# MARSSIM Overview I

MARSSIM Technical Seminar Series

September 15, 2006

Eric W. Abelquist
Oak Ridge Associated Universities

# *Lecture Topics*

- MARSSIM Overview
- Use of DQO Process
- Integrated Final Status Survey

# *MARSSIM experience….just a few of the many examples*

- Nuclear power plants – Trojan, CY, MY
- DNSC Curtis Bay and Hammond Depots
- DOE at ANL, BNL, Rocky Flats, Battelle
- Gaseous Diffusion Plants
- Army Corps FUSRAP sites; Air Force and Naval Base Cleanups

# *COMPASS—MARSSIM Software*

- Funded by the NRC, assists D&D professionals and regulators with MARSSIM implementation
- Help trains MARSSIM users with survey designs, power curves, DQA
- Consistency of information which facilitates the regulator's review

# *Decontamination and Decommissioning Science Consortium*

- Consortium of DOE decommissioning expertise to help D&D professionals stay abreast of the increasing number of technical information resources available
- “The information is out there… the DDSC effectively integrates and transfers the D&D information to those who need it.”
- Consortium members are now ORAU and ANL

DDSC

The Decontamination and Decommissioning Science Consortium

# www.orau.gov/ddsc/ *(DDSC Web Site)*

- Provides location for all the diverse and dispersed elements of D&D operations
- Provides latest in decommissioning news
- Offers an “Ask the Expert” feature
- Integrates the many disciplines of D&D...D&D projects, dose modeling, survey instrumentation, regulations, remediation technologies, D&D operations

# *MARSSIM Overview*

# *MARSSIM*

- A consensus document prepared by DOD, DOE, EPA and NRC on the methodology for performing radiological surveys
- A flexible approach to planning, conducting, and assessing radiological surveys to demonstrate compliance
  - Based on the DQO Process…nothing (not much anyway) is written in stone!

# *MARSSIM Scope*

- Demonstrating compliance with release criteria for **building surfaces** and **surface soils** (up to 15 cm depth)
- MARSSIM does **not** include selecting the release criterion, obtaining DCGLs, subsurface soil, or building materials

(MARSSIM group also preparing guidance for subsurface soils and building materials)

# *MARSSIM Objectives*

- Guidance for planning final status surveys:
  - How many samples are needed?
  - What measurement methods and survey instrumentation to use?
  - How to determine if DQOs have been met?
  - How to reduce survey data to demonstrate compliance with release criteria?

# *MARSSIM Process (Data Life Cycle)*

- Plan  (DQO process)
- Implement (conduct surveys)
  - Scanning, direct measurements, and samples
- Assess (data quality assessment)
  - Statistical tests and EMC
- Decide (compliance with release criteria)

# *Data Quality Objectives (DQOs)*

- DQO process is a series of planning steps for establishing criteria for data quality and developing survey designs
- “Guidance for the Quality Objectives Process” EPA QA/G-4; August 2000

# *DQO process consists of 7 steps*

1) State the problem
2) Identify the decision
3) Identify inputs to the decision
4) Define the study boundaries
5) Develop a decision rule
6) Specify limits on decision errors
7) Optimize the survey design

We are working on independent verification DQOs!

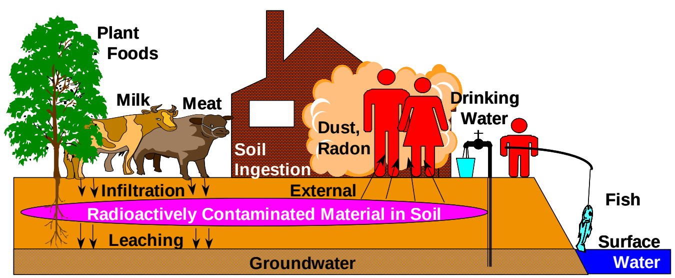
# *Release Criteria*

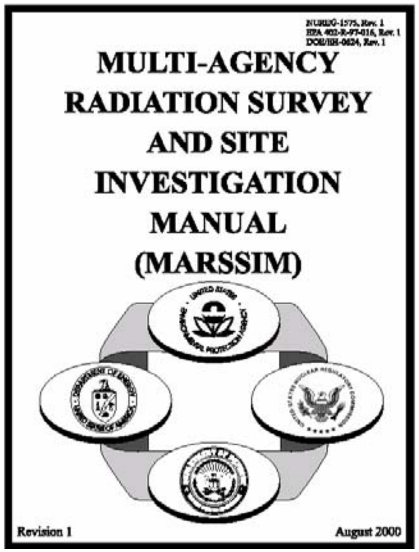
- Regulatory agencies establish release criterion (e.g. 25 mrem/y); NRC's SRP
- Exposure scenarios and pathway modeling to convert to measurable concentrations called DCGLs (RESRAD, DandD codes):
  - Derived Concentration Guideline Levels
  - For both soil concentrations and surface activity on structures

# *Gaps Between DCGL Development and MARSSIM*

Pathway Analysis

DCGL MARSSIM Implementation





MULTI-AGENCY RADIATION SURVEY AND SITE INVESTIGATION MANUAL (MARSSIM)

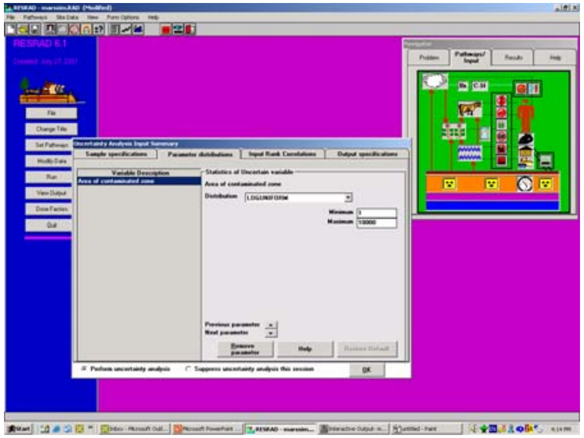
Revision 1

August 2000

# *RESRAD/COMPASS: Enhanced Computational Ability*

- Incorporating RESRAD and COMPASS would allow users to quickly integrate dose based area factors into the MARSSIM DQO/DQA process

RESRAD



OpenLink

COMPASS

# **Scenarios** Used to Determine DCGLs

- Residential
- Building occupancy
- Building renovation
- Drinking water
- Commercial/Industrial
- Agricultural
- Recreational

# **Pathways** Used to Determine DCGLs

- External
- Ingestion of drinking water
- Plant ingestion
- Fish and seafood ingestion
- Inhalation of resuspended particulates
- Meat ingestion
- Milk ingestion
- Soil ingestion
- Radon inhalation

# Use of DCGLs

- Average level of radioactivity

- Units
  - Surface activity in $Bq/m^2$ or dpm/100 $cm^2$
  - Volumetric (soil) in Bq/kg or pCi/g

- Obtained from regulatory guidance based on default pathway parameter values, or from site-specific pathway modeling

# Types of DCGLs

- $DCGL_W$
  - DCGL for residual radioactivity evenly distributed over a large area
  - Use with WRS or Sign test
- $DCGL_{EMC}$
  - DCGL for small areas of elevated activity
  - Used for the elevated measurement comparison to identify areas that require further investigation
  - Developed using different exposure assumptions than $DCGL_W$
  - Considers results of individual measurements

# Area Factor

- A factor used to adjust $DCGL_W$ to estimate $DCGL_{EMC}$

$$DCGL_{EMC} = DCGL_W * \text{Area Factor}$$

- Represents magnitude by which the residual radioactivity in a small area of elevated activity can exceed the $DCGL_W$ while maintaining compliance with the release criterion

- Site-specific area factors should be determined based on regulatory guidance

# Prerequisites for Applying DCGLs

- Identify site-specific contaminants of potential concern
- Identify relative ratios among contaminants
- Identify isotopic ratios and determine state of equilibrium for decay chains (e.g., $^{238}U$, $^{232}Th$)

# Surrogate Measurements

- Surrogate measurements
  - Measure one radionuclide to demonstrate compliance for one or more radionuclides
  - One "easy" to measure radionuclide present in a "consistent" ratio with difficult to measure radionuclide(s)

- Establish "consistent" ratio
  - Members of a natural decay series
  - Process knowledge

# Example of Surrogate Measurements

- $^{60}Co$ and $^{55}Fe$ are present in soil
  - $^{60}Co$ gamma rays are easier to measure

- $^{60}Co$ $DCGL_W = 10$ pCi/g
  $^{55}Fe$ $DCGL_W = 200$ pCi/g
  Ratio of $^{55}Fe$ to $^{60}Co = 5$

$$DCGL_{Co,\,Mod} = 10 * \frac{200}{(5/10) + 200} = 8 \text{ pCi/g}$$

# Multiple Radionuclides

- Each nuclide-specific DCGL corresponds to the release criterion
- Presence of multiple radionuclides would exceed the release criterion
- Methods for accounting for multiple radionuclides
  - Modify assumptions made in exposure pathway modeling to account for multiple radionuclides
  - Unity rule
  - Gross Activity DCGL

# *Radiation Survey and Site Investigation Process*

- Historical Site Assessment
- Preliminary Surveys (Scoping/Char.)
- Remedial Actions (RA)/RA Support Survey
- Final Status Survey
  - Classify site areas
  - Divide into Survey Units
  - Demonstrate compliance with release criteria

# *Historical Site Assessment (HSA)*

- Identify potential sources of contamination
- Differentiate areas of different contamination potential - Impacted or Non-impacted
- Provide input to scoping and characterization survey designs
- Provide assessment for potential of contaminant migration

# *Classification of Areas*

- Areas with higher potential for contamination receive higher degree of survey effort
- Impacted
  - Class 1
  - Class 2
  - Class 3
- Non-impacted

# *Class 1 Areas*

- **Class 1 survey:** applies to *areas* with the highest potential for contamination, and meet the following criteria: (1) *impacted*; (2) potential for delivering a dose above the *release criterion*; (3) potential for small *areas of elevated activity*; and (4) insufficient evidence to support reclassification as *Class 2* or *Class 3*.
- Areas that have, or had prior to remediation, a potential for radioactive contamination (based on site operating history) or known contamination (based on previous radiation surveys) above the $DCGL_W$

# *Class 2 Areas*

- **Class 2 survey:** applies to *areas* that meet the following criteria: (1) *impacted*; (2) low potential for delivering a dose above the *release criterion*; and (3) little or no potential for small *areas of elevated activity*.

- Areas that have or had prior to remediation, a potential for radioactive contamination or known contamination, but are **not expected** to exceed the $DCGL_W$

# Class 3 Areas

- **Class 3 survey:** applies to *areas* that meet the following criteria: (1) *impacted*; (2) little or no potential for delivering a dose above the *release criterion*; and (3) little or no potential for small *areas of elevated activity*.
- Any impacted areas that are not expected to contain any residual radioactivity or are expected to contain levels of residual radioactivity at a **small fraction** of the $DCGL_W$ based on site operating history and previous radiation surveys.

# *Scoping Survey*

- Expands upon HSA data by collecting **judgmental** samples in potential areas of concern
- Objectives
  - Provides input to characterization survey design
  - Supports classification of site areas
  - Identifies site contaminants and their variability
  - Identifies non-impacted areas that may be suitable background reference areas

# *Characterization Survey*

- Primary Objective: Determine the nature and extent of contamination - Builds upon the HSA and scoping survey results
- Other Objectives:
  - Evaluating remediation alternatives
  - Modeling input for site-specific DCGLs
  - Input to final status survey design - MARSSIM emphasis

# *Remedial Action Support Survey*

- Provides a real-time assessment of the effectiveness of decontamination efforts
- Typically relies on a simple radiological parameter - direct measurements of surface activity, soil scans/analysis in the field
- Determines when an area/survey unit is ready for the final status survey

# *Final Status Survey*

- Objective: Demonstrate that residual radioactivity in **each survey unit** satisfies release criteria
- Builds on data from HSA and survey results from scoping and characterization surveys
- Survey design relies on DQO process for data collection (MARSSIM Appendix D)

# *Final Status Survey (cont.)*

- Null hypothesis ($H_0$): Residual radioactivity **exceeds** the release criteria
  - compare to NUREG/CR-5849 which used t test and confidence interval approach
- Decision errors occur when $H_0$ is rejected when it is true (Type I), or when $H_0$ is accepted when it is false (Type II)

# *MARSSIM Statistics: Hypothesis Testing*

- Survey results are used to select between one condition of the environment (null hypothesis) and an alternative condition

| | **True Condition** | |
|---|---|---|
| Decision | $H_0$ is True | $H_0$ is False |
| Accept $H_0$ | No error | Type II error |
| Reject $H_0$ | Type I error | No error |

# *Statistical Power (1 - β)*

- Type I errors (or $\alpha$) are specified at the $DCGL_W$, while Type II errors (or $\beta$) are specified at the lower bound of the gray region (LBGR)
- Power ($1 - \beta$): Probability of rejecting the null hypothesis when it is false; survey design with high power means correctly releasing survey units (high power is good)

# *Final Status Survey (cont.)*

- Two statistical tests are used to plan and evaluate final status survey data:
  - Wilcoxon Rank Sum (contaminant in bkg)
  - Sign Test (contaminant **not** in bkg)
- Elevated measurement comparison test
  - not a statistical test; performed on judgment samples that were collected at likely areas of contamination or based on scanning results

# *Identify Survey Units*

- Class 1, 2 and 3 areas divided into survey units—prior to final status survey
  - Areas of similar contamination potential or common history
  - Areas naturally distinguishable from other portions of site
- A survey unit may **not** include areas that have different classifications

# *Suggested Survey Unit Sizes*

| | Typical Maximum |
|---|---|
| **Class 1** | |
| Structures | 100 $m^2$ floor area |
| Land areas | 2,000 $m^2$ |
| **Class 2** | |
| Structures | 100 to 1,000 $m^2$ floor |
| Land areas | 2,000 to 10,000 $m^2$ |
| **Class 3** | |
| Structures | no limit |
| Land areas | no limit |

# *Background Reference Areas*

- For contaminants that are present in background media or when gross activity measurements performed
- Similar physical, geological, radiological characteristics as site being evaluated
- Site may require more than 1 reference area if it exhibits significant variability

# *Selection of Instrumentation*

- Selection based on contaminants, their associated radiations, media surveyed and MDCs
- Consider field (static measurements and scanning) and lab instrumentation
- MDCs less than 10% of the DCGL are preferable—while MDCs up to 50% of the DCGL are acceptable

# *Minimum Detectable Concentration (MDC)*

- MDC = expected activity level a specific instrument/technique can be expected to detect 95% of the time
- Critical for select a “realistic” MDC (overestimate) for a specific measurement method
- Calculate for each type of area

# *Scanning Sensitivity*

- Greater sensitivity = lower levels of contaminant detected
- Sensitivity depends on
  - Sensitivity of instrument
  - Ability of surveyor
- Slowing down the scanning speed improves scan sensitivity

# *Final Status Survey—DQOs*

- Outputs from DQO process
  - State decision errors associated with $H_0$
  - Specify a gray region ($\Delta = \text{DCGL - LBGR}$)
    - DCGL is the upper bound of the gray region
    - lower bound of gray region (LBGR) is set at the **expected mean concentration** in the survey unit (depends on good characterization)

# *Final Status Survey Design— WRS Test*

- Estimate standard deviation of contaminant in both reference area ($\sigma_r$) and survey unit ($\sigma_s$)
  - From scoping/characterization surveys, or collect limited number of measurements
  - Use larger value of $\sigma_r$ or $\sigma_s$

# *Final Status Survey Design—WRS Test*

- Calculate the relative shift—ratio of $\Delta/\sigma$

  ($\Delta$ = DCGL - LBGR)

- Determine $P_r$ —tabulated probability based on relative shift ($\Delta/\sigma$)
- Determine decision error percentiles, $Z_{1-\alpha}$ and $Z_{1-\beta}$ (based on selected decision errors)

# *Final Status Survey Design—WRS Test*

- Calculate sample size (N) for each reference area/survey unit pair:

$$N = \frac{(Z_{1-\alpha} + Z_{1-\beta})^2}{3(P_r - 0.5)^2}$$

- Increase number of data points by 20% to allow for lost or unusable data (Table 5.3 provides sample sizes—already includes 20% increase)

# *Final Status Survey—WRS Example*

- Site contaminant: Cs-137
- Parcel of land on site has been characterized
  - Class 2 area—12,000 $m^2$
  - Divided into 2 survey units
- Background reference area selected
- $DCGL_W$ for Cs-137 is 8 pCi/g

# *Final Status Survey—WRS Example*

- Characterization data used for planning:

| | Survey Unit | Reference Area |
|---|---|---|
| Cs-137 | 4.8 ± 2.9 (1σ) | 0.8 ± 0.5 (1σ) |

- Relative shift calculated with LBGR set at 4 pCi/g: $\Delta/\sigma = (8-4)/2.9 = 1.38$

- For this relative shift (rounded down to 1.3), $P_r = 0.82$

# *Final Status Survey—WRS Example*

- Decision errors chosen
  - Type I ($\alpha$) is 0.025; Type II ($\beta$) is 0.10, so $Z_{1-\alpha}$ = 1.96 and $Z_{1-\beta}$ = 1.28
- Substituting into sample size eqn:

$$N = \frac{(1.96+1.28)^2}{3(0.82-0.5)^2} = 34.2$$

- Increase by 20% and round up—42 samples [Confirm in Table 5.3: N/2 = 21]

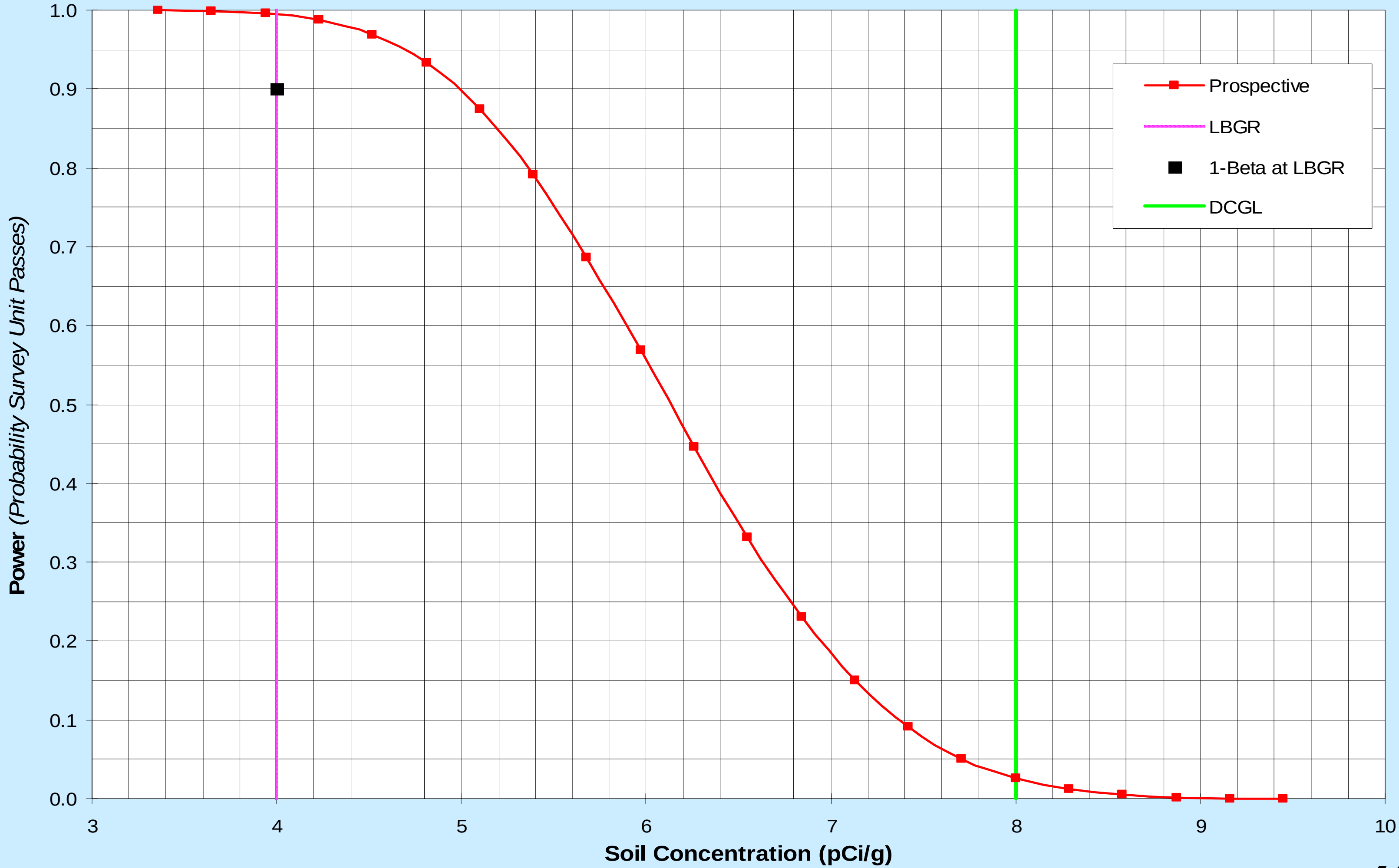
# *Final Status Survey—Prospective Power Curve*

- Prospective power curve is used to evaluate survey design relative to DQOs

(facilitates survey design iteration)

- Type I and II errors specified at the $DCGL_W$ and LBGR, respectively; only Type II errors occur below the $DCGL_W$

# WRS Example—Power Curve



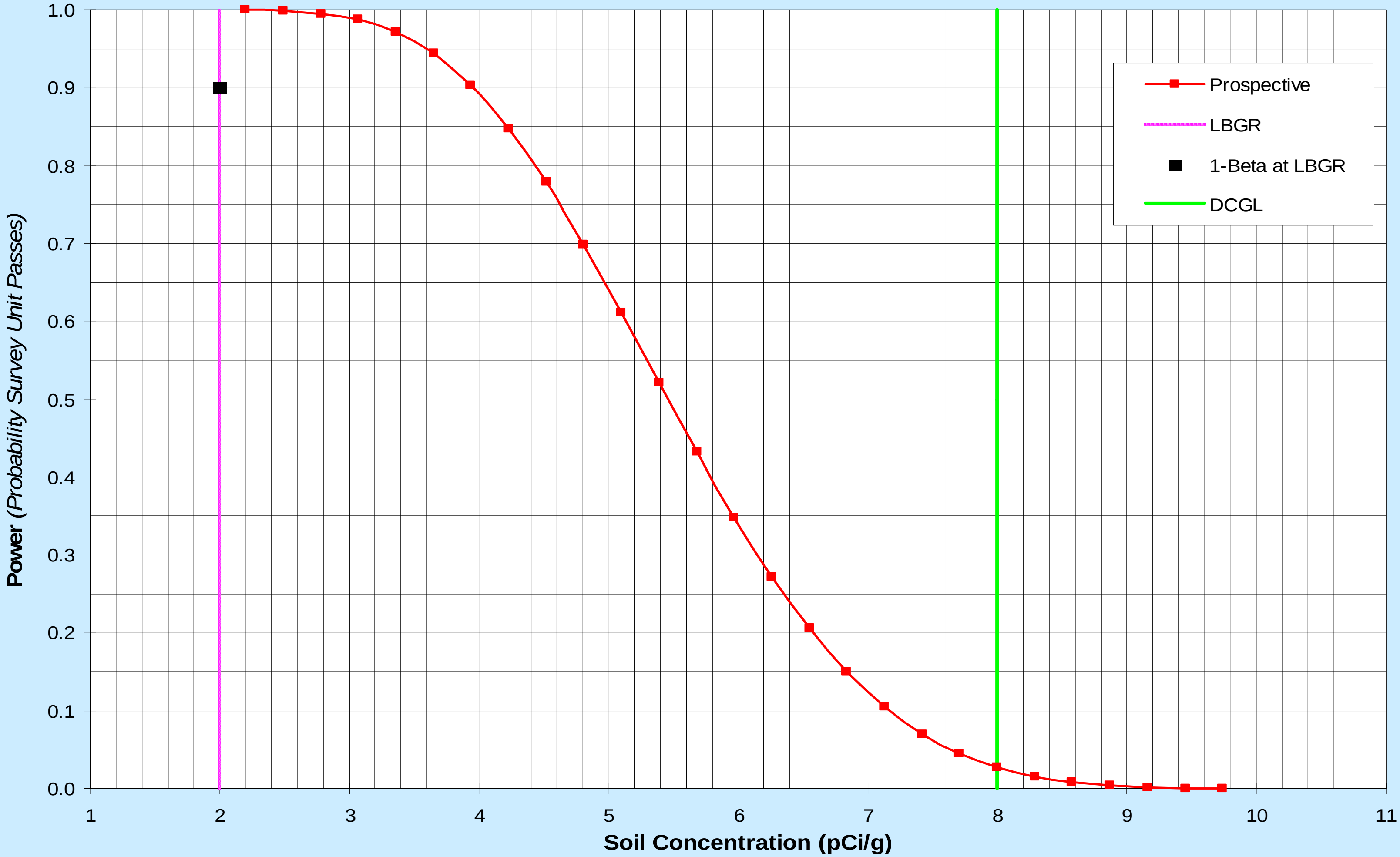
# *Final Status Survey—WRS Example (Revised Survey Design)*

- Now assume expected mean is 2.8 pCi/g Cs-137; LBGR is set at 2 pCi/g which increases $\Delta/\sigma$, reducing sample size:

  $$\Delta/\sigma = (8-2)/2.9 = 2.07$$

  (Type I and II errors remain unchanged)
- From Table 5.3, N/2 = 12 samples
- How does this reduction in sample size affect the power curve? (reduced power)

# WRS Revised Example—Power Curve



# *Determining Survey Locations (cont.)*

- Random-start triangular grid pattern
  - Beginning with random start location, identify a row of points parallel to x-axis at intervals of L
  - A second row of points is then developed, parallel to the first row, at a distance of 0.866 L from the first row
  - MARSSIM Figure 5.5 provides an example of the triangular grid pattern

# *Hot Spot Considerations*

- Hot Spot Survey Design
  - For Class 1 areas, determine if sample size is sufficient for hot spots that may be present
  - Based on n, average area bounded by sample points (a') represents largest hot spot that could exist, and not be sampled

# *Hot Spot Considerations (cont.)*

- Area Factor—factor by which this area may exceed $DCGL_W$
- Determine **required** Scan MDC (same as $DCGL_{EMC}$):

  $$= DCGL_W * \text{Area Factor}$$

- Compare **required** scan MDC to **actual** scan MDC (based on detection sensitivity)

# *Hot Spot Considerations (cont.)*

- If **Actual** Scan MDC < **Required** Scan MDC—then initial data point spacing sufficient (no additional samples needed)
- If Actual Scan MDC > Required Scan MDC—then calculate Area Factor that corresponds to actual Scan MDC:

$$Area\ Factor = \frac{Scan\ MDC(actual)}{DCGL_W}$$

# *Hot Spot Considerations (cont.)*

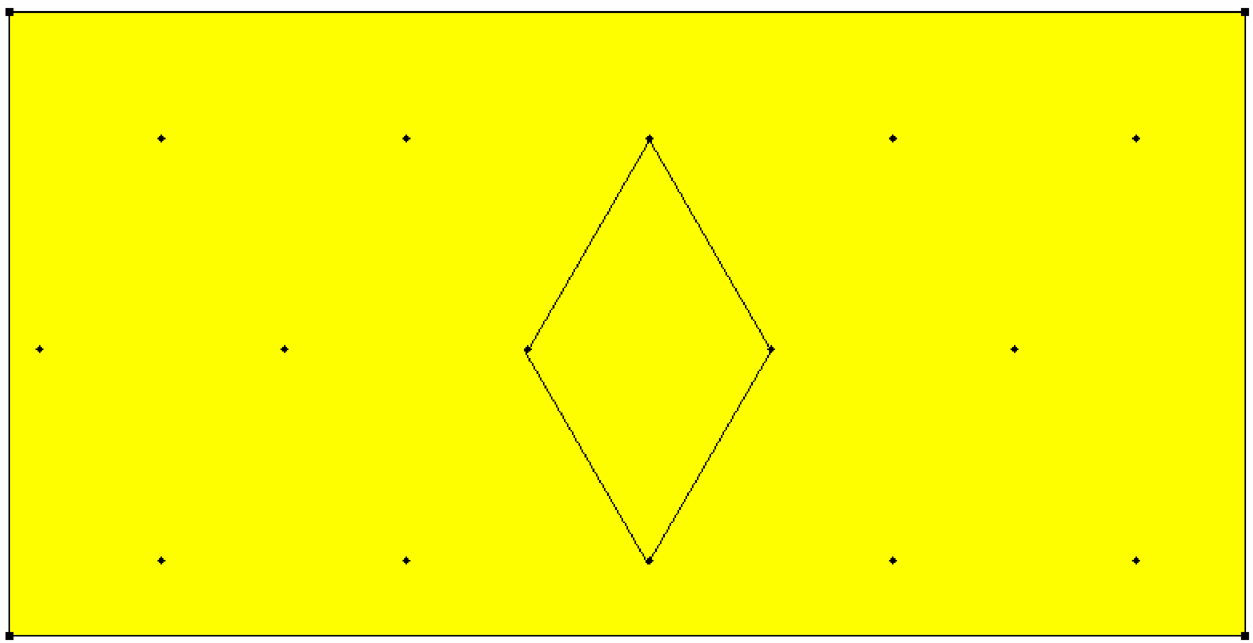
- Determine hot spot area (new a') that corresponds to the calculated area factor (using actual scan MDC)
- New sample size ($n_{EA}$)is calculated by dividing new a' into the survey unit area, A

# *Example: Hot Spot Survey Design*

- Sign test required 15 samples in Class 1 survey unit (A = 1800 $m^2$)
- $DCGL_W$ = 2.5 pCi/g for Th-232
- a’ = 1800/15 = 120 $m^2$
- Look up AF that corresponds to 120 $m^2$ (may need logarithmic interpolation)
- Actual scan MDC = 5 pCi/g

**Sample Plan**

**Phase 1**



# *Example Outdoor Area Factors*

**Area Factors (AF)**

| Area ($m^2$) | Th-232 |
|---|---|
| 3000 | 1 |
| 300 | 1.19 |
| 100 | 1.36 |
| 30 | 1.78 |
| 10 | 2.63 |
| 3 | 5.49 |
| 1 | 12.4 |

Area Factor = 1.33 for a' of 120 $m^2$

# *Example: Hot Spot Survey Design*

- Scan MDC (required) = (2.5 pCi/g)(1.33)

  = 3.3 pCi/g
- Since the actual scan MDC (5 pCi/g) cannot detect 3.3 pCi/g, determine AF corresponds to actual scan MDC:

$$AreaFactor = \frac{ScanMDC(actual)}{DCGL_W} = 5/2.5 = 2$$

# *Example Outdoor Area Factors*

**Area Factors (AF)**

| Area ($m^2$) | Th-232 |
|---|---|
| 3000 | 1 |
| 300 | 1.19 |
| 100 | 1.36 |
| 30 | 1.78 |
| 10 | 2.63 |
| 3 | 5.49 |
| 1 | 12.4 |

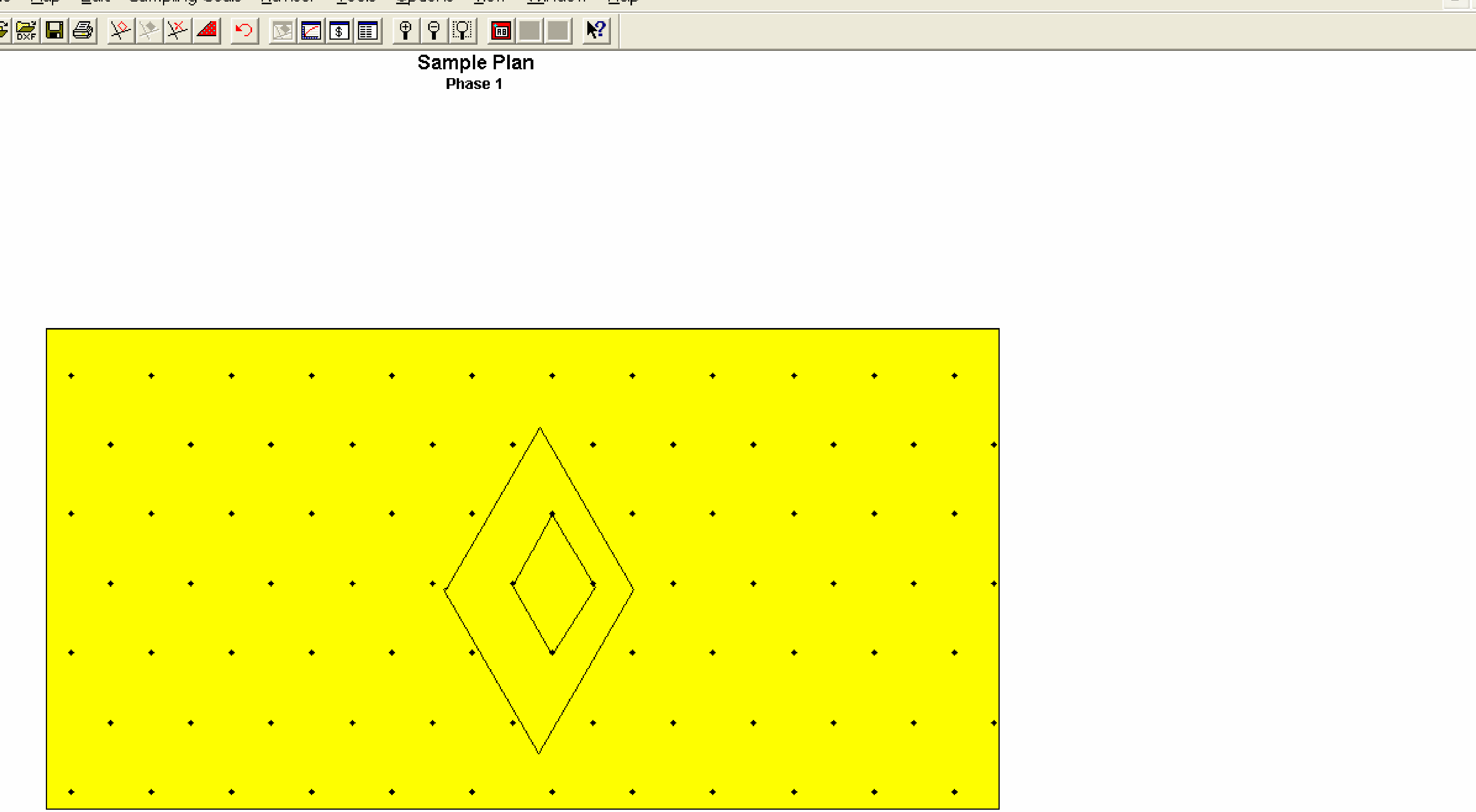
New a' = 21.6 $m^2$ for area factor of 2

# *Example: Hot Spot Survey Design*

- New sample size ($n_{EA}$): 1800/21.6 = 83.3

  **Round up to 84 samples !**

- This sample size has been driven by the potential for hot spots and an inadequate scan MDC



Sample Plan
Phase 1

# *Integrated Final Status Survey*

# *Key Steps of FSS Design (by P. Frame)*

1) Classify site areas; identify survey units and reference areas
2) Determine the DCGLs
3) Determine whether Scenario A or B will be used; specify statistical tests for survey design (Sign test or WRS test)
4) Determine whether unity rule will be used for multiple radionuclides (also gross DCGLs for surface activity)
5) Choose equipment and measurement protocols
6) Determine scan and measurement MDCs
7) Determine survey investigation levels
8) Set acceptable probability of Type I and II errors
9) Determine number of statistical samples
10) Create reference grid and sample locations

# *Objectives of MARSSIM Integrated Design*

- Understand the three types of radiation survey techniques
- Understand how information in MARSSIM impacts calculating detection limits and scanning sensitivity issues
- Understand the importance of an integrated survey design

# *Radiation Survey Techniques*

- Three methods to measure radiation
  - Scanning
  - Direct measurement
  - Sampling
- No single method can provide comprehensive survey data

# *Direct Measurement*

- Static measure of area -- detector placed near surface being surveyed for specific time and distance
  - Confirms scan surveys
  - Exposure rate measurements
- Radioactivity level is read out “directly” -- real time measurement

# Scanning

- Controlled instrument moving across contaminated surface
  - Specified speed
  - Specified height
- Used to assess average activity and locate high activity areas
- Detects alpha, beta, gamma, and x-rays

# *Soil Sampling*

- Collect samples that accurately represent radionuclide concentrations at sample location (no standing water)
- Generally collect surface soil (0 to 15 cm depth) – even surfaces at depth
- Depending on analysis, 100 grams to 1 kg of soil are collected for lab analysis
  - Identify specific radionuclides
  - Establish equilibrium status of decay series

# *Class 1 Areas -- Structures/Land*

- 100% surface scan
- Number of data points from statistical tests plus additional measurements for small areas of elevated activity
- Scan designed to detect areas of elevated activity not detected by a systematic pattern

# *Class 2 Areas -- Structures/Land*

- 10 to 100% surface scans in systematic and/or judgmental pattern
- Number of data points from statistical tests
- Scan designed to detect areas of elevated activity not detected by a systematic pattern

# *Class 3 Areas -- Structures/Land*

- Random/Judgmental -- scan where experience tells surveyor contamination may exist
- Number of data points from statistical tests

# *Investigation Levels*

- Investigation levels are radionuclide-specific levels used to indicate when additional investigations may be necessary
- When investigation level is exceeded, first step is to confirm measurement/sample
- Results of all investigations and corresponding actions must be documented

# *Investigation Levels*

- Class 1 Area
  - Measurement/sample > $DCGL_W$ and exceeds $3\sigma$ of mean should be compared with elevated measurement levels (depends on surface area)
  - Measurement/sample > $DCGL_{EMC}$ should be remediated and resurveyed
  - Positive scan results - investigate and determine areal extent and level of elevated activity

# *Investigation Levels*

- Class 2 Area
  - Measurement/sample > $DCGL_W$ should be remediated as necessary and reclassified as Class 1
  - Positive scan results - investigate and determine areal extent and level of elevated activity

# *Investigation Levels*

- Class 3 Area
  - Measurement/sample > $DCGL_W$ should be remediated as necessary and reclassified as Class 1 (some portions may remain Class 3)
  - Measurement/sample < $DCGL_W$, but residual radioactivity identified, should be reclassified as Class 1 or 2
  - Positive scan results - investigate and determine areal extent and level of elevated activity

# *Survey Methods and Techniques Applied to Real D&D Sites*

- General survey conditions/H&S
- Survey unit selection
- Establish reference grid
- Surface scans
- Soil sampling

# *General Survey Conditions/H&S*

- All standing water must be pumped out prior to survey
- No backfilling excavations/trenches until regulatory agency gives OK
- ISM concerns: tripping hazards due to uneven terrain; pit/trench entries possible confined space; underground utilities

# *Survey Unit Identification When Terrain is Uneven*

- Terrain is likely uneven due to remediation, so survey units are Class 1
- Consider treating pits/excavations as their own survey units rather than part of the general uneven surface
  - fact that more soil was excavated indicates different contamination potential

# *Establish Reference Grid*

- Establish a grid on uneven terrain as for any other 2-D land surface
- Gridding on more serious “moonscape” surfaces should account for all exposed surfaces (3-D)—so all exposed surfaces have equal probability of being sampled
- Excavations/trenches should have separate map with walls/sides folded out

# *Shielding/Collimation for Scanning in High-Background Areas*

- Cone-shielded NaI scintillators for gamma walkovers
- Portable lead shields for NaI (heavy)
- *In situ* gamma spectrometry (HPGe) shielded units
- May not adequately reduce background

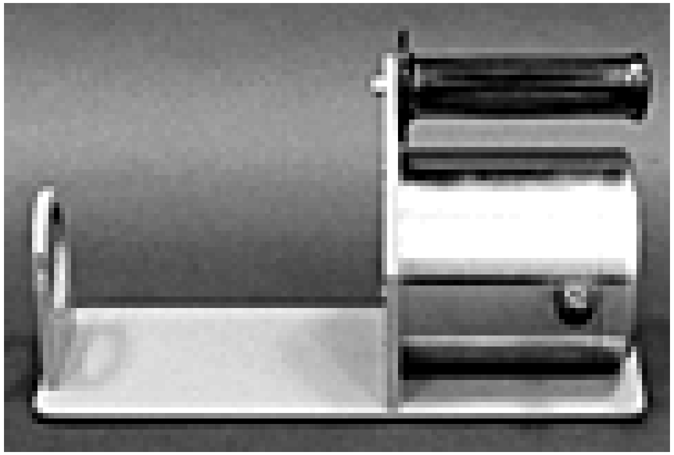
# *Scanning Considerations*

- More difficult to move the detector over soil surface (uneven terrain/shield weight)
- Difficult to detect hot spots in the presence of high-background levels (hot spots easily masked)
- Requires re-assessment of scan MDCs – even with shielding the background is higher; scan MDC will increase due to reduced signal-to-noise ratio

# *Ludlum Model 44-40, Shielded GM*

# Canberra Model 7417/7418 Carrier/Shields

- Compatible with 2" x 2" and 3" x 3" NaI detectors
- 18 mm lead shielding; 20 to 30 pounds



# *Portable Germanium Detector Shield*

# *MARSSIM Overview I Conclusion*

- There's a lot to know about the entire MARSSIM Process...but taken step-by-step, mastering MARSSIM is very doable!
- Our goal is to be the **MARSSIM experts** in 1) training and 2) evaluation of its implementation during our independent verification activities.