Statistical Methods to Identify Low-level Bias in Radioanalytical Data

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ABSTRACT

Monitoring and reporting of potential radionuclide contamination can present challenges in identifying the mere presence of radioactivity even at low concentrations especially for radionuclides that would not be expected to be present based on physical inventory or radioactive half-life considerations. At reactor decommissioning sites, a comprehensive list of radionuclides is included as potential analytes to support all regulatory site closure needs. With such a comprehensive list, positive results for some nuclides, especially where chemical extraction and liquid scintillation is used, occasionally occurs. Since analysis such a liquid scintillation does not specifically identify radionuclides (as in gamma spectroscopy) the identification is more reliant on radiochemical separations and may be subject to carryover effects of reagent chemicals or sample matrix effects. However, in other cases that require tracers for the quantification of chemical recovery fractions, even alpha spectroscopy methods have shown laboratory bias.

Results of these analyses are presented along with the statistical methods for identifying laboratory biases, both positive and negative. These statistical methods include “t-tests” Filibens normality testing, and rank trend plots. Examples of these applied tests are presented for various cases of both positive and negative laboratory biases and how these may be used to identify or refute the long term presence of long-lived plant-related radionuclides.