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DESIRED MODE OF PRESENTATION: Oral presentation

SOURCES OF BIAS AND UNCERTAINTY ASSOCIATED WITH GROSS ALPHA AND BETA ANALYSIS

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Gross Alpha and Beta analysis is perhaps one of the most frequently requested, economical and useful tools in the area of environmental radiological testing. At first glance the test appears to be a simple, rapid and economical tool for identifying potential radionuclide contamination. Indeed, it is ideally suited for monitoring ongoing, well-characterized and relatively stable systems for changes. Given the appropriate assumptions, it can dependably identify the potential presence or absence of a radionuclide in a sample. In many cases it can provide confirmation that isotopic testing has accounted for the majority of radioactivity in a sample.

Available techniques range from surface emission measurements in solid samples using low sensitivity, hand-held survey equipment to fixed laboratory analysis with solid scintillators, low-background gas-flow proportional counters, and liquid scintillation spectrometers following careful preparation. US EPA Methods 900.0 and SW-846 9310 promulgated for the analysis of water samples are representative of the most frequently employed approach to Gross Alpha and Beta analysis. An aliquot of water is evaporated following addition of nitric acid, transferred to a stainless steel planchet and alpha and beta emissions determined by gas flow proportional counting. The same technique is routinely used for the analysis of solid matrices via their leachates and digestates.

For all of its benefits, Gross Alpha and Beta testing is very limited in its ability to precisely and accurately predict or account for summed concentrations of alpha and beta emitters in a sample. The semi-quantitative estimates of alpha or beta radioactivity it provides are based on multiple assumptions about the *gross* composition of the sample matrix and the chemical and physical behavior of radionuclides present in this matrix. These assumptions are designed to generate accurate yet conservative estimates of total radioactivity (i.e., biased high) which should reliably identify the need for isotope specific testing. Yet limitations in the precision and accuracy of gross activity measurements are routinely ignored by end users and regulators.

The presentation will address several issues:

- The most commonly used methods do not define a standard calibration matrix. The methods appear to assume that using tap water as a source of solids for calibration will provide the most accurate results. While this may be appropriate for the local drinking water provider, much radiological testing is not performed on-site, but is sent to a contract laboratory that must a calibration based on an unrelated matrix. Variations in the chemical composition of solids used for calibration can easily lead to measurement discrepancies of a factor of two or more. Thus intercomparability of results from laboratory to laboratory is suspect.

- The evaporation process is not as simple as one might imagine. Chemical components in the sample matrix and the radionuclides being determined interact and significantly impact results from sample to sample even within a given laboratory supplying compliant data.
- Irreproducibility of counting sources resulting from poor residue distribution, especially at low residue masses, will have a large effect on result precision and accuracy.
- A poor match between nuclides sought and reference nuclides can cause very significant bias in results.
- The timing of a sample count relative to preparation and sampling will lead to simultaneous high and low bias in results.

Basic issues surrounding comparison of the results of isotopic and gross activity measurements will also be addressed.