Penn E&R
Environmental & Remediation, Inc.

September 9, 2004
4000:PA04072

Mr. John T. Buckley
US Nuclear Regulatory Commission
TWFN, 7F27
Washington, DC 20555

Subject: Plans and Procedures
Thorium Remediation Project
Kaiser Aluminum & Chemical Corporation
Tulsa, Oklahoma

Dear Mr. Buckley:

On behalf of Kaiser Aluminum & Chemical Corporation, please find enclosed the following revised plans, procedures and forms for the Thorium Remediation Project in Tulsa, Oklahoma:

Procedure No.	Title	Effective Date	Revision No.
NA	Recon Conveyor Mounted Radiation Work Plan Addendum No. 1	September 2004	00
Penn E&R /HPM/M-3-6	Penn E&R Gross Gamma Surveys of Soil Cores	September 2004	01

Please destroy all previous versions of these plans, procedures and forms, and replace with the enclosed revisions. Please do not hesitate to contact me if you should have any questions.

Sincerely,
PENN ENVIRONMENTAL & REMEDIATION, INC.

Charles Beatty
Project Manager

Enclosures

NMSS01

Cc: US Nuclear Regulatory Commission (NRC) Document Control Desk
Mr. Dwight D. Chamberland, NRC Region IV
Ms. Pamela L. Bishop, State of Oklahoma, Department of Environmental Quality
Ms. Kelly Hunter Burch, State of Oklahoma, Office of Attorney General
Mr. Scott Van Loo, City of Tulsa
Ms. Roberta Fowlkes, CCF Associates
Mr. S. Paul Handa, Kaiser
Mr. Tre Fischer, Kaiser
Mr. L. Max Scott, ADA Consultants
Mr. Alvin G. Gutterman, Morgan, Lewis & Bockius LLP
Ms. Diana Brown, RECON
Mr. Danny Brown, RECON
Mr. Charles Beatty, Penn E&R
Mr. Dave Weyant, Penn E & R
Mr. Dan Baker, A&M Engineering

PROCEDURE: ESC/HPM/M-3-6

Gross Gamma Surveys of Soil Cores

REVISION: 01

EFFECTIVE DATE: SEPTEMBER 2004

Bill Vinzant

APPROVED BY: J.W. Vinzant, Project Manager

DATE: 9-07-04

PROCEDURE: Penn E&R/HPM/M-3-6

Gross Gamma Surveys of Soil Cores

REVISION: 01

EFFECTIVE DATE: SEPTEMBER 2004

8/27/04

Prepared by: Date:
Andrew J. Lombardo
Civil & Environmental Consultants, Inc.

8/27/04

Approved by: Date:
M. David Tourdot
Vice President – Radiological Services

Penn E&R
359 North Gate Drive Suite 400
Warrendale, PA 15086
(724) 934-3530

Procedure: **Penn E&R/HPM/M-3-6**

Title: **Gross Gamma Surveys of Soil Cores**

1.0 PURPOSE

The purpose of this procedure is to provide instruction for performing gross gamma surveys of soil boring cores (soil cores) and the subsequent sampling of the core.

2.0 DEFINITIONS

Soil Core: A soil sample obtaining by boring down vertically through soil. The resulting sample is a cylinder in shape with a constant diameter.

3.0 PREREQUISITES/PRECAUTIONS/LIMITATIONS

3.1 Instrument must pass preoperational checks as outlined in Procedure Penn E&R/HPM/M-2-1 and the appropriate instrument procedure. Ensure the preoperational and source checks have been completed prior to initiating survey.

3.2 Background count rates may vary. Background should be at least daily for each area and counting geometry to be used.

3.3 Before initiating a gross gamma soil survey be sure to record the instrument serial number(s), calibration date(s), date of survey, time of survey, and any other pertinent information.

3.4 The sodium iodide (NaI) detector may be shielded with at least 1/16 inch of lead.

3.5 The detector and the scaler should be configured so that the Health Physics Technician can move the core past the detector (or the detector past the core) while observing the count rate and hear the audible response.

3.6 Ensure that samples are properly labeled by location and depth of collection.

4.0 EQUIPMENT

4.1 2-inch-by-2-inch NaI scintillator detector, Ludlum Model 44-10, or equivalent

4.2 Ludlum Model 2221 Scaler, or equivalent

4.3 Sturdy Mixing Bucket, or equivalent and trowel

4.4 Standard Sample Containers (3)

4.5 Archive Sample Containers (3)

5.0 PROCEDURE

Record the results of measurements on Form HPM/M-3-6-1. Sections of the form that are not applicable to the survey should be marked "N/A."

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359 North Gate Drive Suite 400
Warrendale, PA 15086
(724) 934-3530

5.1 Determine Background

5.1.1 Ensure that the NaI detector is in the standard counting configuration, (e.g., inside of the shield, at the location that scans or fixed counts are to be performed).

5.1.2 Perform five consecutive 1-minute fixed counts with the detector in the desired standard scanning configuration (Ambient Background Geometry). A phantom core segment of background soil may be used to establish background.

5.1.3 Calculate the average background count rate.

5.2 Perform Soil Core Scan

5.2.1 Record the soil core serial number, (e.g. location and depth interval).

5.2.2 With the instrument in the rate mode, move the detector (or the soil core) at a rate of no greater than 1 inch per second, keeping the detector as close as possible to the soil core. Ensure that the scan rate is slow enough to detect changes in the audible response of the instrument.

5.2.3 Record the average count rate observed for each 1-foot segment of the soil core. Core segments are 0 to 1 foot, 1 to 2 feet, 2 to 3 feet, etc.

5.3 Composite Sample Each 1-Meter Section of Core

5.3.1 Separate the core into approximate 1-meter segments using an appropriate tool (e.g. a saw).

5.3.2 Place the 1-meter segment into the bucket (or equivalent mixing container) and mix the core thoroughly with the trowel.

5.3.3 From the bucket fill a standard soil sample container with the soil. Place the remaining soil into a standard archive container. Clean the bucket and trowel before handling the next sample.

5.3.4 Label the sample container with sample number and depth interval.

5.4 Calculate the net counts per minute for each measurement by subtracting the appropriate average background, i.e., ambient background for scan measurements and the sample container background for fixed counts.

5.5 Forward the standard soil sample to the laboratory for analysis.

5.6 Store the archive sample in the appropriate storage facility.

Penn E&R
359 North Gate Drive Suite 400
Warrendale, PA 15086
(724) 934-3530

6.0 REFERENCES

6.1 ESC/HPM/M-2-1, Basic Instrument Operation

7.0 ATTACHMENTS

7.1 Forms

Form HPM/M-3-6-1 Soil Core Gross Gamma Survey

w:\6000\hpmm\manual\hpm-3-6.doc

Form HPM/M-3-6-1

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359 North Gate Drive
Warrendale, PA 15086
724/934/3530

Form HPM-3-6-1
Soil Core Gross Gamma Survey

Effective Date: September 2004
Revision: 1

Date:	Time:	Instrument/SN:

Background Counts

Ambient Geometry	(cpm)	Core Phantom Geometry	(cpm)	Sample Container Geometry	(cpm)
Air-1		Core-1		Container-1	
Air-2		Core-2		Container-2	
Air-3		Core-3		Container-3	
Air-4		Core-4		Container-4	
Air-5		Core-5		Container-5	
Average:		Average:		Average:	

Core Counts

Core Sample Designation	Core Segment	Gross Count Rate (cpm)	Net Count Rate (cpm)

Notes:

Comments:

Prepared By:	Date:
Reviewed By:	Date:

W:\6000\hpmm\manual\form3-6-1.xls

Conveyor Mounted Radiation System Work Plan
Addendum No. 1

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: **00**

EFFECTIVE DATE: **September 2004**

Bill Vinzant 7-9-04

Approved by: J. W. (Bill) Vinzant – Project Manager Date:

Kaiser Aluminum & Chemical Corporation

Conveyor Mounted Radiation System Work Plan
Addendum No. 1

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: 00

EFFECTIVE DATE: September 2004

Danny P. Brown – Project Manager / Date

Richard Lewis – Quality Control Supervisor / 9/9/04

Remedial Construction Services, L.P.

Conveyor Mounted Radiation System Work Plan
Addendum No. 1
September 2004

Addendum Contents:

I. Re-Processing Low Density Diverted Materials
II. Sorting of High Concentration Materials

I. Re-Processing Low Density Diverted Material

Purpose:

The purpose of this addendum is to modify the Conveyor Mounted Radiation System Work Plan, Revision No. 01, Effective Date May 2004, specifically Section 4.5, Sorting Methods. This addendum provides the necessary information required to identify what piles of diverted material should be re-processed based upon data obtained through the SMCM.

Current experience at the site while processing below criteria material (<32.2 pCi/g), indicates that the majority of the diverted material has been diverted due to low density alarms.

During the sorting process at the same concentration (pCi/g) the SMCM roughly gets the same count rate from 4" to 6" depth of material on the conveyor belt. This is what was planned. When the conveyor has less than 4" to 6" depth, the count rate due to thorium drops. The SMCM would improperly sort if a correction were not made. A measurement and correction is made down to an "average" depth of one inch. At this point, the SMCM multiplies the count rate by 3. The SMCM diverts due to low density to avoid using a larger correction factor than 3 times the count rate. The material is diverted because there is little on the belt, and the correction is so large that the SMCM is unable to measure the thorium as accurately as when the belt is full.

Diverted Material:

The SMCM diverts material for several reasons:

1. For "On-Site" mode: 32.2 pCi/g averaged over material on the conveyor belt.
2. For "Landfill" mode: 165.0 pCi/g averaged over material on the conveyor belt.
3. For "Landfill" mode: 55.0 pCi/g averaged over 100 tons.
4. For "Landfill" mode: over 100 tons of material.

5. For either "On-Site" or "Landfill" modes: low density (<0.3 g/cc), corresponding to an average depth of less than one inch of material on the belt. Based upon current data, the set point for low density diverting is (0.3 g/cc). The set point may be changed after additional operation, if data shows it is possible and necessary. The low density set point will be documented on the Diverted Release Record forms attached to this addendum. Changes will also be documented in the SMCM's Daily Startup Notes and SMCM's Daily Shutdown Notes.

During the calibration of the SMCM, the density/depth gauge was found to be needed to correct the concentration of thorium. Examination of the data showed that (under the conditions during calibration) at apparent densities of (0.3 g/cc) a reasonable separation of an empty and a full belt could be made. The density gauge was intended to read density for a full belt (approximately 4-6 inches), but if the belt is not full, the density gauge becomes a thickness rather than density gauge. The term "apparent density" was coined to describe the reading with a less than full conveyor. The real change is the amount of material on the conveyor.

Low density diverting occurs when the belt is averaging a depth of less than one inch of material (<0.3 g/cc). The following lists are possible reason(s) for the low density diverting:

1. Scraper bar on the feed hopper is plugging,
2. Material with too many air voids (clodding), and
3. Hopper system not being fed with enough material.

In any monitoring campaign, the SMCM starts with the diverter gate positioned at "divert" because the belt is empty and the density is (<0.3 g/cc). As the excavator begins to feed the SCREEN-IT machine hopper, the monitoring conveyor feed hopper fills and the conveyor belt fills. When the depth rises above a density reading of (0.3 g/cc) (about an inch of material on the belt), the SMCM sends a signal to the diverter to switch as long as conditions are met (concentration limits below 32.2 or 55 pCi/g). At the end of a soil campaign, the excavator stops feeding the hopper, then the conveyor empties. When the density falls below (0.3 g/cc) the SMCM again sends the "divert" signal. Thus, even a perfect campaign will have some acquisitions diverted because of low density due to the initial filling of the belt and the shutdown of the system.

Example: On Thursday, 7/22/04, 632 tons of material at about 17 pCi/g average thorium concentration was processed, with 63 tons diverted. Of the 63 tons, less than 1% was diverted due to concentration above 32.2 pCi/g while the density was greater than (0.3 g/cc). The bulk of the material was diverted due to low density. This was not just the start and end of the campaign, but rather was due to the causes listed above (empty belt, voids, etc.).

The SMCM software automatically generates a summary report of the diverted material. This report is used to make a decision regarding the final disposition of the diverted material.

Resolution:

Operations will include preparing the material to be more consistent with regard to clump size and moisture content. When a diverted pile is created, the RECON Quality Control Supervisor will review the summary report of diverted material to assess if there is sufficient data to characterize it for Thorium content either for backfill, off-site disposal, or for re-processing. The decision on whether to re-run the diverted material will be based on judgment depending on how much was diverted for low density. The attached Diverted Release Record will be used to document data available on the diverted material, including the percent of time that material was diverted for low density and the percent of time the material was diverted while it met the required density.

The RECON Quality Control Supervisor will decide on a pile by pile basis whether to re-process the material. That decision will be based on the percentage of material that was diverted due to low density, not due to being characterized as over-criteria material.

II. Sorting of High Concentration Material

Background:

The system will also be operated in a "High Concentration Mode". During High Concentration Mode the 55 pCi/g alarm will be turned off and material with Thorium 232 concentration between 55 pCi/g and 165 pCi/g will be produced. This material will be blended with material produced in the Landfill Mode to increase average Thorium concentration of a shipment, without exceeding the U.S. Ecology waste acceptance criteria.

During initial testing on 8/30/04, in attempting to create a high concentration pile (about 100 pCi/g), the conveyor system diverted continuously due to apparent low density alarms. The cause was studied and found to be the loss of signal from the Cs-137 gamma source used for density measurement. The counts were lost in the increased background from the high concentration material. In addition, the Cs-137 source was used for automatic zero stabilization of the multichannel analyzer, and the loss of the signal in background caused the zero to shift, with software using a nearby gamma peak from Tl-208. Throughout this counting, the thorium measurement was largely unaffected, as the Tl-208 peak at 2614 keV is used both for gain stabilization as well as thorium monitoring.

The issue is that the system, under current field conditions and with high concentrations, can no longer measure the density of material on the conveyor using the Cs-137 source. The conveyor is provided with a scale that measures the weight of material on the belt. The relationship between density and the scale has been studied, and the scale can be used in lieu of the density gauge for analysis via post-processing. In about a month, the system will be moved, and the density gauge will be relocated to improve its performance. Following that change, the capabilities will be re-assessed to confirm that operation with the density gauge can be attained with high concentration material. Until that time, the following modifications will be made to process.

SMCM Operations for High Concentration Materials

1. During High Concentration mode, density will not be measured using the Cs-137 source. This change does not affect onsite mode.
2. During High Concentration mode, diversion of low density material will not be made. This change does not affect onsite mode.
3. During High Concentration mode, the summary report for the pile will be calculated using the scale measurement rather than the density measurement. This calculation will convert scale indication to apparent density to estimate the belt fill and use that apparent density to establish the correction factor for the concentration measurement. This correction factor is documented in previous tech notes. The summary report will use a weighted average to determine the pile concentration. This change does not affect onsite mode.
4. The automatic zero stabilization will be turned off in software. This change affects all modes of operation. As a compensatory measure, the frequency of source response checks (SRCs, a measurement of peak width and location in the spectrum when the belt is empty) will be increased to be; prior to and following each production run. This will likely mean a minimum of 4 SRCs daily instead of 3. If the data shows adequate stability after a week of operations with the automatic zero stabilization turned off, the frequency of SRCs can be reduced to levels specified in the current procedure via an email memo from the SRA project manager to the site documenting results of the tests.
5. A study will be made of the potential use of other nuclides such as K-40 primordial gamma as a suitable peak for zero stabilization. K-40 has a higher energy gamma with less background influence from thorium. If the study demonstrates that other nuclides, such as K-40, can serve for zero stabilization, automatic zero stabilization can be turned back on following an email memo from the SRA project manager to the site documenting results of the tests.

Certain modifications to operating parameters may be necessary during the course of the project. These future modifications will be reviewed by the Health Physics Advisor/RSO and documented in the SMCM's Daily Startup Notes and SMCM's Daily Shutdown Notes.

Attachments: (Example Record) Onsite Mode Diverted Release Record
(Blank Record) Onsite Mode Diverted Release Record
(Blank Record) Landfill Mode Diverted Release Record

Diverted Release Record
Onsite Mode

Pile Name	D-0008-A
Sorting Equipment	Sub-Surface Multi-Spectral Contamination Monitor
Sorting Date	22-Jul-2004 08:06:17, 22-Jul-2004 11:44:30
Sorter Operator	K. Murray
Sorted Material	Soil and Dross
Criteria	32.2 pCi/g
Number of Measurements	2672
Tons Diverted	63

Table 1. SMCM Diverted Pile Status.

Description	Percent of Time
Material diverted due to density less than 0.3 g/cc.	99.81
Material over the criteria at densities greater than 0.3 g/cc	0.19

Table 2. SMCM Diverted Pile Concentrations of Material Over the Criteria at Densities Greater than 0.3 g/cc Reported in pCi/g.

Isotope	Mean	Median	Maximum	Minimum	2-Sigma
Th-232	33.3	32.9	34.3	32.6	1.6

SRA Technician _____ Date _____

Table 3. SMCM Diverted Pile Resolution.

Action	Resolution
☐	Return Diverted Pile to "On-Site" Feed Pile
☐	Return Diverted Pile to "Landfill" Feed Pile
☐	Other – See Notes

JUSTIFICATION: _____

NOTES: _____

RECON Quality Control Supervisor _____ Date _____

Diverted Release Record
Onsite Mode

Pile Name	
Sorting Equipment	Sub-Surface Multi-Spectral Contamination Monitor
Sorting Date	
Sorter Operator	
Sorted Material	
Criteria	
Number of Measurements	
Tons Diverted	

Table 1. SMCM Diverted Pile Status.

Description	Percent of Time
Material diverted due to density less than 0.3 g/cc.	
Material over the criteria at densities greater than 0.3 g/cc	

Table 2. SMCM Diverted Pile Concentrations of Material Over the Criteria at Densities Greater than 0.3 g/cc Reported in pCi/g.

Isotope	Mean	Median	Maximum	Minimum	2-Sigma
Th-232					

SRA Technician _____ Date _____

Table 3. SMCM Diverted Pile Resolution.

Action	Resolution
☐	Return Diverted Pile to "On-Site" Feed Pile
☐	Return Diverted Pile to "Landfill" Feed Pile
☐	Other – See Notes

JUSTIFICATION: _____

NOTES: _____

RECON Quality Control Supervisor _____ Date _____

Diverted Release Record
Landfill Mode

Pile Name	
Sorting Equipment	Sub-Surface Multi-Spectral Contamination Monitor
Sorting Date	
Sorter Operator	
Sorted Material	
Criteria	
Number of Measurements	
Tons Diverted	

Table 1. SMCM Diverted Pile Status.

Description	Percent of Time
Material diverted due to density less than 0.3 g/cc.	
Material over the criteria at densities greater than 0.3 g/cc	

Table 2. SMCM Diverted Pile Concentrations of Material Over the Criteria at Densities Greater than 0.3 g/cc Reported in pCi/g.

Isotope	Mean	Median	Maximum	Minimum	2-Sigma
Th-232					

SRA Technician _____ Date _____

Table 3. SMCM Diverted Pile Resolution.

Action	Resolution
☐	Return Diverted Pile to "On-Site" Feed Pile
☐	Return Diverted Pile to "Landfill" Feed Pile
☐	Other – See Notes

JUSTIFICATION: _____

NOTES: _____

RECON Quality Control Supervisor _____ Date _____