UMTRA PROJECT

Remedial Action Contractor

Health Physics Procedures

May 1985

Prepared by:

Chem-Nuclear Systems, Inc.

for

Morrison-Knudsen Company, Inc.

Remedial Action Contractor

Health Physics Procedure References

UMTRA
RAC

Chem-Nuclear Systems, Inc.

1.0 Scope

These procedures establish the minimum requirements for RAC activities at all UMTRA locations. Work will be performed using good, established Health Physics practices.

The procedures are written in a generic manner and guidelines are attached to suggest methods to implement specific procedures.

2.0 References

The following list of references may be used to further define requirements and approved methods for implementation. It is not intended for the reference to be located at each site. Copies are available on request.

2.1 Title 10 Code of Federal Regulations, Part 20.203.

2.2 Title 10, Code of Federal Regulations, Part 20. Standards for Protection Against Radiation.

2.3 Title 10, Code of Federal Regulations, Part 50. Appendix B, Criterion XII.

2.4 NRC Regulatory Guide 8.15. Acceptable Programs for Respiratory Protection.

2.5 NRC Regulatory Guide 1.86. Termination of Operative License for Nuclear Reactors.

2.6 NRC Reg. Guide 4.14, "Radiological & Environmental Monitoring at Uranium Mills."

2.7 ANSI N13.12.

2.8 ANSI N-45.2, 1971 Quality Assurance Program Requirements for Nuclear Power Plants, Part XIII.

2.9 ANSI/ASME NQA-1 1979 with Addendas A-81 through C-82.

2.10 ANSI N 7.1, 60 "Radiation Protection in Uranium Mines and Mills: American National Standards Institute, New York, NY 10018.

2.11 ANSI N 13.1, "Radiation Protection in Uranium Mines," ANSI, New York, NY 10018.

2.12 DOE 5480.1A. Environmental Protection, Safety and Health Protection Program.

2.13 DOE 5700.6A 8/13/81.

2.14 DOE AL5700.6B 5/10/82.

2.15 Contract DE-AC04-83AL18796 - UMTRA Prime Contract.

2.16 EPA "Standards for Remedial Actions at Inactive Uranium Processing Sites" 40 CFR 192, January 5, 1983.

2.17 UMTRA Project Health and Safety Plan - UMTRA RAC.

2.18 UMTRA Quality Assurance Plan, Issue B 6/83.

2.19 UMTRA-DOE/AL-050601 (June 1984), "Vicinity Property Management and Implementation Manual."

2.20 RAC (Fall 1983), "Canonsburg, Pennsylvania Site and Vicinity Property Health Physics Monitoring Plan."

2.21 Health Physics Monitoring Plan. (UMTRA RAC) June 3, 1984.

2.22 "Evaluation of Methods for the Estimation of Indoor Radon Daughter Concentrations for Remedial Action Programs" USDOE GJ/TMC-04 (83) UC-70A, June 1983.

2.23 "Review of selected DOE Remedial Action Field Measurement Procedures for the Summer of 1982" USDOE GJ/TMC-02 (82), August 1982.

2.24 ORNL (September 1982 draft), "Procedures Manual for ORNL Remedial Action Survey and Certification Activities (RASCA) Program."

2.25 TMC (December 1982), "Abbreviated Total-Count Logging Procedures for Use in Remedial Action."

2.26 TMC (August 1982), "Review of Selected DOE Remedial Action Field Measurement Procedures for the Summer of 1982."

2.27 TMC (April 1983), "Surface Gamma-Ray Measurement Protocol for Small Parcels on Open Lands."

2.28 TMC (November 1982), "Field Calibration Facilities for Environmental Measurement of Radium, Thorium, and Potassium."

2.29 NCRP Report 58, "A Handbook of Radioactivity Measurements."

2.30 NLO, Inc., (April 1982), "Project Management Plan, Remedial Action, Vicinity Properties, Canonsburg, PA."

2.31 Radiological Health Handbook, issued by U.S. Department HEW, PHS, 1970.

2.32 HPSR-1 (1980), "Upgrading Environmental Radiation Data," Health Physics Committee Report. EPA 520/1080-012, August 1980.

2.33 Health Physics Vol. 45, No. (Aug 425-8)83 "Results of Indoor Radon Measurements Using the Track Etch@ Method."

2.34 Schiager, Keith J. and W. John Smith II, "Simple Field Method for Determining Compliance with EPA Land Clean-Up Standards," Symp. on Uranium Mill Tailings Management, Fort Collins, Colorado, December 9-10, 1982.

2.35 "State Background Radiation Levels: Results of measurements taken during 1975-1979" Myrick, Berven, Haywood, 1981. ORNL/TM-7343.

2.36 LBL 80, Lawrence Berkeley Laboratory, "Mining and Milling and Nuclides" In: "Instrumentation for Environmental Monitoring of Radiation," LBL-1, Vol 3., Environmental Instrumentation Group, University of California, Berkeley, CA.

2.37 Borak, T. B., and Inkert W. "Verification of a Generalized Kusnetz Method for Measuring Potential Alpha Energy from Radon Daughters" (Submitted to H.P. Journal).

2.38 Borak, T.B., Franko, E.D., Holub, R.F., "An Evaluation of WL Measurements using a generalize Kusnetz Method". H.P. Vol. 42 p. 459-567; 1982.

2.39 Borak, T.B., Holub, R.F., "A Comparison of alpha Spectroscopy and gross alpha Techniques for Determining WL in Mines and Houses" (to be published in H.P. in press).

3.0 Health Physics Procedures

These procedures are meant to be generic and state the minimum requirements. Site specific guidelines will be generated by the site HP Manager.

The appendices which include forms to be used are not meant to be all inclusive and modification or additions may be made at each site.

HEALTH PHYSICS PROCEDURES
Table of Contents

Table of Contents (Continued)

RADIOLOGICAL INSTRUMENTS CALIBRATION AND FUNCTIONAL CHECKS
RAC-001

1.0 Scope

1.1 Purpose

This procedure provides instructions for instrument calibration, instrument functional checks, and record keeping for radiation detection instruments and equipment.

1.2 Applicability

All functional radiation detection instruments and equipment used by Health Physics personnel at all UMTRA locations.

1.3 Measuring and test equipment is calibrated against equipment having a known valid relationship to NBS or other recognized standard.

2.0 Prerequisites

2.1 All equipment to be used to take data shall have a valid calibration.

3.0 Requirements

3.1 Instrument Calibration

3.1.1 Calibration Frequency

3.1.1.1 All portable survey instruments, personnel dosimetry devices, continuous air monitoring instruments, air flow check devices, and counters and scalers shall be calibrated at least annually, and after repair that could effect the calibration.

3.1.1.2 All off site calibration of instruments used on the UMTRA Project shall be performed by a qualified vendor as determined by the M-K Quality Department. The annual calibration does not substitute for daily field checks and vice versa.

3.1.1.3 Air particulate samplers shall be air flow checked once per month.

3.1.2 Calibrated Equipment Issue Record

3.1.2.1 The Calibrated Equipment Issue Record is audited by the Quality Department.

3.1.2.2 Only properly identified and calibrated equipment will be issued for quality controlled construction, inspection, and tests.

3.1.3 Calibration Labels

3.1.3.1 Each calibrated piece of equipment shall have a label attached indicating the equipment identification number, date of last calibration, and due date for next calibration.

3.1.3.2 Labels that are deteriorated to a point of illegibility are to be replaced. Calibration dates are to be obtained from the Equipment Calibration Record.

3.1.3.3 Equipment to which labels cannot be applied shall be uniquely marked in a permanent manner. These I.D. markings shall be traceable to the Equipment Calibration Record.

3.1.4 Discrepancies

3.1.4.1 When calibrated equipment is found to be inaccurate while in use or during checks, the equipment will be withdrawn from use and labeled as "Out of Calibration" or "Hold for Inspection" and returned to a certified vendor for calibration.

3.1.4.2 All verification data acquired with faulty equipment during that day will be reverified with calibrated instruments.

3.2 Radiological Equipment Functional Checks

3.2.1 Functional Check Frequency

The following functional checks will be made at the specified minimum frequency.

Instrument set up background -- 20 minutes for alpha, 1.0 minute for beta, gamma: once daily and for each geometry change.

Minimum detectable activity -- once daily for swipe and filter counting instruments.

Reliability of instrument -- once daily for swipe and filter counting instruments.

Air Partiuclate Samples -- Air flow checks, monthly.

Efficiency -- once daily for swipe and filter counting instruments.

High voltage plateau -- initially and then quarterly or if other parameters change, or after power loss.

Response check -- once daily.

Tools and equipment which are not adjustable will be checked against gauge block or by volume measurements. The frequency of checks shall be determined according to the item usage.

3.3 Definition of Potential Detection Problems

3.3.1 Detection Problems

In reviewing the Instrument MDA Control Field Record, the Site HP manager or HP supervisor must be alerted for the following developing problems:

- Alpha background greater than 0.25 counts per minute.
- A calculated MDA equal to 50% of the maximum permissible concentration obtained from 10 CFR 20, Appendix A.
- Reliability factors greater than 1.37 or less than 0.5 for ten consecutive source measurements.

4.0 Records

4.1 An instrument calibration file shall be maintained at the site. This file shall include all Certification of Calibration documents and information contained on the attached "Equipment Calibration Record" as a minimum.

4.2 The Site HP Manager or his designee, on a monthly basis, shall forward copies of all pertinent records, daily logs, forms and memos to the RAC Albuquerque Project Office.

List of Attachments

The following list of forms are to be filled out when performing the applicable function described in this procedure.

1. Daily Instrument MDA Control Field Record (FS-100)
2. Assurance of Reliability of Instrument (FS-120)
3. Statistical Limits of Counter Reliability
4. High Voltage Plateau
5. Form QP5-1 Equipment Calibration Record
6. Form QP5-2 Equipment Identification List
7. Calibrated Equipment Issue Record
8. Health Physics Equipment Record
9. High Voltage Plateau Data Sheet

DAILY INSTRUMENT MDA CONTROL FIELD RECORD

PROJECT NAME/# _____

INSTRUMENT TYPE/# _____

DATE	SOURCE COUNTS	BACKGROUND COUNTS	BACKGROUND COUNT TIME	MDA MINIMUM DETECTABLE ACTIVITY	LIMIT OF RADIONUCLIDE OF INTEREST	% EFFICIENCY	BATTERY CHECK	INSTRUMENT RELIABILITY FACTOR R.F.	DONE BY	COMMENTS

I have reviewed the above data and/or procedures generating the data and certify them to be acceptable and accurate to the best of my knowledge.

_____
Site H.P. Manager

FS-100 Rev-B

Assurance of Reliability of Instrument

Project Name/#_____ Source #_____

Instrument Type/#_____ Radiation Type_____

Technician_____ Date/Time_____

1. a. Record 10 (M) - one minute counts for a source of known activity (C).

_____	_____
_____	_____
_____	_____
_____	_____

b. Determine the average of the ten values (C) and the standard deviation of these observations (S_n)

M = Number of observations
M - 1 = 10 - 1 = 9

$$S_n = \sqrt{\frac{\Sigma (C - \bar{C})^2}{M - 1}}$$

Avg._____ = $\bar{C}$

c. Calculate the reliability of the instrument; S_n = observed standard deviation as defined below; $\sigma_n = \sqrt{\bar{C}}$ or the theoretical standard deviation

$$\text{R.F.} = \frac{S_n}{\sqrt{\bar{C}}}$$

R.F._____

2. Determine the efficiency of the system for the type of particle of interest using a source of known activity.

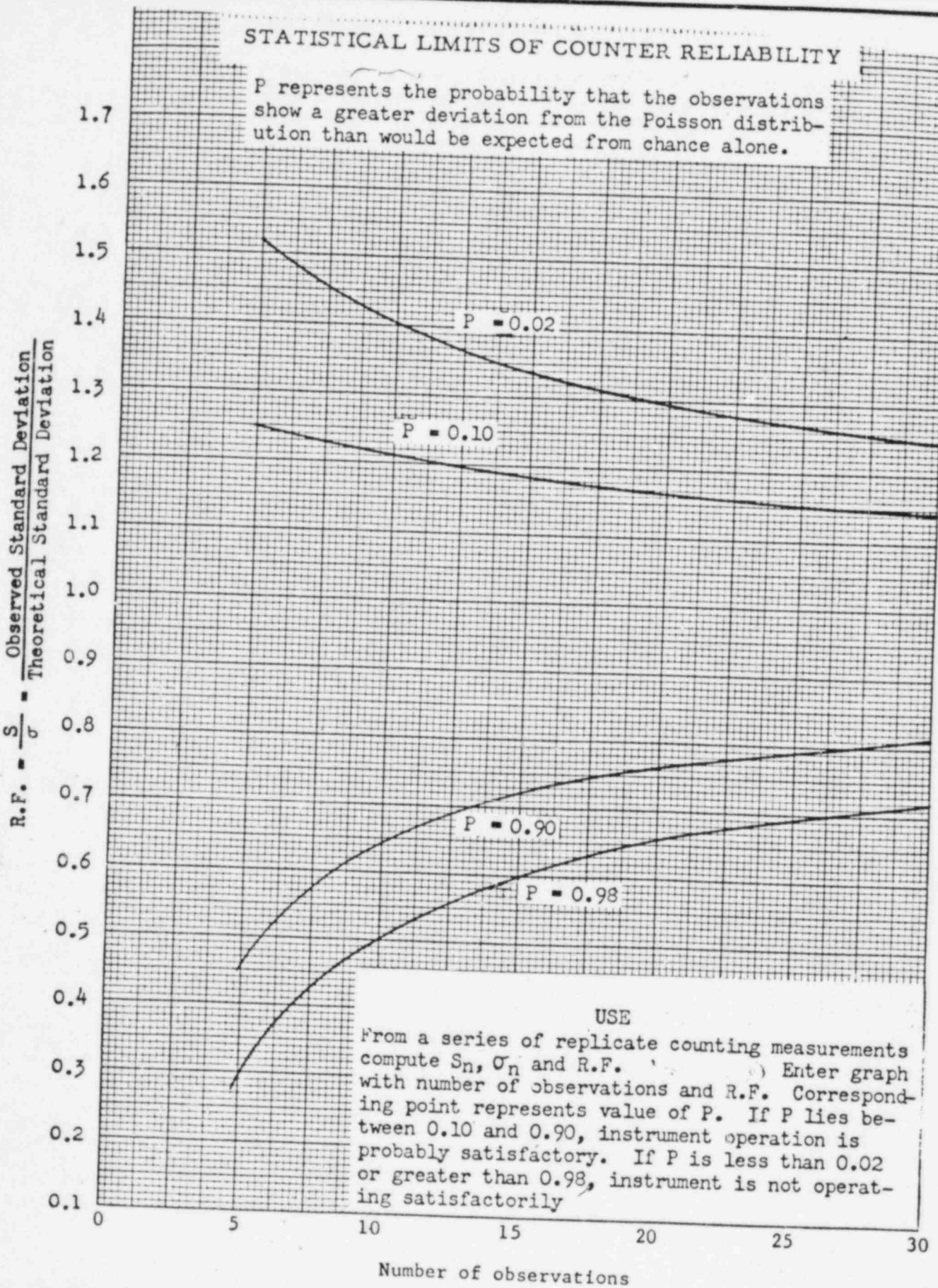
a. Count a source for one minute: Source activity in DPM_____

E = Efficiency $\frac{\text{CPM}}{\text{DPM}}$ $\frac{\text{net Counts per minute}}{\text{disintegration per minute}}$

E = _____

STATISTICAL LIMITS OF COUNTER RELIABILITY

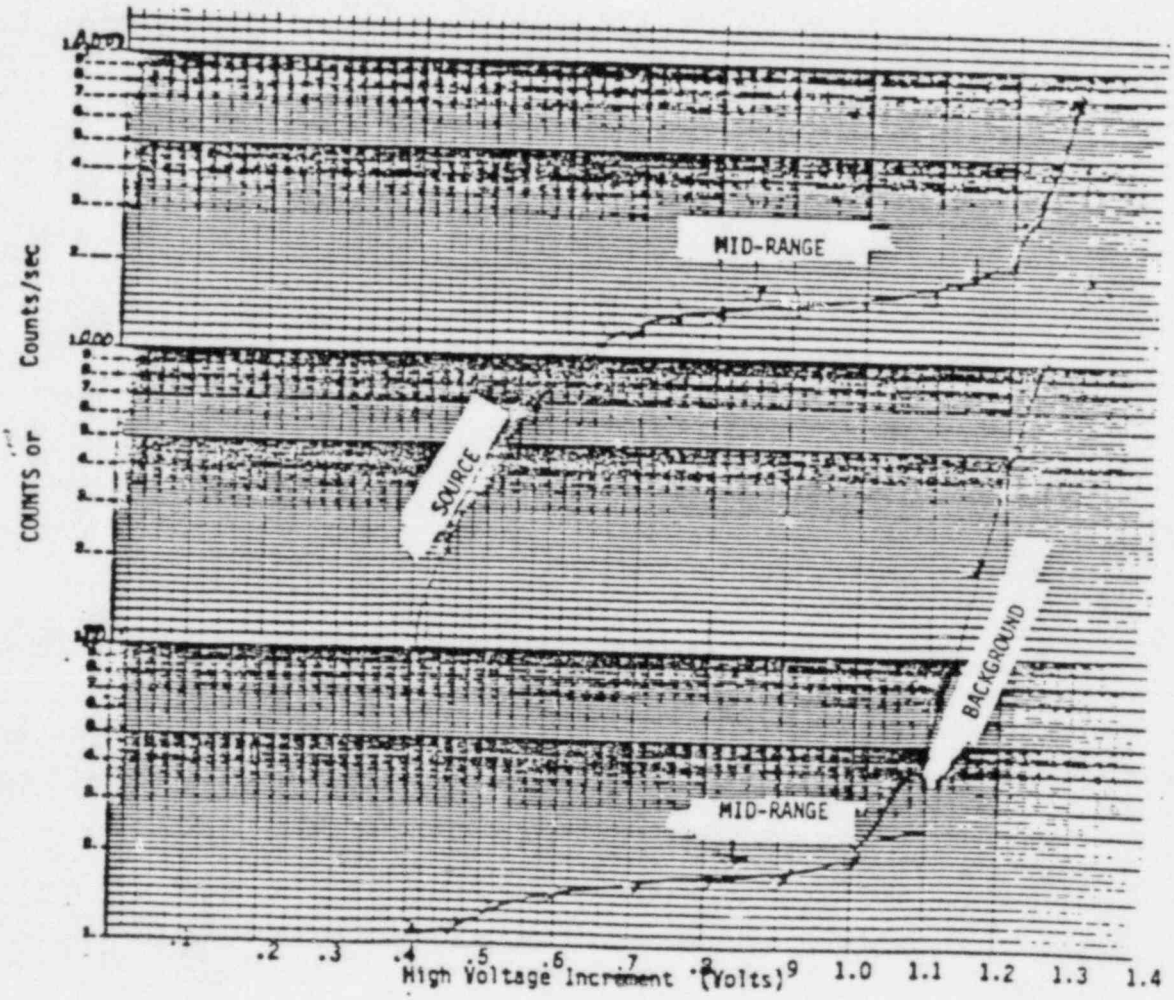
P represents the probability that the observations show a greater deviation from the Poisson distribution than would be expected from chance alone.



USE

From a series of replicate counting measurements compute S_n, σ_n and R.F. Enter graph with number of observations and R.F. Corresponding point represents value of P. If P lies between 0.10 and 0.90, instrument operation is probably satisfactory. If P is less than 0.02 or greater than 0.98, instrument is not operating satisfactorily

HIGH VOLTAGE PLATEAU AND
BACKGROUND DETERMINATION



MORRISON-KNUDSEN COMPANY, INC.

Form CP

EQUIPMENT CALIBRATION RECORD

Instrument Name			Project No.
		Range & Accuracy	Project ID No.
Manufacturer		Cost	Calibration Frequency
Model No.	Serial No.	Assigned To	

DATE						
CALIBRATED	NEXT CALIBRATION	CALIBRATED BY	CALIBRATION STD	CALIBRATION PROCEDURE/ REV.	CALIBRATION TOLERANCE	AS FOUND CONDITION IF NOT IN TOLERANCE

MORRISON-KNUDSEN COMPANY, INC.

Form QP 5

EQUIPMENT IDENTIFICATION LIST

Project No.

PROJECT IDENTIFICATION NUMBER	EQUI NT DESCRIPTION	RANGE	SERIAL NUMBER	DATE CALIBRATED	CALIBRATION FREQUENCY

0220B

MORRISON-KNUDSEN COMPANY, INC.

Form CP

Project No.

CALIBRATED EQUIPMENT ISSUE RECORD

PROJECT IDENTIFICATION NUMBER	EQUIPMENT TO BE USED FOR:	CALIBRATION CURRENT		TIME & DATE		EQUIPMENT CHECKED OUT BY:
		YES	NO	OUT	IN	

0320B

Health Physics Equipment Record

Tag No.	Property No.	MFG Serial No.

Manufacture:

Job Location:

Description of Equipment:

History of Equipment

Date	P.O.	Description of Repairs	Comments

HIGH VOLTAGE PLATEAU DATA SHEET

Reviewed By: _____

INSTR. TYPE: _____

INSTR. ID NO.: _____

DATE: _____

TIME: _____

TECHNICIAN: _____

THRESHOLD: _____

SHEET _____ OF _____

WINDOW: _____

SOURCE: _____

RADIATION TYPE: _____

SOURCE COUNT TIME: _____

BKG COUNT TIME: _____

SELECTED HIGH VOLTAGE (DIAL) SETTING: _____

Volts or Dial Setting	Source Counts	Background Counts	Volts or Dial Setting	Source Counts	Background Counts

DOSIMETRY PROGRAM
RAC 002

UMTRA
RAC

Chem-Nuclear Systems, Inc.

1.0 Scope

1.1 Purpose

This procedure describes the personnel monitoring program which shall be utilized to provide the legal record for personnel radiation exposure during employment at an UMTRA project.

1.2 Applicability

The methodology of the issuance, administration and record keeping of thermoluminescent dosimeters (TLD), the use of self-reading dosimeters (SRD) and collection of bioassay samples are subject to this procedure.

2.0 Prerequisites

2.1 Qualifed vendor to supply, process and provide TLD readouts.

3.0 Requirements

All personnel who require routine access to radiologically controlled areas for more than 40 working hours in any 3 consecutive months shall be issued a TLD and be required to submit bioassay samples prior to entry into any of these areas.

3.1 Thermoluminescent Dosimeters (TLD)

All personnel, excepting Visitors, requiring TLDs for the performance of their job tasks shall have met the following requirements prior to being issued a TLD.

3.1.1 All personnel shall have completed radiation worker training and documentation of that training shall exist in on-site radiological personnel files.

This requirement may be waived by the Site H.P. Manager for personnel who may spend more than 40 working hours per 3 consecutive month period in areas requiring TLDs for entry, but are not considered to be part of the normal work crew associated with that site, if, by virtue of their job title, they may be expected to have the radiological knowledge necessary for the purpose of entering TLD areas.

3.1.2 An up-to-date NRC Form 4 should be available for inclusion in on-site radiological personnel files. If that form is not readily obtainable, then an Estimate of Previous Radiation History (EPRH) form shall be filled out and signed by the person requesting the TLD. The EPRH form does not replace the purpose of a copy of an individual's permanent exposure history, but is to be used for a reasonable amount of time until the permanent record is obtained. If an individual has no previous history of radiation exposure, then the EPRH must be inserted in the person's radiological file with "N/A" in the appropriate blocks. A copy will be submitted to the Dosimetry Health Physicist in the Project Office.

3.1.3 Each person requesting a TLD shall fill out and sign a Request for Previous Radiation History form. This form permits the RAC to obtain copies of an individual's permanent radiation exposure record from previous employers. The site HP Manager shall mail such forms to previous employers, record the mailing date, and send a copy of each form the RAC-ALB EAV Manager.

3.1.4 The Site H.P. Manager shall establish a quarterly exchange of TLDs thru coordination with the vendor supplying the TLDs.

3.1.5 All TLDs shall be exchanged on the same day.

3.1.6 When the quarterly exchange of TLDs is completed, the previous quarter TLDS shall be shipped immediately to the Vendor for processing, including all control TLDs and unissued TLDs.

3.1.7 Upon receipt of dose readings for the previous quarter's TLDs, personnel files shall be updated, discrepancies resolved, alert lists updated, and a report sent to the RAC-ALB.

3.1.8 TLDs shall be stored in an area of lowest practical radiation level.

3.1.9 The Site H.P. Manager shall estimate the dose an individual who has lost a TLD may have received, from the date of issue through the date of loss, by utilizing area radiation levels, hours worked, etc. The estimated dose shall be incorporated in the individual's permanent exposure history as follows:

It is expected that personnel assigned to a particular work crew should remain relatively constant for the length of a project. Therefore, the highest dose received by a person in the same work crew as the individual who has lost a TLD shall also be assigned to the person who lost the TLD. If the combined estimated dose and dose from a reissued TLD is exceeded for that reporting period. If the combined doses for a lost TLD is not exceeded by the highest dose for the work crew, then the combined doses shall be assigned to the person who lost the TLD. A copy of the report will be submitted to the Dosimetry Health Physicist in the Project Office.

Example: Rodney had been working with a crew requiring a TLD for 15 days. On the 16th day he lost his TLD. The Site RSO estimated his dose for the 16 days at 10 mrem. Rodney was reissued a TLD and at the end of the reporting period that TLD read 10 mrem. His combined dose is 20 mrem. Jane, a member of Rodney's work crew, received the highest dose of the work crew for that reporting period - 30 mrem. Rodney's permanent radiation exposure history was assigned 30 mrem. If Jane's dose had been less than 20 mrem, Rodney would have been assigned 20 mrem.

3.1.10 TLDs shall be worn on the front of the body between the neck and waist unless otherwise dictated by the Site H.P. Manager. Additional dosimetry may be required by the Site H.P. Manager and, excepting extremity dosimetry, should be worn adjacent to the TLD.

3.2 Bioassay

3.2.1 All personnel who work at least 40 hours per calendar quarter in a controlled area will sign a bioassay agreement and submit a urine sample prior to beginning work on the project. A sample will be collected upon termination of the individuals work activity at the project. A 2 liter sample is required for each submittal. A copy of the bioassay agreement will be submitted to the RAC Project office dosimetrist. Additional samples may be required if specific individuals when in the opinion of the site HP manager, potential overexposure to airborne radionuclides may have occurred.

3.2.2 The site health physics manager will review the bioassay analytical results and observe the following action levels for Th-230, Ra-226 and uranium in urine.

Th-230

-resample - 0.05 pCi/l
-investigate work conditions - 0.1 pCi/l
-prohibit employee from working in controlled area - 0.2 pCi/g.

Ra-226

-resample - 0.5 pCi/l
-investigate work conditions - 0.7 pCi/l
-prohibit employee from working in a controlled area - 1.0 pCi/l.

Uranium

-resample - 10 ug/l
-investigate work conditions - 15 ug/l
-prohibit employee from working in a controlled area - 30 ug/l

3.3 Radiation Exposure Limits

3.3.1 The UMTRA Project Health and Safety Plan, Section 3.0, sets forth allowable radiation exposure limits on a quarterly and annual basis. All site radiation exposure control methodology shall be based on the following table:

Radiation Exposure Standards

Type of Exposure	Exposure Period	Dose Equivalent (Dose or Dose Commitment * rem) Admin Limit	DOE Order 5480.1
Whole body, head and trunk, gonads, lens of the eye**, red bone marrow, active blood-forming organs.	Year	2.5	5
	Calendar Quarter	1.5	3
Unlimited areas of the skin (except hands and forearms). Other organs, tissues, and organ systems (except bone).	Year	7.5	15
	Calendar Quarter	2.5	5
Bone	Year	15	30
	Calendar Quarter	5	10
Forearms	Year	15	30
	Calendar Quarter	5	10
Hands	Year	37.5	75
	Calendar Quarter	12.5	25

*To meet the above dose commitment standards, operations must be conducted in such a manner that it would be unlikely that an individual would assimilate in a critical organ, by inhalation, ingestion, or absorption, a quantity of radionuclides or mixture of radionuclides that would commit the individual to an organ dose that exceeds the limits specified in the above table.

**A beta exposure below a maximum energy of 700 KeV will not penetrate the lens of the eye; therefore, the applicable limit for these energies would be that for the skin (7.5 rem/year).

3.3.2 The Site Manager may, by his signature, permit personnel to exceed the administrative levels.

3.3.3 Personnel shall not be permitted to receive radiation exposure in excess of 90% of the limits established by the UMTRA Health and Safety Plan, Section 3.0, except in life-threatening situations.

3.4 Self-Reading Dosimeters (SRD)

Visitors entering a controlled access area will be required to wear SRDs.

3.4.1 Visitors will be issued SRDs.

3.4.2 The site HP Manager will determine if and when escorting is required.

3.4.3 Low range, 0-200 mR max, SRDs shall be used.

3.4.4 SRDs shall be issued, collected, and doses recorded on a daily basis.

3.4.5 At the discretion of the site HP manager, groups of visitors may be issued one SRD for the group.

4.0 Records

4.1 The site HP Manager or his designee, shall establish and maintain RAC personnel files for all individuals issued TLD and SRDs. Copies of their files will be sent to RAC-AL monthly.

List of Attachments

The following list of forms are to be filled out when performing the applicable functions described in this procedure.

1. TLD Issue Record
2. Radiation Worker Bioassay Agreement
3. Exposure Extension Authorization
4. Dosimeter Record Checklist
5. Daily Exposure Record (to be used only for frequent recurrent visitors, normally use visitors log)
6. Dosimetry Investigation Form
7. Bioassay ID Form
8. Urinalysis Form
9. Sample Collection Form
10. Request for Report of Radiation History

MORRISON-KNUDSEN

Reviewed by: ____________

UMTRA

T L D

YEAR:__________ COMPANY:____________ SITE/LOCATION:________________

NAME	COMPANY	SOCIAL SECURITY	DATE OF BIRTH	ISSUE DATE	QUARTERLY REISSUE DATES AND TLD NUMBER				CANCEL DATE	COMMENTS
					1st	2nd	3rd	4th		

Radiation Worker Bioassay Agreement

The term "bioassay" means the collection and analysis of biological samples. Usually, only entrance and exit (beginning and ending of employment) urine samples are required. In some cases, if the site Health Physics Manager feels than an employee may have been working in an area with unusually high concentrations of airborne tailings, he may request additional samples. These samples are intended to assure the health physics staff that no overexposures occur during this project. Other types of samples may also be requested, including nasal swipes. Additional protective measures, including air sampling, TLD badges, radon measurements, working level measurements, and gamma exposure measurements are also regularly performed to minimize the chance of overexposure of any worker.

The site Health Physics manager is required to obtain both exit and entrance urine samples from all radiation workers. The resulting information on urine concentrations of radium and thorium is an important part of the overall record of your radiation exposure while on this job. This information is also available to you, if you request it, and will provide you with assurance that you were not overexposed during your UMTRA employment.

Agreement:

I understand the above, and agree to provide bioassay samples as requested by the site Health Physics Manager, including an entrance and an exit urine sample.

_____ _____

Signature Date

_____

Printed Name

_____

Social Security Number

_____

Site/Location

EXPOSURE EXTENSION AUTHORIZATION

NAME: _____ QTR._____ YEAR_____

JOB TITLE: _____ SUPERVISOR_____

A. AUTHORIZATION TO EXCEED 100 mRem PER WEEK:

	Exposure					
Date	Week To Date	Qtr. To Date	Year To Date	Week Ending	Not to Exceed	RSO

B. AUTHORIZATION TO EXCEED QUARTERLY ADMINISTRATIVE EXPOSURE LIMITS:

1. Authorization to exceed 1000 mRem:

   Current Exposure: _____ QTR. _____ YEAR _____ RSO

   _____
   Review: Site Manager

2. Authorization to exceed 1250 mRem:

   Current Exposure: _____ QTR. _____ YEAR

   Review: _____
   Site Manager

3. Authorization to exceed 1500 mRem:

   Current Exposure: _____ QTR. _____ YEAR _____ RSO

4. Authorization to exceed 2000 mRem:

   Current Exposure: _____ QTR. _____ YEAR _____ RSO

DOSIMETRY RECORD CHECK LIST

/_/ 1. Record of radiation worker exam score.

/_/ 2. NRC form 4 and record of request including date sent to the previous employers where exposures took place. A copy is sent to RAC project office dosimetrist at the same time as the original is sent to the previous employer.

/_/ 3. Current quarter exposure record.

/_/ 4. Baseline bioassay(s) collection date and result.

/_/ 5. Dosimetry issue; TLD number; any SRD's issued and dates of issue.

/_/ 6. Instructions on exposure to unborn fetus form.

/_/ 7. Rad Worker certification record -- signed and dated.

/_/ 8. Estimate of previous radiation history record form. "NA" if no previous rad history.

/_/ 9. Personnel information -- SSN, Date of birth, permanent home address, mailing address. (Copy sent to ALB, DOS as soon as completed.)

/_/ 10. TLD issue, number and date of issue transmitted to the RAC project office quarterly. (Form "TLD ISSUE RECORD" page 004-8 HP Procedure 004).

/_/ 11. In the event of a lost TLD a "CNSI Dosimeter Investigation" report must be filed in the individuals file and copies as soon as available to the RAC Project office dosimetrist, (HP Procedure 004).

/_/ 12. Any exposure extension authorization records; (RAC HP Procedure 004).

/_/ 13. Bioassay agreement. (Copy sent to the RAC Project office dosimetrist as soon as signed.)

MORRISON-KNUDSEN COMPANY, INC.

DAILY EXPOSURE RECORD

SITE/LOCATION: _____

Name	Date	DOB	SSN	Organization	Time In / Out	SRD No.	SRD Reading	Comments

CHEM-NUCLEAR SYSTEMS, INC.	DOSIMETER INVESTIGATION

NAME: _____ DATE: _____

SOC. SECURITY NO. _____ JOB CLASS: _____

TYPE:

☐ Beta-Gamma Film Badge or TLD ☐ Other - Explain

☐ Pocket Dosimeter

PERIOD COVERED:

FROM _____ TO _____

REASON FOR DOSIMETER INVESTIGATION:

RADIATION MONITORING ESTIMATE OF DOSE DURING PERIOD

AVAILABLE DOSIMETER RESULTS DURING PERIOD:

METHOD(S) USED FOR ESTIMATING DOSE:

SUPPLEMENTARY EXPOSURE DATA:

ESTIMATED DOSE: WHOLE BODY _____ SKIN _____ EXT. _____

INVESTIGATOR: _____

EXPOSURE RELODS CLERK: _____

H.P. SUPERVISOR _____ DATE: _____

FORM NO. 110 McGOWEN

5/8/85

0321B

Reviewed by: _____

UMTRA

BIOASSAY ID NO. ISSUE FORM

SAMPLE I.D.	EMPLOYEE NAME/SSN	COMPANY	LOCATION

NOTE: The letters I, E or R shall be assinged to the I.D. number at time of issue.
I = initial sample E = exit R = resample

MORRISON KNUDSEN

5/8/85
0321B

SITE/LOCATION: _____

UMTRA
URINALYSIS

Reviewed by: _____

NAME	COMPANY	SOCIAL SECURITY NO	INITIAL SAMPLE				EXIT SAMPLE				RESAMPLE AND/ OR COMMENTS
			ID NO.	ISSUE DATE	SHIP. DATE	LOG NO.	ID NO.	ISSUE DATE	SHIP. DATE	LOG NO.	

0

002-15

SAMPLE COLLECTION FORM Location: _____

Sample I.D.	Location	Time Date	Sampler's Name	Chem.-Nuclear I.D.

Location_____

CHEM-NUCLEAR SYSTEMS, INC.
UMTRA Project
P.O. Box 9136
Albuquerque, NM 87119

REQUEST FOR REPORT OF RADIATION HISTORY

Name_____

Period of Exposure_____ Birth Date_____

Social Security No._____

Service Number (if applicable)_____

Branch of Service (if applicable)_____

Gentlemen:

We would appreciate receiving any internal or external radiation exposure history which you may have for the above employee.

This request is necessary to facilitate control of occupational radiation exposure in accordance with DOE Manual Chapter 5480.1.

A statement authorizing the release of the requested information is below.

Sincerely,

Larry Hoffman
Health Physicist/UMTRA
Chem-Nuclear Systems, Inc.

TO WHOM IT MAY CONCERN: You are authorized to furnish to Chem-Nuclear Systems, Inc., P.O. Box 9136, Albuquerque, New Mexico, 87119, any information concerning my radiation exposure history while I was associated with your organization.

_____
(Signature/Date)

SOURCE ACCOUNTABILITY AND LEAK TESTING
RAC-003

UMTRA
RAC

Chem-Nuclear Systems, Inc.

1.0 Scope

1.1 Purpose

This procedure describes the requirements for the handling and storage of radioactive sources used in UMTRA activities. These requirements include inventory, accountability and custody identification.

1.2 Applicability

All radioactive sources of licensable quantities used by RAC personnel are subject to this procedure.

2.0 Prerequisites

N/A

3.0 Requirements

3.1 Each radioactive source must remain under the custody of the Site Health Physics Manager (H.P. Manager). The H.P. Manager or his designee, shall maintain a master inventory listing of the sources.

3.2 It is the responsibility of the Site H.P. Manager or his designee to assure that all sources are inventoried. An inventory list shall be submitted to the RAC-ALB on a quarterly basis.

3.3 It is the responsibility of the Site H.P. Manager to periodically review the utilization of each source and justify its retention, transfer or disposal.

3.4 Leak Test Requirements: Except as noted below, all sources must be leak tested semiannually by swiping.

3.4.1 Sealed sources with isotopic source strengths less than those identified in Appendix C of the Code of Federal Regulations, Title 10, Part 20 (10 CFR 20) need not be leak tested. All other sources, including all liquid sources, whose total source strengths exceed 2000 pCi beta-gamma or 200 pCi alpha activity shall be leak tested, with the exception of opposed crystal system soil standards up to 60 pCi/g and up to 830g.

3.4.2 For sources stored in a container designed to minimize radiation levels from the source or in a complex device requiring extensive disassembly to expose the source, it is permissible to perform the required leak test at locations where one might expect contamination to accumulate. The source itself, if dose rates permit, should then be leak tested by swiping when the container or device is next opened for other reasons.

3.4.3 For sources whose seal could be damaged or active material removed by direct swiping, the leak test shall not be performed by swiping the active surface of the source. Rather, the adjacent surface and/or other locations where one might expect contamination to accumulate shall be swiped.

3.4.4 Total leak test activity, the sum of alpha and beta-gamma radioactivity must be less than 0.005 uci. Sources whose leak tests exceed 0.005 uci, total activity shall be removed from service and shall be disposed in accordance with applicable local, state and federal regulations after consultation with RAC-AL Office.

3.5 If a source is lost, immediate steps shall be taken to recover the source and minimize radiation exposure to, or contamination of, personnel as a result of the lost source.

3.6 All radiological sources, except for those attached to or permanently installed in or on equipment, shall be stored in an area designated by the Site H.P. Manager in a locked source locker. The locker will be permanently mounted or of such dimensions as to physically impede its removal from the area designated by the Site H.P. Manager as the source storage area.

3.7 A sign-out log shall be kept beside the source locker so that any time a source is removed for use outside the counting area, it is signed out by the person using that source. After use of the source, the source will be logged back into the source locker.

3.8 The sign-out log will be routinely reviewed and signed by the Site H.P. Manager, or his designee, verifying that all sources are returned and accounted for.

3.9 Upon completion of a project, radioactive sources shall be removed from local responsibility upon receipt of written instructions from the RAC Albuquerque office by one of the following methods:

3.9.1 Transfer to another UMTRA project in accordance with applicable local, state and Federal regulations.

3.9.2 Transfer to the RAC-AL office in accordance with applicable local, state and Federal regulations.

3.9.3 Transfer to the US DOE in accordance with applicable local, state and Federal regulations.

3.9.4 Disposed of as radioactive waste in accordance with applicable local, state and Federal regulations.

4.0 Records

4.1 The site HP Manager or his designee shall maintain a site file of all data sheets, records, logs, forms, memos and shall forward to RAC AL copies on a monthly basis.

List of Attachments

The following list of forms are to be filled out when performing the applicable function described in this procedure.

1. Source Inventory
2. Radioactive Source Checkout Log
3. Radioactive Material Accountability Log
4. Source Leak Test Log

PAGE _____ of _____

SOURCE INVENTORY

SOURCE NUMBER	VISUAL INVENTORY (DATE/ INITIAL)	VISUAL INVENTORY (DATE/ INITIAL)	VISUAL INVENTORY (DATE/ INITIAL)	VISUAL INVENTORY (DATE/ INITIAL)	SOURCE/STRENGTH/LOCATION

NOTES: (1) Counts Per Minute=Total Counts Divided by Counting Time

CUSTODIAN: _____

PAGE _____ of _____

RADIOACTIVE SOURCE CHECKOUT LOG

DATE	OUT		IN		REMARKS
	SOURCE #	INITIAL	TIME	INITIAL	

PAGE _____ of _____

RADIOACTIVE MATERIAL ACCOUNTABILITY LOG

SOURCE ID#	DESCRIPTION	LOCATION	DATE IN	DATE OUT	DISPOSITION

SOURCE LEAK TEST LOG

SOURCE _____ ACTIVITY _____ LOCATION _____

SERIAL NO. _____ DESCRIPTION _____ ASSAY DATE _____

LEAK TEST DATE	COUNTER	TOTAL COUNTS	COUNT TIME (MIN)	TOTAL(1) COUNT RATE(cpm)	(2) BKG (cpm)	NET. COUNT RATE(cpm)	COUNTER EFF.	ACTIVITY (dpm) (3) Beta-Gamma/Alpha	ACTIVITY (uci)(4) Beta-Gamma/Alpha	TOTAL (uci)(4)	INITIALS ACTIVITY

NOTES: (1)Counts Per Minute=Total Counts Divided by Counting Time
(2)Net Counts Per Minute=Counts Per Minute minus Bkg
(3)DPM=Net Counts per minute divided by efficiency
(4)uci=DPM divided by $2.22(10^6)$
(5)$A_T = A_A + A_{B-G}$; must be < 0.005 uci

CUSTODIAN _____

1.0 Scope

1.1 Purpose

This procedure establishes guidelines for the collection and analysis of airborne particulate radioactivity and for monitoring and controlling radiation and contamination.

1.2 Applicability

These requirements apply to sampling and checking of areas where real or potential airborne particulate/radiation/contamination may exist.

2.0 Prerequisites

2.1 All instruments used under this procedure will have a valid calibration.

2.2 Flow rates of air sample equipment will be checked monthly.

2.3 Rotometer readings are visually checked prior to each sample collection date. Changes of ± 15% are considered acceptable performance.

3.0 Requirements

3.1 Air Particulate Sample Collection

Delays between collection time and counting time of airborne dusts and radon daughters require accurate timing information to properly analyze the data generated; therefore, thought should be given to the most efficient method of taking the air samples and delivering them to the counting station for analysis. For occupational and environmental exposure estimation, air samples shall be counted 48 to 72 hours after collection to allow short-lived Radon daughter products to decay.

If the need to determine the activity level prior to 72 hours decay arises, use the long lived activity formula and count the samples at 4 hours decay and 14 hours decay times.

3.2 Analysis for Airborne, Particulate Radioactivity - Gross Alpha Analysis

Analysis for airborne alpha particulate radioactivity using a scaler and an alpha detector, combination, is for unidentified alpha emitters. The most restrictive applicable MPCa (Th-230) from 10 CFR 20 shall be used in determining action levels for indications of high airborne radioactivity.

3.3 Offsite QA Analysis

This section applies to occupational, site boundary and environmental sampling for radioactive particulates.

3.3.1 High-vol air sample filters used for collecting occupational air sample data in areas of high activity excavation will be sent to a qualified radiochemistry vendor for Ra-226 and Th-230 analyses on a monthly basis. The boundary and off site air samples will be composited by location for each month (by station) for radiochemistry analysis. Specific analyses are designated in the site specific HP Monitoring Plan.

3.3.2 A report to the radiochemistry vendor will accompany the filters giving either the total air volume associated with each filter or with each sample location.

3.3.3 Unused filters from each lot (box) of filters used for boundary and/or off-site air sampling equal to the largest number of filters used at any location shall be included in the shipment of sample filters to the radiochemistry vendor.

3.4 Occupational Working Level (WL) Sample Within a Structure

The working level will be determined by obtaining a grab sample and using the modified Kuznetz WL method. If the level exceeds a projected .3 WL/month, respirators will be required or level reduced.

3.5 Occupational Radon Gas Sample Within a Structure

The radon gas activity level will be established by obtaining a grab sample. If the level exceeds 30 pCi/l, the structure will be ventilated to reduce the level below the limit.

3.6 Radiation/Contamination Surveys

3.6.1 Alpha and/or beta/gamma surveys using direct instruments will be utilized routinely.

3.6.2 Smear surveys will be utilized routinely, as defined below.

3.6.3 Whole body dose rate survey and calculation of stay time will be utilized where determined necessary by the HP manager.

3.7 Frisker Stations

Personnel must monitor themselves upon exiting from all radioactive contamination boundaried areas. It is the responsibility of each individual to use the frisker stations for the purpose of controlling the spread of contamination and decreasing the possibility of internal deposition of radioactive materials. Any detectable contamination on personnel, personal clothing, or personal items shall be removed under the direction of health physics personnel.

3.8 Radioactive/Contaminated Equipment and Material Control

3.8.1 General - Tools, materials, instruments, and equipment have the potential for becoming contaminated at the facility. Contaminated equipment in excess of 200 dpm/100 cm^2 alpha and 1000 dpm/100 cm^2 beta-gamma smearable must be packaged and appropriately labeled before being transferred through clean areas.

3.8.2 Equipment and Material Release

General - All equipment and material which has been removed from work areas for the purpose of being transferred from the facility shall require HP screening/clearance. The unrestricted release limits for equipment and materials are:

	Total	Smearable
alpha	1000 dpm/100 cm^2	200 dpm/100 cm^2
beta-gamma	5000 dpm/100 cm^2	1000 dpm/100 cm^2

3.8.3 Vehicle/Driver Release

General - All vehicles exiting radiological control areas will be checked as directed by the site Manager. Driver of vehicles shall frisk out of access control areas, as required.

3.8.3.1 A visual inspection of all vehicles for possible contaminated material will be made.

3.8.3.2 A spot check swipe survey of the tires and the floorboards shall be conducted at the direction of the Health Physics Manager.

3.8.3.3 Direct probe surveys may be substituted for swipe surveys; however, if indications of contamination are found, a swipe survey shall be conducted to verify compliance with the limits of Section 2.6.2.

3.8.3.4 Vehicle release surveys shall be recorded in the Access Control log, with vehicle identification number included.

4.0 Records

4.1 The site HP Manager or his designee shall maintain a site file of all data sheets, records, logs, forms, memos and shall forward to RAC AL copies on a monthly basis. The particulate air sampling log will be sent weekly to RAC-ALB.

List of Attachments

The following list of forms are to be filled out when performing the applicable function described in this procedure.

1. High Vol Air Sample

2. Particulate Air Sample

MORRISON KNUDSEN

UMTRA

High Vol Air Sample Activity

MPC Summary

Reviewed By: _____

MPC on Site Limit _____

MPC off Site Limit _____

Date Samples Taken _____

HV NO.	TIME SAMPLES TAKEN	LOCATION	INITIAL COUNT			SECOND COUNT			THIRD COUNT		
			ELAPSED TIME	uCi/Ml	MPC	ELAPSED TIME	uCi/Ml	MPC	ELAPSED TIME	uCi/Ml	MPC

MORRISON KNUDSEN

0323R

UMTRA

PARTICULATE AIR SAMPLING ACTIVITY/MDA CALCULATIONS

Reviewed by: _____

FILTER ID NO. LOCATION	SAMP IN DATE	SAMP OUT DATE	TIME IN	TIME OUT	IN/ OUT BY	TOTAL RUN (MIN)	ACTUAL FLOW (LPM)	VOL (ML)	20 MIN BKG	EFFIC	SAMP CTS	CALC BY	COUNT DATE/ TIME	ACT uCi/ml	MPC	MDA

FORMULAE:

$$\text{VOLUME} = (\text{FLOW} \quad \text{RUNTIME})\left(1000\frac{\text{ml}}{\text{l}}\right)$$

$$\text{ACTIVITY} = \frac{(\text{NET COUNTS})(\text{FILTER RATIO})}{(2.22\text{x}10^6)(\text{VOL})(\text{EFF})(0.665)\left(\frac{\text{COUNT}}{\text{TIME}}\right)}$$

MPC LIMIT: _____

INST. TYPE: _____

INST. ID NO.: _____

RESPIRATORY PROTECTION PROGRAM
RAC-005

UMTRA
RAC

Chem-Nuclear Systems, Inc.

1.0 Scope

1.1 Purpose

1.1.1 This procedure shall be used to provide minimum standards for respirator training and respirator use during performance of jobsite work.

1.1.2 This procedure shall apply to all personnel required to use respirator protective devices as prescribed by the U.S. Department of Labor Occupational Safety and Health Standards for Construction 29 CFR 1926 and/or all local authorities.

1.1.3 This program shall not be used in lieu of generally accepted engineering practices for air containment control.

1.2 Applicability

Respirator protection certified by NIOSH shall be provided all employees subject to harmful concentration of dusts, gases, fumes, mists, toxic materials, or atmospheres deficient in oxygen. Respiratory protection is applicable to all personnel entering real or potential airborne radioactivity areas.

2.0 Prerequisites

N/A

3.0 Requirements

3.1 MK Project Director. The MK Project Director is responsible for implementing and maintaining the respirator protection program including the following specific duties:

3.1.1 Monitor and evaluate all applicable work activities requiring respiratory protection to verify compliance with this procedure.

3.1.3 Require and provide respiratory training for all workers that will wear respirators.

3.1.4 Comply with requirements for respiratory protection as required by the U.S. Department of Labor Occupational Safety and Health Standards for Construction 29 CFR 1926, Department of Energy/UMTRA and/or all local authorities.

3.1.5 Identify jobsite respiratory hazards.

3.1.5.1 Oxygen Deficiency.

3.1.5.2 Air Contaiminants

3.1.5.2.1 Particulates are described as dusts, mists, fumes, smoke and biological agents.

3.1.5.2.2 Gaseous contaminants are described as inert, acid, alkaline, organic, or organometallic gases.

3.1.5.2.3 Airborne radioactivity areas.

3.1.6 Assess the degree of respiratory hazard through sampling and testing of the work environment.

3.1.6.1 Instrumentation will be available for determining oxygen deficiency, explosive vapor percent explosive limit, and limited quantitative specific gas grab sampling. The Albuquerque Office Safety and Health Department will provide assistance as required.

3.1.6.2 CNSI Health Physics site personnel will assess radioactivity exposure levels.

3.1.6.3 Material Safety Data Sheets, OSHA Form 20, shall be obtained for hazardous materials from the manufacturers.

3.1.7 Establish procedures to control respiratory hazards through engineering or administrative controls, product/material substitution, respiratory protective devices or a combination of these methods.

3.1.8 Select and provide adequate respiratory protective devices for use on the project.

3.1.8.1 This selection shall be based upon the specific type of air contaminant(s), the concentration of the contaminants(s) or oxygen deficiency in the work environment. Selection shall be determined by the MK UMTRA Project Respirator Program administrator.

3.1.8.2 All respirators must be approved by the National Institute for Occupational Safety and Health (NIOSH).

3.1.9 Provide respirator and job safety training when hazardous air contaminants are determined to be associated with the work environment. All personnel required to wear respirators will be trained in wearing and using the respirator. The following guide shall be followed:

3.1.9.1 Distribute the respirators and allow personnel to read use instructions, labels, etc.

3.1.9.2 Stress and limitations of the respirator; for example, if it is not for use in oxygen deficient atmospheres or in atmospheres that are immediately hazardous to life and health, be certain that this is clearly stated.

3.1.9.3 Contact lenses will not be allowed while wearing a full face respirator unless physicians written approval is obtained.

3.1.9.4 Long sideburnes and beards may interfere with the face seal of a half-face or full-face respirator. Glass temples will interfere with the face seal of a full-face respirator.

3.1.9.5 A training program for specific type respirators will be used as directed by the MK UMTRA Project Respirator Program administrator.

3.1.9.6 A qualitative fit test shall be conducted for each worker that may wear respirators.

3.1.10 Verify that workers are physically and psychologically able to perform work while using the respiratory protective devices. The verification is the responsibility of the MK UMTRA Project Respirator Program administrator.

3.1.10.1 Review the respirator Medical Questionnaire with the employees designated to wear respirators. (See Attachment I). Have the employees complete and sign the form.

If there are any questions about the ability of any worker to wear the respiratory protection, a signed physician's statement shall be obtained for that worker before he/she is allowed to work while wearing a respirator.

3.1.11 Maintain in the site files a signed record indicating satisfactory completion of the respirator training program for the duration of the job and forward this record to the Albuquerque Office, Safety and Health Department at the completion of the job

4.0 Program Review. The MK Project Director shall regularly review the Respiratory Protection Program to assure its continuing effetiveness.

Contact the Albuquerque Office Safety and Health Department for monitoring and assistance with evaluating jobsite respiratory protection needs.

List of Attachments

1. Medical Questionnaire for Respirator Program
2. Respirator Training Record
3. Respiratory Protection Qualification Sheet

Attachment I

MORRISON-KNUDSEN COMPANY, INC,

MEDICAL QUESTIONNAIRE FOR RESPIRATOR PROGRAM

Based upon the criteria established by the Corporate Medical Director and upon the recommendations listed in the American National Standard, ANSI Z88.2-1980, "Practices for Respiratory Protection", all employees who will or may be required to wear respirators on this project must complete the following questionnaire:

Instructions:

Please indicate if you have any of the following: (If you answer any items "yes", please explain below).

	YES	NO
High Blood Pressure	_____	_____
Emphysema	_____	_____
Chronic Obstructive pulmonary disease	_____	_____
Bronchial Asthma	_____	_____
Pneumoconiosis	_____	_____
Coronary artery disease	_____	_____
Cerebral blood vessel disease	_____	_____
Severe or progressive hypertension	_____	_____
Epilepsy, grand mal or petit mal	_____	_____
Anemia	_____	_____
Diabetes	_____	_____
Punctured eardrum	_____	_____
Breathing difficulty when wearing a respirator	_____	_____
Claustrophobia or anxiety when wearing a respirator	_____	_____

Describe nature of illness/any medications:

_____

_____

_____

_____

_____

Name (Print)_____

Last First Middle

Date_____ _____

Signature

Attachment II

RESPIRATOR TRAINING RECORD

Group/Dept./Craft: _____ Date: _____

Project/Location: _____

Respirator Training was given in accordance with the MK Respiratory Protection Program. Oualitative fit testing was completed using an appropriate test atmosphere. NIOSH certified respirators were issued to the following individuals and each individual checked for proper fitting.

Signature	Respirator Style & No.	Cartridge Type & No.	Qualitative Fit Test For For Exp to	Certified Fit: Yes No	Trainers Initials

Complete all Sections fully and Submit to the Safety Department

Trainer _____

Supervisor _____

Attachment III

RESPIRATORY PROTECTION QUALIFICATION SHEET

NAME _____

SOCIAL SECURITY NO. _____

1. Medical Questionnaire on File

   _____ Signature _____ Date

2. Respiratory Training Completed

   _____ Signature _____ Date

3. Respirator Fit Test

   A. Quantitative Test
      Protection Factor _____

      _____ Signature _____ Date

   B. Qualitative Test

      _____ Signature _____ Date

I, _____, acknowledge the receipt and understanding of the respiratory training and fitting.

_____ Signature _____ Date

EMERGENCY PREPAREDNESS POLICY
RAC-006

UMTRA
RAC

Chem-Nuclear Systems, Inc.

1.0 Scope

1.1 Purpose

The purpose of this procedure is to establish guidelines to protect lives, property, and the public health and safety under conditions of radiological, operational, natural, civil, or national emergencies.

1.2 Applicability

All personnel at UMTRA sites.

2.0 Prerequisites

2.1 N/A

3.0 Requirements for Emergency Preparedness

3.1 Individuals

The responsibilities of each employee are to:

3.1.1 Report an actual or potential emergency upon discovery.

3.1.2 Evacuate promptly from the immediate area.

3.1.3 Take action as specified in following sections.

3.2 Supervision

The general responsibilities and duties of supervisors include, but are not limited to, the following:

3.2.1 Anticipation of potentially hazardous conditions and advising site management of such conditions.

3.2.2 Assist in the training of personnel to cope with emergencies.

3.2.3 Alert personnel in time of emergency.

3.2.4 Assist in planning evacuation routes and procedures.

3.2.5 Assist in evacuation of personnel when necessary.

3.2.6 Meeting and directing emergency service units to the scene of an emergency.

3.2.7 Preparing a list of all personnel present in the area if a major disaster occurs.

3.2.8 Participate in the critique of an emergency.

3.3 General Emergency Procedure

3.3.1 The most probable emergency to occur at an UMTRA site would be a fire. The emergency potential resulting from natural phenomena varies because of each site's geographic and geologic location. Sufficient warning of severe weather conditions or potential flooding should be available to make adequate preparation for such conditions.

3.3.2 All visitors to the site are required to register at the field office.

3.3.3 Field employees shall be notified of emergency conditions by site supervision personnel.

3.4 Operational Procedure - Fire

3.4.1 The Site Manager shall indoctrinate the local fire department about the conditions and hazards that may be encountered at the site. Small fires shall be combatted with adherence to radiological controls; large fires may be fought without adherence to radiological controls, but additional recovery time may be necessary. The fire department should be given permission to enter the site after hours even though site personnel may not be present.

3.4.2 The person discovering a fire should notify the Site Manager or designated personnel; if unable to contact site management, he shall request assistance from the fire department.

3.4.3 Site personnel are not authorized to fight fires except for occasions where one may reasonably expect to put out a fire with onsite fire extinguishers.

3.5 Severe Weather

3.5.1 There is a potential for dispersion of contaminated materials through wind or water erosion.

3.5.2 Under direction of the Site Manager and the Site Health Physics Manager, contamination controls shall be implemented in preparing the work site for severe weather. If sufficient time is not available to prepare the site for severe weather, radiological contamination controls become secondary to preparation for personnel and equipment safety.

3.5.3 Post-severe weather clean-up action warrants priority over remedial action, depending on the amount and level of radioactive contaminates that migrated offsite during severe weather conditions.

3.6 Contaminated Materials Spill in Transit

3.6.1 An accident could occur with a truck or train causing a spill over public thoroughfares.

3.6.2 Response to a truck or train spill.

3.6.2.1 The MK Site Manager and the Site Health Physics Manager at each site shall be responsible for implementation of an accidental spill response procedure based on local conditions and available personnel. The response shall, at least, include the following:

3.6.2.1.1 Notify the MK Site Manager or his designee, and the site Health Physics Manager or his designee, immediately upon occurrence of any offsite spill.

3.6.2.1.2 Mobilization of sufficient personnel and equipment to clean up the spill quickly with a minimum of radiological exposure to workers or the general public. The Site Health Physics Manager shall supervise offsite spill response and health physics activities, to ensure minimizing of exposures.

3.6.2.1.3 Immediate notification of offsite authorities, including local police, fire and civil authorities as necessary. Notification shall include the following information: The Site Health Physics Manager's initial estimate as to its radiological significance, giving the quantity, radioactivity and location involved, and whether the problem is of

sufficient magnitude to require special assistance from local police, fire or other agencies. Frequent communication with local authorities shall be maintained to ensure that complete and correct information is reaching the general public, and that no unnecessary actions on the part of local authorities are initiated.

3.6.2.1.4 Notify the MK office in Albuquerque, New Mexico as soon as feasible, detailing spill magnitude, location, spill response procedures being implemented, and a summary of communications and assistance from local authorities

3.6.2.1.5 A "spill kit" shall be previously assembled and ready for use as required.

3.7 Evacuation from Work Site

3.7.1 If work site evacuation is necessary, notification will verbally be given by site management to all personnel.

3.7.2 The staging area will be immediately outside of the access control point.

3.7.3 Evacuation shall be rapid, therefore radiation control monitoring will be minimal at the access control point. If there is a life threatening situation, evacuation shall take precedence over monitoring.

3.7.4 All supervisors and foremen will report accountability of personnel to the site manager or the site project engineer.

3.8 Medical Response

3.8.1 Arrangements shall be made with local hospitals and ambulance services for transportation and treatment of potentially contaminated injured personnel.

3.8.2 Site RAC personnel are authorized to treat minor scratches and abrasions only. Flushing of small open wounds is also permitted. Emergency first aid may be given by trained personnel. All other medical treatment shall be performed by medically qualified personnel.

3.9 Civil Disturbances

3.9.1 Anti-nuclear demonstrations and similar activities will not be permitted on DOE property. The Site Manager shall notify the local Police Department and the RAC of impromptu demonstrations.

3.9.2 Site personnel are not authorized to attempt the dispersement of demonstrators.

3.10 Press Relations

3.10.1 The Site Manager is authorized to answer both routine questions and technical questions and shall advise the Project Office of the questions asked and the answers given. Other site personnel are permitted to respond to the press only with the specific authorization of the Site Manager and only concerning matters with which they have specific cognizance.

3.11 Emergency Notification

3.11.1 Each site shall post an emergency notification list in an obvious place. The list shall contain names and telephone numbers of all personnel to be notified in case of an emergency.

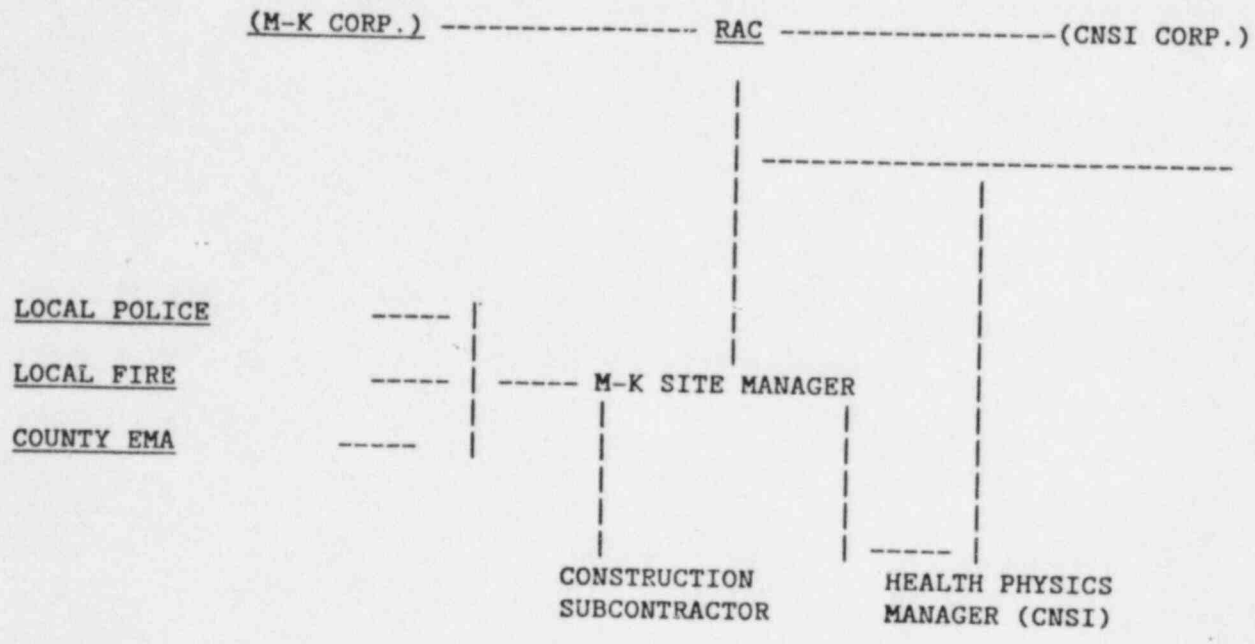
4.0 Records

4.1 The site HP Manager or his designee shall maintain a site file of all data sheets, records, logs, forms, memos and shall forward to RAC AL copies on a monthly basis.

List of Attachments

1. Emergency Notification Schedule and Telephone Numbers

EMERGENCY NOTIFICATION PHONE NUMBERS



		WORK	HOME
DOE	John Arthur	(505) 844-3941	(505) 821-9610
	David Ball	(505) 844-3941	(505) 292-2740
RAC	Russ Hopkins	(505) 766-3080	(505) 296-9050
	Jack Hammond	(505) 766-3084	(505) 292-0048
	Marv Henderson	(505) 766-3047	(505) 292-8926
	H.R. Meyer	(505) 766-3040	(505) 821-4886
	Jim Purvis	(505) 766-3061	(505) 298-9313
	Dawn Skinner	(505) 766-3033	(505) 897-1910
M-K SITE MANAGERS	Larry Farnes	(412) 745-4883	(412) 941-5017
	Jim Powers	(801) 265-9406	(801)571-7053
	Frank Davis	(505) 368-4324	
	John Jones		
	John Innis	(303) 247-8874	(303) 259-6452

DECONTAMINATION OF PERSONNEL AND EQUIPMENT
RAC-007

UMTRA
RAC

Chem-Nuclear Systems, Inc.

1.0 Scope

1.1 Purpose

The purpose of this procedure is to establish the minimum guidelines necessary for the decontamination of personnel and equipment.

1.2 Applicability

All RAC UMTRA personnel and equipment are subject to this procedure.

2.0 Prerequisites

2.1 Instrumentation shall have been calibrated.

2.2 A personnel decon area shall be available with provision for collecting waste water.

2.3 A truck washing area shall be available.

2.4 Arrangements with medical facilities shall have been made for cases of internal contamination, nose, ears, eyes, and open wound decontamination.

3.0 Requirements

Personnel contamination may fall into one of three categories, or any combination thereof: external, internal, and open wound. The following subsections illustrate the minimum corrective actions that may be required to decontaminate personnel.

3.1 External Decontamination of Personnel

Cases of personnel contamination are expected to be minimal because of personnel training, use of procedures, etc.; however, if decontamination is required the following steps will be taken:

3.1.1 Transport individuals to the personnel decon area, taking care not to spread contamination. Health Physics personnel must accompany the contaminated person.

3.5 Small Tools Decon for Release to Unrestricted Areas

3.5.1 Direct probe and/or swipe surveys of the tool and/or parts shall be conducted by Health Physics personnel to determine the effectiveness of the decon process.

3.5.2 Document the uncontrolled release survey for the Health Physics files, i.e. smear log and access control log.

4.0 Records

4.1 The site HP Manager or his designee shall maintain a site file of all data sheets, records, logs, forms, memos and shall forward to RAC AL copies on a monthly basis.

3.1.2 Wash the contaminated portion of the body in cool or tepid water--never use hot water.

3.1.3 Health Physics personnel shall survey the affected area to determine the effectiveness of the decon process.

3.1.4 Consult medical personnel if injury requires it.

3.1.5 Enter all instances of personnel contamination in the site RSO's logbook and issue follow-up reports as required.

3.1.6 Decon solutions shall be disposed of on site as radioactive wastes.

3.2 Internal Decontamination

3.2.1 The site H.P. Manager may permit the flushing of ears and eyes with cool, clean water to decon those areas. If flushing is not successful, medical personnel shall direct additional decon efforts.

3.2.2 Only medically qualified personnel shall probe the eyes, ears, nose, and throat of potentially contaminated personnel.

3.2.3 Whole body counts and/or urinalysis may be required for personnel who may have inhaled or ingested radioactive material.

3.2.4 The RAC-AL shall assign doses for internally contaminated individuals. In questionable cases the site HP Manager shall contact RAC-ALB program manager with all information necessary to support RAC-ALB evaluation.

3.3 Contaminated Open Wounds

3.3.1 Flushing of contaminated large open wounds will be discouraged, however, when wounds are not substantial, i.e. cuts and scrapes they may be cleaned with clean water. Other techniques shall be directed by medically qualified personnel.

3.4 Equipment Decontamination

3.4.1 Transport the equipment onto a designated area within the control area specified as the equipment decon area.

3.4.2 Decontaminate equipment using water, brush, etc.

HABITABLE STRUCTURE ALPHA SURVEY
RAC-008

UMTRA
RAC

Chem-Nuclear Systems, Inc.

1.0 Scope

1.1 Purpose

This procedure provides guidelines for conducting alpha contamination surveys in habitable structures.

1.2 Applicability

This procedure applies only to alpha contamination in habitable structures. Alpha surveys are conducted inside habitable structures, following the gamma survey. Habitable structures are defined as structures where persons now reside, structures where persons are likely to spend as much as 20 hours per week, and structures which reasonably could be remodeled for habitation.

2.0 Prerequisites

All instruments used must have valid calibration.

3.0 Requirements

3.1 Alpha Survey - Direct Instrument

3.1.1 Survey the surface at points where alpha contamination is suspect. The probe should be held motionless until an accurate count for the location can be determined. This may involve counting the audible clicks for a specified time period, usually at least 30 seconds, to determine the count rate.

3.1.2 Contamination levels are to be averaged over areas of not more than 1 square meter. When alpha contamination is detected at one point, two other points within the same square meter should be monitored. The average of the three measurements within the area will show if the standards given in Section 3.3 have been exceeded.

3.1.3 When the surface being surveyed does not have a simple configuration for averaging (for example, a wall stud or ceiling beam), the survey crew leader shall make the best possible estimate of the survey area and shall determine the number of measurements to be made on that survey.

3.2 Smear Survey

3.2.1 Take an adequate number of approximately 100 cm^2 (4" x 4") smears to determine the contamination status of the area.

3.3 Standards

3.3.1 The EPA UMTRA standards do not address the problem of alpha contamination in habitable structures. However, alpha contamination represents a potential health hazard to populations living or working in these structures.

3.3.2 The NRC has established guidelines, found in NRC Regulatory guide 1.86, for decontamination of facilities for release to unrestricted use. These guidelines apply also to habitable structures contaminated with alpha-emitting material from uranium mill residues. The pertinent guidelines are given in the following table. All numbers are dpm/100 cm^2.

Material	Fixed Contamination Average	Maximum	Removable Contamination
natural uranium, U-235, U-238, (as metal, oxide, or other processed form); and unprocessed uranium ore	5,000	15,000	1,000
Ra-226, Th-230, Th-228 (from process residues or process products)	100	300	20
natural thorium, Th-232, and unprocessed thorium ore	1,000	3,000	200

Contaminated levels in this table are to be averaged over areas of not more than 1 square meter.

3.3.3 Radon daughters may create short-lived alpha activity anywhere. Swipes which indicate alpha activity above the NRC guidelines should be held in a protected location for at least 24 hours and then recounted.

3.4 Recommended Action

If removable alpha above the NRC guideline, not from radon daughters, is found, the surface should be wiped down and then sealed (painted or other) during remedial action. If fixed, non-removable alpha contamination is found but no other remedial action is needed, a sealer/paint may be applied during remedial action. More drastic remedial action would be performed only if the EPA standards for indoor gamma or radon daughter concentrations are being exceeded.

4.0 Records

4.1 The site HP Manager or his designee shall maintain a site file of all data sheets, records, logs, forms, memos and shall forward copies to RAC AL copies on a monthly basis.

PROBLEM REPORT
RAC-009

UMTRA
RAC

Chem-Nuclear Systems, Inc.

1.0 Scope

1.1 Purpose

This procedure provides instructions for filling out the Problem Report (PR).

1.2 Applicability

This procedure applies to all field related problems.

2.0 Prerequisites

N/A

3.0 Requirements

3.1 General - The Problem Report can be originated by anyone. The site/group manager at point of origination may approve or disappprove any further action on the PR. If approval is granted the PR then becomes a mandatory document to be completed and closed out.

3.2 Problem Report Form (Attachment)

3.2.1 Block 1 - The date the originator fills out the PR.

3.2.2 Block 2 - This is the 5 digit property number.

3.2.3 Block 3 - The response due date required should be a realistic and honest as possible.

3.2.4 Block 4 - Originator's name (printed).

3.2.5 Block 5 - The manager at the location of origination (site or project office) will review the request and either approve or disapprove the PR. If approved the PR will be sent to RAC AL Radiological Manager. If disapproved the PR will stop and be filed at that location.

3.2.6 Block 6 - Reference material that creates the problem if any.

3.2.7 Block 7 - List all known affected documents.

3.2.8 Block 8 - Define in sufficient detail the problem giving examples, lost time, etc.

3.2.9 Block 9 - Resolution will be complete and detailed so as to eliminate any confusion or contradiction.

3.2.10 Block 10 - Reference all material and attach to PR to support the resolution, if any.

3.2.11 Block 11 - Name of person resolving problem (printed).

3.2.12 Block 12 - Manager of Radiological Programs signature. His signature indicates that he approves the resolution, all affected documents have change notices instituted.

3.2.13 Block 13 - Manager of Environmental Assessment, Verification & Dosimetry signature, if problem is in any way associated with these areas.

3.2.14 Block 14 - Listing of all affected documents that have change notices issued.

3.2.15 Block 15 - Boxes marked or handwritten for distribution of complete PR.

4.0 Records

The location of origination will maintain a file of all PRs issued. The Project office will maintain a file of all resolved PRs.

List of Attachments

1. Problem Report

MORRISON-KNUDSEN COMPANY, INC.

Problem Report
UMTRA Project

Date (1)	Project No. (2)	Response Date (3)

Originator (4) _____

Disapproved _____

Location Manager Approval (5)

_____ Date _____

References (6)

Documents Affected (7)

Subject/Problem (8)

Resolution (9)

Reference (10)

Resolution by (11) _____ Date

Manager of RAD (12) _____ Date

EAV Manager (13) _____ Date

Affected Documents Changed (14)

Copies to: (15) QA ☐ PM ☐ DOE ☐ DOC ☐ COLA, SC ☐

Projects

	REV. NO.
	PAGE NO.

AUGERING AND GAMMA LOGGING OF BOREHOLES, AND REA SOIL SAMPLING
RAC-010

1.0 Scope

1.1 Purpose

This procedure provides guidelines for gamma logging during initial RAC radiological engineering assessments (REA) and other activities.

1.2 Applicability

All augered hole gamma logging activities, indoor as well as outdoor, performed by the RAC on UMTRA projects are subject to this procedure.

2.0 Prerequisites

All instruments used shall have valid calibration.

3.0 Requirements

3.1 Standards

The general standards for determining locations that must be excavated on a vicinity property are the EPA standards defined in 40 CFR 192. These require removal of materials where the average concentration of Ra-226 from mill tailings exceed 5 pCi/g above natural background in the first 6 inches of soil, or where the concentration exceeds 15 pCi/g above background at greater depths than 6 inches.

In addition to the general EPA standards, the DOE has directed that consideration should be given to removing materials under or near habitable structures, if the materials are contaminated above natural background.

The following clarifications are established to define the standards for field use:

3.1.1 5 or 15 pCi/g above background: 5 or 15 pCi/g, including background, as determined by site-specific gamma logging correlations with soil samples from boreholes. This provides a degree of conservatism in estimating the extent of contamination on a property.

3.1.2 Background: the average background for various depths in as many background holes as practical for each site, but not less than 10 holes. Readings shall be considered to be within the background range if they are within the average site background plus 2 sigma.

3.1.3 Habitable structure: a building where persons now reside or are likely to spend as much as 20 hours per week, or a building which reasonably could be remodeled for habitation. For example, an attached garage would probably be considered to be a habitable structure, but a metal garden storage shed would not be.

3.2 Background Determination and Soil Analysis

A minimum of 10 background holes are to be augered at each site and soil samples should be collected from each hole. The gamma count rate in each background hole may be recorded at 6- or 12-inch increments to the bottom of the hole. Soil samples will be counted on the Opposed Crystal System (OCS) for the site. If no OCS is available, soil samples will be analyzed by an outside vendor.

Several boreholes must be augered in areas known to be contaminated for each site. In these boreholes, soil samples must be collected from each 6-inch increment of each hole. These samples will be counted on the OCS, if possible, or sent to a vendor for analysis. The count rate for each 6-inch increment as measured by a 2220/4410 instrument will be recorded for comparison with the soil analysis. It is necessary that each instrument which may be used for downhole gamma logging, be checked for count rate versus concentration in this manner before it is used on vicinity properties. The comparison of c/0.1 m for the instrument with the soil analysis will be used to report soil concentrations on Ra-226.

It is, therefore, necessary that a range of concentrations be found to determine the correlation. It is especially necessary to determine the correlation for the range 3-20 pCi/g, thus bracketing the EPA standards.

3.3 Bore Hole Location Determination

3.3.1 The location of boreholes is normally determined from the results of a gamma survey. Depending on the size of the potentially contaminated area, one or more holes should be drilled inside the area of contamination, normally at the point(s) of maximum activity, to determine the average depth. Several holes are needed on both sides of the apparent (from the gamma survey) extent of contamination, and if a hole outside the area of increased gamma radiation shows

contamination, another hole is needed beyond that. Negative data, properly recorded, becomes very useful in determining and demonstrating the extent of contamination. The intent is to provide a set of boreholes that adequately describes the vertical and horizontal extent of radioactive material in contaminated areas; and a second set of boreholes that adequately demonstrates the absence of radioactive material in non-contaminated areas.

3.3.2 The Site HP Manager shall work closely with the M-K Site Manager to ascertain the locations of sewer lines, buried telephone or electrical cables, gas lines, or other underground hazards. Electrical cables and gas lines shall be located before boreholes are drilled anywhere. Other lines should be located if possible before augering. Since tailings have often been used for bedding utility lines, boreholes should be augered in these areas. Extreme care must be taken not to puncture the utility lines during augering.

3.3.3. When contamination is located adjacent to a structure boreholes must be augered as near to the structure as possible, to determine if the contamination does or does not extend underneath the structure. One borehole should be augered along each wall of the structure. If this determination cannot be made from outdoor boreholes, then boreholes as may be appropriate should be augered inside the structure in the area of concern. If indoor boreholes are not possible (e.g. a crawl space of 2-3 feet in height exists between the floor and the ground surface) other measurement procedures, such as soil sampling, will be performed.

3.3.4 Boreholes or soil samples should also be taken at isolated gamma survey "hot spots" (points where the gamma survey reading is greater than specific vicinity property background plus 50 percent or specific vicinity property background plus 2 sigma, whichever is smaller) to determine if a subsurface deposit of contamination exists.

3.4 Hole Logging

3.4.1 Prior to drilling take a contact surface reading. Record counts/0.1 min in the first (surface) row of the borehole log. Identify the borehole by number of the borehole log and by coordinates on the property survey coordinates log, or directly by coordinates on the Borehole Log.

3.4.2 Check to see that there is not standing water in the augered hole. If necessary, lower a plastic pipe (capped at the bottom) to the bottom of the hole and secure. The plastic pipe shall be used whenever water is present in the hole.

3.4.3 Lower the bagged detector to the surface of the hole and record the depth on data sheet as 0" and then record data on the borehole log every 6" to the bottom of the hole.

3.4.4 After logging of the hole, visually inspect detector for damage/contamination. Replace outer protective bag if damaged or contaminated, and recheck detector background.

3.5.5 Locate the boreholes on an engineering drawing, if available, or on the property survey sketch sheet.

3.6 Identification of Contaminated Material

3.6.1 Local background rates, tailings composition, or other factors may influence the level of the borehole count rate. Each site HP Manager is responsible for making recommendations as to the specific count rate selected to indicate the presence of contaminated material.

3.6.2 The recommendation should be based on the average count rate measured in several apparently uncontaminated local boreholes, and, generally, the limit selected may be approximately background plus 2 sigma, or a value demonstrated by soil analysis to correspond to the applicable standard.

3.6.3 Recommended borehole count rates shall be evaluated and approved by the RAC Health, Safety, and Environmental Group, and properly documented at the site.

4.0 Soil Samples

Soil samples must be gathered at various locations when conducting radiological and spillover surveys. This action has been requested by the DOE Project Office. The samples should be collected at areas that are considered to be borderline (typically about 2000 c/0.1m surface and about 4000 c/0.1m subsurface, but varying according to the correlation data gathered at each site). This action is requested because our procedures may exclude these areas from remedial action and field verification is required to prevent misinterpretation of the data. Soil samples in the first 12 inches can be collected with a shovel. Samples from greater depths in boreholes should be collected with a hand trowel by digging out the hole itself, where possible, or by collecting the auger cuttings. Care must be taken in such cases to assure that the soil identified is from a particular depth.

5.0 Records

5.1 The site HP Manager or his designee shall maintain a site file of all data sheets, records, logs, forms, memos and shall forward copies to RAC AL copies on a monthly basis.

The following list of forms are to be filled out when performing the applicable function described in this procedure.

List of Attachments

1. Form VP-03A, Rev. 1 Property Survey Coordinates
2. Form VP-03B, Proper Survey Sketch
3. Form VP-04B, Borehole Log

MORRISON KNUDSEN

PROPERTY SURVEY COORDINATES

Sheet ________ of ________

SITE LOCATION ____

ADDRESS ____

PROPERTY TYPE ______________________ LOT NO. ____________

OWNER ____

SKETCH COMPLETED BY ______________________ DATE ____________

AUGER HOLE	COORDINATES

GAMMA SCAN BOUNDARY			
POINT	COORDINATES	POINT	COORDINATES

0329B

MORRISON KNUDSEN

PROPERTY SURVEY SKETCH

Sheet _____ of _____

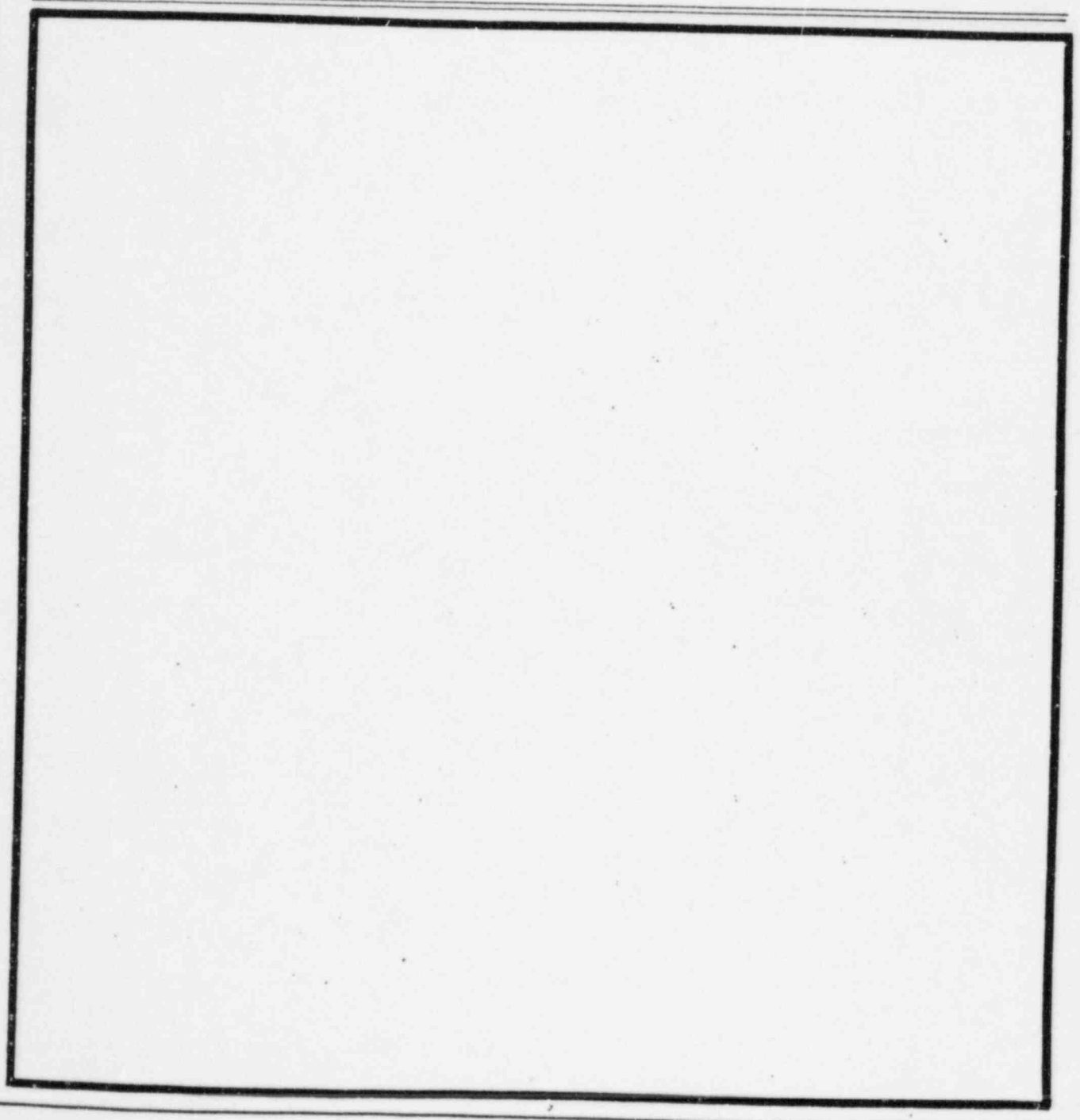
SITE LOCATION _____

ADDRESS _____

PROPERTY TYPE _____ LOT NO. _____

OWNER _____

SKETCH COMPLETED BY _____ DATE _____



MORRISON KNUDSEN

BOREHOLE LOG

LOGGING CREW: _____

_____

_____

INSTRUMENT ID NO. _____

SHEET _____ OF _____ PAGE _____

DATE: _____

PROPERTY ID: _____

AREA: _____

NOTES: 1. ALL HOLES ARE 4"DIA. UNLESS OTHERWISE NOTED.
2. RECORD UNUSUAL CONDITIONS, SUCH AS THE PRESENCE OF WATER IN BOREHOLES AND DEPTH, CASING TYPE AND THICKNESS IF USED, CONCRETE CORES AND THICKNESS, OBSTRUCTIONS, UTILITIES, ETC., IN THE REMARKS SECTION.

HOLE ID: _____ TIME DRILLED: _____ TIME LOGGED: _____ SOIL TYPE: _____		HOLE ID: _____ TIME DRILLED: _____ TIME LOGGED: _____ SOIL TYPE: _____		HOLE ID: _____ TIME DRILLED: _____ TIME LOGGED: _____ SOIL TYPE: _____		HOLE ID: _____ TIME DRILLED: _____ TIME LOGGED: _____ SOIL TYPE: _____	
DEPTH	COUNTS/.1MIN	DEPTH	COUNTS/.1MIN	DEPTH	COUNTS/.1MIN	DEPTH	COUNTS/.1MIN
SURFACE		SURFACE		SURFACE		SURFACE	
0"		0"		0"		0"	
6"		6"		6"		6"	
12"		12"		12"		12"	
18"		18"		18"		18"	
24"		24"		24"		24"	
30"		30"		30"		30"	
36"		36"		36"		36"	
42"		42"		42"		42"	
48"		48"		48"		48"	
54"		54"		54"		54"	
60"		60"		60"		60"	
66"		66"		66"		66"	
72"		72"		72"		72"	
78"		78"		78"		78"	
84"		84"		84"		84"	
90"		90"		90"		90"	
96"		96"		96"		96"	

REMARKS: _____

_____

_____

_____

_____

_____

0329R

VICINITY PROPERTY GAMMA SURVEYS
RAC-011

UMTRA
RAC

Chem-Nuclear Systems, Inc.

1.0 Scope

1.1 Purpose

This procedure provides guidelines for initial RAC gamma scanning activities to be performed on vicinity properties selected for UMTRA remedial action. Survey results are intended to verify and more completely document locations of gamma anomalies and contours associated with surface and buried tailings, and to determine the existence of previously undiscovered material.

1.2 Applicability

Gamma surveys of vicinity properties are subject to this procedure.

2.0 Prerequisites

All instruments used under this procedure must have valid calibration.

3.0 Requirements

3.1 Gridding

3.1.1 Outdoor grids should be no larger than 10-foot centers, except in remote, open land areas, unless instrumentation is used which can "view" a larger area. Grid sizes should not be smaller than 3-foot centers. Grid spacing for large areas of windblown contamination vary according to the extent of contamination. The site HP Manager may select the grid site in these areas from 10-foot to 100-foot centers. Larger grid spacings shall be approved by the Radiological Programs Manager or his designee.

3.1.2 Indoor grids are not generally required, except for large buildings such as garages or shops; however, a locally generated sketch of the area containing elevated gamma readings should be used to locate "hot spots" and other pertinent data.

3.1.3 Background data recorded on survey sheets in uR/hr shall be the average of 30 PIC readings taken in the region of the vicinity properties, but well removed from any vicinity property.

3.1.4 Each site must have a site-specific correlation of surface gamma count rates to surface soil concentrations of Ra-226, to determine surface contamination boundaries during outdoor gamma surveys of vicinity properties. However, as an initial guideline a value equivalent to twice the background surface count rates shall be used.

Five 0.1 minute surface counts should be made with each site 2220/4410 survey instrument at each of the 30 background points to determine the average background count rate for each instrument. Surface soil samples should be collected at each background point and analyzed on the site Opposed Crystal System (OCS) or by an outside vendor.

A correlation of surface gamma readings with surface soil concentrations of Ra-226 is necessary at each site. As many points as practical, but not less than 10, shall be selected at each site, with count rates ranging from background to four times background (if four times background cannot be achieved, the maximum found at the site shall be used). Surface gamma readings shall be made at these monitoring points and surface soil samples shall be collected for analysis in the same manner as for the background determination, above.

Once the general correlation of count rate to soil concentration has been completed, an additional 20 measurement points shall be identified where the gamma count rate appears to indicate a Ra-226 soil concentration ranging from 3 to 8 pCi/g. The surface count rate for each instrument shall be recorded and soil samples from these points shall be analyzed.

Once the correlation study has been completed the "twice background" guideline shall be discarded and the site-specific correlation between count rate and soil concentration shall be used.

3.2 Surveys

There are two different types of gamma surveys which may be performed. The first is a grid survey where gamma readings are made at each point of the grid which has been established for the property. A grid survey should be performed if the site HP Manager determines the need. The second type of gamma survey is a scan

survey where the extent of contamination is determined by observing the line or point where gamma activity increases beyond a certain level. Field crews shall perform a comprehensive scan survey and may incorporate a grid as necessary for a more complete characterization of large deposits; however, the site HP Manager may direct the application of a grid survey where this is needed, for example, on large properties. The coordinates for each grid survey point must be recorded. Care must be taken to record data in areas where the inclusion survey has identified the possible presence of contamination. This is particularly true where the inclusion survey information cannot be confirmed.

3.2.1 Outdoor Grid Surveys

3.2.1.1 Collect survey data at each grid point at the surface and 1.0 meters. Record data on the Outdoor Gamma Data Sheet.

3.2.1.2 When the grid survey is complete, scan the area for "hot spots". Record the count rates and locations of any "hot spots". "Hot spots" are places where the gamma level is equal to background plus 50 percent, or greater. These shall be investigated according to the steps given in Section 3.2.2.6, below.

3.2.2 Outdoor Scan Surveys

3.2.2.1 Scan the area by moving detector from left to right. The scan width should be three or four feet. Keep the detector as close as possible to the surface.

3.2.2.2 Locate the contamination boundaries as determined by twice background of the established level for the specific site. Identify the contamination boundaries clearly.

3.2.2.3 Record the location of the labeled stakes on the engineering drawing, if available, or on a site-generated property survey sketch.

3.2.2.4 Several points inside the region of identified contamination shall be surveyed and the results recorded. The maximum value and any other hot spots are the points to be recorded. All data recorded shall be on the Outdoor Gamma Survey Data Sheet.

3.2.2.5 Several survey points outside the region of the identified contamination shall be surveyed and recorded.

3.2.2.6 Gamma anomalies (i.e. points outside the gamma scan boundary) or "hot spots" where the count rate is background plus 50 percent, or greater, must be documented. These also shall be investigated further, by augering a borehole or by removing a shovel of dirt from the point and resurveying. An increase in the count rate during the resurvey indicates a need for a borehole, while a decrease indicates a need to analyze the soil which was removed from the location.

3.2.2.7 Contamination along an underground line such as sewer line or buried power line must be investigated to be sure it does not extend below the line. Extreme care must be taken to avoid penetrating the line.

3.2.2.8 Slightly elevated readings on concrete surfaces should be investigated because of the inherent shielding effects of the concrete. On concrete, readings exceeding background plus 2 sigma are considered elevated.

3.2.3 Indoor Gamma Surveys

3.2.3.1 Perform a detailed gamma survey of VP interior areas. Record the gamma exposure rates (uR/hr) measured and their locations on the Interior Survey Sheet. Typically, five measurements will be performed in each room; in the four corners and the center. Larger rooms may require additional interior measurements, and smaller rooms may need only one or two measurements.

3.2.3.2 Complete gamma surveys in all areas of structures are required.

3.2.3.3 In large rooms, such as unfinished basement areas or industrial work areas, the gamma survey should be conducted on a grid system. This indoor grid should be tied to the outdoor survey grid, if possible.

4.0 Records

4.1 The site HP Manager or his designee shall maintain a site file of all data sheets, records, logs, forms, memos and shall forward to RAC AL copies as each property survey is completed.

List of Attachments

The following list of forms are to be filled out when performing the applicable function described in this procedure.

1. Form VP-02B, Interior Survey Data Log/Hot Spot
2. Form VP-04A, Outdoor Gamma Screening Survey Data Sheet
3. Form VP-03B, Property Survey Sketch

MORRISON KNUDSEN

INTERIOR SURVEY DATA LOG/HOT SPOT

SURVEY CREW ______________________

____

____

____

SHEET ______ OF ______ PAGE ______

DATE ______________________

PROPERTY ID # ______________________

PROJECT ______________________

GAMMA SCINTLLATOR HOT SPOT DATA

2220 INSTRUMENT ID # ____________ uR/h CONVERSION CURVE # ____________ (ATTACHED)

NOTES: 1) RECORD SPOT ID LOCATIONS ON INTERIOR SURVEY SKETCH AND ATTACH COPY.
2) INCLUDE DISCUSSION OF ANOMALIES, SUGGESTIONS, OBSERVATIONS, MATERIAL SAMPLES INFORMATION, SOURCES OF NATURAL RADIOACTIVITY, ETC., IN COMMENTS.

HOT SPOT ID #	COUNTS /0.1MIN	RATE uR/h
LOCATION:		
LOCATION:		
LOCATION:		

HOT SPOT ID #	COUNTS /0.1MIN	RATE uR/h
LOCATION:		
LOCATION:		
LOCATION:		

HOT SPOT ID #	COUNTS /0.1MIN	RATE uR/h
LOCATION:		
LOCATION:		
LOCATION:		

COMMENTS: ______________________

MORRISON KNUDSEN

OUTDOOR GAMMA SCREENING
SURVEY DATA SHEET

LOGGING CREW: ______________________________
____
____

SHEET __________ OF ______ PAGE ______

DATE: ______________________________

PROPERTY ID: ______________________________

INSTRUMENT ID NO.: ______________________________

BACKGROUND CALCULATION:

#1 __________ + #2 __________ + #3 __________ = __________ ÷ 3 = __________ COUNTS/.1MIN

AREA: __________		AREA: __________		AREA: __________		AREA: __________	
POINT ID	READING COUNTS/.1MIN	POINT ID	READING COUNTS/.1MIN	POINT ID	READING COUNTS/.1MIN	POINT ID	READING COUNTS/.1MIN

REMARKS: ____
____
____

MORRISON KNUDSEN

PROPERTY SURVEY SKETCH

Sheet _____ of _____

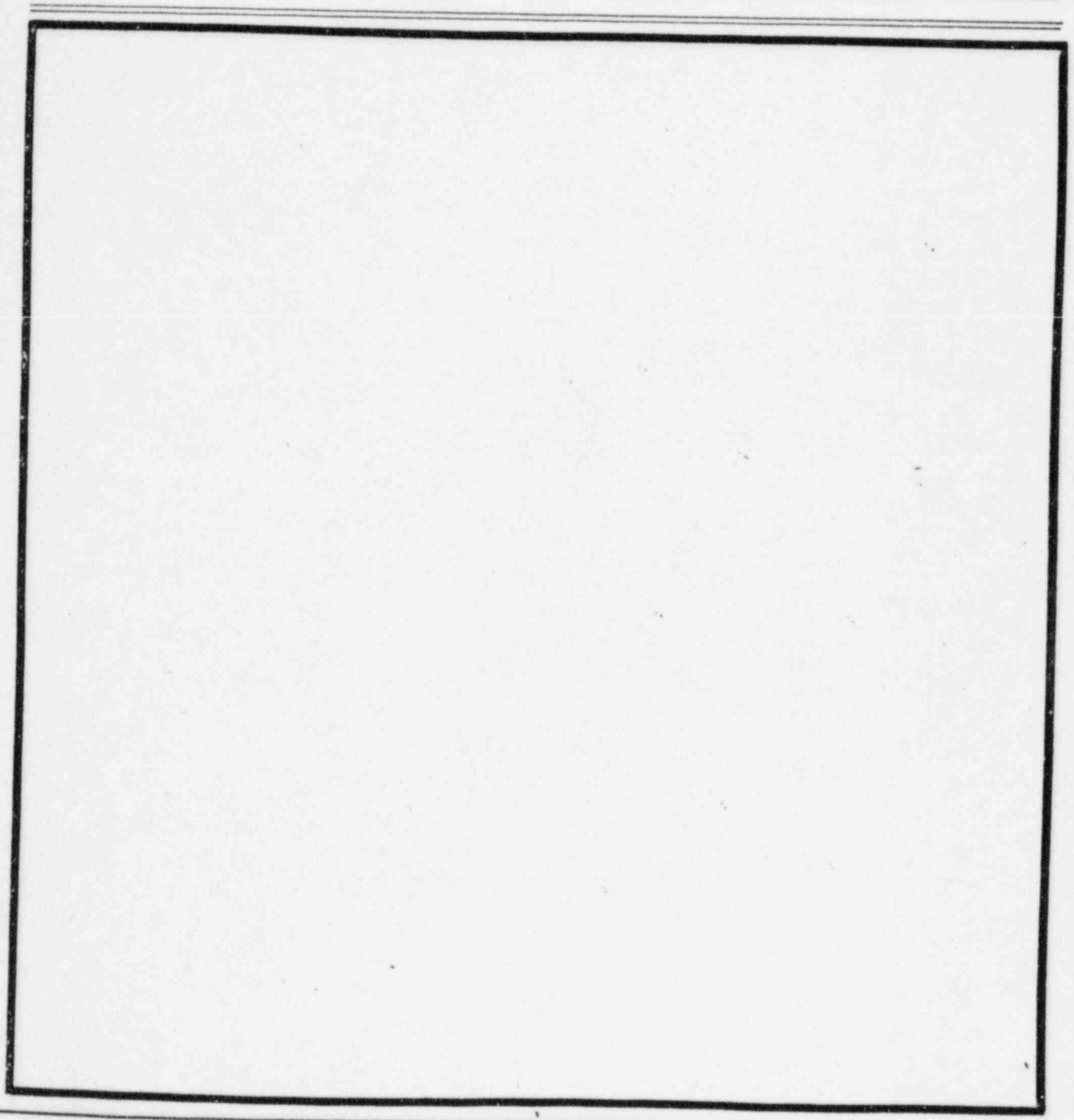
SITE LOCATION _____

ADDRESS _____

PROPERTY TYPE _____ LOT NO. _____

OWNER _____

SKETCH COMPLETED BY _____ DATE _____



ENVIRONMENTAL RADON AND GAMMA MONITORING
RAC-012

UMTRA
RAC

Chem-Nuclear Systems, Inc.

1.0 Scope

1.1 Purpose

This procedure provides instructions for monitoring environmental releases of radon and provides available options for the Site Manager and/or Subcontractors to implement to reduce or mitigate releases within applicable regulations. This procedure also defines the required environmental gamma monitoring program.

1.2 Applicability

This procedure is applicable to all UMTRA sites.

2.0 Prerequisites

2.1 All instruments used shall have valid calibration labels.

3.0 Requirements

3.1 Monitoring Radon Concentrations

3.1.1 It is recognized that remedial action activities at the site are intended to reduce the long term releases of radon to the environment. It is further recognized that releases during remedial action activities will necessarily increase above those existing prior to conduct of remedial action activities at the site. Releases are to be limited to 3 pCi/l as an annual average and 6 pCi/l maximum for a semi-annual average. Controls of releases shall be based on the annual average limits. Radon concentrations shall be monitored and compared to the annual release limit on a weekly basis. These concentrations shall be reported to the Site Manager for his review and analysis to determine any actions to be taken to reduce radon releases.

3.2 Control Actions for Radon

3.2.1 It is emphasized that routine, low-level releases of radon do not constitute an emergency situation. Actions to reduce or minimize releases in accordance with the ALARA philosophy will be taken to control offsite releases to 3 pCi/l above local background, annual average. Any one, or a combination of the section 3.2.2 actions to reduce or mitigate releases shall be taken, if the offsite releases average 6 pCi/l or more above background, weekly average.

3.2.2 The Site Manager will take actions when necessary to mitigate or reduce the release of radon. Based on consultation with the Site Health Physics Manager, any action or combination of actions may be taken based on site conditions (weather conditions, moisture content of soil, work being conducted, relative cost of mitigating action).

3.2.2.1 Reduce the amount of exposed tailings by reducing the exposed surface area, by placing cover over as much material possible, or by working smaller areas.

3.2.2.2 Cover portions of exposed tailings with plastic film or other radon barriers.

3.2.2.3 Modify work activities to reduce the amount of exposed tailings.

3.2.2.4 Provide watering of areas suspected to be responsible for increased radon emanation.

3.3 RGM-2 Requirements

3.3.1 Background checks utilizing fresh activated charcoal tubes will be done monthly; in place, on all RGM's. During this time actual radon concentration data will not be available for averaging with the annual concentration data.

3.3.2 High voltage will be checked monthly.

3.3.3 RGM calibration is required annually by an approved vendor in an approved radon chamber at environmental levels of radon concentrations.

3.4 Environmental Gamma Monitoring

3.4.1 Boundary and community locations will be continuously monitored for gamma dose (in rads). This will be accomplished by locating several environmental TLDs around the sites and community. Locations to be selected by the HP site manager but at a minimum one ETLD is required at each environmental monitoring station. (site specific locations as designated in the site HP Monitoring Plans).

3.4.2 TLD services will be provided by an approved vendor. Environmental TLDs will be exchanged quarterly. TLD assignment shall be recorded on the attached ETLD location log.

4.0 Records

4.1 The site HP Manager or his designee shall maintain a site file of all data sheets, records, logs, forms, memos and shall forward copies to the RAC ALB EAV manager, on a weekly basis.

LIST OF ATTACHMENTS

The following list of forms are to be filled out when performing the applicable function described in this procedure.

1. 24 Hour Radon Averages
2. Radon Concentrations in Air
3. Continuation of Weekly RGM-2 Data Report
4. Environmental TLD Locations

TO:_____ Today's Date_____

From:_____

TELEX WEEKLY
24 HOUR RADON AVERAGES
Weekly Summary
(All averages are in units of pCi/l)

Week Ending Date_____

Site Location_____

Date → / Location ↓	S/N							

RADON CONCENTRATIONS IN AIR

Weekly report of RGM-2 data to Manager, Environmental Assessment, Albuquerque.

RGM-2 Location: _____
(Also attach a map indicating current locations of site and nearby RGM-2's).

RGM-2 #: _____ S.N. #: _____ Report Date _____ To _____

Sampler Location _____

Date of last calibration: _____ Calibration _____ C/pCi/l
(Annual Calibration Required)

Date of last background check _____ Background _____ pCi/l
(Monthly background check required)

Radon Weekly Average _____ pci/l

Signature of Reporting Technician _____

RSO reviewed _____ (Attach printouts below:)

Continuation of Weekly RGM-2 Data Report.

RGM-2 S.N._____Report Date_____to_____Page_____

Location:_____

ENVIRONMENTAL TLD LOCATION (ETLD)
UMTRA PROJECT
EXPOSURE QUARTER: _____

ISSUED BY: _____ DATA COLLECTED: _____

LOCATION (ATTACH MAP IF NECESSARY	BADGE NUMBER	DATE OF ISSUE

BORROW
MATERIAL RADIOACTIVE SCREENING
RAC-013

UMTRA
RAC

Chem-Nuclear Systems, Inc.

1.0 Scope

1.1 Purpose

This document provides instructions and guidance to determine acceptability of borrow pit materials for use as backfill.

1.2 Applicability

Any time new material is proposed as backfill, it must be checked for radioactive contamination. Periodically and routinely, large borrow pits must be checked for radioactive contamination.

2.0 Prerequisites

All instruments used under this procedure must have valid calibration.

3.0 Requirements

3.1 Establishment of Background

3.1.1 If background count rates and exposure rates have not been previously established for a particular site/location, they must be established and documented the first time borrow material is checked.

3.1.2 If it is necessary to measure background values, go to an area easily accessible, not influenced by the UMTRA site.

3.1.3 Take 10 surface and 10, 3 feet height gamma 0.1-1.0 minute counts.

3.1.4 Collect a 500g soil sample under each surface reading.

3.1.5 Take a PIC reading.

3.1.6 Calculate the average of the 10 surface counts. This represents the surface count rate for that region record.

3.1.7 Analyze the soil samples for Ra-226. (OCS and/or offsite lab)

3.1.8 Calculate the average exposure rate for the site location. This is the average of the 10 PIC readings (uR/h.) record.

2.2 Determination of statistical limits of the background.

3.2.1 Average the background count readings ($\bar{c}$); record.

3.2.2 Take the square root of the average ($\sqrt{\bar{c}}$); record. This is the standard deviation of the background 3 sigma.

3.2.3 Multiply this value by 3, ($3\sqrt{\bar{c}}$); record.

3.2.4 Calculate the range upper limit by adding the value calculated in 2.2.3 to the measured mean ($\bar{c}$) for the background; record.

3.2.5 Subtract the value calculated in 2.2.3 from the measured mean for the background; record. This is the lower limit of the range.

3.2.6 The mean plus or minus 3 sigma represents the range of background count values at the 99% confidence level.

3.3 Gamma screening of Borrow Material

3.3.1 Take several contact surface gamma counts (time 0.1 - 1.0 min.); ten is usually a good number to start with. The actual number of readings depend on the volumes of material to be used in the immediate future. Periodic checking of borrow material will be necessary.

3.3.2 Calculate the mean; $\bar{c}$.

3.4 Interpretation of the Calculated Range

3.4.1 If the calculated mean falls within the range of the (previously or recently) established background count, the material is acceptable for fill.

3.4.2 If there is question about the above results contact RAC-AL. A sample of the borrow material shall be sent off to the Approved Laboratory for Ra-226, Th-230, and U-238 analyses.

3.5 Alternate Method

At the direction of the site HP Manager initial and routine samples may be collected from the haul trucks and analyzed to determine if the borrow material meets the requirements.

4.0 Records

4.1 The site HP Manager or his designee shall maintain a site file of all data sheets, records, logs, forms, memos and shall forward to RAC AL copies of pertinent data on a monthly basis.

List of Attachments

The following data sheet shall be filled out when performing Borrow Material Testing.

1. Background/Borrow Material Testing

BACKGROUND/BORROW MATERIAL TESTING

DATE: _____

TECH: _____

☐ BACKGROUND DETERMINATION; RANGE OF VALUES = _____ to _____

☐ BORROW MATERIAL INVESTIGATION

NOTE: Columns 3 and 4 are to be used when doing a background determination. They are unnecessary if this is a borrow material investigation.

SURFACE GAMMA COUNTS	COUNT TIME	PIC READING uR/h	3 FOOT HEIGHT GAMMA COUNTS/MIN.	COMMENTS
Ave: _____ ($\bar{c}$)		Ave: _____ u/Rh	Ave: _____	

CALCULATIONS:

1. Calculate the means counts i.e. $\bar{c}$ _____ and mean uR/h _____.
2. Calculate the standard deviation of the counts; i.e. sigma $= \sqrt{\bar{c}} =$ _____
3. Calculate the range of the measured values.

   i.e. $c - 3\sqrt{\bar{c}}$ and $\bar{c} + 3\sqrt{\bar{c}}$

   Range = _____ to _____.

4. If the mean falls in the background range, the borrow material is acceptable fill material.

EXCAVATION CONTROL PROCEDURE
RAC-014

1.0 Scope

1.1 Purpose

The purpose of this procedure is to establish the survey methods that shall be used to control the excavation of radioactive materials at UMTRA sites and vicinity properties.

1.2 Applicability

This procedure applies to the excavation of all radioactive material.

2.0 Prerequisites

N/A

3.0 Requirements

There are four radiological measurement techniques used for excavation control on the UMTRA project. They are, direct gamma measurements with shielded and unshielded probe, "delta" measurements, Schiager soil analysis system and the OCS immediate soil analysis. Any and all combinations of these methods will be used to ensure that the applicable standards are met prior to collection of the official verification samples and backfilling.

The direct gamma and delta measurements shall be the primary methods used for excavation control. Direct measurements can be used in low gamma (shine) background areas. The "delta" system is to be used when the "shine" is high enough to interfere with collecting accurate soil readings. When the "shine" exceeds 40,000 CPM corrections are to be applied to the delta concentrations determinations. The Schiager or immediate OCS soil analysis may also be used in high "shine" areas.

The final "delta" and final immediate OCS sample results, prior to official verification sampling and backfilling, are to be recorded. These results and the OCS final excavation control samples will be used as back-up in case the official verification sample concentration exceeds the standards.

3.1 Use the methods described above, as appropriate, to direct excavation control until the area meets applicable standards. Consideration should be given to the removal of contaminated areas beneath and near vicinity property structures to background levels, as they are potential radon conduits into a structure.

3.2 Grid the area as outlined in the soil verification procedure and collect delta readings at each grid point. Officially record and identify each point that indicates the standards have been met. Refer to the RAC verification procedure for the specific procedure to be used in performing final delta measurements.

3.3 When all grid points in the area indicate the standards have been met, by the averaged delta measurements, collect (15 cm deep) soil samples at the locations where the delta measurements were made. The preferred method for soil sample collection is the soil sampling auger. Use this method whenever possible. (Ensure all tools used are radiologically clean). Collect enough soil to fill <u>two</u> OCS cans as a minimum. If the final excavation control sample indicates standards are met, the second can is to be used as the verification sample.

3.4 Homogenize the soil sample as much as possible, under field conditions. This is extremely important to eliminate "hot spots" in the samples.

3.5 When the soil sample is thoroughly homogenized fill 2 OCS cans. Pack the soil firmly in each can. Fill the cans as full as possible without interfering with properly sealing the cans.

3.6 Seal one of the samples "wet" and analyze on the OCS as soon as possible. Multiply the OCS pCi/g by (the established site specific correction factor). If the standards are met, the area may be backfilled. If not further excavation and resampling is required. Identify this sample as the <u>final excavation control</u> sample and the other as the final verification sample as per the RAC sample numbering system. Log the final excavation control sample no. on the soil excavation control Sample Log. Retain this sample until the final dried, equilibrated verification sample has been analyzed.

3.7 If the final excavation control sample indicates the standards are met, dry and seal the verification sample.

3.8 Leak test each verification sample can after it is sealed. Re-can all leakers.

3.9 Make sure that the verification sample is properly and permanently identified (labeled), and retain for 20 days prior to counting. Cross reference the excavation control sample on the verification sample.

3.10 After 20 days, count the verification sample and record the results on the verification sample log.

3.11 If the verification sample results meet the standards, the final excavation control sample can be discarded archive the verification sample. If the standards are not met, contact the radiological programs manager or his designee, for instructions.

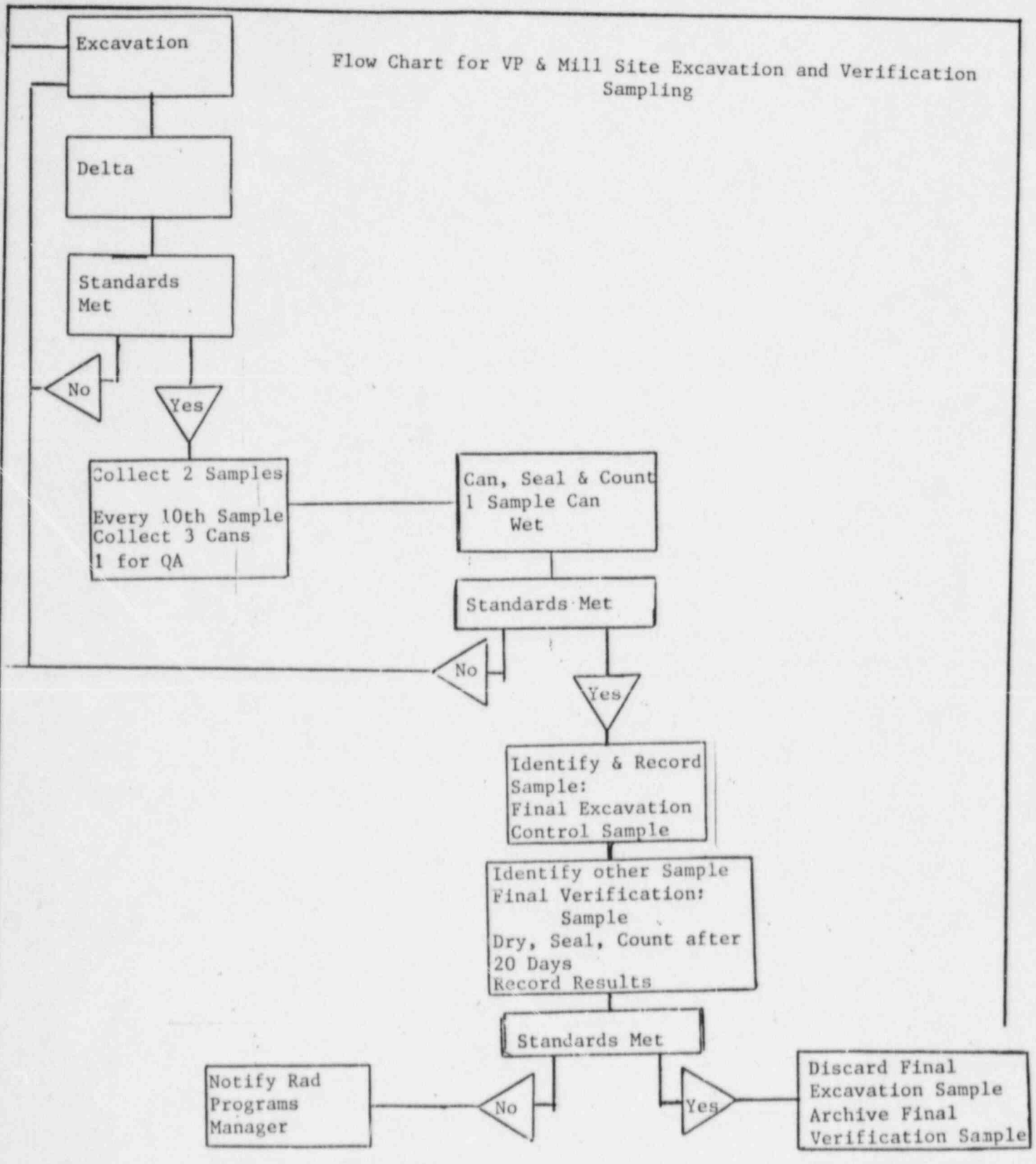
3.12 If the Schiager soil sampling method is used for the final excavation control sample instead of the OCS, the bucket must be retained until the OCS dry, equilibrated verification sample results are received. If the verification results meet the standards, the bucket sample can be discarded. If not, contact the radiological programs manager, or his designee for instructions.

3.13 Split a sample from every tenth verification sample (well homogenized) and send to an outside vendor for analysis for Ra226 and Th230. This is a quality assurance sample. It is recommended that samples numbered 10, 20, 30 etc., be split for ease of remembering and recording. When the vendor QA sample results are received, log them on the soil verification Sample Log and retain the vendor sheets.

4.0 Records

The site HP Manager or his designee shall maintain a site file of all data sheets, records, logs, memos and shall forward copies of pertinent data to RAC ALB monthly.

Flow Chart for VP & Mill Site Excavation and Verification Sampling



List of Attachments

The following data sheet will be filled out when performing the applicable function described in the procedure.

1. Excavation Control Log

UMTRA RAC
Excavation Control Log

Sampling Technician_____ Excavation Sample ID_____

OCS Analysis Technician_____ OCS Immediate pCi/g_____
(Corrected for Emanation and Moisture)

Ludlum 2220/4410 ID#_____ Average "delta" c/0.5 min_____

Area ID_____ Average delta pCi/g_____

_____ Other_____pCi/g_____

Standard ID:_____

Open Gamma c/0.5 min	Shielded Gamma c/0.5 min	Shine c/0.5 min	Shine Corrections	Delta pCi/g	Comments

VERIFICATION PROCEDURES FOR VICINITY PROPERTIES AND TAILINGS SITES (SOIL SAMPLING AND ANALYSIS) RAC-015

UMTRA RAC

Chem-Nuclear Systems, Inc.

1.0 Scope

1.1 Purpose

To define procedures for final verification that excavated areas comply with mill tailings site or vicinity property standards.

1.2 Applicability

This procedure applies to all UMTRA vicinity properties and tailing sites. Compliance with the procedure is to be verified before back filling or other restoration work begins.

2.0 Prerequisites

2.1 All instruments used under this procedure will have valid calibration.

3.0 Requirements

3.1 Vicinity Property and Mill Tailings Sites Soil Verification Procedures

In general, UMTRA mill sites and vicinity properties will be cleaned to the US EPA standards. Exceptions to date are as follows:

US EPA standards: 5 pCi/g average concentration above background for surface areas, 15 pCi/g above background for areas to be more than 6 inches below grade after backfill). There is an additional DOE requirement that beneath and within 10 feet of vicinity property occupied structures, and potential conduits into a structure (utility lines) are to be excavated to background levels. The area to be verified shall previously have been determined to be clean via delta measurements, immediate OCS analysis or other methods. Note: the following delta procedure represents the same measurements in the RAC excavation control procedure identified there as the final delta measurement.

3.2 For site, survey grid the area to be verified into 100 square meter blocks, for vicinity properties, duplicate the X and Y coordinates used for initial inclusion or REA surveys. Location of these blocks must be tied to landmarks used in defining the previous survey grid.

3.3 For sites and VPs, X-Y grid coordinates AND depth of final soil sample are required to be recorded in the sample ID/location column (an average depth for the area being verified). Verification sample numbers and results are required to be recorded on a map of the site (construction drawing) and/or VP (as built drawing).

3.4 The OCS must be energy calibrated/checked. Record of these checks must be recorded on the OCS Soil Verification Log. The KeV/channel, peak channel # and ROI may be recorded in the Activity/Ra Conc. column or comments column.

3.5 Site specific emanation and moisture correction factors must be developed prior to utilizing the OCS to count wet, unequilibrated soil samples.

3.6 The operation protocol for the OCS must be utilized to set up and run soil samples on the system.

3.7 Background and Ra-226 and Th-232 reference materials must be counted periodically in accordance with the OCS operating protocol. Acceptable performance is $\pm$ 2 σ.

4.0 Procedure

4.1 Informally, grid each 100 square meter block into approximate 10 x 10 foot elements, as per Figure 1. Eleven contiguous 100 ft^2 sampling area very closely approximately 100 m^2. This gridding may normally be done visually by the technician performing the verification survey, as the purpose is to provide a random sampling of the area to be verified. Delta system analysis, and soil sample extraction, will be jointly performed at each of the approximately 19-24 intersections of the 10 foot grid, as indicated in Figure 1. Because the purpose of final verification sampling is to establish the average radium concentration in a 100 m^2 area, biased, non-grid interaction sampling (hot spot sampling), is not required. Prior excavation control surveying should have resulted in removal of significant hot spots.

For areas to be verified which are smaller than 100 m^2, only 10 (rather than 20) total Delta and OCS measurements need to be taken. Otherwise, all steps apply for such smaller areas.

4.2 While performing the delta measurements, routinely check operating parameters of the 2220 ratemeter: battery voltage (generally must be higher than 5.4 V), window OUT, threshold setting as directed by the site HP Manager (generally threshold = 100). Also, routinely (several times daily) perform an open shield recount at a single point on a property to demonstrate that the overall counting efficiency of the unit has not changed ($\pm$ 2 sigma).

4.3 Perform the following at each of the 19-24 intersections of the 10x10 foot grid:

4.3.1 Using spray paint, a stake, or other means, mark a spot on the ground surface at one of the 10 foot grid intersections. This spot must be exactly identified for verification soil sampling later.

4.3.2 Set the Delta shield, with 2x2" 44-10 probe inserted, on the marked intersect, with the exposed face of the probe centered on the intersect. Take a 0.5 minute count with the 2220 ratemeter. Record this count on the excavation control data log sheet as "OPEN" reading.

4.3.3 Place the 1/2" thick, circular lead shield under the detector in the shield holder, centered on the marked intersection point, under the Delta Shield. Take another 0.5 minute count, and record the result on the excavation control log sheet as the "SHIELDED" reading.

4.3.4 Record the difference between the "OPEN" and "SHIELDED" readings as the "DELTA" value. Use the appropriate Delta System Calibration Curve to determine whether the reading falls within allowable limits for the area being surveyed. Make "shine" corrections as necessary if "shine" is above 20,000 c/0.5 min, (40,000 cpm).

4.3.5 Remove the RAC Delta system from the marked intersection. If the delta analysis indicates that the standards have been met, extract a 6" deep soil sample from the center of the marked intersection point, using the soil sampling auger, if possible. Do not collect final excavation control or verification samples until all measurements indicate that the 100 m^2 area meets the standards.

4.3.6 Proceed to the next point on the 10 foot grid system within the 100 square meter area being verified, and perform steps 3.5.1 through 3.5.5, above. Continue to record Delta measurements, followed by extraction of OCS soil samples, at all grid intersections within the area. Record all Delta concentration estimates on a VP map. Average the 20 Delta estimates of soil concentration. Make sure that the delta average indicates that the standards have been met.

4.3.7 After completion of the 100 square meter area make sure there is enough soil to completely fill 2 OCS cans. Mix the 20 soil samples carefully within the soil drill container, then transfer the composite to two OCS counting cans. Fill the cans completely with thoroughly hand packed soil. Leave just enough space to properly seal the cans. One of these samples is to be used as the final excavation control sample and the other as the verification sample. If insufficient material was collected to fill the cans, repeat steps 4.3.1 through 4.3.7, above, at the same locations, until sufficient soil is available to fill the OCS cans.

4.3.8 Seal one of the samples "wet" and count on the OCS immediately. If the OCS pCi/g multiplied by the site specific correction factor indicates that the standards have been met, number and label this sample as the final excavation control OCS sample, enter the results on the Excavation Control Log and retain. If the final excavation control sample results indicate the area is clean, it may be backfilled. If not, further cleaning is necessary. When the final excavation control sample indicates the area is clean, the other OCS sample can then be identified as the final verification sample per the RAC sample numbering system (Attachment B). Enter the final excavation control OCS sample number (SE #) and the OCS soil verification number (SV #) in the OCS Verification Log (Attachment A).

4.3.9 As soon as feasible, dry the verification composite sample, seal within the OCS can, leak test the can, weigh, subtract an average value for weight of the empty can and lid, record initial (dry) weight of soil, and count at least 20 days later for 1000 seconds on the calibrated OCS System using standard procedures. Record the Ra-226 concentration on the verification log sheet.

4.3.10 If the final results exceed the standards for the specific property, notify the manager, radiological programs immediately for guidance.

4.3.11 If the final results are more than 10% different than the average estimate obtained by the RAC Delta system or the final excavation control OCS sample results, for that 100 square meter area, notify the site HP Manager. If the estimates agree within 10%, copy the verification log sheet for transmittal to the ALB office.

4.3.12 At least every tenth verification sample (10%) is to be sent to an offsite laboratory for Ra-226 and Th-230 analysis on a routine basis. These QA samples are to be sent out as soon ar possible after collection. It is recommended that verification QA samples be numbered 10, 20, 30 etc., for ease of remembering. Results from vendor analysis should be recorded on the original verification data sheet, when received, and the vendor results form also retained.

4.3.13 Permanently store all other verification samples at the site. Do not store any sample or sources near the OCS. The DOE requires that all final verification samples taken at tailings sites and vicinity properties be stored by the RAC until further notice.

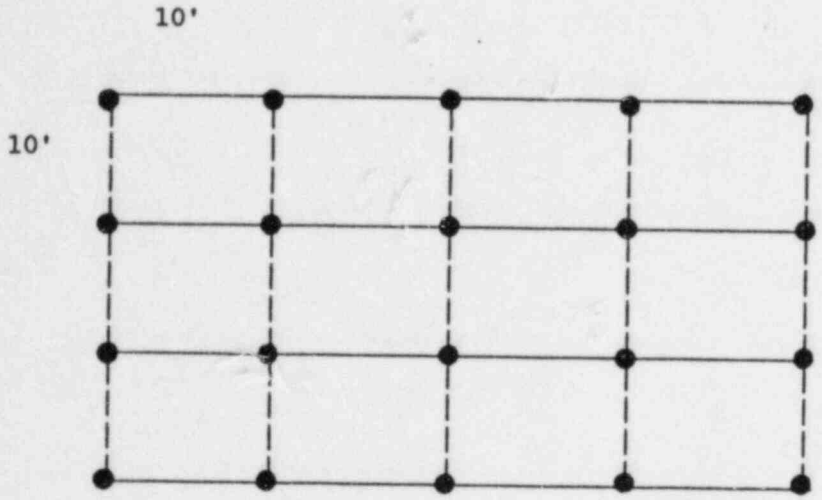
4.3.14 QA samples sent to offsite laboratory should be returned to the originator after analysis for archiving.

5.0 Records

All records of verification will be filed at the site and copies sent weekly to the RAC ALB EAV Manager.

Figure 1

Gridding an Area to be Verified



Approximately 100 m^2 area to be verified. Composed of 10' x 10' grid elements.

20 sampling locations, marked by " ● ", for Vicinity Property Verification

Note: Area need not be rectangular, but should include approximately 100 m^2 total area.

Peripheral sampling locations should be adjusted inward approximately 2 1/2" to prevent sampling the exact same location that was sampled in ajoining plots.

Attachment A
OPPOSED CRYSTAL SAMPLE VERIFICATION RECORD

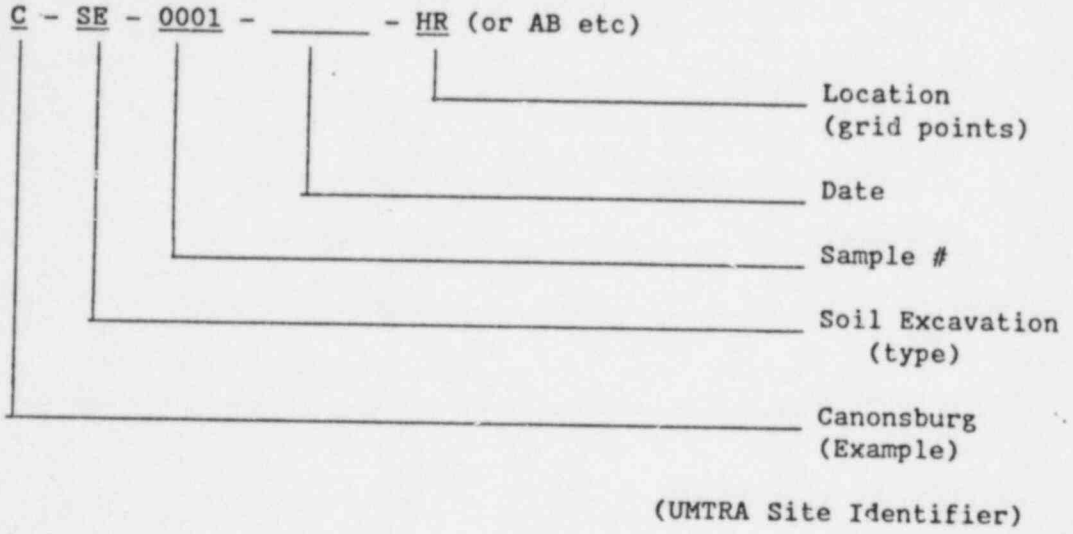
Site Location: _____
Reviewed by: _____

ENTRY NO	SAMPLE ID/ LOCATION	DATE TAKEN	ACTIVITY (pCi) / RA CONC. (pCi/g)	DATE SEALED	DATE COUNTED	DRY WT. NET (g)	LAB RESULTS 10% QA RA (pCi/g)	LAB RESULTS TH-230 (pCi/g)	EXCAVATION CONTROL/ SAMPLE # (Cross Ref.)	COMMENTS

Attachment B
UMTRA Systematic Sample Numbering System

SOIL SAMPLES (two types)

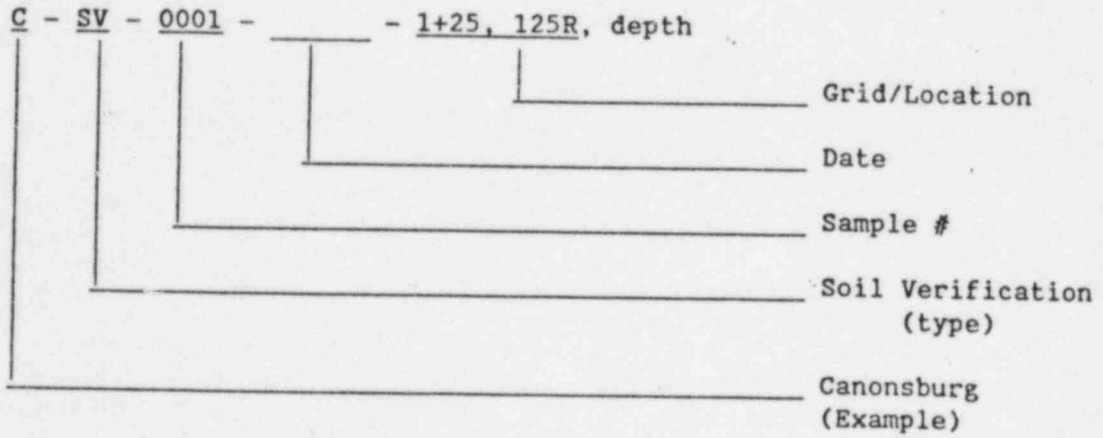
1) Excavation soil samples (Assigned in Excavation Control Log. Recorded on Verification and Excavation Control Log).



Location Abreviations: (Example)

HR = Haul Road
AB = Area B
AC = Area C
SP = Sed Pond
CR = Creek Bank

2) Verification soil samples (Assigned and Recorded in OCS Verification Log).



Location can also be designated:

MK-T = MK Trailer
CNSI-T = CNSI Trailer
BKHO-B = Back Hoe Bucket/Blade
TK-0152 = Truck License # etc.

Keep a legend of location abbreviations for sample designations.

CALIBRATION CURVE IDENTIFICATION - Assigned in Albuquerque for Schiager curve, delta curve.

1) *___ - RaO - 001 - 11/20/84

- Date
- Rev #
- Radium in soil OCS immediate counts
- Site

(UMTRA Site Identifier)

2) *___ - RaD - 001 - 11/20/83

- Date
- Rev #
- Ra in soil Delta
- Site

(UMTRA Site Identifier)

3) *___ - Ras - 001 - 11/20/83

- Date
- Rev #
- Radium in soil Schiager System
- Site

(UMTRA Site Identifier)

C - Canonsburg
S - SLC
SH - SHP
D - DUR
Etc.

INDOOR STRUCTURE WORKING LEVEL VERIFICATION
RAC-016

UMTRA
RAC

Chem-Nuclear Systems, Inc.

1.0 Scope

1.1 Purpose

This procedure provides guidelines for remedial action verification within vicinity property structures, using the grab sampling method or by annual average sampling.

1.2 Applicability

This procedure is to be utilized by qualified health physics personnel to demonstrate EPA indoor standards compliance. Guidance requirements per DOE letter 3050-84-907, (12/19/84) are to be implemented (i.e., if no previous WL measurements have been recorded, or if previously taken WL measurements exceed EPA standards - 0.02 WL.)

1.3 REA Surveys

Radon daughter concentrations should be measured in all habitable structures during the REA survey when the inclusion survey did not perform these measurements. These measurements will be conducted using either the grab sampling technique described below or the modified Kusnetz method.

If remedial action is required indoors because gamma readings exceed 20 micro R/hr plus background or because soil concentrations beneath the structure exceed EPA standards, an REA working level measurement is not necessary but is helpful as a benchmark measurement for future reference.

2.0 Prerequisites

2.1 If the Eberline WLM-1 (or equivalent) is utilized, it must be calibrated by an approved vendor at least annually; i.e., exposed to a known radon daughter concentration in a radon chamber.

2.2 The pump flow rate must be determined by the wet bubble tube or equivalent method prior to and after each use for verification data generation.

2.3 The efficiency of the counting system or WLM-1 must be determined immediately preceding use when verification data is generated.

2.4 The WLM must be fully charged prior to use; continue charging for at least 2 hours after the red LED (80% charged) light on the WLR goes off.

2.5 QA controls for Track Etch measurements include eight Track-Etch type SF Detectors sent to Mound for WL standard exposures for each batch received from Terradex. In addition, two community locations (two replicates per location) must be monitored to provide community average WL concentrations. Also, 2 blank i.e., unexposed detectors are requried. These controls are required per batch of detectors (generally a batch will include detectors to support verification of 9 or more VPs).

3.0 Requirements

3.1 The first stage is essentially a (duplicate) grab WL sample. This can be completed with an Eberline WLM-1 (or equivalent) by setting up parameters on the WLM for eight hours of 5 minute sample intervals and four hours of 60 minute tail intervals. This can also be completed by utilizing the grab sample technique (Modified Kuznetz WL method) discussed in RAC training manual. Standard conditions must be adhered to as discussed in the DOE VPMIM (section A.2.4), and are as follows:

3.1.1 Recent outside measurements of RN-222 concentrations have not exceeded 2.0 pCi/1. The use of local RGM values is acceptable to determine this condition.

3.1.2 Local wind speeds have not exceeded 10 mph for the preceding 4 hours. The meteorological station at the site or local weather information is acceptable.

3.1.3 Doors, windows and other openings have been closed for the preceding 12 hours. The property owner will have to agree to this condition.

3.1.4 Ventilation systems introducing outside air have not operated during the preceding 12 hours. The property owner will have to shut systems off.

3.1.5 The two samples must be collected at least 18 inches above the floor in the location of highest expected occupancy or the area of highest expected RDC. (Typically the lowest potentially habitable area of the structure).

It is important to recognize that this first level of data acquisition may be considered an optional step since there will be property owners who will not adhere to the above and times of the year when the standard conditions listed above cannot be easily controlled. This determination will be left

up to the discretion of the MK Site Manager and the HP Site Manager. In those cases documentation should be included as to the specific problems encountered (a memo to that VP file is fine). It is also important to recognize that it is necessary to try to complete this level since a value of 0.01 WL indicates that no further measurements are required (DOE VPMIM Section E.5).

Note: As per the VPMIM, a grab sample taken under the above conditions, or a WLM-1 set of measurements averaging less than 0.01 WL (average of the final 5, 5-minute measurements), may be taken as evidence that remedial action was successful, with respect to radon daughter levels. In general, no further WL measurements need be made within such a property.

If the (duplicate) grab sample results exceed 0.01 WL, the second stage shall commence.

3.2 WLM Setup and placement in a structure.

3.2.1 With a filter in place, check the pump flow rate.

3.2.2 Determine the counting efficiency.

3.2.3 Replace the 0.8 um filter with a clean filter.

3.2.4 Set up the WLM by entering parameter routine as:

The sample interval shall be 5.0 minutes for the grab WL.

The sample quantity shall be 100 for eight hours of 5 minute grab samples. The 100 sample quantity allows the last 5 readings to be averaged to represent grab WL samples taken under the "standard conditions" listed above, if the unit is set up to start at the maximum delay time of four hours after initial set up time. (The entire data read out tape must be placed in the V.P. file for that property.)

The tail interval shall be 60 minutes for the grab sample.

The tail quantity shall be 4 for the grab sample.

3.2.5 Remember that the WLM does an automatic count prior to sampling. The length of background count time is equivalent to the sampling interval, i.e., 5.0 minutes in the above case. The earliest possible start time is 5.0 minutes from the initial set up time. The maximum delay start time is four hours from initialization time. (This may be the case for some early models. Later models may allow later start times. The technician should test the WLM to see if this restriction applies.)

3.2.6 Place the WLM(s) in the lowest habitable room.

3.2.7 The WLM will run for approximately 8 hours for the grab sample measurement. However, remember that the WLM-1 must be placed in the structure at least 4 hours prior to sampling to comply with the DOE VPMIM requirements listed above (section 4.1). After the allotted time (i.e., 1 day after the grab sample) the WLM should be picked up and read. After reading, the flow rate should be verified and documented that it did not change during the previous sampling interval. Notes as to flow verification or actual flow check tapes can be referred to in the vicinity file. Actual flow rate documentation will be recorded.

3.2.8 Record the data on the attache Interior Survey Data Log/Radon Daughter form. Include a statement in the comments that the data represent VERIFICATION DATA.

3.3 Track Etch type SF Placement-READ CAREFULLY BEFORE PLACING DETECTORS

The second stage of the verification method will include monitoring of indoor radon with Track-Etch type SF detectors. Six detectors will be placed in the lowest habitable room of the house. Replicate measurements, standards, blanks and locally exposed detectors will provide controls for this part of the verification procedure. It will be most convenient to group vicinity properties together to order Track-Etch detectors. At least 5-10 properties should be grouped if possible when ordering the Track-Etch type SF detectors.

3.3.1 It will be necessary to contact Albuquerque procurement department to phone orders for the detectors on an as needed basis. The detectors must NEVER be stored onsite becasue radon may contaminate them before placement in the vicinity property requiring verification. Arrangements should be made to receive the detectors NO MORE THAN A FEW DAYS IN ADVANCE OF SETTING THEM OUT AT VICINITY PROPERTIES. Overnight delivery is required to avoid the question of potential contamination prior to placement. Detectors should not be stored onsite, due to potentially high radon levels onsite. Requests for same batch devices from the vendor will be required. Normally an order for detectors would be 54 (count) for placement in 9 vicinity property structures. With this order 14 extra SF detectors for QA purposes.

3.3.2 It is necessary to order at least FOURTEEN EXTRA detectors (out of the SAME batch) from the vendor for quality control. Two of the detectors will be utilized for unexposed detector controls (store these in an off-site location, a HP manager's home is acceptable) sealed in a shipping envelope. Another eight will be sent, by the site, to the Mound (or equivalent) calibration chamber for exposure to radon as a standard for comparison to the Track-Etch results. The final four detectors will be placed at two representative non-tailings-contaminated homes in the community to measure background WL. (Duplicate detectors placed in the lowest potentially habitable room).

3.3.3 SF detectors should be supplied by Terradex with the filters already in place, to avoid particulate contamination. Notify Albuquerque if the cups are received without filters in place (snapped on).

The general procedure is to place six Track Etch SF detectors side by side in the lowest potentially habitable room in the house. Detectors must be located such that disturbance is unlikely during the extended sampling period. Some ingenuity on the part of the HP technician placing these detectors will be required to reduce the possibility of disturbance or disappearance during this extended sampling. Detectors should generally be placed at approximate breathing zone height, but since radon diffuses rapidly in air, this factor should not override the need to minimize the possibility of detector disturbance. In all cases, the detector filter must be left exposed to the room atmoshphere, to allow radon diffusion to the detector at the bottom of the Track Etch SF cup. Three detectors will be pulled and read at 6 months and the final 3 will be pulled and read at 1 year.

3.4 General Procedure/Detector types

Type SF filtered radon detector Track-Etch cups. These will require Terradex reading at the HIGH sensitivity.

3.4.1 Track Etch SF radon detectors will be utilized to estimate annual average WL concentrations. Six detectors will be placed in one location at a vicinity property. Location as discussed at the TMC workshop April 9-11, 1985/DOE ABQ meeting is the lowest potentially habitable room.

3.4.2 Three detectors will be collected after 6 months. These will be returned to the vendor for reading. One year after placement, the other 3 SF detectors will be read by Terradex. This last measurement provides the verification WL concentration.

3.4.3 The eight Track Etch detectors sent to Mound for calibration and blanks should be returned to the vendor for reading shortly after WL chamber calibration has been completed. In this manner, problems with a particular set of detectors will be determined prior to the investment of a great deal of time of the corresponding set of VP's.

3.4.4 The 4 SF detectors placed in uncontaminated homes will be collected and read at the 1 year integration period.

3.5 WL will be calculated, by the Track-Etch vendor, based on the following equation.

$$WL = \frac{WLR \times Rn}{100}$$

Where

WL = working level from Track Etch SF measurements average value.

WLR = working level ratio - 0.5

Rn = radon - 222 concentration (pCi/l)

The working level ratio will normally be assumed to be 0.5, as per the Vicinity Property Management and Implementation Manual, Review Draft, April, 1984.

3.6 Sample Identification Numbering System

The sample identification numbering system should not give information to the vendor as to sample location or expected working levels. To avoid this each Site HP Manager must keep a sample ID log with a numbering system such as:

C-TE-V-CA-053-06-84 Where: C=Canonsburg
TE-V=Track-Etch verification
CA-053=Vicinity prop. 053
06-84=the month of year collected.

or for a background sample:

C-TE-B-001-06-84 Where: C, TE have the same meaning as above, B stands for background. 001 is the first of many consecutive background WL measurements. 06-84 is the date collected.

or for a standard sent to Mound:

C-TE-S-001-06-84 Where; All symbols are the same as discussed above. "S" implies a standard sample.

As with all verification records, duplicates of all information concerning WL verification, including HP manager log entries, detector placement information, dates times, etc., MUST be forwarded to ALB. ATTN: Vicinity Properties Manager, immediately upon creation. Sample tracking, statistical handling of outliers and averaging data analysis will be completed in the ALB project office under the direction of the Vicinity Properties Manager.

A copy of the sample number assignment log shall also be sent to the EAV manager.

4.0 Records

All records of working level verification will be filed at the site and copies sent to RAC-ALB monthly.

List of Attachments

The following list of forms are to be utilized when recording data for this procedure:

1. Track Etch SF Sample Number Assignment Log.

2. Interior Survey Data Log/Radon Daughter

Site: _____

Track Etch SF Sample Number Assignment Log

Sample ID	Location/Description	Vendor Serial No.

	REV. NO.
	PAGE NO.

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INTERIOR SURVEY DATA LOG/RADON DAUGHTER

SURVEY CREW _____ SHEET _____ OF _____ PAGE _____

_____ DATE _____

_____ PROPERTY ID # _____

_____ PROJECT _____

RADON DAUGHTER SURVEY

SURVEY METHOD: ☐ SHORT TERM INTEGRATED (I.E., 8 HR. INTEGRAL WITH WLM - 1)
(ATTACH PRINTOUT TAPES)

NOTE: TAPE ID NO. = INST. SERIAL NO. + PROPERTY ID NO.

TAPE ID NO.					
LOCATION					
SAMPLE INTERVAL					
SAMPLE QUANTITY					
AVERAGE WL					
THORON %					

SURVEY METHOD: ☐ GRAB (MINIMUM OF TWO REQUIRED)

LOCATION					
WL - 1					
WL - 2					
WL - 3					
WL - 4					
AVERAGE WL					

COMMENTS: _____

VP 026

Appendix A
Guidelines for Calculations, Comparisons and Correlations

These calculations, comparison and correlations are examples to be used to assist project personnel in performing their daily functions.

1.0 Calculation of MDA (Minimum Detectable Activity)

1.1 When applicable (swipe and filter counting instruments), minimum detectable activity will be calculated daily in units of activity/volume or area.

Once the MDA is calculated, it will be compared to the maximum permissible concentration in air (MPC a) for the radionuclide being considered. See 10 CFR 20 Appendix B for restricted (Table I) or unrestricted (Table II) values. If the calculated MDA is greater than or equal to the maximum permissible concentration in air, the HP Supervisor (or Site H.P Manager) will act to mitigate the apparent detection problem.

1.2 Minimum detectable activity (MDA) is the minimum number of counts detectable (MDC) above background. We will require that our overall sampling and analysis system be capable of detecting the applicable MPCa with 95% confidence. Therefore, we define MDC as:

$$MDC = \sqrt{(\bar{C})} \times 4.65$$

$\sqrt{(\bar{C})}$ = the square root of the average of a number of background counts. In our case, this will be the square root of the average of 10 one minute counts for beta-gamma or one 20 minute count for alpha.

If zero counts are obtained, use the longterm background average of the instrument for $\sqrt{(\bar{C})}$.

1.3 The MDA is derived from the daily MDC by one of 2 equations:

(a)

$$MDA = \frac{MDC}{2.22 \times 10^6 \times E \times V \times t}$$ units: micro-Ci/ml (Air, Water Sample)

(b)

$$MDA = \frac{MDC}{E \times \text{Area swiped} \times t}$$ (Swipe Sample)

units: dpm/(sample or 100 sq cm)

Equation (a) is for liquids or air samples; equation (b) is for swipe samples.

Where:

V = area or smallest volume of air sample for that day in units of ml.
E = counting and collection efficiency for radiation of interest (see section 3.7)
t = sample or background count time; these must be the same, assuming that measured air concentrations will be near MPCa.

NOTE: For this calculation, the background count time must equal the anticipated sample count time.

1.4 If calculated in this manner, the MDA can be compared directly to the 10 CFR 20, Appendix B (Table I or II) or removable alpha limits. This will ensure that detection is below the maximum permissible concentration in air, water or unrestricted removable alpha limits (200 dpm/100 cm 2).

1.5 If the MDA is greater than the maximum permissible concentration obtained from 10 CFR20, Appendix B, instrument problems may be occurring (possibly contaminated detector, cable problems, etc), and shall be corrected.

2.0 Instrument Reliability

Instrument reliability will be calculated when applicable.

3.0 Efficiency Determination

3.1 Count a known activity source for at least one minute. Determine by examination of calibration records the disintegrations per minute of the source. It may be necessary to correct the source activity for decay by the equation $A = A_o e^{-\lambda t}$ when such decay is significant

where A_o = initial activity
A = present activity
λ = decay constant for source isotope
t = time since initial preparation of source.

3.2 Calculate the net counts per minute obtained. Net cpm is total cpm minus background cpm.

3.3 Calculate the instrument efficiency as follows:

$$E = \frac{\text{net cpm}}{\text{dpm}}$$

4.0 Calculation of MPC Hours

4.1 Determine the alpha air concentration using an eberline MS-2/FC-2, or equivalent, counting system.

$$uCi/ml = (ncpm \times Fr)/(Ec \times Ef \times Vx\ 2.22 \times 10\ 6\ )$$

Where:

ncpm = gross sample counts per minute minus background counts per minute (net cpm).

Fr = Filter size ratio Af/Ac, Af = exposed area of filter, Ac = area of the portion of the filter counted
V = sample volume
Ec = counter efficiency
Ef = collection efficiency of filter

4.2 Divide this concentration by the concentration listed in 10 CFR 20, App. B, Table I, Col. for the most restrictive isotope, Th 230 (2 X 10 - 12 uCi/ml).

The resulting number is the MPC fraction (fractions less than 1 are permissible).

4.3 Multiply the MPCa fraction by the number of hours the individual worked in the area. The result is his MPCa hours.

4.4 No individual shall be allowed to exceed 40 MPCa hours in seven (7) consecutive days. When projected weekly MPCa hours exceed 40 MPCa hours, precautionary procedures (e.g., increased surveillance, dust prevention measures, work time limits) shall be instituted, and samples shall be analyzed for specific radionuclides. Values for specific radionuclides shall be compared to 10 CFR 20 as above, and precautions to prevent over exposure shall be implemented. All exposures shall be controlled to minimize worker intake to the extent reasonably achievable.

5.0 Calculating Stay Time for Whole Body Dose Rate

5.1 Formula Stay time in minutes =

$$\frac{\text{Allowable dose in mrem}}{\text{Dose rate in mrem/hour}} \times 60 \text{ min. per 1 hr.}$$

5.2 Example: The calculation of stay time for an individual to receive a whole body dose of not more than 250 mrem while working in a radiation field where the dose rate is 1000 mrem/hr - whole body is as follows:

$$\frac{\text{250 mrem allowable dose}}{\text{1000 mrem/hour}} \times 60 \text{ min. per 1 hr.} = 15 \text{ min}$$

5.3 Use the above formula for calculating stay times for the whole body, skin, and extremities to determine which is the most limiting. When determining which stay time is the most limiting, i.e., whole body, skin or extremities, use the individual's authorized dose to each.

6.0 Calculations of MPC

6.1 Determine the number of MPCs present by using the following formula for decay times greater than 72 hours:

$$\text{MPC's} = \frac{\text{Air Concentration (micro Ci/cc)}}{\text{MPCa of Nuclide of Interest (micro Ci/cc)}}$$

(a) When any of the contributing radionuclides are unknown, use the MPC for the most restrictive radionuclide likely to be present. These MPCs are:

6 E-9 micro Ci/cc (for Beta-gamma, Bi-210)

2×10^{-12} micro Ci/cc (for alpha emitters, Th-230)

7.0 Calculation of long-lived activity 4 and 14 hour decay

Long-lived activity formula:

$$C_{LL} = \frac{C_2 - C_1 e^{\left(\frac{.693}{10.6 \text{ hr}} \Delta t\right)}}{1 - e^{\left(\frac{.693}{10.6 \text{ hr}} \Delta t\right)}}$$

Where:

C_{LL} = long lived count rate

C_2 = count rate at time t_2

C_1 = count rate at time t_1

Δt = time between counts ($t_1 - t_2$)

8.0 Calculation of WL (Modified Kuznetz)

8.1 Calculation of working level is accomplished by the following formula:

$$WL = \frac{\text{Net Alpha Counts}}{E * V * ST * CT * K}$$

Where:

E = detection system efficiency ; $\frac{cpm}{dpm}$

V = Volume (flow per minute (l/m)

ST = Sampling collection time (m)

CT = Counting time (m)

K = Converstion Factor (dpm per WL)

Use Table 8.1

9.0 Radon Concentration Calculation

8.1 Calculation of radon concentration in pCi/l is accomplished through the following formula:

$$Rn\ (pCi/l) = cpm * C * e^{\lambda t} * \frac{1}{V}$$

Where:

CPM =Net alpha count rate

C = Conversion factor (pCi/cmp)

λ = Rn decay constant ($7.55 \times 10^{-3}\ h^{-1}$)

t = Time from sampling to midpoint of counting interval (in hours)

V = Volume of lucas cell used.

10.0 WL Calculation by Track-Etch Method

10.1

$$WL = \frac{WLR \times Rn}{100}$$

Where:

WL = working level from Track Etch R measurements average value)

WLR = working level ratio = 0.5

Rn = radon - 222 concentration (pCi/l)

Table 8.1

Conversion Factors

DECAY TIME (Min)	Kusnetz*	SUM OF SAMPLING + COUNTING TIMES (MIN)									
		4	6	7	8	9	10	15	20	40	60
40	150	151	151	150	149	148	146	141	136	117	99
45	140	142	141	140	139	138	136	131	126	107	91
50	130	132	131	130	129	128	126	121	117	99	83
55	120	122	121	120	119	118	116	112	107	90	75
60	110	113	112	111	110	109	107	102	98	82	68
65	100	103	102	101	101	100	98	94	89	74	62
70	90	94	94	93	92	91	89	85	81	67	56
75	83	86	85	84	84	83	81	77	74	61	50
80	75	78	77	77	76	75	74	70	67	55	45
85	68	71	70	69	79	68	67	63	60	49	41
90	60	64	63	63	62	61	60	57	54	44	36

Conversion factor, K, for modified WL Method and the generalized Kusnetz* Method derived from the average mixture of radon daughters measured in uranium mines (see Ref. 2.3.8).

Appendix B
Additional Data Sheets

All data sheets used at each UMTRA RAC shall be approved by the ALB office to ensure consistency and data completeness at all sites. This appendix includes data sheets that have been generated at the sites and may be used in specific cases.

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0770B

PIC uR vs 2220 Instrument Counts
Calibration Curve Data

Tech: ____________________

Date/Time: ____________________

PIC Reading (uR/h)	Inst No: ____ cts/.1 min	Inst. No: ____ cts/.1 min	Inst. No: ____ cts/.1 min	Inst. No: ____ cts/.1 min	Inst. No: ____ cts/.1 min	Inst. No: ____ cts/.1 min	Reading Location

AP-002

MORRISON-KNUDSEN COMPANY, INC.

RADIATION WORK PERMIT

DATE _____ TIME _____ RWP NUMBER _____

LOCATION _____ DATE/TIME OF APPROVAL _____

DESCRIPTION OF WORK _____

APPROVALS: HP TECH _____ HP SUPERVISOR _____

PERSONNEL MONITORING REQUIREMENTS

___ TLD
___ D/R DOSI
___ SKIN TLD

___ PERSONNEL RELEASE
___ TOOL & EQUIP. RELEASE
___ WORK AREA RELEASE

AREA AIR CONCENTRATION

___ NOT REQUIRED
___ uCi/cc ALPHA
___ uCi/cc B Y

PROTECTIVE CLOTHING REQUIREMENTS

HEAD	BODY	HANDS	FEET
___ CLOTH HAT	___ PAPER COVERALLS	___ PLASTIC GLOVES	___ SHOE COVERS
___ CLOTH HOOD	___ CLOTH COVERALLS	___ SURG GLOVES	___ BOOTS
___ FACE SHIELD	___ PLASTIC SUITS	___ CLOTH GLOVES	___ TOE RUBBERS
			___ PLASTIC BAG

RESPIRATOR PROTECTION

___ FULL FACE
___ PARTICULATE
___ VAPOR

___ S C B A
___ SUPPLIED AREA
___

HP COVERAGE

___ START
___ FINISH
___ FULL TIME

RADIATION CONDITIONS

Typical Smearable Contamination dpm/100 cm 2 dpm/100 cm 2
Maximum Smearable Contamination dpm/100 cm 2 dpm/100 cm 2

LOCATION	WB (mrem/hr)	SKIN (mrem/hr)	EXTREMITY (mrem/hr)	WORKING TIME

PERSONNEL INFORMATION

WORKER'S SIGNATURE	DOSE	WORKER'S SIGNATURE	DOSE
	___		___
	___		___

PREJOB CONFERENCE HELD: TIME _____ DATE _____

TERMINATION OF RWP

DEPARTMENT _____ TIME _____ DATE _____ SIGNATURE _____
COMMENTS _____

OCS DATA

SAMBLE ID#	SAMPLE DATE/TIME	WET WEIGHT	FIRST COUNT (WET) DATE/TIME; PCI/G
			F1:
			F1:
			F1:

Appendix C
Typical Equipment

This list is not all inclusive of equipment used but a guide of equipment used to date.

Typical Equipment

1. TLD - Thermoluminescent dosimeter
2. SRD - Self reading dosimeter
3. Air samplers
4. Counter-Scaler/Detector for alpha analysis Eberline MS-2/FC-2 Counter scaler/detector for beta-gamma.
5. Gamma scintillation radiation detection instrument.
6. Eberline cone shield.
7. Canberra Series 10 MCA with AM stabilized NaI probe.
8. Friskers
9. MSHA/N10SH approved resirators
10. Fit test Kit Respirators
11. Lucus cells
12. RGM-2 Printer/Timers
13. Type SF Track Etch R detectors
14. TE Detectors
15. NaI Detectors
16. Muli-channel Analyzer
17. Eberline WLM-1
18. Ludlum Model 2220 Portable Scaler Rate Meter
19. Ludlum Model 44-10 Gamma Scintillator 2" X 2" crystal with integrated photomultiplier tube
20. Reutor-Stokes Model RSS-111

MORRISON KNUDSEN

WM Record File

WM Project 39

Docket No.

PDR ✓

LPDR

Distribution:

Sollenberger w/encl. LBH w/o encl.

DSmith w/encl. DEM w/o encl.

(Return to WM, 623-SS) Coughlin w/o encl.

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