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SITE CHARACTERIZATION LESSONS LEARNED

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Importance of Site Characterization

- **Site characterization sets the stage for successful implementation of decommissioning planning and demonstration of compliance with release criteria**

- **Serves as the basis for dose modeling, final status survey design, and development of the license termination plan (LTP) or decommissioning plan (DP).**

Plan Development Resources

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Guidance provides a roadmap to successful site characterization.

NUREG-1575, *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM)

NUREG-1757, Revision 2, *Consolidated Decommissioning Guidance*, Volume 2, “Characterization, Survey, and Determination of Radiological Criteria”

NUREG-1700, *Standard Review Plan for Evaluating Nuclear Reactor License Termination Plans*

Regulatory Guide, 1.179, Rev. 2, *Standard Format and Content of License Termination Plans for Nuclear Power Reactors*

LTP/DPs Site Characterization Readiness

Recognizing different industry approaches to decommissioning

- NRC reviews and RIS 2002-02 recommend submitting licensee termination plans (LTPs) or decommissioning plans (DPs) after sufficient site characterization is conducted
- Characterization includes a summary of soil and structure data
- Data is useable for remediation and final status survey planning

Missing or Incomplete Site Characterization Information

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Characterization Study and Data

- Data Quality Objectives – Describe and Demonstrate their Use
- Incomplete Set of Radionuclides of Concern (ROCs) Used in the Characterization Analysis
- Missing Characterization Sample Results

Survey Classification

- Define and Identify Survey Units
- Survey Unit/Area Maps Without Measurement/Sampling Locations
- No Justification for Classification of Areas as Non-impacted Areas

Missing or Incomplete Site Characterization Information

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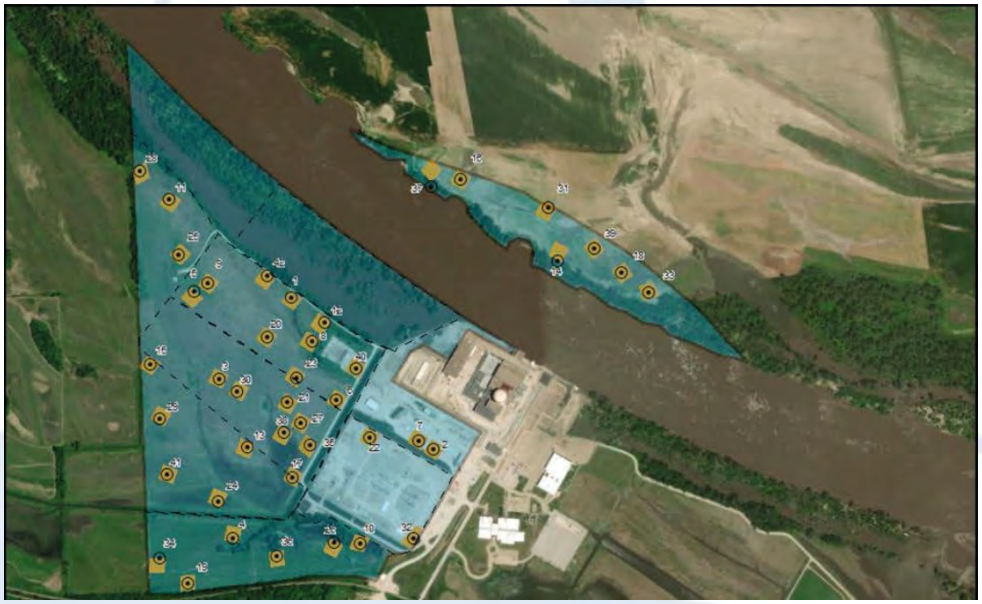
Justification/Sample Analysis Deficiencies

- Use of Samples Containing No Residual Radioactivity
- Sample Analysis Limited to Only a Subset of Radionuclides
- Absence of Instrument Selection and Measurement/Sampling Sensitivities
- No Characterization Survey Background Measurement Information
  - Background measurements in soil and other materials
  - If the background measurements are applied to the survey measurement data
  - Perform Statistical Analysis to Determine Background (Sign or Wilcoxon Rank Sum Test)

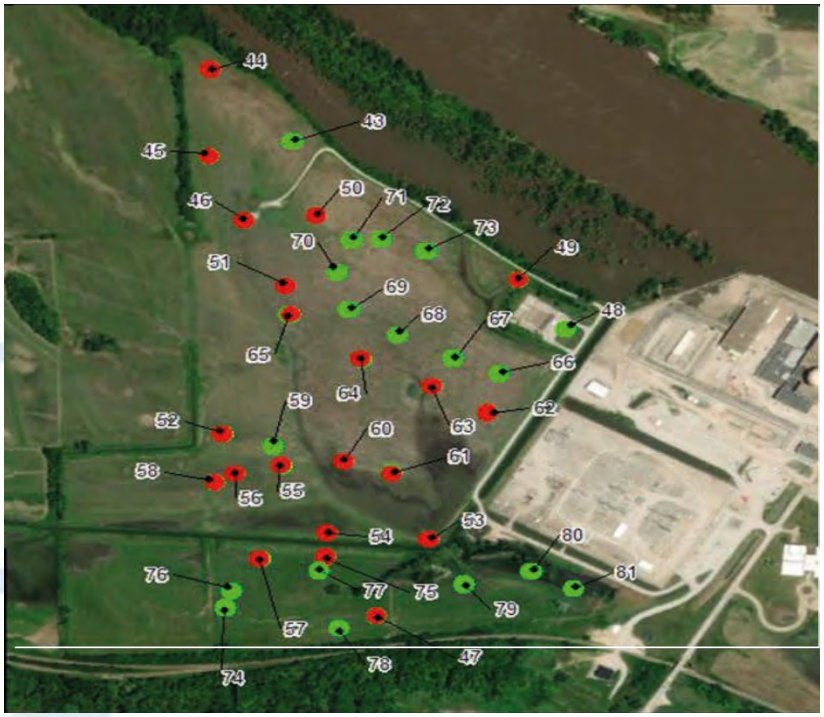
Example: Scanning with No Sample Locations and Results

Adequate information is needed to demonstrate areas are characterized appropriately and data exists to support final status survey design for license termination.

Example: Scanning and Sample Locations



Random Sampling Locations



Judgmental Sampling and Scanning Locations

Missing or Incomplete Information: Groundwater

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- Adequate Description of Conceptual Site Model for Flow and Transport Not Provided or Not Applied

- Monitoring Program Not Modified To Meet Objectives of License Termination Plan

  - Monitoring Network Design
  - Radionuclides of Concern
  - Insignificant Contributors
  - Measurement Methods and Data Interpretation

Issues with Radionuclide Fractions and Insignificant Contributor Analysis

- No Radionuclide Fractions Developed
- Too Few Samples to Demonstrate Representativeness and Variability Across Areas/Media
- Incomplete Insignificant Contributor and ROC Analysis
- Absence of Quality Assurance for Verification of Radionuclide Fractions and Insignificant Contributors
- No Method to Account for Insignificant Contributor Dose in Determining Dose Compliance
- ALARA Analysis

Summary of Site Characterization Impact

An insufficient site characterization can lead to inadequate final status survey planning and implementation.

- Survey Unit Classification

$$DCGL_{sur,\,mod} = \frac{1}{\frac{1}{DCGL_{sur}} + \frac{R_1}{DCGL_{inf\,1}} + \frac{R_2}{DCGL_{inf\,2}} + \ldots + \frac{R_n}{DCGL_{inf\,n}}}$$

- Relative Shift and Sample Number

$$DCGL_{SR} = DCGL_{SUR} \times \frac{DCGL_{REP}}{[(C_{REP} \div C_{SUR})(DCGL_{SUR})] + DCGL_{REP}}$$

- Surrogate DCGLs and Ratios

- Gross Activity DCGLs

$$DCGL_{AG} = \frac{1}{\left[\left(\frac{f_1}{DCGL_1}\right) + \left(\frac{f_2}{DCGL_2}\right) + \cdots \left(\frac{f_i}{DCGL_i}\right)\right]}$$

- Weighted instrument efficiencies

$$\epsilon i\ (\text{weighted}) = (\epsilon i_1 \times RF_1) + (\epsilon i_2 \times RF_2) + \ldots + (\epsilon i_j \times RF_j)$$

2005 Lessons Learned - Surrogate Ratios

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Search Criteria: Year: 2005 ***Facility Type:*** All Facility Types

Stage: All Functional Areas ***Benefit:*** All Benefits

Lesson ID: 2005-15 ***Facility Type:*** Reactors, Material Facilities ***Stage:*** Decommissioning Planning

Benefits: Facilitates Decommissioning Licensing, Facilitates Decommissioning Work

Subject: Derivation of site-wide ratios between various contaminants in a facility should consider collecting soil samples in such a manner that the ratio developed accurately represents both spatial and depth variability of the radionuclide concentrations

Discussion: There have been several instances where a limited number of soil samples were used to determine a site-wide ratio between various contaminants. A surrogate contaminant was then to be measured and the ratio used to account for the remaining site contaminants. In one case, the sampling procedure did not take into account the actual site spatial contaminant distribution.

Instead, a limited sample data set from one area of the site was relied upon to prepare the radionuclide ratios. A review of site data collected during earlier scoping surveys clearly demonstrated that the ratio varied among the radionuclides of concern, dependent upon which area of the site the sample represented. When the varying ratios were analyzed, it was determined that the site-specific surrogate ratio that had been developed would significantly underestimate the inferred radionuclide concentrations for portions of the site. This issue can be readily avoided provided representative samples are collected in such a manner that the ratio developed accurately represents both spatial, and in some cases, depth variability.

References: NUREG-1757: Consolidated Decommissioning Guidance: Characterization, Survey, and Determination of Radiological Criteria, Vol. 2, Rev. 1, Appendix O

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QUESTIONS?