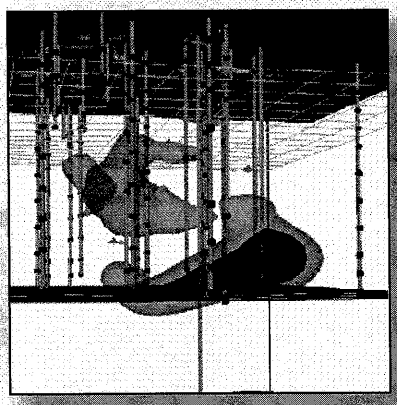
Colorado School of Mines Research Institute



November 3, 2005

Creekside Site Contaminated Soil Disposal Work Plan Revision 2

Prepared for:

Colorado School of Mines Reseach Institute

Prepared by:

The S.M. Stoller Corporation

Stoller

Colorado School of Mines Research Institute
Creekside Site

Contaminated Soil Disposal Work Plan
Revision 2

Prepared for:

Colorado School of Mines
Golden, Colorado

Prepared by:

S.M. Stoller Corporation
Lafayette, Colorado

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Colorado School of Mines Research Institute
Creekside Site
Contaminated Soil Disposal Work Plan
Revision 2

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Approved by:

Dalene C. Nickelson 10/27/05

Dalene Nickelson, Stoller Radiation Safety Officer (RSO) Date

Steve Brintzman for Joseph Gordon 10/27/05

Joseph Gordon, Stoller Project Director and alternate RSO Date

Linda Kaiser 10/27/05

Linda Kaiser, Project Quality Assurance Date

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List of Acronyms

CDOT	Colorado Department of Transportation
CDPHE	Colorado Department of Public Health and Environment
CEDE	committed effective dose equivalent
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CSM	Colorado School of Mines
CSMRI	Colorado School of Mines Research Institute
cy	cubic yard
DAC	derived air concentration
DOT	U.S. Department of Transportation
EPA	U.S. Environmental Protection Agency
GPS	global positioning system
LSA	low-specific activity
OSHA	Occupational Safety and Health Administration
PEL	Permissible Exposure Level
PPE	personal protective equipment
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RSO	Radiation Safety Officer
SOP	standard operating procedure
SSHSP	site-specific health and safety plan

1. Introduction

The S.M. Stoller Corporation (Stoller) on behalf of Colorado School of Mines (CSM) has prepared this work plan. This plan has been prepared for loading and transportation of 455 four-cubic-yard (cy) bags of radioactive/metals-contaminated soils to the BFI Foothills landfill. The total quantity of radioactive/metals-contaminated soils to be shipped for disposal is estimated to be 1,776 cy located at the CSMRI former Creekside site (Site).

1.1 Site Location

The Site is located near the School's baseball field and is defined by the fenced area north of the intersection of Birch and 12th Streets in Golden, Colorado. An 8-foot chain-link fence restricts access to the Site. The Site includes an area that was the location of a former settling pond. The pond was remediated and closed by the U.S. Environmental Protection Agency (EPA) in 1997, and this area is not part of the Site's investigative action. The radioactive/metals-contaminated soils are currently staged in the fenced area adjacent to the east side of the baseball field.

1.2 Site History

Numerous industrial mineral research projects involving materials that contained naturally occurring radionuclides and metals were undertaken on the Site from 1912 until about 1987. Sixteen buildings once occupied the six-acre Site that is located on the south bank of Clear Creek near CSM. The Colorado Department of Public Health and Environment (CDPHE) has issued a Radioactive Materials License (License) to CSMRI for the Site (License No. RML #617-01). The License authorizes storage of "naturally occurring, source, and byproduct radionuclides."

In 1992, a City of Golden water main broke and released water into an inactive settling pond on the Site. This prompted the EPA to undertake an emergency removal action pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). This activity involved the excavation of 22,000 cy of soil from the vicinity of the pond. The material was later disposed as a "special solid waste" at a local solid waste landfill. The EPA removal action ended in 1997.

All of the aboveground structures on the Site have been removed, including concrete slabs, asphalt-paved areas, and subsurface footers for some of the buildings.

Numerous environmental assessments of the CSMRI Site have been accomplished. Some assessments show that material with levels of radionuclides and/or metals above background remain in locations at the CSMRI Site. Where these materials are present, they are part of naturally occurring decay chains and minerals.

In 2002, CSM contracted with New Horizons Environmental Consultants Inc. (New Horizons) to provide surface and subsurface sampling and analysis of the Site and to generate a Remedial Investigation/ Feasibility Study report (RI/FS). New Horizons also assisted with the production of a Record of Decision (ROD) for the Site. This work constituted Phase I of the environmental assessment and response work.

In 2004, New Horizons was selected to identify, excavate, and dispose of contaminated soils at the Site. Fieldwork began in April 2004. This fieldwork constituted Phase II of the

environmental assessment and response. By May 2004, it was apparent that excavated soil volumes exceeded previously estimated volumes. Work was halted and the Site stabilized.

During the 2004 remediation work, approximately 1,870 cy of radioactive/metals-contaminated soil were excavated, bagged, and staged on the Site by New Horizons. At the time of New Horizons contract termination in Fall 2004, an estimated 100 cy of the radioactive/metals-contaminated soils had been shipped from the Site for disposal leaving an estimated 1,776 cy remaining for transport and disposal.

In December 2004, Stoller collected representative soil samples from a portion of the 455 super-sack containers staged at the Site to generate a legitimate data set to evaluate potential disposal options of the containerized material. Results were submitted to the CDPHE for review in the April 2005 report, *Dose Assessment for the Emplacement of the CSMRI Site Containerized and Remaining Subsurface Soil into a RCRA Subtitle D Solid Waste Landfill* (Stoller 2005). After review of the dose assessment report, the CDPHE approved shipment of radioactive/metals-contaminated soils and similar soils to a solid waste landfill in a letter dated August 26, 2005.

1.3 CDOT Permits

In February 2004, New Horizons constructed a road at the western end of the project site to access westbound Highway 6. The access road was constructed in accordance with Colorado Department of Transportation (CDOT) Permit No. 603100. Stoller has applied for a new permit from CDOT to use this existing access road.

After the Site characterization is complete, a remediation alternative will be chosen that may involve transportation of additional material from the Site. Upon completion of the Site investigation and remediation, Stoller will coordinate with CDOT for the permanent closure of the access road, including obliteration of the access lane on Highway 6, fencing off the project site from the access road, replacement of the guardrail, and re-grading and revegetating to pre-construction conditions.

1.4 Personnel Responsibilities

Steve Brinkman will perform overall project management duties for the bag removal. As Stoller's Project Manager, Mr. Brinkman will be responsible for coordination with the School. Mr. Brinkman will supervise Stoller's Onsite Project Supervisor to ensure that all work complies with the work plan and all conditions of Stoller's Radioactive Materials License, including the following elements:

- Ensuring that no employee exceeds annual occupational dose or intake exceeding 10 percent of applicable regulations. This will be accomplished by monitoring the dose rate using a Ludlum Model 19 Micro R meter, as detailed in section 3.2. Monitoring will continue for the duration of the radioactive/metals-contaminated soils disposal operation.
- Ensuring that criteria for requiring air sampling and sample analysis for breathing zone air monitoring are established.
- Ensuring that release criteria for contamination on persons and equipment leaving the work site are met.

- Ensuring that survey methods and analytical requirements are appropriate and achieve the established intent.
- Ensuring that technical specifications and capabilities of survey instrumentation and equipment achieve project goals.
- Ensuring that analytical requirements for the analysis of samples are met.

Dalene Nickelson is the Radiation Safety Officer (RSO) designated under Stoller's Radioactive Materials License issued by CDPHE (RML #1094-01), and Joe Gordon is the designated alternate RSO. One of these individuals will be onsite periodically during field activities and will be on call at all times. These individuals are responsible for ensuring compliance with the terms of the radioactive materials license and compliance with appropriate radiological controls at the Site.

Michael (Harry) Bolton has been designated the Onsite Project Supervisor and will be available onsite from start-up to completion, assuring continuity of services and facilitating communications with the School. Mr. Bolton's responsibilities will include ensuring day-to-day compliance with the work plan and coordination between Stoller personnel and subcontractors. Mr. Bolton will be responsible for health and safety in accordance with the site-specific health and safety plan (SSHSP) and conducting daily toolbox safety meetings.

Nick Malczyk will be responsible for ensuring materials handling is performed in compliance with the work plan and materials transportation plan, including record keeping. In addition, Mr. Malczyk will share responsibilities for health and safety in accordance with the SSHSP and conducting daily toolbox safety meetings.

Recycled Materials Inc. will be responsible for the loading and transportation of radioactive/ metals-contaminated soils and construction debris for disposal.

1.5 Scope of Work

The scope of work for this phase of the project includes the following tasks:

- Task 1 – Develop a health and safety plan and materials transportation plan for removal of radioactive/metals-contaminated soils currently staged at the Site
- Task 2 – Load and transport radioactive/metals-contaminated soils to the disposal facility
- Task 3 – Remove solid waste stockpiles from the Site
- Task 4 – Document and report transportation and disposal activities

2. Project Objectives and Approach

The objectives of this project are to remove the radioactive/metals-contaminated soils currently staged at the Site and transport the material to the BFI Foothills landfill facility. The goal is to load and transport the material in the safest manner possible and with a minimum amount of disturbance to residents in the surrounding neighborhood.

Stoller will load soil material into dump trucks or a suitable alternative using an articulated front-end loader or track excavator equipped with a thumb. Loading will require four trucks hauling for about six days, with a four-man team as ground support. Ground support will include an

operator for the loader or wheel loader, a health and safety supervisor, and two people taking notes, assisting the operator, providing dust suppression, and directing traffic as necessary. All four ground personnel will also be responsible for compliance with the materials transportation plan (Appendix A). The RSO will either be onsite or be in close communication with the ground support team.

Empty trucks will travel south from the landfill on Highway 93 and will continue south on Highway 6 until turning east on 19th Street. They will continue on 19th Street to Illinois Street, where they will turn north to 12th Street to access the Site. Once loaded with soil, trucks will exit the Site by use of the dirt road to the paved Highway 6 (6th Avenue) access ramp. One-way truck traffic will be maintained onsite. The number of trucks may be increased or decreased as necessary. The shipments will be treated as a bulk shipment during transport and disposal. Therefore, the integrity of the bags themselves will not be considered crucial during loading.

The soil material will be transported in dump trucks, eliminating the need for landfill-based ground support. Trucks will enter the landfill, follow direction to the disposal site, and dump their loads. Trucks will then exit the landfill and return to the Site for reloading. The location of the CSMRI material in the landfill will be recorded daily by the Project Manager, Steve Brinkman, using a handheld global positioning system (GPS).

A final waste disposition report will be prepared that identifies the weight and date of each shipment. Field radiological survey information will be included, as will landfill receipt tickets showing the weights for each load, shipping papers, and the location of the material in the landfill.

3. Health and Safety Control

The SSHSP, approved by the RSO, is provided in Appendix B. The engineering controls and personnel protection and monitoring practices to ensure worker safety during the radioactive/ metals-contaminated soils removal activities are detailed in the following subsections. The RSO will either be onsite during field activities or be in close contact by telephone. All Site workers and visitors will be briefed on the SSHSP, including specifics on radiological protection and control, prior to entering the Site. Records of the training will be kept onsite.

3.1 Work Area Air Monitoring

Perimeter Site air samples will be collected to determine if air quality standards for radionuclides are maintained during the field operations. These air monitors will be operated on a continuous basis to monitor air quality in the vicinity of the Site. Air monitoring will be conducted in accordance with SOP-RAD-018, *Long-Lived Airborne Radioparticulate Surveys*. Airborne radioactivity samples will be obtained on a 47-millimeter diameter glass fiber filter at a sampling rate of 60 to 80 liters per minute, with monthly or weekly filter sampling as described below. Two air monitoring stations are located at approximately the east and west boundaries of the Site. These monitoring stations have been in continuous operation since February 2005, and monthly sampling results are available showing Site background air quality. Two additional monitoring stations will be added during field activities and will be located immediately adjacent to the work zone in the downwind direction. These samplers will have filters exchanged on a

weekly basis. The Health and Safety manager will oversee placement of these samplers based on wind direction

Engineering controls will be used to minimize dust generation during field activities. Water from fire hydrants will be used as a dust suppressant during bag loading. Wind speed and direction will be monitored, and when windy conditions are creating visible dust that cannot be adequately controlled using water, then the Onsite Project Supervisor will shut down field activities and notify the RSO.

Based on the maximum Site metals concentrations presented in the RI/FS, calculations (provided in the SSHSP) show that air concentrations of metals will not exceed permissible exposure levels (PELs) published by the Occupational Safety and Health Administration (OSHA), assuming adequate dust suppression water is used. No perimeter or personal air samples will be analyzed for metals, based on this determination.

The need for personnel radiological air sampling was evaluated by calculating the required soil concentration for each isotope of interest that, if resuspended, would equate to a 40 derived air concentration (DAC)-hr exposure during the expected time period that a worker would be on the project. The time required to receive a committed effective dose equivalent (CEDE) of 25 mrem (assuming member of the public) for each of the radionuclides, using their maximum concentrations and assuming complete resuspension, was calculated. This calculation is conservative, as the Site personnel are subject to the occupational dose limit of 100 mrem. Based on this calculation (provided in the SSHSP), personnel air monitoring is not required for these radionuclides.

3.2 Work Area Dose Rate Monitoring

Work areas will be monitored daily for ionizing radiation. Monitoring will be performed using a Ludlum Model 19 MicroR meter. Occupational exposure monitoring for external radiation is required if a worker is likely to exceed 500 mrem per year from sources external to the body, per 6 CCR 1007-1, Part 4. Stoller has established a limit of 100 mrem per year in accordance with the company Radiation Protection Program. These limits are not anticipated to be exceeded on this Site; therefore, personal dosimetry will not be required. Dose rates will be monitored hourly in the work areas and recorded on a tracking sheet. Work duration will also be recorded for each site worker to determine total dose rates. If area dose surveys indicate that personnel may receive a dose greater than 100 mrem/year, a dosimetry program will be implemented. Technical specifications and capabilities of the survey instrumentation and equipment are included in Appendix C.

3.3 Radiological Contamination Control Procedures

All vehicles entering and leaving the Site will be surveyed to verify that they are free of radioactive contamination. Surveys will be documented on appropriate survey forms. If a vehicle has excessive dirt on the outside, it may be cleaned and dried prior to the survey being performed. A hand-held alpha/beta scintillator probe such as a Ludlum Model 43-89 in conjunction with a Ludlum Model 2360 alpha/beta scaler/ratemeter will be used for frisking and general surveys. A dual alpha/beta scintillation counter, such as a Ludlum Model 2929 with a Model 43-10-1 detector, will be used onsite to count swipes and air-monitoring samples. The

alpha/beta scintillation probe will be used to survey exterior surfaces (e.g., tires, cab floors, and excavation attachments) for total (fixed plus removable) contamination. Smears will also be taken from the surfaces in accordance with SOP-RAD-002, *Swipe Sample Collection* and counted for alpha and beta activity if the total measured activity is greater than the limit for removable contamination. The U.S. Department of Transportation (DOT) release criteria for removable contamination are shown in Table 3-1. Equipment with contamination above this level will be decontaminated until they are below this level.

Table 3-1
Department of Transportation Removable External Contamination Limits

Contaminant	Maximum Limit* (dpm/cm^2)	Maximum Limit ($dpm/100\ cm^2$)
Alpha-emitting radionuclides	2.2	220
Beta and gamma emitters	22	2,200

*From 6 CCR 1007-1 Part 17, Section 17.15.18.1 Table 3. Equivalent to DOT limits in 49 CFR Part 173.443 when the 0.10 swiping efficiency is included.

All personnel and equipment leaving the contaminated area of the work site will be thoroughly surveyed for contamination. Levels of contamination listed in Table 3-2 must be met prior to being released from the area. Personnel frisking will be performed after removal of protective clothing. Personal items, such as notebooks, papers, and pens, will be subject to the same frisking requirements. Personnel shall be frisked after leaving the excavation area prior to leaving the Site. Instructions for personnel frisking will be posted adjacent to frisking instruments. Personnel found with detectable contamination on their skin or clothing will be promptly decontaminated. Contaminated equipment may be decontaminated or disposed.

Table 3-2
Total and Removable Contamination Limits for Unrestricted Release

Contamination Type	Removable ($dpm/100\ cm^2$)	Total (fixed + removable) ($dpm/100\ cm^2$)
Gross alpha	20	100 avg, 300 max
Gross beta	1,000	5,000 avg, 15,000 max

From U.S. Nuclear Regulatory Commission Regulatory Guide 1.86, based on most restrictive alpha limits (Ra-226, Ra-228, Th-230, Th-228)

Instrument calibration and performance testing requirements for the survey instruments are provided in the standard operating procedures (SOPs) for the instruments. Equations to calculate detection limits and convert these limits to count rates are also provided in the SOPs. Technical specifications and capabilities of the survey instrumentation and equipment are included in Appendix C, and SOPs are provided in Appendix D.

All radiological surveys shall be documented on a radiological survey form. Survey forms will be kept onsite and at the end of the project they will be archived in the Stoller project file. Example survey forms are provided in Appendix E. The following information shall be recorded, at a minimum:

- Equipment identification in sufficient detail to make the record unique (i.e., description, serial number, license plate number, etc.)
- Model and serial numbers of survey instrument(s)
- Name of person performing the survey
- A sketch of the equipment or digital photo showing survey and/or smear locations, as applicable
- Date and time of the survey

If surveys indicate that a vehicle or piece of equipment is contaminated greater than the limits, it shall be decontaminated and resurveyed. The repeat survey shall be recorded on a separate survey form.

3.4 Personal Protective Equipment

Personnel working on the Site will wear sturdy, over-the ankle leather boots, a high-visibility safety vest, and safety glasses. In addition, personnel working directly with the soil bag opening and loading will wear Tyvek, boot covers, and gloves (nitrile, latex, or equivalent). Contamination control personal protective equipment (PPE) will be doffed prior to exiting the established work site.

3.5 Decontamination Procedures

Prior to release from the Site, heavy equipment will be cleaned using dry and/or wet decontamination procedures. Excessively dirty equipment will be cleaned by brushing or scraping excess soil from the equipment. This technique should be used only when the soil is wet or damp to prevent an airborne dust hazard. Following initial cleaning, Site water (fire hydrant) may be used for wet decontamination. Equipment will be positioned in the designated decontamination area during the cleaning process. Radiological surveys will be performed on the equipment as described in Section 3.3. Good housekeeping will be emphasized onsite to assist in keeping contaminated material controlled.

4. Field Activities Work Plan

This section describes the technical and field procedures Stoller proposes to employ in the field to complete each of the work tasks. This section includes a detailed description of the equipment and personnel resources that will be used for loading, transportation, disposal, and documentation of the removal of the radioactive/metals-contaminated soils from the Site.

4.1 Task 1 - Plan Development

In addition to this work plan, Stoller has prepared a detailed materials transportation plan (Appendix A) and a SSHSP (Appendix B).

The materials transportation plan addresses the specifics of how the materials will be transported to the disposal facility, including transportation routes, material classification, transport protocols, general transportation guidelines, and emergency notifications.

The SSHSP will be used during all Stoller and subcontractor field operations and will be used with this work plan for project-specific activities. The objective of the SSHSP will be to provide guidance to maintain safe working conditions at the Site. The SSHSP will address personnel

responsibilities and include a job hazard analysis, Site and personnel monitoring requirements, training requirements, PPE, Site controls, accident prevention, decontamination procedures, and record keeping. All Site workers, during site-specific training, will review and sign the SSHSP. All work activities will be conducted to reduce or eliminate, to the extent possible by planning and managing, those conditions that might be harmful to project personnel. Worker protection is a major consideration in project design and is essential during the execution of planned field activities.

4.2 Task 2 - Load and Transport Radioactive/Metals-Contaminated Soil to Disposal Facility

4.2.1 Project Mobilization

Mobilization of personnel, equipment, and materials is described in this section. Mobilization will include establishment of work zones, material and equipment staging areas, and construction of any earthen ramps that may help in the loading of bulk soil into trucks.

Stoller will be responsible for Site security throughout the life of the project. Stoller and subcontractor personnel will produce proper identification upon request. A log will be maintained onsite for all personnel and equipment entering and leaving the Site. A list of authorized personnel will be provided to CSM prior to the initiation of mobilization activities. Visitors will not be allowed onsite without the approval of the CSM. Approved visitors will be required to read and sign the SSHSP.

Mobile telephones will be provided and carried by designated field personnel. Bottled drinking water and fire extinguishers will be maintained on site. Temporary sanitary facilities will be established and maintained adjacent to the work area.

As necessary, a decontamination area will be designated in an area of the Site that will be included in the subsequent Site characterization.

Equipment and material laydown and storage areas will be established at the Site. All materials and equipment will be stored in accordance with manufacturer specifications to prevent damage, disfigurement, etc. Secondary containment will be provided for materials, chemicals, or equipment that may cause environmental damage. These areas will be kept clean and maintained on an as-needed basis.

4.2.2 Materials and Equipment

The following equipment may be mobilized to the CSMRI Creekside Site:

- One articulated wheel loader or track excavator equipped with a thumb - used for bulk loading radioactive/metals-contaminated soils into dump trucks and to shuttle materials around the Site as needed.
- One water meter and fire hose - application of water to work areas as needed during truck loading activities for dust control and equipment decontamination.
- One diesel-fueled generator - a 35-kilowatt generator will be used to supply electrical power for general electrical needs during field activities.

- Four dump trucks - transporting radioactive/metals-contaminated soils from staging area to disposal facility.
- One mobile storage unit - secured storage container for tools and equipment used during the project.
- Radiation survey instrument(s) - conduct radiation monitoring of personnel, transport vehicles, and work areas during loadout and screen equipment leaving Site.
- One designated vehicle with emergency supplies - designated Stoller vehicle supplied with first aid equipment, to be used only in the event of an emergency.
- One handheld GPS - determination of location and elevation of bulk soil shipments at the disposal facility.
- Portable sanitary facility

Miscellaneous equipment may include fire extinguishers, 4-mil poly sheeting, hand tools, slings, PPE, emergency eye wash stations, air horns, first aid equipment, water tanks, mobile telephones, Nextel walkie-talkies, and portable toilets.

4.2.3 Loading, Transport, and Disposal of Radioactive/Metals-Contaminated Soils

Stoller will load bags into 20-yard highway dump trucks using a loader or excavator. Because the soil contained inside the bags will be shipped as a bulk shipment, bags will be broken open using the loader or intentionally cut open with a utility (or similar) knife, whichever is determined to be more protective of the employee and environment. Intentionally opening the bags prior to loading minimizes the safety risks of loading whole bags, which are heavy and unstable.

Loading activities will require a minimum of four trucks hauling for about six days, with a four-man team as ground support. The ground support crew will include Stoller personnel and Stoller subcontractors who will be present during loading activities. These personnel will assist the equipment operators and provide health and safety oversight. Duties will include acting as spotters for heavy equipment operators, providing dust suppression, record keeping, general labor, Site and traffic control, and personnel and environmental monitoring.

During loading, the bags will be misted with water as necessary to eliminate wind blown dust from escaping the immediate work area. Water will be supplied from one of two fire hydrants located on the Site. Fire hydrants will be metered using a City of Golden water meter and cost reimbursed as required.

Prior to loading soil, the rear of the truck bed will be diapered by placing plastic sheeting inside the truck bed across the rear gate to prevent soil from leaking during transport. Placement of the plastic sheeting over the tailgates will be completed by attaching two corners of the plastic to two sufficiently long poles and lifting the plastic into place. The pole can be leaned against the rear of the truck to support the plastic while soil is placed in the truck. Once the truck is filled the poles will be pulled free of the plastic. Stepladders will be on site and used as necessary to support the plastic placement as necessary. After soil loading has been completed, a tarp will be placed over the bed of the dump truck. The bed of the truck will remain covered at all times when not loading or offloading. Before the truck is permitted to leave the Site, it will be visually inspected and any loose soil observed during inspection removed. Trucks will be monitored for

removable contamination and radiation dose rate as specified in the materials transportation plan. These surveys are not a regulatory requirement, but will be conducted using DOT and CDPHE regulations for low-specific activity (LSA) radioactive materials as a guideline.

The empty trucks will enter and exit the Site in accordance with the materials transportation plan. One-way traffic will be maintained by dump trucks entering and leaving the Site. The number of trucks may be increased or decreased as necessary. All material handling and transportation will be conducted in accordance with the approved materials transportation plan.

The containerized material will be transported in dump trucks, eliminating the need for a landfill-based ground support. However, at the start of each day, a Stoller employee will be designated to go to the disposal facility and show the truck drivers where that day's loads will be offloaded. This will ensure that soil is placed in the portion of the disposal facility that will have the most cover placed on top. Employees and subcontracted truck drivers will follow all health and safety protocols and other Site requirements established by the disposal facility.

Trucks will enter the landfill, be weighed at the facility's scales, and follow Stoller's directions to that day's disposal area (first load each day) and dump their loads. Trucks will then exit the landfill and return to the Site for reloading. The location of the soil placed in the landfill will be recorded each day using a handheld GPS to record the general location and elevation of each day's shipments. Stoller personnel and truck drivers will remain in their vehicles at all times while on the landfill property.

After the soil-loading activities are complete, the heavy equipment used during loading operations will be radiologically surveyed prior to leaving the Site and decontaminated, as necessary, as described in Section 3.5.

4.3 Task 3 - Remove Solid Waste Stockpiles from Site

Stoller will load the stockpiled construction debris into 20-yard highway dump trucks using an articulated front-end loader with a 4-cy bucket. Loading activities will require one truck hauling for one day, with a four-man team as ground support. The ground support crew will include Stoller personnel and Stoller subcontractors and be present during loading activities. These personnel will assist the equipment operators and provide health and safety oversight. Duties will include acting as spotters for heavy equipment operators, providing dust suppression, record keeping, general labor, Site and traffic control, and personnel and environmental monitoring.

Empty drums and debris such as metal, wood, plastic, and vegetation may be placed in rolloff boxes or loaded directly into dump trucks and transported for disposal. During loading, the construction debris may be misted with water as necessary to minimize wind blown dust from escaping the immediate work area. Water will be supplied from one of two fire hydrants located on the Site. Fire hydrants will be metered using a City of Golden water meter and cost reimbursed as required. After loading has been completed, a tarp will be placed over the bed of the dump truck. Before the truck is permitted to leave the Site, it will be visually inspected and any loose debris observed on the exterior of the truck will be removed. The truck will then proceed to the solid waste landfill as directed by the field supervisor.

4.4 Task 4 - Document and Report Transportation and Disposal Activities

Recordkeeping is an integral part of this soil removal and transportation project and as such Stoller will record each load on a Truck Departure Record Form (Appendix F). Weigh tickets from each truckload as well as Site control logs, radiation surveys, and daily safety meeting attendance will be recorded. Daily project activities will be documented photographically and activities recorded in a field notebook.

A final report will be submitted in draft to CSM with a final report to CDPHE that documents the radioactive/metals-contaminated soils disposal activities.

Colorado School of Mines Research Institute
Materials Transportation Plan

Revision 2

Prepared for:

Colorado School of Mines
Golden, Colorado

Prepared by:

S. M. Stoller Corporation
Lafayette, Colorado

November 3, 2005

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1. Introduction

As part of the site environmental assessment project at the Colorado School of Mines Research Institute (CSMRI) facility located in Golden, Colorado (Site), solid waste materials consisting of radioactive/metals-contaminated soils in bulk quantity will be transported over public roadways to disposal facilities. This materials transportation plan (MTP) describes the classification of material(s) to be transported, specifies the transportation guidelines for the material(s), and details the emergency response plan for material(s) in transit.

2. Material Classification

The type of material to be transported from the Site is limited to solid waste, principally radioactive/metals-contaminated soils resulting from industrial operations. Materials to be transported from the CSMRI Site are classified as solid waste as defined in 6 CCR 1007-2, section 1.2.

This material is classified as industrial waste, which is solid waste, including materials resulting from the mineral research activities, that is not hazardous waste. In addition to metals, the waste contains radioactive isotopes at low concentrations that are not classified as radioactive material under U.S. Department of Transportation (DOT) regulations in 49 CFR Parts 173.403 and 173.436. Attachment 1 provides the basis for the determination that the waste materials are below DOT limits for radioactive material.

3. Disposal Facilities

During this project, more than one disposal facility may be used. Table 3-1 will be updated to include information on the disposal facilities receiving material from the Site. BFI's Foothills facility will receive the initial soil shipment. Driving maps to and from each facility are provided as Attachment 2.

Table 3-1
Disposal Facilities

Facility Name	Address	Contact Person	Phone Number
BFI Foothills Landfill	8900 Hwy 93 Golden, CO	Jill Nelson	303-279-2344

4. Transport Guidelines

This MTP establishes guidelines for the packaging and transportation of the radioactive/metals-contaminated soils that are intended to minimize potential occupational and public exposures. These include requirements for shipping papers, loading, transporting, and radiological protection to ensure that potential exposures remain As Low As Reasonably Achievable (ALARA). General transportation guidelines established in this MTP apply to all excavated soil material shipments and are listed below.

4.1 Shipping Papers

Each radioactive/metals-contaminated soils shipment shall be accompanied by shipping papers that include, at a minimum, the following information:

- Name and address of the shipper, carrier, and destination
- Emergency contacts and a 24-hour emergency phone number for the shipper
- A detailed description of the material
- Total quantity of material in the shipment
- Certification by the carrier that the shipment conforms to DOT requirements

4.2 Loading and Transporting Guidelines

The following general guidelines will apply to all radioactive/metals-contaminated soils shipments:

- All initial, intermediate, and final loading operations will be carried out under the direction of Stoller by personnel trained and appropriately equipped for the material type.
- All unloading operations will be carried out under the supervision of disposal facility personnel who have been trained on the safe handling of the material.
- All shipments will be by closed or covered transport vehicle.
- There must be no leakage of material from the vehicle.
- All shipments will be made in accordance with the project Colorado Department of Transportation (CDOT) permit.
- In the event a truck breaks down on the haul route, it will be dealt with immediately. The carrier will have a current contract with a towing firm capable of towing loaded trucks.
- Carrier personnel shall ensure that daily DOT vehicle inspections are performed and documented prior to loading the trucks. Documentation shall be maintained by the carrier personnel.
- Carrier personnel shall check truck beds daily to ensure that no holes or cracks exist that could facilitate a release of material while the truck is in transit.
- Carrier personnel will inspect tailgate linkages daily (clevises, pins, hardware, etc.) to ensure proper fit and adjustment. Tailgate gaps between dump body and tailgate shall not exceed one-quarter inch.
- Truck tailgates shall be diapered with a minimum single sheet of 4-mil plastic overlapping 4 feet on the dump bed bottom and 2 feet on the dump bed sides. After the truck is loaded, the diaper shall be tucked inside the bed.
- Drivers shall not stop at any location with a haul truck en route to or from the disposal site.
- Dust suppression techniques shall be used when loading the material.
- The carrier shall have radio or cellular communications in every vehicle so that contact can be made in case of an emergency or breakdown.
- Posted speed limits and all vehicle laws shall be followed at all times.
- All personnel in a vehicle shall wear seat belts at all times.

4.3 Radiological Protection Guidelines

Transportation of radioactive/metals-contaminated soils does not require limitations on radiation control; however, in an effort to transport Site radioactive/metals-contaminated soils in the safest and most health protective manner, Stoller has developed work practices to ensure that potential exposures remain ALARA. Work controls and good housekeeping practices will be used, including ensuring the trucks do not drive through radioactive/metals-contaminated soils and

and decontaminating the truck exteriors with water as necessary after loading. In addition, radiation surveys will be conducted to measure external contamination and radiation dose rates. While not required, these surveys will use limits set forth in DOT and State of Colorado regulations for transportation of low-specific activity (LSA) materials as guidelines, as defined in Table 4-1. All surveys shall be documented on appropriate survey forms.

Table 4-1
Department of Transportation Removable External Contamination Limits

Contaminant	Maximum Limit* (dpm/cm^2)	Maximum Limit ($dpm/100\ cm^2$)
Alpha-emitting radionuclides	2.2	220
Beta and gamma emitters	22	2,200

*From 6 CCR 1007-1 Part 17, Section 17.15.18.1 Table 3. Equivalent to DOT limits in 49 CFR Part 173.443 when the 0.10 swiping efficiency is included.

Prior to filled trucks leaving the Site, the following practices will be followed:

- Verify that the truck tailgate liner is in place and the load is covered.
- Visually verify that no waste materials are on the exterior of the truck, including the tires; decontaminate using water from hydrant as necessary.
- Survey the exterior of the truck, using wipe samples in representative locations, to verify that removable contamination is less than or equal to the limits in Table 4-1.
- Survey the exterior of the truck using a radiation dose rate meter to verify that the dose rate does not exceed 200 mrem/hr at any point on the external surface and does not exceed 10 mrem/hr at a distance of 1 meter (also referred to as the transport index not exceeding 10.) [49 CFR Section 173.441(a) and 6 CCR 1007-1 Section 17.15.9]

After each use, empty trucks will be surveyed upon return to the Site as follows:

- Survey the accessible surfaces to verify that dose rate does not exceed 0.5 mrem/hr and there is no significant removable contamination (meets limits in Table 4-1.) [49 CFR Section 173.443(c)]

Prior to releasing empty trucks at the end of each day and end of the job:

- Visually verify that no waste materials are on the exterior of the truck or in the interior of the bed, and decontaminate using water from hydrant as necessary.
- When releasing empty trucks at the end of a day that will be reused on the project the following day, the interior truck bed may be covered instead of decontaminated.
- When releasing empty trucks that will not be reused on the project, survey the accessible surfaces to verify that dose rate does not exceed 0.5 mrem/hr, and there is no significant removable contamination (meets limits in Table 4-1) [49CFR Section 173.443(c)]

The radioactive/metals-contaminated soils loading equipment will also be decontaminated and surveyed prior to releasing it from the job site.

5. Emergency Response

Emergency response procedures for potential transportation accidents or radioactive/metals-contaminated soils on the public highways are listed below. This procedure does not include response actions for accidents and spills that occur on the CSMRI Site. Response activities on the CSMRI Site are covered in the site-specific health and safety plan, with Stoller personnel considered the principal respondents for access road incidents.

The carrier has the primary responsibility for response operations in the event of an accident and/or spill occurs during the transportation of radioactive/metals-contaminated soils. Stoller personnel will respond with specialized equipment and trained personnel to assist in the prompt retrieval of any material spilled at the incident site. General carrier responsibilities are listed below, followed by the Stoller response guidelines.

5.1 Carrier's Responsibilities

The carrier will be responsible for the following items.

5.1.1 Preparation of Response Plan

The carrier must have a response plan in place for potential accidents and/or spills that may occur during radioactive/metals-contaminated soils transport. The carrier is responsible for providing sufficient labor and equipment to mount an effective response to any spill, including reportable quantity (RQ) spills. The carrier must also have access to external services for responding to potential spills and accidents that exceed the carrier's own internal resources. These external services must be listed in the carrier's emergency response plan. The selected carrier must submit a copy of its emergency response plan for solid materials transport under this procedure.

5.1.2 Emergency Notifications

The carrier must immediately notify the following specific entities, in addition to local emergency responders, if a material spill occurs during transportation:

- The DOT at (800) 424-8802
- The Contractor at the Emergency Contact numbers listed on the shipping papers and/or the "Driver Emergency Notification Procedure" form

Within 30 days of the occurrence, the carrier will also report the incident to the DOT on Form F 5800.1.

5.1.3 Emergency Response Training

The driver of any vehicle involved in a spill of radioactive/metals-contaminated soils must be trained and equipped to fulfill the following requirements:

- Provide notification to internal dispatch, local authorities, and Stoller personnel, as necessary.
- Provide area control and the preliminary containment of spilled materials.

A description of the material being shipped and emergency response information relevant to that specific material is included in the emergency response information packet supplied with each shipment.

5.2 Contractor's Responsibilities

Stoller's response to any transportation incident that involves a spill of radioactive/metals-contaminated soils will proceed in three phases described in the following subsections.

5.2.1 Emergency Notifications

The first person at the CSMRI Site or disposal/recycling facility who receives notification of a potential spill of radioactive/metals-contaminated soils will immediately notify Stoller Project Manager and the site Radiation Safety Officer (RSO). The Stoller Project Manager will act as the Emergency Coordinator during transportation incidents. Alternate Emergency Coordinators include the Site Health and Safety Officer (HSO) and the CSMRI Project Manager. The Project Manager or RSO will immediately contact the CSMRI Project Manager, and the situation will be evaluated to determine the necessity of field response operations by Stoller or carrier personnel, and the appropriate level of government agency notification. The CSMRI Project Manager will subsequently notify other officials and the agencies identified in the following table (as appropriate).

Table 5-1
Emergency Contact Information

Agency	Department	Telephone
Colorado Department of Public Health and Environment	Emergency Management Unit	(303) 756-4455
Colorado Department of Public Health and Environment	Hazardous Materials and Waste Management Division	(303) 293-1788
Colorado Emergency Operations Center	Emergency	(303) 279-8855

The Stoller Project Manager will notify and assemble the appropriate technical staff personnel for field response operations, if warranted by the ongoing incident evaluation. The Project Manager and RSO will arrange for effective alternate coverage of their area of responsibility during scheduled, or unscheduled, periods of absence. The Project Manager shall ensure that the training level of alternates will be suitable to effectively discharge the duties assigned them.

5.2.2 Response Personnel

Response operations by Stoller personnel are limited to the performance of specialized material surveillance and monitoring activities, affected area boundary establishment, area control, and tracking and oversight functions for both Stoller and non-Stoller response personnel and equipment, and the general public. The transporter is committed to rendering all possible technical assistance required for the prompt retrieval of spilled material and the restoration of affected areas to a level as close to original conditions as can be reasonably achieved.

Trained personnel will be available for response to transportation incidents. A Field Operations Outline, for use by the RSO or the designated Emergency Coordinator, is provided as Attachment 3.

5.2.3 Incident Review

Within 48 hours of an incident response, Stoller and the carrier will review operating methods, procedures, equipment, and training for adequacy of content and implementation. Changes will be made to any, or all, of these categories if indicated by the incident review. In addition, the field response team will review the actions taken during the incident response. This review will be documented and a report shall be issued to all involved and regulatory parties, which contains the findings and any applicable recommendations.

Within 30 days of an incident response, CSMRI, Stoller, the carrier, and relevant State and local agencies will review the incident and subsequent operations to determine if any corrective actions in planning or implementation are necessary. This review will be documented and a report shall be issued to CSM and CDPHE that contains the findings and any applicable recommendations.

Attachment 1
Determination that CSMRI Soils are not Radioactive Material per DOT Requirements

DOT definition of Radioactive Material is found at 49 CFR Part 173.403:
Radioactive Material means any material containing radionuclides where both the activity concentration and the total activity in the consignment exceed the values specified in the table in section 173.436 or values derived according to the instructions in section 173.433.

The following table lists the isotopes of concern at the Site, the mean and maximum activity concentrations (from risk assessment report), and the DOT limits from Section 173.436.

Isotope	mean + 95% UCL (pCi/g)	max sampled (pCi/g)	activity conc for exempt material (pCi/g)	activity limit for exempt consignment (Ci)	max pounds per exempt load
U-234	19.45	44.2	270	2.70E-07	30.60
U-235	1.13	2.71	270	2.70E-07	526.77
U-238	19.86	45.8	270	2.70E-07	29.97
Th-228	3.56	3.9	27	2.70E-07	167.21
Th-230	21.45	35.1	27	2.70E-07	27.75
Th-232	3.47	3.88	270	2.70E-07	171.54
Ra-226	27.96	43.9	270	2.70E-07	21.29
Ra-228	3.66	4.1	270	2.70E-06	1,626.37

Activity concentration limits:
The mean + 95% UCL is below the exemption limits for all isotopes. However, two individual samples were above the exemption limit for Thorium 230 (one at 35.1 and one at 27.5 pCi/g). Because the sample plan was designed to essentially sample bulk soil from a pile (as opposed to a percentage of containers in a population), using the mean to characterize the waste is appropriate. It should be noted that if we were shipping containers (bags) of waste, the two bags that were above the exemption limit could NOT be shipped as non-radioactive waste. However, as the bags will be broken open and we will be shipping bulk soils, using the mean is valid.

Total activity in consignment
Using the mean concentrations of the isotopes, we calculated the maximum number of pounds that would equal the exempt total curies. These are listed in the above table, and all are below what we would reasonably limit a load to.

Therefore, although the total activity in the consignment will exceed the limits, the activity concentrations are all exempt and thus this material is not Radioactive Material per DOT.

Attachment 2
Disposal Facility Driving Direction Maps

Attachment 2

Truck Route:
BFI to CSMRI Site

Explanation

Haul Route

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S

Stoller

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Attachment 3
Field Response Operations Outline

The following outline serves as a guideline for field response operations. Deviations from this outline may be warranted due to actual field conditions at the Site.

1. Determine necessity of field response operations during ongoing incident evaluation by the Emergency Coordinator (Project Manager) and/or the RSO.

2. The Project Manager will designate field response personnel who will collect field equipment and arrange transportation for use during the incident evaluation. The Project Manager may request additional equipment if field personnel deem it necessary.

3. The Emergency Coordinator will attempt to coordinate the field response efforts with any local emergency response agencies prior to the arrival of a field response team at the incident site.

4. All assembled response personnel will proceed to the incident site and report to the local Incident Command structure, if the incident evaluation indicates a field response is necessary. The Stoller Project Manager will assume Incident Command functions if no official command structure exists. As Incident Commander, the Stoller Project Manager will coordinate all response activities until relieved by a higher authority. In all cases, the Stoller Project Manager will coordinate field response activities with other responding personnel and/or official agencies.

5. All Stoller field response personnel shall receive training according to applicable regulatory requirements. Training topics and material may be revised at the discretion of the site RSO.

6. Trained field response personnel may provide the following functions, where necessary.

    - Area control and assistance in material containment.
    - Exposure monitoring for contaminants of concern.
    - Definition of the potential contamination area boundary.
    - Technical assistance for material control and remediation techniques.
    - Incident-related personnel and equipment tracking.

S.M. STOLLER CORPORATION
SITE-SPECIFIC HEALTH AND SAFETY PLAN

Project Location:	Colorado School of Mines Research Institute (CSMRI)
Task Name:	Bagged soil and debris loading and transportation
Duration of Activities:	Duration of contract. This HASP will be modified, as necessary, if new tasks are added.

APPROVALS

Title/Organization:	*Printed name:*	*Signature:*	*Date:*
Project Manager	Steve Brinkman		
Health and Safety Supervisor	Harry Bolton		
Health and Safety Manager/RSO	Dalene Nickelson		

SCOPE OF WORK

Breakdown and description of work activities:

1. Mobilize and establish work zones and equipment staging areas. Construct earthen ramps as necessary to facilitate truck loading.
2. Install plastic liners over dump truck tail gates.
3. Open soil bags using utility knife or loader.
4. Apply dust suppression water as required.
5. Load soil and stockpiled construction debris into trucks.
6. Cover trucks after loading.
7. Decontaminate exterior of trucks as necessary prior to shipping offsite.
8. Decontaminate loading equipment and dump trucks (interior of bed and exterior of truck) at completion of job.

Should any off-normal event occur, work will immediately stop and will not commence unless the hazards have been addressed and the necessary THA, procedure, or HASP modification completed.

PERSONNEL

Assigned Responsibility:	*Name and Organization:*	*Phone Number:*
Project Manager	Steve Brinkman	303-546-4388 office, 303-994-1883 cell
Assistant Project Manager	Harry Bolton	303-546-4351 office, 303-435-4872 cell
Health & Safety Supervisor	Harry Bolton	303-546-4351 office, 303-435-4872 cell
Radiation Safety Officer (RSO)	Dalene Nickelson	208-525-9358 office, 208-521-3693 cell
Alternate RSO	Joe Gordon	303-546-4318 office, 303-817-4884 cell

TASK HAZARD ANALYSIS

Task-specific hazard control measures are specified in each Task Hazard Analysis (THA). THAs have been developed for the following activities and are included as attachments. Activities with procedures have hazard abatement incorporated into the procedure and do not have THAs.	
Activities with a THA:	
General Maintenance	
General Site/Visitor	
Bagged Soil Disposal	

PERMITS

(Required permits must be signed before work commences.)

Permit:	No	Yes	Notes and Comments:
Hot Work	X		Hot work is not anticipated.
Rad Worker	X		Conditions identified onsite do not warrant this permit.
Confined Space	X		This type of work is not anticipated.
Lockout/Tagout	X		Most of the activities anticipated can be controlled by unplugging the cord. Any other electrical activities will be undertaken by a licensed electrician.
Excavation/Intrusive Soil Activity	X		Previously excavated soil will be loaded into trucks. No new excavation will be performed under this task.
Other:			

PERSONAL PROTECTIVE EQUIPMENT

The following personal protective equipment (PPE) will be used for the identified activities.

Activity	Head/Face	Foot	Hands	Respiratory	Clothing
Site preparation, general maintenance, and support functions	Safety glasses	Sturdy, over the ankle leather boots	Dedicated leather gloves when using tools	NA	Standard work clothing, high-visibility safety vest when heavy equipment is onsite

Load soil and debris into trucks	Safety glasses. Hearing protection as necessary.	Sturdy, over the ankle leather boots. Tyvek or latex boot covers	Synthetic gloves (nitrile) or dedicated leather gloves	NA	Standard work clothing, Tyvek suit, high-visibility safety vest
Dust suppression and decontamination	Safety glasses, face shield when spraying water	Sturdy, over the ankle leather boots. Latex boot covers	Synthetic gloves (nitrile), dedicated leather gloves when using tools	NA	Standard work clothing, Tyvek or coated Tyvek suit or rain suit, high-visibility safety vest
Visitor	Safety glasses	Sturdy, over the ankle leather boots	NA unless touching equipment	NA	Standard work clothing, high-visibility safety vest when heavy equipment is onsite

The following competent person certifies that a hazard assessment for the identified activities has been performed and the selection of PPE is based on best available information.

Printed Name:	Signature:	Date:
Dalene C. Nickelson		October 27, 2005

TASK HAZARD(S) SUMMARY

The potential health and safety hazards of these tasks are summarized below. The potential for encountering these hazards is ranked (high, medium, or low) based on the work to be performed and the hazard control measures to be used.

Summary	*Hazard Potential (High, medium, or low)*	*Description of potential hazards (List each potential hazard)*
☒ Safety *Walking and working surfaces, falls, power and hand tools, materials handling*	Medium	Slips, trips, or falls due to uneven walking surface or wet/snow/icy conditions, hand tool usage
☐ Utilities *Buried, overhead, or in general work area*	Low	

☐ Chemical *Identify chemicals of concern here, and attach MSDSs*	Low	
☒ Physical *Heat, cold, noise, radiological*	Medium	Radiological contamination from inhalation or skin contact. Data results indicate that rad concentrations in soil and air are sufficiently low that the PPE described for each task will eliminate exposure potential. Potential heat stress issues for personnel wearing Tyvek. Potential cold stress due to weather.
☒ Biological *Plants, animals, insects, spiders, infectious waste*	Medium	Spiders/insects may be present, and possibly animals such as raccoons, foxes, coyotes, and squirrels.
☒ Other - Heavy Equipment	Medium	Dump trucks and loader will be onsite. All personnel working in vicinity of heavy equipment will wear reflective safety vests and will act as spotters for equipment operators as necessary.

SITE MONITORING

(Task-specific monitoring requirements are identified below.)

Direct Reading Exposure Monitoring (to monitor potential worker exposure)

Activity(s)	*Instrument*	*Action Level(s) and Actions*	*Frequency*
Scanning trucks, equipment, and personnel monitoring	Ludlum Model 19 MicroR dose rate survey instrument (or similar). Alpha/beta scintillation probe with rate meter/scaler for contamination surveys	Monitoring to be conducted periodically/as needed to evaluate site conditions and keep personnel exposures as low as reasonably achievable. Dose rates will be tracked hourly and used with personnel work durations to ensure personnel exposure remains below 100 mrem/yr.	All personnel and equipment leaving contamination area must be surveyed. All trucks will be surveyed prior to leaving site.

Integrated Personal Air Monitoring (full-shift worker exposure sampling and/or analysis)

Activity(s)	*Contaminant*	*Method*	*Frequency*
This will be conducted should sample results indicate airborne material is present			
Comments or special instructions:	Metals: lead, arsenic, mercury Radionuclides: radium, thorium, uranium	Using maximum site concentrations of metals and radionuclides from RI/FS, calculations show no personal air monitoring will be required (see attached analyses).	Metals: lead, arsenic, mercury Radionuclides: radium, thorium, uranium

Perimeter or Work Area Monitoring (ambient work area or fence line monitoring)			
Activity(s) /Location	***Contaminant(s)***	***Method***	***Frequency***
Perimeter air monitoring stations will be operated at the site. Two are run throughout the contract period (sampled quarterly) and two additional monitors will be used during bag disposal (sampled weekly).	Radionuclides	Filters counted for gross alpha/beta onsite. Filters sent to offsite laboratory for isotopic analysis if gross alpha/beta above action level specified in work plan.	Weekly during bag disposal; monthly during remainder of contract
Comments or special instructions: Operations will be evaluated by site supervisor when wind speeds exceed 20 mph as determined by onsite anemometer reading or local weather stations. If dust cannot be adequately controlled by dust suppression water, activities will be shut down.			

SITE CONTROL

(Task-specific site control measures are specified below)

Site Control for General Work Area(s)	
Location	***Site Control Procedure (discuss important elements such as signs, barricades, fencing, briefings, sign-in/out logs, etc)***
	Individual time in the work area will be documented in log books or a sign-in log. A tailgate meeting will be completed for activities conducted at the site on a daily basis. The work area is fenced.
Site Control for Potentially Contaminated Area(s)	
Location	***Site Control Procedure (discuss important elements such as signs, barricades, briefings, qualifications, required supplies and equipment, sign-in/out logs, etc.)***
Support Zone	The work area is fenced and posted.
Contamination Reduction Zone	NA
Exclusion Zone	NA

DECONTAMINATION

(Required decontamination procedures are described below)

Type of decontamination	***Identify activity(s) requiring decontamination and describe decontamination steps, location, required equipment, and collection and disposal of potentially contaminated liquids and solids.***
Personnel decontamination	Proper doffing and disposal of booties, gloves, and Tyvek as sanitary waste.
Equipment decontamination	Trucks will be visually inspected to ensure the exterior is free from waste material. Trucks will be decontaminated using water from a hydrant as necessary. At the end of the project, the loader and the interior of the truck beds will also be decontaminated with water from a hydrant as necessary.
Other:	Radiological surveys will be conducted on all personnel and equipment leaving the contamination area, and on all trucks leaving the site.

COMMUNICATIONS

(A primary and back-up means of communications for field crews have been established as described below)

Type of communication	Primary means	Back-up means
Communications with home base	Cell phones 303-546-4300, Stoller Office	
Communications among field crew members	Hand signals or voice communications	
Communications with client	Cell phone 303-273-3998	

MEDICAL SURVEILLANCE AND QUALIFICATION

The following medical surveillance is required for onsite personnel working in the field.

Required medical surveillance:	Job-specific medical testing:
_____ Hazardous Waste _____ Respirator Use _____ Hearing Conservation _____ Other: **None required**	Describe: NA

HAZARDOUS CHEMICALS

Hazardous chemicals (as defined in 29 CFR 1910.1200) to be brought or used onsite are identified below. This chemical inventory will be maintained and Material Safety Data Sheet(s) shall be maintained on the site.

Chemical Name	Amount	Location	Purpose
NA			

REQUIRED FACILITIES AND EQUIPMENT

The following facilities and equipment are required for safe completion of work.

Facility	*Type:*	*Location:*
_____ Worker Showers/Lockers		
x____ Restrooms	Portable	Adjacent to Conex onsite.
_____ Supplementary Illumination		
_____ Emergency eyewash/shower		
x____ First Aid Supplies	Eyewash bottle will be included in first aid kit	Vehicle
x____ Fire Extinguishers		Vehicle
_____ Hazardous Materials Storage		
x____ Spill Containment/Clean-up	For solid waste spills (shovels, bags, wipes, decon solution). For liquid waste spills, vermiculite and shovel	Vehicle/Conex
_____ Other:		

TRAINING

(The following training is required for onsite personnel working in the field. Copies of training certificates and training records will be kept onsite)

_____ 40-hour General Site Worker _____ 8-hour Supervisor _____ 3-day On the Job _____ 8-hour Refresher _x_ HASP Orientation _____ Hazard Communication _____ Hearing conservation _*_ Radiation Worker	Please describe: Personnel must be trained on the requirements of the health and safety plan and the PPE requirements. *Radiation protection requirements will be covered in site-specific training.

EMERGENCY ACTION AND RESPONSE

Personnel responsible for coordinating emergency situations during site activity are identified below. A site map showing directions to the authorized medical facility is attached.

Responsibility	*Name*	*Phone Number(s)*
Task Emergency Coordinator	Steve Brinkman	303-546-4388 office, 303-994-1883 cell
Client Interface	Linn Havelick	303-273-3998
Type/Frequency of Rehearsal	NA	

If an emergency situation develops that requires evacuation of the work area, the following steps shall be implemented.

Evacuation Step	*Methods and comments:*
Notify affected workers	Cell phones, hand signals, or voice communications
Evacuate to safe location	Parking area, immediately offsite.
Assemble and account for workers	At parking area
Notify emergency services	Call 911
Complete incident report	Affected worker and /or supervisor

Potential emergency situations and response actions are identified below:

In case of:	*Response actions:*
Fire or personnel injury	911

ATTACHMENTS

Applicable attachments to the task-specific health and safety plan are identified below:

Attachment Number:	*Title:*
1	Personnel Air Monitoring Calculations
2	Site Map
3	Task Hazard Analysis Forms
4	Tailgate Safety Meeting Forms
5	Map to Hospital

ATTACHMENT 1
PERSONNEL AIR MONITORING CALCULATIONS
CSMRI CREEKSIDE SITE

Permissible Exposure Level (PEL) Calculations

Utilizing the average and maximum values for the metal and radionuclide contaminants of concern from the RI/FS report, a calculation was made for how large a dust cloud would need to be to reach the PEL of any of the contaminants. The results are shown in the following table.

Sample Location	Contaminant	RI/FS data used	Size of dust cloud to reach PEL of any contaminant
Surface Soils	Metals	Maximum contaminant values	Dust Cloud of 0.7 mg/m^3
Surface Soils	Metals	Mean contaminant values	Dust Cloud of 16 mg/m^3
Surface Soils	Th and Uranium Isotopes	Maximum contaminant values	Dust Cloud of 2.5 mg/m^3
Borings	Metals	Maximum contaminant values	Dust cloud of 2.42
Borings	Metals	Mean contaminant values	Dust cloud of 33 mg/m^3
Borings	Th and Uranium Isotopes	Maximum contaminant values	Dust cloud of 2.98 mg/m^3
Test Pits	Th and Uranium Isotopes	Maximum contaminant values	Dust cloud of 5.72 mg/m^3
Test Pits	Metals	Maximum contaminant values	Dust cloud of .9 mg/m^3
Test Pits	Metals	Mean contaminant values	Dust cloud of 17.28 mg/m^3

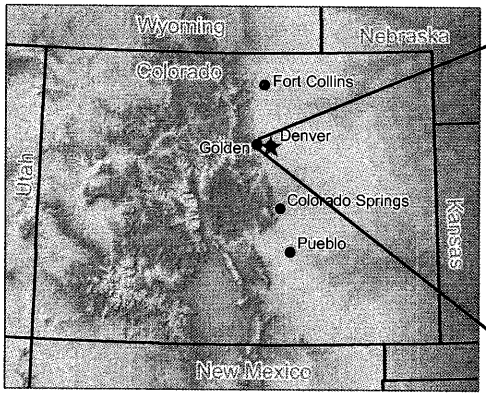
For example, this table shows that for mean metals surface data, a dust cloud with a concentration of 16 mg/m^3 would have to be generated to reach the PEL of any of the contaminants. This type of dust concentration would be seen for miles and would not occur at the site even if we did not do dust suppression. Using the maximum concentration for metals surface sampling, a dust cloud with a concentration of 0.7 mg/m^3 would be required to reach any of the PELs. Good dust suppression will accomplish this. Therefore, if we achieve adequate dust suppression even with the maximum concentrations, respirators will not be required.

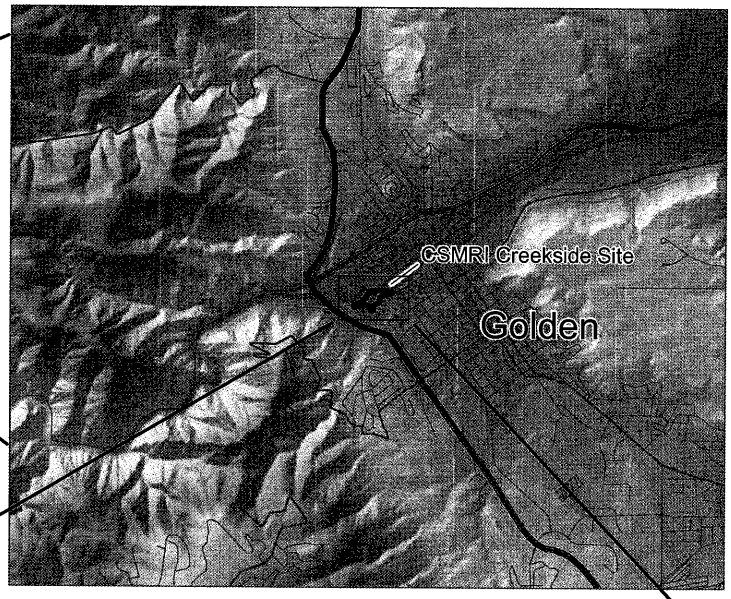
Internal and External Radiation Monitoring

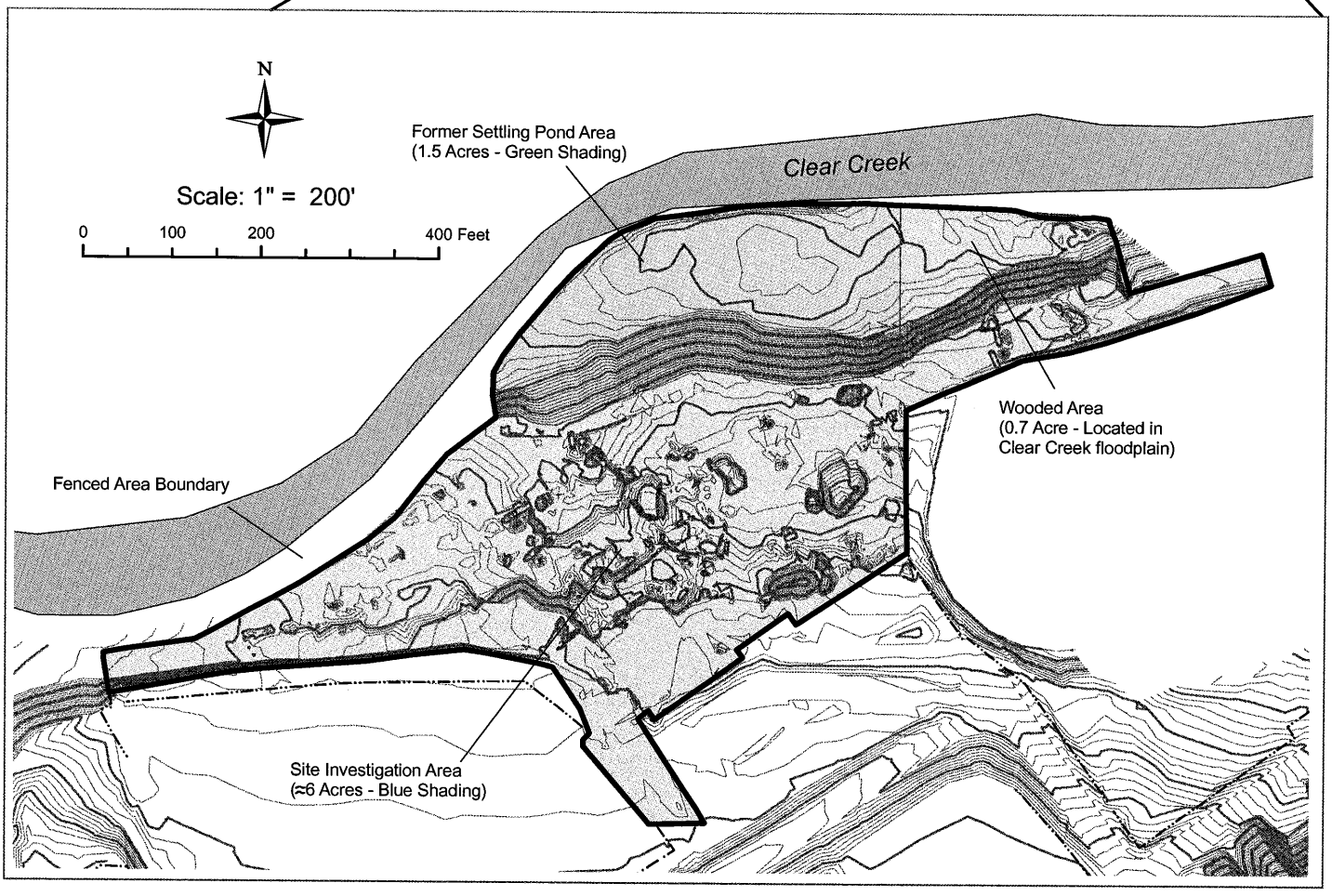
The 100 mrem/yr limit is a total effective dose equivalent (TEDE). The TEDE is a summation of the Deep Dose Equivalent (external exposure) and the Committed Effective Dose Equivalent (internal exposure). Therefore one needs to assess the potential exposures from airborne and external radiological sources.

One can estimate the need for air sampling by calculating the required soil concentration for each isotope of interest if resuspended that would equate to a 40 DAC-hr exposure during the expected time period that a worker was to be on the project. We have calculated the time required to receive a CEDE of 25 mrem (assuming member of the public) for each of the radionuclides using their maximum concentrations shown in the RI/FS report and assuming resuspension. Based on this calculation, one does not need to perform air monitoring for these radionuclides (note this calculation does not include radon progeny).

We have also computed the dose rate at a vertical distance of 3 feet from an infinite slab 1 foot thick. The slab contains the maximum concentrations of the reported radionuclides. The dose at this distance is approximately 1.1 mrem/hr. If an individual were to work at the site in this average field for 8 hours per day they could potentially receive 8 mrem. Therefore, we will monitor the dose rates in the work zone and determine stay times so that individuals cannot exceed the 100 mrem/yr constraint.







Attachment 2

CSMRI
Site Location Map

Explanation

- CSMRI Creekside Site
- Fences
- Topography (1 ft Intervals)
- Topography (5 ft Intervals)

CSMRI
Data Evaluation Report

Stoller

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FIGURE 1. TASK HAZARD ANALYSIS FORM AND INSTRUCTIONS

Task Hazard Analysis (THA) is an important accident prevention tool that works by finding hazards and eliminating or minimizing them before the job is performed and before they have a chance to become accidents. Use the THA for job clarification and hazard awareness, as a guide in new employee training, for periodic contacts and for retraining of senior employees, as a refresher on jobs that run infrequently, as an accident investigation tool, and for informing employees of specific job hazards and protective measures.

To complete this form you should consider the purpose of the job, the activities it involves, and the hazards it presents. If you are not familiar with a particular job or operation, interview an employee who is. In addition, observing an employee performing the job, or "walking through" the operation step by step may give additional insight into potential hazards.

SEQUENCE OF BASIC JOB STEPS

Break down the job into a series of steps or tasks to discover potential hazards employees may encounter. Some steps may not be performed each time; however, if that step is part of the job, it should be listed.

POTENTIAL HAZARDS

A hazard is a potential danger. The purpose of the THA is to identify all hazards – both those produced by the environment or conditions and those connected with the job procedure. Compiling an accurate and complete list of potential hazards will allow you to develop the recommended safe job procedures needed to prevent accidents.

HAZARD CONTROL/PPE

Using the first two columns as a guide, decide what actions or procedures are necessary to eliminate or minimize the hazards that could lead to an accident, injury, or occupational illness.

List the recommended safe operating procedures. List the required or recommended personal protective equipment necessary to perform each step of the job. Give a recommended action or procedure for each hazard.

Stoller Corporation

TASK HAZARD ANALYSIS FORM

Project & Location **CSMRI** **Golden, CO**	**Health and Safety Manager/Supervisor Approval**	**Date** **8/18/2005**
Description of Job Maintenance of Facility	Page 1 of 2	THA # CSMRI 2
	Title of Person Who Does Job: Technician	
	Required PPE: Standard work clothing, safety glasses, leather gloves, sturdy over the ankle leather boots, safety vest when heavy equipment is onsite	
	THA Completed By Dalene Nickelson	

Sequence Of Basic Job Steps	Potential Hazards	Hazard Control/PPE
Complete Tailgate Meeting Document and necessary Procedure review before work		
1. Trash pick up and removal	Slips, trips and falls on uneven terrain	1. Wear appropriate sturdy over the ankle leather boots
	Cuts	1. Ensure any glass or sharp metal is placed in a separate trash receptacle to reduce possibility of cuts 2. Wear leather gloves
	Wind	1. Wear appropriate clothing and safety glasses, as needed, to reduce the possibility of eye injury 2. Refrain from this duty on windy days, if possible
	Potential cross-contamination	1. Wear disposable boot covers or chemical resistant boots when wet/muddy
2. Fence integrity	Cuts	1. Fence repair will be conducted by contracted Company

Sequence Of Basic Job Steps	Potential Hazards	Hazard Control/PPE
3. Electrical maintenance	Electrical shock	1. Electrical repair will be conducted by contracted Company
4. Onsite visual survey	Slips, trips and falls	1. Wear appropriate sturdy over the ankle leather boots
	Potential cross contamination	1. Wear disposable boot covers or chemical resistant boots when wet/muddy

FIGURE 1. TASK HAZARD ANALYSIS FORM AND INSTRUCTIONS

Task Hazard Analysis (THA) is an important accident prevention tool that works by finding hazards and eliminating or minimizing them before the job is performed and before they have a chance to become accidents. Use the THA for job clarification and hazard awareness, as a guide in new employee training, for periodic contacts and for retraining of senior employees, as a refresher on jobs that run infrequently, as an accident investigation tool, and for informing employees of specific job hazards and protective measures.

To complete this form, you should consider the purpose of the job, the activities it involves, and the hazards it presents. If you are not familiar with a particular job or operation, interview an employee who is. In addition, observing an employee performing the job, or "walking through" the operation step by step may give additional insight into potential hazards.

SEQUENCE OF BASIC JOB STEPS

Break down the job into a series of steps or tasks to discover potential hazards employees may encounter. Some steps may not be performed each time; however, if that step is part of the job, it should be listed.

POTENTIAL HAZARDS

A hazard is a potential danger. The purpose of the THA is to identify all hazards – both those produced by the environment or conditions and those connected with the job procedure. Compiling an accurate and complete list of potential hazards will allow you to develop the recommended safe job procedures needed to prevent accidents.

HAZARD CONTROL/PPE

Using the first two columns as a guide, decide what actions or procedures are necessary to eliminate or minimize the hazards that could lead to an accident, injury, or occupational illness.

List the recommended safe operating procedures. List the required or recommended personal protective equipment necessary to perform each step of the job. Give a recommended action or procedure for each hazard.

Stoller Corporation

TASK HAZARD ANALYSIS FORM

Project & Location **Colorado School of Mines Research Institute** **Visitor THA**	**Health and Safety Manager/Supervisor Approval**	**Date** **8/18/2005**
Description of Job This THA encompasses activities a visitor would conduct on the site (just walking through. No contact with work surfaces)	Page 1 of 2	THA # CSMRI 1
	Title of Person Who Does: Various	
	Required PPE Minimum - Safety glasses, sturdy over the ankle leather boots, safety vest when heavy equipment is onsite	
	THA Completed By Dalene Nickelson	

Sequence Of Basic Job Steps	Potential Hazards	Hazard Control/PPE
1. Receive THA orientation, sign THA and sign visitor log	Loss of site control	Use buddy system Adhere to requirements of THA
2. Park/walk in designated areas	Loss of site control creating potential spread of contaminants	Stoller will provide direction as to where to walk and/or park
3. Training	Uninformed visitors	Site-specific THA training required No other training No medical surveillance requirements
4. No contact rule	Potential for contamination	Do not sample soil Do not touch bags Walk around standing water Do not sit on the ground Wear disposable boot covers as directed

Sequence Of Basic Job Steps	Potential Hazards	Hazard Control/PPE
5. Booty disposal	Potential cross contamination	Wear disposable booties when ground is wet/muddy Follow proper doffing techniques Place booties in receptacles provided and as directed
6. Emergency procedures	Visitors not accounted for	Meet in designated assembly area Follow directions provided by Stoller project manager on site

FIGURE 1. TASK HAZARD ANALYSIS FORM AND INSTRUCTIONS

Task Hazard Analysis (THA) is an important accident prevention tool that works by finding hazards and eliminating or minimizing them before the job is performed and before they have a chance to become accidents. Use the THA for job clarification and hazard awareness, as a guide in new employee training, for periodic contacts and for retraining of senior employees, as a refresher on jobs that run infrequently, as an accident investigation tool, and for informing employees of specific job hazards and protective measures.

To complete this form you should consider the purpose of the job, the activities it involves and the hazards it presents. If you are not familiar with a particular job or operation, interview an employee who is. In addition, observing an employee performing the job, or "walking through" the operation step by step may give additional insight into potential hazards.

SEQUENCE OF BASIC JOB STEPS

Break down the job into a series of steps or tasks to discover potential hazards employees may encounter. Some steps may not be performed each time; however, if that step is part of the job, it should be listed.

POTENTIAL HAZARDS

A hazard is a potential danger. The purpose of the THA is to identify all hazards – both those produced by the environment or conditions and those connected with the job procedure. Compiling an accurate and complete list of potential hazards will allow you to develop the recommended safe job procedures needed to prevent accidents.

HAZARD CONTROL/PPE

Using the first two columns as a guide, decide what actions or procedures are necessary to eliminate or minimize the hazards that could lead to an accident, injury, or occupational illness.

List the recommended safe operating procedures. List the required or recommended personal protective equipment necessary to perform each step of the job. Give a recommended action or procedure for each hazard.

Stoller Corporation

TASK HAZARD ANALYSIS FORM

Project & Location **CSMRI** **Golden, CO**	**Health and Safety Manager/Supervisor Approval**	**Date** **9/26/2005**
Description of Job **Field sampling/remediation**: Bagged soil disposal: Line tailgate with plastic, open soil bags, load soil bags into dump trucks with loader, decontaminate dump trucks/loaders, and provide dust suppression with water from hydrant.	Page 1 of 4	THA # CSMRI 3
	Title of Person Who Does Job: Technician	
	Required PPE: Standard work clothing, safety glasses, nitrile or dedicated leather gloves, sturdy over the ankle leather boots, Tyvek or latex boot covers, Tyvek coveralls, high-visibility safety vest when heavy equipment is on site, face shield when spraying water.	
	THA Completed By Carolyn Hicks	

Sequence Of Basic Job Steps	Potential Hazards	Hazard Control/PPE
Complete Tailgate Meeting Document and necessary Procedure review before work		
1. Line truck tailgate with plastic	Slips, trips and falls on uneven or slippery terrain	1. Wear appropriate sturdy, over the ankle leather boots. 2. Maintain good housekeeping. 3. After rain or snow events, extra care should be taken when walking on site and working in excavations.

Sequence Of Basic Job Steps	Potential Hazards	Hazard Control/PPE
	Heat stress from wearing Tyvek coveralls	1. Drink plenty of fluids. 2. Take rest breaks as needed 3. Follow heat stress stay times or work/rest regimens as directed by H&S lead.
	Cold stress	1. Drink plenty of fluids. Avoid the use of alcohol, caffeine, and tobacco. 2. Wear appropriate cold weather clothing (hat, gloves, boots, etc.) Dress in layers. Adjust clothing as needed to prevent excessive sweating while working in the cold. Keep clothing dry. 3. Take warm up breaks as needed.
	Falls when lining tailgate with plastic	1. If step ladder must be used, ensure stable footing and do not stand on top rung.
2. Open soil bags	Cuts	1. Wear appropriate hand protection (leather gloves). 2. Keep knife closed when not in use. 3. Always cut away from the body.
	Radiological hazards	1. Wear appropriate PPE: Tyvek coveralls, boot covers, gloves 2. Follow proper doffing techniques. Self-monitor after doffing PPE using alpha/beta frisker 3. Do not touch face while working. 4. Ensure dust suppression water is used adequately. 5. Stand upwind of bags if windy conditions are present.
	Cold stress	1. Drink plenty of fluids. Avoid the use of alcohol, caffeine, and tobacco. 2. Wear appropriate cold weather clothing (hat, gloves, boots, etc.) Dress in layers. Adjust clothing as needed to prevent excessive sweating while working in the cold. Keep clothing dry. 3. Take warm up breaks as needed.
3. Load soil bags into dump trucks with loader	Personnel injured by heavy equipment	1. Maintain a safe distance from the operating equipment and wear high visibility safety vests. 2. All equipment shall be operated per manufacturers instructions. 3. Only trained and qualified personnel shall operate heavy equipment. 4. Operators to inspect heavy equipment to ensure proper working order. 5. Personnel will not walk to the side of behind heavy equipment without the operator's knowledge. 6. Ground personnel and equipment operator are to maintain communication using hand signals, radios, or voice commands. 7. Loader operator may need assistance in spotting during material moves. 8. At no time shall personnel be under a suspended load.
	Heat stress from wearing Tyvek coveralls	1. Drink plenty of fluids. 2. Take rest breaks as needed 3. Follow heat stress stay times or work/rest regimens as directed by H&S lead.

Sequence Of Basic Job Steps	Potential Hazards	Hazard Control/PPE
	Cold stress	1. Drink plenty of fluids. Avoid the use of alcohol, caffeine, and tobacco. 2. Wear appropriate cold weather clothing (hat, gloves, boots, etc.) Dress in layers. Adjust clothing as needed to prevent excessive sweating while working in the cold. Keep clothing dry. 3. Take warm up breaks as needed.
	Slips, trips and falls on uneven terrain	1. Wear appropriate sturdy, over the ankle leather boots. 2. Maintain good housekeeping. 3. Dust suppression water should be applied as a mist and not applied in excessive quantities that would cause muddy conditions. 4. After rain or snow events, extra care should be taken when walking on site and working in excavations.
	Radiological hazards	1. Wear appropriate PPE: Tyvek coveralls, boot covers, gloves 2. Follow proper doffing techniques. Self-monitor after doffing PPE using alpha/beta frisker 3. Do not touch face while working 4. Stand upwind of loading operations if windy conditions are present.
	Noise	1. Wear hearing protection in high noise areas (where normal conversation is difficult with other person two feet away).
4. Decontaminate dump trucks and loaders and provide dust suppression with water from hydrant	Personnel injured by heavy equipment	1. Maintain a safe distance from the operating equipment and wear high visibility safety vests. 2. All equipment shall be operated per manufacturers instructions. 3. Only trained and qualified personnel shall operate heavy equipment. 4. Operators to inspect heavy equipment to ensure proper working order. 5. Personnel will not walk to the side or behind heavy equipment without the operator's knowledge. 6. Ground personnel and equipment operator are to maintain communication using hand signals, radios, or voice commands. 7. Loader operator may need assistance in spotting during material moves. 8. At no time shall personnel be under a suspended load.
	Heat stress from wearing Tyvek coveralls	1. Drink plenty of fluids. 2. Take rest breaks as needed 3. Follow heat stress stay times or work/rest regimens as directed by H&S lead.
	Cold stress	1. Drink plenty of fluids. Avoid the use of alcohol, caffeine, and tobacco. 2. Wear appropriate cold weather clothing (hat, gloves, boots, etc.) Dress in layers. Adjust clothing as needed to prevent excessive sweating while working in the cold. Keep clothing dry. 3. Take warm up breaks as needed.

Sequence Of Basic Job Steps	Potential Hazards	Hazard Control/PPE
	Slips, trips and falls on uneven terrain	1. Wear appropriate sturdy, over the ankle leather boots. 2. Maintain good housekeeping. 3. Dust suppression water should be applied as a mist and not applied in excessive quantities that would cause muddy conditions. 4. After rain or snow events, extra care should be taken when walking on site and working in excavations.
	Radiological hazards	1. Wear appropriate PPE: Tyvek coveralls, boot covers, gloves 2. Follow proper doffing techniques. Self-monitor after doffing PPE using alpha/beta frisker 3. Do not touch face while working
	Water spray from hose	1. Wear face shield when spraying water 2. Wear coated Tyvek coveralls or rain suit when individual could contact significant water spray 3. Stand upwind of truck or loader when spraying water.

Stoller

TAILGATE MEETING DOCUMENTATION

Tailgate Discussion Topic

Date of Meeting _____

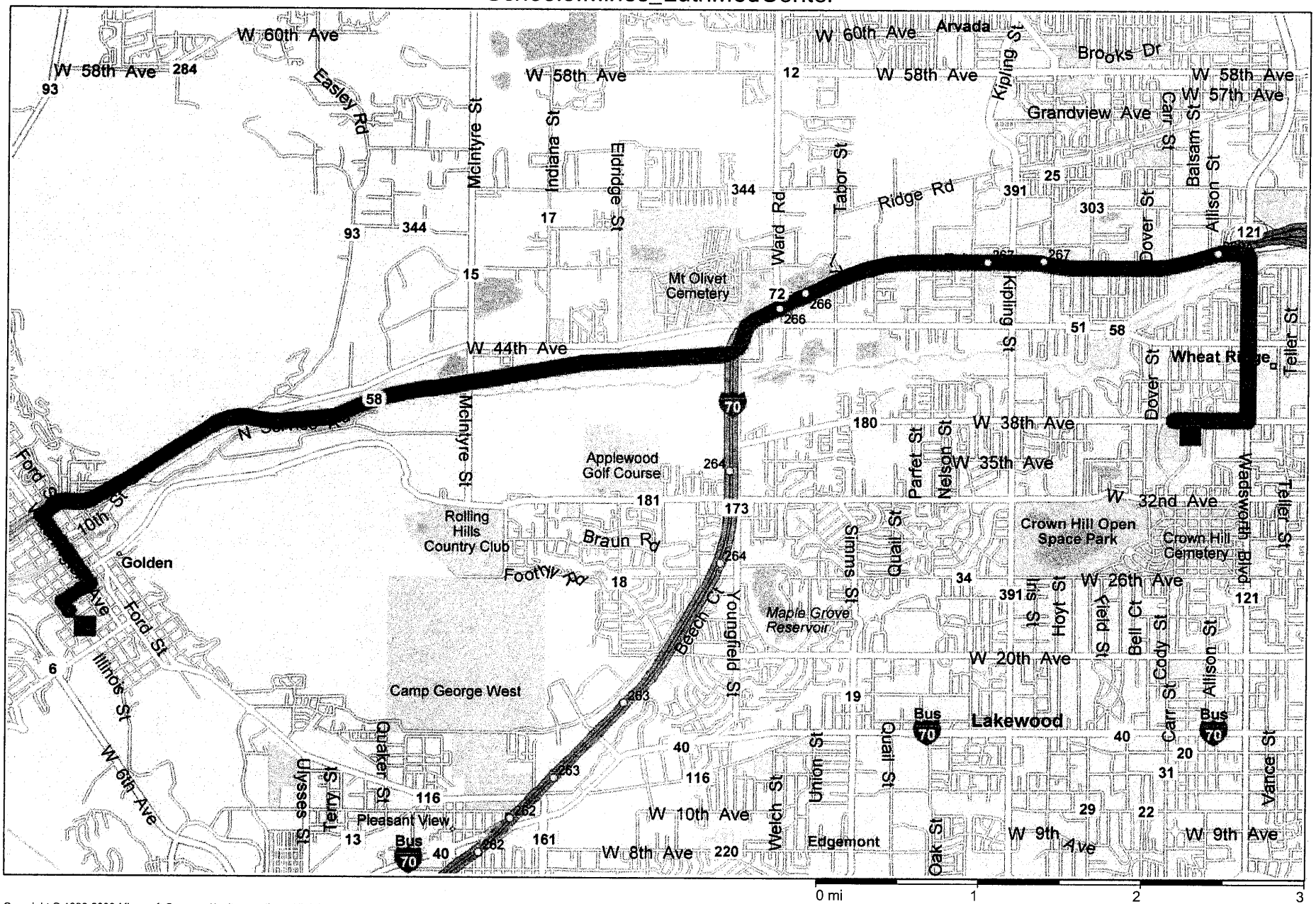
Meeting Conducted by:

Printed Name _____ **Signature** _____

Meeting Attendees: Attach Any Handouts and File in Project Files

DATE	PRINTED NAME	SIGNATURE

SchoolofMines_LuthMedCenter



SchoolofMines_LuthMedCenter

10.4 miles; 15 minutes

9:00 AM	0.0 mi	Depart 1500 Illinois St, Golden, CO 80401 on Illinois St (North-West) for 120 yds
9:00 AM	0.1 mi	Turn RIGHT (North-East) onto 14th St for 0.2 mi
9:01 AM	0.3 mi	Turn LEFT (North-West) onto Washington Ave for 0.5 mi
9:02 AM	0.8 mi	Take Ramp (RIGHT) onto SR-58 for 4.6 mi towards CO-58
9:08 AM	5.4 mi	Take Ramp onto I-70 for 3.4 mi towards I-70
9:11 AM	8.7 mi	At exit 269A, turn RIGHT onto Ramp for 0.2 mi towards CO-121 / Wadsworth Blvd
9:11 AM	8.9 mi	Take Ramp (RIGHT) onto SR-121 [Wadsworth Blvd] for 1.1 mi towards Wheat Ridge / Lakewood
9:14 AM	10.0 mi	Turn RIGHT (West) onto W 38th Ave for 0.5 mi
9:15 AM	10.4 mi	Arrive 8300 W 38th Ave, Wheat Ridge, CO 80033

Appendix C
Monitoring Equipment Specifications

NOTE: This information was provided to CDPHE on October 7, 2005 with a submittal of updates to application information provided for Stoller's Radioactive Materials License 1094-01.

15. Radiation Detection/Measurement Equipment

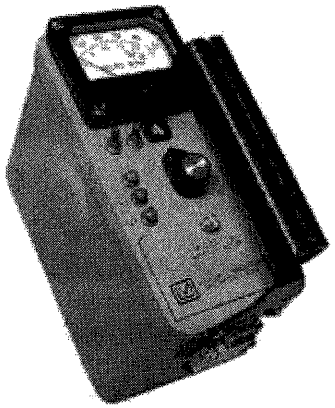
The S.M. Stoller Corporation owns the following radiation detection/measurement equipment. Any additional instruments and equipment will be leased or rented as needed in support of the project. Instrument selection is based on response to project-specific radionuclides as assessed by the Project Manager, Radiation Safety Officer, and radiation control technicians. Stoller specifies that all instruments and equipment be correctly calibrated by specifically licensed vendors prior to their delivery and use on a project site. Additionally all instruments and equipment used for qualitative radiation measurements will be calibrated by a licensed vendor as per the manufacturer's recommendations at intervals not to exceed 12 months.

Instrument Manufacturer & Model Number	Ludlum 2350-1 Data Logger	Ludlum 2360 Alpha/Beta Data Logger	Ludlum Model 19 MicroR	Ludlum 2929 Alpha Beta Scaler
Meter Readout	Display options: rem/hr, Sv/hr, R/hr, cpm, cps, dpm, dps, rad(r), Gray(G), C/kg, Ci/cm^2, or Bq/cm^2	0 - 500 cpm, 0 - 2 kV,	0 - 25 microR/hr, 0 - 50 microR/hr,	2 ea 6 digit LEDs
Scale multipliers	NA	X1, X10, X100, X1000	Range Selectors 0- 25, 0 - 50, 0 - 250, 0 - 500, 0 - 5000 microR/hr	NA
Probe/Detector	Ludlum 44-10 2x2 NaI Scintillator	Ludlum 43-89 Alpha/Beta Scintillator	1" X 1" sodium iodide (NaI)Tl scintillator	Model 43-10-1 Sample Counter
Surface Area of Probe	N/A	Active - 125 cm^2 Open - 100 cm^2	N/A	20.3 cm^2
Radiation Detected	γ	α, β	γ	α, β
Efficiency (4π)	900 cpm/microR/hr (Cs-137)	Alpha: 16% - Pu-239 Beta: 5% - Tc-99; 16% - S-90/Y-90	Typically 175 cpm/microR/hr (Cs-137)	Alpha: 37% - Th-230; 39% - U-238; 37% - Pu-239 Beta: 8% - C-14; 27% - Tc-99, 29% - Cs-137; 26% - Sr-90/Y-90

MODEL 19 MicroR Meter

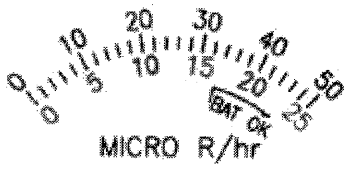
PART NUMBER:48-1615

- ***Built-In 1" X 1" NaI (Tl) Gamma Scintillator***
- ***5 Ranges***
- ***Splashproof Shields***
- ***Total Range from 0 - 5,000 µR/hr***



WORKING ENVIRONMENT: Splash proof shields for outdoor use
INDICATED USE: Low level (microR) gamma survey
DETECTOR: 1" X 1" sodium iodide (NaI)Tl scintillator
SENSITIVITY: Typically 175 cpm/microR/hr (*137Cs gamma*)
ENERGY RESPONSE: Energy dependent
METER DIAL:0 - 25 microR/hr, 0 - 50 microR/hr, BAT TEST
RANGE SELECTIONS: 0 - 25, 0 - 50, 0 - 250, 0 - 500, 0 - 5000 microR/hr
LIGHT: Push-button to activate
LINEARITY: Reading within plus or minus 10% of true value
AUDIO: Built in unimorph speaker with ON/OFF switch (*greater than 60 dB at 2 feet*)
CALIBRATION CONTROLS: Accessible from front of instrument (*protective cover provided*)
RESPONSE: Toggle switch for FAST (4 seconds) or SLOW (22 seconds) from 10% to 90% of final reading
RESET: Push-button to zero meter
POWER: 2 each "D" cell batteries (*housed in sealed compartment that is externally accessible*)
BATTERY LIFE: Typically 600 hours with alkaline batteries (*battery condition can be checked on meter*)
METER: 2.5" (6.4cm) arc, 1 mA analog type
CONSTRUCTION: Cast and drawn aluminum with beige polyurethane enamel paint
TEMPERATURE RANGE: -4° F(-20° C) to 122° F(50° C)
May be certified for operation from -40° F(-40° C) to 150° F(65° C)
SIZE: 7.8"(19.8 cm)H X 3.5"(8.9 cm)W X 8.5"(21.6 cm)L
WEIGHT: 4.5 lbs(2.1 kg) including batteries

Common Meter Dial



202-016

202-016
0 - 50 μR/hr; 0 - 25 μR/hr

202-702

202-702
0 - 0.5 μSv/h; 0 - 0.25 μSv/h

Accessories

Check Source
Headset
Standard Carrying Case
Air and Water Tight Carrying Case

Replacement Parts

Meter Bezel
Meter Movement
Handle
Detector Assembly

Ordering Info. Manual ANSI Test Report Model 19 Response Curve

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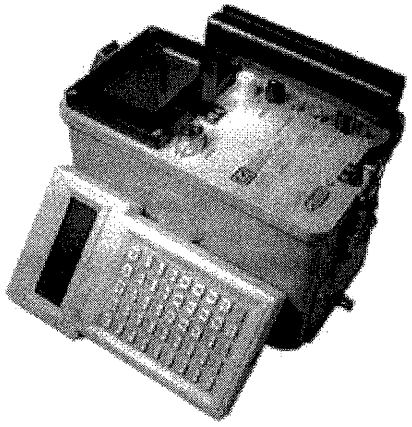
MODEL 2350-1 Data Logger

- *Data Logger*
- *16 Independent Detector Setups*
- *Microprocessor Based Electronics*
- *RS-232 Output*
- *Optional Keypad for Setup*
- *LCD Display with backlight*
- *Scaler*
- *Ratemeter*
- *Integrated Dose*
- *5 decade Logarithmic Trend Indicator*
- *Bar Code Reader*

PART NUMBER:48-2751



INDICATED USE: Field analysis and data logging
COMPATIBLE DETECTORS: G-M, proportional, scintillation
CONNECTOR: Series "C" (*others available on request*)
DISPLAY: 8 line LCD display with 15 characters per line
BACKLIGHT: A two position toggle switch to turn backlight ON or OFF
SCALER: 6 digit display
TIMER: Used in conjunction with scaler. Count time can be set from 1 - 65,535 seconds in 1 second intervals
RATEMETER: Digital ratemeter, corrected for dead time and calibration constant
TREND INDICATOR: 5 decade logarithmic bar graph
LINEARITY: Reading within plus or minus 10% of true value with detector connected
SCALE: Can display in rem/hr, Sv/hr, R/hr, cpm, cps, dpm, dps, rad(r), Gray(G), C/kg, Ci/cm squared, or Bq/cm squared
INTEGRATED DOSE: Counter provided to give total accumulated dose for up to 45 days (*Will display in same units as ratemeter*)
AUDIO: Built in unimorph speaker with volume control (*greater than 60 dB at 2 feet, full volume*)
AUDIO DIVIDE: Operator selected divisions of 1, 10, or 100 events-per-click
ALARM: Separate alarms for digital ratemeter, scaler, and integrated dose can be set at any point (*audible and visual indicators*)
ACK/SCROLL: Push-button to silence audio after alarm has been indicated and/or scroll through the various displays
DATA LOGGER: Capable of logging up to 1000 individual data points with the following identifiers for each point

```
8 Location codes (5 character )  Time of day
Month, Day, and Year             Count rate/scaler count/integrated dose
Count time                             Detector number
```

Logging mode	Sample number

DETECTOR PARAMETERS: Capable of storing the following parameters for 16 different detectors

Model number	Serial number
Calibration constant	Dead time correction
High voltage	Threshold
Window	Display range multiplier
Display time base	Display units
Overload current	Ratemeter alarm setting
Scaler alarm setting	Low ratemeter alarm setting
Integrated dose alarm setting	Scaler count time

RS-232 PORT: A full duplex communication port that allows for instrument setup by optional keypad or PC. Also allows for data to be transferred to a PC file.
BAR CODE READER (optional): Allows for setup of instrument by computer generated bar codes
HIGH VOLTAGE: Adjustable from 200 - 2500 volts
THRESHOLD: Adjustable from 100 - 1000
WINDOW: Adjustable from 0 - 1000 above threshold
GAIN: Adjustable from 2 - 350 mV at threshold setting of 100
DEAD TIME: Adjustable to compensate for dead time of detector and electronics
RESPONSE:
Fixed - Adjustable from 1 - 127 seconds in 1 second intervals
Variable - Will vary according to number of counts present.
Typical times FAST: 4 - 25 seconds, SLOW: 4 - 60 seconds from 10% to 90% of final reading
POWER: 4 each "D" cell batteries (*housed in sealed compartment that is accessible from back of instrument*)
BATTERY LIFE: Greater than 75 hours (*low battery condition is automatically indicated*)
CONSTRUCTION: Milled and drawn aluminum with beige polyurethane enamel paint
TEMPERATURE RANGE: 32° F(0° C) to 122° F(50° C) (*LCD limits temperature range*)
SIZE: 6"(15cm)H X 4.3"(11cm)W X 8.8"(22cm)L
WEIGHT: 5 lbs (2.3kg) including batteries

For Alpha Measurements	For Beta Measurements	For Gamma Measurements	For Alpha/beta/gamma Measurements
Model 43-1	Model 43-20	Model 44-2	Model 44-7
Model 43-2	Model 43-68	Model 44-3	Model 44-9
Model 43-5	Model 44-1	Model 44-6	Model 44-88
Model 43-20	Model 44-6	Model 44-7	Model 44-89
Model 43-44	Model 44-7	Model 44-9	Model 44-94
Model 43-44-1	Model 44-9	Model 44-10	
Model 43-65	Model 44-21	Model 44-17	
Model 43-68	Model 44-38	Model 44-20	
Model 43-90	Model 44-88	Model 44-21	

Model 44-7
Model 44-9
Model 44-88
Model 44-89
Model 44-94

Model 44-89
Model 44-92
Model 44-94
Model 44-98
Model 44-116

Model 44-38
Model 44-62

Accessories

Check Source
Source Holder
Headset
Shoulder Strap
Programmable Keypad
Standard Carrying Case
Air and Water Tight Carrying Case

Replacement Parts

Cable
Meter Bezel
LCD Display
Handle
Probe Clip

Application Software

DOS Application Software

Windows Interface Software

Ordering Info. Manual Technical Info.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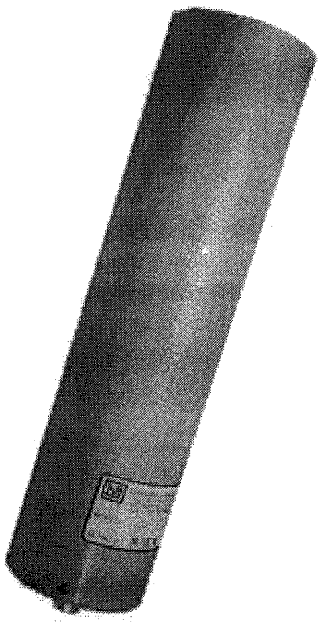
Page last updated: August 2003

MODEL 44-10 Gamma Scintillator

PART NUMBER:47-1540

The Model 44-10 is a 2" X 2" NaI(Tl) Gamma Scintillator that can be used with several different instruments including survey meters, scalers, ratemeters, and alarm ratemeters



INDICATED USE: High energy gamma detection
SCINTILLATOR: 2" (5.1 cm) diameter X 2" (5.1 cm) thick sodium iodide (NaI)Tl scintillator
SENSITIVITY: Typically 900 cpm/microR/hr (*Cs-137*)
ENERGY RESPONSE: Energy dependent
COMPATIBLE INSTRUMENTS: General purpose survey meters, ratemeters, and scalers
TUBE: 2"(5.1cm) diameter magnetically shielded photomultiplier
OPERATING VOLTAGE: Typically 500 - 1200 volts
DYNODE STRING RESISTANCE: 60 megohm
CONNECTOR: Series "C" (*others available*)
CONSTRUCTION: Aluminum housing with beige polyurethane enamel paint
TEMPERATURE RANGE: -4° F(-20° C) to 122° F(50° C)
May be certified to operate from -40° F(-40° C) to 150° F(65° C)
SIZE: 2.6" (6.6 cm) diameter X 11" (27.9 cm)L
WEIGHT: 2.3 lb (1.1kg)

Replacement Parts

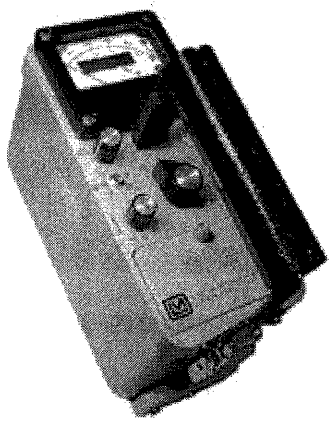
Photomultiplier Tube
Scintillator

Ordering Info. **Model 44-10 Response Curve**

MODEL 2360 Alpha/Beta Data Logger

- *Data Logger*
- *Simultaneous Alpha/Beta Counting*
- *6 Digit LCD Scaler*
- *Ratemeter with Total Counting Range from 0 - 500,000 cpm*
- *RS-232 Output*
- *Optional Keypad for setup*
- *Bar Code Reader*
- *Alpha Only, Beta Only, or Alpha/Beta Counts*

PART NUMBER:48-2872



INDICATED USE: Alpha, beta discrimination, and data logging
COMPATIBLE DETECTORS: Proportional and dual phosphor scintillation detectors
DATA LOGGER: Capable of logging up to 550 individual data points with the following identifiers for each point (*All data is stored in non-volatile memory allowing batteries to be removed without loss of data*)

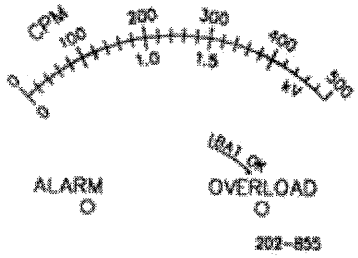
```
alpha and beta sample counts     sample number

date/time stamp                  scaler count time

10 character location identifier
```

LOGGING PUSHBUTTON: Located in the handle; used to activate scaler and/or log a count
LOGGING FUNCTION CONTROL: Internal selection that enables the pushbutton to log the ratemeter reading, initiate a scaler count, and log the resulting reading, log both the scaler and ratemeter reading, or disables the logging function.
LOCATION CODE: A 10 character alphanumeric identifier. (*Can be set by bar code reader, ASCII terminal, or PC*)
CALIBRATION DUE DATE: An internal date that disables the instrument if the required calibration interval has been missed
HEADER INFORMATION: Six lines of user defined memory at the beginning of the stack for storing user name, survey name, serial numbers, etc. (*Information is dumped with logged data*)
RS-232 PORT: Located on the can, this allows the instrument to be connected to a PC for dumping data, and setup parameters.
CONNECTOR: Series "C" (*others available on request*)
AUDIO: Built in unimorph speaker with volume control (*greater than 60 dB at 2 feet, full volume*)
AUDIO DIVIDE: Selectable dual or individual click-per-event for alpha and beta counts and divisions of 1, 10, 100, or 1000 events-per-click(*beta channel only*)
METER: 2.5"(6.4cm) arc, 1 mA analog type
METER DIAL: 0 - 500 cpm, 0 - 2 kV, BAT OK, OL(overload)
MULTIPLIERS: X1, X10, X100, X1000

LINEARITY: Reading within plus or minus 10% of true value with detector connected
SCALER: 6 digit LCD with 0.25" digits, overflow arrow, and colons to indicate when a count is in process
COUNT TIME: Switch selectable times of 0.1, 0.5, 1, 2, 5, 10, and 60 minutes, or PC to allow for a specific count time to be set from a PC.
SELECTOR SWITCH: Toggle switch to select alpha+beta, alpha only, or beta only
RESET/READ HV: A two position momentary action switch to allow for the meter to be reset or a reading of the HV setting.
HIGH VOLTAGE: Adjustable from 200 - 2000 volts (*Can be read on the meter*)
THRESHOLD: Internal control allows for adjustment from 2 - 15 mV for beta, and 40 - 700 mV for alpha
WINDOW: Internal control allows for adjustment from the beta threshold up to the alpha threshold setting (*Beta only*)
OVERLOAD: Senses detector saturation. Indicated by red lamp on meter and meter deflecting to full scale (*Adjustable depending on detector selected*)
RESPONSE: Will vary according to the number of counts present. Typically 2 - 11 seconds from 10% - 90% of final reading
POWER: 2 each "D" cell batteries (*housed in sealed compartment that is accessible from front of instrument*)
BATTERY LIFE: Greater than 150 hours (*battery condition can be checked on meter*)
CONSTRUCTION: Cast and drawn aluminum with beige polyurethane enamel paint
TEMPERATURE RANGE: -4° F(-20° C) to 122° F(50° C)
May be certified for operation from -40° F(-40° C) to 150° F(65° C)
SIZE: 6.5"(16.5cm)H X 3.5"(8.9cm)W X 8.5"(21.6cm)L
WEIGHT: 3.5 lbs (1.6kg) including batteries

For
Alpha/Beta
Measurements
Model 43-1-1
Model 43-2-2
Model 43-20
Model 43-68
Model 43-89
Model 43-93

Common Meter Dial

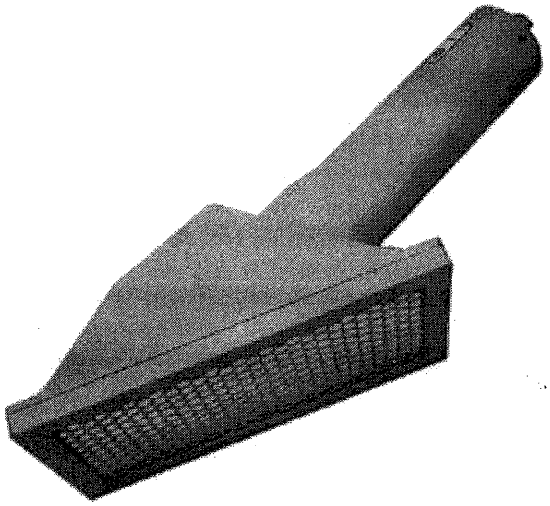


202-855
0-500 cpm

MODEL 43-89 Alpha/Beta Scintillator

PART NUMBER:47-2430

The Model 43-89 is a 100 cm² dual phosphor alpha/beta scintillator that is designed to be used for simultaneously counting alpha and beta contamination

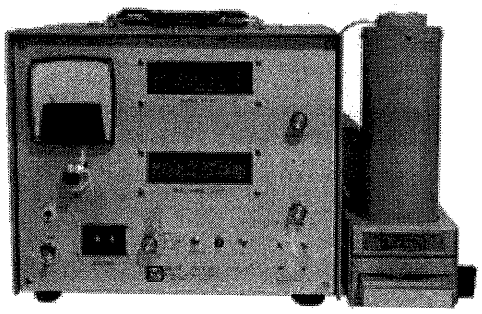


INDICATED USE: Alpha-beta survey
SCINTILLATOR: ZnS(Ag) adhered to 0.010" thick plastic scintillation material
WINDOW: Typically 1.2 mg/cm² aluminized mylar
WINDOW AREA:
Active - 125 cm²
Open - 100 cm²
EFFICIENCY (4pi geometry): Typically 16% - Pu-239; 5% - Tc-99; 16% - S-90/Y-90
BACKGROUND:
Alpha - Less than 3 cpm
Beta - Typically 300 cpm or less (*10 microR/hr field*)
NON-UNIFORMITY: Less than 10%
CROSS TALK:
Alpha to Beta - Less than 10%
Beta to Alpha - Less than 1%
COMPATIBLE INSTRUMENTS: Model 2224, 2360, 2929
TUBE: 1.5"(3.8cm) diameter magnetically shielded photomultiplier
OPERATING VOLTAGE: Typically 500 - 1200 volts
DYNODE STRING RESISTANCE: 100 megohm
CONNECTOR: Series "C" (*others available*)
CONSTRUCTION: Aluminum housing with beige polyurethane enamel paint
TEMPERATURE RANGE: -4° F(-20° C) to 122° F(50° C)
May be certified for operation from -40° F(-40° C) to 150° F(65° C)
SIZE: 5.5"(13.9cm)H X 4"(10.2cm)W X 12.3"(33cm)L
WEIGHT: 1.5 lb (0.7kg)

MODEL 2929 Alpha/Beta Scaler

PART NUMBER:48-1245

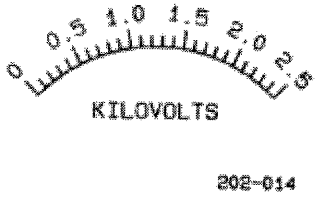
- ***Dual Alpha/Beta Scaler***
- ***Maximum Sample Size of 2" Diameter X 0.4" thick***



INDICATED USE: Alpha beta sample counting
DETECTOR: Model 43-10-1 Alpha beta sample counter (*included*)
SCINTILLATOR: ZnS(Ag) adhered to plastic scintillation material
TUBE: 2"(5.1cm) diameter magnetically shielded photomultiplier
WINDOW: 0.4 mg/ square cm aluminized mylar
ACTIVE AND OPEN AREA: 20.3 square cm
SAMPLE HOLDER: Anodized aluminum tray with 1" diameter sample ring to allow for 1" or 2" diameter samples
SAMPLE SIZE (maximum):2"(5.1cm) diameter X 0.4"(0.9cm) thick
EFFICIENCY (4pi geometry):
ALPHA: 37% - Th-230; 39% - U-238; 37% - Pu-239
BETA: 8% - C-14; 27% - Tc-99, 29% - Cs-137; 26% - Sr-90/Y-90
CROSS TALK:
Alpha to beta - 10% or less
Beta to alpha - 1% or less
BACKGROUND:ALPHA - 3 cpm or less
BETA - Typically 80 cpm or less (*10μR/hr field*)
AUDIO: Built in unimorph type speakers with volume controls to provide a dual tone (*1 per channel*) click-per-event audio
SCALERS: 2 ea. 6 digit LED displays providing a range of 0 - 999999 counts (*controlled by COUNT and HOLD buttons*)
SCALER LINEARITY: Reading within plus or minus 2% of true value
TIMER: Thumbwheel adjustment from 0 - 99 minutes with selectable divisions of X0.1, X1, X10, or EXT for manual timing
METER DIAL: 0 - 2.5 kV; BAT TEST
LINEARITY: Reading within plus or minus 10% of true value
HIGH VOLTAGE: Adjustable from 200 - 2500 volts (*will support 60 megohm scintillation loads*)
THRESHOLD:
Alpha - 175 mV
Beta - 4 mV
BETA WINDOW: 50 mV
DATA OUTPUT: Two 15 pin connectors allowing for recorder, printer, or software interface (*one for alpha, one for beta*)

AMP OUT: "BNC" connector provides amplified detector pulse
POWER: 95 - 135 VAC (*178 - 240 VAC available*), 50 - 60 Hz single phase (*less than 100 mA*)
METER: 2.5"(6.4cm) arc, 1 mA analog type
CONSTRUCTION: Aluminum housing with beige polyurethane enamel paint
TEMPERATURE RANGE: -4° F(-20° C) to 122° F(50° C)
SIZE: 8.5"(21.6cm)H X 14.5"(36.8cm)W X 9"(22.9cm)D (*including detector*)
WEIGHT: 12.6 lbs (5.7kg) (*including detector*)

Meter Dial



202-014
0 - 2.5 kV

Accessories

Model 264
Model 464-2

Replacement Parts

Cables
Meter Assembly
Meter Movement

Ordering Info.; Manual

Return to ludlums.com

For comments or suggestions please contact webmaster at: rludlum@ludlums.com
Page last updated: December 2000

Appendix D
Standard Operating Procedures for Monitoring Equipment

Stoller

established 1959

October 7, 2005

Colorado Department of Public Health and Environment
Radiation Management Program, HMWMD-B2
4300 Cherry Creek Drive South
Denver, CO 80246-1530

Subject: Updates to Application Information Provided for Radioactive Materials License No. 1094-01

The S.M. Stoller Corporation has made some minor updates and revisions to the information provided in our application for a radioactive materials license. Attached please find the following updates:

- Revision 1 to Authorized Users (item 10 in application). The personnel provided on this list all have current Radiation Worker II training or General Employee Radiation Training (GERT) as detailed in our original application and subsequent material provided to the Department.
- Revision 1 to Calibration and Reference Sources (item 11 in application)
- Revision 1 to Radiation Detection and Measurement Equipment (item 15 in application)
- Revision 1 to SOP-RAD-001, Portable Radiation Survey Instrument Operation
- Revision 1 to SOP-RAD-002, Swipe Sample Collection
- Revision 0 to SOP-RAD-031, Counting System Operation (new procedure not previously submitted with application)

Please call me directly at (303) 546-4318 if you have any questions or comments regarding any aspect of these updates.

Sincerely,

Joseph W. Gordon
Vice President and Alternate RSO
The S.M. Stoller Corporation

Attachments: As stated

Stoller

Document No: SOP-RAD-001, Rev.1

Title: Portable Radiation Survey Instrument Operation

Approved: _____ Date 10/7/05
Stoller Health and Safety Manager/
Radiation Safety Officer

Approved: _____ Date 10/7/05
Stoller Quality Assurance

Approved: _____ Date 10/7/05
Stoller Project Director and
Alternate Radiation Safety Officer

Revision Number	Date
0	1/17/05
1	10/7/05

UNCONTOLLED WHEN PRINTED

1. Introduction

1.1 Summary

Radiation detection instruments are required to be performance checked prior to use. This procedure includes requirements for establishing control limits and performing required instrument checks for a variety of portable radiation survey instruments. If specific instruments require different or additional performance tests, these will be addressed in instrument-specific standard operating procedures.

1.2 Scope

All portable radiation survey instruments will be calibrated, in accordance with manufacturer's requirements, by a certified vendor. This procedure does not include calibration procedures.

This procedure is applicable to portable radiation survey instrumentation that is used to detect ionizing radiation. It is not applicable to gamma spectroscopy or neutron instrumentation.

2. Definitions

ALARA: As Low As Reasonably Achievable

Location: A new location or site, for the purpose of this procedure, means a location with an altitude that varies by more than 1,000 feet from the altitude at which the control limits were previously measured.

3. Responsibilities and Qualifications

Personnel using this procedure must be qualified to handle radioactive sources and to operate the instrument that is being used. Documentation of qualification and training will be maintained in the project files.

Personnel performing on-site surveys shall have the required training to enter the job site, or be escorted by qualified personnel, as permitted by the Site-Specific Health and Safety Plan.

The Radiation Safety Officer will approve sources other than those listed in Appendix A for use as check sources.

The Project Manager, in conjunction will the project Quality Assurance Officer, will evaluate situations in which an instrument has been taken out of service for failure to meet the acceptance criteria. This evaluation will determine whether or not a Non-conformance Report (NCR) and/or Corrective Action Request (CAR) are required.

4. Safety

Personnel shall understand the potential hazards of the job site and comply with the requirements of the site-specific work plans and the Site-Specific Health and Safety Plan.

Personal protective equipment specified in project-specific work plans shall be used.

Personnel shall use As Low As Reasonably Achievable (ALARA) principles to minimize exposure.

5. Quality Control

Instrument calibrations are performed, in accordance with the manufacturer's recommendations, by a qualified vendor. Frequently, the probe and meter will have separate calibration stickers. However, the probe and meter are required to be calibrated as a unit. Therefore, the calibration dates must be the same for both, and the calibration sticker(s) must have evidence that they were calibrated as a unit.

The check sources shall be manufactured from NIST traceable material. However, they are not required to have current calibrations.

6. Special Equipment

Radiation survey instrument, including the instrument operating manual, if applicable.

Applicable source for the survey meter, as shown in Appendix A. The minimum activity above background that should be used to test a surface contamination survey instrument's response is approximately 150 cpm or 4,000 dpm/100cm^2. Source activities below this value will not yield statistically valid variations within the ±20% acceptance criterion specified in the ANSI standard.

7. Material

Shielding and/or source placement devices necessary to obtain appropriate count rates and repeatable geometries.

8. Instructions

8.1 Instrument Configurations

For analog meters, the instrument should be tested on each scale normally used (or expected to be used) in the performance of radiological surveys. For microprocessor-based digital instruments (which do not have "scales"), the instrument should be tested at least three points over the activity range expected to be measured in the performance of radiological surveys. Selection of a range is not necessary for microprocessor controlled or auto-ranging instruments. For these instruments, check the instrument's response at three points over the anticipated range of radioactivity to be measured in field operations. Indicate "Auto-Ranging" in the "Scale" column.

For each applicable scale or activity range, choose a source-to-detector distance and geometry and any shielding necessary to obtain an instrument response at or near the middle of the scale. If the performance check will be a static count, select the applicable count time. If the performance check is a count rate, the count time will be "N/A". Document the applicable configurations in Instrument Configuration section of the Portable Radiation Survey Instrument Operation Performance Check Data Sheet, Form SOP-RAD-01.1 (Appendix B).

8.2 Instrument Response Control Limits

Note: Control limits should be established promptly upon receipt of an instrument following repair and/or calibration, relocation from another location, or when a new check source will be used. The instrument response control limits used for the Daily Source Checks are valid only at the location (site) where the data used to establish the control limits were collected.

8.2.1 Perform miscellaneous instrument checks as described in Section 8.3.

8.2.2 Select the correct source (in accordance with Appendix A) for the instrument being checked.

8.2.3 Obtain any necessary shielding, as documented in the Instrument Configuration section of form SOP-RAD-01.1.

8.2.4 Record the following information at the top of form SOP-RAD-01.1:

- Project,
- Location (site),
- Instrument manufacturer, model number, and serial number,
- Probe manufacturer, model number, and serial number,
- Instrument and probe calibration and calibration due dates,
- Scaler/Probe efficiency, and
- Radioactive check source identification number and isotope.

8.2.5 Count the source. If the performance check is a static count, count the source for the length of time specified in the configuration. If the performance check is a count rate, count the source long enough to allow the count rate to stabilize (normally approximately 30 seconds).

8.2.6 Record the observed count or count rate.

8.2.7 Repeat steps 8.2.5 and 8.2.6 until five data points have been generated.

8.2.8. Measure the instrument background using the same procedure and record the background count or count rate.

8.2.9 Calculate the average count or count rate as shown in Step 9.1, as applicable, and record on form SOP-RAD-01.

8.2.10 Calculate the control limits as shown in Step 9.2 and record these values in the appropriate locations on form SOP-RAD-01.1. Limits need to be recorded on page 1 and on continuation sheets.

8.2.11 Repeat steps 8.2.2 through 8.2.10 for each type configuration for the instrument being checked. A separate form will be used for each type of radiation (or each different source) that is used to test the instrument.

8.3 Miscellaneous Instrument Checks

8.3.1 Prior to establishing control limits or performing the daily instrument performance checks, the following items shall be checked, as applicable for the instrument.

- Inspect the instrument to verify that the calibration is current. Refer to Section 5 for additional information regarding calibration requirements.
- Check the batteries to ensure that sufficient battery strength is available. Replace the batteries, if necessary.
- Check the physical condition of the instrument to ensure that there is no obvious damage that might impact proper instrument response.
- Check for audible response to a source (as applicable).

8.3.2 If all items checked are acceptable, check (√) the Instrument Check box on form SOP-RAD-01. Add a note in the comments field if the batteries were changed.

8.3.3 If any of the checks are not acceptable, write "No" in the Instrument Check box and describe the problem in the comments field. Tag the instrument out of service.

8.4 Daily Instrument Response Check

8.4.1 Obtain the same source as the one used to establish the control limits.

8.4.2 Perform miscellaneous instrument checks as described in Section 8.3.

8.4.3 Measure the instrument response for each configuration, using the same source to detector distance, geometry, and shielding as listed on form SOP-RAD-01.1.

8.4.4 Record the instrument's response for each configuration.

8.4.5 Measure the instrument background.

8.4.6 Evaluate the results of each test against the applicable control limits. All results must be in control to be acceptable. Note the results of this evaluation (Pass or Fail).

8.4.7 If all of the results are acceptable, the instrument is released for use. If any of the results are not within the applicable control limit range, the performance check may be repeated once. Repeat counts shall be recorded on the next line in the log, and the recount annotated in the comments section. If the performance check fails a second time, tag the instrument "OUT OF SERVICE", provide a brief description of the problem, and notify supervision.

9. Calculations

9.1 Average Calculation

$$AVG = \frac{(y_1 + y_2 + \ldots y_n)}{n}$$

where: y = each individual count or count rate
n = number of counts

9.2 Control Limits

The control limits are established as follows:

Upper Control Limit = 1.2 * AVG
Lower Control Limit = 0.8 * AVG

where:

AVG = The average count or count rate, as applicable, determined in Step 9.1.

10. Records

10.1 Records Generated by this Procedure

Portable Radiation Survey Instrument Operation, Performance Check Data Sheet, Form SOP-RAD-01.1.

10.2 Supervisory Review

Review the completed documentation to ensure completeness, accuracy, legibility, and reproducibility.

Compare the data recorded with data from like instruments and data for the same instrument from previous months to determine if trends are developing or unexpected results were obtained.

Notify the Radiological Safety Officer or Project Manager of any trends or unexpected results.

10.3 Record Disposition

Maintain the documentation generated by this procedure with the project records. Retention of these records will be in accordance with the requirements for the project records.

11. References

ANSI N323 – 1997, Radiation Protection Instrumentation Test and Calibration.

12. Appendices

Appendix A – Instruments and Applicable Check Sources

Appendix B – Portable Radiation Survey Instrument Operation Performance Check Data Sheet, Form SOP-RAD-01.1, Rev. 1

13. Supersession

This procedure supersedes procedure SOP-RAD-01, Rev. 0, January 2005.

Appendix A

Instruments and Applicable Check Sources

Source	Instruments
Sr-90	β/γ Exposure/Dose rate ion chamber survey instruments
Cs-137 or Ra-226	γ Exposure/Dose rate survey instruments
Cl-36 or Tc-99	Contamination Rate meters with β probes
Th-230	Contamination Rate meters with α probes

Note: *Sources not listed above shall be approved for use by the Radiological Safety Officer.*

Appendix B

Portable Radiation Survey Instrument Operation
Performance Check Data Sheet

Project_____
Location _____

Check Source Information
Source ID _____
Isotope(s) _____
Activity/Units _____

Survey Instrument Information
Manufacturer _____
Model _____
Serial Number _____

Detector/Probe Information (if applicable)
Manufacturer _____
Model _____
Serial Number _____

Calibration Information
Scaler Calibration Date _____
Scaler Calibration Due Date_____
Detector/Probe Calibration Date_____
Detector Probe Cal. Due Date_____

Calibration Efficiency_____

Instrument Configuration				
Configuration	Scale	Source/Detector Distance	Shielding	Count Time (minutes)
1				
2				
3				

Check Source Control Limits Check Source Control Limits										
Configuration	Observed Count or Count Rate					Average	Background	LCL	UCL	Units
1										
2										
3										
CL Generated By: _____ **Date:** _____										
CL Reviewed By: _____ **Date:** _____										

Performance Check Data (continuation sheet)			
Established Control Limits (from page 1) by Configuration			
Configuration	**1**	**2**	**3**
Lower Control Limit			
Upper Control Limit			

Date/Time	Observed Gross Count/Count Rate by Configuration			Background	Units	Pass/ Fail	Instrument Checks	Initials	Comments
	1	2	3						

Stoller

Document No: SOP-RAD-02, Rev.1

Title: Swipe Sample Collection

Approved: _____ Date 10/7/05
Stoller Health and Safety Manager/
Radiation Safety Officer

Approved: _____ Date 10/7/05
Stoller Quality Assurance

Approved: _____ Date 10/7/05
Stoller Project Director and
Alternate Radiation Safety Officer

Revision Number	Date
0	1/17/05
1	10/7/05

UNCONTOLLED WHEN PRINTED

1. Introduction

1.1 Summary

This procedure establishes the requirements and provides instructions to collect swipe samples for the purpose of determining the level of removable contamination on solid surfaces. The objective of the procedure is to establish a uniform method for collecting swipe samples to achieve data comparability.

The techniques described in this procedure are wet and dry swipe sampling, tape press sampling, and large area swipes (LAS). Wet and dry swipe techniques are used to test for removable contamination on hard surfaces. Tape press swipes are used to test for removable contamination on rough or soft surfaces where normal swipe techniques would not be effective. Tape press swipes may also be used when the contamination is believed to be present as "hot particles" as opposed to widely distributed contamination. LASs are used to obtain a gross indication of contamination over large areas or large pieces of equipment. LAS may be used to check normally clean areas or materials not suspected of having contamination.

1.2 Scope

This procedure is limited to the collection of swipes for contaminants that can be sampled using wet or dry swiping techniques or a tape press sampling technique. It was specifically written for surveying for radionuclide contaminants. However, it may be applicable for other contaminants provided that the contaminant(s) of concern can be adequately removed using one of the techniques provided in this procedure.

2. Definitions

Swipe Sample (Smears): A sample collected by wiping a hard surface with an absorbent pad in such a manner that the removable contamination on the swiped surface will be transferred onto the pad.

Tape Press Swipe: A sample collected by pressing a piece of tape onto the survey area in such a manner that the removable contamination on the survey area will be transferred onto the tape.

Removable Contamination: The fraction of the radioactive contamination present on a surface that can be transferred to a swipe or piece of tape by rubbing with moderate pressure.

3. Responsibilities and Qualifications

Sampling personnel shall be trained and qualified on this procedure. This training shall be documented in the project files using training rosters and/or read and sign sheets.

Sampling personnel shall have the required training to enter the job site, or be escorted by qualified personnel, as permitted by the Site-Specific Health and Safety Plan.

The Project Manager, in conjunction with the Radiation Safety Officer, has the responsibility to ensure that the swipe sample collection method/materials are appropriate for the project needs.

4. Safety

Sampling personnel shall understand the potential hazards of the job site and comply with the requirements of the site-specific work plans and the Site-Specific Health and Safety Plan.

Gloves (latex, Nitrile, or equivalent) are the minimum protection required for the collection of swipe samples. In addition to these minimum requirements, personal protective equipment (PPE) specified in project-specific work control documents or posted in the work area shall be worn.

Personnel shall employ "As Low As Reasonably Achievable (ALARA)" principles to minimize exposure.

5. Quality Control

Two blank smears shall be submitted with the samples when smears are collected for low-energy beta-emitting isotopes.

6. Special Equipment

No special equipment is required for this procedure.

7. Material

The materials used to collect swipe samples will vary depending on the surface to be swiped and the contaminant(s) of concern. The project-specific work plan may dictate specific sampling materials. For certain types of contaminants, the laboratory that will perform the swipe analysis may provide the sampling materials. In the event specific guidance is not provided, the Project Manager will specify the sampling methods/materials. The following information can be used as a guideline.

7.1 Alpha and Hi-Energy Beta/Gamma-Emitting Isotopes

- Disc smears, such as Defensap® swipes, or other suitable soft absorbent cloth swipes
- Tape, 2-inch wide, duct tape, or other suitable tape (tape press method only)
- Tape press jig (tape press method only)
- Protective envelope, such as a Glassine envelope (if not provided with swipe)

7.2 Low-Energy Beta-Emitting Isotopes (including tritium)

- Whatman 41 filter paper or polystyrene smear papers (as specified by laboratory)
- Vials for smear
- Wetting solution (glycerin or de-ionized water, for tritium only)

7.3 Large Area Smears

- Masselin cloth, or other absorbent cloth

8. Instructions

8.1 Swipe Sample Collection

Note: This section is applicable to collection of wet or dry swipes from hard surfaces. The physical collection of the sample is the same for wet and dry swipes.

8.1.1. Select sampling locations based on project objectives and the purpose of the swipe samples identified in project-specific work plans. Swipes normally cover an area of approximately 100 cm^2. However, in some instances the survey requirements may be based upon a different survey area. Ensure that the applicable area is surveyed. Some projects may require use of a paper template to control the size of the survey area. When the item to be surveyed has an area less than 100 cm^2, estimate the actual area surveyed.

8.1.2 If the smear will be analyzed for tritium, apply a thin film of de-ionized water or glycerin to the smear, unless the smears come pre-wetted from the laboratory. This may be done by dipping the smear into the container of sorbent, and allowing the excess sorbent to drip back into the container. Care must be taken to keep the forceps or tweezers uncontaminated in order to ensure that the sorbent remains uncontaminated. In hot or very dry environments, glycerin is the preferred sorbent due to the significant evaporation rate of water.

8.1.3 Collect the swipe by moving the smear paper in an "S-shaped" pattern over the area to be sampled. Apply moderate pressure to the smear paper during swipe collection. The pattern should cover an area approximately 4-inches (one hand-width) wide and 9-inches in length for a 100 cm^2 swipe.

8.1.4 If swipes will be analyzed by liquid scintillation counting (typically low-energy beta emitters), prepare two blank smears, using the same technique except do not swipe anything with the prepared swipes.

8.1.5 Place the swipe in an envelope or in a vial, as applicable. If a vial is used, secure the lid tightly.

Note: If the swipe will be analyzed by liquid scintillation counting, the exterior of the vial may not be written on. A separate label secured with a rubber-band to the top or outside of the vial should be used for these samples.

Note: If the swipes are being taken as part of an area survey or for release of equipment, the description or location of the swipe may be referenced to the survey map or release survey form to satisfy the description requirement listed in the following step.

8.1.6 Record the following information on the envelope or vial:

- Date/time of sample collection
- Name (or initials) of person collecting the swipe
- Description of sampling location in sufficient detail to definitively identify where the swipe was taken
- Size of area surveyed
- Sorbent, if applicable

8.1.7 Submit the swipe for counting or analysis.

8.2 Tape Press Sample Collection

Note: This section is applicable to collection of swipe samples from soft or rough surfaces, or when presence of "hot particles" is suspected.

8.2.1 Place tape over a tape press jig or use a strip of tape approximately 2" x 8".

8.2.2 Place tape press jig (or tape) on the survey area and apply moderate pressure. Do not rotate or "grind" the tape onto the surface.

8.2.3 If the sample will not be immediately counted, place the sample into a protective container, taking care to prevent the tape from adhering to the container.

8.2.4 Submit the sample for counting or analysis.

8.3 Large Area Smears

Note: This type of smear should be used to supplement standard swipe techniques in areas generally assumed not to be contaminated, such as entrances to radiological areas. If an evaluation indicates that an area wiped is contaminated, a thorough contamination swipe survey should be performed (Section 8.1).

8.3.1 Wipe over the area to be surveyed with a masselin or other absorbent cloth.

8.3.2 Count the swipe using a contamination survey instrument capable of detecting the type of contamination suspected.

8.3.3 Calculate the results in dpm using the highest reading observed and the area correction factor (total swipe area/measured area).

8.3.4 Report the results in dpm/LAS. If the data indicate that the contamination level is above the allowable limit, perform a swipe survey as described in Section 8.1.

9. Calculations

If the item smeared is less than 100 cm^2, the results shall be reported as dpm/"estimated size of area smeared" in cm^2 and normalized to dpm/100 cm^2 unless the requirement is based on a different size area.

10. Records

If the smears will be submitted to a laboratory for analysis, complete the required chain of custody form. If the swipes will be counted at the project site, no records are specifically generated by this procedure. Smears are generally taken in support of actions such as release of equipment or materials or area surveys. The documentation associated with these activities will be discussed in the applicable procedure.

11. References

There are no references for this procedure.

12. Appendices

There are no appendices to this procedure.

13. Supersession

This procedure supersedes procedure SOP-RAD-02, Rev. 0, January 2005.

Stoller

Document No: SOP-RAD-31, Rev 0

Title: Counting Systems Operation

Approved: _____ Date 10/7/05
Stoller Health and Safety Manager/
Radiation Safety Officer

Approved: _____ Date 10/7/05
Stoller Quality Assurance

Approved: _____ Date 10/7/05
Stoller Project Director and
Alternate Radiation Safety Officer

Revision Number	Date
0	1/17/05
1	10/7/05

UNCONTOLLED WHEN PRINTED

1. Introduction

1.1 Purpose

The purpose of this procedure is to provide instructions for performance testing and the routine operation of the laboratory integrated scaler counting systems. It also includes the procedure to establish the control limits used for instrument performance tests.

1.2 Scope

This procedure addresses testing and operation of integrated laboratory scaler counting systems used for radiometric measurements. It includes requirements common to all types of integrated counting systems. It does not include specific operating instructions for each counting system. These instructions are provided in the applicable instrument operating manual.

1.3 Applicability

This procedure only applies to radionuclides with a half-life of 405 days (1.1 years) or longer. This procedure does not cover the operation of field-use instruments.

2. Definitions

ALARA: As Low As Reasonably Achievable

Location: A new location or site, for the purpose of this procedure, means a location with an altitude that varies by more than 1,000 feet from the altitude at which the control limits were previously established.

3. Responsibilities and Qualifications

Personnel using this procedure must be qualified to handle radioactive sources and to operate the instrument that is being used. Documentation of this training will be maintained in the project files.

The Project Manager shall ensure that the count time(s) used for project samples generate data with a minimum detectable activity (MDA) that is adequate for the intended use of the data.

4. Safety

Gloves (latex, Nitrile, or equivalent) are required to be worn when handling samples and sources. Safety glasses are also required to be worn when handling beta-emitting sources. In addition to these minimum requirements, personal protective equipment (PPE) specified in project-specific work control documents or posted in the work area shall be worn.

Samples shall be handled with care to prevent cross-contamination.

Radioactive sources shall be handled by the edges to avoid damaging the active area.

Personnel shall use "As Low As Reasonably Achievable (ALARA)" principles to minimize exposure from sources and elevated activity samples.

5. Quality Control

5.1 Calibration

Instrument calibrations are performed, in accordance with the manufacturer's recommendations, by a qualified vendor. At a minimum, the calibration shall be performed annually. Frequently, the probe and meter will have separate calibration stickers. However, the probe and meter are required to be calibrated as a unit. Therefore, the calibration dates must be the same for both, and the calibration sticker(s) must have evidence that they were calibrated as a unit.

Only instruments with a current calibration may be used. Instruments with an expired calibration shall be tagged "Out of Service" and supervision shall be notified.

5.2 Performance Check Requirements

NOTE: If the scaler is used for both alpha and beta counting, the efficiency (check source) and background will be tested for both channels.

5.2.1 Instrument performance shall be verified each working day before the instrument is used.

5.2.2 Performance checks include miscellaneous instrument checks, efficiency (check source) checks, and instrument background checks. The performance check procedure is described in Subsection 8.2.

5.2.3 Control limits for check sources are established when the instrument is re-calibrated, when the location of the instrument changes, or when the check source used for the performance check is changed. The control limits are calculated as ± 10% of the average efficiency from ten counts of the check source.

5.2.4 The instrument background is dependent on the inherent scaler/detector background and environmental ambient radiation levels, which are affected by location and altitude. The acceptance criteria for instrument background will be based on a combination of the instrument background that is achievable (at the specific project site) and the required MDAs for data being generated with the instrument. The acceptance criteria for the instrument background(s) will be established based on these criteria at the inception of the project.

5.2.5 If the instrument fails to meet the acceptance criteria for background and/or check source (efficiency), the instrument will be tagged "Out of Service." Supervision shall be notified if this occurs.

5.2.6 The person(s) generating the data used to calculate control limits shall initial and date the top section of the check log. A second person who is technically qualified to review the data and calculations shall approve the established control limits.

5.3 Establishing Check Source Control Limits

NOTE: Control limits are established when the instrument is serviced, moved to a new location, or re-calibrated. New control limits are also established whenever a new check source will be used to perform the instrument check.

NOTE: If the instrument will be used for both alpha and beta counting, this section will be performed twice, once with each type of source. A separate log sheet will be used for alpha and beta data.

5.3.1 Obtain the appropriate check source for the instrument type.

5.3.2 Obtain a blank Integrated Scaler Performance Check Log, form SOP-RAD-31.1, Appendix A. Complete the instrument information at the top of the form and the check source information section.

5.3.3. Determine a count time for the source that will generate more than 10,000 counts. Record the Check Source Count Time on form SOP-RAD-31.1.

5.3.4 Set the count time on the scaler.

5.3.5 Count the source 10 times, removing the source and replacing it in a random position between counts. Record each count in the Check Source Information, Control Limit Data section of form SOP-RAD-31.1.

5.3.6 Calculate the average of the data set (counts) as shown in Step 9.1 and record it on form SOP-RAD-31.1 under Control Source Information Average Count.

5.3.6 Calculate the Upper and Lower Control Limits as described in Step 9.2, and record these values on form SOP-RAD-31.1 (under the Check Source Information section).

5.4 Establishing Background Control Limits

NOTE: If the limiting factor in achieving the required lower limit of detection is instrument background, the background control limit (upper limit only) may be based on the maximum background that will yield the desired MDA. If this is not the limiting factor, the control limits for background may be based on the average and standard deviation of a set of 20 background measurements.

5.4.1 Using the equation provided in Section 9.3, determine the maximum background count rate that will yield the desired MDA given the detector efficiency and desired count time. If this value is not significantly higher than the expected maximum (based upon counting statistics and normal instrument fluctuations), the maximum can be used as the upper control limit.

5.4.2 If the allowable maximum is significantly higher than expected maximum, the control limits can be established based on statistical variation in a set of background counts. If this is the appropriate method, collect 20 background counts (using the routine sample count time). Calculate the average and standard deviation of the data set. Establish the upper and lower control limits as the average count rate plus and minus 3 standard deviations, respectively.

5.4.3 Document the background count time, applicable control limit(s) and data used to generate these limits, if applicable, and the basis for those limits on form SOP-RAD-31.1.

6. Special Equipment

Integrated scaler counting system, including the instrument operating manual(s).

Applicable check source(s) for the scaler. The check source shall have the appropriate geometry (diameter and thickness), activity type, and energy for the system being checked. The activity of the source should be high enough to produce between 500 cpm and 30,000 cpm. The check source shall be manufactured from NIST traceable material.

7. Material

Stainless steel planchets or vendor-supplied sample holders.

Integrated Scaler Performance Check Log, Form SOP-RAD-31.1, Appendix A

Defensap® cloth swipes, or equivalent

Tweezers or forceps

8. Instructions

8.1 Instrument Start-Up

8.1.1 If the instrument is off, turn it on and allow it to warm-up/stabilize according to manufacturer's instructions.

8.1.2 Inspect the instrument to verify that the calibration is current. Refer to Section 5 for additional information regarding calibration requirements.

8.2 Performance Checks

NOTE: Performance checks are required to be performed daily, or before each use, whichever is less frequent. If the instrument is used for both alpha and beta counting, the background and check source performance tests will be performed for both channels. Acceptable performance check results must be obtained before the instrument can be used.

8.2.1 Miscellaneous Instrument Checks

- Examine the instrument and cable(s) for visible damage or defects. If damage or defects are noted, do not use the instrument. Tag it "Out of Service" and inform supervision.
- Ensure that display(s) is(are) readable.
- Ensure that the timer light is working properly, if applicable.

8.2.2 Background Check

- Obtain a clean smear and place it on a clean planchet.
- Place the planchet into the counting instrument.
- Count the background for the pre-selected count time. The background count time should be the same as the routine sample count time. However, if the sample count times are longer than 10 minutes, a 10-minute background count time will be used, unless otherwise specified in project-specific work plans. Record the background count on form SOP-RAD-31.1.
- Repeat the background counts for a total of five background counts.
- Calculate the average background count rate (cpm) and record on form SOP-RAD-31.1.
- Compare the average background count rate to the acceptance criteria. Note the result of the evaluation (Pass/Fail) on the check log. If the background data do not meet the performance criteria, tag the instrument "Out of Service" and inform supervision.

8.2.3 Source Check

- Obtain the appropriate check source.
- Place the source into the counting instrument.
- Count the source for the pre-selected count time (as noted on the check log). Record the source count on form SOP-RAD-31.1.

- Compare the source count to the acceptance criteria. Note the result of the evaluation (Pass/Fail) on the check log. If the background data do not meet the performance criteria, tag the instrument "Out of Service" and inform supervision.

8.3 Routine Use of Instrument

8.3.1 Turn on the instrument as described in Subsection 8.1.

8.3.2 Refer to the Performance Check Log. If the instrument has not been performance checked for the day, complete the Performance Check tests as described in Subsection 8.2.

8.3.3 Select the count time for the type of sample being counted. The appropriate count time(s) for the types of samples being counted for a particular project will be posted on the instrument or specified by the Field Supervisor.

8.3.4 Using tweezers, remove the swipe from the envelope and place the swipe on a clean planchet.

8.4.5 Place the planchet in the detector, close the drawer, and start the count.

8.4.6 At the end of the count, the instrument will display the total number of alpha and/or beta, as applicable, counts that occurred.

8.4.7 Record the count time and counts on the smear envelope.

8.4.8 Remove the planchet from the drawer and return the swipe to its labeled envelope.

8.4.9 Calculate the activity of the smear (dpm) and the MDA (dpm) using the equations provided in Section 9.

8.4.10 Periodically clean (or replace) the planchet used to count swipes.

9. Calculations

Note: If the instrument is being used to measure both alpha and beta activity, the calculations below will be performed for each channel.

9.1 Efficiency Control Limits

$UCL = 1.1 * S_{Avg}$
$LCL = 0.9 * S_{Avg}$

Where:
LCL = Lower control limit
UCL =Upper control limit
S_{Avg} = Average count rate of check source data set (Step 9.1)

9.2 Sample Activity (dpm)

$$Activity = \frac{C_s - C_b}{Eff}$$

Where:

C_b	=	average count rate (cpm) of instrument background
C_s	=	average count rate (cpm) of sample
Eff	=	efficiency of detector from calibration certificate

9.3 Minimum Detectable Activity (MDA) (dpm)

$$MDA = \frac{3 + 3.29\sqrt{R_b t_s * \left(1 + \frac{t_s}{t_b}\right)}}{Eff * t_s}$$

Where:

R_b	=	count rate (cpm) of instrument background
Eff	=	efficiency instrument from calibration certificate
t_b	=	count time for background (minutes)
t_s	=	count time for sample (minutes)

10. Records

10.1 Records Generated by this Procedure

Integrated Scaler Performance Check Log Sheet, Form ST-RAD-31.1.

10.2 Supervisory Review

Review the completed documentation to ensure completeness, accuracy, legibility, and reproducibility.

Compare the data recorded with data from like instruments and data for the same instrument from previous months to determine if trends are developing or unexpected results were obtained.

Notify the Radiological Safety Officer or Project Manager of any trends or unexpected results.

10.3 Record Disposition

Maintain the documentation generated by this procedure will be maintained with the project files.

11. References

ANSI N323 – 1997, Radiation Protection Instrumentation Test and Calibration.

12. Appendices

Appendix A – Integrated Scaler Performance Check Log Sheet, Form SOP-RAD-31.1

13. Supersession

This procedure is original.

Appendix A

INTEGRATED SCALER PERFORMANCE CHECK LOG

Radiation Type (circle one) **ALPHA BETA**

Scaler/Probe Description _____

Scaler/Probe Serial Number(s)_____

Efficiency (from calibration certificate)_____

CHECK SOURCE INFORMATION			
Isotope(s)	*Serial Number*	*SV (dpm)*	*Reference Date*

CONTROL LIMIT DATA				

Check Source Count Time (min)	Lower Control Limit
Average count	Upper Control Limit

BACKGROUND CONTROL LIMIT INFORMATION
Background Count Time (min)

CONTROL LIMIT DATA				

Basis for Control Limits	Lower Control Limit (cpm)
	Upper Control Limit (cpm)

Initials/Date Reviewer/Date

PERFORMANCE CHECK DATA

Date	Check Source Data		Instrument Background Data								Initials	Comments
	OV	Pass/Fail	#1	#2	#3	#4	#5	Avg.	Avg. cpm	Pass/Fail		

INTEGRATED SCALER PERFORMANCE CHECK LOG

Radiation Type (circle one) **ALPHA** **BETA**

(continuation sheet)

Scaler/Probe Description _____

Scaler/Probe Serial Number(s)_____

Efficiency (from calibration certificate)_____

Check Source LCL _____ UCL_____

Bkg (cpm) LCL _____ UCL_____

PERFORMANCE CHECK DATA													
Date	Check Source Data		Instrument Background Data								Initials	Comments
	OV	Pass/Fail	#1	#2	#3	#4	#5	Avg.	Avg. cpm	Pass/Fail		

Form SOP-RAD-31.1, Rev. 0

Page _____

Appendix E
Example Survey Forms

S.M.STOLLER PACKAGE RADIOLOGICAL SURVEY FORM

Survey Type:	**INSTRUMENT DATA**					
Location:	**Mfg.**					
Purpose:	**Model**					
Date:	**Serial #**					
Time:	**Cal Due**					
Surveyed by:	**Bkg.**					
Comments:	**Efficiency**					
	MDA					

ALPHA/BETA TOTAL AND REMOVABLE CONTAMINATION SURVEY								
Location	Total alpha		Removable alpha		Total beta		Removable beta	
	cpm/100 cm^2	dpm/100 cm^2	cpm/100 cm^2	dpm/100 cm^2	cpm/100 cm^2	dpm/100 cm^2	cpm/100 cm^2	dpm/100 cm^2
1								
2								
3								
4								
5								
6								
7								
8								

GAMMA DOSE RATE SURVEY (µrem/hr)					
Location	@ surface	@ 1 meter	Location	@ surface	@ 1 meter
1			5		
2			6		
3			7		
4			8		

DRAWING SHOWING SURVEY POINTS

S.M.STOLLER RADIOLOGICAL SURVEY FORM

Survey Type:	INSTRUMENT DATA					
Location:	Mfg.					
Purpose:	Model					
Date:	Serial #					
Time:	Cal Due					
Surveyed by:	Bkg.					
Comments:	Efficiency					
	MDA					

SURVEY RESULTS

DRAWING SHOWING SURVEY POINTS

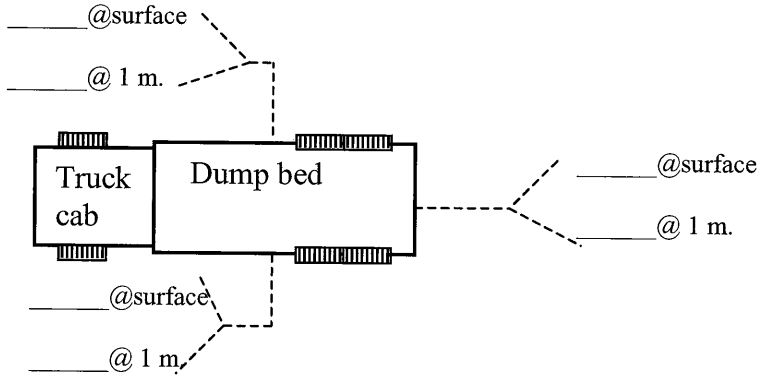
S.M. STOLLER TRUCK RADIATION SURVEY FORM

Date/Time: _____

Truck Survey: **Incoming** ☐ **or Outgoing** ☐ **Surveyed by:**_____

Trucking Company: _____ **Truck license plate no. /state:** _____

Gamma Dose Rate Survey (μrem/hr)

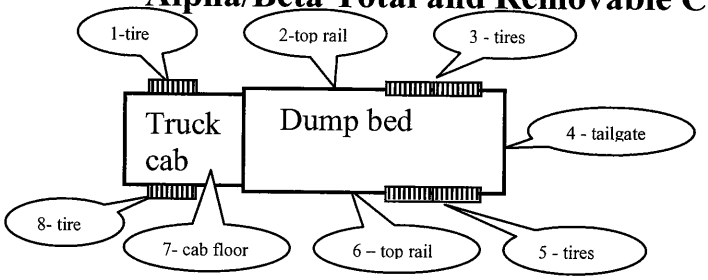


Notes:
Dose rates should be recorded at highest reading for each side.

Incoming Limits (49CFR 173.443)
0.5 mrem/hr at surface

Outgoing Limits (49CFR 173.441)
200 mrem/hr at surface
10 mrem/hr at 1 m
(If surface is <10mrem/hr, survey is complete.)

Alpha/Beta Total and Removable Contamination Survey



Removable Contamination limits:
Alpha: 220 dpm/100 cm^2
Beta: 2200 dpm/100 cm^2

*If total reading is less than limit, survey is complete. If total reading is greater than limit, collect smear and count for removable.

Location	Total alpha		Removable alpha*		Total beta		Removable beta*	
	cpm/100 cm^2	dpm/100 cm^2	cpm/100 cm^2	dpm/100 cm^2	cpm/100 cm^2	dpm/100 cm^2	cpm/100 cm^2	dpm/100 cm^2
1								
2								
3								
4								
5								
6								
7								
8								

INSTRUMENT DATA				
Mfg.				
Model				
Serial #				
Cal Due				
Bkg.				
Efficiency				
MDA				