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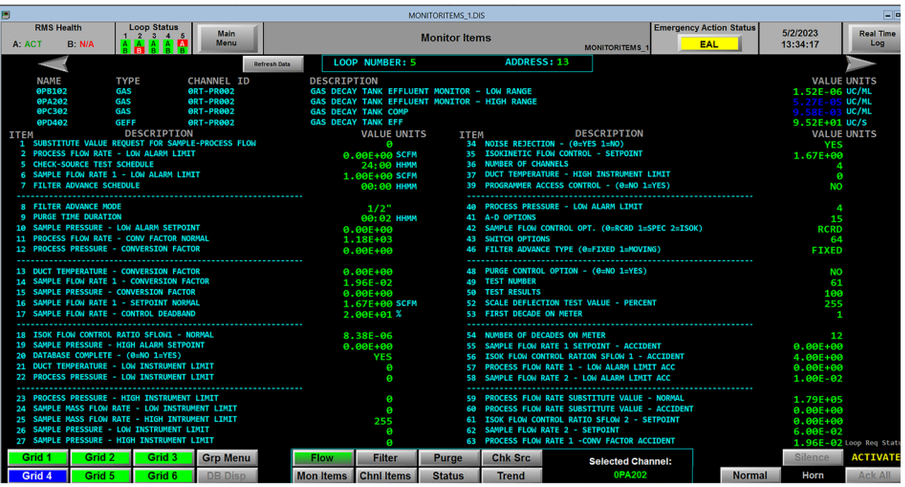

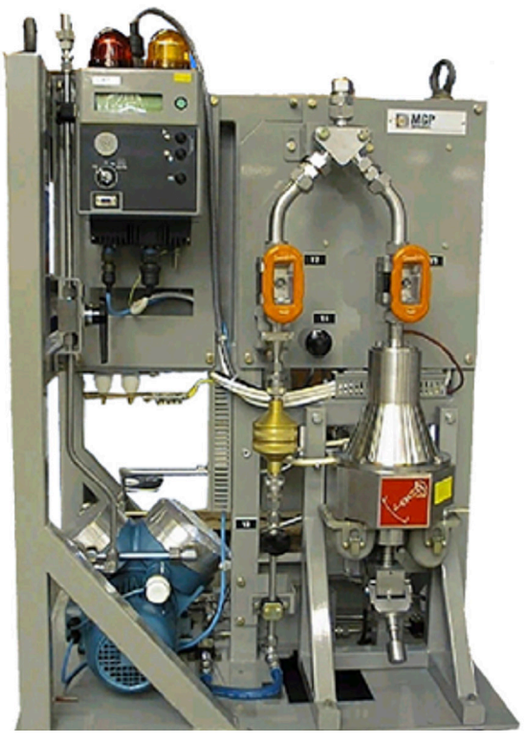

Radiation Monitoring Systems for Nuclear Power Plants

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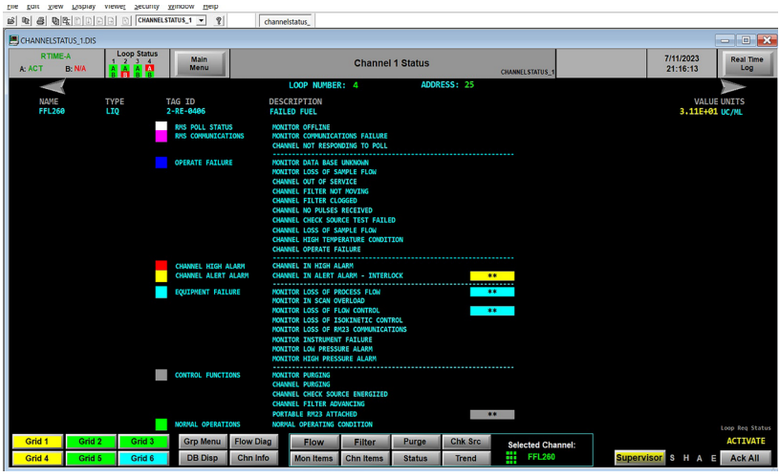
Reduce Obsolescence & Improve Worker Efficiency with Integrated Digital Controls

The Importance of Monitoring Radiation



The U.S. Nuclear Regulatory Commission (NRC) requires licensees to monitor radiation discharges and analyze nearby environmental samples to ensure that the impacts of plant operations are minimized. Radiation Monitoring Systems (RMS) help to ensure that plants follow appropriate safety protocols, protecting workers and the public of any potential risk of radiation exposure. These systems are configured with pre-set alarm levels that permit real-time monitoring of the radiological conditions throughout the plant. If certain atmospheric levels are exceeded, alarms are activated, and in some cases, automatic protective functions are initiated.

Nuclear power plants must comply with specific public dose limits set by the NRC and the Environmental Protection Agency. Plant operators must report to the NRC any time those levels are exceeded. Meeting these rules ensures reactors keep doses to the public so small that they are difficult to distinguish from background radiation.

Radiation Monitoring Systems are used by control room operators and radiation protection specialists to make rapid assessments of radioactivity levels in process and effluent streams, plant areas, and HVAC ducts. Many RMS have become dated and require obsolescence management. This presents an opportunity for these plants to consider integrated systems that simplify maintenance and utilize cost-effective digital technologies. In some instances, these RMS upgrades can be monetized as capital improvements (CapEx) rather than operational expenses (OpEx).

This paper outlines how Curtiss-Wright Nuclear Division partners with nuclear power plants to implement integrated RMS as part of a connected fabric of hardware and software, modernizing the plant with integrated digital controls.

The Problem: Aging, Disconnected Radiation Monitoring Systems

Nuclear power plants are systematically addressing obsolescence issues within their control systems. However, despite a steady push towards modernization, many plants still depend on instrumentation and control systems that contain aging electronics, including radiation monitoring systems that are gradually becoming obsolete. These components are difficult to support and must ultimately be replaced, often with digital controls.

Beyond obsolescence, there are many other reasons to upgrade these systems. For example, integrating disparate components into a common technology platform allows disparate plant systems to talk to one another, and to utilize common methods of data acquisition, storage, and analysis. Enforcing standard data management and analytic practices simplifies system maintenance and enhances workforce effectiveness.

A complete RMS and associated PPC system incorporates four primary elements, some of which may already be utilized within the plant:

1. An I/O system that collects data from analog and digital equipment
2. A redundant communication network and server environment, which includes cybersecurity components
3. A common human-machine interface (HMI), often featuring large-format displays, workstations, and peripheral devices
4. Software applications that execute on the digital platform to handle data collection, validation, reporting, and archiving as a proven platform

The Curtiss-Wright Solution: RMS Modernization Integrated with R*TIME

Curtiss-Wright has extensive experience implementing plant process computer systems, radiation monitoring systems, and other digital control systems at many of the world's leading nuclear power plants. At the heart of these implementations is Curtiss-Wright's R*TIME technology, a stable and proven data management platform with the capacity and flexibility to grow with each plant's needs.

Because R*TIME is vendor-agnostic by design, nuclear power plants can quickly integrate the software with RMS equipment from many different vendors, including the following:

- Kaman
- General Atomics
- Mirion
- Fluke Biomedical (Victoreen)
- Thermal Fisher Scientific (Eberline)

R*TIME connects to these radiation monitoring systems via RS-485, Ethernet, current loop, and other popular communication interfaces.

In conjunction with RMS, many plants turn to Curtiss-Wright for help integrating other monitoring systems, which leads to the development of application programming interfaces (APIs) that enable R*TIME to integrate many types of systems and sensors, all operating a common HMI that operators are familiar utilizing.

Common HMI: R*TIME as a Plant-Wide Approach to Automation

Curtiss-Wright specializes in helping nuclear power plants modernize plant process computers, control systems, and data acquisition systems. The R*TIME platform anchors these installations by allowing customers to integrate data from multiple control systems to handle many different needs. With support for hundreds of industry protocols and standard connections to virtually any nuclear power system, R*TIME is easy to interface with radiation monitoring systems as well as many other types of analog and digital controls.

A UNIFIED SOFTWARE ENVIRONMENT

R*TIME is a plant information system that is used to implement plant process computers and integrate data from many types of plant systems, including safety related controls and non-safety related controls. This versatile software platform provides fast, reliable, real-time data retrieval, processing, presentation, and reporting, along with a powerful data archiving program, scalable to tens of thousands of channels. The software platform includes:

- Graphical user interface (GUI)
- Data acquisition functions
- Data conversion functions
- Data logging functions
- Data alarming functions
- Calculation functions
- Data historian for data archival
- Connectivity to local and wide area networks

R*TIME displays RMS data using numeric values, graphical trends, or graphical shapes. Real-time and historical data is readily accessible through a point-and-click interface, enabling engineers and operators to select data points, monitor real-time conditions, and display trends. Color-coded status indicators make it easy to see the alarm condition of each data point. A data historian maintains a complete history of all data inputs and outputs.

What to Consider: RMS Implementation/Upgrade Insights

Each RMS includes a collection of radiation monitor assemblies, also known as skids, which are independently capable of sampling the environment and communicating the results through R*TIME displays (or transmitting those results to another system via a communications network). R*TIME also controls skid hardware (such as pumps, valves and mechanical devices), retrieves status alerts, monitors self-test/diagnostics, and manages other skid-specific functions.

While Curtiss-Wright generally does not install the RMS equipment, it does perform a complete cycle of integration and testing. Once factory testing is complete and approved by plant personnel, Curtiss-Wright ships the system to the plant for site-acceptance testing prior to installation.

Typically, the plant will stage the new system side-by-side with the existing system, and then cut over from old to new, one loop at a time. The communication link to the data collection system is usually redundant to ensure reliable and robust information transfer. The RMS system supports both the existing communication structures and modern Ethernet interconnections, as required by the customer.

The RMS is a Critical Digital Asset (CDA) typically located at Level Three of the cyber security architecture, utilizing well-established interfaces for all of the popular data archives, as well as proven data diode links to lower level CDAs. When a skid also performs a safety function, a separate hard wired connection is made to the pertinent devices and alarms, which are generally located in the main control room.

Due to regulatory requirements, R*TIME can collect all the data from the RMS monitors, but is unable to directly modify the database on safety-related channels. However, R*TIME can display and archive that data on the CDA non-safety side.

All RMS data collection and display systems are fully redundant, with automatic failover and mirrored databases to maintain continual awareness of radiation parameters throughout monitored sections of the plant.

One of the advantages to standardizing on R*TIME are the economies of scale that come with having a fleet-wide standard. Once plant personnel are trained on R*TIME, the skills are transferable, which allows for easier staff movement during maintenance and outages.

In summary, Curtiss-Wright's modern software infrastructure delivers real-time data for controlling every facet of the operation—as well as more precise methods for adjusting configuration parameters with precise granularity. For a growing number of nuclear power plants, R*TIME is the only monitoring platform they need.

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