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.

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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)

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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".

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Low-Level Concentrations of Radionuclides

◆ Per MARSSIM, a *Class 3* Area i*s a*ny 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.

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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."

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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.

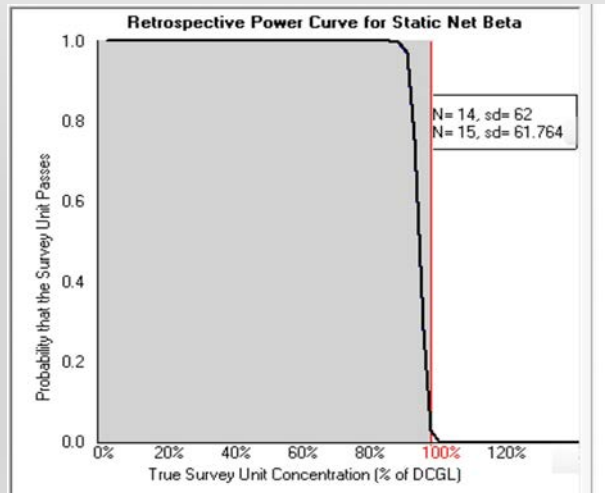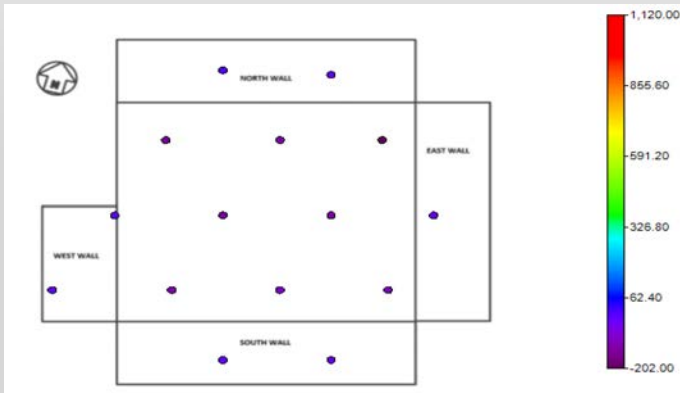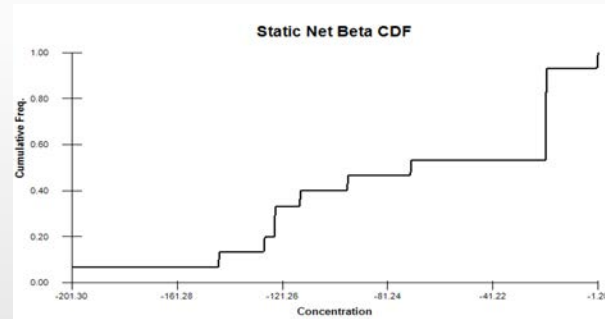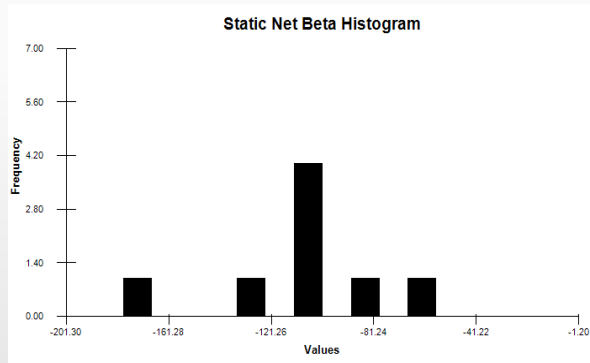◆ Sample size (length) should be consistent with DCGL development.

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Spatial Analysis and Decision Assistance (SADA) Statistical Package

Univariate Statistics

- ☑ Detects
- ☑ N
- ☑ Mean
- ☑ Median
- ☑ Variance
- ☑ Standard Deviation
- ☑ Geometric Mean
- ☑ Coefficient of Variance

- ☑ Range
- ☑ Interquartile Range
- ☑ UCL95 (Normal- Student's t)
- ☑ UCL95 (Lognormal- Land's H)
- ☑ Skewness
- ☑ Kurtosis
- ☑ Mean Absolute Deviation
- ☑ Mode

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SADA Ready-to-Use Figures

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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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