Attachment 5.
Supporting Documents

Evaluation of Cap Rock by RB&G Engineering, Inc.

"Ra-226 Sample Verification Process to Meet Remedial Action Plan's for the Seven Foot Criteria"

"Random Sampling Locations for Comparing a Median with a Fixed Threshold (nonparametric – MARSSIM)"

October 15, 2010

R B&G
ENGINEERING, INC.

Jason Whitman, Project Manager
Nielson Construction
P.O. Box 620
825 North Loop Road
Huntington, UT 84528

Re: Uranium Mill Tailings Remedial Action Project (UMTRA)
Disposal Cell near Crescent Junction

Dear Mr. Whitman:

On Friday, October 12, 2010, at the request of Mark Greenhalgh of Nielson Construction, a visit was made to the site of the Moab Uranium Mill Tailings Remedial Action Project (UMTRA) Disposal Cell near Crescent Junction, Utah, operated by Energy Solutions. The purpose of the visit was to evaluate the fill material being used as part of the cap layer which overlies the uranium tailing. We were asked to determine if the material being used contained less than 5 percent sandstone fragments. It is our understanding that this layer of the cap is referred to as the Biointrusion Infiltration Layer. At the time of this visit, the layer appeared to be approximately 6 to 8 inches thick. The material consisted predominately of cobble sized angular basalt with some rounded quartzite with some finer gravels. It is our understanding that this layer will be covered by additional layers of other materials.

The evaluation was conducted by randomly selecting an area 100 feet by 100 feet. The area was then systematically traversed while visually noting the number and size of the sandstone fragments within the given area. It should be noted that, in addition to the softer sandstone fragments, some relatively soft red volcanic scoria was also observed. These fragments appear to breakdown just as readily as the sandstone and have been included with the percent of sandstone. Most sandstone fragments ranged from 0.15 to 0.5 foot. Our calculated visual percentage within this area was less than 1% sandstone fragments. It is our opinion that, based on this visual inspection, this material meets the specification of containing less than 5% sandstone fragments.

If there are any questions regarding the information contained herein, please call.

Sincerely,

RB&G ENGINEERING, INC.

Michael N. Hansen, P.G.

REVIEWED BY:

Bradford E. Price, P.E.

REGISTERED PROFESSIONAL ENGINEER
NO.162291
BRADFORD E. PRICE
11/6/10
STATE OF UTAH

1435 WEST 820 NORTH, PROVO, UTAH 84601-1343
PROVO 801-374-5771 SALT LAKE CITY 801-521-5771 FAX 801-374-5773

Ra-226 Sample Verification Process to Meet Remedial Action Plan's for the Seven Foot Criteria

August 25, 2010

Moab Site Sampling

The Moab UMTRA Project will collect two samples from each of the two load-out areas, per shift. The first samples will be collected at the beginning of each shift and the second samples will be taken at approximately the midpoint of each shift. Samples will be collected in the standard Moab sampling can. On a normal day there would be 8 samples collected. If during the day the load-out is moved to a new location, two additional samples will be collected at the new location.

Each shift's samples will be averaged and become the shift's Ra-226 sample average. If the shift's Ra-226 average is greater than 707 pCi/g, the shipped material will be placed in the bottom of the tailings section of the cell; if the shift's Ra-226 average is less than 707 pCi/g, the shipped material can be placed on the top seven feet of the tailings section of the cell.

The samples should be counted as soon as they are collected. Crescent Junction Operations will be notified of the results as soon as that shift's samples are counted and averaged. Crescent Junction Operations will make the determination as to where to place the material in the cell.

Crescent Junction Sample Verification Process

The verification process is based on performing sampling at two–lift increments. A lift is defined in this process as approximately 12 inches of loose material or 8 inches of compacted material, so two lifts would contain approximately 16 inches of compacted material. Sampling will occur at every other lift. For example, we would collect samples on the 2^{nd}, 4^{th}, 6^{th}, 8^{th}, and 10^{th} lifts. If an additional lift is required to meet the appropriate grade, an additional set of samples will be required at that lift. At each of these sampling levels, we will require a minimum of 5 random samples with one additional sample taken at the very top level. Samples will be collected prior to compaction of that particular lift. Each compacted seven foot section will require collecting a minimum of 26 samples, to verify whether the average sample concentration is below the 707 pCi/g limit for Ra-226. The basis for collecting 26 samples was determined using PNNL-developed software, the Visual Sample Plan (VSP)[1.] (See attached VSP Design Summary Document). This plan provides a 95% confidence that the actual mean of the seven foot section is at or below the 707 pCi/g limit.

Samples will be collected using the standard Moab sampling can. The samples will be counted as soon as they're collected to determine if the lift is acceptable. If a set of samples exceeds the average of 707 pCi/g, the lift can be re-sampled by selecting two points on either side of the original sample location at approximately a two to three feet offset. If the additional samples fall below 707 pCi/g, than the lift would be determined acceptable. If the additional samples are still above the 707 pCi/g limit, Crescent Junction Operations will be promptly notified of the situation with the lift.

[1] Visual Sample Plan (VSP) is a software tool for selecting the right number and location of environmental samples so that the results of statistical tests performed on the data collected via the sampling plan have the required confidence for decision making. More than 4000 users from every state as well as many in other countries have registered a downloaded copy of VSP. Users include employees of the federal government, state and local governments, and private industry. Sponsors of this public domain software include the U.S. Environmental Protection Agency (EPA), U.S. Department of Energy (DOE), U.S. Department of the Defense (DOD), U.S. Department of Homeland Security (DHS) , National Institute for Occupational Safety and Health (NIOSH) within the Centers for Disease Control and Prevention (CDC), and the U.K. Atomic Weapons Establishment (AWE).

Random sampling locations for comparing a median with a fixed threshold (nonparametric - MARSSIM)

Summary

This report summarizes the sampling design used, associated statistical assumptions, as well as general guidelines for conducting post-sampling data analysis. Sampling plan components presented here include how many sampling locations to choose and where within the sampling area to collect those samples. The type of medium to sample (i.e., soil, groundwater, etc.) and how to analyze the samples (in-situ, fixed laboratory, etc.) are addressed in other sections of the sampling plan.

The following table summarizes the sampling design developed.

SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Compare a site mean or median to a fixed threshold
Type of Sampling Design	Nonparametric
Sample Placement (Location) in the Field	Simple random sampling
Working (Null) Hypothesis	The median(mean) value at the site exceeds the threshold
Formula for calculating number of sampling locations	Sign Test - MARSSIM version
Calculated total number of samples	26
Number of samples on map [a]	0
Number of selected sample areas [b]	0
Specified sampling area [c]	10000.00 m^2
Total cost of sampling [d]	$0.00

[a] This number may differ from the calculated number because of 1) grid edge effects, 2) adding judgment samples, or 3) selecting or unselecting sample areas.
[b] The number of selected sample areas is the number of colored areas on the map of the site. These sample areas contain the locations where samples are collected.
[c] The sampling area is the total surface area of the selected colored sample areas on the map of the site.
[d] Including measurement analyses and fixed overhead costs. See the Cost of Sampling section for an explanation of the costs presented here.

Primary Sampling Objective

The primary purpose of sampling at this site is to compare a site median or mean value with a fixed threshold. The working hypothesis (or 'null' hypothesis) is that the median(mean) value at the site is equal to or exceeds the threshold. The alternative hypothesis is that the median(mean) value is less than the threshold. VSP calculates the number of samples required to reject the null hypothesis in favor of the alternative one, given a selected sampling approach and inputs to the associated equation.

Selected Sampling Approach

A nonparametric random sampling approach was used to determine the number of samples and to specify sampling locations. A nonparametric formula was chosen because the conceptual model and historical information (e.g., historical data from this site or a very similar site) indicate that typical parametric assumptions may not be true.

Both parametric and non-parametric equations rely on assumptions about the population. Typically, however, non-parametric equations require fewer assumptions and allow for more uncertainty about the statistical distribution of values at the site. The trade-off is that if the parametric assumptions are valid, the required number of samples is usually less than if a non-parametric equation was used.

Locating the sample points randomly provides data that are separated by many distances, whereas systematic samples are all equidistant apart. Therefore, random sampling provides more information about the spatial structure of the potential contamination than systematic sampling does. As with systematic sampling, random sampling also provides information regarding the mean value, but there is the possibility that areas of the site will not be represented with the same frequency as if uniform grid sampling were performed.

Number of Total Samples: Calculation Equation and Inputs

The equation used to calculate the number of samples is based on a Sign test (see PNNL 13450 for discussion). For this site, the null hypothesis is rejected in favor of the alternative one if the median(mean) is sufficiently smaller than the threshold. The number of samples to collect is calculated so that if the inputs to the equation are true, the calculated number of samples will cause the null hypothesis to be rejected.

The formula used to calculate the number of samples is:

$$n = \frac{(Z_{1-\alpha} + Z_{1-\beta})^2}{4(SignP - 0.5)^2}$$

where

$$SignP = \Phi\left(\frac{\Delta}{\sqrt{s^2_{sample} + \frac{s^2_{analytical}}{r}}}\right)$$

$\Phi(z)$ is the cumulative standard normal distribution on $(-\infty,z)$ (see PNNL-13450 for details),
n is the number of samples,
S_{sample} is the estimated standard deviation of the measured values if measurements were made without analytical error,
$S_{analytical}$ is the estimated standard deviation of the measured values due to the analytical method,
r is the number of replicate analyses per sample,
Δ is the width of the gray region,
α is the acceptable probability of incorrectly concluding the site median(mean) is less than the threshold,
β is the acceptable probability of incorrectly concluding the site median(mean) exceeds the threshold,
$Z_{1-\alpha}$ is the value of the standard normal distribution such that the proportion of the distribution less than $Z_{1-\alpha}$ is $1-\alpha$,
$Z_{1-\beta}$ is the value of the standard normal distribution such that the proportion of the distribution less than $Z_{1-\beta}$ is $1-\beta$.

Note: MARSSIM suggests that the number of samples should be increased by at least 20% to account for missing or unusable data and uncertainty in the calculated value of n. VSP allows a user-supplied percent overage as discussed in MARSSIM (EPA 2000, p. 5-33).

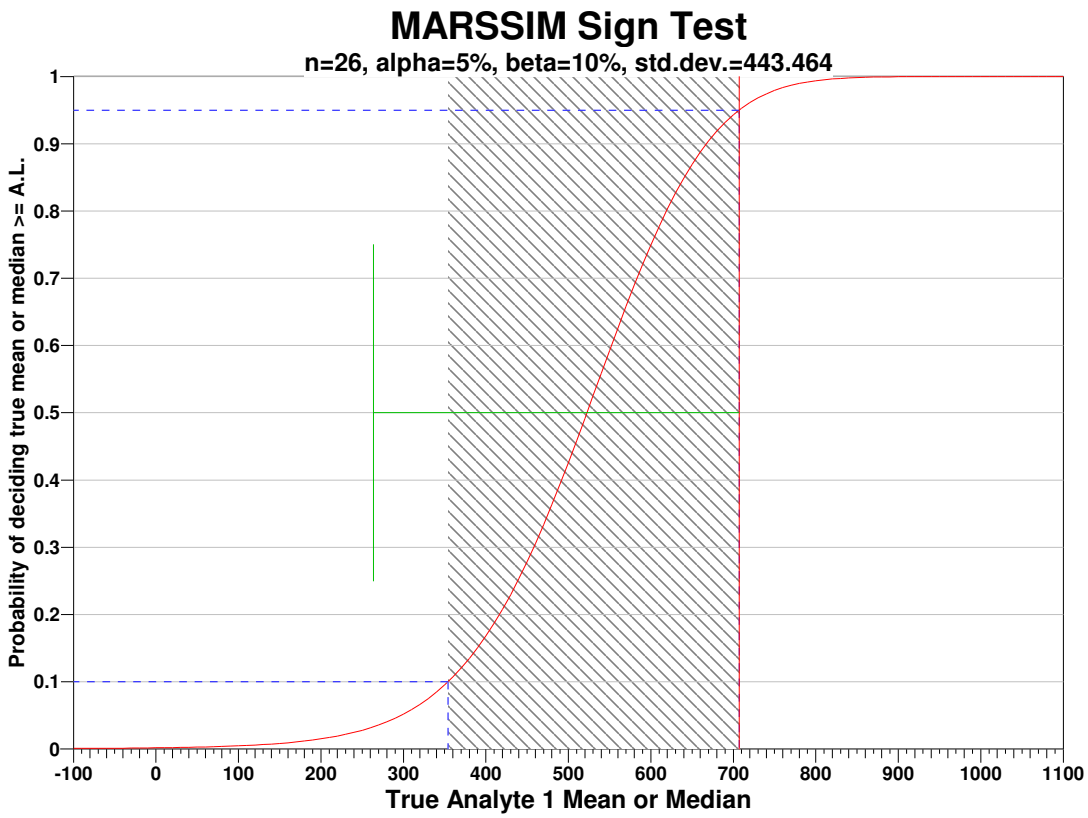
The values of these inputs that result in the calculated number of sampling locations are:

Analyte	n[a]	Parameter							
		S_{sample}	$S_{analytical}$	r	Δ	α	β	$Z_{1-\alpha}$ [b]	$Z_{1-\beta}$ [c]
Analyte 1	26	442	36	1	353	0.05	0.1	1.64485	1.28155

[a] The final number of samples has been increased by the MARSSIM Overage of 0%.
[b] This value is automatically calculated by VSP based upon the user defined value of α.
[c] This value is automatically calculated by VSP based upon the user defined value of β.

The following figure is a performance goal diagram, described in EPA's QA/G-4 guidance (EPA, 2000). It shows the probability of concluding the sample area is dirty on the vertical axis versus a range of possible true median(mean) values for the site on the horizontal axis. This graph contains all of the inputs to the number of samples equation and pictorially represents the calculation.

The red vertical line is shown at the threshold (action limit) on the horizontal axis. The width of the gray shaded area is equal to Δ; the upper horizontal dashed blue line is positioned at $1-\alpha$ on the vertical axis; the lower horizontal dashed blue line is positioned at β on the vertical axis. The vertical green line is positioned at one standard deviation below the threshold. The shape of the red curve corresponds to the estimates of variability. The calculated number of samples results in the curve that passes through the lower bound of Δ at β and the upper bound of Δ at $1-\alpha$. If any of the inputs change, the number of samples that result in the correct curve changes.



Statistical Assumptions

The assumptions associated with the formulas for computing the number of samples are:

1. the computed sign test statistic is normally distributed,
2. the variance estimate, S^2, is reasonable and representative of the population being sampled,
3. the population values are not spatially or temporally correlated, and
4. the sampling locations will be selected randomly.

The first three assumptions will be assessed in a post data collection analysis. The last assumption is valid because the sample locations were selected using a random process.

Sensitivity Analysis

The sensitivity of the calculation of number of samples was explored by varying the sampling standard deviation, lower bound of gray region (% of action level), beta (%), probability of mistakenly concluding that μ > action level and alpha (%), probability of mistakenly concluding that μ < action level. The following table shows the results of this analysis.

Number of Samples							
AL=707		α=5		α=10		α=15	
		s_{sample}=884	s_{sample}=442	s_{sample}=884	s_{sample}=442	s_{sample}=884	s_{sample}=442
LBGR=90	β=5	2668	675	2112	534	1773	449
	β=10	2112	534	1620	410	1325	335
	β=15	1773	449	1325	335	1060	268
LBGR=80	β=5	672	173	532	137	446	115
	β=10	532	137	408	105	334	86
	β=15	446	115	334	86	267	69
LBGR=70	β=5	302	81	239	64	201	54
	β=10	239	64	184	49	150	40
	β=15	201	54	150	40	120	32

s_{sample} = Sampling Standard Deviation
LBGR = Lower Bound of Gray Region (% of Action Level)
β = Beta (%), Probability of mistakenly concluding that μ > action level
α = Alpha (%), Probability of mistakenly concluding that μ < action level
AL = Action Level (Threshold)

Cost of Sampling
The total cost of the completed sampling program depends on several cost inputs, some of which are fixed, and others that are based on the number of samples collected and measured. Based on the numbers of samples determined above, the estimated total cost of sampling and analysis at this site is $0.00, which averages out to a per sample cost of $0.00. The following table summarizes the inputs and resulting cost estimates.

COST INFORMATION			
Cost Details	**Per Analysis**	**Per Sample**	**26 Samples**
Field collection costs		$0.00	$0.00
Analytical costs	$0.00	$0.00	$0.00
Sum of Field & Analytical costs		**$0.00**	**$0.00**
Fixed planning and validation costs			$0.00
Total cost			**$0.00**

Recommended Data Analysis Activities
Post data collection activities generally follow those outlined in EPA's Guidance for Data Quality Assessment (EPA, 2000). The data analysts will become familiar with the context of the problem and goals for data collection and assessment. The data will be verified and validated before being subjected to statistical or other analyses. Graphical and analytical tools will be used to verify to the extent possible the assumptions of any statistical analyses that are performed as well as to achieve a general understanding of the data. The data will be assessed to determine whether they are adequate in both quality and quantity to support the primary objective of sampling.

Because the primary objective for sampling for this site is to compare the site median(mean) value with a threshold value, the data will be assessed in this context. Assuming the data are adequate, at least one statistical test will be done to perform a comparison between the data and the threshold of interest. Results of the exploratory and quantitative assessments of the data will be reported, along with conclusions that may be supported by them.