Background
Westinghouse’s Advanced Logic System® (ALS®) platform is a Class 1E field programmable gate array (FPGA)-based system designed with modular components that can be combined to implement most safety critical needs, including post-accident monitoring systems (PAMS).

Post-accident monitoring instrumentation installed in many nuclear power plants dating from the 1970s to the 1990s is mostly now obsolete and costly to repair or replace.

To resolve the increasing operations and maintenance (O&M) costs associated with this obsolescence, Westinghouse offers an ALS platform PAMS.

New technologies such as field programmable gate arrays (FPGAs) are starting to be applied to nuclear instrumentation and control systems due to their reliability, deterministic behavior and elimination of operating system software. The Westinghouse ALS platform PAMS is a safety-related platform that provides proven reliability and deterministic behavior while eliminating weaknesses of software-based systems, such as the potential for software common mode failures inherent in operating systems.

Westinghouse developed the ALS platform to be a reliable, robust platform, ideal for safety-system-upgrade applications such as PAMS.

Description

Advanced Logic System Platform
The ALS platform is a safety-related platform suitable for implementation of Class 1E applications such as PAMS, reactor protection systems, engineered safety feature actuation systems, main steam/steam isolation systems, diesel load sequencers and core protection calculator systems. The ALS platform can duplicate current system functions, but also includes the capacity for enhanced algorithms that offer the potential for increased operating margins and power uprate.

Applying the ALS platform solution to all safety-system applications will reduce O&M costs, including technical support, training and spare parts. In addition, Westinghouse has structured a long-term obsolescence management program that benefits all program participants. Obsolescence management will also be integrated with critical spare-parts stocking agreements between Westinghouse and the utility.

Post-accident Monitoring System
The ALS platform PAMS consists of the ALS platform, flat panel display system (FPDS) and power supplies. The ALS platform PAMS is designed to implement the Regulatory Guide 1.97 functions, which include the following features:
• Core exit thermocouple (CET) monitoring and alarms
• Reactor vessel level monitoring and alarms using various methods such as differential pressure or heated junction thermocouples, depending on the application
• Subcooled margin monitoring and alarms based on combinations of hot and cold leg temperatures, CET inputs and various reactor coolant system pressures
• FPDS screens to support the functions previously listed, including a real-time core map with CET temperatures
• FPDS functions such as real time trending capabilities, alarms, bypass and setpoint control, system diagnostics, event lists and logs
• Plant computer communications interfaces (compliant with ISG-04 guidelines)

The ALS platform is especially suited to acquiring signals from legacy field equipment using a wide variety of analog, digital and data interfaces, and to providing interfaces to main control room (MCR) alarms, annunciators, panel meters, etc., using class 1E input/output (I/O) hardware. Additionally, the ALS platform interfaces to a qualified touch-sensitive flat panel display that provides a state-of-the-art human interface.

ALS Platform Equipment

ALS platform hardware consists of a qualified 6U high chassis and backplane that can be configured with the following boards, depending on the system:

• ALS-102 – Core Logic Board. Contains the functional logic for the system along with I/O control, self testing and maintenance features implemented using FPGA technology. This card also supports communication interfaces to external systems
• ALS-321 – Eight Channel Analog Input Board. Performs analog-to-digital conversion of 4-20mA and 0-10V signals

The Westinghouse ALS platform PAMS is designed for nuclear safety-related applications.

Supporting Equipment

• Redundant Class 1E qualified power supplies
• Safety-qualified FPDS, typically installed in the MCR for plant operator functions and installed in the secured electronics cabinet for maintenance functions

Benefits

• The Westinghouse ALS platform PAMS is designed for nuclear safety-related applications.
• Westinghouse’s approved verification and validation program is used for safety-critical development activities.
• Westinghouse provides support and expertise to assist customers with their system commissioning and Nuclear Regulatory Commission licensing submittals.
• The Westinghouse comprehensive cyber-security policy addresses aspects of the design process, development environment, configuration control and deployment of Westinghouse products.
• Internal independent cyber security audits are performed during the design process so that the design is being developed in compliance with the Westinghouse cyber-security policy.

The Westinghouse design philosophy is to move away from the safety systems that involve custom designs and to move toward standard system designs. This standard design philosophy is intended to reduce system development costs, minimize system commissioning costs and minimize risks compared with using customized algorithms. The ALS platform hardware design is owned and controlled by Westinghouse, thus providing site configuration control for investment protection and management of the long-term component support.