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Decommissioning Survey and Site Characterization Issues and Lessons Learned

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Characterization and Survey Issues Lessons Learned & Good Practices

- Subsurface Sampling and Survey
- Dose Modeling & Derivation of DCGLs for Survey Units
- Buried Pipes Survey and Characterization
- DQO Concept in Survey & Characterization
- Characterization of Solid Materials for Release
- Survey & Monitoring for Detection and Characterization of Leakages & Spills
- Lessons Learned
- Benefits of Good Practices

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Subsurface Generic Issues

- Doing more with less
- Optimizing sampling costs and analytical costs
- Better survey design using site knowledge as a guide (**Bayesian?**)
- Better data analysis using sophisticated statistics (G**eostatistics?**)
- Dispersed plume versus discrete sources
  - "Elevated volume" analogue to "elevated area"
- Cannot scan 100% in Class 1 – How do we keep confidence High and uncertainty Low?
- Incorporating **surrogate data** and **professional judgment** data into the decision process (e.g., geophysical, hydrological data)

HOW DO YOU MAKE IT USABLE?????

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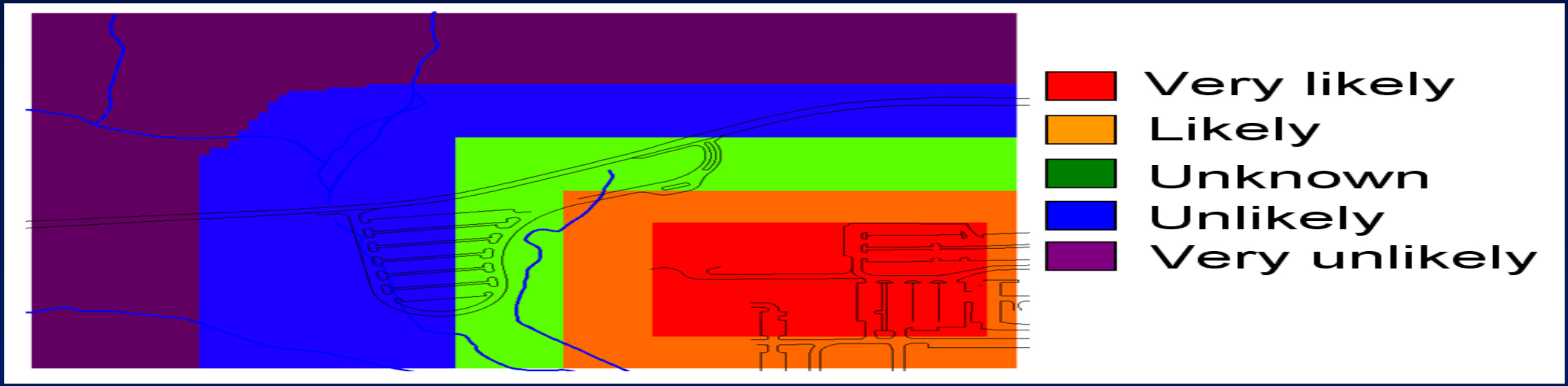
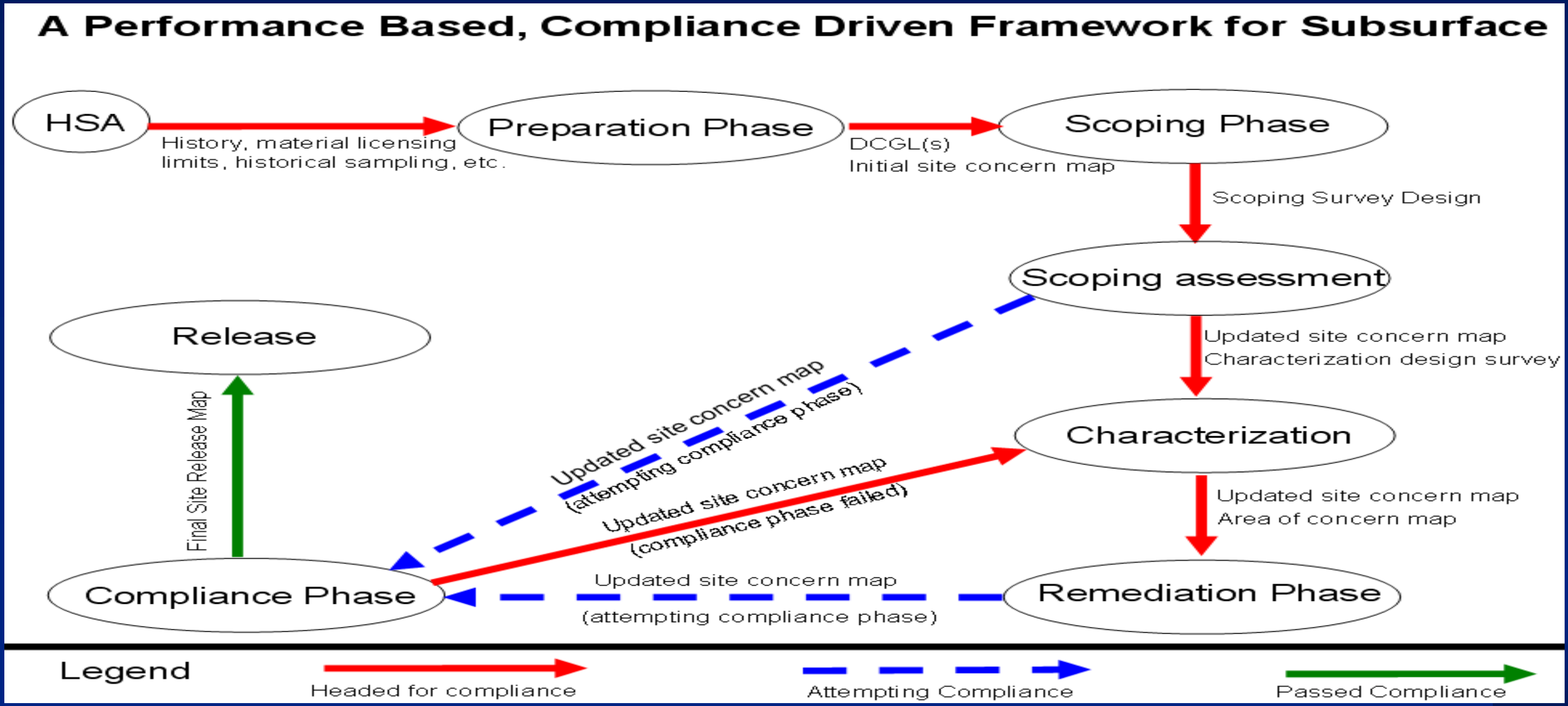
Subsurface Specific Issues

- Lack of sampling, modeling, and decision framework approach
- Lack of quality in the decision-making throughout the site investigation and remediation processes
- Calculation of a $DCGL_W$ is problematic due to formulation of an appropriate exposure scenario that would occur in the subsurface. Similarly, the $DCGL_{EMC}$ is also problematic.
- Statistical hypothesis testing for surface assumes that the samples come from the same population. In the subsurface, this may not be the case.
- The greatest difficulty stems from the fact that investigators cannot completely scan the subsurface (e.g.; Lack of comprehensive coverage easily gained at the surface now presents a real obstacle in determining activity levels at depth).
- Problems with adapting MARSSIM to the subsurface:
  - Assuming no explicit knowledge which contradictory to the investigation
  - Subsurface is difficult to access
  - Volume (not area) is being investigated, increasing sampling requirements
  - Comprehensive scans are possible

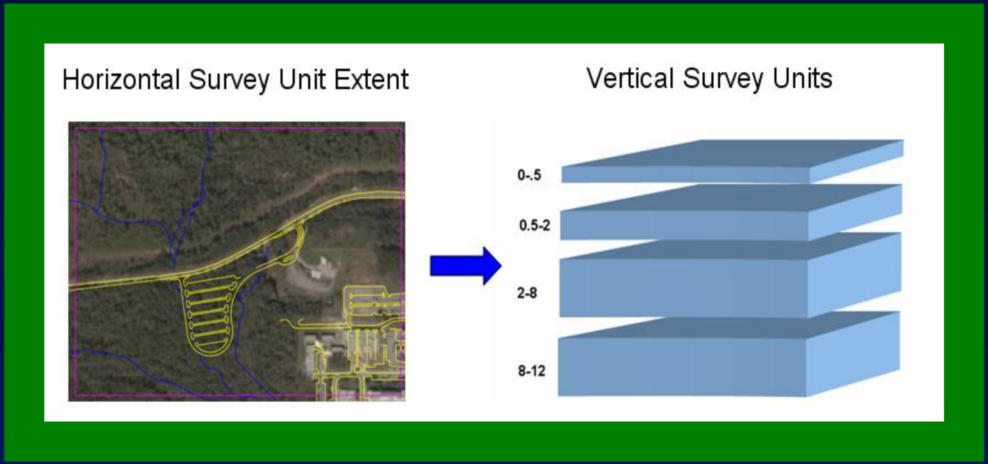
Subsurface Performance Based Sampling and Survey

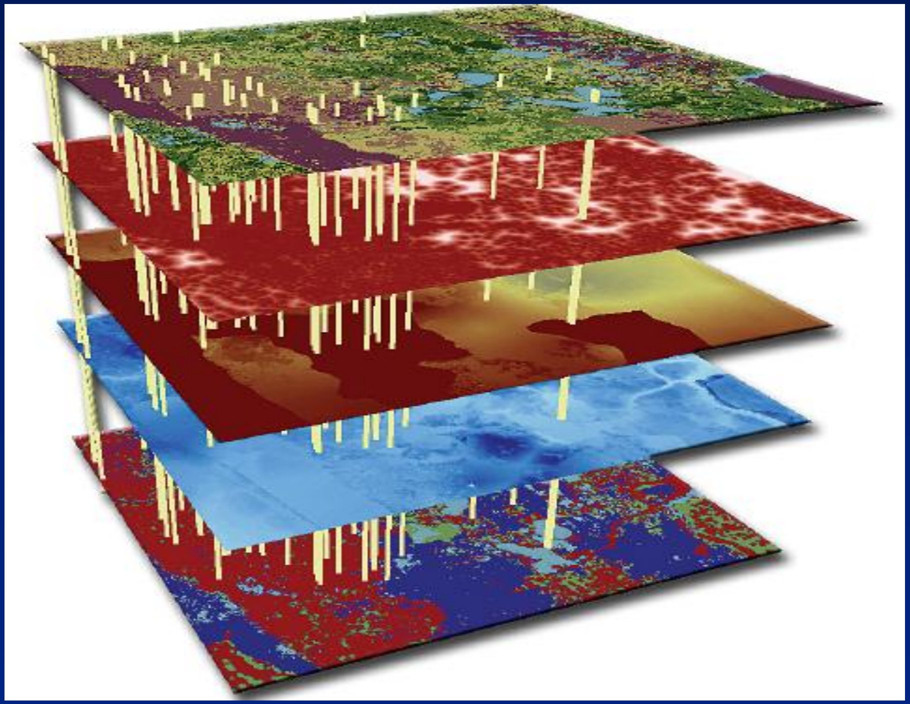


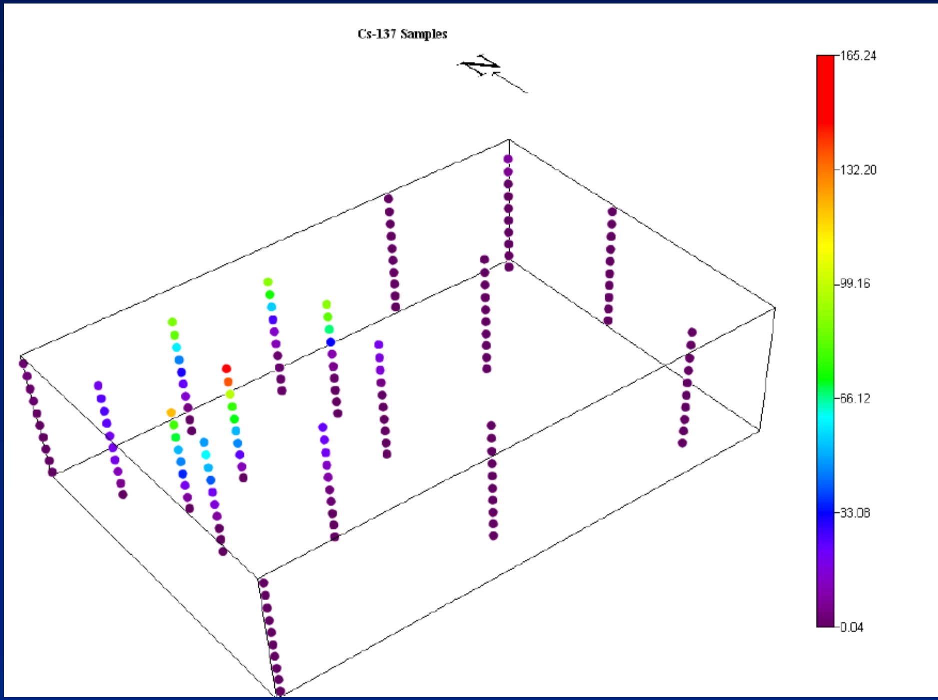


Subsurface Data

Focus on Area of Concern Map (ACM)

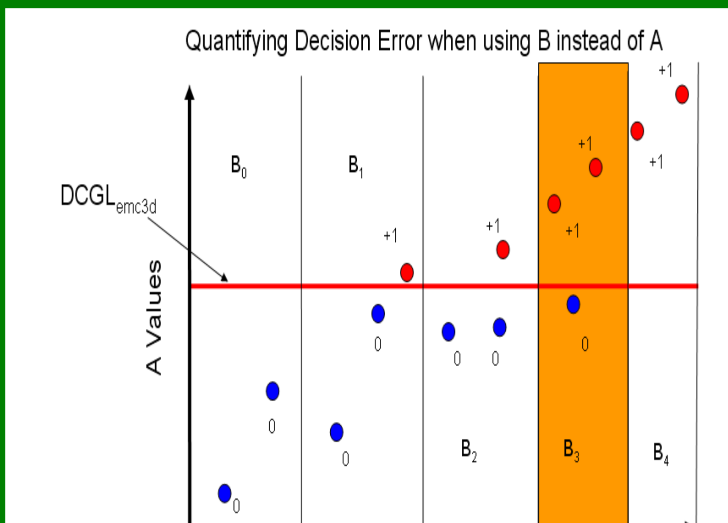






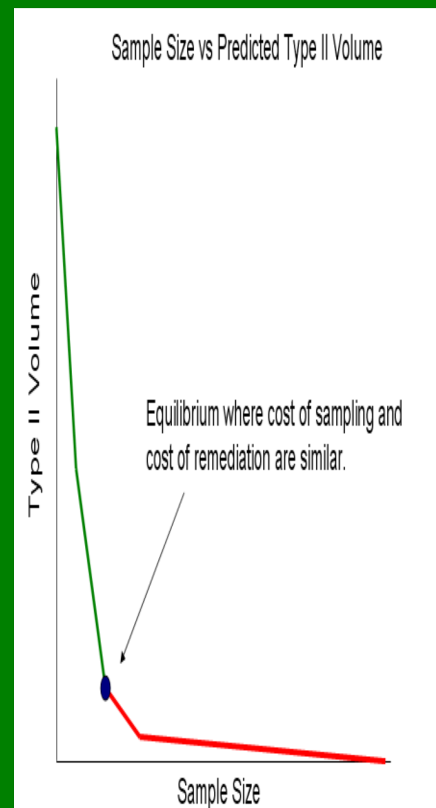
MARSSIM3D defines survey units both horizontally and vertically.

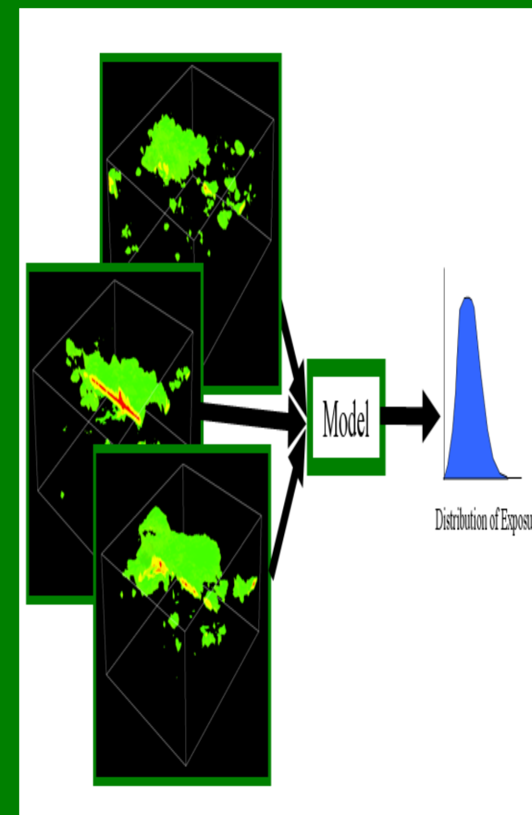
MARSSIM 3D – Sample Size & Probabilistic Distribution Analysis



	B0	B1	B2	B3	B4
Number of Excedances	0	1	1	2	2
Number of Data	2	3	3	3	2
Prob A > $DCGL_{emc3d}$	0	1/3	1/3	2/3	2/3
Exceeds DCGL Rule	False	False	False	True	True
P(Wrong Decision)	0	1/3	1/3	0	0
P(Actual B Value)	0.2	0.2	0.2	0.2	0.2

B Values





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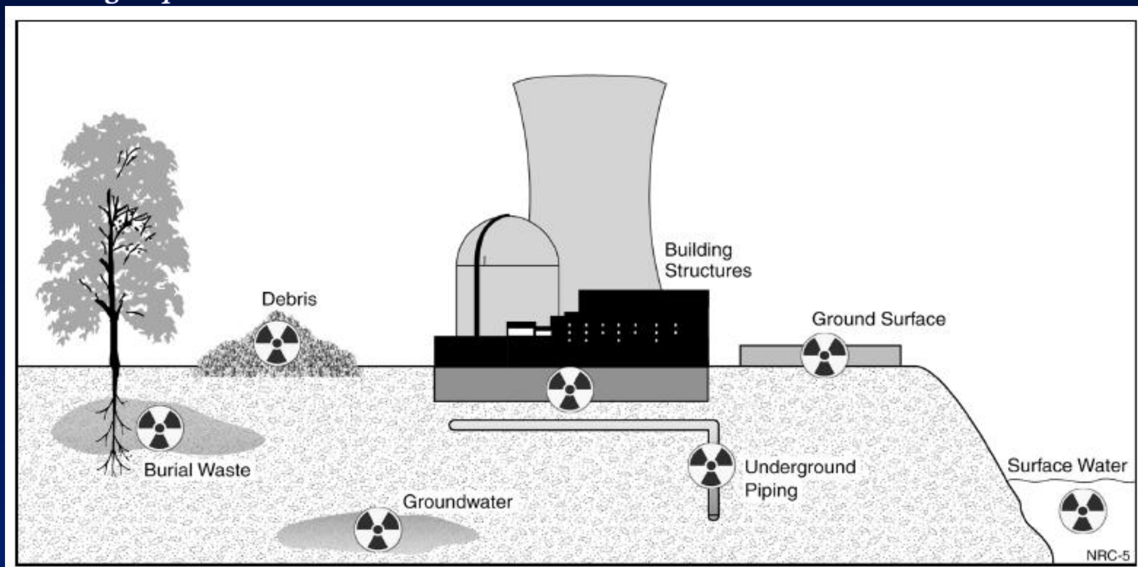
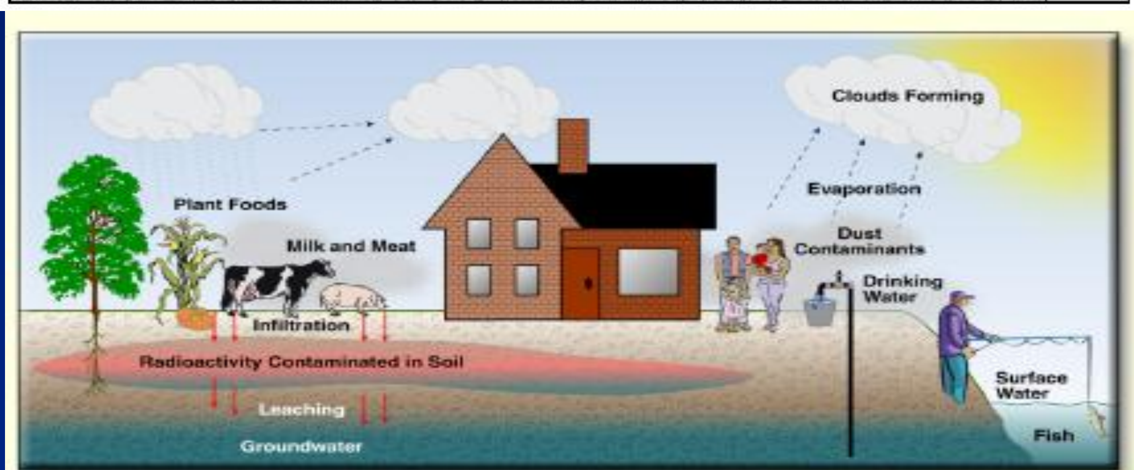
Dose Modeling Issues

- Site conceptual 3D model & compatibility with the code used
- Justification of input parameters based on site characteristics
- Exposure scenarios & elimination of pathways - DCGL issue
- Land use issues - DCGL
- Performance of barriers and vaults (characterization issue)
- Contaminant transport and location of receptor
- Input of probabilistic parameter distributions and correlation of parameters
- Peak of the mean vs. mean of the peak approach (DCGL issue)
- Misuse of codes/models (lack of data – complex models)
- Dose analysis for derivation of $DCGL_{EMC}$ (sampling issues)
- Issues in addressing uncertainties (models, parameters, & scenarios)

Dose Modeling Process





1. Evaluation of existing data, which determines source term
2. Scenario development and pathway identification
3. Conceptual model
4. Parameter selection
5. Dose assessment/analysis

Priority 1 Parameters in RESEAD Codes & Scatter Plots Dose *vs.* Parameter Value

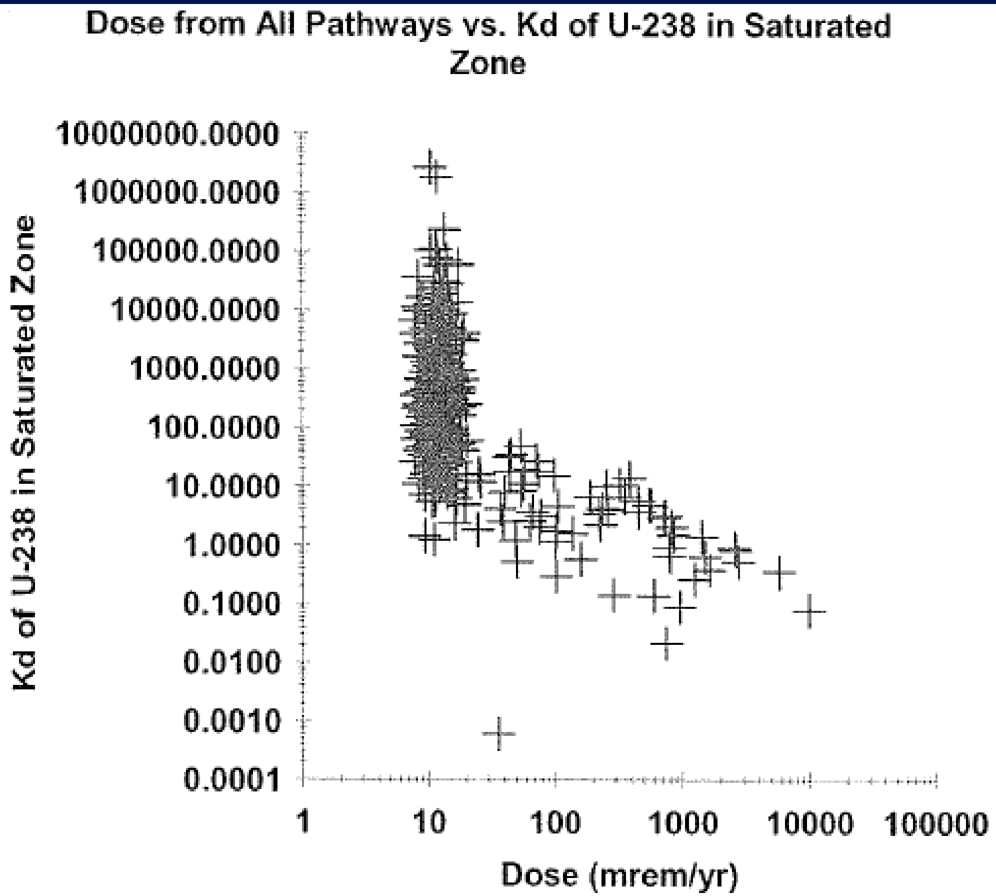


TABLE 6-1 Priority 1 Parameters in RESRAD and RESRAD-BUILD

RESRAD	RESRAD-BUILD
Distribution coefficient (K_d)	Resuspension rate
Density of cover material	Removable fraction
Density of contaminated zone	Source density
Density of saturated zone	Shielding density
Saturated zone total porosity	
Saturated zone effective porosity	
Saturated zone hydraulic conductivity	
Depth of roots	
Transfer factors for plants	

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DQOs Process In Developing Final Survey Design

- Experience has shown that the process is often rigidly structured by relying too much on characterization data and not being readily open to the possibility of incorporating new information as it becomes available.

- This approach makes the implementation of any changes difficult and is an inefficient use of resources,

  since it imposes time delays while determining how to implement any changes.

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Characterization of Solid Materials for Release

- **Relationship between the LTR and the current case-by-case approach for controlling the disposition of solid materials:**
  - The relationship is unclear between the LTR's dose constraint of 0.25 milliSievert per year (mSv/yr) [25 millirem per year (mrem/yr)] for unrestricted use of a site, and existing guidance for controlling the disposition of solid materials on a case-by-case basis, particularly for instances where materials and equipment containing residual contamination might be removed from an

    unrestricted-use site after license termination
  - NUREG-1757 states that the dose from release of solid material is 1-5 mrem/y (0.01 – 0.05 mSv/y)
- **Need to adopt a unified approach for survey, detection, and release of materials and equipment using (MARSAME) approach.**

Buried Pipes Survey & Characterization

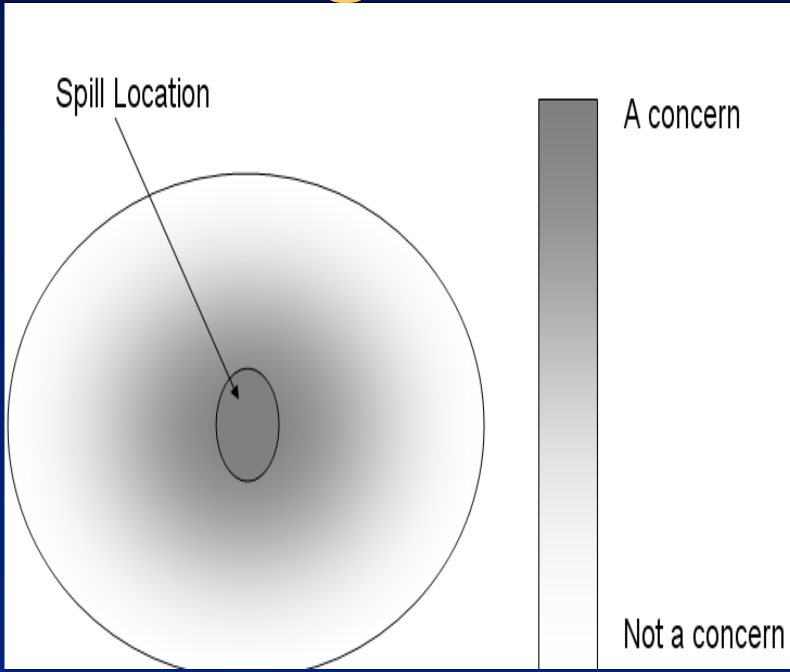
- Characterization survey and detection techniques
- Remediation method, and decontamination technique due to inaccessibility
- Dose analysis and criteria for release
- Blockage and debris deposition

- Characterization:
- Robotic Crawlers - Flow through - Pull through (In-Line)
- Remote Ultrasonic, remote field testing, magnetic flux leakage,

- Manual Ultrasonic's Guided Wave
- Remote field testing, Eddy current techniques, and Radiography
- Remediation Options: hydrolyzing, media blasting, chemical decontamination, and removal of piping

Spills & Leakages – Monitoring Data

- Locations where radioactive materials were used and stored,
- Records that indicate locations of spills, discharges or other unusual occurrences,
- Locations where radioactive materials were buried or disposed.



A fuzzy delineation of concern level surrounding a spill location.

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Lessons Learned

Based on NRC staff reviews of several DPs or LTPs, the following lessons have been learned:

- **Communications -** Early and frequent discussions between NRC staff and licensees are encouraged during the planning and scoping phase supporting the preparation of the DPs or LTPs.
- **Groundwater -** Additional environmental monitoring data may be needed because there may not be enough operational environmental monitoring of groundwater for adequate site characterization and dose assessments.
- **Data Quality Objectives -** The data quality objectives process is encouraged in planning and designing the final status survey plan.
- **Inspections -** In-process inspections are more efficient than one-time confirmatory surveys.
- **Flexibility -** Continued communications between NRC staff and the licensee during the staff's review is encouraged to help the licensee take full advantage of the inherent flexibility in NUREG-1575, "Multi-Agency Radiation Survey and Site Investigation Manual," and NUREG-1727, "NMSS Decommissioning Standard Review Plan."

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Survey & Monitoring for Detection and Characterization of Leakages & Spills

- Facility monitoring is an important early line of defense in an environmental monitoring program. The detection of tritium in the groundwater took many years due to inadequate facility monitoring.
- Understand the potential sources of groundwater contamination
- Use of new techniques (horizontal wells for locating the source, in this case)
- The release of contaminants from the aquifer's vadose zone, particularly mobile contaminants such as tritium needs to be considered as a continuing Source term.
- Hot spot removal in the groundwater for mobile contaminants should be done as soon as possible. Delays can lead to a longer and more complicated cleanup
- Geo-probes and temporary wells (vertical profiles) are effective tools for an "early response" plume Characterization
- Effort should be expended to manage a plume within the facility boundaries. Once offsite migration occurs both real and perceived risk greatly increase.
- For porous media that do not cause substantial mechanical dispersion, modeling using finite-difference methods may under predict down-gradient concentrations for tritium unless great care is placed on accounting for numerical dispersion
- Political and Institutional Risks may dominate technical risks in the decision making process

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Lessons Learned

- **Modeling Issues** - Submittal of assumptions and justification for parameters used in developing site-specific derived concentration guideline levels (DCGLs) and application of those DCGLs is encouraged.
- **Decommissioning Cost Estimate** - The discussion should include a clear relationship between the planned decommissioning activities and the associated updated cost estimate.
- **Records** - Old records should not be used as the sole source of information for the historical site assessment/site characterization, because these old records may be inadequate or inaccurate.
- **Environmental Assessments** - Some environmental submittals have not provided sufficient information addressing non-radiological impacts of the proposed action, as required by the National Environmental Policy Act.
- **Classifications of Survey Units** - DPs and/or LTPs should be submitted only after sufficient site characterization has occurred.
- **Embedded Piping** - Some LTPs and DPs have not adequately described the methods the licensee plans to use when surveying the embedded piping planned to be left behind.
- **Minimum Detectable Concentrations** - Some LTPs and DPs have not adequately described the methodologies the licensees plan to implement to scan minimum detectable concentrations of mixtures of radionuclides that may remain in given survey areas/units.

Lessons Learned

- Eliminating exposure pathways during the use of realistic scenarios in a dose assessment at a site requires a technically sound justification
- Adequate characterization of the subsurface of the site during the design and construction phase of a nuclear facility could be beneficial during the operation and decommissioning of the facility.
- Minimizes Contamination, Minimizes Generation of Waste
- Benefits from minimizing the use of embedded piping in nuclear facilities
- Licensees should make reasonable efforts to prevent, detect, and control minor leaks of radioactive materials over prolonged periods of time.
- Benefits of having a quality assurance inspection program for grouted areas in a nuclear facility.
- Licensees should ensure that concrete block walls are completely sealed to prevent the inadvertent intrusion of radioactive material.
- Licensees should follow the guidance in NUREG-1757, Volume 2, Revision 1, regarding deselecting radionuclides from a detailed evaluation in demonstrating compliance during license termination.
- Licensees should follow the guidance in NUREG-1757, Volume 2, Revision 1, when choosing acceptable methods for surveying embedded piping and buried piping.
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Lessons Learned

- Licensees should follow the guidance in NUREG-1757, Volume 2, Revision 1, when developing input distribution coefficient (Kd) values for soil or concrete when using site-specific dose modeling codes
- Licensees can use illustrative examples to demonstrate appropriate selection of survey instrumentation
- radionuclide distribution profiles are necessary to ensure
- that survey and analysis techniques are appropriate and that dose assessments properly consider all the radionuclides that may be present
- **Radionuclide Deselection**
- When developing derived concentration guideline levels (DCGLs) for the FSS, which
- radionuclides can be deselected from further consideration?
- **Embedded and Buried Piping Characterization**
- What are acceptable methods to characterize embedded piping and buried piping?
- **Development of Site-Specific Distribution Coefficient**
- **Values for Soil or Concrete**
- What is an acceptable approach for the development of input distribution coefficient (Kd) values
- for soil or concrete when using site-specific dose modeling codes?

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Examples of Benefits of Good Practices

- Benefits of using a "split sample" approach during the analysis of radiological samples to support a decision or conclusion during decommissioning activities.
- Benefits of conducting a comprehensive characterization of the site before starting decommissioning activities.
- Benefits of demonstrating the appropriateness of ratios used to calculate Derived Concentration Guideline Levels before the final status survey
- Benefits from understanding the differences between decommissioning in stages and phased decommissioning
- The Radioactivity and Effluents Monitoring Program (REMP) may not be sufficient to characterize subsurface contamination at operating sites.
- Benefits of implementing a good quality control (QC)/quality assurance (QA) program throughout a decommissioning project
- Benefits of using realistic scenarios to demonstrate compliance with unrestricted release requirements under the License Termination Rule.

Lessons Learned

- **Demonstrating Appropriate Selection of Survey**
- **Instrumentation by Illustrative Example**
- Using appropriate illustrative examples in the license termination plan (LTP), is it acceptable to
- define (a) the data quality objectives (DQO) process and (b) the acceptance criteria for
- demonstrating that radiation survey instrumentation, selected for use in the FSS, is sufficiently
- sensitive for a given derived concentration guideline level (DCGL) and expected survey conditions.
- DQOs and FSS Issues
- **Instrumentation Issues:**
  - **Temperature Effects on Gas Proportional Detectors**
  - **Instrument Count Rate Plateaus**
  - **Gamma Fixed Point Measurement in Place of**
  - **Surface Scanning**
  - **Instrument Calibration for Assessing Surface Activity**
  - **Using ISO 7503-1**

Questions?