CORRES. CONTROL OUTGOING LTR. NO.		
DOE ORDER #		
98-RF-03969		
DIST.	LTR	ENC
BENSUSSEN, STAN		
BORMOLINI, ANN		
BRAILSFORD, M.		
BURDGE, LARRY		
CARD, BOB		
FULTON, JOHN		
HARDING, WYNN		
HILL, JOHN		
MARTINEZ, LEN		
PARKER, ALAN	X	X
POLSTON, STEVE		
SHELTON, DAVE		
TUOR, NANCY		
CROWE, STEVE		
HEDAHL, TIM		
MATHIS, BRIAN		
RODGERS, ALAN	X	X
ANDERSON, S.		
BUTLER, LANE		
GREENGARD, TOM		
HAHN, STEVE		
HICKLE, GORDON		
JENNINGS, MIKE		
KENNEDY, C.		
LAHOUD, RUSS		
LAVORATO, K.		
SHAFER, DOUG		
CORR. CONTROL	X	X
ADMIN REC/B116	X	X
PATS/T130G		

CLASSIFICATION:		
UCNI		
UNCLASSIFIED		
CONFIDENTIAL		
SECRET		

AUTHORIZED CLASSIFIER SIGNATURE:
EXEMPT PER: CEX-266-95

Date:

IN REPLY TO RFP CC NO.:

ACTION ITEM STATUS:
☐ PARTIAL/OPEN
☐ CLOSED

LTR APPROVALS:

ORIG. & TYPIST INITIALS:
LJB:pmm

KAISER•HILL
COMPANY

August 04, 1998

98-RF-03969

Norma I. Castaneda
Environmental Safety & Health
Program Assessment
DOE , RFFO

TRANSMITTAL OF REDLINE REVISIONS TO THE FINAL SAMPLING AND ANALYSIS PLAN (SAP) FOR THE SITE CHARACTERIZATION OF THE 903 DRUM STORAGE AREA (INDIVIDUAL HAZARDOUS SUBSTANCE SITES (IHSS) 112), 903 LIP AREA (IHSS 155), AND AMERICIUM ZONE, REV. O, RF/RMRS-97-084 - JLB-017-98

Please find enclosed, the redline revisions to applicable sections of the above referenced subject (Enclosure # 1). These revisions incorporate recommendations to the Sampling and Analysis Plan (SAP) provided by Canberra Industries, Inc. The revisions were discussed with the Colorado Department of Public Health and Environment (CDPHE) on June 25, 1998, and with the United States Environmental Protection Agency (EPA) on July 15, 1998. Please transmit to the agencies for approval by August 18, 1998. I am providing three (3) copies for the DOE, two (2) copies for EPA, and two (2) copies for CDPHE.

If you have any comments regarding this correspondence, please contact me at X5245.

J. Lane Butler
Waste & Remediation Operations
Kaiser-Hill Company, L.L.C.

JLB:pmm

Enclosure:
As Stated

Orig. and 1 cc – Norma I. Castaneda

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2.7 Optimize the Design for Obtaining Data

2.7.1 Surface Soils

This SAP will use a linear regression double sampling technique to estimate the activity of actinides in surface soils. The double sampling method (Gilbert, 1987) was selected because there is a strong linear correlation between ^{241}Am and $^{239/240}$Pu in the Investigation Area surface soils. The process flow for quality control of HPGe measurements is shown in Figure 2.1.

HPGe measurement will determine activities of ^{241}Am, ^{235}U and ^{238}U in surface soils. The sum of ratios equation requires input activities for ^{241}Am, $^{239/240}$Pu, ^{234}U, ^{235}U, and ^{238}U. Therefore, activities for $^{239/240}$Pu and ^{234}U will be required to complete the sum of ratios calculation. $^{239/240}$Pu and ^{241}Am are known to have a linear relationship and a high coefficient of correlation. Two hundred and eleven surface soil samples collected in support of the OU2 Phase II RFI/RI produced a correlation coefficient of 0.96 when $^{239/240}$Pu was regressed from ^{241}Am. ^{241}Am activities in surface soils can be measured with less expensive *in situ* gamma-ray spectroscopy methods to determine $^{239/240}$Pu concentration rather than $^{239/240}$Pu concentrations determined from expensive radiochemical techniques performed in a laboratory.

The $^{239/240}$Pu soil sample results from the laboratory and the HPGe ^{241}Am measurements will be correlated through linear regression to ~~determine~~verify the relationship established between the two radionuclides activities from previous samplings studies. The quantitative relationship will allow determination of $^{239/240}$Pu in soils from HPGe ^{241}Am measurements for consequent comparison with RFCA Tier I soil action levels for the Buffer Zone (hypothetical resident, 85 millirem annual dose) based on HPGe measurements alone.

Activities of ^{234}U will be determined from ^{238}U results, based on the fact that ^{234}U is in equilibrium with ^{238}U. Equilibrium between a parent (^{238}U) and daughter (^{234}U) indicates that the activity ratio between these two isotopes should be near 1.0. Analytical data collected in support of the OU2 Phase II RFI/RI CDH surface soil sampling program (DOE, 1995a) supports this relationship with an mean activity ratio of 0.97 between the two isotopes. Activities of ^{234}U will be estimated from ^{238}U results.

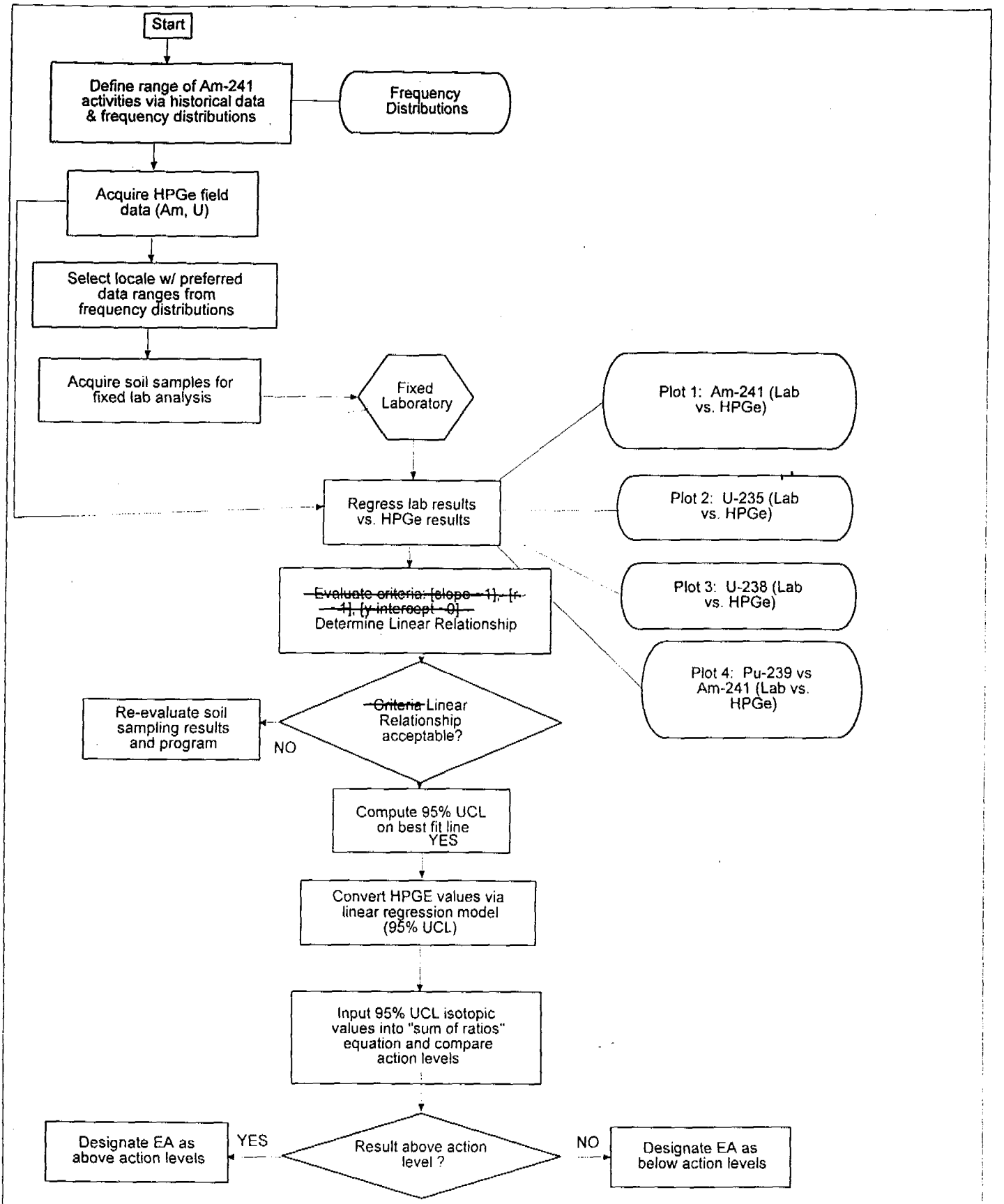


FIGURE 2.1
PROCESS FLOW FOR CORRELATION OF HPGe MEASUREMENTS TO FIXED LAB RESULTS

The OU2 Phase II RFI/RI report states that 90% of the total actinide activity is located in the top 15 cm (6 in) of soils. Further evaluation of data for soil profile Pits TR04, TR05, TR09, TR11, and TR12, all of which are located within undisturbed areas in the Investigation Area, indicates that 70 to 88% of the total actinide activity is in the upper 6 cm (2.4 in) of soils. Therefore, soil samples will be collected to a depth of 5 cm (2 in) for correlation with HPGe measurements. HPGe results will be integrated over a depth of 5 cm (2in). The 5 cm (2 in) depth was selected based on the fact a majority of the activity is in the upper 2.4 cm (1 in) and that numerous OU2 RFI/RI surface soil data, collected from 0 - 5 cm (0 - 2 in), currently exists in the study area for comparison purposes. The detection frequency of OU2 surface soil ^{241}Am is provided in Figure 2.2.

2.7.2 Subsurface Soils

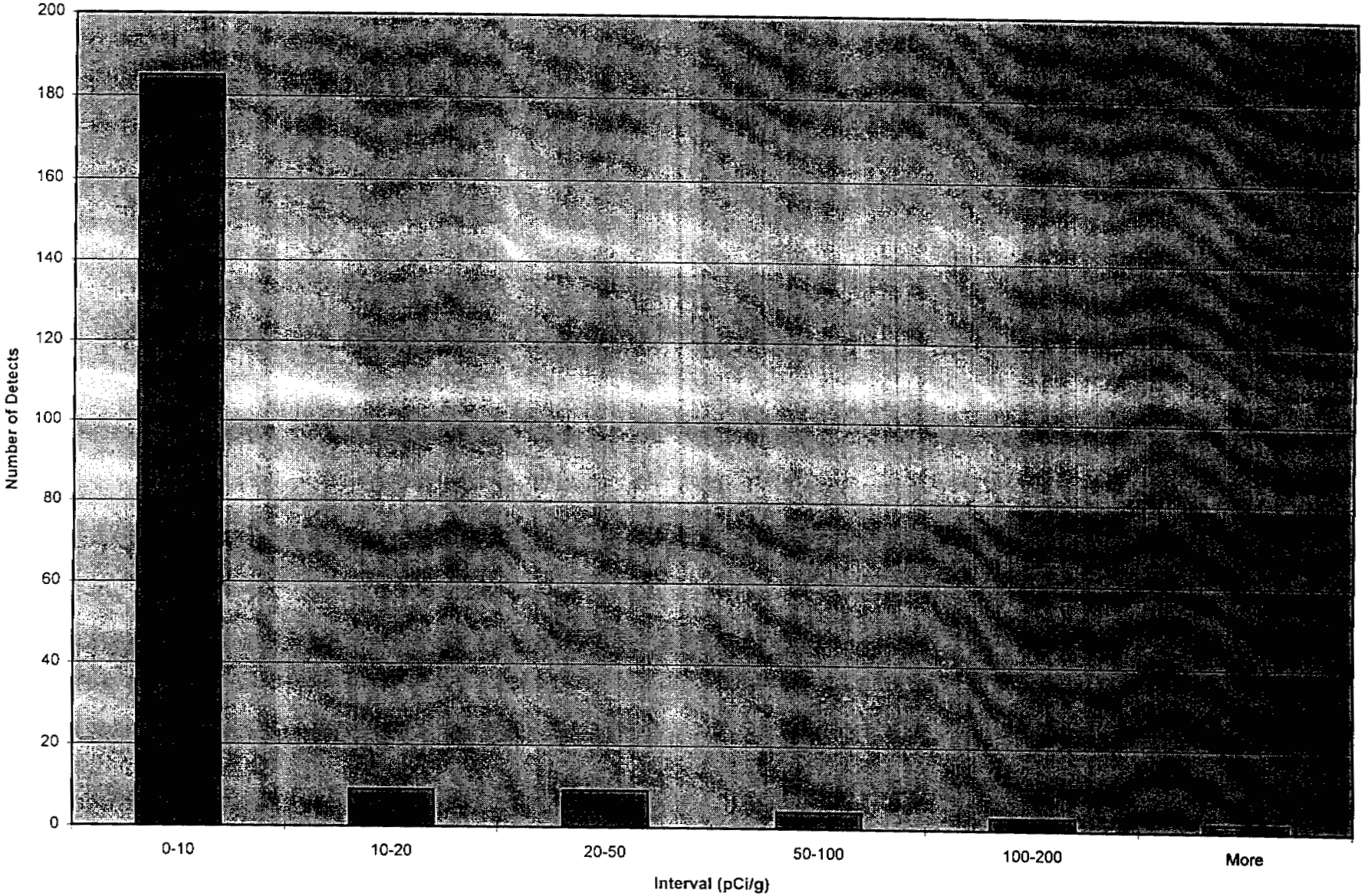
Determination of the vertical and thus the areal distribution of radiological contaminants will be optimized through a "step-out" boring approach. This will be implemented by the placement of a boring half way between locations exhibiting radiological contaminants above and below Tier I soil action levels respectively. Only one "step-out" boring will be completed per original grid sample location, as needed.

Determination of the vertical and areal extent of VOC contaminants will be optimized through a "step-out" boring approach. This will be implemented by the placement of a boring upgradient of a boring with analytical results indicating VOCs are above 10 % of the RFCA Tier I action level. The sampling grid will be extended an additional 6.1 m (20 ft) in an upgradient direction (based on the potentiometric surface, [DOE, 1995]) of that location and additional samples will be collected for laboratory analysis.

3.0 SAMPLING AND ANALYSES - STRATEGY AND DESIGN

Radiological contamination in the Americium Zone surface soils will be evaluated using HPGe *in situ* gamma-ray spectrometry methodology. Subsurface soil samples will be collected to further refine the depth of radiological contamination. HPGe results will be correlated to radiochemical data by the analysis of surface soil samples collected from ~~156~~ HPGe survey measurement locations. The soil samples will be collected over the same depth interval as the HPGe measurement.

Figure 2.2
Frequency of AM-241 Detections in Surface Soils
CDH and RF Sampling Method Results



The vertical and lateral extent of radiological and VOC contamination at the 903 Pad and Lip Area will be assessed utilizing Geoprobe® or conventional hollow-stem auger drilling techniques to collect subsurface soil samples for analysis. Asphalt samples from the 903 Pad will be collected to obtain a preliminary waste characterization data for disposal purposes. Field activities will be performed in accordance with FO.1, Air Monitoring and Particulate Control.

3.1 Radiological Contamination

The areal extent of radiological surface soil contamination will be primarily assessed using a non-intrusive *in situ* gamma-ray spectrometry techniques (i.e., HPGe survey) and collection of surface soil samples for isotopic laboratory analysis for correlation of the HPGe results. Vertical and areal extent of radiological contamination will be assessed with subsurface soil samples submitted for isotopic laboratory analysis using gamma and alpha spectrometric methods. Follow-up FIDLER surveys may be performed to further refine the areal extent of radiological contamination.

3.1.1 Surface Soil Investigation

The surface soil investigations will be implemented by performing an HPGe survey and collecting surface soil samples at HPGe measurement locations with predetermined ^{241}Am activities. The soil sample results and HPGe measurement results will be correlated to estimate activities of radionuclides for input into the RFCA sum of ratios equation.

Field Preparation - Reference stakes for the HPGe grid will be placed in the field before and during data collection activities. From these stakes, the HPGe survey grid will be laid out using ~~tape and compass~~manual methods, at the ~~12 m~~3 m triangular grid spacing specified below. Each measurement point will be staked, flagged, and numbered for reference by the HPGe crew.

HPGe Survey - The HPGe survey will be initiated in the Americium Zone adjacent to the Lip Area's eastern boundary in this area and proceed eastward. Subsurface soil results are required in the Lip Area prior to performing the HPGe survey. In the Lip Area it will be assumed that if subsurface soil contamination exists, the overlying surface soils will require similar remedial action and these soils and will be included into the volume estimate of soil exceeding the Tier I action level. HPGe surveys will therefore not be required in portions of the Lip Area where

subsurface soils exceed Tier I action levels. Figure 3.1 shows the configuration of a typical HPGe survey grid.

The ~~tripod-mounted~~ HPGe system will be used to determine the average ^{241}Am, ^{238}U and ^{235}U activity over a FOV with a diameter of 12 meters (39.4 ft) and an area of 113 m^2 (1,217 ft^2 or 2.8 x 10^{-2} acre) with an appropriate detector height of approximately 1 m (3.28 ft) above the ground surface. Thus the EA has been defined to be single HPGe measurement with a FOV of 12 m (39.4 ft) in diameter. A ~~12 m~~3 m triangular grid spacing to achieve 747% coverage which translates to ~~81~~72 HPGe measurements for complete coverage of a 2.5-acre area. Table 3.1 provides an estimate of the number of HPGe measurements proposed in the Lip Area and Americium Zone (assuming full coverage is required).

Table 3.1 Surface Soil Investigation - Field Program

Area	HPGe Measurements (Estimated)	Surface Soil Samples[1] (Estimated)
903 Pad	0	0
Lip Area	~~50~~440	0
Americium Zone	875	18 (6 locations)
~~Americium Zone~~	~~1000~~	~~45~~

[1] = A minimum of ~~45~~18 surface soil samples will collected to correlate HPGe measurements.

Measurement count times will be approximately 15 minutes to ensure a 95% confidence level of the HPGe to determine ^{241}Am activities in soils to 1 pCi/g. Complete HPGe coverage of the proposed Investigation Area, if required, is estimated to require approximately 1,500 measurements. The HPGe survey will be discontinued in a given direction when two consecutive and adjacent measurements are less than 10 pCi/g ^{241}Am. Soil moisture measurements will be collected from a representative number of sample nodes. The number of nodes required will be determined based on variability of initial measurements and environmental parameters (i.e., precipitation). A moisture-density gauge, or equivalent, will be used for soil moisture measurements in accordance with the manufacturer's specifications. HPGe locations and elevations will be surveyed by land survey methods or with a Global Positioning System (GPS) operated in accordance with the manufacturers specifications.

FIDLER Surveys - A follow-on FIDLER survey may be conducted in selected areas where contiguous or isolated HPGe measurements exceed the 10 pCi/g ^{241}Am decision level . An evaluation of the nature of the exceedence will be conducted to determine if detailed FIDLER

surveys are required. If an HPGe measurement for an individual FOV is above the decision level, and adjacent FOVs are below the decision level, a FIDLER survey will be conducted to determine if the high FOV measurement is caused by the presence of a smaller area containing a hot spot. In addition, detailed FIDLER surveys will be conducted at three locations where HPGe measurements for individual and surrounding FOVs exceed the RFCA Tier I action level. The purpose of the survey is to determine whether the contamination is homogeneous and widespread as suggested by the conceptual model, or heterogeneous and consists of numerous individual hot spots.

A grid with four-foot spacings will be staked in the field for the FIDLER survey. While all available data will be used to determine whether a FIDLER survey is required, it is anticipated that these will be conducted only in areas where HPGe measurements are above the decision level of 10 pCi/g, ^{241}Am. When performing a FIDLER survey, measurements will be taken with the instrument placed on the ground surface at each of the four-foot grid nodes. When walking between grid nodes, the operators will move their instruments slowly and observe the instrument response between readings. If a sharp increase in the reading is seen between grid nodes, the surrounding area will be investigated. The FIDLER surveys will be conducted in accordance with Radiological Operating Instructions (ROI) Manual, 4-H58-ROI-06.6, Use of Bicron FIDLER and will be used to locate smaller areas of increased radiological activity such as would be caused by a hot spot.

The FIDLER readings will be used to define localized areas with higher readings and will be marked as potential hot spots. Potential hot spots and areas of higher concentrations identified during the hand-held FIDLER survey will then be staked, surveyed and labeled for future evaluation. For each hot spot, additional soil samples may be collected for isotopic analysis if it is determined that this information is necessary to determine whether a remedial action is required, or to disposition the soil from a remedial action.

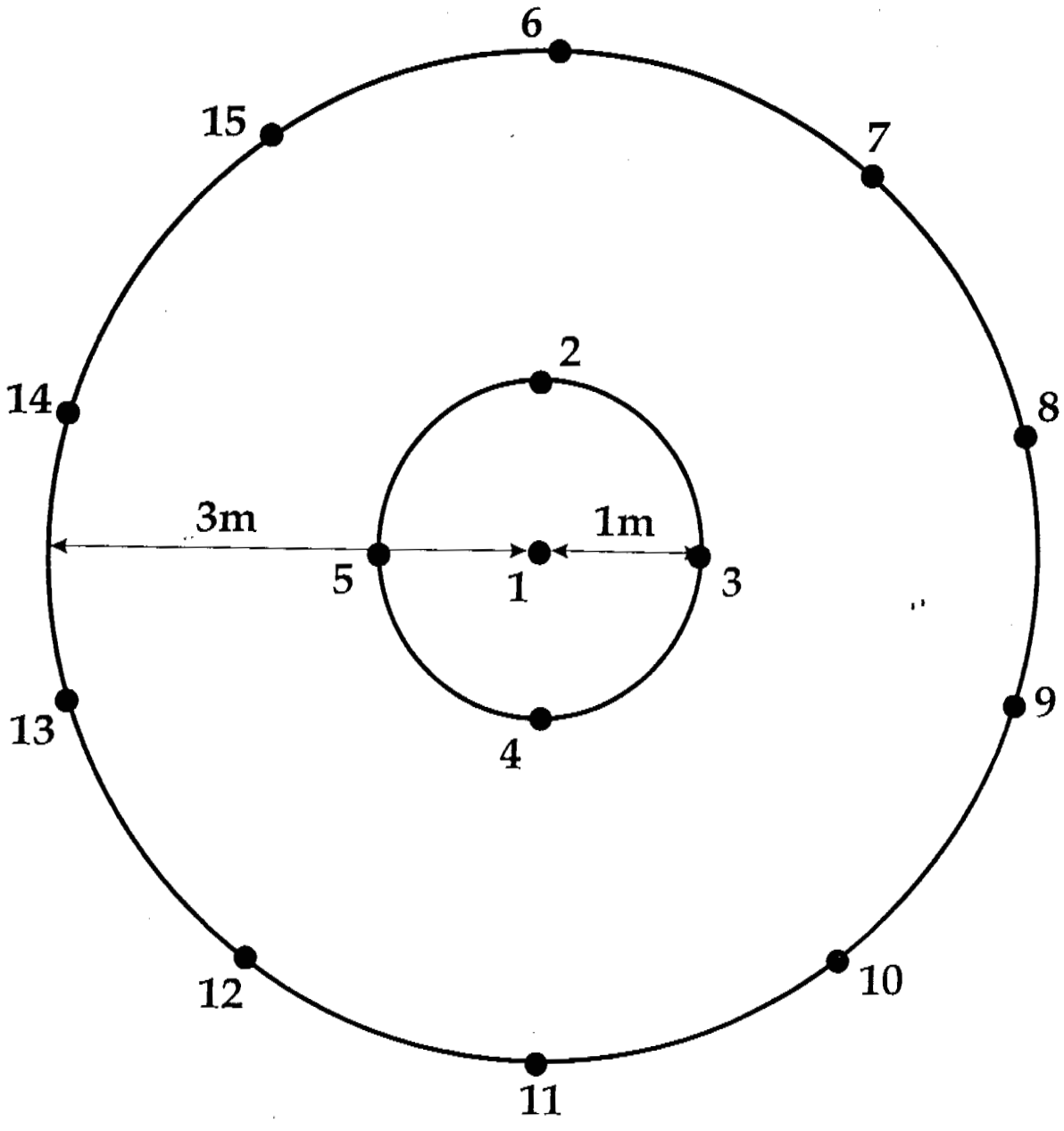
Surface Soil Samples - Surface soil samples will be collected using a geometry developed by the DOE (DOE, 1997b) at the Fernald Environmental Management Project site in Ohio in an effort to correlate HPGe results to surface soil results. The sampling method involves the collection of 6a set of soil subsamples for a given HPGe measurement FOV for ~~radiochemical~~laboratory analysis. The location and number of subsamples collected relative to HPGe measurements is

based on the theory of *in situ* gamma-ray spectroscopy and is expected to be representative of radionuclide contamination over the FOV. Figure 3.2 provides the surface soil sampling scheme for collection of the soil sample. ~~Six~~Up to 15 grab samples will be collected at a selected HPGe location; one grab sample from the center; ~~two~~four grab samples collected at 1 m radius, and ~~three~~en grab samples from 3 m radius. The 1 and 3 m radius grab samples will be composited into a 1 m and 3 m sample representative of the individual band. Therefore, three separate gamma and alpha spectroscopy analyses will be performed at each selected HPGe location.

~~Fifteen (15~~Six (6) selected HPGe locations will have three soil samples collected, for a total of ~~45~~18 samples, and analyzed by gamma and alpha spectrometry to determine ^{241}Am, $^{239/240}Pu$, $^{233/234}U$, ^{235}U, and ^{238}U. The locations of soil samples will be based on the results of the HPGe measurement's ^{241}Am activity. In order to acquire a good correlation over the anticipated range of ^{241}Am activities, soil samples will be collected over ~~11~~six ^{241}Am activity intervals; ~~0-5, 5-10, 10-20, 20-30, 30-40, 40-50, 50-75, 75-100, 100-150, 150-200, greater than 250 pCi/g. Two soil samples will be collected in the 0-5, 5-10, 10-20, 20-30 intervals to provide more control of the regression at activities near the investigation~~ ~~boundary action level (10 pCi/g).~~ 0-10, 10-20, 20-50, 50-100, 100-200, and greater than 200 pCi/g. These intervals were selected based on the detection frequencies of ^{241}Am from CDH and RF surface soil samples collected in support of the OU2 Phase II RFI/RI (DOE, 1995a). The detection frequency of OU2 surface soil ^{241}Am is provided in Figure 2.2. These intervals provide full coverage over the range of known activities of ^{241}Am detected in the study area.

Samples will be collected in a "bullseye" pattern to mimic the averaging done by the field HPGe detector over the FOV. The HPGe detector receives gamma-ray photons from every point within the circle; however, it receives more gamma rays from soil closer to the detector than from soil further from the detector. If the circle is divided into concentric bands, the relative weighting factor for each band can be calculated based upon the percentage influence of gamma photons at the detector which originates from a given band of soil, assuming a uniform source distribution with depth and a one MeV photon energy. The relative weighting factor is the relative importance of each band with respect to the probability of gamma-rays emitted from within that band being detected by the HPGe. The sample results are divided by the weighting factor per band, then products are summed to determine the activity of the soils in the FOV area. The 15

point sampling pattern was selected to provide adequate sampling for high and/or heterogeneous activity distributions.



15-Point Sampling Pattern

Sampling and Analysis Plan for the Site Characterization at the 903 Drum Storage Area, 903 Lip Area and Americium Zone

Legend

● Grab Sampling Location

Figure 3.2 Surface Soil Sampling Scheme

Table 3.2 provide the results of these calculations and the weighting factors per sample will be used to calculate the weighted statistical data. Table 3.3 provides the analytical program for surface soil samples. The results of the HPGe measurements and soil samples will be utilized to establish the correlation between the two methods to estimate $^{239/240}Pu$ activities at locations where only HPGe measurements are obtained.

Table 3.2 Surface Soil Samples, Weighted Average Calculations

No. of Subsamples	Horizontal Distance from Point Under Detector (m)	Weight (per circle)
1	0	0.1
4	1	0.36
10	3	0.54
15	Total	1.00
~~2~~	~~1~~	~~0.36~~
~~3~~	~~3~~	~~0.54~~
~~6~~	~~Totals~~	~~1.00~~

Table 3.3 Surface Soil/Asphalt/Artificial Fill - Analytical Program

Analytical Method	Analytes	Container	Preser-vative	Holding Time
Radiological Screen	Gross Alpha/Gross Beta	125-ml wide mouth glass or poly jar	None	6 months
Gamma and Alpha Spectroscopy	Plutonium-239/240, Americium-^{241}, Uranium Isotopes	125-ml wide mouth glass or poly jar	None	6 months

Surface soil sampling locations will be selected based on the HPGe results obtained in the field. Ranges for HPGe concentrations are based on the previous HPGe ^{241}Am activities from the Americium Zone. The first sample will be collected from directly below the HPGe tripod setup location. Sampling will then proceed radially outward in the pattern as shown on Figure 3.2.

Sample locations will be pre-surveyed with the FIDLER and results recorded in the sample collection log or field logbook. Samples will be collected per GT.08, Surface Soil Sampling, Section 4.~~3, Grab Sampling, with the following modifications. Samples will be collected from 0 to 5 cm (2 in) depth using a 7.6 cm (3 in) diameter, polybutyrate or brass~~4, Soil Sampling with the Vertical Soil Profile Method, and specifically Section 4.4.6 Procedures For Coring. The RF soil sampling jig will be utilized as a ~~liner with or without a split barrel sampler, as conditions~~

~~require, with a drive hammer. Individual samples will include organic material and will include coarse material~~template to collect the individual soil samples from 0 - 2 inches in depth. Soil samples will include all organic matter and coarse grained geologic materials (gravel size fraction or larger). Samples will be prepared in the laboratory by crushing to promote homogeneity and representativeness of the sample prior to alpha spectroscopy analysis. Soil ~~m~~Moisture measurements will be collected from

each surface soil sampling area with a moisture-density gauge operated in accordance with the manufacture's specifications. A single soil and air temperature measurement will be recorded for each surface soil sampling area.

Sample locations will be identified with the unique location number assigned, with indelible ink or paint pen either on a wooden lathe or pin flag. Sample locations will be surveyed for location and elevation using standard land surveying techniques or GPS receivers operated in accordance with the manufacturer's specifications.

Asphalt and Artificial Fill Samples - Asphalt and artificial fill samples from the 903 Pad will be collected to obtain preliminary estimates of the samples variance and mean for waste characterization purposes. Random sampling techniques are appropriate methods for estimating the population mean and determination of total amount of contaminants present as well as calculating the standard errors of these two estimates. A minimum of nine asphalt and artificial fill samples will be collected from sample locations randomly selected from the twenty-five 903 Pad subsurface soil sampling locations as shown in Figure 3.3. Table 3.2 provides the analytical program for asphalt and artificial fill samples.

3.1.2 Subsurface Soil Investigation

The depth of radiological contamination is required to estimate the volume of soil requiring remedial action. The depth of radiological contamination will be investigated at the: 903 Pad; Lip Area; and Americium Zone where the HPGe has identified surface soils equal to or greater than the Tier I soil action levels.

Table 3.4 provides an estimate of the number of boreholes and samples required to complete the subsurface soil investigation program. Table 3.5 provides the subsurface soil investigation analytical program. Figure 3.3 provides the radiological subsurface sampling locations for the 903 Pad and Lip Area.

903 Pad - Twenty-five shallow boreholes are proposed for the characterization of radionuclide contamination beneath the 903 Pad. Twenty-five boreholes over the 3.4-acre 903 Pad represents a borehole completed at each node of a 23 m by 23 m (75 ft by 75 ft) grid. Table 2.4 shows the diameter and error associated with detecting circular areas of contamination.