likelihood of having an isolated failure too high. The lack of component OEM support and replacement parts makes repairing many of the components difficult or impossible. In addition, component spares have often been exhausted.

Solution

Framatome has developed a replacement FMS composed of a new automated controller with integrated data acquisition, new detector high voltage DC power supplies, new detector drive motors with integrated resolvers, new digital motor controllers and a new user interface panel. Framatome can optionally rebuild your existing rotary transfer devices or interface directly to existing units. Components that historically have been reliable are retained to minimize total cost, risk and installation time. Framatome's FMS is built from proven commercial-off-the-shelf components that ensure reliability and long-term support to meet your needs. The Framatome FMS can be installed in either the existing FMS cabinets or in new replacement cabinets that have the same footprint as the existing cabinets. Our design phase builds from conceptual evaluation, solid scope definition, incorporating industry operating experience, station experience, constructability, a robust Human Performance program and lessons-learned, to foster a culture of safety, continuous learning, and continuous improvement — all key elements to sustainable, predictable, reliable results.

Customer benefits

- High system availability and reliability
- Reduced maintenance costs
- Designed for easy installation, either online or during outage
- Fully automated operation
  - Minimizes operator training requirements
  - Reduces human performance errors
- Product life cycle of >20 years
  - Built with industry proven commercial-off-the-shelf equipment
  - Supplied with all control code and user interface code for life cycle maintainability
- Strong modular design tailored to customer needs

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

Technical Information

- RFI/EMI qualified equipment
- With the increased automation and reliability of the FMS, typical full maps are consistently completed in less than two hours
- Automatic determination of grid shift
- Automatic optimal voltage setting based on I/V curve plateau
- Flexible manual motion capability and enhanced I/O diagnostics
- Integrated resolvers eliminate position errors inherent in original design
- Real time flux trending
- Intelligent alarming and error reporting
- Customized plant specific reporting
- Compatible with many existing core monitoring software programs

Framatome can assist you with:

- Supply of new, proven FMS hardware and software to replace your existing analog FMS
- An Engineering Change Package developed in accordance with your procedures to implement your new FMS
- FAT testing your new FMS using Framatome's unique, full scope plant equipment simulator to comprehensively test your new FMS under normal and failure conditions
- Full installation or installation support for your FMS
- Training, including a separate training mock-up if requested, on your new FMS
- A Framatome-developed Integrated Simulator And Tester (ISAT) for testing and simulating your transfer devices
- Assessing the potential for rebuilding or upgrading your transfer devices to provide additional flexibility in your flux mapping

Project Experience

Framatome has a long history of providing Traversing Incore Probe Systems (TIPS) for BWR units worldwide, including in the U.S. market. Our first BWR TIPS installation was put into service in 1990, and we are still supporting that system today. Based on success with TIPS, Framatome adapted this system to replace problematic FMS equipment in PWR units.

Our first replacement of a Flux Mapping System was in 2004. Framatome is a leading vendor offering full scope upgrades backed up with multiple successful installations. Our customers benefit from this experience in a number of ways:

- Framatome's significant experience lowers risk
- Framatome provides a proven solution, not "first-of-a-kind"
- A track-record of successful completion of all project phases in 12-18 months from contract initiation to online operation of the first successful flux map
- We have learned from our previous projects and are able to effectively implement our FMS projects with greater customer satisfaction
- A growing customer base provides valuable shared operating experiences

Technical Solution

Framatome's FMS is equipped with a commercial-off-the-shelf PLC for system control and data acquisition. The PLC supplier is a worldwide leader in PLC technology used across multiple industries. Complementing the PLC is a Panel PC, which is used as the HMI. Similar to the PLC, the Panel PC is used in a wide range of industrial applications, and uses the Windows™ operating system that is highly familiar and intuitive to operators and support staff. For the FMS motor controller and gear motors, Framatome provides a solution tailored to your specific needs relative to required speed, torque range, available space and ambient conditions. These motor controllers and gear motors are manufactured by a leader in the global market for electrical drives.

The key to a successful project is testing. Framatome developed a unique plant equipment simulator that allows simulation of all normal and typical failure conditions of all plant equipment and the FMS interfaces with them. This simulator eliminates the surprises that can occur when replacing plant systems. The simulator is used during Factory Acceptance Testing, and can be made available during Site Acceptance Testing and training. Additionally, Framatome can provide complete training and development systems to provide a platform for off-line support of the installed equipment. The training and development system is supplied in mobile cabinets and consists of a complete FMS control console, a single train of motor controller, drive motor, and detector power supply, and the complete Framatome plant equipment simulator.

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