RECON
Remedial Construction Services, L.P.

Kaiser Aluminum & Chemical Corp
Thorium Remediation Project

Section	Procedure No.	Title	Effective Date	Revision No.
1	REC-WP-1-01	PROCEDURES	MAY 2004	01
2	REC-WP-1-02	CHANGES TO PROCEDURES	MAY 2004	01
3	REC-WP-1-03	COMPLETION OF FORMS	MAY 2004	01
4	REC-WP-2-01	BASIC INSTRUMENT OPERATION	MAY 2004	01
5	REC-WP-2-02	INSTRUMENT MDC CALCULATION	MAY 2004	01
6	REC-WP-2-03	LUDLUM MODEL 2224 w/ 43-93	MAY 2004	01
7	REC-WP-2-04	LUDLUM MODEL 3 w/ 44-9	MAY 2004	01
8	REC-WP-2-05	LUDLUM MODEL 19	MAY 2004	01
9	REC-WP-2-06	LUDLUM MODEL 177 w/ 44-9	MAY 2004	01
10	REC-WP-2-07	LUDLUM MODEL 2929 w/ 43-10-1	MAY 2004	01
11	REC-WP-2-08	LUDLUM MODEL 2221 w/43-5	MAY 2004	01
12	REC-WP-2-09	DOSIMETER ISSUANCE AND TRACKING	MAY 2004	02
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22	REC-WP-6-01	COMPLETING CHAIN-OF-CUSTODY	MAY 2004	01
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25	REC-WP-7-03	BACKFILL	MAY 2004	01
26	REC-WP-7-04	LOADING VIBRATING SCREEN	MAY 2004	01
27	REC-WP-7-05	LOADING RAIL CARS	MAY 2004	01
28	REC-WP-7-06	INSPECTING RAILCARS	MAY 2004	00
29	REC-WP-7-07	PREPARATION OF RAIL CAR FOR LOADING	MAY 2004	00

RECON Procedure: REC-WP-1-01

Procedures

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: 01

EFFECTIVE DATE: MAY 2004

Approved Bill Vinzant
J. W. (Bill) Vinzant – Project Manager

5-10-04
Date

Kaiser Aluminum & Chemical Corporation

RECON Procedure: REC-WP-1-01

Procedures

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: 01

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5/7/04 — Danny P. Brown – Project Manager / Date

5/7/04 — Richard Lewis – Quality Control Supervisor / Date

RECON Procedure: REC-WP-1-01 Procedures

1.0 PURPOSE

The purpose of this procedure is to provide a written reference on the organization of the Work Plan Manual.

2.0 DEFINITIONS

NA

3.0 PREREQUISITES/PRECAUTIONS/LIMITATIONS

NA

4.0 EQUIPMENT

NA

5.0 PROCEDURE

Procedures are broken down into categories and are presented in this manual as chapters. These are:

- REC-WP-1 – General Practices
- REC-WP-2 – Instrumentation
- REC-WP-3 – Surveys
- REC-WP-4 – Sampling
- REC-WP-5 – Quality Assurance
- REC-WP-6 – Chain of Custody
- REC-WP-7 – Field Practices

6.0 REFERENCES

NA

7.0 ATTACHMENTS

NA

RECON Procedure: REC-WP-1-02

Changes to Procedures

Thorium Remediation Project
Tulsa, Oklahoma

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W. W. (Bill) Vinzant – Project Manager

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RECON Procedure: REC-WP-1-02

Changes to Procedures

Thorium Remediation Project
Tulsa, Oklahoma

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5/7/04
Danny P. Brown – Project Manager / Date

5/7/04
Richard Lewis – Quality Control Supervisor / Date

1.0 PURPOSE

The purpose of this procedure is to provide written guidelines for revising existing procedures prior to implementing these changes.

2.0 DEFINITIONS

NA

3.0 PREREQUISITES/PRECAUTIONS/LIMITATIONS/RESPONSIBILITIES

3.1 Kaiser's Project Manager, Kaiser's Radiation Safety Officer and RECON's Lead Health Physics Technician or his designee is responsible to review and approve proposed field changes, when appropriate.

3.2 Site personnel are responsible to request a field change and receive authorization for such changes prior to implementation of the changes, when appropriate.

4.0 EQUIPMENT

NA

5.0 PROCEDURE

5.1 Major Field Changes

5.1.1 A major field change has the potential to affect one or more of the following:

1. Adversely affect the quality of the data.
2. Adversely affect the consistency of the data.
3. Cause significant change in the cost of the field effort.
4. Create a major change in the scope of the field effort.
5. Cause significant delays in the schedule of the field effort.

5.1.2 Organizations that originally reviewed and approved the procedure will review and approve the major field changes.

5.1.3 After the major field changes have been reviewed and approved the affected procedure(s) will be re-issued.

5.2 Minor Field Changes

5.2.1 A minor field change is one which does not do one or more of the following:

1. Adversely affect the quality of the data in the field.
2. Affect the rationale for field procedures or sampling locations.

5.2.2 Organizations that originally reviewed and approved the procedure will review and approve the minor field changes.

5.2.3 The only exception to the requirement of Substep 5.2.2 is a minor change to a document, such as inconsequential editorial corrections. These corrections will not require review and approval.

5.2.4 Field Change Requests will be maintained as part of the project files.

6.0 REFERENCES

NA

7.0 ATTACHMENTS

NA

RECON Procedure: REC-WP-1-03

Completion of Forms

Thorium Remediation Project
Tulsa, Oklahoma

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Approved Bill Vinzant

J. W. (Bill) Vinzant – Project Manager

5-10-04

Date

Kaiser Aluminum & Chemical Corporation

RECON Procedure: REC-WP-1-03

Completion of Forms

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: **01**

EFFECTIVE DATE: **MAY 2004**

5/11/04 — Danny P. Brown – Project Manager / Date

5/11/04 — Richard Lewis – Quality Control Supervisor / Date

RECON Procedure: REC-WP-1-03 Completion of Forms

1.0 PURPOSE

The purpose of this procedure is to provide instruction on the proper completion of forms, including survey and instrumentation forms that are required for the project.

2.0 DEFINITIONS

Form Field: A space on a form where information is to be entered.

3.0 PREREQUISITES/PRECAUTIONS/LIMITATIONS

3.1 Additional guidance on performing surveys, taking samples, or instrument use can be found in the appropriate Work Plan procedure.

3.2 The forms used to record data are generic, i.e., designed for recording data from various instruments. Record "N/A" in any fields that are not applicable to the instrument.

4.0 EQUIPMENT

4.1 Appropriate form(s) for the work being performed.

4.2 Black pen.

5.0 PROCEDURE

5.1 General Information

5.1.1 Information should be entered in the appropriate manner and in the appropriate form field.

5.1.2 Information should be entered using black ink.

5.1.3 A form field where information is not available or not applicable should be filled with "N/A."

5.1.4 An entire column with repeating information may be filled with a line from top to bottom. The line should begin immediately below a completed form field with the proper information and have definitive markings where the information ceases to apply. The next form field should be properly filled with new information.

5.2 Dates and Times

5.2.1 Dates should be entered in a format that clearly identifies the day, month, and year (e.g., 1/1/02; 01/01/2002; Jan 1, 2002).

5.2.2 Times should be entered in a format the clearly identifies the hour and minutes (e.g., 8:00 a.m.; 0800; 1:30 p.m.; 1330).

5.3 Signatures, Personnel, and Contact Information

5.3.1 Signature lines should be filled legibly. Include a printed name where necessary.

5.3.2 Initials may be used in a form field if the full name appears elsewhere on the form.

5.3.3 Contact information should include a full name, address, zip code, and telephone number with area code.

5.4 Abbreviations

5.4.1 The use of nonstandard abbreviations should be avoided unless the full wording appears elsewhere on the form and it clearly identifies the abbreviation to be used.

5.5 Result Form Fields

5.5.1 Result form fields should be completed utilizing units that are specified on the form. Form fields that identify units are to be filled clearly utilizing standard notation for the information requested.

5.6 Form Attachments

5.6.1 Attachments to forms should be appropriately labeled to indicate the specific form they accompany.

5.6.2 The accompanying form should clearly reference the attachment (e.g., see Attachment A).

5.7 Corrections

5.7.1 Corrections to form fields shall be made by entering the correct information next to the proper form field and placing a single line through the incorrect entry along with the initials of the person making the correction and the date of correction.

6.0 REFERENCES

NA

7.0 ATTACHMENTS

NA

RECON Procedure: REC-WP-2-01

Basic Instrument Operation

Thorium Remediation Project
Tulsa, Oklahoma

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Approved Bill Vinzant
/s/W. (Bill) Vinzant – Project Manager

5-10-04
Date

Kaiser Aluminum & Chemical Corporation

RECON Procedure: REC-WP-2-01

Basic Instrument Operation

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: **01**

EFFECTIVE DATE: **MAY 2004**

5/7/04 — Danny P. Brown – Project Manager / Date

5/7/04 — Richard Lewis – Quality Control Supervisor / Date

1.0 PURPOSE

The purpose of this procedure is to provide instruction on the basic operation of radiological survey instruments.

2.0 DEFINITIONS

Calibration source: A National Institute of Standards and Technology- (NIST) traceable source of a known value used to calibrate an *instrument.*

Check source: A radiological source, not necessarily calibrated, which is used to confirm the continuing satisfactory operation of an instrument

Detector: The portion of an *instrument* that transmits a signal to a *meter* based upon the radioactive activity present. Some detectors are contained within a *meter.*

Instrument: A meter-detector combination that has been calibrated as a single unit. Some instruments are capable of being calibrated with several detectors simultaneously.

Meter: The portion of an *instrument* that receives and translates signals from the *detector* into a user observable result.

Efficiency: A measure of the instrument's ability to detect radiological activity. It is calculated by using the formula:

$$E_i = ((C-B_r)/D)$$

Where:

E_i = Instrument efficiency
C = Displayed value from the instrument count of the calibration source (count rate)
B_r = Background count rate
D = Known decay-corrected disintegrations per minute (dpm) value of the calibration source. This value is geometry dependent and should be noted on the calibration certificate, e.g., 2π or 4π geometry. (Note that for gamma detection, the value of D may be provided in different units, e.g., μR/hr.)

3.0 PREREQUISITES/PRECAUTIONS/LIMITATIONS

3.1 Any person operating a radiological survey instrument must be trained in its use or supervised during its operation by a qualified instructor.

3.2 Failure of any preoperational check will result in the instrument being removed from operation and repaired as necessary.

3.3 An operator repair such as replacing batteries or cables does not require the instrument to be recalibrated. However, the efficiency of the instrument should be recalculated.

3.4 Any operator repair that may affect the efficiency response of the detector requires that the new efficiency response be within 20 percent of the calibration value but does not necessarily require a new calibration. If the new efficiency response is not within 20 percent of the calibration value, the

instrument will be removed from operation and recalibrated.

3.5 Manufacturer's recommendations regarding use, calibration, and/or maintenance of an instrument will be followed unless otherwise documented in this or other written procedure(s).

3.6 Additional guidance for operating an instrument can be found in the appropriate procedure and/or the manufacturer's manual for that instrument.

3.7 The forms used to record instrument daily check data are generic, i.e., designed for recording information from various instruments. Record "N/A" in any fields that are not applicable to the instrument check.

4.0 EQUIPMENT

4.1 Appropriate check source(s) or calibration source(s), as necessary.

5.0 PROCEDURE

5.1 Preoperational Checks (All instruments before use)

5.1.1 Verify the calibration is current and applicable to the meter-detector combination.

5.1.2 Verify the instrument is capable of detecting the desired activity (e.g., alpha or beta/gamma detector) and that the instrument range encompasses the expected activity.

5.1.3 Inspect any cables for exposed wires, cracks, loose connectors, etc.

5.1.4 Connect any necessary cables or power cords.

5.1.5 Turn instrument on and perform a battery check or verify that the power is on. Replace batteries (or charge battery as appropriate), if necessary.

5.1.6 Hold the detector in the air away from any potentially contaminated surface. Observe the digital and/or analog output and allow the reading to stabilize. Record the resulting background value on the appropriate form for each specific model.

5.1.7 Expose the detector to an appropriate check source and allow the response to stabilize. Verify that the response value is acceptable. Enter the response result on the appropriate form for the instrument being used.

5.1.8 While the detector is exposed to the check source, turn up the volume or turn on the speaker (as appropriate) and check for audible response.

5.2 Establish Performance Check Values (Scaler instruments/postcalibration)

5.2.1 Perform necessary preoperational checks to ensure the instrument is operating properly.

5.2.2 Using a repeatable-count geometry, expose the detector to an appropriate check source for the type of radiation required (e.g., alpha, beta, gamma). Perform a minimum of 10 consecutive 1-minute counts of the check source and record the results on the appropriate form.

5.2.3 Calculate the average of the consecutive counts (x) using the formula provided on the appropriate form.

5.2.4 Calculate the standard deviation of the consecutive counts (s) using the formula provided on the appropriate form.

5.2.5 Calculate the minimum number of source counts required (n) based on 10 percent accuracy at the 95 percent confidence level using the following formula. The values of t corresponding to the degrees of freedom (df) can be looked up in Table 1. Degrees of freedom is equal to the number of counts minus 1 (e.g., if 10 counts were performed the df is equal to 9).

$$n = \left[\frac{t_{95,df} \cdot S_x}{0.1 \cdot \bar{x}}\right]^2$$

5.2.6 If n is less than or equal to 10, proceed to the next step. If n is greater than 10, perform the additional number of counts required (i.e., n –10) and return to Substep 5.2.3.

5.2.7 Calculate the acceptance criteria for daily source checks by adding and subtracting two standard deviations from the average. Record the results on the appropriate form.

5.2.8 Repeat Section 5.2 each time the instrument is recalibrated.

5.3 Establish Performance Check Values (Ratemeter instruments)

5.3.1 Perform all necessary preoperational checks to ensure the instrument is operating properly.

5.3.2 Using a repeatable-count geometry expose the detector to an appropriate check source for the type of radiation required (e.g., alpha, beta, gamma). Perform a minimum of 10 consecutive 1-minute counts of the check source and record the results on the appropriate form.

5.3.3 Calculate the average of the consecutive counts (x) using the formula provided on the appropriate form.

5.3.4 Calculate the standard deviation of the consecutive counts (s) using the formula provided on the appropriate form.

5.3.5 Calculate the minimum number of source counts required (n) based on 20 percent accuracy at the 95 percent confidence level using the following formula. The values of t corresponding to the df can be looked up in Table 1. Degrees of freedom is equal to the number of counts minus 1 (e.g., if 10 counts were performed the df is equal to 9).

$$n = \left[\frac{t_{95,df} \cdot s_x}{0.2 \cdot \bar{x}} \right]^2$$

5.3.6 If n is less than or equal to 10, proceed to the next step. If n is greater than 10, perform the additional number of counts required (i.e., n –10) and return to Substep 5.3.3.

5.3.7 Calculate the acceptance criteria for daily source checks by adding and subtracting 20 percent of the average from the average. Record the results on the appropriate form.

5.3.8 Repeat Section 5.3 each time the instrument is recalibrated.

Table 1
t-Values

df	t-Value 95%	t-Value 97.5%		df	t-Value 95%	t-Value 97.5%
1	6.314	12.706		36	1.689	2.029
2	2.920	4.303		37	1.688	2.027
3	2.353	3.182		38	1.687	2.025
4	2.132	2.776		39	1.685	2.023
5	2.015	2.571		40	1.684	2.021
6	1.943	2.447		41	1.683	2.020
7	1.895	2.365		42	1.683	2.019
8	1.860	2.306		43	1.682	2.018
9	1.833	2.262		44	1.681	2.017
10	1.812	2.228		45	1.681	2.016
11	1.796	2.201		46	1.680	2.015
12	1.782	2.179		47	1.679	2.014
13	1.771	2.160		48	1.679	2.013
14	1.761	2.145		49	1.678	2.012
15	1.753	2.131		50	1.677	2.010
16	1.746	2.120		51	1.677	2.009
17	1.740	2.110		52	1.676	2.008
18	1.734	2.101		53	1.676	2.007
19	1.729	2.093		54	1.675	2.006
20	1.725	2.086		55	1.674	2.005
21	1.721	2.080		56	1.674	2.004
22	1.717	2.074		57	1.673	2.003
23	1.714	2.069		58	1.672	2.002
24	1.711	2.064		59	1.672	2.001
25	1.708	2.060		60	1.671	2.000
26	1.706	2.056		120	1.658	1.980
27	1.703	2.052		140	1.649	1.966
28	1.701	2.048		∞	1.645	1.960
29	1.699	2.045				
30	1.697	2.042				
31	1.696	2.040				
32	1.694	2.038				
33	1.693	2.036				
34	1.692	2.034				
35	1.690	2.031				

6.0 REFERENCES

6.1 Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), NUREG/CR-1575, August 2000, Rev. 1.

7.0 ATTACHMENTS

Form REC-WP-2-01-1	Performance Check Values
Form REC-WP-2-01-2	Performance Check Values for Ludlum Model 19 (Only)

Form REC-WP-2-01-1

Form REC-WP-2-01-1
Performance Check Values

Project Number:		Project Name:	
Instrument Model:		Technician:	
Instrument S/N:		Date:	
Calibration Due:		Detector Model:	
Radiation Detected:		Detector S/N:	
Source Isotope & S/N:		Detector Type:	
Bkg Count Rate:			

Data Point	Gross Count	Net Count	DPM
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Average Net Count:		
Standard Deviation of Net Count (Scalers):		
20% of Net Count (Ratemeters):		
Average minus 2 X standard deviation (Scalers):		
Average plus 2 X standard deviation (Scalers):		
Average minus 20% (Ratemeters):		
Average plus 20% (Ratemeters):		

Formulas

Where: n = number of 1 min the counts (10)

$\overline{x}$ = average of (10) 1 min counts

x_i^2 =each count result squared

$$StdDev = \sqrt{\frac{n\sum_{i=1}^{n} x_i^2 - \left(\sum_{i=1}^{n} \overline{x}_i\right)^2}{n(n-1)}}$$

Comments:

Prepared By:	Date:
Reviewed By:	Date:

Form REC-WP-2-01-2

Form REC-WP-2-01-2
Performance Check Values
for
Ludlum 19

Project Number:		Project Name:	
Instrument Model:		Technician:	
Instrument S/N:		Date:	
Calibration Due:		Detector Model:	
Radiation Detected:		Detector S/N:	
Source Isotope & S/N:		Detector Type:	
Bkg µR/hr:			

Data Point	Gross µR/hr	Net µR/hr
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Average Net µR/hr			
Standard Deviation of Net µR/hr			
20% of Net µR/hr			
Average minus 20%			
Average plus 20%			

Formulas

Where: n = number of 1 min the counts (10)

$\overline{x}$ = average of (10) 1 min counts

x_i^2 =each count result squared

$$StdDev = \sqrt{\frac{n\sum_{i=1}^{n} x_i^2 - \left(\sum_{i=1}^{n} \overline{x}_i\right)^2}{n(n-1)}}$$

Comments:

Prepared By:	Date:
Reviewed By:	Date:

RECON Procedure: REC-WP-2-02

Instrument Minimum Detection Concentration Calculation

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: 01

EFFECTIVE DATE: MAY 2004

Approved Bill Vinzant — 5-10-04

J. W. (Bill) Vinzant – Project Manager — Date

Kaiser Aluminum & Chemical Corporation

RECON Procedure: REC-WP-2-02

Instrument Minimum Detection Concentration Calculation

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: **01**

EFFECTIVE DATE: **MAY 2004**

5/7/04
Danny P. Brown – Project Manager / Date

5/7/04
Richard Lewis – Quality Control Supervisor / Date

Remedial Construction Services, L.P.

1.0 PURPOSE

The purpose of this procedure is to provide instruction on the calculation of the Minimum Detectable Concentration (MDC) value of a radiation detection instrument/detector as required for survey activities at the Thorium Remediation Project in Tulsa, Oklahoma. Instruction for the calculation of the sample count time (t_s) required to achieve the MDC value is also provided.

2.0 DEFINITIONS

Calibration source: A National Institute of Standards and Technology- (NIST) traceable check source of a known value used to calibrate or verify the response efficiency of an *instrument.*

Detector: The portion of an *instrument* that transmits a signal to a *meter* based upon the radioactive activity present. Some detectors are contained within a *meter.*

Instrument: A meter-detector combination that has been calibrated as a single unit. Some meters are capable of being calibrated with several detectors simultaneously.

Meter: The portion of an *instrument* that receives and translates signals from the *detector* into a user observable result.

Instrument Efficiency: A measure of an instrument's ability to detect radiological activity. It is calculated by using the formula:

$$E_i = ((C-B_r)/D)$$

Where:

E_i = Instrument efficiency
C = Displayed value from the instrument count of the calibration source (count rate)
B_r = Background count rate
D = Known decay-corrected disintegrations per minute (dpm) value of the calibration source. This value is geometry dependent and should be noted on the calibration certificate, e.g., 2π or 4π geometry.

Note that, for gamma detection, the value of D may be provided in different units (e.g., μR/hr).

3.0 PREREQUISITES/PRECAUTIONS/LIMITATIONS

3.1 The MDC value should be calculated at a minimum each month or as directed by the RECON LHPT.

3.2 The calculation of MDC is background dependent Therefore, if background is known to change (e.g., the instrument is moved to a new location for use), the background count rate should be re-determined and the MDC value recalculated.

3.3 For static (fixed-count time) measurements, the MDC value is count-time dependent. The MDC value corresponding to each count time used should be calculated.

3.4 When the calculated MDC value for a static measurement is calculated always ensure that the MDC value is adequate for the survey (e.g., the MDC value is a fraction of the acceptance criteria). If the

MDC value is not adequate for the survey, increase the background count time and/or the sample count time and recalculate the MDC value.

4.0 EQUIPMENT

4.1 Calculator or spreadsheet with calculation built in.

5.0 PROCEDURE

5.1 Determination of Counting Times and Minimum Detectable Concentrations

Minimum counting times for background determinations and counting times for measurement of total and removable contamination will be chosen to provide a MDC that meets the acceptance criteria required by the site specific survey plan or other technical basis documents. The Multi-Agency Radiation Survey and Site Investigation Manual's (MARISSM) equations have been modified to convert to units of disintegrations per minute (dpm)/100 square centimeters (cm^2). Count times and scanning rates are determined using the following equations:

5.1.1 Static Counting of Alpha or Beta/Gamma Radiation

Static counting MDC at a 95 percent confidence level is calculated using the following equation, which is an expansion of NUREG 1507, *Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions*, Equation 6-7 (Strom & Stansbury, 1992):

$$MDC_{static} = \frac{3 + 3.29\sqrt{B_r \cdot t_b \cdot (1 + \frac{t_s}{t_b})}}{t_s \cdot E_{tot} \cdot \frac{A}{100}}$$

Where:

MDC_{static} = minimum detectable concentration level in dpm/100 cm^2
B_R = background count rate in counts per minute
t_B = background count time in minutes
t_S = sample count time in minutes
A = detector probe physical (active) area in cm^2
E_{tot} = total detector efficiency for radionuclide emission of
= E_i x E_s, Where:

E_i = 2π instrument efficiency in counts per disintegration (cpd)
E_s = source (or surface contamination) efficiency

Note: Es values can be determined or the default values provided in NUREG-1507 can be used as follows: 0.25 for all alpha energies and beta maximum energies between 0.15 and 0.4 MeV, 0.5 for all beta maximum energies greater than 0.4 MeV. All calculations will be recorded on the Monthly Static MDC and Count Time Calculation Form REC-WP-2-02-1.

5.1.2 Beta Ratemeter Scanning

Beta scanning MDC at a 95 percent confidence level is calculated using the following equation which is a combination of MARSSIM Equations 6-8, 6-9, and 6-10:

$$MDC_{scan} = \frac{d'\sqrt{b_i}\left(\frac{60}{i}\right)}{\sqrt{p}\cdot E_{tot}\cdot\frac{A}{100cm^2}}$$

Where:

MDC_{scan}	= minimum detectable concentration level in dpm/100 cm^2
d'	= desired performance variable (usually 1.38 corresponding to alpha and beta errors of 0.05)
b_i	= background counts during the residence interval
i	= residence interval in seconds
ρ	= surveyor efficiency (0.5 – 0.75, 0.5 is conservative)
A	= detector probe physical (active) area in cm^2
E_{tot}	= total detector efficiency for radionuclide emission of = E_i x E_s, Where:

E_i = 2π instrument efficiency in cpd
E_s = source (or surface contamination) efficiency

Note: Es values can be determined or the default values provided in NUREG-1507 can be used as follows: 0.25 for all alpha energies and beta maximum energies between 0.15 and 0.4 MeV, 0.5 for all beta maximum energies greater than 0.4 MeV. All calculations will be recorded on the Monthly Static MDC and Count Time Calculation Form REC-WP-2-02-1.

5.1.3 Alpha Ratemeter Scanning

There are two equations used to determine the alpha scanning Derived Concentration Guideline Values depending on the background level:

For a background level of <3 cpm, the probability of detecting a single count while passing over the contaminated area is:

$$P(n \geq 1) = 1 - e^{\frac{-GE_{tot}d}{60v}}$$

Where:

P(n ≥ 1)	= probability of observing a single count
G	= activity (dpm)

E_{tot} = total detector efficiency for radionuclide emission (E_i x E_s)
d = width of detector in direction of scan (cm)
v = scan speed (cm/s)

Increase the value of G until the corresponding probability equals the desired confidence level (e.g., 95 percent).

Once a count is detected while scanning, stop and hold the detector over the area long enough so that there is a 90-percent probability of getting another count as calculated by:
t=13,800/CAE

Where:

t= time period for static count(s)
C= contamination guideline (dpm)
A= physical probe area (cm^2)
E= total efficiency

For a background level of 3 cpm to about 10 cpm, the probability of detecting two or more counts while passing over the contaminated area is:

$$P(n \geq 2) = 1 - \left(1 + \frac{(GE_{tot} + B)d}{60v}\right)\left(e^{-\frac{(GE_{tot}+B)d}{60v}}\right)$$

Where:

$P(n \geq 2)$ = probability of observing two or more counts
G = activity (dpm)
E_{tot} = total detector efficiency for radionuclide emission (E_i x E_s)
B = background count rate (cpm)
d = width of detector in direction of scan (cm)
v = scan speed (cm/s)

Increase the value of G until the corresponding probability equals the desired confidence level (e.g., 95 percent).

Note: All calculations will be recorded on the Monthly Static MDC and Count Time Calculation Form REC-WP-2-02-1.

5.1.4 Gamma Soil Scanning

Gamma soil scanning MDCs are calculated for scanning instruments using the method provided in MARSSIM for calculating MDC that controls both Type I and Type II errors (i.e., elimination of false negatives and false positives), as follows:

$$\text{Scan MDC}_{\text{surveyor}} = \frac{d'\sqrt{b_i}(60/i)}{\sqrt{p}\,\epsilon_i}$$

Where: Scan $MDC_{surveyor}$ is the MDC in uR/hr, and

ϵ_i = instrument efficiency in cpm/μR/hour, radionuclide specific, see table below

ρ = surveyor efficiency. Based on laboratory studies documented in References 6 and 7, the value of ρ has been estimated to be between 0.5 and 0.75. The value of 0.5 is conservative

d' = is the value selected from MARSSIM Table 6.5 based on the required true positive and false positive rates, usually 1.38 corresponding to 5 percent false positives and 40 percent false negatives.

b_i = the number of background counts in the interval i

i = the scan time interval usually 1 second

In accordance with MARSSIM, the Scan $MDC_{surveyor}$ can be converted to Scan MDC in volumetric units of picocuries per gram by use of a radionuclide specific conversion factor calculated by use of the code MICROSHIELD. Some of the factors are listed below for 2-inch-by-2-inch sodium iodide detectors.

Radio-nuclide	ϵ_i (cpm/ μR/hr)	CF (pCi/g / μR/h)
Cs-137	900	3.81
Co-60	430	0.97
Am-241	13,000	271
Ra-226*	760	1.41
Th-232*	830	0.99

*In equilibrium with all progeny.

Note: All calculations will be recorded on the Monthly Static MDC and Count Time Calculation Form REC-WP-2-02-1.

6.0 REFERENCES

6.1 NUREG-1575, Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), December 1997

6.2 NUREG-1507, Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions, December 1997

7.0 ATTACHMENTS

Form REC-WP-2-02-1	Static MDC and Count Time Calculation
Form REC-WP-2-02-2	Beta Scan MDC Calculation
Form REC-WP-2-02-3	Alpha Scan MDC Calculation
Form REC-WP-2-02-4	Gross Gamma Scan MDC Calculation

RECON Procedure: REC-WP-2-02 Instrument MDC Calculation

Form REC-WP-2-02-1

Form REC-WP-2-02-1
Monthly Static MDC and Count Time Calculation

Instrument Serial Number:	Cal. Due:
Detector Serial Number:	Cal. Due:
Radiation Detected:	

E_i (Instrument Efficiency):	(cpd)
E_s (Source Efficiency):	(-)
E_{tot} (Total Efficiency):	(cpd)
A (Active Probe Area):	(cm^2)

$$MDC_{static} = \frac{3 + 3.29\sqrt{B_r \cdot t_s \cdot (1 + \frac{t_s}{t_b})}}{t_s \cdot E_{tot} \cdot \frac{A}{100}}$$

	D date	B background (counts)	t_b background count time (min)	B_r background count rate (cpm)	t_s sample count time (min)	MDC_{static} min. detectable concentration (dpm/100cm^2)
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						

Comments:	
Prepared By:	Date:
Reviewed By:	Date:

Notes:

1. $E_{tot} = E_i \times E_s$.
2. Source Efficiency (E_s) is also refered to as Contamination Source Efficiency or Surface Efficiency.
3. E_s is equal to 0.25 for all alpha emissions and beta emissions with maximum energy between 0.15 and 0.4 Mev. For maximum beta energies > 0.4 MeV, E_s is equal to 0.5.

Form REC-WP-2-02-2

Form REC-WP-2-02-2
Monthly Beta Scan MDC Calculation

Instrument Serial Number:		Cal. Due:	
Detector Serial Number:		Cal. Due:	
Radiation Detected:	Beta		

E_i (Instrument Efficiency):	(cpd)
E_s (Source Efficiency):	(-)
E_{tot} (Total Efficiency):	(cpd)
A (Active Probe Area):	(cm^2)

$$MDC_{scan} = \frac{d'\sqrt{b_i}\sqrt{(60/i)}}{\sqrt{p}\cdot E_{tot}\cdot\frac{A}{100cm^2}}$$

	D date	b_i background count rate (cpm)	I scan time (seconds)	ρ surveyor E (0.5 - 0.75) (-)	d' MARSSIM Table 6.5 (-)	MDC_{scan} min. detectable concentration (dpm/100cm^2)
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						

Comments:	
Prepared By:	Date:
Reviewed By:	Date:

Notes:

1. $E_{tot} = E_i \times E_s$.
2. Source Efficiency (E_s) is also refered to as Contamination Source Efficiency or Surface Efficiency.
3. E_s is equal to 0.25 for all alpha emissions and beta emissions with maximum energy between 0.15 and 0.4 Mev. For maximum beta energies > 0.4 MeV, E_s is equal to 0.5.
4. ρ = surveyor efficiency, ranges from 0.5 to 0.75, 0.5 is conservative.
5. d' = desired performance variable (usually 1.38 corresponding to alpha and beta errors of 0.05).

Form REC-WP-2-02-3

Form REC-WP-2-02-3
Monthly Alpha Scan MDC Calculation

Instrument Serial Number:		Cal. Due:	
Detector Serial Number:		Cal. Due:	
Radiation Detected:	Alpha		

Probability of observing 2 or more counts:

$$P(n \geq 2) = 1 - \left(1 + \frac{(GE+B)d}{60v}\right)\left(e^{-\frac{(GE+B)d}{60v}}\right)$$

Probability of observing a single count:

$$P(n \geq 1) = 1 - e^{\frac{-GEd}{60v}}$$

	D date	G Activity (dpm)	d Detector Width (cm)	E Instrument Efficiency (cpm)	v Scan Speed (cm/s)	B Background Countrate (cpm)	P Probability (-)
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							

Comments:	
Prepared By:	Date:
Reviewed By:	Date:

Note:
1. Instrument efficiency is the 4p instrument efficiency.

RECON Procedure: REC-WP-2-02

Instrument MDC Calculation

Form REC-WP-2-02-4

Form REC-WP-2-02-4
Gross Gamma Scan MDC Calculation

Instrument Serial Number:		Cal. Due:	
Detector Serial Number:		Cal. Due:	
Radiation Detected:	Gamma	Type of Detector:	

$$MDCR = \frac{d' \sqrt{b_i}(60 / i)}{\sqrt{p}}$$

$$\text{Scan MDC}_{\text{surveyor}} = \frac{d' \sqrt{b_i}(60 / i)}{\sqrt{p}\,\epsilon_i}$$

$$\text{Scan MDC} = \frac{d' \sqrt{b_i}(60 / i)}{\sqrt{p}\,\epsilon_i\,CF}$$

D date	Radio-nuclide	b_i background count rate (cpm)	E_i	I scan time (seconds)	r surveyor E (0.5 - 0.75) (-)	d' MARSSIM Table 6.5 (-)	MDCR min. detectable countrate (cpm)	Scan $MDC_{surveyor}$ min. detectable concentration (mR/hr)	CF conversion factor (pCi/g / mR/hr)	Scan MDC min. detectable concentration (pCi/g)

Comments:

Prepared By:	Date:
Reviewed By:	Date:

Notes:
CF = Conversion factor (Microshield/NUREG-1507).
ncpm = Net counts per minute.
mR/h = microRoentgen per hour.
E_i = Instrument efficiency (from Table 6.7 of MARSSIM).
pCi/g = Picocuries per gram.

RECON Procedure: REC-WP-2-03

Ludlum Model 2224 Scaler/Ratemeter with the Model 43-93 Detector

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: 01

EFFECTIVE DATE: MAY 2004

Approved, Bill Vinzant — 5-10-04

W. (Bill) Vinzant – Project Manager — Date

Kaiser Aluminum & Chemical Corporation

RECON Procedure: REC-WP-2-03

Ludlum Model 2224 Scaler/Ratemeter with the Model 43-93 Detector

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: **01**

EFFECTIVE DATE: **MAY 2004**

5/7/04
Danny P. Brown – Project Manager / Date

5/7/04
Richard Lewis – Quality Control Supervisor / Date

RECON Procedure: REC-WP-2-03

Ludlum Model 2224 Scaler/Ratemeter with the Model 43-93 Detector

1.0 PURPOSE

The purpose of this procedure is to provide basic operational instruction for the Ludlum Model 2224 Scaler/Ratemeter with the alpha/beta Model 43-93 Detector.

2.0 DEFINITIONS

Background: A measurement taken by this instrument to determine the amount of naturally occurring radiation at a given time at a given location.

Calibration source: A National Institute of Standards and Technology- (NIST) traceable check source of a known value used to calibrate or verify the response efficiency of the *instrument*.

Detector: The portion of this *instrument* that transmits a signal to a *meter* based upon the radioactive activity present. The model 43-93 detector is attached to the model 2224 *meter*.

Instrument: A meter-detector combination that has been calibrated as a single unit. Some instruments are capable of being calibrated with several detectors simultaneously.

Meter: The portion of this *instrument* that receives and translates signals from the *detector* into a user observable result.

Efficiency: A measure of this instrument's ability to detect radiological activity. It is calculated by using the formula:

$$E = ((C-B_r)/D)$$

Where:

E = Instrument efficiency
C = Displayed value from the instrument count of the calibration source (count rate)
B_r = Background count rate
D = Known decay-corrected disintegrations per minute (dpm) value of the calibration source

3.0 PREREQUISITES/PRECAUTIONS/LIMITATIONS

3.1 Any person operating a radiological survey instrument must be trained in its use or supervised during its operation by a qualified instructor.

3.2 Failure of any preoperational check will result in the instrument being removed from operation and repaired as necessary.

3.3 Any operator repair that may affect the efficiency response of the detector requires that the new efficiency response be within 10 percent of the calibration value but does not necessarily require a new calibration. If the new efficiency response is not within 10 percent of the calibration value, the instrument will be removed from operation and recalibrated.

3.4 An operator repair such as replacing batteries or cables does not require the instrument to be recalibrated. However, the efficiency of the instrument should be recalculated by using the formula listed above.

3.5 All manufacturer's recommendations regarding use, calibration, and/or maintenance of an instrument will be followed unless otherwise documented in this or other written procedure(s).

3.6 Additional guidance for operating an instrument can be found in the appropriate procedure and/or the manufacturer's manual for that instrument.

3.7 Basic Instrument Operation - See Procedure REC-WP-2-01

3.8 Instrument Minimum Detectable Concentration Calculations – See Procedure REC-WP-2-02

4.0 EQUIPMENT

- Ludlum Model 2224 Scaler/Ratemeter, or equivalent
- Ludlum alpha/beta Model 43-93 Detector, or equivalent

5.0 PROCEDURE

5.1 Preoperational Checks

5.1.1 Turn the instrument on and perform a battery check or verify that the power is on. Replace batteries (or charge battery as appropriate) if necessary.

5.1.2 Adjust the audible volume so that the alpha and beta/gamma clicks can be easily heard.

5.2 Operational Checks

5.2.1 Prior to using the counting system, the source check acceptance criteria of the average response will be determined. If the instrument is recalibrated at any point, the source check acceptance criteria will need to be re-established, in accordance with Procedure REC-WP-2-01.

5.2.2 Each day the instrument is used, determine ambient background and record on appropriate form.

5.2.3 Each day that a counting system is used, the response will be checked using an appropriate source, as follows.

5.2.4.1 Perform the source count by placing the appropriate source (alpha or beta) beneath the detector in a fixed-count geometry. This count is performed on both alpha and beta sources.

5.2.4.2 The net counts per minute value is compared to the acceptance criteria to determine a pass or fail status.

5.2.4.3 Record the source check readings on the appropriate form.

5.2.4 Check the source check result against the established postcalibration acceptance criteria. Failed source checks will be repeated. Consecutive failures will result in additional testing of the instrument. Refer to instrument manual.

5.2.5 Survey data acquired prior to an instrument failing a source check will be reviewed to determine the validity of the data. This review will be documented.

5.2.6 Determine the minimum detectable concentration for the instrument as required, in accordance with Procedure REC-WP-2-02.

6.0 REFERENCES

6.1 Instruction Manual - Ludlum Measurements, Inc., Sweetwater, TX, for Model 2224 Scaler/Ratemeter, March 2002 for Serial Number 183080 and succeeding serial numbers.

6.2 Instruction Manual - Ludlum Measurements, Inc., Sweetwater, TX, for Model 43-93 Alpha/Beta Scintillators, March 2002.

7.0 ATTACHMENTS

Form REC-WP-2-03-1 Daily Check for Ludlum Model 2224 with a 43-93 Detector

RECON Procedure: REC-WP-2-03

Ludlum Model 2224 Scaler/Ratemeter
with the Model 43-93 Detector

Form REC-WP-2-03-1

Form REC-WP-2-03-1 Daily Check Log
Ludlum Model 2224 with 43-93 Detector

Instrument/SN: Ludlum Model 2224 /		*Check Source(s) Used:*	
Detector/SN: Model 43-93 /		Date Calculated:	
EFF % α = %, β= %	Total EFF % α = %, β= %	Calc. By: Alpha	Beta
CALIB. SOURCE USED:		**Comments:**	
DATE OF CALIB.:			
CALIB. DUE DATE:			
PERFORMED BY:			

TECHNICIAN'S NAME	ALPHA / BETA	DATE	TIME	background count time (minutes)	background counts	GROSS READING	**NET READING**	BATT. CHECK	NEEDS CALIB.	
	α									
	β									
	α									
	β									
	α									
	β									
	α									
	β									
	α									
	β									
	α									
	β									
	α									
	β									
	α									
	β									
	α									
	β									
	α									
	β									
	α									
	β									

Prepared By:	Date:
Reviewed By:	Date:

RECON Procedure: REC-WP-2-04

Ludlum Model 3 Scaler/Ratemeter with the Model 44-9 Detector

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: 01

EFFECTIVE DATE: MAY 2004

Approved, J. W. Vinzant — 5-10-04

J. W. (Bill) Vinzant – Project Manager — Date

Kaiser Aluminum & Chemical Corporation

RECON Procedure: REC-WP-2-04

Ludlum Model 3 Scaler/Ratemeter with the Model 44-9 Detector

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: **01**

EFFECTIVE DATE: **MAY 2004**

5/7/04 — 5/7/04

Danny P. Brown – Project Manager / Date — Richard Lewis – Quality Control Supervisor / Date

RECON Procedure: REC-WP-2-04

Ludlum Model 3 Scaler/Ratemeter with the Model 44-9 Detector

1.0 PURPOSE

The purpose of this procedure is to provide basic operational instruction for the Ludlum Model 3 Scaler/Ratemeter with the alpha/beta/gamma Model 44-9 Detector.

2.0 DEFINITIONS

Background: A measurement taken by an instrument to determine the amount of naturally occurring radiation at a given time at a given location.

Calibration source: A National Institute of Standards and Technology- (NIST) traceable check source of a known value used to calibrate or verify the response efficiency of an *instrument.*

Detector: The portion of an *instrument* that transmits a signal to a *meter* based upon the radioactive activity present. The model 44-9 detector is attached to the model 3 *meter.*

Instrument: A meter-detector combination that has been calibrated as a single unit. This instrument is capable of being calibrated with several detectors simultaneously.

Meter: The portion of this *instrument* that receives and translates signals from the *detector* into a user observable result.

Efficiency: A measure of this instrument's ability to detect radiological activity. It is calculated by using the formula below:

$$E = ((C-B_r)/D)$$

Where:

E = Instrument efficiency
C = Displayed value from the instrument count of the calibration source (count rate)
B_r = Background count rate
D = Known decay-corrected disintegrations per minute (dpm) value of the calibration source

3.0 PREREQUISITES/PRECAUTIONS/LIMITATIONS

3.1 Any person operating a radiological survey instrument must be trained in its use or supervised during its operation by a qualified instructor.

3.2 Failure of any preoperational check will result in the instrument being removed from operation and repaired as necessary.

3.3 Any operator repair that may affect the efficiency response of the detector requires that the new efficiency response be within 10 percent of the calibration value but does not necessarily require a new calibration. If the new efficiency response is not within 10 percent of the calibration value, the instrument will be removed from operation and recalibrated.

3.4 An operator repair such as replacing batteries or cables does not require the instrument to be recalibrated. However, the efficiency of the instrument should be recalculated by using the formula listed above.

3.5 All manufacturer's recommendations regarding use, calibration, and/or maintenance of this instrument will be followed unless otherwise documented in this or other written procedure(s).

3.6 Additional guidance for operating this instrument can be found in the appropriate procedure and/or the manufacturer's manual for that instrument.

3.7 Basic Instrument Operation - REC-WP-2-01

3.8 Instrument Minimum Detectable Concentration Calculations - REC-WP-2-02

4.0 EQUIPMENT

- Ludlum Model 3 Scaler/Ratemeter, or equivalent
- Ludlum Model 44-9 Detector, or equivalent

5.0 PROCEDURE

5.1 Preoperational Checks

5.1.1 Turn the instrument on and perform a battery check or verify that the power is on. Replace batteries (or charge battery as appropriate) if necessary.

5.1.2 Adjust the audible volume so that the alpha and beta/gamma clicks can be easily heard in work area.

5.2 Operational Checks

5.2.1 Prior to using the counting system, the source check acceptance criteria of the average response will be determined. If the instrument is recalibrated at any point, the source check acceptance criteria will need to be re-established, in accordance with Procedure REC-WP-2-01.

5.2.2 Each day the instrument is used, determine ambient background and record on form REC-WP-2-04-1.

5.2.3 Each day that a counting system is used, the response will be checked using an appropriate source, as follows.

5.2.4.1 Perform the source count by placing the appropriate source (alpha or beta) beneath the detector in a fixed-count geometry. This count is performed on both alpha and beta sources.

5.2.4.2 The value of the net counts per minute is compared to the acceptance criteria to determine a

pass or fail status.

5.2.4.3 Record the source check readings on the form REC-WP-2-04-1.

5.2.4 Check the source check result against the established postcalibration acceptance criteria. Failed source checks will be repeated. Consecutive failures will result in additional testing of the instrument. Refer to instrument manual.

5.2.5 Survey data acquired prior to the instrument failing a source check will be reviewed to determine the validity of the data. This review will be documented on form REC-WP-2-04-1.

5.2.6 Determine the minimum detectable concentration for the instrument as required, in accordance with Procedure REC-WP-2-02.

6.0 REFERENCES

1.1 Instruction Manual - Ludlum Measurements, Inc., Sweetwater, TX, for Model 3 Survey Meter, February 2004 for Serial Number 202088 and succeeding serial numbers.

6.2 Instruction Manual - Ludlum Measurements, Inc., Sweetwater, TX, for Model 44-9 Alpha, Beta, Gamma Detector, Revised June 1995 for Serial Number PR090405 and succeeding serial numbers.

7.0 ATTACHMENTS

Form REC-WP-2-04-1 Daily Check for Ludlum Model 3 with a 44-9 Detector

RECON Procedure: REC-WP-2-04

Ludlum Model 3 Scaler/Ratemeter
with the Model 44-9 Detector

Form REC-WP-2-04-1

Remedial Construction Services, L.P. (Recon)
9720 Derrington
Houston, TX 77064
(281) 955-2442

Form REC-WP-2-04-1
Daily Check Log for Ludlum Model 3 with 44-9 Detector

Instrument Model:	3
Instrument S/N:	
Detector Model:	44-9
Detector S/N:	
Calibration Due:	

Source S/N:	
Source DPM:	
Radiation Detected:	Alpha/Beta/Gamma
Acceptable Range: (Refer to REC-WP-2-01-1)	

Date	Background Count Rate	Gross Source Count Rate	Net Source Count Rate	Technician	Comments

Comments:	
Prepared By:	Date:
Reviewed By:	Date:

RECON Procedure: REC-WP-2-05

Ludlum Model 19

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: 01

EFFECTIVE DATE: MAY 2004

Approved Bill Vinzant
J. W. (Bill) Vinzant – Project Manager

5-10-04
Date

Kaiser Aluminum & Chemical Corporation

RECON Procedure: REC-WP-2-05

Ludlum Model 19

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: 01

EFFECTIVE DATE: MAY 2004

5/7/04
Danny P. Brown – Project Manager / Date

5/7/04
Richard Lewis – Quality Control Supervisor / Date

Remedial Construction Services, L.P.

RECON Procedure: REC-WP-2-05 Ludlum Model 19

1.0 PURPOSE

The purpose of this procedure is to provide basic operational instructions for the Model 19 gamma survey Meter.

2.0 DEFINITIONS

AEPR: Acceptable End Point Range, range of detection displayed on the instrument where the confidence of the meter is not in question. The AERP is generally the center three quarters of the analog meter face.

3.0 PREREQUISITES/PRECAUTIONS/LIMITATIONS

3.1 Basic Instrument Operation – See Procedure REC-WP-2-01

4.0 EQUIPMENT

- Ludlum Model 19 gamma survey Meter
- Batteries

5.0 PROCEDURE

5.1 Installing Batteries

5.1.1 Open the lid and install two "D" size batteries. Note (+) (-) marks on the inside of lid. Match the battery polarity to these marks.

NOTE: To open the battery lid, twist the lid button counterclockwise one-quarter turn. To close, twist clockwise one-quarter turn.

5.1.2 Close the battery box lid.

5.2 Preoperational Checks

5.2.1 Adjust the audio (AUD) ON-OFF switch as desired.

5.2.2 Replace the batteries if the meter pointer is below the "BAT TEST" line. Check the battery by switching the power switch to "BATT".

5.2.4 Depress the Light Button (L). Check for light on the meter face.

5.2.5 Check the meter response in the "F" (fast) and "S" (slow) positions.

5.2.6 Check the audio indication with the "AUD ON-OFF" switch.

5.2.7 Check the instrument for the proper scale indication with a known source.

5.2.8 Depress the reset (RES) pushbutton. Check to see that the meter pointer returns to the zero position.

5.3 Operational Checks

5.3.1 Prior to using the Ludlum Model 19, the performance check value of the average response will be determined. If the instrument is recalibrated at any point, the performance check values will need to be re-established in accordance with Procedure REC-WP-2-01.

5.3.2 Each day the instrument is used, determine the ambient background and record on Form REC-WP-2-05-1.

5.3.3 Each day that the Ludlum Model 19 is used, the response will be checked using an appropriate check source as follows:

5.3.3.1 Place the check source on the front lower portion of the meter.

5.3.3.2 Allow for the meter face to stabilize.

5.3.3.3 Ensure that the meter reading is taken within the AEPR for accuracy and reproducibility.

5.3.4 Check the source check result against the established post-calibration acceptance criteria. Failed source checks will be repeated. Consecutive failures will result in additional testing of the instrument. Refer to the instrument manual.

5.3.5 Survey data acquired prior to an instrument failing a source check will be reviewed to determine the validity of the data. This review will be documented on form REC-WP-2-05-1.

5.3.6 Record the source check reading on Form REC-WP-2-05-1.

6.0 REFERENCES

6.1 Instruction Manual - Ludlum Measurements, Inc., Sweetwater, TX, for Model 19 Micro R Meter, Revised June, 2000 for Serial Number 144020 and succeeding serial numbers.

7.0 ATTACHMENTS

Form REC-WP-2-05-1 Daily Check Log for Ludlum Model 19

RECON Procedure: REC-WP-2-05

Ludlum Model 19

Form REC-WP-2-05-1

Form REC-WP-2-05-1
Daily Check Log for Ludlum Model 19

Instrument Model:	19
Instrument S/N:	
Detector Model:	N/A
Detector S/N:	N/A
Calibration Due:	

Source S/N:	
Source DPM:	N/A
Radiation Detected:	Gamma
Acceptable Range: (Refer to REC-WP-2-01-1)	

Date	Background µR/hr	Gross Source µR/hr	Net Source µR/hr	Technician	Comments

Comments:

Prepared By:	Date:
Reviewed By:	Date:

Remedial Construction Services, L.P. (Recon)
9720 Derrington
Houston, TX 77064

Revision 01
May 2004

RECON Procedure: REC-WP-2-06

Ludlum Model 177 Alarm Ratemeter with the Model 44-9 Detector

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: 01

EFFECTIVE DATE: MAY 2004

Approved, Bill Vinzant
J. W. (Bill) Vinzant – Project Manager

5-10-04
Date

Kaiser Aluminum & Chemical Corporation

RECON Procedure: REC-WP-2-06

Ludlum Model 177 Alarm Ratemeter with the Model 44-9 Detector

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: 01

EFFECTIVE DATE: MAY 2004

5/7/04 — Danny P. Brown – Project Manager / Date

5/7/04 — Richard Lewis – Quality Control Supervisor / Date

RECON Procedure: REC-WP-2-06

Ludlum Model 177 Alarm Ratemeter with the Model 44-9 Detector

1.0 PURPOSE

The purpose of this procedure is to provide basic operational instruction for the Ludlum Model 177 Alarm Ratemeter with the alpha/beta/gamma Model 44-9 Detector.

2.0 DEFINITIONS

Background: A measurement taken by this instrument to determine the amount of naturally occurring radiation at a given time at a given location.

Calibration source: A National Institute of Standards and Technology- (NIST) traceable check source of a known value used to calibrate or verify the response efficiency of an *instrument.*

Detector: The portion of the *instrument* that transmits a signal to a *meter* based upon the radioactive activity present. The model 44-9 detector is attached to the model 177 *meter.*

Instrument: A meter-detector combination that has been calibrated as a single unit. Some instruments are capable of being calibrated with several detectors simultaneously.

Meter: The portion of the *instrument* that receives and translates signals from the *detector* into a user observable result.

Efficiency: A measure of the instrument's ability to detect radiological activity. It is calculated by using the formula below:

$$E = ((C-B_r)/D)$$

Where:

E = Instrument efficiency
C = Displayed value from the instrument count of the calibration source (count rate)
B_r = Background count rate
D = Known decay-corrected disintegrations per minute (dpm) value of the calibration source

3.0 PREREQUISITES/PRECAUTIONS/LIMITATIONS

3.1 Any person operating a radiological survey instrument must be trained in its use or supervised during its operation by a qualified instructor.

3.2 Failure of any preoperational check will result in the instrument being removed from operation and repaired as necessary.

3.3 Any operator repair that may affect the efficiency response of the detector requires that the new efficiency response be within 10 percent of the calibration value but does not necessarily require a new calibration. If the new efficiency response is not within 10 percent of the calibration value, the instrument will be removed from operation and recalibrated.

3.4 An operator repair such as replacing batteries or cables does not require the instrument to be recalibrated. However, the efficiency of the instrument should be recalculated.

3.5 All manufacturer's recommendations regarding use, calibration, and/or maintenance of an instrument will be followed unless otherwise documented in this or other written procedure(s).

3.6 Additional guidance for operating an instrument can be found in the appropriate procedure and/or the manufacturer's manual for that instrument.

3.7 REC-WP-2-01, "Basic Instrument Operation"

3.8 REC-WP-2-02, "Instrument Minimum Detectable Concentration Calculations"

4.0 EQUIPMENT

- Ludlum Model 177 Scaler/Ratemeter, or equivalent
- Ludlum Model 44-9 Detector, or equivalent

5.0 PROCEDURE

5.1 Preoperational Checks

5.1.1 Turn the instrument on and perform a battery check or verify that the power is on. Replace batteries (or charge battery as appropriate) if necessary.

5.1.2 Adjust the audible volume so that the alpha and beta/gamma clicks can be easily heard.

5.2 Operational Checks

5.2.1 Prior to using the counting system, the source check acceptance criteria of the average response will be determined. If the instrument is recalibrated at any point, the source check acceptance criteria will need to be re-established, in accordance with Procedure REC-WP-2-01.

5.2.2 Each day the instrument is used, determine ambient background and record on appropriate form.

5.2.3 Each day that a counting system is used, the response will be checked using an appropriate source, as follows.

5.2.4.1 Perform the source count by placing the appropriate source (alpha or beta) beneath the detector in a fixed-count geometry. This count is performed on both alpha and beta sources.

5.2.4.2 The net counts per minute value is compared to the acceptance criteria to determine a pass or fail status.

5.2.4.3 Record the source check readings on the appropriate form.

5.2.4 Check the source check result against the established postcalibration acceptance criteria. Failed source checks will be repeated. Consecutive failures will result in additional testing of the instrument. Refer to instrument manual.

5.2.5 Survey data acquired prior to an instrument failing a source check will be reviewed to determine the validity of the data. This review will be documented.

5.2.6 Determine the minimum detectable concentration for the instrument as required, in accordance with Procedure REC-WP-2-02.

6.0 REFERENCES

6.1 Instruction Manual - Ludlum Measurements, Inc., Sweetwater, TX, for Model 177 Alarm Ratemeter, September 1999 for Serial Number 121166 and succeeding serial numbers.

6.2 Instruction Manual - Ludlum Measurements, Inc., Sweetwater, TX, for Model 44-9 Alpha, Beta, Gamma Detector, Revised June 1995 for Serial Number PR090405 and succeeding serial numbers.

7.0 ATTACHMENTS

Form REC-WP-2-06-1 Daily Check for Ludlum Model 177 with a 44-9 Detector

RECON Procedure: REC-WP-2-06

Ludlum Model 177 Alarm Ratemeter
with the Model 44-9 Detector

Form REC-WP-2-06-1

Form REC-WP-2-06-1
Daily Check Log for Ludlum Model 177 with 44-9 Detector

Instrument Model:	177
Instrument S/N:	
Detector Model:	44-9
Detector S/N:	
Calibration Due:	

Source S/N:	
Source DPM:	
Radiation Detected:	Alpha/Beta/Gamma
Acceptable Range: (Refer to REC-WP-2-01-1)	

Date	Background Count Rate	Gross Source Count Rate	Net Source Count Rate	Technician	Comments

Comments:

Prepared By:	Date:
Reviewed By:	Date:

RECON Procedure: REC-WP-2-07

Ludlum Model 2929 Dual-Channel Scaler with the Model 43-10-1 Detector

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: **01**

EFFECTIVE DATE: **MAY 2004**

J. W. (Bill) Vinzant – Project Manager

5-10-04
Date

Kaiser Aluminum & Chemical Corporation

RECON Procedure: REC-WP-2-07

Ludlum Model 2929 Dual-Channel Scaler with the Model 43-10-1 Detector

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: **01**

EFFECTIVE DATE: **MAY 2004**

5/7/04 — Danny P. Brown – Project Manager / Date

5/7/04 — Richard Lewis – Quality Control Supervisor / Date

RECON Procedure: REC-WP-2-07

Ludlum Model 2929 Dual-Channel Scaler with the Model 43-10-1 Detector

1.0 PURPOSE

The purpose of this procedure is to provide basic operational instruction for the Ludlum Model 2929 Dual-Channel Scaler with the alpha/beta Model 43-10-1 Detector.

2.0 DEFINITIONS

Background: A measurement taken by an instrument to determine the amount of naturally occurring radiation at a given time at a given location.

Planchet: A tray onto which a *swipe* sample or *smear* is placed in order to be analyzed.

Swipe: A cloth or paper disc that is wiped on the surface of an area or object being surveyed. Also referred to as a *smear.*

3.0 PREREQUISITES/PRECAUTIONS/LIMITATIONS

3.1 REC-WP-2-01, "Basic Instrument Operation"

3.2 REC-WP-2-02, "Instrument Minimum Detectable Concentration Calculations"

4.0 EQUIPMENT

- Ludlum Model 2929 Dual-Channel Scaler
- Planchets
- Cloth Swipes

5.0 PROCEDURE

5.1 Preoperational Checks

5.1.1 Turn the instrument on.

5.1.2 Slide sample receiver into the base of the counting instrument and lock down the receiver by turning the locking mechanism clockwise.

5.2 Operational Checks

5.2.1 Prior to using the counting system, the source check acceptance criteria of the average response will be determined. If the instrument is recalibrated at any point, the source check acceptance criteria will need to be re-established, in accordance with Procedure REC-WP-2-01.

5.2.2 Each day the instrument is used, determine the ambient background and record on the form REC-WP-2-07-1..

5.2.3 Perform the background count for the predetermined duration by completely closing and locking the tray and pressing the count button. At the end of the time, record the results on form REC-WP-2-07-1.

5.2.4 Each day that a counting system is used, the response will be checked using an appropriate source, as follows.

5.2.4.1 Perform the source count by placing the appropriate source (alpha or beta) on a planchet. Place the planchet in the tray and insert the tray. Completely close the tray and lock the source into place. Begin the source count by depressing the count button. At the end of the time, record the results on form REC-WP-2-07-1. This count is performed on both alpha and beta sources.

5.2.4.2 The net counts per minute (cpm) value is compared to the acceptance criteria to determine a pass or fail status.

5.2.4.3 Record the source check readings on the form REC-WP-2-07-1.

5.2.4 Compare the source check result against the established postcalibration acceptance criteria. Failed source checks will be repeated. Consecutive failures will result in additional testing of the instrument. Refer to instrument manual.

5.2.5 Survey data acquired prior to an instrument failing a source check will be reviewed to determine the validity of the data. This review will be documented on form REC-WP-2-07-1.

5.2.6 Determine the minimum detectable concentration for the instrument as required, in accordance with Procedure REC-WP-2-02.

5.3 Counting Samples

5.3.1 Check and set the time indicator for the sample count guidelines.

5.3.2 Place the swipe sample on a planchet. Open the tray and insert the planchet. Completely close the tray and lock it into place. Press the count button.

5.3.3 At the end of the predetermined time period, record the alpha and beta/gamma counts on form REC-WP-2-07-1.

5.3.4 Remove the planchet and repeat, as necessary.

6.0 REFERENCES

6.1 Instruction Manual - Ludlum Measurements, Inc., Sweetwater, TX, for Model 2929 Dual-Channel Scaler, September 2001 for Serial Number 171575 and succeeding serial numbers.

6.2 Instruction Manual - Ludlum Measurements, Inc., Sweetwater, TX, for Model 43-10-1 Alpha, Beta, Gamma Detector, Revised June 1995 for Serial Number PR090405 and succeeding serial numbers

RECON Procedure: REC-WP-2-07

Ludlum Model 2929 Dual-Channel Scaler with the Model 43-10-1 Detector

7.0 ATTACHMENTS

Form REC-WP-2-07-1 Daily Check for Ludlum Model 2929 with a 43-10-1 Detector

RECON Procedure: REC-WP-2-07

Ludlum Model 2929 Dual-Channel Scaler
with the Model 43-10-1 Detector

Form REC-WP-2-07-1

Form REC-WP-2-07-1
Daily Check Log for Ludlum Model 2929 with a 43-10-1 Detector

Instrument Model:	2929
Instrument S/N:	
Detector Model:	43-10-1
Detector S/N:	
Calibration Due:	

Source S/N:		
Source Amount		
Radiation Detected:	Alpha	Beta
Acceptable Range:		
Background Count Time:		

Date	Background Count Rate Alpha (cpm)	Background Count Rate Beta (cpm)	Gross a Source Count Rate (cpm)	Gross b Source Count Rate (cpm)	Net a Source Count Rate (cpm)	Net b Source Count Rate (cpm)	Technician	Comments

Prepared By:	Date:
Reviewed By:	Date:

RECON Procedure: REC-WP-2-08

Ludlum Model 2221 Scaler/Ratemeter with the Model 43-5 Detector

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: 01

EFFECTIVE DATE: MAY 2004

Approved B. W. Vinzant — 5-10-04

J. W. (Bill) Vinzant – Project Manager — Date

Kaiser Aluminum & Chemical Corporation

RECON Procedure: REC-WP-2-08

Ludlum Model 2221 Scaler/Ratemeter with the Model 43-5 Detector

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: 01

EFFECTIVE DATE: MAY 2004

5/7/04 — Danny P. Brown – Project Manager / Date

5/7/04 — Richard Lewis – Quality Control Supervisor / Date

RECON Procedure: REC-WP-2-08

Ludlum Model 2221 Scaler/Ratemeter with the Model 43-5 Detector

1.0 PURPOSE

The purpose of this procedure is to provide basic operational instruction for the Ludlum Model 2221 Scaler/Ratemeter with the alpha Model 43-5 Detector.

2.0 DEFINITIONS

Background: A measurement taken by an instrument to determine the amount of naturally occurring radiation at a given time at a given location.

Calibration source: A National Institute of Standards and Technology- (NIST) traceable check source of a known value used to calibrate or verify the response efficiency of an *instrument.*

Detector: The portion of the *instrument* that transmits a signal to a *meter* based upon the radioactive activity present. The model 43-3 detector is attached to the model 2221 *meter.*

Instrument: A meter-detector combination that has been calibrated as a single unit. Some instruments are capable of being calibrated with several detectors simultaneously.

Meter: The portion of this *instrument* that receives and translates signals from the *detector* into a user observable result.

Efficiency: A measure of this instrument's ability to detect radiological activity. It is calculated by using the formula below:

$$E = ((C-B_r)/D)$$

Where:

E = Instrument efficiency
C = Displayed value from the instrument count of the calibration source (count rate)
B_r = Background count rate
D = Known decay-corrected disintegrations per minute (dpm) value of the calibration source

3.0 PREREQUISITES/PRECAUTIONS/LIMITATIONS

3.1 Any person operating a radiological survey instrument must be trained in its use or supervised during its operation by a qualified instructor.

3.2 Failure of any preoperational check will result in the instrument being removed from operation and repaired as necessary.

3.3 Any operator repair that may affect the efficiency response of the detector requires that the new efficiency response be within 10 percent of the calibration value but does not necessarily require a new calibration. If the new efficiency response is not within 10 percent of the calibration value, the instrument will be removed from operation and recalibrated.

3.4 An operator repair such as replacing batteries or cables does not require the instrument to be recalibrated. However, the efficiency of the instrument should be recalculated.

3.5 All manufacturer's recommendations regarding use, calibration, and/or maintenance of an instrument will be followed unless otherwise documented in this or other written procedure(s).

3.6 Additional guidance for operating an instrument can be found in the appropriate procedure and/or the manufacturer's manual for that instrument.

3.7 REC-WP-2-01, "Basic Instrument Operation"

3.8 REC-WP-2-02, "Instrument Minimum Detectable Concentration Calculations"

4.0 EQUIPMENT

- Ludlum Model 2221 Scaler/Ratemeter, or equivalent
- Ludlum Model 43-5 alpha Detector, or equivalent

5.0 PROCEDURE

5.1 Preoperational Checks

5.1.1 Turn the instrument on and perform a battery check or verify that the power is on. Replace batteries (or charge battery as appropriate) if necessary.

5.1.2 Adjust the audible volume so that the alpha and beta/gamma clicks can be easily heard.

5.2 Operational Checks

5.2.1 Prior to using the counting system, the source check acceptance criteria of the average response will be determined. If the instrument is recalibrated at any point, the source check acceptance criteria will need to be re-established, in accordance with Procedure REC-WP-2-01.

5.2.2 Each day the instrument is used, determine ambient background and record on appropriate form.

5.2.3 Each day that a counting system is used, the response will be checked using an appropriate source, as follows.

5.2.4.1 Perform the source count by placing the appropriate alpha source beneath the detector in a fixed-count geometry. This count is performed on alpha sources.

5.2.4.2 The net counts per minute value is compared to the acceptance criteria to determine a pass or fail status.

5.2.4.3 Record the source check readings on the appropriate form.

5.2.4 Check the source check result against the established postcalibration acceptance criteria. Failed source checks will be repeated. Consecutive failures will result in additional testing of the instrument. Refer to instrument manual.

5.2.5 Survey data acquired prior to an instrument failing a source check will be reviewed to determine the validity of the data. This review will be documented.

5.2.6 Determine the minimum detectable concentration for the instrument as required, in accordance with Procedure REC-WP-2-02.

6.0 REFERENCES

6.1 Instruction Manual - Ludlum Measurements, Inc., Sweetwater, TX, for Model 2221 Portable Scaler Ratemeter, Revised July 1994 for Serial Number 89651 and succeeding serial numbers.

6.2 Instruction Manual - Ludlum Measurements, Inc., Sweetwater, TX, for Model 43-05 Alpha Scintillator Revised October 1996.

7.0 ATTACHMENTS

Form REC-WP-2-08-1	Daily Check for Ludlum Model 2221 with a 43-5 Detector

RECON Procedure: REC-WP-2-08

Ludlum Model 2221 Scaler/Ratemeter
with the Model 43-5 Detector

Form REC-WP-2-08-1

Form REC-WP-2-08-1 Daily Check Log
Ludlum Model 2221 with 43-5 Detector

Instrument/SN: Ludlum Model 2221 /		*Check Source(s) Used:*	
Detector/SN: Model 43-5 /		Date Calculated:	
EFF % α = %, β= %	Total EFF % α = %, α= %	Calc. By: Alpha	
CALIB. SOURCE USED:		**Comments:**	
DATE OF CALIB.:			
CALIB. DUE DATE:			
PERFORMED BY:			

TECHNICIAN'S NAME	ALPHA	DATE	TIME	background count time (minutes)	background counts	GROSS READING	**NET READING**	BATT. CHECK	NEEDS CALIB.		
	α										
	α										
	α										
	α										
	α										
	α										
	α										
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Prepared By:	Date:
Reviewed By:	Date:

RECON Procedure: REC-WP-2-09

Dosimeter Issuance and Tracking

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: 02

EFFECTIVE DATE: MAY 2004

Approved: Bill Vinzant — 5-10-04

J. W. (Bill) Vinzant – Project Manager — Date

Kaiser Aluminum & Chemical Corporation

RECON Procedure: REC-WP-2-09

Dosimeter Issuance and Tracking

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: **02**

EFFECTIVE DATE: **MAY 2004**

5/7/04 5/7/04

Danny P. Brown – Project Manager / Date

Richard Lewis – Quality Control Supervisor / Date

RECON Procedure: REC-WP-2-09 Dosimeter Issuance and Tracking

1.0 PURPOSE

The purpose of this procedure is to provide instruction for the issuance and tracking of radiation badges.

2.0 DEFINITIONS

NA

3.0 PREREQUISITES/PRECAUTIONS/LIMITATIONS

3.1 Personnel will have successfully completed Radiation Health and Safety Plan (RHASP) training requirements.

3.2 Personnel shall have completed Cumulative Occupational Dose History, U.S. Nuclear Regulatory Commission (NRC) Form 4.

3.3 Personnel shall not knowingly take dosimeter off site.

3.4 Personnel shall notify the Recon Radiation Safety Officer when they have undergone medical procedures involving radioactive materials or procedures involving the use of radiation.

4.0 EQUIPMENT

4.1 Appropriate check source(s) or calibration source(s), as necessary.

5.0 PROCEDURE

5.1 Radiation Badge Issuance (Dosimeter)

5.1.1 Dosimeter will be issued to all individuals who are subject to entering into restricted / controlled areas as per the Radiation Health and Safety Plan, section 6.0.

5.1.2 Individuals shall wear dosimetry when entering the Restricted Area at all times.

5.1.3 After exiting the Restricted Area dosimeters will be returned to Access Control.

5.1.4 At least one control dosimeter shall be posted in Access Control to assess normal background radiation.

5.1.5 Lost or damaged dosimeters shall be reported to the Recon LHPT immediately.

5.1.6 Lost or damaged dosimeters shall be documented on form REC-WP-2-09-1.

5.2 Review/Notification/Reports

5.2.1 Individual exposure results will be maintained on NRC Form 5 in the RHASP Attachment 8.

5.2.2 Dosimetry will be reviewed quarterly and annually by the Recon LHPT.

5.2.3 Abnormal results will be investigated and reported by the Recon LHPT to the Kaiser Aluminum and Chemical Corporation RSO.

5.2.4 Copies of individual exposure results will be provided to each individual at the end of each year.

6.0 REFERENCES

6.1 Radiation Health and Safety Plan, Attachment 8 (NRC Form 4)

7.0 ATTACHMENTS

Form REC-WP-2-09-1 Lost or Damaged Dosimeter Report

RECON Procedure: REC-WP-2-09 Dosimeter Issuance and Tracking

Form REC-WP-2-09-1

Form REC-WP-2-09-1
Lost or Damaged Dosimeter Report

Name:_____ Date:_____

SSN:_____ Date Lost or Damaged:_____

Dosimeter Number:_____

Location Lost:_____

Remarks:_____

_____

_____

_____

_____
Signature

_____
Radiation Safety Officer

Actions Taken:_____

_____

_____
Reviewed By

RECON Procedure: REC-WP-3-01

Gross Gamma Survey

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: **01**

EFFECTIVE DATE: **MAY 2004**

Approved, Bill Vinzant — 5-10-04

J. W. (Bill) Vinzant – Project Manager — Date

Kaiser Aluminum & Chemical Corporation

RECON Procedure: REC-WP-3-01

Gross Gamma Survey

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: 01

EFFECTIVE DATE: MAY 2004

5/7/04 5/7/04

Danny P. Brown – Project Manager / Date | Richard Lewis – Quality Control Supervisor / Date

RECON Procedure: REC-WP-3-01 Gross Gamma Survey

1.0 PURPOSE

The purpose of this procedure is to provide written instruction for measuring gross gamma activity on soil or structure surfaces during the Thorium Remediation Project.

2.0 DEFINITIONS

Site Background Count: A measurement taken by an instrument to determine the amount of naturally occurring radiation at a given time at a given location.

Shine: Radiation detected from radioactive material in the vicinity of the area that is being surveyed, in addition to natural background radiation.

3.0 PREREQUISITES/PRECAUTIONS/LIMITATIONS

3.1 Instrument must pass preoperational and operational checks as outlined in Procedure REC-WP-2-01 and the appropriate instrument procedure.

3.2 A site background may have been established.

3.3 Procure any drawings of the survey area which indicate the facility features and reference locations.

3.4 Background microR per hour rates may vary by area and time of day. Background should be established in discrete areas based on variations in the background microR per hour rate and should be established at least daily for each such area. Variations in background as the elevation of the measurement changes should be accounted for. For example, shine from surrounding structures may be shielded at a lower elevation but may increase background as elevation increases.

3.5 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, study area and survey unit and person conducting survey.

3.6 Ensure the preoperational and source checks have been completed prior to initiating survey.

4.0 EQUIPMENT

4.1 Ludlum Model 19, or equivalent.

5.0 PROCEDURE

5.1 The background microR per hour rate should be established for each discrete area to be surveyed and each time (at least daily) that a survey is performed.

5.2 Background microR per hour rate should be established at approximately 1 meter above the surface to be scanned. If shine causes the background microR per hour rate at 1 meter above the surface to exceed the count rate at the surface, note on the survey map and/or other survey documentation.

5.3 Record the background established for the survey area, the date and time of the background

microR per hour for each area, and the average background microR per hour rate on the appropriate form.

5.4 Using the guidance provided in Procedure REC-WP-2-02, calculate the scan Minimum Detectable Concentration prior to surveying the area.

5.5 Position the detector as close to the surface as reasonable but not greater than 10 centimeters from the surface to be surveyed.

5.6 Slowly pass the detector across the surface at a rate of lateral motion not to exceed 0.5 meters per second.

5.7 Listen for a change in the audible response and watch the analog or digital readout for a change.

5.8 If an increase in the audible microR per hour rate is detected, pause and allow the reading to stabilize (approximately 15 to 30 seconds) and complete the following:

5.8.1 Perform a station fixed-time microR per hour rate (e.g., 1-minute fixed-time on contact with the soil).

5.8.2 Subtract background established for the grid from the fixed-microR per hour result and record the net.

5.9 Mark any areas of elevated activity using paint, grease pencil, survey flags, or other methods, depending on the survey location.

5.10 Continue traversing the survey unit (area) until the required survey coverage is achieved.

5.11 Record the results in the appropriate survey documentation.

5.12 Attach drawings, pictures, and/or supporting data.

6.0 REFERENCES

NA

7.0 ATTACHMENTS

REC-WP-3-01-1	Survey Data Log

RECON Procedure: REC-WP-3-01 Gross Gamma Survey

Form REC-WP-3-01-1

Form REC-WP-3-01-1
Survey Data Log

Instrument Model:	
Instrument S/N:	
Detector Model:	
Detector S/N:	

Date of Survey:	
Units of Measure:	µR/hr / cpm
Radiation Detected:	β γ
Calibration Due:	

Time	Survey Area	Ambient Bkg. Count Rate On Contact	@ 1 Meter	Scan of the Area Maximum	Minimum	Average	On Contact Measurement	Comments

Technician:	
Prepared By:	Date:
Reviewed By:	Date:

RECON Procedure: REC-WP-3-02

Personnel Radiation Survey (Frisking)

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: 01

EFFECTIVE DATE: MAY 2004

Approved, Bill Vinzant — 5-10-04

/s/ W. (Bill) Vinzant – Project Manager — Date

Kaiser Aluminum & Chemical Corporation

RECON Procedure: REC-WP-3-02

Personnel Radiation Survey (Frisking)

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: 01

EFFECTIVE DATE: MAY 2004

5/7/04 5/7/04

Danny P. Brown – Project Manager / Date Richard Lewis – Quality Control Supervisor / Date

RECON Procedure: REC-WP-3-02 Personnel Radiation Survey (Frisking)

1.0 PURPOSE

The purpose of this procedure is to provide written instructions to measure for the possible presence of radioactive material on the body or clothing.

2.0 DEFINITIONS

Standoffs: Spacers used to keep the detector a specified distance from a surface.

3.0 PREREQUISITES/PRECAUTIONS/LIMITATIONS

3.1 When performing a personnel radiation survey the detector must be within one half inch of the body or clothing being surveyed.

3.2 Instrument must pass preoperational checks as outlined in Procedure REC-WP-2-01 and the appropriate instrument procedure.

3.3 Only qualified and trained personnel may complete these surveys.

3.4 Additional guidance on performing personnel radiation surveys is provided in NUREG-1575.

4.0 EQUIPMENT

4.1 Appropriate calibrated survey meter and detector.

5.0 PROCEDURE

5.1 Presurvey

5.1.1 When exiting a restricted area, proceed to the boot wash station and wash boots.

5.1.2 Carefully remove all other PPE as per site specific briefing and dispose in appropriately marked containers before entering access control.

5.1.3 Proceed to frisking station.

5.2 Scan Survey

5.2.1 Prior to picking up the probe carefully frisk hands to prevent cross contamination as per the Radiation Health and Safety Plan.

5.2.2 The person will be frisked (see illustration) at a rate not to exceed 3 inches per second. Due to the delicate nature of the probe face, care must be taken to avoid coming in contact with rough surfaces or sharp objects that could cause damage.

5.2.3 Listen for a change in the audible count rate and observe for changes in needle deflection.

5.2.4 If contamination is detected, step away from the meter and notify the Recon Radiation Safety Officer or designee prior to any decontamination attempt.

5.2.5 Decontamination efforts will be taken prior to conducting another frisk.

5.2.6 Personal clothing or other articles that are unable to be decontaminated will not be allowed to leave the access control area and will be placed in appropriately marked containers.

5.2.7 Repeat sub-steps 5.2.1, 5.2.2 and 5.2.3 as necessary.

5.2.8 After completing the frisk wash face and hands and sign out on the Access Control Log.

6.0 REFERENCES

Radiation Health and Safety Plan, Attachment 4 (Access Control Log)

7.0 ATTACHMENTS

Max Scott Illustration of Frisking Techniques

RECON Procedure: REC-WP-3-02 Personnel Radiation Survey (Frisking)

Max Scott Illustration of Frisking Techniques

ATTACHMENT A

PROTOCOL FOR SURVEYING PERSONNEL FOR CONTAMINATION

(1) Have a person stand on a step-off pad.

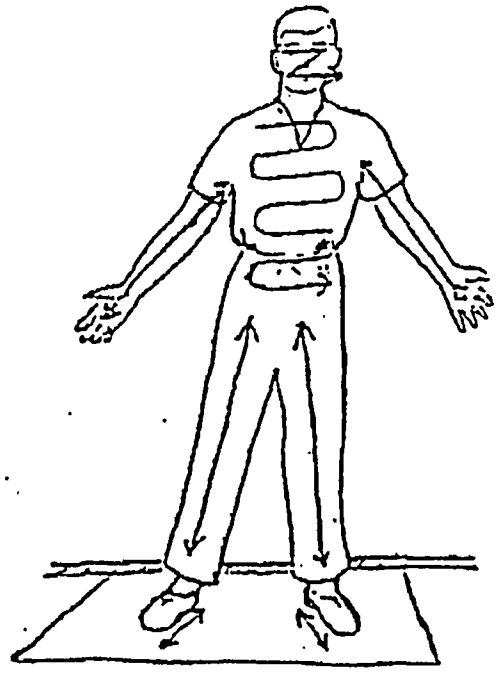
(2) Instruct the person to stand straight, feet spread slightly, arms extended with palms up and fingers straight out.

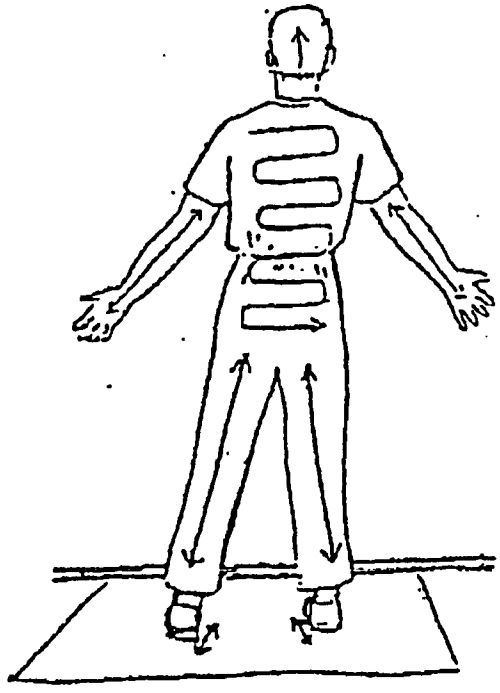
(3) Monitor both hands and forearms to the elbow palms up, then repeat with hands and arms turned over.

(4) Starting at the top of the head, cover the entire front of the body, monitoring carefully the forehead, nose, mouth, neck line, torso, knees, and ankles.

(5) Have the subject turn around, and repeat the survey on the back of the body.

(6) Monitor the soles of the feet.





RECON Procedure: REC-WP-3-03

Entrance or Unrestricted Release Survey

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: 01

EFFECTIVE DATE: MAY 2004

Approved, Bill Vinzant — 5-10-04

J. W. (Bill) Vinzant – Project Manager — Date

Kaiser Aluminum & Chemical Corporation

RECON Procedure: REC-WP-3-03

Entrance or Unrestricted Release Survey

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: **01**

EFFECTIVE DATE: **MAY 2004**

5/7/04 5/7/04

Danny P. Brown – Project Manager / Date Richard Lewis – Quality Control Supervisor / Date

1.0 PURPOSE

The purpose of this procedure is to provide written instruction for the collection of removable alpha/beta surface contamination samples and to survey fixed beta/gamma contamination.

2.0 DEFINITIONS

Swipe: A cloth or paper disc that is wiped on the surface of an area or object being surveyed. Also referred to as a *smear*.

3.0 PREREQUISITES/PRECAUTIONS/LIMITATIONS

3.1 Ensure the area surveyed by the swipe is approximately 100 square centimeters (cm^2).

3.2 Additional guidance on performing removable contamination surveys is provided in NUREG-1575.

3.3 Scanned tools or equipment exceeding limits will not be released.

4.0 EQUIPMENT

4.1 Swipes

4.2 Gloves (latex, nitrile, canvas, etc.)

4.3 Using appropriate instrument

4.4 Ludlum Model 2929 with 43-10-1 Detector

5.0 PROCEDURE

5.1 Label the swipe to ensure the result is associated with the proper area. Some swipes come with an adhesive-type back and are adhered to a cover paper with an area for labeling. These swipes are preferred.

5.2 Hold the swipe so that the collection area will contact the surface being surveyed.

5.3 Wipe the area to be surveyed over a 100 cm^2 area (about a 4-inch-by-4-inch area) in a back-and-forth motion. An alternate method is to wipe the surface using an "S" motion that is 9 inches from top to bottom and from side to side.

5.4 Close the cover of the swipe or place in an envelope or bag. Several swipes may be placed in one envelope or bag, depending on the potential for cross contamination.

5.5 Label the bag as appropriate.

5.6 Count on an appropriate counter (e.g., Ludlum Model 2929, et al.) utilizing appropriate procedures; or

5.7 Log the swipe including the date, time taken, and results of the counting (if available) on Form REC-WP-3-05-1 and the Entrance / Unrestricted Form.

5.8 If counted per Step 5.6, convert the counts per minute result to disintegrations per minute (dpm)/100 cm^2

using the following equation:

$$dpm/100cm^2 = \frac{(c_s/t_s)-(c_b/t_b)}{E}$$

Where:

c_s = counts recorded for sample
c_b = counts recorded for background
E = the detection efficiency of the instrument in counts per disintegration
t_s = the time period (in minutes) over which the count was recorded for the sample
t_b = the time period (in minutes) over which the count was recorded for the background sample

5.9 Fixed contamination is measured using appropriate instrument. Each selected survey location is scanned at the rate of 3 inches per second. The CPM will be documented for conversion to DPM on the appropriate form(s). The release limits for fixed contamination will be those of 10 CFR Part 835, Appendix D.

6.0 REFERENCES

6.1 Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), NUREG/CR-1575, August 2000, Rev. 1.

6.2 Radiation Health and Safety Plan, Attachment 5 (Entrance/Unrestricted Release Form)

6.3 Radiation Health and Safety Plan, Attachment 6 (Release Limit Criteria)

7.0 ATTACHMENTS

Form REC-WP-3-05-1 Sample Log for Ludlum Model 2929 with a 43-10-1 Detector

Form REC-WP-3-05-1

Form REC-WP-3-05-1
Removable Alpha/Beta Survey Sample Log Detector

Instrument Model:	2929
Instrument S/N:	
Detector Model:	43-10-1
Detector S/N:	
Calibration Due:	

Source S/N:	N/A	N/A
Source Amount	N/A	N/A
Radiation Detected:	Alpha	Beta
Acceptable Range:		
(Refer to REC-WP-2-01-1)		

Date	Background Count Rate Alpha (cpm)	Background Count Rate Beta (cpm)	Gross a Sample Count Rate (cpm)	Gross b Sample Count Rate (cpm)	Net a Sample Count Rate (cpm)	Net b Sample Count Rate (cpm)	a Contamination (dpm/100 cm^2)	b Contamination (dpm/100 cm^2)	Technician	Comments

Prepared By:	Date:
Reviewed By:	Date:

RECON Procedure: REC-WP-3-04

Exposure Rate Survey

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: **01**

EFFECTIVE DATE: **MAY 2004**

Approved Bill Vinzant 5-10-04

J.W. (Bill) Vinzant – Project Manager — Date

Kaiser Aluminum & Chemical Corporation

RECON Procedure: REC-WP-3-04

Exposure Rate Survey

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: **01**

EFFECTIVE DATE: **MAY 2004**

5/7/04
Danny P. Brown – Project Manager / Date

5/7/04
Richard Lewis – Quality Control Supervisor / Date

1.0 PURPOSE

The purpose of this procedure to provide written instruction for measuring gamma exposure rate levels.

2.0 DEFINITIONS

Background Exposure Rate: A radiation exposure rate that occurs naturally in the environment. Background exposure rate would include exposure to cosmic radiation from outer space, terrestrial radiation from the radioactive elements in rocks and soil, and radiation from radon and its decay products in air.

3.0 PREREQUISITES/PRECAUTIONS/LIMITATIONS

3.1 The instrument to be used must pass the preoperational checks as outlined in Procedure REC-WP-2-01 and the appropriate instrument procedure.

3.2 Background measurements for land areas should be collected at locations which are unaffected by effluent releases (upwind and upstream) and other site operations (upgradient from disposal areas).

3.3 Locations of potential runoff from areas of surface contamination and locations that may have been affected or disturbed by nonsite activities should also be avoided.

4.0 EQUIPMENT

4.1 A Ludlum Model 19, or equivalent.

5.0 PROCEDURE

5.1 All Surveys

5.1.1 Complete the preoperational checks in accordance with Procedure REC-WP-2-01 and the appropriate instrument procedure.

5.1.2 Establish the background exposure rate for the area to be surveyed. Background is determined by measurements at locations on site or in the immediate vicinity of the site (out to several kilometers from the site boundary), which are unaffected by site operations. All measurements should be taken at approximately 1 meter above ground. Take measurements in accordance with Section 5.2.

5.1.3 To obtain an accurate background measurement, six to 10 measurements will be taken above unaffected areas and a confidence level of 95 percent determined to ensure accuracy. The equation for determining the number of samples is as follows:

$$n_B = \left[\frac{t_{95\%,df} * S_x}{0.2 * \bar{x}_B} \right]^2$$

Where:

n_B = Number of background measurements required

$\bar{x}_B$ = Mean of initial background measurements

S_x = Standard deviation of background measurements

$t_{95\%,df}$ = t Statistic for 95 percent confidence at df = n-1 degrees of freedom, where n is the number of initial background data points. A table of t values is provided in Procedure ESC/HPM/M-2-1.

5.1.4 If the above calculation indicates that additional background measurements are needed, it is recommended that they be collected uniformly over the area, using the same methodology as that used for the initial measurements. The average background is then recalculated using all data points.

5.2 General Area Survey

5.2.1 Position the detector approximately 1 meter above the surface to be surveyed.

5.2.2 Listen for a change in audible response and watch for needle deflection on the analog readout.

5.2.3 Record result on Form REC-WP-3-01-1.

5.3 Contact Survey

5.3.1 Position the detector within one-quarter inch (0.6 centimeter [cm]) of the surface to be surveyed.

5.3.2 Listen for a change in the audible count rate and observe for changes in needle deflection.

5.3.3 Mark any areas of elevated activity, utilizing flagging tape or spray paint.

5.3.4 Record the results in the appropriate survey documentation (e.g., survey maps, Form REC-WP-3-01-1).

5.4 Scan Survey

5.4.1 Position instrument within 10 cm of the surface to be scanned.

5.4.2 Slowly move the instrument across the surface to be scanned at a rate of lateral motion not to exceed 0.5 meter per second.

5.4.3 Listen for a change in audible response and watch for needle deflection on the analog readout.

5.4.4 Mark any areas of elevated activity, as necessary and record the results on Form REC-WP-3-01-1.

6.0 REFERENCES

6.1 NUREG-1575, Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), NUREG/CR-1575, August 2000, Rev. 1.

7.0 ATTACHMENTS

Form REC-WP-3-01-1 Survey Data Log

RECON Procedure: REC-WP-3-04 Exposure Rate Survey

Form REC-WP-3-01-1

Form REC-WP-3-01-1
Survey Data Log

Instrument Model:	
Instrument S/N:	
Detector Model:	
Detector S/N:	

Date of Survey:	
Units of Measure:	µR/hr / cpm
Radiation Detected:	β γ
Calibration Due:	

Time	Survey Area	Ambient Bkg. Count Rate On Contact	@ 1 Meter	Scan of the Area Maximum	Minimum	Average	On Contact Measurement	Comments

Technician:	
Prepared By:	Date:
Reviewed By:	Date:

RECON Procedure: REC-WP-3-05

Removable Alpha/Beta Contamination Surveys

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: 01

EFFECTIVE DATE: MAY 2004

Approved, Bill Vinzant — 5-10-04

J.W. (Bill) Vinzant – Project Manager — Date

Kaiser Aluminum & Chemical Corporation

RECON Procedure: REC-WP-3-05

Removable Alpha/Beta Contamination Surveys

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: **01**

EFFECTIVE DATE: **MAY 2004**

5/7/04 — 5/7/04

Danny P. Brown – Project Manager / Date

Richard Lewis – Quality Control Supervisor / Date

1.0 PURPOSE

The purpose of this procedure is to provide written instruction for the collection of removable alpha/beta structural surface contamination samples.

2.0 DEFINITIONS

Swipe: A cloth or paper disc that is wiped on the surface of an area or object being surveyed. Also referred to as a *smear.*

3.0 PREREQUISITES/PRECAUTIONS/LIMITATIONS

3.1 Ensure the area surveyed by the swipe is approximately 100 square centimeters (cm^2).

3.2 Additional guidance on performing removable contamination surveys is provided in NUREG-1575.

4.0 EQUIPMENT

4.1 Swipes

4.2 Gloves (latex, nitrile, canvas, etc.)

5.0 PROCEDURE

5.1 Label the swipe to ensure the result is associated with the proper area. Some swipes come with an adhesive-type back and are adhered to a cover paper with an area for labeling. These swipes are preferred.

5.2 Hold the swipe so that the collection area will contact the surface being surveyed.

5.3 Wipe the area to be surveyed over a 100 cm^2 area (about a 4-inch-by-4-inch area) in a back-and-forth motion. An alternate method is to wipe the surface using an "S" motion that is 9 inches from top to bottom and from side to side, both methods are approved for proper collection of samples.

5.4 Close the cover of the swipe or place in an envelope or bag, as long as there is no potential for cross contamination.

5.5 Label the bag as appropriate.

5.6 Count on an appropriate counter (e.g., Ludlum Model 2929, et al.) utilizing appropriate procedure, REC-WP-2-07.

5.7 On selected samples we will complete a COC and submit to the selected laboratory for analysis.

5.8 Log the swipe including the date, time taken, and results of the counting (if available) on Form REC-WP-3-05-1.

5.9 If counted per Step 5.6, convert the counts per minute result to disintegrations per minute (dpm)/100 cm^2 using the following equation:

$$dpm/100cm^2 = \frac{(c_s/t_s)-(c_b/t_b)}{E}$$

Where:

c_s = counts recorded for sample
c_b = counts recorded for background
E = the detection efficiency of the instrument in counts per disintegration
t_s = the time period (in minutes) over which the count was recorded for the sample
t_b = the time period (in minutes) over which the count was recorded for the background sample

6.0 REFERENCES

6.1 Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), NUREG/CR-1575, August 2000, Rev. 1.

7.0 ATTACHMENTS

Form REC-WP-3-05-1 Sample Log for Ludlum Model 2929 with a 43-10-1 Detector

RECON Procedure: REC-WP-3-05 Removable Alpha/Beta Contamination Surveys

Form REC-WP-3-05-1

Form REC-WP-3-05-1
Removable Alpha/Beta Survey Sample Log Detector

Instrument Model:	2929
Instrument S/N:	
Detector Model:	43-10-1
Detector S/N:	
Calibration Due:	

Source S/N:	N/A	N/A
Source Amount	N/A	N/A
Radiation Detected:	Alpha	Beta
Acceptable Range:		
(Refer to REC-WP-2-01-1)		

Date	Background Count Rate Alpha (cpm)	Background Count Rate Beta (cpm)	Gross a Sample Count Rate (cpm)	Gross b Sample Count Rate (cpm)	Net a Sample Count Rate (cpm)	Net b Sample Count Rate (cpm)	a Contamination (dpm/100 cm^2)	b Contamination (dpm/100 cm^2)	Technician	Comments

Prepared By:	Date:
Reviewed By:	Date:

RECON Procedure: REC-WP-4-01

Surface Soil Sampling

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: **01**

EFFECTIVE DATE: **MAY 2004**

Approved, Bill Vinzant

J. W. (Bill) Vinzant – Project Manager

5-10-04

Date

Kaiser Aluminum & Chemical Corporation

RECON Procedure: REC-WP-4-01

Surface Soil Sampling

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: 01

EFFECTIVE DATE: MAY 2004

5/7/04 5/7/04

Danny P. Brown – Project Manager / Date Richard Lewis – Quality Control Supervisor / Date

Remedial Construction Services, L.P.

RECON Procedure: REC-WP-4-01 Surface Soil Sampling

1.0 PURPOSE

The purpose of this procedure is to provide instruction for the collection of surface soil samples.

2.0 DEFINITIONS

Chain of Custody: An unbroken trail of accountability that ensures the physical security of samples, data, and records.

3.0 PREREQUISITES PRECAUTIONS/LIMITATIONS

3.1 Surface soil contamination criteria specify the average concentration in the upper 15 centimeters (cm) (6 inches) of soil. For this reason, care must be used to ensure that surface soil samples are collected only from the upper 15 cm of soil.

3.2 Check the applicable health and safety guidance for the site to be sampled. Ensure the proper protocol and other precautions delineated in the appropriate documents (e.g., Environmental Health and Safety Plan, Radiation Health and Safety Plan, Safe Work Permit, etc.) are followed.

3.3 Additional guidance on performing soil sampling surveys is provided in NUREG-1575.

4.0 EQUIPMENT

4.1 Garden trowel, spoon, or shovel

4.2 Plastic bags and twist ties or "ziplock"-type bags, or equivalent sample containers

4.3 Masking tape

4.4 Indelible marking pens

4.5 Sampling equipment cleaning supplies

4.6 Logbook or data sheets

5.0 PROCEDURE

5.1 Preparation

5.1.1 Remove rocks, vegetation, and other obstructions in the area selected for surface soil sampling.

5.1.2 Loosen the soil at the selected sampling locations to a depth of 15 cm (6 inches) using a trowel or other digging implement.

5.1.3 Prepare an appropriate sample container for sample collection. The laboratory that will receive the sample may specify a preferred sample container.

5.1.4 Label the container with indelible marker in accordance applicable guidance for the site.

5.2 Collection

5.2.1 A surface soil sample will be taken at each sample point, for a given location at a depth of 15 cm (6 inches).

5.2.2 Collect an appropriate aliquot (e.g., approximately 1 kilogram) of soil and place it into the prepared container. Be sure that the soil is thoroughly mixed.

5.2.3 Record the sample identification, location, and any other pertinent information and complete a *chain of custody* in accordance to the laboratory instructions.

5.2.4 Clean the sampling tools, as necessary, prior to proceeding to the next sample collection point.

6.0 REFERENCES

NA

7.0 ATTACHMENT

NA

RECON Procedure: REC-WP-4-02

Air Sampling

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: 02

EFFECTIVE DATE: MAY 2004

Approved, Bill Vinzant — 5-10-04

J.W. (Bill) Vinzant – Project Manager — Date

Kaiser Aluminum & Chemical Corporation

RECON Procedure: REC-WP-4-02

Air Sampling

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: **02**

EFFECTIVE DATE: **MAY 2004**

5/7/04 5/7/04

Danny P. Brown – Project Manager / Date Richard Lewis – Quality Control Supervisor / Date

1.0 PURPOSE

The purpose of this procedure is to provide instruction for the collection of air samples.

2.0 DEFINITIONS

NA

3.0 PREREQUISITES PRECAUTIONS/LIMITATIONS

3.1 Air samples are performed in specific work areas to determine the extent of the airborne radiological hazards, establish radiological protective measures/controls and control personnel exposure.

3.2 Check the applicable health and safety guidance for the site. Ensure the proper protocol and other precautions delineated in the appropriate documents (e.g., Environmental Health and Safety Plan, Radiation Health and Safety Plan, Safety Work Permit, etc.) are followed.

3.3 Additional guidance on performing air sampling is provided in NUREG-1575.

4.0 EQUIPMENT

4.1 Air Sample Data Log (REC-WP-4-02-1), Air Sampler Filter Envelope(s) (REC-WP-4-02-2) and Air Sampling Analysis Log (REC-WP-4-02-3).

4.2 Black ink pen (indelible)

4.3 Cellulose-ester filters or other appropriate filters

4.4 High Volume Sampler

5.0 PROCEDURE

5.1 Preparation

5.1.1 Obtain air sample envelope(s) and fill out with the appropriate information: Date, Serial Number, and Placement Location.

5.1.2 Load filter head with appropriate filter and start pump.

5.1.3 Record time meter flow rate on sample envelope form REC-WP-4-02-2.

5.2 Collection

5.2.1 Record final pump stop time and ending flow rate on sample envelope.

5.2.2 Remove filter from sampling head and place in sample envelope.

5.2.3 Determine total elapsed time and enter on envelope and data log.

5.2.4 Multiply total elapsed time by the average flow rate to determine volume sampled in liters of cubic feet as appropriate and enter on envelope.

5.2.5 Place sample media on a planchet and insert in Ludlum Model 2929 and record results on REC-WP-4-02-3.

6.0 REFERENCES

NA

7.0 ATTACHMENT

Form REC-WP-4-02-1	Air Sampling Data Log
Form REC-WP-4-02-2	Air Sampling Envelope
Form REC-WP-4-02-3	Air Sampling Analysis Log

Form REC-WP-4-02-1

Form REC-WP-4-02-1
Air Sample Data Log

Date of Survey:	Ambient Conditions:
Instrument Serial #:	
Calibration Due Date:	
BKG Counts:	
Derived Air Concentration (DAC) 2.00E-12 uCi/ml	

Placement Location	Flow Rate (lpm)	Pump Start Time	Pump Stop Time	Elapsed Time (min)	Volume Collected (liters)	Laboratory Result	µCi/ml	Fraction of DAC

Prepared By:	Date:
Reviewed By:	Date:

RECON Procedure: REC-WP-4-02

Air Sampling

Form REC-WP-4-02-2

Form REC-WP-4-02-2
Air Sample Envelope

Date: _____ Sample # _____

Time On: _____ Sampler ID # _____

Time Off: _____ Total Min: _____

Flow: _____ Volume: _____

Technician: _____

Location: _____

Reason: _____

Remedial Construction Services, L.P. (Recon)
9720 Derrington
Houston, TX 77064

Revision 02
May 2004

RECON Procedure: REC-WP-4-02

Air Sampling

Form REC-WP-4-02-3

Form REC-WP-4-02-3
Air Sampling Analysis Log

Instrument Model:	2929
Instrument S/N:	
Detector Model:	43-10-1
Detector S/N:	
Calibration Due:	

Source S/N:	N/A	N/A
Source Amount	N/A	N/A
Radiation Detected:	Alpha	
Acceptable Range:		
(Refer to REC-WP-2-01-1)		

Date	Background Count Rate Alpha (cpm)	Gross a Sample Count Rate (cpm)	Net a Sample Count Rate (cpm)	Technician	Comments

Prepared By:	Date:
Reviewed By:	Date:

RECON Procedure: REC-WP-4-03

Storage Tank Water Sampling

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: **01**

EFFECTIVE DATE: **MAY 2004**

Approved, Bill Vinzant

J. W. (Bill) Vinzant – Project Manager

5-10-04

Date

Kaiser Aluminum & Chemical Corporation

RECON Procedure: REC-WP-4-03

Storage Tank Water Sampling

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: **01**

EFFECTIVE DATE: **MAY 2004**

5/7/04 5/7/04

Danny P. Brown – Project Manager / Date Richard Lewis – Quality Control Supervisor / Date

Remedial Construction Services, L.P.

RECON Procedure: REC-WP-4-03 Storage Tank Water Sampling

1.0 PURPOSE

The purpose of this procedure is to provide instruction for the collection of water samples from the temporary storage tanks prior to discharge into the City of Tulsa Sanitary Sewer System.

2.0 DEFINITIONS

Chain of Custody: An unbroken trail of accountability that ensures the physical security of samples, data, and records.

PREREQUISITES PRECAUTIONS/LIMITATIONS

2.1 All liquid samples collected will be handled as radioactive liquids until analyzed as being non-radioactive.

2.2 Liquids which are suspected to have come into contact with contaminated items or liquids found in controlled areas with unknown history will be analyzed.

2.3 Samples will be analyzed to meet the requirements as specified in the City of Tulsa Ordinance 19991 and with the requirements set by 10 CFR Part 20 (Standards for the Protection Against Radiation).

3.0 EQUIPMENT

3.1 Sample containers

3.2 Black ink pen (indelible)

3.3 Absorbent towels

3.4 Plastic bags

3.5 Chain of Custody

4.0 PROCEDURE

4.1 Preparation

4.1.1 Obtain 1 gallon sample container (supplied by laboratory), indelible marker, absorbent towels and plastic bags.

4.1.2 Mark sample container with location, time, date and name of person collecting sample.

4.2 Collection

4.2.1 Fill container by submerging sample container into the liquid to be sampled. Replace cap and seal with tape across top of container and cap.

4.2.2 Wipe off container and place container in plastic bag along with used absorbent towels and seal bag. Place a second bag over the first.

4.2.3 Complete chain of custody.

4.2.4 Transportation of samples to the laboratory for analysis shall be done by Recon or a laboratory technician.

5.0 REFERENCES

5.1 City of Tulsa Ordinance 19991

5.2 10 CFR Part 20 (Standards for the Protection Against Radiation)

ATTACHMENT

Chain of Custody Record

Chain of Custody Report

OUTREACH TECHNOLOGIES, INC.

311 North Aspen
Broken Arrow, OK 74012
Phone: (918) 251-2515
Fax: (918) 251-0008

CLIENT	BILL TO:
CONTACT	CONTACT
ADDRESS	ADDRESS
CITY STATE ZIP	CITY STATE ZIP
PHONE	PHONE
FAX	FAX

CHAIN OF CUSTODY RECORD

PROJECT NO. _____

PROJECT NAME _____

TURNAROUND TIME _____

SAMPLER _____
(SIGNATURE)

LAB SAMPLE #	CLIENT SAMPLE ID	DATE SAMPLED	TIME SAMPLED	MATRIX	# CONTAINERS											COMMENTS

RELINQUISHED BY	DATE	TIME	RECEIVED BY	RELINQUISHED BY	DATE	TIME	RECEIVED BY

RELINQUISHED BY	DATE	TIME	RECEIVED BY	RELINQUISHED BY	DATE	TIME	RECEIVED BY

REMARKS

RECON Procedure: REC-WP-5-01

Check Source Accountability

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: 01

EFFECTIVE DATE: MAY 2004

Approved Bill Vinzant
T. W. (Bill) Vinzant – Project Manager

5-10-04
Date

Kaiser Aluminum & Chemical Corporation

RECON Procedure: REC-WP-5-01

Check Source Accountability

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: **01**

EFFECTIVE DATE: **MAY 2004**

5/7/04 5/7/04

Danny P. Brown – Project Manager / Date Richard Lewis – Quality Control Supervisor / Date

1.0 PURPOSE

The purpose of this procedure is to ensure that the check sources that are used for daily instrument checks are kept under positive control and to ensure the integrity of the source.

2.0 DEFINITIONS

Positive control: The ensurement that access to sources is restricted.

Check source: Sources of radiation that are used to periodically assure the operation of calibrated instruments.

3.0 PREREQUISITES/PRECAUTIONS/LIMITATIONS

3.1 This procedure is only to be implemented on sealed sources that do not fall under the exempt quantities limits set by 10 Code of Federal Regulations (CFR) 39.35.

3.2 Sealed sources that only emit alpha particles require leak testing every 3 months.

3.3 Sealed sources that are neutron, beta, gamma, or a combined alpha emitter require leak testing every 6 months.

3.4 It is recommended that the surveying individuals handling the sealed source wear surgeons' gloves or forceps. The natural oils that are released by the human body can, over time, degrade the finish of the electroplated isotopes. Also, a build up of oil may cause inaccuracy when using the sealed sources as check sources.

4.0 EQUIPMENT

- Smears or Swipes
- Dionized (DI) water
- Sample containers
- Appropriate instrumentation (i.e., gas proportional)
- Surgical gloves
- Forceps

5.0 PROCEDURE

5.1 Accountability

5.1.1 All check sources that are to be used for instrument calibration shall be kept under positive control by the on-site employee(s) of Remedial Construction Services, L.P. (Recon). Positive control on location includes locking up sources in storage locker when not in use. Recon will maintain documentation when check sources are used for calibration checks, and supervision of the check source when it is being used.

5.2 Leak Testing

5.2.1 Establish Background

5.2.1.1 Background will be established by following the guidance provided by the manufacturer. Recon will use a blank swipe for determining background. This will ensure that the counting of the surveys contains the same geometry as the background counting.

5.2.2 Surveying Sealed Sources

5.2.2.1 Record all information on form REC-WP-3-05-1 that accompanies each particular sealed source (i.e., serial number, isotope, origin date, responsible person, decay method, date, time, and survey interval).

5.2.2.2 The survey is done by swiping all edges, seams, and openings where it may be possible for the sealed source to "leak" or breakdown.

5.2.2.3 Only one swipe is usually required per source. However, this may vary due to the physical dimensions of some particular sources.

5.2.2.4 After swiping is complete, each swipe is placed in a labeled sample container until it is counted on model 2929 with a 43-10-1 detector to ensure that the source has retained its physical integrity.

5.2.2.5 Record all information obtained from counting the swipes REC-WP-3-05-1.

5.2.2.6 If elevated readings (.005 µCi) are obtained from performing a survey on a sealed source the survey may be performed again. If the surveyor is confident that the initial results are accurate than the source must be disposed of in accordance with Nuclear Regulatory Commission guidelines for the disposal of that particular isotope.

6.0 REFERENCES

6.1 10 CFR 39.35, "Leak Testing of Sealed Screens"

7.0 ATTACHMENTS

Form REC-WP-3-05-1 Sample Log for Ludlum 2929 with a 43-10-1 Detector

RECON Procedure: REC-WP-5-01 Check Source Accountability

Form REC-WP-3-05-1

Form REC-WP-3-05-1
Removable Alpha/Beta Survey Sample Log Detector

Instrument Model:	2929
Instrument S/N:	
Detector Model:	43-10-1
Detector S/N:	
Calibration Due:	

Source S/N:	N/A	N/A
Source Amount	N/A	N/A
Radiation Detected:	Alpha	Beta
Acceptable Range:		
(Refer to REC-WP-2-01-1)		

Date	Background Count Rate Alpha (cpm)	Background Count Rate Beta (cpm)	Gross a Sample Count Rate (cpm)	Gross b Sample Count Rate (cpm)	Net a Sample Count Rate (cpm)	Net b Sample Count Rate (cpm)	a Contamination (dpm/100 cm^2)	b Contamination (dpm/100 cm^2)	Technician	Comments

Prepared By:	Date:
Reviewed By:	Date:

RECON Procedure: REC-WP-6-01

Completing Chain-of-Custody

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: 01

EFFECTIVE DATE: MAY 2004

J. W. (Bill) Vinzant – Project Manager

5-10-04
Date

Kaiser Aluminum & Chemical Corporation

RECON Procedure: REC-WP-6-01

Completing Chain-of-Custody

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: **01**

EFFECTIVE DATE: **MAY 2004**

5/7/04 — Danny P. Brown – Project Manager / Date

5/7/04 — Richard Lewis – Quality Control Supervisor / Date

Remedial Construction Services, L.P.

RECON Procedure: REC-WP-6-01 Completing Chain-of-Custody

1.0 PURPOSE

The purpose of this procedure is to provide instruction for filling out the necessary chain-of-custody forms for sampling procedures.

2.0 DEFINITIONS

Chain of Custody: An unbroken trail of accountability that ensures the physical security of samples, data, and records.

3.0 PREREQUISITES/PRECAUTIONS/LIMITATIONS

3.1 A chain of custody must be filled out before relinquishing control of the sample.

3.2 Exert positive control of radioactive or potentially radioactive samples.

4.0 EQUIPMENT

4.1 Chain-of-Custody Forms

5.0 PROCEDURE

5.1 Laboratory Chain of Custody

- Project name.
- Project number.
- Sampler – Name of person taking the sample (printed and signed).
- Relinquished by – Name of person giving up custody (printed and signed).
- Date and time – Enter date and time that the sample was turned over to a new custodian.
- Received by – Name of person taking custody (printed and signed).
- Date and time – Enter date and time that the sample was received from the old custodian.
- Enter the client sample identification number.
- Date and time – Enter date and time that the sample was taken.
- Enter the matrix type.
- Enter the number of containers.
- Enter container size and type – either plastic or glass.
- List what preservatives (if any) were used. If none, then list "NA".
- List any remarks that are pertinent to the samples being analyzed.
- Enter the address of the party receiving the results.
- Enter the address of the party responsible for the billing.
- Enter requested turnaround time.
- Verify information on the sample container is the same as on the chain-of-custody form.

6.0 REFERENCES

NA

Remedial Construction Services, L.P. (Recon)
9720 Derrington
Houston, TX 77064
(281) 955-2442

7.0 ATTACHMENTS

Outreach Technologies, Inc.	Chain of Custody Record

RECON Procedure: REC-WP-6-01 Completing Chain-of-Custody

Chain of Custody Record

OUTREACH TECHNOLOGIES, INC.
311 North Aspen
Broken Arrow, OK 74012
Phone: (918) 251-2515
Fax: (918) 251-0008

CLIENT | BILL TO:

CONTACT | CONTACT

ADDRESS | ADDRESS

CITY STATE ZIP | CITY STATE ZIP

PHONE | PHONE

FAX | FAX

CHAIN OF CUSTODY RECORD

PROJECT NO. _____

PROJECT NAME _____

TURNAROUND TIME _____

SAMPLER _____
(SIGNATURE)

LAB SAMPLE #	CLIENT SAMPLE ID	DATE SAMPLED	TIME SAMPLED	MATRIX	# OF CONTAINERS											COMMENTS

RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:
RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:

REMARKS

RECON Procedure: REC-WP-7-01

Discharging Water From Holding Tanks

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: 01

EFFECTIVE DATE: MAY 2004

Approved, Bill Vinzant

F. W. (Bill) Vinzant – Project Manager

5-10-04

Date

Kaiser Aluminum & Chemical Corporation

RECON Procedure: REC-WP-7-01

Discharging Water From Holding Tanks

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: **01**

EFFECTIVE DATE: **MAY 2004**

5/7/04 5/7/04

Danny P. Brown – Project Manager / Date

Richard Lewis – Quality Control Supervisor / Date

1.0 PURPOSE

The purpose of this procedure is to provide instruction for discharging water to the City of Tulsa Sanitary Sewer System.

2.0 DEFINITIONS

NA

3.0 PREREQUISITES/PRECAUTIONS/LIMITATIONS

3.1 Sample results will be verified to be below criteria set by the City of Tulsa, Ordinance 19991 and the requirements and limitations set by 10 CFR Part 20, Standards for the Protection Against Radiation.

3.2 If sample results received do not meet the above mentioned criteria the contents of the temporary storage tank will be re-sampled later. This allows the contents more settling time. If samples continue to fail the situation will be evaluated for other treatment or disposal options.

4.0 EQUIPMENT

4.1 Black Pen

4.2 Form REC-WP-7-01-1 "Discharge to Sanitary Sewer Log"

5.0 PROCEDURE

5.1 Discharging Water

5.1.1 Analytical results will be sent to the City of Tulsa, Public Works Department, Environmental Compliance Division via e-mail or fax for approval to discharge.

5.1.2 Upon receipt of approval to discharge from the City of Tulsa, Public Works Department, Environmental Compliance Division, the Field Supervisor will be notified that approval has been given to discharge.

5.1.3 Record date, time and previous gross total of flow meter on form REC-WP-7-01-1.

5.1.4 Open flow regulator valve all the way.

5.1.5 Confirm tank identification to be discharged from.

5.1.6 Place suction hose into tank to be discharged.

5.1.7 Check pump and fill out Equipment Inspection Form prior to starting.

5.1.8 Start pump.

5.1.9 Ensure pump has been primed and has begun to discharge.

5.1.10 Return to flow meter and regulator valve, confirm flow is within approved City of Tulsa, Public Works Department, Environmental Compliance Division requirements and working properly.

5.1.11 Periodically check system to ensure proper flow is being maintained, record flow rate on REC-WP-7-01-1.

5.1.12 When discharge is complete shut pump off.

6.0 REFERENCES

City of Tulsa Ordinance 19991
10 CFR Part 20, Standards for the Protection Against Radiation

7.0 ATTACHMENTS

Form REC-WP-7-01-1 Discharge to Sanitary Sewer Log

Form REC-WP-7-01-1

Form REC-WP-7-01-1
Discharge to Sanitary Sewer Log

Date	Storage Tank ID	Discharge Start Time	Meter Reading Prior to Discharge	Discharge Stop Time (or at verification)	Meter Reading Post Discharge (or at verification)	Net Gallons Discharged (or at verification)	Technician	Daily Verification (To be done AM & PM)			
								Elapsed Time	GPM	Elapsed Time	GPM

Reviewed by: _____

RECON Procedure: REC-WP-7-02

Excavation

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: **01**

EFFECTIVE DATE: **MAY 2004**

Approved, Bill Vinzant — 5-10-04

J. W. (Bill) Vinzant – Project Manager — Date

Kaiser Aluminum & Chemical Corporation

RECON Procedure: REC-WP-7-02

Excavation

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: **01**

EFFECTIVE DATE: **MAY 2004**

5/7/04 5/7/04

Danny P. Brown – Project Manager / Date Richard Lewis – Quality Control Supervisor / Date

RECON Procedure: REC-WP-7-02 Excavation

1.0 PURPOSE

The purpose of this procedure is to provide instruction for Excavation.

2.0 DEFINITIONS

N/A

3.0 PREREQUISITES/PRECAUTIONS/LIMITATIONS

3.1 Review Safe Work Permit (SWP) for safe work practices.

3.2 All excavation activities will be conducted in accordance with Occupational Health and Safety Administration (OSHA) guidelines.

3.3 Review appropriate specifications for activity.

3.4 Only qualified operators will be allowed to operate equipment.

4.0 EQUIPMENT

4.1 Excavator(s)

4.2 Dozer(s)

4.3 Articulated Dump Truck(s)

4.4 Skid Steer(s)

4.5 Front End Loader(s)

5.0 PROCEDURE

5.1 Excavation

5.1.1 Check equipment and fill out Equipment Inspection Form.

5.1.2 Inspect work area; be aware of any above or below ground utility locations, environmental hazards and indigenous biological hazards.

5.1.3 All topsoil and subsoil will be excavated as required by the Project Specifications and the Decommissioning Plan and Decommissioning Plan Addendum for remediation activities.

5.1.4 Unsuitable material (debris) encountered during excavation will go into a separate stockpile to be either decontaminated and loaded into roll off boxes for offsite disposal at an approved disposal facility or loaded onto a rail car for disposal at the U.S. Ecology disposal facility.

5.1.5 Begin excavation as described in section I.A.6.2 of the Work Plan.

5.1.6 Operator will load excavated material into articulated dump truck(s) to be transported to appropriate area i.e.: drying area, above criteria (Th-232>31.1 pCi/g net) stockpile or below criteria (Th-232 <31.1 pCi/g net) stockpile as described in section I.A.6.2 of the Work Plan. Material will be loaded in articulated dump truck(s) so that spillage will be kept to the very minimum so as not to spread contamination within the excavated area or en-route to the above mentioned areas.

5.1.7 Water that accumulates in the excavation area will pumped into weir tanks as described in section I.A.5.3 of the Work Plan.

5.1.8 Excavation will continue until all soil with concentrations greater than Th-232 3 pCi/g net above background is removed. Verification samples will be collected in accordance with procedure REC-WP-4-01 Surface Soil Sampling.

5.2 Stockpile Construction

5.2.1 Above and below criteria stockpiles will be located as approved by the Owner or designee.

5.2.2 Stockpiles will be built in accordance with section 02220 of the Project Specifications and the Decommissioning Plan and Decommissioning Plan Addendum.

5.2.3 Material shall be dumped in the stockpile area and spread in even layers as the stockpile is built.

5.2.4 A water truck or other effective means will be utilized to control dust.

6.0 REFERENCES

Project Specifications, Decommissioning Plan and Decommissioning Plan Addendum.
Occupational Health and Safety Administration
Recon Work Plan

7.0 ATTACHMENTS

Equipment Inspection Form

Equipment Inspection Form

Equipment Inspection Form

Thorium Remediation Project
Tulsa, Oklahoma

Job # _____ Name: _____

Daily Equipment Check List			Remarks	Hours Last Serviced
Date				Please note the hour reading recorded on the oil, air, fuel and hydraulic filters on the equipment.
Equipment				
Operator				
Hour Meter				
Start				
End				
Fluids Check List				
	Ok	**Add**		
Fuel Grease				
Oil				
Brake/Hydraulic				
Water				
Transmission				
Equipment Condition				
	Ok	**Repair**		
Glass				
Horn				
Lights				
Mirrors				
Seat Belt				
Step/Ladder				
Travel Alarm				
Wipers				
Tires				
Belts				
Air Filter				
Fuel Leaks				
Oil Leaks				
Hyd. Cylinders				
Steering				
Brakes				
Hoses				
Fire Extinguisher				

Comments

_____

_____

_____

_____

_____

_____

RECON Procedure: REC-WP-7-03

Backfill

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: 01

EFFECTIVE DATE: MAY 2004

Approved, Bill Vinzant

J. W. (Bill) Vinzant – Project Manager

5-10-04

Date

Kaiser Aluminum & Chemical Corporation

RECON Procedure: REC-WP-7-03

Backfill

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: 01

EFFECTIVE DATE: MAY 2004

5/7/04
Danny P. Brown – Project Manager / Date

5/7/04
Richard Lewis – Quality Control Supervisor / Date

RECON Procedure: REC-WP-7-03 Backfill

1.0 PURPOSE

The purpose of this procedure is to provide instruction for Backfill operations.

2.0 DEFINITIONS

N/A

3.0 PREREQUISITES/PRECAUTIONS/LIMITATIONS

3.1 Review Safe Work Permit (SWP) for safe work practices.

3.2 Review appropriate specifications for activity.

3.3 Only qualified operators will be allowed to operate equipment.

3.4 All clean offsite material will be characterized for existing radiological and chemical quality as required by the specifications before any material is brought onsite.

3.5 Clean offsite backfill material and topsoil will be analyzed for soil classification as required by the specifications. Verified results will be submitted to the engineer prior to the material being brought onsite.

4.0 EQUIPMENT

4.1 Excavator(s)

4.2 Dozer(s)

4.3 Articulated Dump Truck(s)

4.4 Compactor(s)

4.5 Front End Loader(s)

4.6 Water Truck(s)

5.0 PROCEDURE

5.1 Backfill

5.1.1 Check equipment and fill out Equipment Inspection Form.

5.1.2 Once analytical verification and Final Status Survey clearance has been obtained backfill operations will begin using below criteria material or clean offsite material.

5.1.3 Place below criteria or clean offsite material in 8 inch lifts and compact as required by section 02220 of the specifications.

5.1.4 Geotechnical subcontractor will perform in place compaction tests as required in section 02220 of the Specifications to verify each lift has met compaction requirements per section 02220 of the Specifications. Test results will be submitted to the engineer within 24 hours of the time the tests were taken as required. Below criteria material will be radiologically surveyed for each 2 foot lift placed.

5.1.5 Approval from engineer or designee will be obtained before placing each lift.

5.1.6 Repeat steps 5.1.4 thru 5.1.6 until backfill area is at the lines and grades indicated on Figure 7 of the Contract Drawings or as directed by the engineer.

5.1.7 Six inches of topsoil will be placed and fine graded to within the tolerances as specified in section 02220 of the specifications.

5.1.8 All clean offsite material will be delivered to the site by dump trucks. All drivers will go through the site specific safety training as per the Recon Radiation and Environmental Health and Safety Plan requirements.

5.1.9 Dump trucks will remain on non-contaminated surfaces at all times.

6.0 REFERENCES

Project Specifications, Decommissioning Plan and Decommissioning Plan Addendum.
Recon Radiation Health and Safety Plan
Recon Environmental Health and Safety Plan

7.0 ATTACHMENTS

Equipment Inspection Form

Equipment Inspection Form

Equipment Inspection Form

Thorium Remediation Project
Tulsa, Oklahoma

Job # _____ Name: _____

Daily Equipment Check List			Remarks	Hours Last Serviced
Date				Please note the hour reading recorded on the oil, air, fuel and hydraulic filters on the equipment.
Equipment				
Operator				
Hour Meter				
Start				
End				
Fluids Check List				
	Ok	**Add**		
Fuel Grease				
Oil				
Brake/Hydraulic				
Water				
Transmission				
Equipment Condition				
	Ok	**Repair**		
Glass				
Horn				
Lights				
Mirrors				
Seat Belt				
Step/Ladder				
Travel Alarm				
Wipers				
Tires				
Belts				
Air Filter				
Fuel Leaks				
Oil Leaks				
Hyd. Cylinders				
Steering				
Brakes				
Hoses				
Fire Extinguisher				

Comments

Remedial Construction Services, L.P.
9720 Derrington
Houston, TX 77064

RECON Procedure: REC-WP-7-04

Loading Vibrating Screen

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: **01**

EFFECTIVE DATE: **MAY 2004**

Approved, Bill Vinzant

J. W. (Bill) Vinzant – Project Manager

5-10-04

Date

Kaiser Aluminum & Chemical Corporation

RECON Procedure: REC-WP-7-04

Loading Vibrating Screen

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: 01

EFFECTIVE DATE: MAY 2004

5/7/04 5/7/04

Danny P. Brown – Project Manager / Date Richard Lewis – Quality Control Supervisor / Date

RECON Procedure: REC-WP-7-04 Loading Vibrating Screen

1.0 PURPOSE

The purpose of this procedure is to provide instruction for Loading Vibrating Screen.

2.0 DEFINITIONS

N/A

3.0 PREREQUISITES/PRECAUTIONS/LIMITATIONS

3.1 Review Safe Work Permit (SWP) for safe work practices.

3.2 Stockpile will be located so that feeding of the vibrating screen can be implemented with an excavator.

3.3 Only qualified operators will be allowed to operate equipment.

4.0 EQUIPMENT

4.1 Vibrating Screen

4.2 Excavator

4.3 Skid Steer

4.4 Water Truck(s)

5.0 PROCEDURE

5.1 Loading Vibrating Screen

5.1.1 Check equipment and fill out Equipment Inspection Form prior to operating equipment.

5.1.2 Excavator will begin feeding the vibrating screen and maintain a steady feed rate, belt speed can be adjusted on the vibrating screen to help maintain feed rate.

5.1.3 The Vibrating Screen allows materials smaller than six inches to fall onto the vibrating screen conveyor and be transferred to the sorting conveyor.

5.1.4 Material greater than six inches that won't pass through the vibrating screen (i.e. rocks, concrete, construction debris) will go into a separate stockpile to be either reprocessed, decontaminated and loaded into roll off boxes for offsite disposal at an approved disposal facility or loaded onto a rail car for disposal at the U.S. Ecology disposal facility.

5.1.5 Water truck(s) or a misting system will be utilized to control dust.

6.0 REFERENCES

N/A

7.0 ATTACHMENTS

Equipment Inspection Form

RECON Procedure: REC-WP-7-04 Loading Vibrating Screen

Equipment Inspection Form

Equipment Inspection Form

Thorium Remediation Project
Tulsa, Oklahoma

Job # _____ Name: _____

Daily Equipment Check List			Remarks	Hours Last Serviced
Date				Please note the hour reading recorded on the oil, air, fuel and hydraulic filters on the equipment.
Equipment				
Operator				
Hour Meter				
Start				
End				
Fluids Check List				
	Ok	**Add**		
Fuel Grease				
Oil				
Brake/Hydraulic				
Water				
Transmission				
Equipment Condition				
	Ok	**Repair**		
Glass				
Horn				
Lights				
Mirrors				
Seat Belt				
Step/Ladder				
Travel Alarm				
Wipers				
Tires				
Belts				
Air Filter				
Fuel Leaks				
Oil Leaks				
Hyd. Cylinders				
Steering				
Brakes				
Hoses				
Fire Extinguisher				

Comments

Remedial Construction Services, L.P.
9720 Derrington
Houston, TX 77064

Revision 01
May 2004

RECON Procedure: REC-WP-7-05

Loading Rail Cars

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: 01

EFFECTIVE DATE: MAY 2004

Approved Bill Vinzant
W. W. (Bill) Vinzant – Project Manager

5-10-04
Date

Kaiser Aluminum & Chemical Corporation

RECON Procedure: REC-WP-7-05

Loading Rail Cars

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: **01**

EFFECTIVE DATE: **MAY 2004**

5/7/04 — Danny P. Brown – Project Manager / Date

5/7/04 — Richard Lewis – Quality Control Supervisor / Date

1.0 PURPOSE

The purpose of this procedure is to provide instruction for Loading Rail Cars.

2.0 DEFINITIONS

N/A

3.0 PREREQUISITES/PRECAUTIONS/LIMITATIONS

3.1 Review Safe Work Permit (SWP) for safe work practices.

3.2 Only qualified operators will be allowed to operate equipment.

3.3 Initial calibration will be conducted onsite by the manufacturers representative before scale is put into service. An object will be selected by the manufactures representative to perform daily checks. The object selected will be taken to a certified scale so that the weight of the object can be verified, this documentation will be kept onsite in Recon's project records. Re-calibration will be in accordance with the manufactures specifications.

4.0 EQUIPMENT

4.1 Front End Loader with a "LOADRITE model LD940" bucket scale and "LOADRITE model LD941 Data Module.

4.2 Water Truck(s)

5.0 PROCEDURE

5.1 Calibration of Bucket Scale

5.1.1 A daily check will be done each day that rail cars are loaded to verify the bucket scale is within calibration. A Daily Bucket Scale Check Log (Form REC-WP-7-05-1) will be completed and become part of Recon's project records.

5.2 Loading Rail Cars

5.2.1 Check equipment and fill out Equipment Inspection Form.

5.2.2 Operator will input information into the LD940 data module i.e. ticket number, rail car number, project etc. Then proceed to designated stockpile, begin loading bucket, operator will be responsible for not overloading the bucket to avoid spillage during transport to the rail car. Operator will "ADD" bucket weight as described in LOADRITE Reference Manual and then proceed to rail car and deposit the bucket of material into the rail car. This step will be repeated until the rail car is loaded (98 - 100 tons).

5.2.3 Once the rail car is loaded the operator will "Clear" as described in LOADRITE Reference Manual to produce ticket associated with the loaded rail car.

5.2.4 Repeat steps 5.2.2 and 5.2.3 for each rail car that is loaded.

5.2.5 Water truck(s) or a misting system or equivalent will be utilized to control dust.

6.0 REFERENCES

LOADRITE Reference Manual

7.0 ATTACHMENTS

Equipment Inspection Form
REC-WP-7-05-1

Daily Bucket Scale Check Log

Equipment Inspection Form

Equipment Inspection Form

Thorium Remediation Project
Tulsa, Oklahoma

Job # _____ Name: _____

Daily Equipment Check List			Remarks	Hours Last Serviced
Date				Please note the hour reading recorded on the oil, air, fuel and hydraulic filters on the equipment.
Equipment				
Operator				
Hour Meter				
Start				
End				
Fluids Check List				
	Ok	**Add**		
Fuel Grease				
Oil				
Brake/Hydraulic				
Water				
Transmission				
Equipment Condition				
	Ok	**Repair**		
Glass				
Horn				
Lights				
Mirrors				
Seat Belt				
Step/Ladder				
Travel Alarm				
Wipers				
Tires				
Belts				
Air Filter				
Fuel Leaks				
Oil Leaks				
Hyd. Cylinders				
Steering				
Brakes				
Hoses				
Fire Extinguisher				

Comments

Remedial Construction Services, L.P.
9720 Derrington
Houston, TX 77064

Revision 01
May 2004

Form REC-WP-7-05-1

Form REC-WP-7-05-1
Daily Bucket Scale Verification Log

Date	Operators Name	Verified Weight	Recorded Weight	Within Verification Limits Yes/No	Comments

Reviewed by: _____

RECON Procedure: REC-WP-7-06

Inspecting Rail Cars

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: 00

EFFECTIVE DATE: MAY 2004

Approved, Bill Vinzant — 5-10-04

J. W. (Bill) Vinzant – Project Manager — Date

Kaiser Aluminum & Chemical Corporation

RECON Procedure: REC-WP-7-06

Inspecting Rail Cars

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: 00

EFFECTIVE DATE: MAY 2004

5/7/04 5/7/04

Danny P. Brown – Project Manager / Date Richard Lewis – Quality Control Supervisor / Date

Remedial Construction Services, L.P.

RECON Procedure: REC-WP-7-06 **Inspecting Rail Cars**

1.0 PURPOSE

The purpose of this procedure is to provide instruction for inspecting rail cars.

2.0 DEFINITIONS

N/A

3.0 PREREQUISITES/PRECAUTIONS/LIMITATIONS

3.1 Visual Inspection and a Swipe survey will be conducted by US Ecology of each rail car prior to it arriving at the Thorium Remediation Project site. Analytical results will be forwarded for review and approval of each rail car.

3.2 Prior to Recon performing the visual inspection US Ecology will perform an inspection as per section 5.10.1 of the US Ecology Transportation Work Plan.

4.0 EQUIPMENT

4.1 Rail Car Inspection Form

4.2 Black Ink Pen

5.0 PROCEDURE

5.1 Visual Inspection

5.1.1 A visual inspection will be conducted upon receipt of each rail car. A Rail Car Inspection Form (Form REC-WP-7-06-1) will be completed and become part of Recon's project records.

5.1.2 If the rail car is not "Acceptable" on any item of the Rail Car Inspection Form corrective action will be taken and documented on the form prior to the rail car being prepared for loading. If corrective can not be achieved the rail car will be removed from the Thorium Remediation Project site.

5.1.3 Once the railcar has passed the inspection the rail car will be prepared for loading as per procedure REC-WP-7-07.

6.0 REFERENCES

US Ecology Transportation Work Plan

7.0 ATTACHMENTS

REC-WP-7-06-1	Rail Car Inspection Form

RECON Procedure: REC-WP-7-06 Inspecting Rail Cars

Rail Car Inspection Form

Remedial Construction Services, L.P.
9720 Derrington
Houston, TX 77064

Revision 00
May 2004

Form REC-WP-7-06-1

RAIL CAR INSPECTION FORM

DATE:___/___/___ INSPECTOR:_____

TIME:_____AM/PM SIGNED:_____

Each inbound rail car shall be inspected before loading for presence of a potential problem which may effect the operation of the rail car, or which may lead to an event which would cause a threat to human health or the environment. For each item identify the inspection areas as Acceptable (A) or Not Acceptable (N). Acceptable also means "Step completed". Any deficient items shall be marked, reported and the date and nature of the corrective action taken. If an item is not inspected, mark "NI" (Not Inspected).

Rail Car #_____

Condition/Inspection Area	A / N / NI	Comments
Is the Car body leaning or listing significantly to the side?	[ ] [ ] [ ]	_____
Is the Car body sagging downward?	[ ] [ ] [ ]	_____
Is the Car body position improperly on the tracks?	[ ] [ ] [ ]	_____
Is the Car body or portions of the car dragging?	[ ] [ ] [ ]	_____
Are objects extending from the side of the car body?	[ ] [ ] [ ]	_____
Is the floor of the rail car damaged?	[ ] [ ] [ ]	_____
Is the interior of the car clean and free of dirt/debris?	[ ] [ ] [ ]	_____
Are the sides of the rail car damaged or torn?	[ ] [ ] [ ]	_____
Are the couplers connected and secure?	[ ] [ ] [ ]	_____
Inspected for overheated wheels or journals (bearings)?	[ ] [ ] [ ]	_____
Are brakes free or do any brakes fail to release?	[ ] [ ] [ ]	_____
Are tracks free and clear of obstructions?	[ ] [ ] [ ]	_____
Are the wheel chocks secured?	[ ] [ ] [ ]	_____
Is the derailer in proper position?	[ ] [ ] [ ]	_____
Are there any other apparent safety hazards likely to cause an accident, injury or casualty?	[ ] [ ] [ ]	_____
Damage (note below)	[ ] [ ] [ ]	_____

Remarks: Record Damage, Date and Nature of any Corrective Actions

_____

_____

_____

_____

Yard Master/Transportation Manager Contacted Time:_____Date:_____

Rail Car Accepted: (Signature)_____Date:_____

RECON Procedure: REC-WP-7-07

Preparation of Rail Car for Loading

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: 00

EFFECTIVE DATE: MAY 2004

Approved, Bill Vinzant

J. W. (Bill) Vinzant – Project Manager

5-10-04

Date

Kaiser Aluminum & Chemical Corporation

RECON Procedure: REC-WP-7-07

Preparation of Rail Car For Loading

Thorium Remediation Project
Tulsa, Oklahoma

REVISION: **00**

EFFECTIVE DATE: **MAY 2004**

5/7/04 5/7/04

Danny P. Brown – Project Manager / Date Richard Lewis – Quality Control Supervisor / Date

Remedial Construction Services, L.P.

RECON Procedure: REC-WP-7-07 **Preparation of Rail Car for Loading**

1.0 PURPOSE

The purpose of this procedure is to provide instruction for the preparation of railcars prior to loading.

2.0 DEFINITIONS

N/A

3.0 PREREQUISITES/PRECAUTIONS/LIMITATIONS

3.1 Prior to installation of liner, ensure railcar has passed inspection and the Rail Car Inspection Form (REC-WP-7-06-1) has been completed.

3.2 A Job Hazard Analysis (JHA) must be completed and reviewed by all employees involved with liner installation.

4.0 EQUIPMENT

4.1 Black Stallion Railcar Liner System

4.2 Front end Loader

5.0 PROCEDURE

5.1 Installation of Liner System

5.1.1 Place liner system into Front end Loader bucket and the Front end loader will put the liner system into the rail car at either end.

5.1.2 Installation of the liner system will follow the attached manufactures installation instruction diagram.

5.1.3 Once liner is installed car may be loaded with material to be shipped offsite as per REC-WP-7-05 (Loading Rail Cars) and the US Ecology Transportation Work Plan.

5.1.4 When loading is complete, closure of the liner system will follow the attached manufactures installation instruction diagram.

6.0 REFERENCES

6.1 REC-WP-7-06-1 Rail Car Inspection Form

6.2 REC-WP-7-05 Loading Rail Cars

6.3 US Ecology Transportation Work Plan

7.0 ATTACHMENTS

Black Stallion Rail Car Liner System Installation Instruction Diagram

RECON Procedure: REC-WP-7-07 **Preparation of Rail Car for Loading**

Installation Instruction Diagram

BLACK STALLION RAILCAR LINER SYSTEM

INSTALLATION INSTRUCTION DIAGRAM

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1. Place liner in either front or rear of rail car, centered along wall.

2. Break straps and unroll liner entire length of the railcar.

3. Unfold the liner to the width/sides of the railcar.

4. Pull side flaps and end flaps up and over side walls of the railcar making sure liner is square and properly aligned in the container.
(If liner is not square to all four sides of the gondola, it will not close properly)

"BLACK STALLION RAILCAR LINER SYSTEM

INSTALLATION INSTRUCTION DIAGRAM

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5. After liner is square, pull the flaps down to bottom half of gondola. Use bungee cords to snug liners and webbing straps to bottom of the car. This is to ensure the liner is properly fitted and ready to load.

6. After loading is completed, remove the bungee cords and fold the two end flaps inward & connect end straps together with snap buckles. Secure buckles with cable ties.

7. Side flap folds inward and loops attached together securely using cable ties, then disconnect buckle straps from flap and let hang over side loosely.

8. Last side flap folded inward & loops secured using cable ties. System is then locked down using adjustable locking buckle system. Adjust the height of liner to load level. Zip tie each buckle to prevent tampering. Zip tie end flaps to the straps at each end to remove any slack as necessary.