Contract No:

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Disclaimer:

Near Real Time Analysis of Tritium in Treated Water

Objective

The Tokyo Electric Power Company (TEPCO) is managing large quantities of treated water at the Fukushima Daiichi Nuclear Power Station. Moving forward, TEPCO will be discharging from the site clean water that meets agreed criteria. As part of agreements with stakeholders, TEPCO is planning to carefully monitor the water prior to discharge to assure compliance. The objective of this proposal is to support implementation of an on-line "real-time" (continuous or semi-continuous) tritium monitor that will reliably measure levels down to the agreed target 1500 Becquerels per liter (Bq/L).

Problem

A number of technologies have been tested for real-time tritium monitoring. Many of these have used solid scintillators configured within flow cells or on the surface of optical fibers. These systems often rely on significant pretreatment of the feed to remove other beta/gamma nuclides and assure reliable tritium measurements. The traditional solid scintillators do not provide the target 1500 Bq/L detection level within a reasonable counting/integration period (count times are longer than 60 minutes).

Technology

SRNL has developed a number of online tritium monitors over the past 20 years. The technology class recommended by SRNL for use by TEPCO is a field-deployable, packaged, flow-through scintillation system based on commercially available liquid chromatography detectors (such as the BetaRam or WILMA units from LabLogic). To achieve the desired sensitivity requires using a liquid-scintillator system, which blends scintillation cocktail into the flowing water and then passes the solution through a measurement cell. The WILMA system has been tested by the US Environmental Protection Agency. We project that that this type of system could be configured to meet TEPCO's objectives (standard detection < 500 Bq/L using a 15 minute count time). This type of system would generate a small quantity of water containing scintillation cocktail; however, the amount of waste could be minimized using low flow rates and intermittent flow strategies. To convert a liquid chromatography detector into a reasonable monitoring system may require pretreatment of the water to remove salts and radionuclides, robust shielding, and developing flow-control systems for background count determination and calibration. Additional pretreatment could be optimized, reduced, or even eliminated based on the effectiveness of the upstream Advanced Liquid Processing System, or ALPS. The detector might also be configured to provide supplemental information on strotium-90 and cesium-137.

In reducing count times to 15 minutes, near real-time management of the ALPS treated liquid is viable. Measuring tritium activity would support reductions in the volume stored in tanks as the water is managed and composited prior to discharge. This detector could reliably support TEPCO in providing the stakeholder effluent check prior to offsite discharge.

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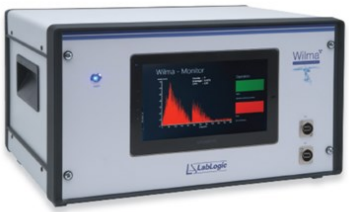
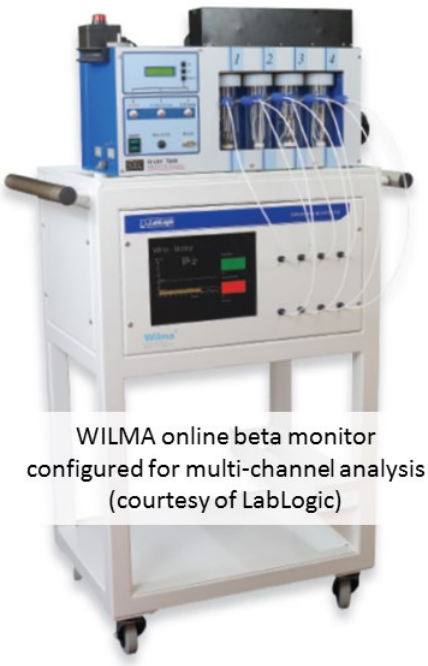


Detector module for the commercially available WILMA online beta monitor (courtesy of LabLogic)



WILMA online beta monitor configured for multi-channel analysis (courtesy of LabLogic)