framatome

Emergency Bus Load Sequencer

Optimized solution to achieve greater reliability of backup power systems, built on the latest generation, non-programmed Hardline platform.



Challenge

During nuclear plant normal operation, there are a variety of potential loss-of-off-site-power (LOOP) events that operators must be prepared to face. An emergency diesel generator (EDG) used in a backup power system should have the capability to start and accelerate a number of large motor loads in rapid succession, while maintaining voltage and frequency within acceptable limits for the electrical consumers. It must also provide power promptly to engineered safety features if a LOOP and a design-basis event occur during the same period, as well as supply power continuously to the equipment needed to maintain the plant in a safe condition. This controlled sequencing prevents excessive loading of the EDGs which, when not controlled, could lead to loss of the EDGs and certain safety-related systems powered by the backup source. Functionality and availability of the EDGs are crucial during both plant operation and outages.

Solution

Provided on Framatome's proven, qualified Hardline platform, the Emergency Bus Load Sequencer (EBLS) solution, also known as the Emergency Diesel Generator Load Sequencer (EGLS) solution, prevents instantaneous full electrical loading of the EDGs during a LOOP event. The EBLS controls the order by which safety-related and other actuators are loaded to the back-up power sources to maintain the plant in a safe condition without impacting EDG functionality.

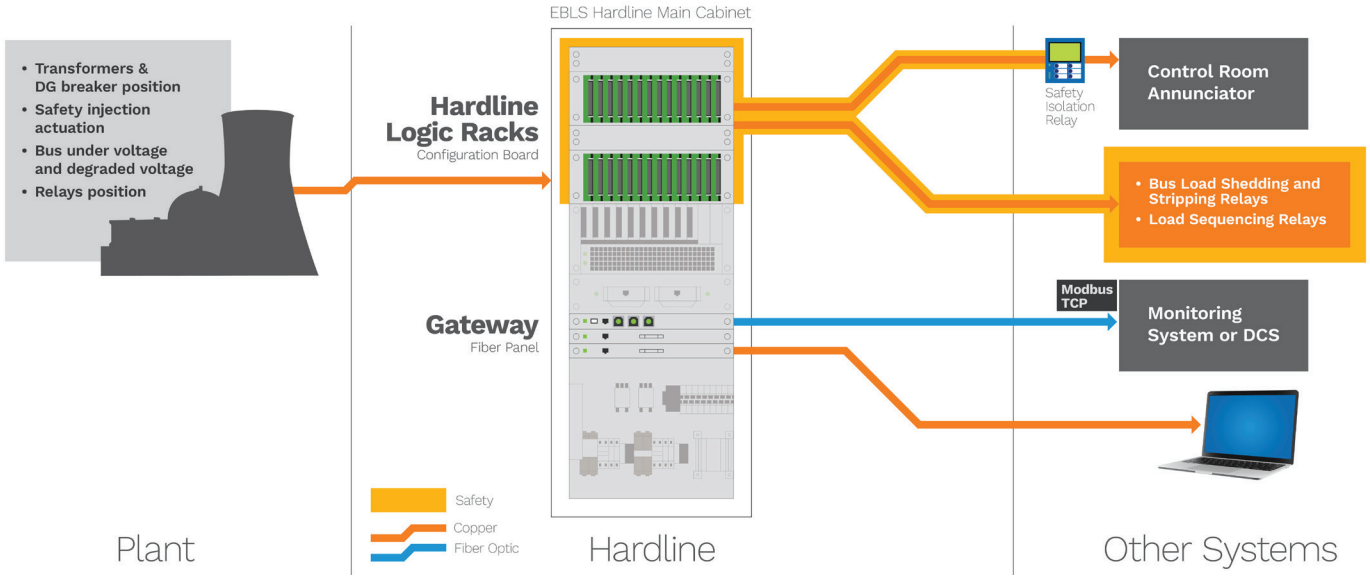
The EBLS power and sequence management application offered on the Hardline non-programmed platform controls the plant safety systems (through selected actuators) and interfaces with the operators and the main nuclear plant control system. Each EDG requires its own independent automatic load sequencing equipment for safe loading of the EDG. The robust design of Framatome's EBLS also incorporates features from the Hardline platform giving operators a cybersecure, high-performing and easily maintained solution.

Customer benefits

- Part of the Hardline family, Framatome's EBLS 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.

EBLS System Architecture

Emergency Bus Load Sequencer



Technical Information

- Hardline's components and distributed capabilities can conveniently build up to 4-fold redundant systems.
- Advanced electronic features provide high functional possibilities with analog thresholds and binary fail-safe logical functions that provide flexibility and scalability in system designs.
- Threshold modules are used to monitor the voltage bus bistables and sense when there is an undervoltage or LOOP event that may require emergency generators.
- Relay logic is used for voting (2oo2, 2oo4, etc.) to determine when the emergency generator should be started.
- Adjustable time delay modules are used to provide dedicated delays for sequencing to prevent the emergency voltage bus from being overloaded.
- Hardline is capable of state-of-the-art monitoring and fault detection, similar to modern digital systems. Modules are continuously checked, and early fault detection helps limit system maintenance.
- 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 allow for troubleshooting.
- Development cycle shortened thanks to its standard design and dedicated engineering processes. This feature allows advanced procurement of hardware since its design can be customized late in the project.

In the past 30 years, Framatome has installed EBLS systems in 22 different plants worldwide.

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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