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ENGINEERING CHANGE NOTICE

Page 1 of 2

1. ECN 196701

Proj. ECN

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.		4. Date
Supplemental [] Direct Revision [x] Change ECN [] Temporary [] Standby [] Supersedure [] Cancel/Void []	R. R. Lehrschall, Environmental Restoration Safety Support, H4-67, 376-6788		4-15-93
	5. Project Title/No./Work Order No. Aggregate Safety Assessment for Shallow/Near Surface Activities, Vol. 2	6. Bldg./Sys./Fac. No. Hanford Site	7. Impact Level 2 ESQ
	8. Document Numbers Changed by this ECN (includes sheet no. and rev.) WHC-SD-EN-SAD-016, VOL 2 Rev. 0-B	9. Related ECN No(s). 189906	10. Related PO No. N/A

11a. Modification Work	11b. Work Package No.	11c. Modification Work Complete	11d. Restored to Original Condition (Temp. or Standby ECN only)
[] Yes (fill out Blk. 11b) [x] No (NA Blks. 11b, 11c, 11d)	N/A	N/A Cog. Engineer Signature & Date	N/A Cog. Engineer Signature & Date

12. Description of Change

Changes have been made to the baseline safety assessment document addressing cone penetrometer work on the Hanford Site. These changes identify the work scope associated with the cone penetrometer soil gas sampling activities. Also included are prudent actions and an operational safety limit defining the appropriate controls that should be considered when performing soil gas sampling using the cone penetrometer system.

MAY 1993 RECEIVED EDMC

13a. Justification (mark one)

Criteria Change [x]	Design Improvement []	Environmental []	
As-Found []	Facilitate Const. []	Const. Error/Omission []	Design Error/Omission []

13b. Justification Details

The proposed changes are required to support soil gas sampling activities for determining the concentrations of carbon tetrachloride in the vadose zone soils. This will provide the basis for determining the most critical areas requiring vapor vacuum extraction operations on the Hanford Site.

14. Distribution (include name, MSIN, and no. of copies)

See attached distribution sheet.

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DATE APR 22 1993

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Page 2 of 2

1. ECN (use no. from pg. 1) 196701

15. Design Verification Required	16. Cost Impact				17. Schedule Impact (days)	
	ENGINEERING		CONSTRUCTION			
[] Yes	Additional	[] N/A	Additional	[] N/A	Improvement	[]
[X] No	Savings	[] N/A	Savings	[] N/A	Delay	[] N/A

18. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 12. Enter the affected document number in Block 19.

SDD/DD	[]	Seismic/Stress Analysis	[]	Tank Calibration Manual	[]
Functional Design Criteria	[]	Stress/Design Report	[]	Health Physics Procedure	[]
Operating Specification	[]	Interface Control Drawing	[]	Spares Multiple Unit Listing	[]
Criticality Specification	[]	Calibration Procedure	[]	Test Procedures/Specification	[]
Conceptual Design Report	[]	Installation Procedure	[]	Component Index	[]
Equipment Spec.	[]	Maintenance Procedure	[]	ASME Coded Item	[]
Const. Spec.	[]	Engineering Procedure	[]	Human Factor Consideration	[]
Procurement Spec.	[]	Operating Instruction	[]	Computer Software	[]
Vendor Information	[]	Operating Procedure	[]	Electric Circuit Schedule	[]
OM Manual	[]	Operational Safety Requirement	[]	ICRS Procedure	[]
FSAR/SAR	[]	IEFD Drawing	[]	Process Control Manual/Plan	[]
Safety Equipment List	[]	Cell Arrangement Drawing	[]	Process Flow Chart	[]
Radiation Work Permit	[X]	Essential Material Specification	[]	Purchase Requisition	[]
Environmental Impact Statement	[]	Fac. Proc. Samp. Schedule	[]	Hazardous Waste Operations Permit	[X]
Environmental Report	[]	Inspection Plan	[]		[]
Environmental Permit	[]	Inventory Adjustment Request	[]		[]

19. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

Document Number/Revision	Document Number/Revision	Document Number Revision
NA		

20. Approvals

Signature	Date	Signature	Date
OPERATIONS AND ENGINEERING		ARCHITECT-ENGINEER	
Cog Engineer B. R. Cassem	4-22-93	PE	
Cog. Mgr. D. J. Moak	4-22-93	QA	
QA T. M. Bennington	4/22/93	Safety	
Safety M. A. Tredway	4/22/93	Design	
Security	4/22/93	Environ.	
Environ. K. A. Gano	4/22/93	Other	
Projects/Programs			
Tank Waste Remediation System			
Facilities Operations		DEPARTMENT OF ENERGY	
Restoration & Remediation		Signature or Letter No.	
Operations & Support Services			
IRM		ADDITIONAL	
Safety K. A. Smith	4/22/93		
ERSS N. R. Kerr	4-22-93		
RRSA J. J. Zimmer	4/21/93		

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SUPPORTING DOCUMENT	1. Total Pages 24

2. Title	3. Number	4. Rev No.
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Characterization Sampling/Remedial Activities Aggregate Safety Assessment Radioactive Contaminated Fugitive Dust	Name: R. R. Lehrschall R. R. Lehrschall Signature Organization/Charge Code 29550/PE7HB

APPROVED FOR PUBLIC RELEASE 4-23-93 N. Solis

7. Abstract

This document is the aggregate safety assessment for shallow/near surface sampling activities in support of Hanford Site characterization.

8. PURPOSE AND USE OF DOCUMENT - This document was prepared for use within the U.S. Department of Energy and its contractors. It is to be used only to perform, direct, or integrate work under U.S. Department of Energy contracts. This document is not approved for public release until reviewed.

PATENT STATUS - This document copy, since it is transmitted in advance of patent clearance, is made available in confidence solely for use in performance of work under contracts with the U.S. Department of Energy. This document is not to be published nor its contents otherwise disseminated or used for purposes other than specified above before patent approval for such release or use has been secured, upon request, from the Patent Counsel, U.S. Department of Energy Field Office, Richland, WA.

9. Impact Level 2 ESQ

10. RELEASE STAMP

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DATE APR 22 1993
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RECORD OF REVISION

(1) Document Number	Page
WHC-SD-EN-SAD-016	Page 2

(2) Title

Main Title: Safety Assessment for Environmental Investigations and Site Characterizations
Volume 2: Aggregate Safety Assessment for Shallow/Near Surface Activities

CHANGE CONTROL RECORD

(3) Revision	(4) Description of Change - Replace, Add, and Delete Pages	Authorized for Release (5) Cog. Engr.	Authorized for Release (6) Cog. Mgr. Date
OA	(7) Revisions ave been made to Table 1 (page 2) to reflect changes in the updated version of WHC-CM-7-7.	J.M. Frain (signature on file)	G.C. Henckel III (signature on file)
	Rev. 0 released per EDT 160032 Rev. 0-A released per ECN 148559 Rev. 0-B released per ECN 189906		
0-B	Updated table of contents and inserted page ii. Revisions have been made to pages 1, 2, 3, 4, 5, 7, 8, 10, 11, 12, 13, 14, 15, 16, and 17. These changes have been made to provide additional guidance to ensure controls are in place to mitigate any potential consequences from a release of radioactive contaminated fugitive dust resulting from remedial activities. In addition, the references have been revised.	M. J. Galgoul (signature on file 4/5/93	R. A. Carlson (signature on file 4/5/93)
	Rev. 0 released per EDT 160032 Rev. 0-A released per ECN 148559 Rev. 0-B released per ECN 189906 Rev. 0-C released per ECN 196701		
0-C RS	Updated table of contents. Revisions have been made to pages 1 through 18; changes have caused main text to increase to 22 pages. Revisions identify the work scope associated with the cone penetrometer soil gas sampling activities. Prudent actions and an operational safety limit have also been added to define the appropriate controls that should be considered when performing soil gas sampling activities using the cone penetrometer system. Attachment C has been added that provides an analysis of consequnces for a scenario involving release of carbon tetrachloride during cone penetrometer sampling activities.	B. R. Cassem R.R. Lehrschall for B.R. Cassem per telecon 4-22-93	D. J. Moak R.R. Lehrschall for D.J. Moak per telecon 4-22-93

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CONTENTS

ATTACHMENTS:

TABLES:

FIGURES:

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1.0 SUMMARY AND INTRODUCTION

The Westinghouse Hanford Company (WHC) manages the investigation and characterization of the Hanford Site for the U.S. Department of Energy (DOE). Groundwater well drilling, deep vadose zone boring, and shallow/near surface sampling are three categories of activities conducted for the purpose of characterizing soils on the Hanford Site. This safety assessment addresses the hazards associated with the shallow/near surface sampling activities.

The majority of the shallow/near surface sampling activities are involved with characterizing the upper 1 m (3 ft) of the vadose zone using trowels, spoons, and hand augers. Earth-moving equipment such as a backhoe is used for deeper soil sampling activities. Soil gas sampling is performed using a cone penetrometer system. Other investigative activities not directly related to the vadose zone such as concrete, pond sludge, and septic tank sampling are also classed as shallow/near surface sampling activities and are covered in this assessment. The Environmental Investigations Instructions (EII) in WHC-CM-7-7, *Environmental Investigations and Site Characterizations Manual* give descriptions of the sampling techniques and procedures for the various types of shallow/near surface sampling activities.

The hazards of the shallow/near surface sampling activities are a function of the quantity of hazardous material and the mechanisms available for dispersing the material. Dispersal of material in air provides the potential avenue for an internal deposition or further spread to the environment. Trench and test pit sampling are examples of the types of activities that present an accumulation of material and provide a potential mechanism for dispersal. The hazardous material consists of potential radiological and nonradiological hazardous substances entrained in the soil.

The radionuclides found in the Hanford Site soils have originated from operations involving mixed fission products. Isotopes of cobalt, strontium, cesium, europium, and uranium are commonly found. Concentrations in the surface soils have generally been found in the pCi/g range. Other hazardous nonradiological substances that may be encountered during shallow characterization activities are heavy metals and organic compounds. Concentrations of these substances in Hanford Site soils are normally measured in p/b [some volatile organic compounds (VOC) have been found in p/m concentrations in the vadose zone soils].

The review and authorization requirements of DOE 5481.1B, *Safety Analysis and Review System* specify the approval levels for hazardous activities (DOE 1986). These requirements would apply to mechanized soil and soil gas sampling (e.g., test pit, trench, auger, and cone penetrometer) in areas that did not meet the release criteria in WHC-CM-4-10, *Radiation Protection Manual* (Section 11). All other shallow/near surface sampling activities specified in WHC-CM-7-7 and WHC-CM-7-4, *Environmental Monitoring Manual* are considered general use and therefore exempt from additional safety analysis and review (DOE 1986).

For the large majority of the sampling activities, the procedures provided in WHC-CM-7-7 and WHC-CM-7-4 are adequate to assure safe operation. Job Safety Analyses (JSA), Radiation Work Permits (RWP) and Hazardous Waste Operations Permits (HWOP) also provide additional guidance for worker safety.

In the case of mechanized soil and soil gas sampling for site characterization, five operational safety limits (OSL) have been established that define the administrative controls required. These OSLs specify limits on surface contamination encountered during excavation, control of radiation exposures during excavation of soils in solid waste disposal sites, stabilization of soils, and monitoring for combustible gases or VOCs. These controls limit the inventory available for possible dispersion of contaminants and minimize the potential for these contaminants to become airborne.

2.0 WORK DESCRIPTIONS

Shallow/near surface sampling activities are performed to obtain samples from potential waste sources other than the deep vadose zone. The samples are then analyzed to determine if hazardous radioactive and nonradioactive substances are present.

The majority of these activities involve characterizing surface soils and the upper 1 m (3 ft) of the vadose zone. The equipment used to perform these particular activities include trowels, spoons and augers. Earth-moving equipment, such as a backhoe, is used for deeper sampling activities while the cone penetrometer is used for soil gas sampling. The following are investigative activities not directly related to the vadose zone, yet are classed under the same general heading of shallow/near surface sampling activities:

- Concrete sampling
- Sampling of septic tanks
- Surface wipes
- Sampling of underground fuel storage tanks (e.g., gas, diesel oil)
- Sampling of underground chemical storage tanks
- Pond sludge sampling
- Biotic/ecological sampling.

Details on sampling equipment and procedures for most of the work described above are contained in the EII (WHC-CM-7-7). Table 1 provides a list of activities and applicable EIIs. All samples will be screened with hand-held field instruments for alpha, beta, gamma radiation, VOCs, and combustible gases.

Table 1. Sampling Activities and Corresponding Environmental Investigations Instructions.

Activities	Environmental Investigations Instruction
Hand auger	5.2 Appendix A, 3.3
Scoop/spade/shovel	5.2 Appendix A, 3.5
Split-spoon	5.2 Appendix B
Test pits/trenches	5.2 Appendix I
Biotic sampling	5.3
Field decontamination	5.4
Soil-gas sampling	5.9
Mechanized auger	6.7 Appendix B

Source: WHC-CM-7-7

2.1 INVENTORIES

The intrinsic hazards of the shallow/near surface sampling activities are a function of the quantity of hazardous material and the mechanisms available for dispersing the material. The types of material sampled may include septic wastes, petroleum based fuels, pond sludge, concrete, soil gas, chemicals, and shallow soils. Radiological, organic and inorganic hazardous substances entrained in the sampled matrix are the inventories of concern.

The radionuclides found at the Hanford Site have originated primarily from operations involving mixed fission products. Isotopes of cobalt, strontium, cesium, europium, and uranium are some of the more common radionuclides. Concentrations in surface and subsurface soils have generally been found in the pCi/g range. The maximum contamination levels evaluated for in this assessment are 100 times the surface radioactivity guides (fixed plus removable) (DOE 1991) for beta/gamma decaying radionuclides, 100 times the guides (fixed plus removable) for uranium, and 100 times the guides for alpha decaying transuranics. For example, the maximum contamination levels would be 500,000 dpm/100 cm^2 for ^{60}Co, ^{137}Cs, and ^{152}Eu; 500,000 dpm/100 cm^2 for ^{238}U; 100,000 dpm/100 cm^2 for ^{90}Sr; and 50,000 dpm/100 cm^2 for ^{239}Pu.

Other hazardous nonradiological substances that may be encountered during characterization activities are heavy metals and organic compounds. Concentrations of these substances in the Hanford Site soils are relatively low (typically measured in p/b but have been found in p/m ranges). Environmental Engineering has provided a summary of controlling inorganic and organic contaminant concentrations that were derived from process analytical data of Hanford Site soils (see Attachment A). This list, summarized in Table 2, represents the maximum concentrations of limiting constituents that are anticipated.

Table 2. Hazardous Organic and Inorganic Substances Anticipated in Hanford Soils.

Analyte	Average concentration p/b	Maximum concentration p/b
Mercury	1.28	20
Lead	28	319
Chromium	54	380
Cyanide	51	246
Hydrazine	59	88
Carbon tetrachloride	4,352	8,700
Cyclohexane	670	900
Tetrachloroethane	410	1,200
Phenol	37	80

For most of the shallow/near surface sampling activities, the potential hazard inventory consists of the material sample volume that in most cases is less than one L. The methods (e.g., hand tools) used to obtain these samples generally do not provide sufficient energy for generating a source term to uninvolved individuals.

Excluding mechanized excavation sampling, mechanisms for generating a source term are not available in the shallow/near surface sampling activities. In the case of mechanized soil sampling, where there are relatively large volumes of dirt [>1 m^3 (0.3 ft^3)], potentially contaminated soil can be brought to the surface, and exposure to wind or other dispersal mechanisms can occur. Any mechanized soil gas sampling could potentially result in small concentrations of CCl_4 vapors being released at the work site. The worst case concentrations of 25,000 p/m (under static well conditions) CCl_4 detected has been at the 216-Z Crib sites in the 200 West Area.

The shallow/near surface sampling activities can be segregated into five categories:

1. Nonintrusive/nonaccumulative (soil gas sampling, radiological surveys, etc.). Based on the lack of a material hazard, the activities fitting this description are excluded from safety review requirements.

2. Intrusive/accumulative sampling (mechanized or nonmechanized), where no contaminants are anticipated. Based on the lack of a material hazard, the activities fitting this description are excluded from safety review requirements.

3. Nonmechanized intrusive/accumulative sampling where the small volumes (measured in L) of accumulated material exceed the release criteria provided in WHC-CM-4-10, Section 11.4.6.

Based on the limited accumulation of material and the lack of a means for dispersing the material, existing safety documentation and procedures are adequate to control the work. The existing documentation consist of JSAs, HWOPs, and RWPs. The procedures that will control the work are the EII (WHC-CM-7-7). Activities that fall into this category are excluded from the OSL requirement.

4. Mechanized intrusive/accumulative (test pit, test trench, auger) sampling where relatively large soil volumes can be displaced or accumulated and exceed the release criteria provided in WHC-CM-4-10 (Section 11.4.6). Activities in this category require a safety review and OSLs to limit the potential spread of contamination and maintain radiation exposures below those limits identified in the RWP.

5. Mechanized intrusive sampling (monitoring of soil gas for VOCs and combustible gases) of subsurface soils using the cone penetrometer probe and sampling system where gas concentrations could exceed the release criteria provided in WHC-CM-4-46, *Nonreactor Facility Safety Analysis Manual*; WHC-CM-7-5, *Environmental Compliance Manual*; and 29 CFR 1910.

Test pit soil sampling, typical of a category 4 activity, is a method of sampling that is used to determine the nature and extent of potential sources of contamination at facilities where shallow, nonradioactive contamination was identified by other shallow/near surface sampling activities (e.g., soil gas sampling).

The test pits will be excavated with a backhoe or similar bucket-equipped heavy equipment. Test pit sampling will be performed in accordance with EII 5.2, Appendix I (WHC-CM-7-7). Disturbed samples will be collected from the bucket of the backhoe. Procedures for decontamination of sampling equipment are contained in EII 5.5 (WHC-CM-7-7). Procedures for decontamination of the excavation equipment are addressed in EII 5.4 (WHC-CM-7-7).

The excavation area and all samples will be screened with field instruments for alpha, beta, and gamma radiation and volatile organic compounds. Field logs will be maintained to record all observations and activities in accordance with EII 1.5 (WHC-CM-7-7). Samples for laboratory analysis will be placed in appropriate containers and properly preserved in accordance with EII 5.2 (WHC-CM-7-7). During test pit excavation and sampling, measures will be taken to prevent migration of contamination in accordance with EII 5.2, Appendix F (WHC-CM-7-7).

The mechanized intrusive sampling, typical of a category 5 activity, is a method of sampling used to determine the concentrations of nonradiological (VOCs and combustible gases) hazardous constituents from the vadose zone soils. This sampling activity involves the use of a cone penetrometer that is forced into the subsurface using a hydraulic load frame mounted in a heavy truck (Figure 1). An inner small diameter flexible tube approximately 0.32 cm (0.13 in.) is used to collect vapor samples at various depths from the sampling chamber on the cone penetrometer probe. The hollow center of the rod is sealed with only the tube exiting. A small pump with a capacity of

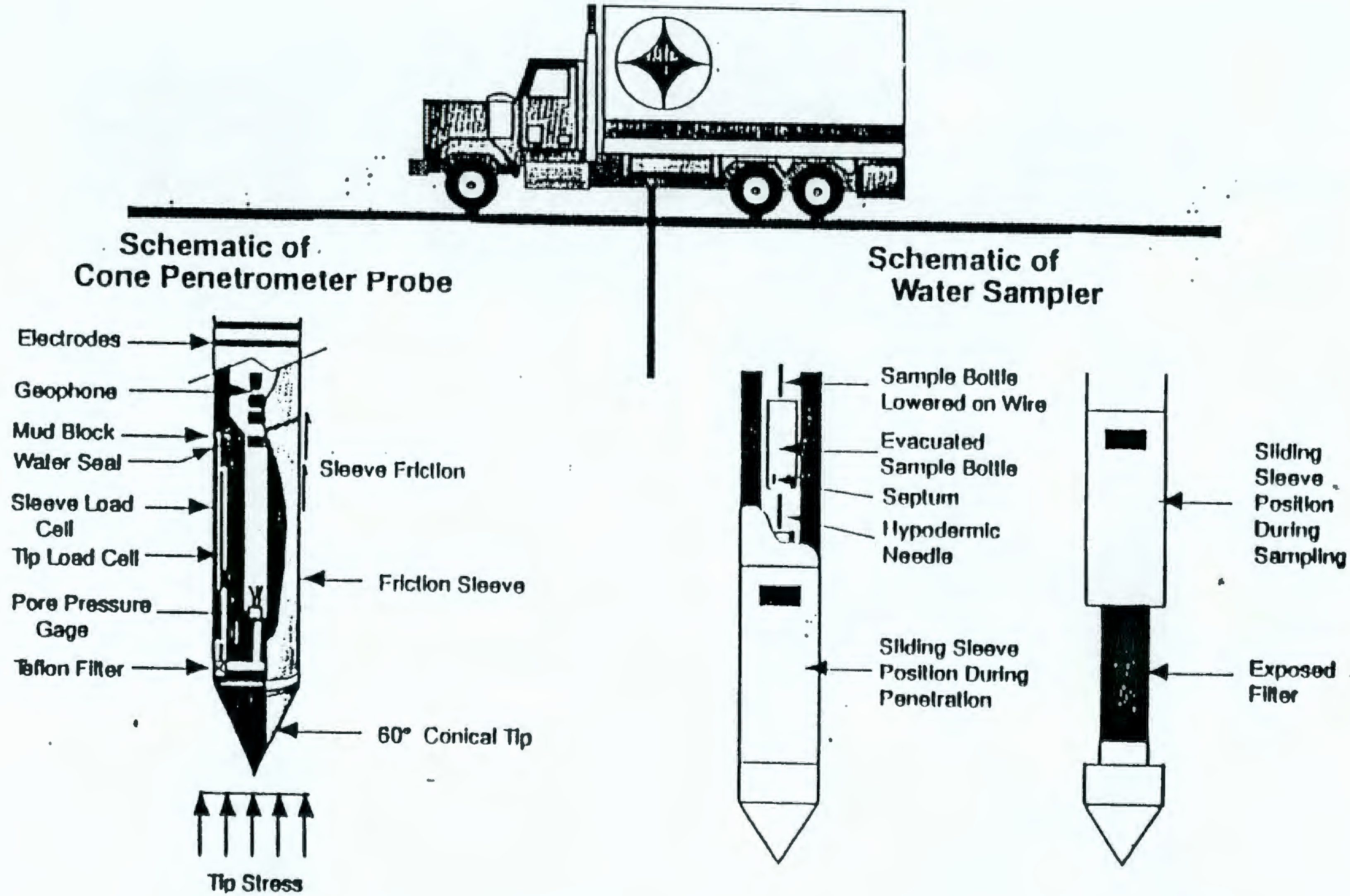


Figure 1. Cone Penetrometer Sampling System.

500 ml/min will be used to obtain vapor samples. The total volume of CCl_4 vapors anticipated to be removed per well would be equivalent to approximately 19 L.

During soil gas sampling, the removal of radionuclides is not anticipated other than low levels of naturally occurring radon activity and subsequent daughters that might produce detectable activity on a carbon adsorption media if used for removal of CCl_4. In the event radionuclides may be present in the borehole, removal (during soil gas sampling) of radioactive contaminants such as plutonium or americium would not be likely as these radionuclides have become firmly attached to the host soil or sediment particles when the contaminants were discharged (Lehrschall 1992).

The cone penetrometer generates very little waste as no soil is removed during installation of the probe or whenever the probe is removed. Only residual contamination (if used in subsurface radiation zones) may be encountered whenever the probe is withdrawn. The cone penetrometer will be cleaned after each use in accordance with EII 5.4 (WHC-CM-7-7).

2.2 POTENTIAL ENERGIES

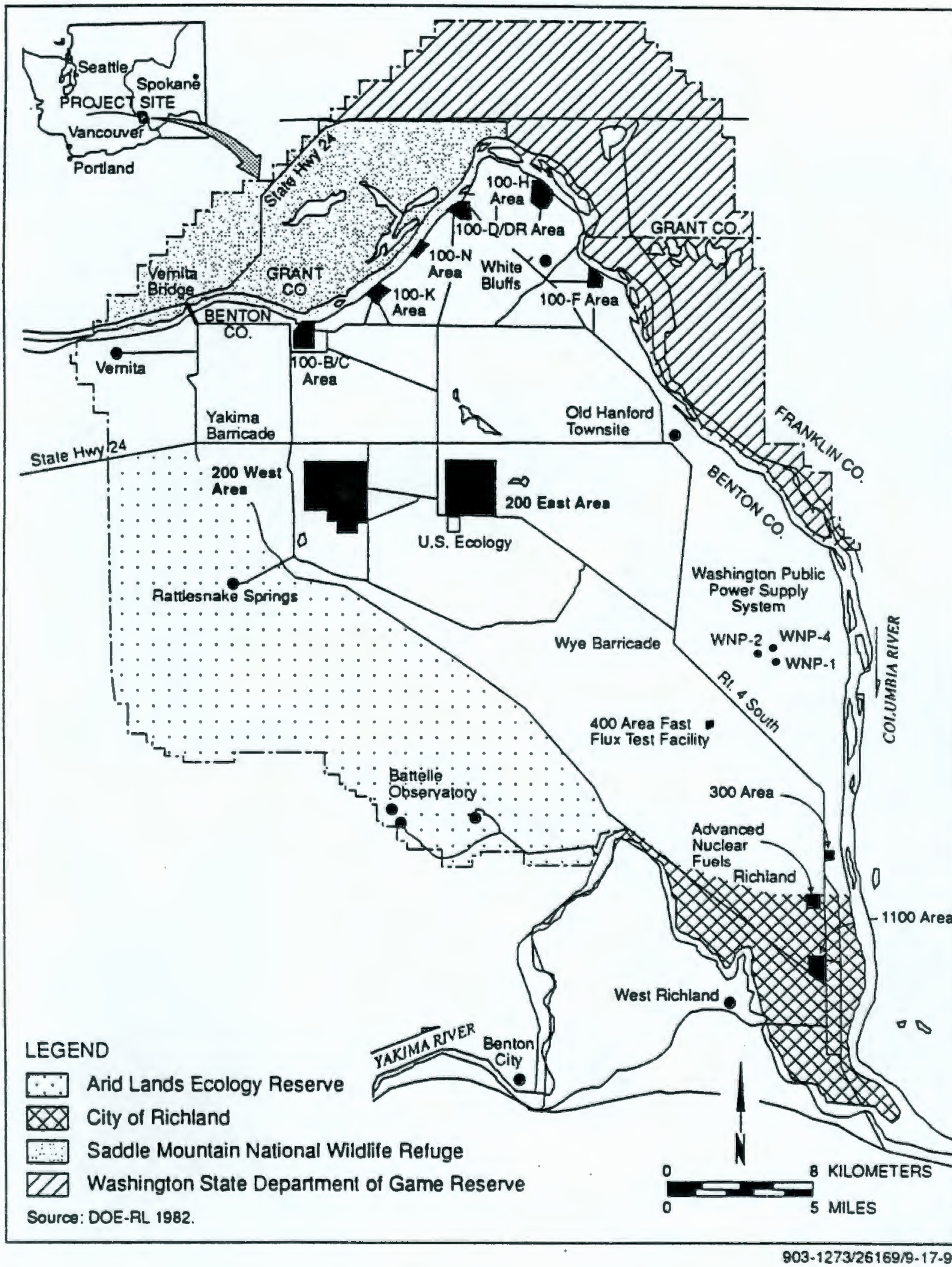
The energies of concern consist of mechanical stresses caused by the digging action of the bucket, auger, wind, or the vacuum pump required for removing gas samples from the cone penetrometer. These energies contribute to a potential inhalation hazard of resuspended dust or vapors. Other energies (such as fire, electricity, etc.) were considered and dismissed as having no appreciable impact on the dispersement of dust. Natural phenomena were considered for hazard impacts. A wind storm was identified as having the undesirable effect of spreading the contamination to other areas, but because of the unstable air conditions, it would not add to an inhalation hazard. In addition, the work is generally not performed in wind speeds greater than 22 km/hr (15 mi/hr). Other phenomena such as a flood or earthquake would not have any appreciable hazard impact during sampling activities.

3.0 SITE DESCRIPTIONS

3.1 PHYSICAL SETTING

The Hanford Site is located in south-central Washington State, approximately 273 km (170 mi) southeast of Seattle and 201 km (125 mi) southwest of Spokane (Figure 2). The average annual precipitation at the Hanford Site is 16.1 cm (6.3 in.). Most of the precipitation takes place during the winter, with nearly half of the annual amount occurring from

Figure 2. Hanford Site.



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November through February (Delaney et al. 1991). Average monthly temperatures at the Hanford Site range from 1.5° C (29° F) in January to 24.7° C (76° F) in July (PNL 1990).

3.2 METEOROLOGY

Prevailing wind directions are generally from the northwest throughout the year. Winds from the northwest quadrant occur most often during the winter and summer. During the spring and fall, the frequency of southwesterly winds increases.

Monthly average wind speeds are generally lowest during the winter, averaging 10 km/hr (6.2 mi/hr) to 11 km/hr (6.8 mi/hr). Monthly average wind speeds peak in the summer, averaging 14 (8.7 mi/hr) to 16 km/hr (9.9 mi/hr). Wind speeds well above average are usually associated with southwesterly winds (PNL 1990).

3.3 GEOLOGY

The Hanford Site sediments consist of pebble to boulder gravel, fine to coarse grained sand, and silt. The 100 Areas are the site of eight old terminated reactors along the Columbia River. Sediments in the 100 Areas consist of poorly sorted gravel, sand, and silt. The moisture content is generally low, ranging from 2% to 7% in coarse and medium grained soils with 7% to 15% in silts.

The 200 Areas contain inactive nuclear fuels reprocessing and plutonium separations facilities, as well as the majority of radioactive waste storage and disposal facilities on the Hanford Site. More than 45 yrs of operations in these areas have resulted in the storage, disposal, and accidental release of radioactive and hazardous wastes. Sediments range from fine grained, silty sands in the southern parts of the 200 Areas to granule to boulder gravels in the northern part of the 200 Areas. Field moisture content of the sediments range from 2% to slightly greater than 6%.

The 1100 Area, which is adjacent to the city of Richland in Benton County, composes the southeastern most portion of the Hanford Site. The 1100 Area has been used as a maintenance area, warehouse facility and equipment storage yard in support of operations at the Hanford Site. Sediments in the 1100 Area consist of interbedded sandy gravel, gravelly sand, and silty sandy gravel.

The 300 Area, located in the southeastern portion of the Hanford Site, contains a number of support facilities for the Hanford Site. Sediments in the 300 Area consist of course grained sand and sandy gravel with cobbles and boulders increasing with depth.

4.0 HAZARDS

4.1 SUMMARY OF POTENTIAL HAZARDS

The potential exposure pathways for hazardous substances encountered during the sampling activities may consist of inhalation, ingestion, absorption, or direct irradiation. The materials to be sampled include septic wastes, petroleum based fuels, pond sludge, concrete, soil gas, chemicals, and near surface soils. Radioactive, organic, and inorganic substances identified in Section 2.1 are the hazards of concern. For those activities in categories 1, 2, and 3 of Section 2.1, the procedures outlined in the EII (WHC-CM-7-7), along with other occupational safety documentation (i.e., JSA, HWOP, and RWP) will adequately control the hazardous materials.

The limiting health hazard associated with these activities is the potential inhalation of contaminated particulates by sampling personnel, direct radiation exposure, or potential exposure to concentrations of VOCs (primarily CCl_4). Other minor health hazards include such events as potential skin contaminations of sampling personnel. Minor environmental contamination could occur from loose piles or exposed excavations in the event of high winds. The worst case exposure analyzed is < 0.01 rem to the maximum exposed worker.

4.2 DISMISSAL OF NEGLIGIBLE HAZARDS

4.2.1 Criticality

A criticality event was dismissed based upon insufficient quantities of fissionable material in the shallow soils of the Hanford Site. However, if characterization activities are to be performed in areas that may potentially contain > 45% minimum critical mass of fissionable material, an evaluation by criticality engineering and a separate safety analysis may be required.

4.2.2 Natural Phenomena

Natural phenomena events such as floods, run-off, lightning, and earthquakes do not contribute to potential health or environmental consequences resulting from the shallow/near surface sampling because of the short duration of the activities.

High wind events could potentially contribute to the spread of minor surface contamination in the case of shallow/near surface sampling excavations. Loose spoils of contaminated silts, clays, and sands could be resuspended or otherwise carried by saltation to cause possible detectable levels of surface contamination. Because of the limited duration of trench and pit sampling, the anticipated low levels of contamination, and the implementation of applicable work procedures, the health or environmental risks are considered to be very low. High wind events would result in potential air concentrations far less than the stable air analysis provided by the American National Standard Institute (ANSI 1978) and summarized in Section 5.0 below.

5.0 HAZARDS ASSESSMENT

5.1 RADIOLOGICAL

The American National Standard Institute document (ANSI 1978) addressing the control of radioactive surface contamination provides a conservative analysis and estimate of surface contamination levels that could, under ideal stable air conditions, produce air concentrations equal to that of the derived concentration guides (DCG) provided in WHC-CM-7-5. The DCGs are derived for the purpose of relating concentrations of radionuclides in the environment to a human dose. When a standard individual is exposed continuously for 1 yr to air concentrations at one times the DCG values, that person will receive an effective committed dose equivalent of 100 mrem (0.0114 mrem if exposed for 1 hour) to the whole body or other limiting dose to an organ (WHC-CM-7-5). The surface contamination guides in HSRCM-1, *Hanford Site Radiological Control Manual* (PNL 1992) reflect the results of the ANSI standard.

The assumed time for an inhalation to occur is 2 hours. The conditions existing in the field during sampling activities (trench and pit sampling) are expected to be less than the ideal and stable air conditions specified in the ANSI standard analysis. The assumption can therefore be made that the ANSI standard analysis would be a conservative application to the shallow/near surface sampling activities. Given the bounding concentrations specified in Section 2.1, the dose consequences and hazard class limits are summarized in Table 3.

Table 3. Dose Consequences and Hazard Class Limits.

Receptor	Dose consequence (rem)	Hazard class limit (rem)
Site worker	< 0.01	25
Onsite worker	<< 0.01	5
Offsite individual	<<< 0.01	0.5

5.2 TOXICOLOGICAL

To assess the health hazards of potential organic and inorganic contaminants in the soils, a rough screening exercise (see Attachment B) was performed to determine whether any potential hazards existed. Air samples obtained during the Mt. St. Helens eruption show maximum dust concentrations in the air to be 5 mg/m^3. This dust loading of 5 mg/m^3 is assumed to be contaminated with the organic and inorganic contaminant concentrations from Section 2.1 as a means of estimating a maximum concentration in air. The results were then compared to the time weighted averages (TWA) and immediately dangerous to life and health (IDLH) values. The results show that the hazard due to the organic and inorganic materials in the soils is insignificant. Table 4 summarizes the results.

To also assess the health hazards associated with VOC vapors that could potentially be discharged (as a result of pumping soil gas from the vadose zone soils during sampling operations), a hypothetical scenario was assumed. A release of CCl_4 vapors occurs involving dumping a total gas volume to the atmosphere of 19 L of CCl_4 at a concentration of 25,000 p/m. This screening evaluation was completed to determine the potential impact to the site, onsite, and public receptors. A summary of the receptor exposures are provided in Table 5 and Attachment C.

Table 4. Air Concentrations and Corresponding Limits.

Analyte	Air concentration mg/m^3	1/10 IDLH in mg/m^3	TWA in mg/m^3
Mercury	1.0E-7	2.8	0.01
Lead	1.6E-6	N/A	0.05
Chromium	1.9E-6	3.0	0.05
Cyanide	1.2E-6	5.0	5.0
Hydrazine	4.4E-7	10.5	1.3
Carbon tetrachloride	4.4E-5	191.0	12.6
Cyclohexane	4.5E-6	3,500.0	1,030.0
Tetrachloroethane	6.0E-6	105.0	6.9
Phenol	4.0E-7	95.0	19.0

Table 5. Receptor Exposures for a Release of Carbon Tetrachloride.

Hazard source inventory	Resultant exposures		Limits for low hazard*	
CCl_4	Onsite 100 m (330 ft)	Offsite 4 km (6 mi)	Onsite 100 m (330 ft)	Offsite 4 km (13 ft)
19 L	< 2 p/m	< 2 p/m	< 50 p/m	< 10 p/m

* Source: *Hanford Emergency Response Planning Guidelines for Chemicals* (WHC 1993)

In some areas (i.e., 200 West locales over CCl_4 plume) where ambient air concentrations of volatile organic compounds may reach TWA levels, personnel protection measures implemented through the work procedures of WHC-CM-7-7 would be necessary to keep worker exposures at as low as reasonably achievable levels.

5.3 CONCLUSION

The intrinsic hazards associated with the shallow, near surface, and deeper soil and gas sampling activities described in category 4 and 5 of Section 2.1 are commensurate with that of a low hazard activity consistent with the criteria in WHC-CM-4-46. The maximum worst case exposure to personnel was estimated to be < 10 mrem, which is more than 3 orders of magnitude below the low hazard class limit of 25 rem. The estimated air concentrations of the organic and inorganic substances are commensurate with that of a low hazard activity. The OSLs that specify limits on surface radioactivity, radiation exposure, and requirements for soil stabilization and soil gas sampling are implemented for defining the safety envelope of this assessment. All shallow/near surface sampling activities that meet the descriptions in category 1, 2, and 3 in Section 2.1 of this assessment are excluded from the OSL requirement.

6.0 OPERATIONAL SAFETY LIMITS AND PRUDENT ACTIONS

An OSL is an auditable limit established within WHC for the safe operation of a nonreactor nuclear facility or activity. The U.S. Department of Energy, Richland Field Office has a policy that at least one acceptable limit be established to assure the facility is operated or activity is performed safely and within the bounds of the safety assessment. Four OSLs are implemented that apply to activities described as category 4 and one OSL for activities described as category 5 in Section 2.1 of this assessment.

6.1 OPERATIONAL SAFETY LIMITS

<u>OPERATIONAL SAFETY LIMIT 1</u>

This OSL applies to direct readings of beta/gamma radiation on soil surfaces measured with a hand-held field instrument such as a Geiger Mueller (GM). If sampling in areas where ^{90}Sr is known to be present in approximate equal amounts with ^{137}Cs, a general purpose energy compensated GM probe with beta shield (e.g., Eberline HP-270 or equivalent) may be used to discriminate between beta and gamma radiation.

1.0 TITLE: Limit the Quantity of Surface Radioactivity.

1.1 APPLICABILITY: This limit applies to beta/gamma activity on soil surfaces of shallow soil sampling and characterization activities in quantities of >1 m^3 (30 ft^3).

1.2 OBJECTIVE: To reduce the potential for generation of airborne contamination.

1.3 REQUIREMENT: When excavating into the shallow soils with a backhoe auger, or other mechanized equipment, the following limits on soil surfaces shall not be exceeded.

1. Surface radioactivity shall not exceed 500,000 dpm/100 cm^2 fixed plus removable.

2. In areas where ^{90}Sr is known to be prevalent, beta readings on a general purpose energy compensated GM probe with a 30 mg/cm^2 wall thickness (Eberline model HP-270 or equivalent) shall not exceed 100,000 dpm/100 cm^2 (these limits may be revised in the future as more data becomes available.)

3. The soil surface radioactivity shall be monitored at the frequency identified in the RWP.

1.4 SURVEILLANCE: The survey records shall be reviewed weekly to verify the limits have not been exceeded and that the frequency for monitoring is complied with as required in the RWP. The results of the weekly surveillance shall be documented in the field log.

1.5 RECOVERY: **Noncompliance with the requirement:**

1. Once a determination has been made that the operating organization is not in compliance with the requirements of this OSL, operations shall immediately cease. The approval of Safety Assurance will be required for restart of operations.

2. Line management shall be responsible for evaluating the source of high contamination levels. Management will also be required to determine if additional analysis is needed (addressing any potential changes in inventories than was previously evaluated in the safety basis).

3. The OSL violation shall be documented as an unusual occurrence report.

Noncompliance with the surveillance:

1. The surveillance shall be performed immediately.

2. If surveillance determines noncompliance with the requirement, then initiate recovery actions as identified in Section 1.5, "Noncompliance with the requirement."

3. Failure to implement a surveillance requirement shall be documented as an off-normal occurrence.

1.6 AUDIT POINT: The field log shall be audited weekly to verify compliance with the requirement and surveillance. The results of the audit shall be documented in the field log.

1.7 BASIS: The maximum contamination levels evaluated for in this assessment are 100 times the surface radioactivity guides (fixed plus removable) (DOE 1991) for beta/gamma decaying radionuclides, 100 times the

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Safety Assessment for Environmental Investigations and Site Characterizations

Volume 2: Aggregate Safety Assessment for Shallow/Near Surface Activities

EDT No.: ECN No.: 196701

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guides (fixed plus removable) for uranium. For example, the maximum contamination levels would be 500,000 dpm/100 cm^2 for ^{60}Co, ^{137}Cs, and ^{152}Eu; 500,000 dpm/100 cm^2 for ^{238}U; and 100,000 dpm/100 cm^2 for ^{90}Sr. The limits provide assurance that the potential worst case consequences estimated in the assessment will not be exceeded.

OPERATIONAL SAFETY LIMIT 2

This OSL applies to areas where alpha contamination is known to occur and cannot be adequately controlled by beta-gama monitoring techniques. Alpha contamination is to be measured with a hand-held field instrument such as a portable alpha meter (PAM).

2.0 TITLE: Limit the Quantity of Surface Radioactivity.

2.1 APPLICABILITY: This limit applies to alpha activity on the surface of the excavation equipment.

2.2 OBJECTIVE: To reduce the potential for generation of airborne contamination.

2.3 REQUIREMENTS:

1. When excavating into the shallow soils with a backhoe or other similar equipment, the following limit on the bucket surfaces shall not be exceeded. Surface radioactivity shall not exceed 50,000 dpm/100 cm^2 alpha fixed plus removable.

2. The soil surface radioactivity shall be monitored at the frequency identified in the RWP.

2.4 SURVEILLANCE: The survey records shall be reviewed weekly to verify the limits have not been exceeded and that the frequency for monitoring is complied with as required in the RWP. The results of the weekly surveillance shall be documented in the field log.

2.5 RECOVERY: **Noncompliance with the requirement:**

1. Once a determination has been made that the operating organization is not in compliance with the requirements of this OSL, operations shall immediately cease. The approval of Safety Assurance will be required for restart of operations.

2. Line management shall be responsible for evaluating the source of the high contamination levels. Management will also be required to determine if additional analysis is needed (addressing any

potential changes in inventories than was previously evaluated in the safety basis).

3. The OSL violation shall be documented as an unusual occurrence report.

Noncompliance with the surveillance:

1. The surveillance shall be performed immediately.

2. If surveillance determines noncompliance with the requirement, then initiate recovery actions as identified in Section 1.5, "Noncompliance with the requirement."

3. Failure to implement a surveillance requirement shall be documented as an off-normal occurrence.

2.6 AUDIT POINT: The field log shall be audited weekly to verify compliance with the requirement and surveillance. The results of the audit shall be documented in the field log.

2.7 BASIS: The maximum contamination levels evaluated for in this assessment are 100 times the guides for alpha decaying transuranics. For example, the maximum contamination levels would be 50,000 dpm/100 cm^2 for ^{239}Pu. The limits are based on the maximum concentration for determination of safety assessment consequences. The limits provide assurance that shallow sampling activities are managed as low hazard activities.

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OPERATIONAL SAFETY LIMIT 3

This OSL applies to areas that are known to contain or suspected to contain solid waste that may be irradiated or contaminated.

3.0 TITLE: Radiation Monitoring Requirements for Excavation Activities.

3.1 APPLICABILITY: This requirement applies to intrusive characterization within solid waste disposal sites.

3.2 OBJECTIVE: To reduce the potential for encountering dose rates in excess of the limits specified in the applicable RWP before removal of material from the excavation site.

3.3 REQUIREMENTS:

1. When excavating in a known or suspected solid waste burial site, a remote detection device shall be used to provide dose rates within 1 m (3 ft) of the back-hoe bucket during the excavation activity.

2. Proposed changes to the dose rate limits (higher dose rate limits than those previously approved) identified in the RWP will require the review and approval of Safety Assurance.

3. A health physics technician shall be required to be in attendance providing radiation monitoring during excavation operations.

3.4 SURVEILLANCE:

1. Before initiation of excavation operations, the responsible operating organization shall verify that the remote detection device is functional and in place.

2. The RWP shall be reviewed weekly to verify if any changes to the dose rate limits have been made, and if so, been reviewed and approved by Safety Assurance.

3. Before initiation of excavation operations, the responsible operating organization shall verify that a health physics technician is in place to provide radiation monitoring support.

3.5 RECOVERY: **Noncompliance with the requirement:**

1. Once a determination has been made that the operating organization is not in compliance with the requirements of this OSL, operations shall immediately cease. The approval of Safety Assurance will be required for restart of operations.

2. Failure to have a detection device in place or a device that is not functional before initiation of operations shall require shutdown of operations. A detection device shall be installed and verified to be functional before restart of operations.

3. Failure to obtain the review and approval of Safety Assurance for changes to the dose rate limits (higher dose rate limits than those previously approved) shall require shutdown of operations. Safety Assurance shall review and concur with the changes before approving restart of operations.

4. The OSL violation shall be documented as an unusual occurrence report.

Noncompliance with the surveillance:

1. The surveillance shall be performed immediately.

2. If surveillance determines noncompliance with the requirement, then initiate recovery actions as identified in Section 3.5 (1), "Noncompliance with the requirements."

3. Failure to implement a surveillance requirement shall be documented as an off-normal occurrence.

3.6 AUDIT POINT: The field log shall be audited weekly to verify compliance with the requirement and surveillance. The results of the audit shall be documented in the field log.

3.7 BASIS: This requirement provides an auditable control to ensure the threshold for low hazard activities is not exceeded. The maximum exposure limit to assure the criteria for a low hazard activity will not be exceeded is based upon an estimated dose equivalent (EDE) to the site worker of ≤ 25 rem. The exposure limits defined in the RWP are required to be lower than the weekly EDE of ≤ 300 mrem for a WHC radiation worker (WHC-CM-4-10) and would most certainly never exceed the annual EDE of ≤ 5 rem as defined in DOE 1991. Controlling the exposures to below the limits (defined in WHC-CM-4-10 and DOE 1991) ensures potential consequences to the site worker, onsite workers, or public receptors are below the risk acceptance criteria as defined in WHC-CM-4-46.

OPERATIONAL SAFETY LIMIT 4

This OSL applies to minimizing the potential for radioactive contaminated fugitive dust generation.

4.0 TITLE: Mitigation of fugitive dust.

4.1 APPLICABILITY: This requirement is applicable to the mechanized soil sampling activities (excavation, hauling, and stock piling activities).

4.2 OBJECTIVE: To reduce the potential for fugitive dust generation from soils accumulated during mechanized soil sampling activities.

4.3 REQUIREMENT: Soils accumulated at the work site, as a result of mechanized soil sampling activities, shall be stabilized (e.g., water, fixants, tarps) if wind speeds exceed 15 km/hr (10 mi/hr) or if spoils are left unattended.

4.4 SURVEILLANCE: At the end of the shift, the responsible operating organization shall verify that the soil spoils are stabilized. This verification shall be documented in the field log at the end of the shift.

4.5 RECOVERY: **Noncompliance with the requirement:**

1. Once a determination has been made that the operating organization is not in compliance with the requirements of this OSL, operations shall immediately cease. The approval of Safety Assurance will be required for restart of operations.

2. Failure to stabilize the soil spoils shall require the responsible operating organization to stabilize the spoils and provide verification before restart of operations.

3. The OSL violation shall be documented as an unusual occurrence report.

Noncompliance with the surveillance:

1. The surveillance shall be performed immediately.

2. If surveillance determines noncompliance with the requirement, then initiate recovery actions as identified in Section 4.5, "Noncompliance with the requirement."

3. Failure to implement a surveillance requirement shall be documented as an off-normal occurrence.

4.6 AUDIT POINT: The field log shall be audited weekly to verify compliance with the requirement and surveillance. The results of the audit shall be documented in the field log.

4.7 BASIS: The basis for this requirement is to assure soil spoils subjected to winds speeds greater than 15 km/hr (10 mi/hr) [18 km/hr (12 mi/hr) wind speed required for soil particles small enough to be resuspended] or if spoils are left unattended will not result in resuspension of any radioactive contaminants. This limit is applicable to soils excavated from trenches, pits, solid waste disposal sites, or other areas.

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OPERATIONAL SAFETY LIMIT 5

This OSL provides limits requiring monitoring for volatile gases.

5.0 TITLE: Limit on Drilling and Sampling Activities Whenever Volatile Gases are Detected.

5.1 APPLICABILITY: This limit applies to sampling for volatile gases and limiting work activities (sampling) if concentrations exceed acceptable limits.

5.2 OBJECTIVE: To assure that VOC sampling operations are curtailed when volatile gases are detected at levels that exceed >10% LEL in and around the boreholes.

5.3 REQUIREMENT:

1. Use of portable combustible gas analyzers are required for detection of volatiles that are potentially flammable. Levels that exceed 10% of the LEL in and around the borehole shall require more frequent monitoring per the requirements of the applicable work procedures.

2. If combustible gas levels exceed >10% LEL in or around the borehole, sampling operations shall cease. Action required by the work procedures shall be implemented to reduce the combustible gas levels below 10% LEL before continuing operations (i.e., purging of borehole volume with inert gas, etc).

5.4 SURVEILLANCE: The responsible operating organization shall verify daily (before startup and during periods of operations) that a calibrated combustible gas analyzer is in place and operable before initiation of operations. Compliance with the stated requirements shall be documented in an auditable log.

5.5 RECOVERY: **Noncompliance with the requirements:**

1. If a calibrated portable combustible gas analyzer is found not to be in place, work shall immediately cease [Section 5.3 (1)]. Notification to the appropriate line and safety assurance management shall be made. Work shall not continue until a calibrated portable combustible gas analyzer is in place and operable.

2. Failure to cease operations and implement the actions as required in the work procedures if combustible gas levels exceed 10% of the LEL shall necessitate immediate shutdown of operations [Section 5.3 (1), "Requirement."]. Notification shall be made to the appropriate line and safety assurance management. Restart of operations shall require line management and safety assurance concurrence.

3. The OSL violation shall be documented as an unusual occurrence report.

Noncompliance with the surveillance:

1. The surveillance shall be performed immediately.

2. If surveillance determines noncompliance with the requirement, then recovery actions identified in Section 5.5 shall be initiated.

3. Failure to implement a surveillance requirement shall be documented as an off-normal occurrence.

5.6 AUDIT POINT: An auditable log shall be maintained at the site documenting the results of the surveillance. The log shall be reviewed weekly by the operating organization assuring compliance with the requirements and surveillance.

5.7 BASIS: The limits of this OSL are conservatively based on the potential volatile concentrations for potential gases that may be encountered but cannot be qualitatively predicated at this time. The concentration limits are set to provide a safety margin between detection and potential deflagration/detonation.

6.2 PRUDENT ACTIONS

Prudent actions are commitments to ALARA goals and are generally good engineering work practices. Credit is given to the EIIs (WHC 1989) for providing the safe work practices for performing these activities. Three specific prudent actions are identified below.

Function 1 - Minimize exposures to potential VOCs.

Prudent Action 1 - If sampling in areas (i.e., CCl_4 plume) where potential air concentrations of VOCs could reach or exceed occupational limits, appropriate protection measures should be taken to minimize personnel exposures below the time weighted average exposure limits.

Function 2 - Minimize potential for radioactive contamination spread.

Prudent Action 2 - The cone penetrometer and piping should be cleaned and decontaminated (if necessary) when withdrawn from the borehole to minimize the potential for a spread of radioactive contamination. The decontamination or cleaning should be conducted per the requirements in WHC-CM-7-7 (EII 5.4) and the applicable RWP.

Function 3 - Removal of CCl_4 vapors during sampling operations.

Prudent Action 3 - Use of a activitated carbon canister for removal of CCl_4 vapors (or other VOCs) should be considered to minimize exposure to personnel and assure release criteria as identified in WHC-CM-7-5, *Environmental Compliance Manual*, is complied with.

7.0 REFERENCES

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PNL, 1992, *Hanford Site Radiological Control Manual*, HSRCM-1, Hanford Contractors: Pacific Northwest Laboratories, Westinghouse Hanford Company, Kaiser Engineers Hanford, and Hanford Environmental Health Foundation, available on Hanford Local Area Network, Hanford Site, Richland, Washington.

WHC, 1993, *Hanford Emergency Response Planning Guidelines for Chemicals*, available on Hanford Local Area Network, Westinghouse Hanford Company, Richalnd, Washington.

WHC-CM-7-5, *Environmental Compliance Manual*, Westinghouse Hanford Company, Richland Washington.

WHC-CM-4-10, *Radiation Protection Manual*, Westinghouse Hanford Company, Richland, Washington.

WHC-CM-4-46, *Nonreactor Facility Safety Analysis Manual*, Westinghouse Hanford Company.

WHC-CM-7-7, *Environmental Investigations and Site Characterization Manual*, Westinghouse Hanford Company, Richland, Washington.

WHC-CM-7-4, *Operational Environmental Monitoring Manual*, Westinghouse Hanford Company, Richland, Washington.

ATTACHMENT C

ANALYSIS OF CONSEQUENCES FOR SCENARIO INVOLVING RELEASE OF CARBON TETRACHLORIDE DURING CONE PENETROMETER SAMPLING ACTIVITIES

From: D. K. Oestreich, Systems Safety Analysis
Phone: 6-2208 H4-67
Date: April 21, 1993

Subject: ANALYSIS OF CONSEQUENCES FOR SCENARIO INVOLVING RELEASE OF CARBON TETRACHLORIDE DURING CONE PENETROMETER SAMPLING ACTIVITIES

To: R. R. Lehrschall H4-67

This memo is a follow-up to an internal memo dated September 9, 1991 (Lehrschall 1991). In that memo, the carbon tetrachloride (CCl_4) source term was calculated on the basis of theoretically derived CCl_4 concentrations in soil gases. Since that time, measurements of soil gas concentrations have been made, and the highest concentration of CCl_4 determined was 25,000 p/m or 2.5% by volume. This figure is only about one-fourth of the theoretical CCl_4 concentration calculated in 1991 which was 9.7% by volume. Consequently, one can expect that the downwind concentrations calculated for any point downwind would also be only about a fourth of that calculated on the basis of the theoretically derived source term. For the sake of completeness, the original theoretically based calculation is discussed below and followed by a discussion of the new calculation based on measured concentrations.

ORIGINAL THEORETICAL CALCULATION

The following theoretical calculations estimate expected downwind CCl_4 concentrations in air for a hypothetical release of CCl_4 vapor during the vapor sampling of soil using a cone penetrometer. The assumption in the release scenario is that a gas sample is taken from the soil but released to the atmosphere from the sampling pump that pumps at a rate of 500 ml/minute. Sampling takes place as the penetrometer advances downward at a rate of 48 in./min. As the cone penetrometer is taken to a depth of approximately 45 m (150 ft), the total sampling time (release period) is 2,250 seconds, and the total gas volume dumped to the atmosphere is 19 L. A soil temperature of 16^{0}C (60^{0}F) was assumed. From Table 3-8 of the *Chemical Engineers' Handbook* (Perry and Chilton 1973), using interpolation, a vapor pressure of 74 Torr was calculated for this temperature. Thus, the mole fraction of CCl_4 in the sample pump gases would be

$$74/760 = 0.097$$

The total volume of gas dumped to the atmosphere (19 L) is equivalent to 19/23.7 = 0.802 moles, as the molar volume of any gas at this temperature is 23.7 L. Thus, the total moles of CCl_4 released is equal to total moles of gas multiplied by mole fraction.

$$(0.802)\ (0.097) = 0.78 \text{ moles } CCl_4$$

The total grams of CCl_4 released are the product of moles and molecular weight.

$$(0.078)\ (154) = 12 \text{ grams}$$

As total release time is 2,250 seconds, the source term is

$$12/2,250 = 5.3 \times 10^{-3} \text{ g/s} = 5.3 \times 10^{-6} \text{ kg/s}$$

CALCULATION BASED ON MEASURED CONCENTRATION IN SOIL

As mentioned above, the highest measured CCl_4 concentration in soil gases is 25,000 p/m, or 2.5% by volume. Thus, a source term based on this concentration may be calculated by multiplying the theoretical source term calculated above by the factor 2.5/9.7 or 0.258.

$$(0.258)(5.3 \times 10^{-6} \text{ kg/s}) = 1.37 \times 10^{-6} \text{ kg/s}$$

DISPERSION CALCULATIONS

The WHAZAN Buoyant Plume model that was used to calculate downwind concentrations will not accept a source term smaller than 1×10^{-3} kg/s, so it was necessary to multiply the above source term of 1.37×10^{-6} kg/s by a factor of 1,000 before using the model (The answer was then divided by 1,000).*

Figure 1-C shows that the CCl_4 concentration drops to less than 2 p/m (the threshold limit value and time weighted average) by the time the plume is only 5 m (16 ft) downwind from the release point. It is clear that there can be no health effect consequences resulting from an accident involving the soil sampling operation.

The calculations are based upon a concentration of 25,000 p/m CCl_4 in soil gases.

WHAZAN Plume Model

Date 16-April-1993 Time 15:42

Data Used in Calculations

Chemical - Carbon Tetrachloride

Height (m)	= .0
Release Rate (kg/s)	= 1.37E-03 *
Concentration of Interest (p/m)	= 2.000
Wind Speed (m/s)	= 1.000
Ambient Temperature (K)	= 293.0
Surface Roughness Parameter	= 1.00E-01

Results

Max Downwind Effect Distance (m)	= 203.0
Max Crosswind Effect Distance (m)	= 6.283
Max Concentration at Ground (p/m)	= 1.00E+06
Max Toxic Effect (Prob of Fatality)	= .523

Risk acceptance criteria are defined in WHC-CM-4-46, *Nonreactor Facility Safety Analysis Manual*. Note that if a probability of one is assumed, the onsite and offsite risk acceptance criteria for CCl_4 for probability = 1 is set as a 15-minute short term exposure limit (STEL) that should not be exceeded at any time during the workday. The STEL for CCl_4 is 2 p/m as identified in the National Institute for Occupational Safety and Health.

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Lehrschall, R. R., 1991, *Safety Assessment for the Cone Penetrometer Test*, (internal letter 9152227 to Distribution, September 23) Westinghouse Hanford Company, Richland, Washington.

Perry, R. H., and C. H. Chilton, 1973, *Chemical Engineers' Handbook*, McGraw Hill Book Company, New York, New York.

WHC-CM-4-46, *Nonreactor Facility Safety Analysis Manual*, Westinghouse Hanford Company, Richland, Washington.

D. K. Oestreich

D. K. Oestreich, Systems Safety Analysis

Peer Review:

J. A. Locklair

J. A. Locklair, Environmental Restoration Safety Support

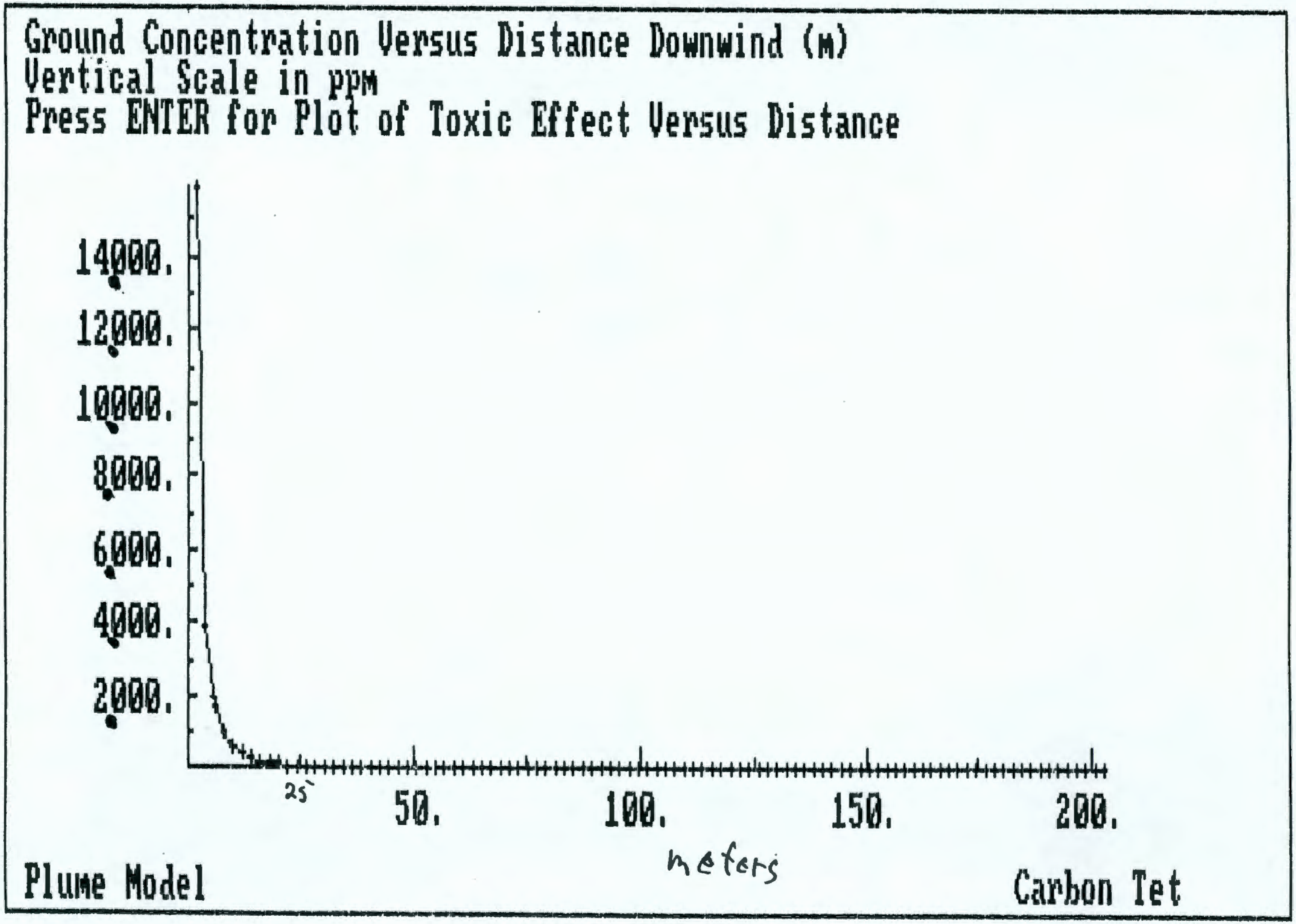

Figure 1-C. Downwind Carbon Tetrachloride Concentration as a Function of Distance.