

Decommissioning: Composite Sampling Application and Regulatory Guidance

**HPS Annual Meeting 2011
Palm Beach, Florida**

Bruce Watson, Timothy Vitkus* & John Clements
Division of Waste Management and
Environmental Protection, *ORISE

Current NRC Guidance

- NUREG 1575, “*MARSSIM*”
 - EPA QA/G-5S, Quality Assurance Project Plan
 - EPA Observational Economy Series, Vol. 1: Composite Sampling
- NUREG 1757, “*Consolidated Decommissioning Guidance*”
- NUREG 1505, “*A Nonparametric Statistical Methodology for the Design and Analysis of Final Status Decommissioning Surveys*”

Current Approach

- MARSSIM integrates a flexible, statistically-based Final Status Survey (FSS) sample size to demonstrate compliance with the $DCGL_W$ together with surface scanning.
- Scan MDCs for Class 1 survey units is a function of spacing and the respective $DCGL_{EMC}$ to assure hotspots are identified.
- For Hard-To-Detect (HTD) Radionuclides of Concern (ROC), where a MDC_{SCAN} or surrogate relationship cannot be established, a higher number of samples are required.

Initial: Composite Sampling Experience

- As part of Site Decommissioning Plans, the Final Status Survey Plans have requested approval for composite sampling to reduce the number of samples taken.
- NRC evaluation of the composite sampling resulted in a number of requests “*specifically to technically justify the application to the site radionuclides of concern.*”

Initial: Composite Sampling Experience

- A Modified Investigation Level (MIL) relative to both the $DCGL_W$ and the $DCGL_{EMC}$ is required to account for dilution of potential hot spots
- Cannot be used when investigation levels ($DCGL_W$) are near the analytical detection limits especially for HTD Nuclides
- Cannot be used when investigation levels ($DCGL_W$) are near the natural background concentration

Current Thoughts for Future NRC Guidance on Composite Sampling

- Advantages and Disadvantages
- Considerations for Applying Composite Sampling
- Limitations

Advantages of Composite Sampling

- Can reduce analytical costs
- Provides a better estimate of the mean concentration in the survey unit
- Identify areas or units that have highest contaminant levels
- With an appropriate MIL, can increase the ability to detect hot spots by increasing the number of locations sampled, yet may maintain statistically required N.

Disadvantages of Composite Sampling

- Information is lost on individual samples comprising the composite, ie $DCGL_{EMC}$ over a specific area due to dilution of one or more increments with elevated activity
- Should not be used for establishing surrogate ratios (due to loss of information on individual samples)
- Cannot be used when investigation levels ($DCGL_W$) are near analytical detection limits

Disadvantages of Composite Sampling

- Cannot be used when investigation levels (DCGLs) are near natural background concentration levels
- For non-homogeneous contaminant distributions, temporal or spatial information may be lost
- Cannot be used when integrity of individual sample values change, such as a loss of volatile contaminants, due to compositing process

Considerations for Composite Sampling

- Better estimates the mean concentration of an ROC in decommissioning for scoping, characterization, remedial action and final status surveys
- Results in less information on the overall variability and this factor will be an important should the data be used in the construction of an upper confidence or in an hypothesis tests

Considerations for Composite Sampling

- To estimate the presence or absence of a specific ROC
- Useful when the size of the pattern, such as hot spots, is smaller than the spacing between the statistically required random sampling locations
- Use must account for potential for large additional errors due to heterogeneous nature of the contaminant in the matrix.

Considerations for Composite Sampling

- Increments to form the composite must be of equivalent weight/volume and individual increments well homogenized;
- Must account for the dilution factor (MIL) when evaluating against a threshold limit; hot spot, $DCGL_W$ or $DCGL_{EMC}$;
- Must be able to maintain the ability for re-testing individual increments to retrieve potentially lost information.

Composite Sampling Limitations

- Reduction in the information on variability
- Potential loss of temporal or spatial information
- Difficulty in homogenizing matrices such as clay soils

Composite Sampling Limitations

- Lost information on maximum concentrations
- Lost correlations for two or more ROCs.
Therefore, composite sampling is not appropriate for determining surrogate relationships.
- Class 2 and 3 survey units must be than the $DCGL_W$ when properly classified. Therefore, under most FSS conditions, composite sampling for class 2 & 3 survey units has limited benefits.

Conclusions

- Based on NRC experience, composite sampling has advantages and disadvantages with significant limitations
- NRC guidance on composite sampling is being developed for incorporation into NUREG 1757.
- Composite sampling must be based on the $DCGL_w$ levels, analytical MDCs and Modified Investigation Levels.

Thank You!

Questions?