



Guidance on Surveys for Subsurface Radiological Contaminants

Surveys of Survey Units with Low-
Levels of Radioactivity

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Introduction

- ◆ Describe key issues concerning contaminants in subsurface soils that might be described as a now “undefined” Class 3 subsurface soil, Materials and Equipment (M&E).
- ◆ Suggest approaches to address survey design (including NUREG-1757, Vol. 2, Rev. 2) and statistical methods for evaluating contaminants in the subsurface.

Class 3 Subsurface Survey Design per MARSSIM

- ◆ MARSSIM provides statistical testing techniques that can be universally applied to the subsurface:
 - Wilcoxon Rank Sum (WRS) Test
 - Quantile Test follows if WRS is passed
 - Sign Test
 - Retrospective Power Test (especially Scenario B)

Scenario A or Scenario B?

- ◆ Scenario A uses a null hypothesis that assumes the concentration of radioactive material in the survey unit exceeds the derived concentration guideline level (DCGL); it is “presumed not to comply” or “presumed not clean”.
- ◆ Scenario B uses a null hypothesis that assumes the concentration of radioactive material in the survey unit is less than or equal to the action level or lower bound of the gray region; it is “indistinguishable from background” or “presumed clean”.

Low-Level Concentrations of Radionuclides

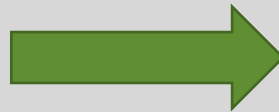
- ◆ Per MARSSIM, a *Class 3 Area* is any impacted area that is not expected to contain any residual radioactive material or is expected to contain levels of residual radioactive material at a small fraction of the DCGL.
- ◆ Per MARSAME, NUREG-1575, Supp. 1, Class 3 M&E have, or had, (1) little, or no, potential for radionuclide concentration(s) or radioactivity above background and (2) insufficient evidence to support categorization as nonimpacted. Radionuclide concentration(s) and radioactivity above a specified small fraction of the DCGL are not expected in Class 3 M&E. The specified fraction should be developed by the planning team using a graded approach and approved by the regulatory authority.

NUREG-1757, Vol. 2, Rev. 2 Guidance

- ◆ The number of cores to be taken is initially the number (N) required for the WRS or Sign test, as appropriate from MARSSIM.
- ◆ Random locations for coring (Class 3).
- ◆ Core samples are homogenized over a soil thickness that is consistent with assumptions made in the dose assessment, typically not exceeding 1 meter in depth. Do not average radionuclide concentrations over an arbitrary soil thickness.
- ◆ Develop a contaminant concern map per NUREG/CR-7021, “A Subsurface Decision Model for Supporting Environmental Compliance.”

Core Scan and Sample Size

- ◆ Standard practice is to sample (~500 grams) at location of highest radiation level. Usually scan survey both core and downhole.
- ◆ Sample size (length) should be consistent with DCGL development.

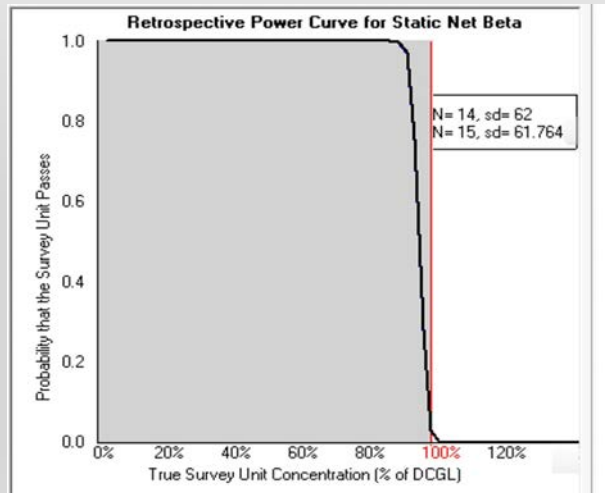
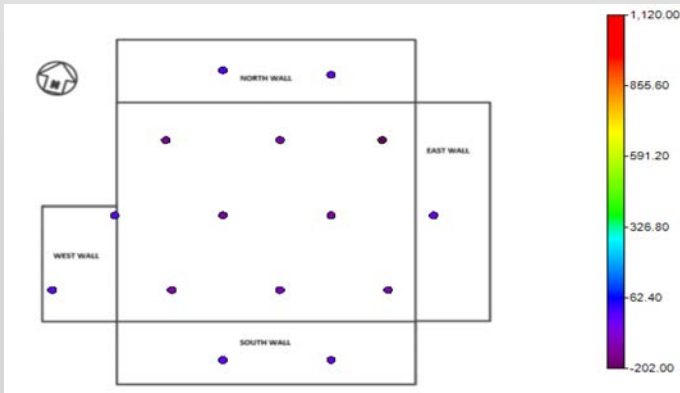
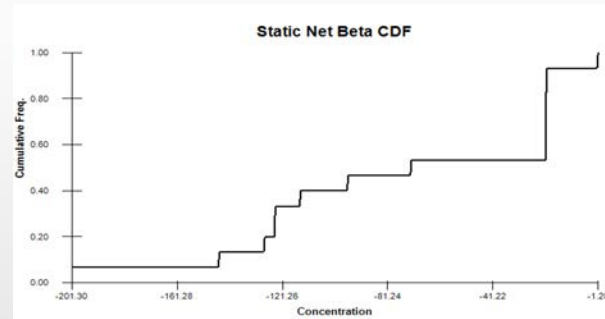
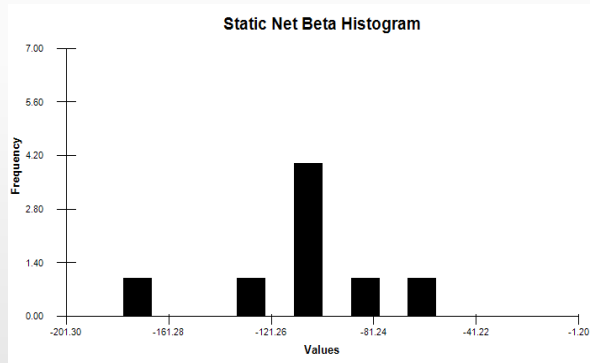


Spatial Analysis and Decision Assistance (SADA) Statistical Package

Univariate Statistics

- | | |
|---|---|
| <input checked="" type="checkbox"/> Detects | <input checked="" type="checkbox"/> Range |
| <input checked="" type="checkbox"/> N | <input checked="" type="checkbox"/> Interquartile Range |
| <input checked="" type="checkbox"/> Mean | <input checked="" type="checkbox"/> UCL95 (Normal- Student's t) |
| <input checked="" type="checkbox"/> Median | <input checked="" type="checkbox"/> UCL95 (Lognormal- Land's H) |
| <input checked="" type="checkbox"/> Variance | <input checked="" type="checkbox"/> Skewness |
| <input checked="" type="checkbox"/> Standard Deviation | <input checked="" type="checkbox"/> Kurtosis |
| <input checked="" type="checkbox"/> Geometric Mean | <input checked="" type="checkbox"/> Mean Absolute Deviation |
| <input checked="" type="checkbox"/> Coefficient of Variance | <input checked="" type="checkbox"/> Mode |

SADA Ready-to-Use Figures



Data Gaps

- ◆ Surface areas for subsurface volumes are not sized and defined for subsurface soil classes.
- ◆ Statistical software is under development.
- ◆ Scenario B is based on either:
 - NUREG-1507, “Minimum Detectable Concentrations with Typical Radiation Survey for Instruments for Various Contaminants and Field Conditions,” for multiple background reference units, or
 - draft MARSSIM Rev. 2.
- ◆ DCGL development: volumetric, multiple layers, or intrusion scenarios.

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