Global Instrumentation and Control

Leakage Monitoring System

Background

The identification and location of leakage sources in the containment building of a pressurized water reactor are important so that plant personnel can take safety measures in a timely manner. Primary water leakage of a pressurized water reactor from reactor vessel, steam generators, reactor coolant pumps or pressurizer, could result in the corrosion of the carbon steel reactor pressure boundary or loss of coolant. The leakage monitoring system (LMS) is designed to address the recommendations of Regulatory Guide 1.45 Revision 1, “Guidance on Monitoring and Responding to Reactor Coolant System Leakage.”

Description

If a leak in the reactor coolant system area occurs, moisture is released into the air volume surrounding the location. With the Westinghouse LMS, air from this volume is drawn through a collection system to measure the moisture content. Redundant sensors, located on an in-containment skid, measure the relative humidity and temperature for all of the locations. These data are transmitted through redundant data links to a monitoring cabinet outside of containment for further analysis and alarm processing. The LMS skid and cabinet are seismically qualified.

The LMS automatically samples from many sources via the skid inside of containment. Typical locations to be monitored are the top and bottom of the reactor vessel, steam generators, reactor coolant pumps, reactor coolant pipes, pressurizer and pressurizer relief tank. With no leaks in the reactor coolant system vicinity, the moisture levels from the sample points, namely mixing ratio or dew point measurements, will be very similar. If a leak were to occur, the mixing ratio or dew point from one or more sample points will increase relative to the other sample points.

At the LMS cabinet located outside of containment, the LMS provides the operator a display of mixing ratio, dew point, relative humidity and temperature for each monitored point. These parameters are monitored in real time. The displays have a variety of zoom-capability and measurement cursors, and have time scales for trending, ranging from one hour to 32 days. Self-test of the system is conducted automatically every day or may be manually initiated, and the self-test does not interfere with alarm determination.

In-containment Skid Photo

Cabinet Outside of Containment

Westinghouse

Benefits

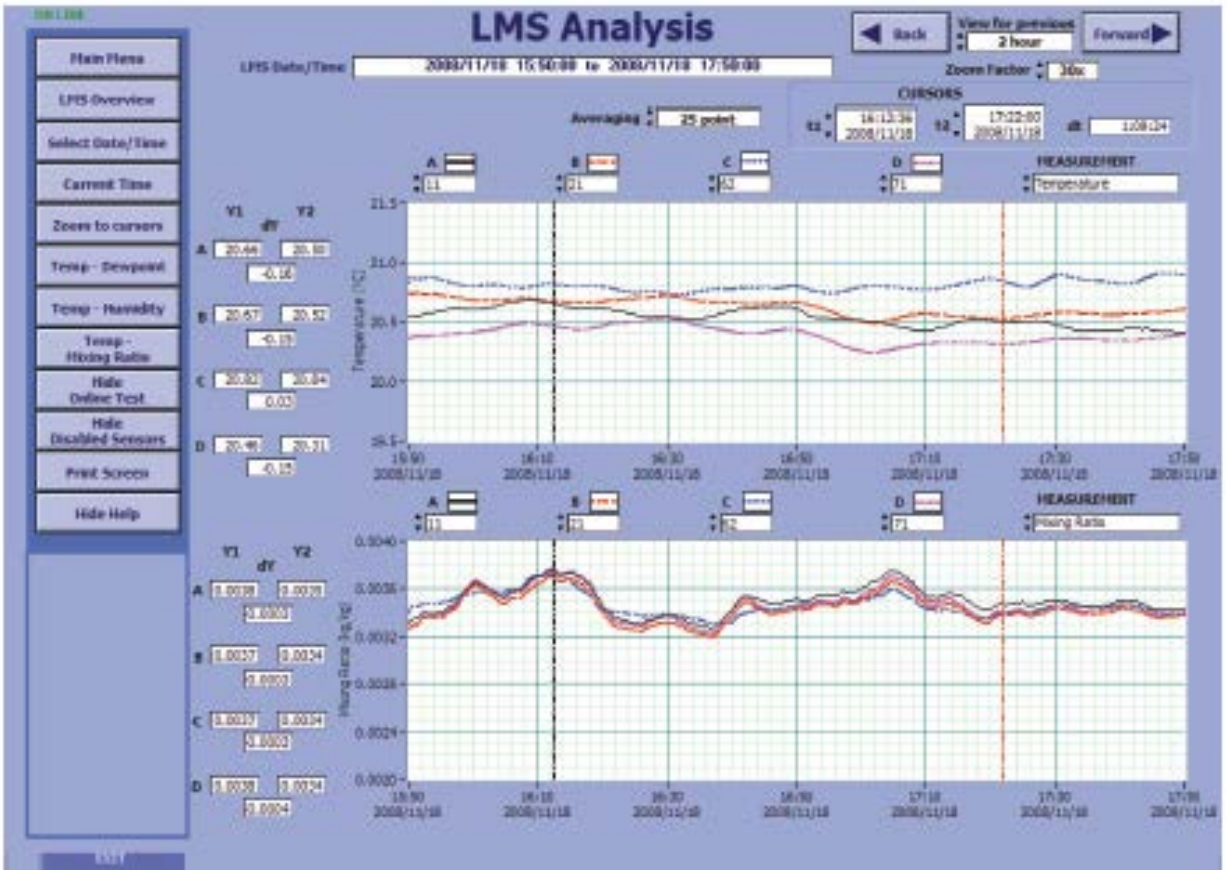
- Real-time measurement and display, and rapid response.
- Digital recording of all measurement data.
- Diagnostic self-testing every 24 hours for high reliability.
- High-resolution graphical display and touch-screen interface for ease of use.
- Outputs for remote alarms and indicators for easy integration with existing systems.
- Redundant in-containment equipment, including the air pumps, sensors, I/O modules and data links for high availability and increased reliability.
- Continuous operation with no sensitivity degradation with a background radiation level of 100 mR/hr (1 mGy/ hr).

Specifications

- Relative humidity (RH) range: 0 to100 percent
- RH accuracy: +/-1.5 percent at 23 C
- Repeatability: Equal or better than 0.5 percent RH
- Temperature accuracy: +/-0.3 C
- Sensor operating temperature: -15 C to 85 C
- In-containment skid approximate dimensions: 57.5 inches long, 44.5 inches wide and 43.0 inches high

Experience

Westinghouse has successfully installed the LMS at one plant in the spring of 2009 and plans to implement this system in other nuclear power plants worldwide.



Leakage Monitoring System Display

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