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Engineered Safety Features Actuation System

Enhanced safety and reliability for nuclear plant modernization and new build projects worldwide



Challenge

As part of reactor protection systems at a nuclear power plant, the engineered safety features actuation system (ESFAS) is necessary to initiate the start of equipment that will protect the public and plant personnel from the accidental release of radioactive fission products by placing the plant in a safe and controlled condition during abnormal or accident scenarios. ESFAS functions to localize, control, mitigate and terminate such incidents to minimize potential radiation exposure levels to the public and environment. Over time, hardware and software systems can become obsolete reducing reliability, necessitating the replacement of this critical safety system. ESFAS must leverage a proven, deterministic and highly robust architecture developed specifically for nuclear safety applications to provide automatic, timely actuation with no reliance on human intervention under safety-significant conditions.

Solution

The Framatome ESFAS solution, implemented on the proven and fully qualified Hardline platform, delivers automated and highly reliable initiation of engineered safety functions needed to place a nuclear power plant in a safe and stable condition during abnormal or accident scenarios. The Hardline platform's enhanced reliability ensures consistent, deterministic system response, enabling prompt execution of safety-critical actuation without dependence on operator intervention. The Hardline platform is a purpose-built analog I&C solution engineered for high determinism, exceptional reliability and long-term sustainability. Its deliberately simple and inherently stable architecture minimizes complexity and provides strong resilience against common failure modes.

The improved functions include:

- Data acquisition and distribution
- Signal conditioning and control of safety signals, detectors and sensors
- Full-scope system diagnostics in real time
- Protection, blocking and monitoring of the automated operation of actuators
- Automatic process control with Fail-safe voting logic
- Manual remote control of actuators

Customer benefits

- Part of the Hardline family, Framatome's ESFAS is easy to maintain due to analog control, but with digital interface and advanced diagnostics so it looks and feels like a fully digital system.
- The fully hardwired design is simple to license and avoids software common-cause failures and cybersecurity risks.
- Due to standard design and dedicated engineering processes, design customization can take place late in the project resulting in shorter development cycle.
- Space-saving, cost-efficient design available in a compact footprint, front-access cabinet or custom retrofit for most 19" cabinets.
- Integrated self-diagnostic and test features like those found on more advanced digital systems continuously check modules, and early fault detection helps limit system maintenance.
- Framatome's commitment to the Hardline platform ensures reliable component availability, expert support and dependable system performance for the long term.

Technical Information

- Hardline's modular components and distributed architecture support scalable configurations of up to four fully redundant divisions.
- Hardwired logic ensures fixed and predictable response times through customizable time delays and predefined relay logic, eliminating any dependence on software execution cycles.
- Advanced electronic features enable extensive functional capability, including analog threshold processing and binary fail-safe logic functions that provide flexibility and scalability in system designs.
- Threshold modules continuously monitor plant signals and compare them to predefined setpoints to detect abnormal conditions requiring automatic intervention.
- Relay-based voting logic (such as 2oo2, 2oo4 and similar schemes) determines when emergency actuation criteria have been met.
- ESFAS actuation outputs are delivered through Class 1E-qualified relays and contact logic, featuring electrically isolated output stages.
- Multiple redundant logic channels provide independent voting paths and fail-safe actuation mechanisms, with divisions that are physically and electrically separated to maintain independence.
- No single component failure compromises the ability of the system to actuate safety features.
- Monitoring capabilities are considered non-safety, and failures on the monitoring parts will have no impact on the safety functions of the system.
- Dedicated local HMIs on the front panel of Hardline racks can be customized using standard keys, switches, pushbuttons and LEDs to manage test modes and facilitate troubleshooting.
- Modular and standard modules allow sharing of spare parts across multiple systems sites using the same Hardline platform.
- Hardline eliminates much of the discrete wiring traditionally required in analog systems by leveraging dedicated PCBs in each logic chassis that are designed to manage and marshal all field functional signals.
- Framatome successfully replaced an ESFAS system in two units at a U.S. customer site in 2019 and 2020. This replacement of an obsolete analog system with modern analog systems integrating DLSS proved that under 50.59, a complete 1E system could be designed and replaced in less than two years.



Key Figures

2,700 I&C professionals at **21** sites in **10** countries.

More than **50** years of I&C experience in non-programmed safety systems.

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